

UKRAINIAN DEFENSE REVIEW

№1 [JANUARY-MARCH 2019]

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UDR



FLYING MACHINES FROM ANTONOV

An-132, An-178

MADE IN UKRAINE



BURST OF THUNDER



COUNTER-DRONE WARFARE

Counter-UAV Technology Solutions from Ukraine



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UKRAINIAN DEFENSE REVIEW

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RADA AMENDS LEGISLATION ON ARMS IMPORT TRADE

Ukrainian parliament, the Verkhovna Rada has approved in a first-reading vote a bill amending the rules governing public defense procurement.

The legislation would allow Government customers to import defense-related products directly from supplying companies (i.e. without mediation of specialized government agencies). This is according to a news report published on the parliamentary website on 21 December 2018.

The changes are aimed to give Government customers greater freedom of

maneuver in importing defense-related articles into Ukraine and to reduce the cost of products, works and services being procured under import trade contracts.

Ukrainian President Petro Poroshenko, in June 2018 signed the Executive Order titled "Updating government policies with respect to the provision of the Ukrainian Armed Forces and other uniformed services with foreign-brand defense articles and fostering defense industrial collaborations with international partners".

This Executive Order deals the first blow to what used to be an exclusive domain of government authorized arms dealers.

The legislation, if adopted, would enable the Ministry of Defense and other National Security agencies to procure imported weaponry and military equipment directly from supplying entities, provided that the procurement is included in the Government Defense Procurement Contract and the products being procured are non-available on the domestic market.

UKRAINE TO SPEND UP TO USD 890M ON MILITARY PROCUREMENT IN 2019

The Government Defense Procurement Contract will receive a budget of up to UAH 25 billion (USD 890 million) for FY 2019, up UAH 4 billion (USD 750M) from FY 2018.

This was reported by Ukrinform quoting a deputy Minister for Economic Development and Commerce.

The funding will pay for weaponry and military equipment procurement and defense-related R&D, Yuri Brovchenko told 2018 year-end press conference at the Ministry in late December.

"In 2018, some UAH 21 billion (USD 750 million) was earmarked for procurement of weaponry, military equipment, and defense-related R&D services. Those appropriations are expected to remain at the same level in 2019, or to be raised to UAH 25 billion

UAH (USD 890 million)", Brovchenko said.

Ukraine's national security and defense expenditure will hit 5.38

percent GDP, which is equivalent to UAH 211.9 billion (about USD 7.5 billion), according to the State Budget Law 2019.



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ARMED FORCES RECEIVED 200 PIECES OF WEAPONRY AND EQUIPMENT IN DECEMBER 2018

A ceremony to hand over 206 pieces of weaponry and equipment to the Ukrainian Armed Forces (UAF) took place at the Ozerne military airfield, Zhytomyr Oblast, attended by President Petro Poroshenko on 21 December 2018.

UAF units were ceremonially handed over technical acceptance certificates for newly produced, re-

refurbished or upgraded weaponry and equipment systems, including, in particular, upgraded T-64 64BV tanks, refurbished T-72 and T-80BV tanks, as well as mine breaching vehicles on MBT chassis.

Motorized infantry units received IFVs and recon vehicles BMP-1, BRDM-2L1, and new Varta APC, while Army's artillery units received

refurbished BM-21 Grad MLRS and 122-mm 2S1 Gvozdika howitzers.

Air defense units received refurbished S-300PT SAM systems, and Air Force units received an Il-76MD military transport aircraft, a Su-25M1K fighter aircraft, a MiG-29MU1 fighter jet airplane, a Mi-8MT cargo helicopter, and several Mi-8MTP troop carrier helicopters.

The equipment handover also included the UAS/UAV systems Leleka-100, A1SM Fury, PD-1, and Sparrow, off-road trucks KrAZ 5233 and Bohdan 6317, buses Otokar and BREM, as well as maintenance and repair kits and the automated command systems 9S1621R Oreanda.

"This handover is made up of nearly 10 percent of what the domestic defense industrial sector has produced over the whole year. The military is anticipating the arrival of MLRS weapons, both newly made and upgraded, and we are witnessing capability improvements in armored fighting vehicles and cannon artillery", Poroshenko said at the equipment handover ceremony.

UKRAINE SUCCESSFULLY TEST-FIRES ITS S-125 SAM UPGRADE, NEWLY DEVELOPED CRUISE MISSILE

Ukraine, in early December 2018, successfully test fired a domestic upgrade of the S-125 SAM system along with a new, indigenously developed cruise missile, Defense Express reported quoting a statement posted on NSDC's official website by Oleksandr Turchynov, Ukraine's National Security and Defense Council (NSDC) Chairman.

The tests achieved important results; in particular, they validated flight performances of the indigenous cruise missile and practiced the use of upgraded S-125 SAM systems for coastal defense roles, Turchynov said.

The cruise missile has validated its performance capabilities in range and accuracy, having hit a target at 280 km away, he said.

Regarding the Soviet legacy surface-to-air missile system S-125 that has undergone a comprehensive upgrade in Ukraine, the upgrade has "...validated its performance capabilities. Eight missiles were launched to

successfully hit eight surface targets. It's a very good result which assures that this upgraded SAM capability is able to robustly defend against an incursion from the air or by sea, and it will come as a welcome addition to coastal defenses of Ukrainian territori-

al waters in the Black Sea and the Sea of Azov", Turchynov said.

Defense Express reported that the shore-based anti-ship missile system Neptune is due to be ready to enter official qualification trials process by mid-2019.



SAUDI ARABIA BUYS SKIF, CORSAR ATGM SYSTEMS FROM UKRAINE

Saudi Arabia's Ministry of Interior has purchased a quantity of brand new Skif and Corsar anti-tank guided missile (ATGM) systems from Ukraine through State-owned Progress Export/Import Trade Firm, Defense Express reported in late December citing Defense Blog.

According to notice by the Import-Genius, Progress shipped to the Ministry of the Interior of the Kingdom of Saudi Arabia, through the port of Mykolayiv, anti-tank guided missiles and launchers manufactured by the Luch R&D Company, Kyiv, worth an estimated USD 24.2 million.

The handover included 30 Skif ATGMs with thermal imaging camera sensors, 15 Corsar ATGM launchers with 300 missiles, along with associated accessories.

UDR note: The 130 mm ATGM Skif is an export-market variant of the proven Stugna-P technology. It has a range of 5,000 meters and a penetration of 850 mm RHA.

The Skif missile carries a tandem HEAT warhead (RK-2S/2M-K) or a HEF warhead (RK-2OF/-2M-OF).

The Corsar is a 107mm man portable ATGW system. With its 2.5 km range and behind-ERA penetration of 550 mm, it is designed to defeat modern armored vehicles, both moving and at rest, other targets protected with combination, spaced or rolled homogeneous armor behind explosive reactive armor, as well as smaller targets like gun emplacements, entrenched tanks, light armored vehicles, and helicopters.

The Corsar missile is available with the RK-3K tandem HEAT warhead or RK-3OF HEF warhead.



UKRAINE'S ARMED FORCES HOPING TO RECEIVE COMBAT HELICOPTERS FROM AIRBUS



Ukraine is likely to purchase military choppers from Airbus Helicopters to meet the requirement of its Armed Forces.

Defense Express reported this quoting a speech delivered by Ukrainian President and Commander-in-Chief of the Ukrainian Armed Forces, Petro Poroshenko at a ceremony to hand over two Airbus H-225 choppers to the National Guard and the State Service for Emergency Management.

"We need to have also combat capable helicopters from Airbus to bolster the Ukrainian Armed Forces' capacity to defend Ukrainian sovereignty, territorial integrity, and independence", Poroshenko said.

The purchase of combat-capable helicopters for the Ukrainian

Armed Forces will comprise the next phase of collaboration with Airbus Helicopters, he said, and added that Ukraine's procurement of the French-German helicopters is going to boost the competition among the Ukrainian companies involved in the production and upgrading of helicopters.

Airbus Helicopters produces a wide nomenclature of helicopters for combat, multi-purpose and airlift roles, among them the multi-purpose NHI NH90 (which can serve in anti-submarine warfare roles), the combat-capable H145M, H125M, H225M, and H135M, as well as the maritime transport and search & rescue helicopter AS565 MB and the recon and attack helicopter Eurocopter Tiger.

UKRAINE, TURKEY PARTNERING IN ACTIVE PROTECTION FOR ARMORED VEHICLES

State-run SpecTechnoExport and Turkey's Aselsan are jointly testing the active protection system Zaslou-L. Subject to the satisfactory completion of the tests, the two companies will negotiate localization of the Ukrainian-designed technology for production in Turkey.

This was reported by Ukroboronprom, SpecTechnoExport's holding company, on December 13, citing MSI Turkish Defense Review.

Beyond that, the testing of the explosive reactive armor system Duplet is now nearing completion in Turkey, in a collaborative project between

SpecTechnoExport and Roketsan. The parties are both interested in having the Zaslou-L and Duplet technologies localized for production in Turkey.

The Zaslou-L and Duplet will both go to the Turkish Army's M60 tanks.

Due to their modular architecture, the two protective systems are easily adaptable for integration onto any armored vehicle.





INDIA LOOKING TO ENHANCE MILITARY TECHNOLOGY COOPERATION WITH UKRAINE

The Republic of India is satisfied with the current level of bilateral cooperation with Ukraine in military technology, but hopes that this cooperation will grow, H.E. Shri Partha Satpathy, Ambassador of India to Ukraine said at

an Interfax-Ukraine press conference held in early December 2018.

India is satisfied with the current level of cooperation and will explore it further, the Ambassador said. He went on to note that the key factors

of growing defense technology cooperation between the two countries are affordable prices and good quality of Ukrainian-produced defense technologies. "This is a very mutually advantageous cooperation, and we hope that this cooperation will only grow", Shri Partha Satpathy said.

UDR note: India is one of Ukraine's key cooperation partners in defense technology development, production and procurement. Ukrainian arms exports to India have exceeded USD 2 billion over the past 12 years.

SpecTechnoExport opened its representative office in New Delhi in 2000 and another one was opened in Nashik in 2018.

The two countries are exploring new avenues for cooperation that include sales of helicopter protection equipment, collaborative R&D, and localization of some aircraft component parts for production in India. Beyond that, SpecTechnoExport is going to bid for Indian contracts to upgrade P-18 and ST-68 radar systems and ZSU-23-4 "Shilka" and S-125 "Pechora" SAM systems.



Scientific & Production Enterprise Spaitech, LLC, has been Ukraine's leading developer and producer of innovative Unmanned Aircraft System (UAS) products since 2012.

Spaitech UAS technologies have been in successful use by the Ukrainian Armed Forces and other national security institutions, and proved effective in real-world combat deployments.

Spaitech products have found a broad range of civilian applications in industries like farming and forestry, miscellaneous construction projects, and infrastructure/environmental monitoring.



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THE FUTURE THROUGH THE PRISM OF THE PAST

Defense Express offers an outlook for 2019 through the prism of international developments of 2018 that affected Ukraine, Russia and Europe as a whole.

Year 2018 was rich in international developments that contributed to atmosphere conducive to tense but stable situation. In Europe, the year was influenced by the unpredictable policies of US President Donald Trump, Russia's hybrid aggression policy, the continued migration crisis caused by civil war in Syria, growing influence of populist parties in Europe, and the continued threat of Russian military incursion in Ukraine. These developments and trends are going to continue into and make an impact on 2019.

HARSH REALITIES

A substantial part of the expert community noted in early 2018 that "the year began in an atmosphere of growing confrontation in West-Russia relations". Lots of statements were made indicating that "the world has come close, too close to the brink of a global conflict". It would seem that the growing migration crisis in Europe, ongoing Syrian civil war with Russian involvement, the Korean peninsula

conflict, proliferation of terrorism and Ukraine-Russia stand-off over Donbas are all markers of an impending crisis of global proportions. But the Rubicon, however, has not been crossed. The escalation continued from 2017 and into 2018. But this was not by the behest of the West who responded – although in a less aggressive and unpredictable manner than Russia did – to growing challenges and threats by

boosting defense budgets, strengthening NATO's posture in the Baltics, Poland, and Romania, and keeping in place sanctions against Russia over its actions in Eastern Ukraine.

During all of 2018, the Russian government continued with its policy of provocations. Moscow's destabilizing policy in Ukraine and Europe remained largely unchanged. Instead of coming back into the legal fold, Mos-



The British finding strongly implies that a former Russian spy, Sergei Skripal and his daughter were poisoned by the "Novichok" nerve agent

cow was acting to the contrary by escalating the situation further still.

President Putin, in the run up to his re-election, delivered his State of the Nation report to the Russian Parliament on March 1, 2018. His speech contained a message aimed to make the West take Russia's interests into account and return to Yalta-2-style concept of spheres of influence. But this message had missed its goal. A presentation of "breakthrough" military technologies mentioned in the report only reinforced the civilized world's perception of Russia as an unpredictable, aggressive neighbor that needs to be treated with special attention.

Tensions in Russo-Western relations have been fueled further by the poisoning, on March 4, 2018, of a former Russian spy, Sergei Skripal and his daughter in London. The British finding strongly implies that the Skripals were poisoned by the "Novichok" nerve agent that had been developed in the USSR and now used in a foreign state. Britain has pinned the blame squarely on the Russian government. In an unusually coordinated response to the nerve-agent attack in Salisbury, twenty-seven countries around the world, including the USA, UK and Ukraine, tossed out Russian diplomats they believed were actually undercover intelligence agents, and NATO kicked out seven diplomats from the Russian mission to the alliance.

Last year saw continuing investigation into Malaysia Airlines flight MH17 downing over eastern Ukraine. The Joint Investigation Team (JIT) probing the 2014 downing said they had found that the Buk missile that shot down MH17 was fired from a launcher belonging to a Russian military brigade. The investigators provided evidence of Russia's involvement, while Australia and the Netherlands said in response to the findings that they held Russia responsible for the downing of the passenger plane. Moscow, for its part, has continued denying any involvement in, and responsibility for the downing of MH17, saying the investigation did not include any Russian participation, and its findings therefore cannot be trusted. In actual fact, however, Russia was the one who refused to cooperate; it left unanswered JIT's request to provide all relevant information in



Russian President V.Putin says Russia has new nuclear-capable weapons that can breach U.S. defenses

2014 and a specific request for details about recovered missile parts in 2017.

2018 also saw a series of spy scandals involving Russia. In July, Greece expelled two Russian diplomats after accusing them of funding protests against a deal that would put an end to a 27-year long dispute between Greece and neighboring Macedonia over the name Macedonia in a new composite for the Former Yugoslav Republic of Macedonia (FYROM). In October, several Russians were tossed out from the Netherlands over suspicions of spying and attempted cyber attacks on the Organization for the Prohibition of Chemical Weapons (OPCW). They were also charged with an attempt to hack the investigation into flight MH17 downing. In November, a high ranking Russian military officer was arrested in Austria on suspicion of spying for the GRU during two decades, and Slovakia kicked out a Russian diplomat on spying charges in late 2018. These are just a few of such facts that have become known to the public.

One of the key developments of the summer of 2018 was the 29th NATO Summit held in Brussels from

July 11 to 12. NATO members agreed to increase their respective defense expenditures to a level "never seen before". As stated by US President Donald Trump, the Allies had "really stepped up their commitment, stepped it up an additional 33 billion". The summit's agenda and consensus decisions clearly identify Russia as a major, well prepared opponent, and signify an end to internal strife in the face of the common threats and challenges posed by Russia.

In Europe, radical-right parties stepped up their activities against the background of migrant crisis. Under the slogans of opposition to government migration policies and of support for national identities, populist parties enjoy growing electoral success while simultaneously increasing their presence in European governments. Most successful in this endeavor have been parties in Germany, Hungary, Spain, France, Finland, and Greece. With their unattainable election pledges, these parties will last so long as crises of all kinds would last in Europe; otherwise they are going to disappear within larger, more →



In 2018 NATO held the biggest military exercise since Cold War

conventional parties or will fall apart as did the populist, nationalist-oriented Finnish party Finns.

These populist parties are often sponsored by Russian special services. Evidences of radical and extremist organizations in Europe collaborating with Russian spy agencies are Russia-friendly statements made by leaders of Catalan separatists. The "yellow vest" rallies in Paris, which originally grew out of peaceful protest against rising gasoline prices, ended up in severe clashes between the protesters and police forces in late 2018. French law enforcement officials held Russia responsible for this peaceful-to-violent transformation of the protest.

At the same time, the United States and Russia were probing opportunities for a bilateral summit where to discuss issues of common concern. At long last, the US and Russian presidents met in Helsinki (Finland), in July 2018. The Trump-Putin summit ended up with no consensus or agreements reached. A new meeting was definitely needed to alleviate bilateral tensions to some extent. But the two presidents never met in Paris nor in Singapore. Finally, President Trump canceled a meeting with Putin originally scheduled to take place at the G-20 summit in Buenos Aires in early December, citing a Russian armed attack on Ukrainian naval vessels bound to pass through the Kerch Strait en route to Sea of Azov in late November 2018.

Russia's refusal to heed calls from Washington to abide by its commitments under the Intermediate-Range

Nuclear Forces Treaty (INF Treaty) dealt another severe blow to the already weakened relations between the two powers. For at the time when the American and North Korean leaders were searching for compromises on North Korean nuclear program, the Kremlin was advertising new missile and nuclear programs with potentially global implications. As a result, the US embassy in Moscow, on December 4, sent a note to the Russian Foreign Ministry, in which it warned the US would pull out of the INF treaty if Russia does not comply within 60 days. Moscow said in response it was honoring its INF obligations and all the accusation against it are "faked" and "destructive".

Along with official statements and diplomatic measures taken during the year, Russia's continuous display of its military muscle contributed to further aggravation of tensions in

West-Russia relations and motivated other countries to seek solutions in response. From 11 to 17 September, the Russian armed forces conducted the active phase of the Vostok-2018 strategic-operational war game – the largest Russian military exercises held over the past four decades. These maneuvers weren't just aimed to yet again demonstrate Russia's military might and to test its forces' readiness status in expansive and extensive military operations. By conducting this exercise, Moscow sought to demonstrate its intention to once again position itself as a key player on the international arena. NATO responded symmetrically by conducting Trident Juncture 2018 – its largest exercise in decades.

In 2018, Russia continued with its provocative airspace incursions all over the world. There were numerous reports of armed Russian airplanes flying very close to airspace borders of NATO countries. Thus, in late 2018, Russian strategic bomber Tu-160 was spotted overflying the Baltic Sea. In November, two Mig-29 and an An-26 airplanes were intercepted while overflying, again, the Baltic Sea. Later the same month, a Russian Navy's Tupolev TU-142 flew over the USS Mount Whitney, flagship of the US Navy's Six Fleet during the NATO-led military exercise Trident Juncture held in the Norwegian Sea. These are just a few of Russia's staged provocations that received media coverage.

Along with aggressive actions on the international arena, Russia was seeking to stuff up crisis-torn countries across the world with its military



The JIT probing the 2014 Downing said they had found that the Buk missile that shot down MH17 was fired from a launcher belonging to a Russian military brigade

contingents disguised as "peacekeepers". Russia, during 2018, continued beefing up its military presence and capabilities in Syria and eastern Ukraine, and facts were reported of Russian private military companies sending in their mercenaries to Africa and elsewhere across the world. By deliberately aggravating the situation in Syria (and the migrant crisis in Europe) and in Ukraine (especially in Donbas), the Kremlin is apparently seeking to show off its significance and to make the West realize the inevitability of cooperation with Russia.

These Russian objectives are too evident to the West, but the latter cannot let Moscow compromise international law and world order in favor of political gain, even if this requires some concessions. Thus, President Trump, in late 2018, ordered the Pentagon to pull out U.S. troops and equipment from Syria, thus raising concerns as to whether this would help Russia beef up its posture in that region.

HOPES AND EXPECTATIONS FOR 2019

As a result of the above considerations it can be predicted that the international situation will remain turbulent in 2019. Russia was involved in most of notorious scandals that occurred during 2018. Looking at how the Kremlin has treated these scandals so far, we can reasonably expect that this trend will run into 2019.

Europe will continue to be the target for regular Russian provocations in the information domain, this to be contributed by the increasingly visible



The Vostok-2018 was the largest military exercise held in Russia since Zapad-81 conducted by the Soviet Union

presence of populist-oriented parties in Europe's political landscape. In addition to the already existing areas of conflict, one can expect that the current Ukraine-Russia standoff over the Sea of Azov and the Kerch Strait will worsen further (Ukraine has announced intention to send, again, its navy ships from the Black Sea into the Sea of Azov through the Kerch Strait). Moreover, Russian military buildup near Ukraine border is raising concerns about the possibility of an all-out military conflict breaking out in the center of Europe.

The situation in Syria does not give hope for a peaceful settlement any time soon. The Syrian conflict has long grown out from a civil war and into a multinational conflict where decisions are made by parties other than the directly warring parties. The buildup of Russian military infrastructure in

Syria indicates that Russia is about to boost its regional posture and take control of the Syrian airspace in order to obtain an exclusive privilege of being in control of aircraft movements in that region of airspace. And the forthcoming U.S. military withdrawal will only contribute to this happening.

Moscow's refusal of the US proposal regarding the future of the INF Treaty, along with the conduct, in late 2018, of prototype technology demonstrator testing of Russia's most recent hypersonic missile system 'Avangard' that is allegedly capable of penetrating U.S. air defenses are both indicative of the Kremlin's willingness to 'raise the stakes' for 2019.

Experts are split on expectations for 2019. Some fear this can even outgrow into an all-out military confrontation, not only in Syria, but in Ukraine as well. Other analysts disagree, and say that Russia, in the near and medium term, will most likely refrain from conventional offensive operations because of the poor state of its economy and the high cost of such measures, and will instead opt for the hybrid warfare techniques it has already tested in Ukraine, Moldova and Georgia.

The bottom line is that tensions in Russo-Western relations remain in place and tend to mount. The world stands at the threshold of major changes that, regrettably, don't look too good. **UDR**



Protests in France, December 2018

Hryhory KUSHCHELEP,
Anton MIKHENKO,
Exclusive to Ukrainian Defense Review



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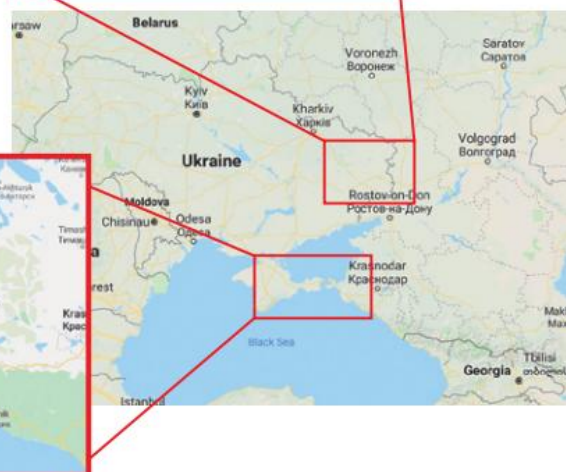
On November 23-25, three Ukrainian Navy vessels were assaulted and seized by Russia's Federal Security Service (FSB) in international waters near the entrance to the Kerch Strait while crossing from the Black Sea to the Sea of Azov. Kyiv claimed this to be a blatant act of overt aggression committed by the Kremlin against Ukraine, while Moscow referred to it as a "minor border incident" and a Ukrainian "provocation".

EVENTS IN THE SEA

In late November 2018, a flotilla of Ukrainian Navy vessels consisting of Gyrza-M-class gunboats, "Nikopol" and "Berdyansk", and the tugboat "Yany-Kapu" were crossing from the Ukrainian port of Odessa on the Black Sea to the Ukrainian port of Mariupol on the Sea of Azov. The vessels were entitled to free passage through the Strait and into the Sea of Azov, per a 2003 agreement between Ukraine and the Russian Federation on cooperation in the use of the Sea of Azov and the Kerch Strait. That being said, the Ukrainian side, according to statements by the Ministry of Internal Af-

fairs and to radio exchange files, had given advance notice to the Russians that the vessels would be moving through the Strait, just as was the case two months earlier when two Ukrainian military vessels – the search and rescue ship A500 Donbas and the tugboat A830 Korets – passed through the Strait without incident in September 2018. But this time around, the Russian side ignored the notification and deliberately chose to escalate tension in the region.

In early hours of November 25, Russia denied three Ukrainian Navy vessels a permit to travel through the Kerch Strait and further to the Sea of Azov. FSB Border Guard ship "Don" intentionally stroke and rammed into the Ukrainian tugboat nine times in an attempt to block its course toward



the Strait. The tug sustained numerous damages to its hull as a result of the ram attacks. The Russians definitely aimed to provoke an aggressive response from the Ukrainian warships, but never succeeded.

The Russians then anchored a large cargo vessel under the Kerch Strait Bridge to physically block access to the strait while officially saying the vessel had run aground right across the passage under the central arc of the bridge. As a result of this intentional blockade, dozens of commercial cargo vessels bound to and from the Ukrainian ports of Berdyansk and Mariupol on the Azov Sea formed a huge jam. As the blockade continued, reports citing crewmembers of other Ukrainian vessels in the area had it that the Russian cargo vessel anchored under the Bridge was tugged off in order to let through the Russian Black Sea Fleet's minesweeper "Vice-Admiral Zakharyin" and several FSB coast guard vessels, then tugged back to its original position later, and this indicates that the Strait blockade had been staged deliberately.

Considering the escalation of this situation, the Ukrainian ships were forced to turn back to Odessa, but their way was blocked by the FSB and Black Sea Fleet boats and aircraft (the coast guard cutters Sobol-Class, coast guard boat Don-Class, Mangust-Class boats, small coast guard boat Suzdalets-Class, etc, over a dozen in total, as well as Su-30 jets and Ka-52 choppers) that were performing dangerous, course blocking maneuvers against them and unlawfully calling the Ukrainian ships to a halt. Finally, the Russians began to threaten the use of force. The FSB ships and Black Sea Fleet's Su-30 jets and a Ka-52 helicopter opened effective lethal artillery fire on the Ukrainian vessels after they had entered international waters (that is, outside of the 12-mile limit area).

The Berdyansk gunboat was damaged by artillery fire and lost speed, with three of its crew members injured as a result of the attack. Shortly afterwards, the Ukrainian flotilla with 24 crewmembers were seized and arrested by Russian special forces.

The Russian FSB said its aggressive actions were in response to an alleged violation of the Russian border by the Ukrainian ships. But there can be no talk of a "border violation", since the Crimean Peninsula is internationally recognized as Ukrainian territory that has been annexed by Russia, and the Ukrainian vessels did not enter Russia's territorial waters off the Taman peninsula, as evidenced by their FSB verified location coordinates.

It is an obviously made-up reason which has nothing to do with reality, that is, that Russia had deliberately blocked the Kerch Strait for the Ukrainian warships.

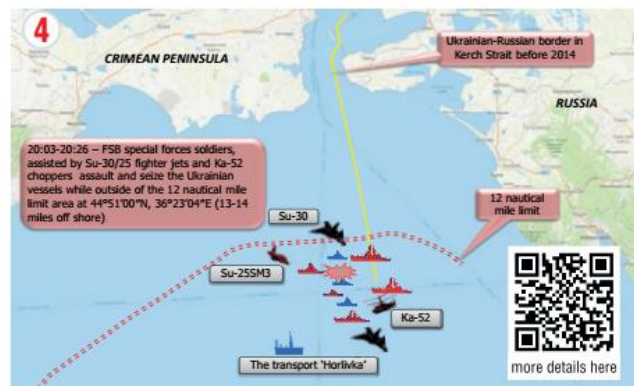
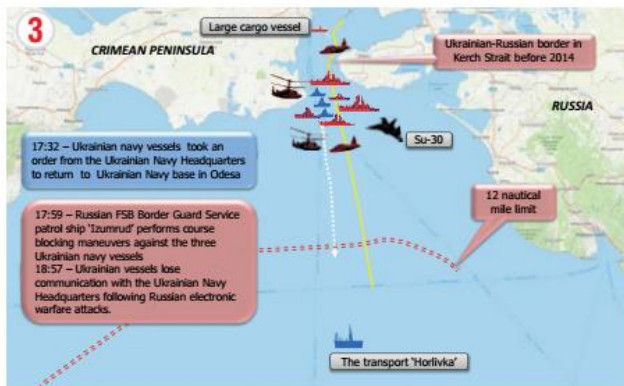
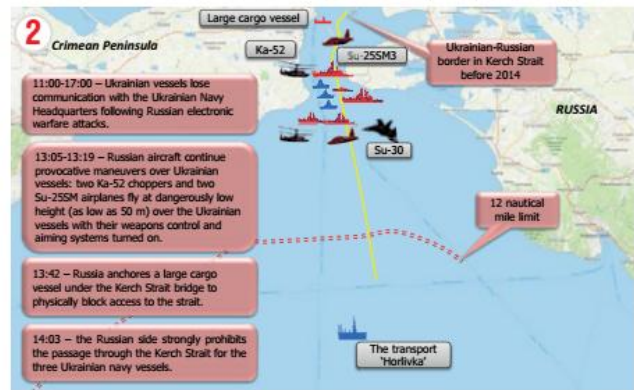
A BLATANT ACT OF NAKED AGGRESSION

By committing these actions, the Russian Federation openly violated international regulations on navigation in the Black Sea. These are the 1982 UN Convention on the Law of the Sea, the UN Charter, UN General Assembly Resolution 3314 (XXIX) 1974, and the 2003 Agreement between Ukraine and Russia on →

Start of the Ukrainian navy vessels' travel toward the Kerch Strait, 25 November 2018



Russia's armed assault and seizure of three Ukrainian navy vessel, November 25, 2018





Russia anchored a large cargo vessel under the central arc of the Kerch Strait Bridge in order to block any unwanted traffic

cooperation in the use of the Sea of Azov and the Kerch Strait, which regulates the use of these two water areas.

In particular, Article 17 of the 1982 UN Convention says vessels of all states, both coastal and landlocked, enjoy the right of "peaceful passage through the territorial sea" if they honor the Convention. According to Article 24 of the same convention, a coastal state "should not prevent a peaceful passage of foreign vessels across a territorial sea".

Section 1, Article 36 of the Convention says that, in the straits referred to in Article 37 of the UN Convention, all ships and aircraft enjoy the right of transit passage, which should not be obstructed.

Further, according to Clause 1, Article 2 of the 2003 Agreement, "commercial and military ships... flying the flag of Ukraine or Russia... enjoy free navigation in the Sea of Azov and the Kerch Strait". In practice, this means that Ukraine did not even have to notify Russia about anything because it acted in accordance with the above-mentioned regulations.

The Project 58155 Gyrza-M class is a series of small armored artillery boats in service with the Ukrainian Navy



What is more, according to current international norms and laws of shipping, a war vessel is the territory of a state whose flag it bears, and a violation of this territory *amounts to an act of aggression*. Alternatively, an armed attack committed by one state against a naval force or a war vessel of another state constitutes an *act of aggression* as defined by the UN General Assembly resolution 3314 (14 December 1974).

Another important nuance is that, under the Russian Law on "Internal Sea Waters, Territorial Sea and Contiguous Zone Outside of the Russian Federation", Russian warships cannot open fire upon foreign war vessels unless first attacked with fire from these vessels. The most the Russians were entitled to do in this situation was to demand that the "intruder" vessel leave Russian waters immediately.

INTERNATIONAL RESPONSES

Ukraine has responded adequately to this situation. In response to this act of true military aggression, not hybrid as it was previously, Ukrainian authorities imposed martial law for 30 days in parts of the country that would be on the front lines of a military conflict with Russia. During the emergency, Ukrainian armed forces were put on combat readiness and reservists were called up.

Kyiv urged all international institutions concerned – the UN, OSCE, EU, NATO, as well as signatories to the Budapest Memorandum – to pressurize Russia into fully complying with its obligations and ceasing its aggression in Ukraine immediately.

The UN Security Council, at its emergency meeting held on 26 November 2018, in a majority vote condemned Russia's conduct in the Kerch Strait, and five SC members – Poland, France, the Netherlands, Sweden and the United Kingdom – demanded that Russia release captured Ukrainian vessels and sailors.

The European Union, for its part, expressed concern over the use of force by the Russian Federation and strongly urged Russia to free the Ukrainian vessels and the crews. NATO Secretary-General Jens Stoltenberg, at a meeting in Brussels with Ukrainian and Georgian officials on December 4, said: "There is no justification for this use of force. We call for calm and restraint. Russia must release the Ukrainian sailors and ships. It must also allow freedom of navigation and unhindered access to Ukrainian ports in the Sea of Azov".

US President Donald Trump canceled a meeting with Russian President Vladimir Putin, which was to be held in Argentina on the sidelines of the G20 summit on December 1, citing the situation with the Ukrainian ships captured in the Kerch Strait. The American leader further noted that he would be ready to meet with Putin in the future, when the situation with the sailors is resolved.

Russia's conduct was strongly condemned also by Federal Chancellor of Germany Angela Merkel, British Prime Minister Teresa May, Canadian



more details here



Don patrol boat (Russia) is deliberately ramming Yany Kapu tugboat (Ukraine)

Prime Minister Justin Trudeau, and French President Emmanuel Macron. Beyond that, there were statements from the governments of Poland, Hungary, Slovakia, Estonia, Lithuania, and several more European countries, which condemned Russia's behavior and urged it to release the Ukrainian ships and the crews, and called on both sides to avoid further escalation.

This strong global response, however, had no effect on Russia's attitude. The Kremlin decided that the Ukrainian sailors would be treated as civilian border intruders rather than prisoners of war that cannot be tried. Moscow ignored the fact that its security forces had attacked and seized foreign warships and crews who operated on orders from their relevant commanders, who announced in radio exchanges that they had no intention of using weapons and would continue their travel in compliance with international rules.

The Kremlin stubbornly refuses to see the obvious things while at the same time creating a complete-



Captured Ukrainian gunboats and a tug anchored in a port of Kerch

A TIMELINE OF THE KERCH STRAIT INCIDENT, NOVEMBER 25, 2018

05:23 – A Ukrainian flotilla consisting of three vessels – the Guryza-M-class artillery boats 'Berdyansk' and 'Nikopol' and the tugboat 'Yany Kapu' – begin sailing towards the Kerch Strait, with the transport 'Horlivka' standing off.

06:08 – the three vessels enter the 12-mile limit area (two hours after notification) at 44°53'10"N, 36° 33'52"E.

06:23 – Russian coast guard vessels including the 'Don' and 'Izumrud', and three FSB Border Guard Service patrol boats approach the Ukrainian flotilla and begin performing dangerous, course blocking maneuvers against it.

06:35, 06:44 – The flotilla continues on their course; the Russian Coast Guard ships 'Don' and 'Izumrud' intentionally strike and ram the tugboat 'Yany Kapu' at 44°56'00 N, 36°30'08 E and at 44°56'06 N, 36°30'05 E, respectively.

07:22 – The flotilla continues on its course; the Don, again, intentionally rams into the Yany Kapu at 44°59'05 N, 36°31'35 E.

07:52 – The flotilla continue on their course; notify the Vessel Traffic Service (VTS) at the port of Kerch about the damages sustained and the need to get repaired at the nearest port location in Ukraine (45°01'12 N, 36°30'45 E).

08:40 – The Ukrainian navy vessels continue on their course; fail to obtain a permit from the Kerch Port's VTS to pass through the Strait of Kerch; ordered by the FSB to stop and anchor at a location 5 km east of the village of Zavitne (anchorage area #471). Provocative maneuvers by Russian military aircraft: a Black Sea Fleet's Mi-8 helicopter was spotted twice flying in an assault like manner at the height of about 100 m over the Ukrainian vessels.

08:56 – the three Ukrainian navy vessels enter the Kerch Strait, anchor at area #471 (Sector 'C', shared Ukrainian-Russian inland waters).

11:00-17:00 – The vessels lose communication with the Ukrainian Navy Headquarters following Russian electronic warfare attacks that had disabled their HF-, VHF- and satellite communication links, and AIC system. The Ukrainian crews are subjected to intense psychological pressure.

13:05-13:19 – Russian aircraft continue provocative maneuvers over Ukrainian vessels: two Ka-52 choppers and two Su-25SM airplanes fly at dangerously low height (as low as 50 m) over the Ukrainian vessels with their weapons control and aiming systems turned on.

13:42 – Russia anchors a large cargo vessel under the Kerch Strait Bridge to physically block access to the Strait.

14:03 – The Russian side strongly denies the passage through the Kerch Strait for the three Ukrainian navy vessels.

17:59 – Russian FSB Border Guard Service patrol ship 'Izumrud' performs course blocking maneuvers against the Ukrainian flotilla.

19:48 – The Berdyansk sustains a damage to its pilothouse when it had taken fire from a Russian vessel while outside of the 12 nautical mile limit area at 44°51'00 N, 36°23'04 E.

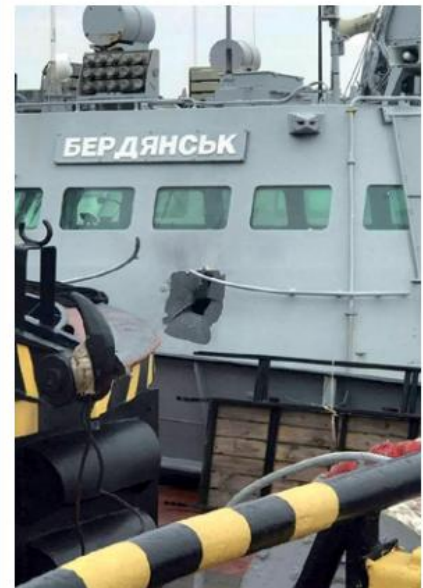
20:01 – The Berdyansk vessel's commander issues mayday calls.

20:03-20:26 – FSB Special Forces soldiers, assisted by Su-30/25 fighter jets and Ka-52 choppers assault and seize the Ukrainian vessels while outside of the 12 nautical mile limit (13-14 miles off shore).

05:30 – The armored gunboats 'Berdyansk' and 'Nikopol', and the tugboat 'Yany Kapu' towed to the Kerch harbor, the Berdyansk and Nikopol have their Harris radios removed and seized by the Russians; crews forcibly removed from the vessels after being confiscated of their personal documents and cell phones.

ly different, parallel reality where it feels as comfortable as possible. Moscow downplays the significance of this event, referring to it as a "minor border incident" between the two countries, which doesn't deserve too much attention. Moreover, Moscow is speaking in terms of a "provocation committed by the authorities in Kyiv on the tip from the West in order to worsen the already tense situation", which certainly is not the case.

The obtaining situation is that the Russian Federation confidently demonstrates that the "fist law" is prevailing over international and national laws. At the same time, the international community has so far confined itself to rather modest po-



Damage inflicted to Berdyansk artillery boat as a result of Russian fire

litical statements and restrained appeals slightly favoring Ukraine, but it seems yet unprepared to strongly pressurize the Kremlin back into the legal fold. After all, it should be appreciated that unless this happens, impunity and arbitrariness will eventually become common in the Black and Azov Sea regions and far beyond. As a matter of fact, the impunity of violating international laws may encourage similar actions on the part of other countries. This would plunge the world into a chaotic atmosphere – something which nobody wants to happen. **UDR**

Volodymyr ZABLITSKY

DOMESTIC DEVELOPMENT OF A SHORT-RANGE BALLISTIC MISSILE SYSTEM – FOR EXPORT MARKETS AND FOR OWN ARMED FORCES

Serhiy ZGHURETS,
Defense Express

Ukraine's 27th Independence Day parade displayed for the first time a prototype mockup of a Transporter Erector Launcher (TEL) for a short-range ballistic missile system under development by KB Pivdenne (aka Yuzhnoye), Dnipro. The TEL is a key element of the operational-tactical missile system variants intended for the domestic and export markets.

BALLISTIC MISSILE PROJECT SAPSAN

Plans regarding the indigenous development of a new ballistic missile program were first discussed on March 7, 2006 at a National Security and Defense Council (NSDC) meeting attended by the then President of Ukraine, Viktor Yushchenko. It then became evident that the country's missile defense shield was in urgent need of modernization. Ukraine's Missile Forces were able to reach targets no longer than 120 km away with aging Soviet-developed Tochka-U ballistic missile complexes that only Russian companies were entitled to overhaul and upgrade. The NSDC meeting agreed that there was a need for developing a new, multifunctional operational-tactical missile system

(MFMS) to offer a non-nuclear deterrence capability for Ukraine's Armed Forces. The domestic defense industry was set to the task of developing a system that would combine the features of tactical missile complexes and multiple launch rocket launchers, i.e. be multifunctional in nature.

M.K. Yangel KB Pivdenne, a State-owned design & development company based in Dnipropetrovsk (now renamed into Dnipro) that previously had developed 12 out of 20 Soviet brands of intercontinental ballistic missile systems, was assigned the job of developing the MFMS project that was assigned the designator name "Sapsan" (meaning "peregrine falcon" in Ukrainian). Operational requirements document for the Sapsan MFMS was agreed upon between the Ministry

of Defense and KB Pivdenne in September 2007. It was foreseen that the project would be a broad collaboration between up to 60 domestic defense industries. The new indigenously developed MFMS was supposed to replace the aging Soviet-designed counterparts operated by the Ukrainian Armed Forces.

In 2009-2010, however, funding for the Sapsan project was



A BURST OF

put on hold due to economic decline in Ukraine, in the wake of the Global 2008 Financial Crisis, and resumed after Sapsan had been formalized into a federally targeted program in November 2011. Approved with a budget of just \$ 0.825 million, the program got only 5-10 percent of the funding to which it was entitled. In August 2013, the Ministry of Defense, then led by Pavlo Lebedev, terminated the funding for the Sapsan program, citing wastage of the program's budget by KB Pivdenne.

HRIM - FOCUS ON EXPORT MARKETS

Against the backdrop of Sapsan's budget expenditure shortfalls, domestic arms dealers began since 2011 offering potential export customers the new operational-tactical missile system (OTMS) named Hrim (also known as Grom, translated as "Thunder"). Two years later, KB Pivdenne received a contract from an undis-

closed country to develop the OTMS Hrim-2.

In mid-2014 when Russian incursion into Ukraine was already underway, KB Pivdenne came out with an initiative to resume work on the Sapsan MFMS program leveraging the expertise that it has gained in developing the Hrim-2 for an export customer. Pivdenne suggested that the Sapsan should be ready for user evaluation by 2018 to enable sooner personnel training, sooner completion of the trials process, and sooner introduction into Ukraine's Armed Forces, the latter being a critical factor for potential export sales.

President Petro Poroshenko, while on a visit to Dnipropetrovsk on October 21, 2014, gave orders that products by Pivdenne (aka Yuzhny) Makarov Machinery Plant should be included into the Government Defense Procurement Contract 2015. In January 2015, Oleksandr Dehtyarev, the Chief Designer at KB Pivdenne, said in an official statement that the Ukrainian government had agreed with the need to unlock the Sapsan MFMS program, and promised that, with adequate and smooth funding, the Sapsan MFMS technology could be ready for testing and evaluation as soon as in 2018.

Ukraine's Ministry of Defense has been closely watching the running of the design and development process for the foreign customer commis-

sioned Hrim-2 OTMS, and hopes that Ukraine's Armed Forces would obtain a more advanced and capable variant.

FURTHER DETAILS ON THE SUBJECT

It would be premature to evaluate the capabilities of the new OTMS until it completes its testing program and low-rate initial production is commenced. But this could be attempted, with a degree of error, based on the technical and engineering design data from multiple technology presentations conducted for foreign-country officials previously.

The data below is what we have been able to reconstruct from open sources. The short-range ballistic missile system under development by KB Pivdenne is designed to defeat targets located in the depths of hostile territory: missile batteries, airplanes and helicopters on the ground, artillery cannons and MLRS, air and missile defenses, command/control and field communication centers, critical civilian infrastructures, etc.

The system, as suggested by KB Pivdenne, should include: TELs, cruise and ballistic missiles; a mobile brigade/ division/ battery command & control center, a transport-loader vehicle with a missile launching canister, mobile electric power units; system control equipment; and a launch support vehicle. →



OFF-ROAD TRANSPORT ERECTOR LAUNCHER (TEL)

Designers: Kharkiv Transport Machinery Plant, State-owned Kharkiv Morozov Machinery Design Bureau

- TEL mass, fully loaded – 38 t
- Road speed – 70 km/h
- Autonomy of operation – 3 days
- Crew – 3
- 10x10 wheeled chassis
- Apparatus compartment

- Launching canister with a missile loaded
- Leveling outriggers
- Deflector

MISSILE

- Missile launching canister
- Interface attachment
- Missile head section
- Interface attachment
- Main engine
- Aerodynamic control surfaces
- Tail section with pulse correction unit

“THUNDER”

The system's range is dependable primarily upon the range performance of the missile being launched. The missile range for export version is 300 km, limited by the Missile Technology Control Regime (MTCR). The version intended for Ukraine's Armed Forces will be able to fly up to 500 km. The minimum range is 20 to 50 km. KB Pivdenne stated that the missile would be able to travel along guided ballistic trajectories as well as aeroballistic trajectories.

Ballistic missile - single-stage, guided, with a non-detachable warhead. Mass of the launch-ready missile is about 4,300 kg, while the launching canister weighs about 5,300 kg when fully loaded.

Main engine - solid fuelled, operating with a fuel blend, featuring a cocoon-type frame. Engine mass is about 3,000 kg. Missile is launched from the canister like a mortar round by gas dynamic jets of the main engine. After launch, the missile has to be guided until impact.

Missile control system combines GPS-supported inertial navigation with guidance from missile's EO/radar seeker. Guidance to target is provided by inertial/GPS navigation system, with fire-and-forget seeker used for terminal guidance.

The EO seeker would match the terrain being overflown with images from the library downloaded into its "brains" during pre-launch preparations. The library contains digital maps compiled from aero- and satellite images of hostile territory. A similar mode of guidance is used in current-generation cruise missiles. A radar seeker (active or passive) is also suited for this application, and Ukraine already has a solu-

tion in this area. The challenge facing the designers of this OTMS is to select a highly accurate guidance system that would provide terminal accuracy measuring in meters of Circular Error Probable (CEP). But the key priority now is to make the missile modular in architecture to enable future improvements driven by technological advances, the Company's growing expertise, and the varying needs of the Customer (Ministry of Defense).

The missile can accept various types of warheads weighing 480 kg or so, either cluster or unitary, of high explosive fragmentation (HEF) type or Advanced Unitary Penetrator (AUP) type. The kill radius is stated to be 10,000 m² for the HEF warhead and up to 3 hectares for the AUP warhead. In the terminal phase of flight, the missile would approach the target at approximately 1,300 m/s. The process of preparing the missile for launch from TEL would take from 5 to 20 minutes depending on preparedness of the firing position and readiness of the TEL crew.

The TEL of the perspective OTMS is built on a purpose-designed off-road 10x10 wheeled chassis, and the same type of chassis will provide a platform on which the OTMS' missile transporter and transporter loader will be built. The mockup prototype of the TEL was developed by State-owned Kharkiv Morozov Machinery Design Bureau and built by PrAT Kharkiv Transport Machinery Plant.

The TEL is outfitted with the systems and equipment required for autonomous pre-launch and launch operations. Seen here is a configuration equipped with 2 x launching canisters loaded with ground-to-ground missiles.


In its full configuration, the TEL with two ballistic missiles loaded weighs about 38 tons. Road speed is stated at 70 km/h. Served by a crew of three, the TEL is provided with fuel, food and water supplies for three days of autonomous operation.

Defense Express proposes to meet the Ukrainian Armed Forces' requirement for OTMS capabilities at the rate of one OTMS brigade per each Operational Command (plus reserve capabilities).

CONTRA SPEM SPERO

The MTCR allows its signatories to sell missiles with ranges up to 300 km to export markets and up to 500 km to their respective domestic markets. Ukraine is fully in its right to develop a domestic ballistic missile capability, considering especially a continuous threat of aggression from the Russian Federation.

In 2007, Ukraine's only ballistic missile brigade was modernized with Tochka-U missile complexes replacing the long outdated Scud tactical ballistic missile systems. Ukrainian forces used Tochka-U missile batteries and individual launchers to counter Russian incursion in 2014. But these weapons were deficient, and there were instances where Tochka-U missiles that had underwent life extension upgrades by Russian engineers from Kolomna Design Bureau just ahead of the war fell short of their targets.

Ukraine, having learnt bitter lessons, has to correct own mistakes of the past. Ukraine, albeit being a missile-armed nation, urgently needs a modern ballistic missile capability, and domestic development of this capability is a challenge that must be met. 





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A NEW LEASE OF LIFE FOR PROVEN WEAPONS

S-125M Pechora

UKRAINE OFFERS UPGRADES FOR PECHORA, OSA, SHILKA, TUNGUSKA SAM SYSTEMS

Ukraine has developed life extension upgrades for Soviet legacy surface-to-air systems, aimed to extend their service life and to bring up to date their specifications and performance parameters.

S-125M PECHORA

The S-125 Pechora is a Soviet-era SAM system developed for defense against aerodynamic threats, manned or unmanned, flying at 20 to 1,800 meters high, at ranges from 3.5 to 25 km away. In total, more than 400 units of the S-125 system have been sold worldwide. Some of them, despite their age, continue to be in operational use. However, the S-125 technology still has much room for upgrading and improvement.

Thus, Radionix, Kyiv, has developed an upgrade package for the S-125M "Pechora" SAM system which includes modernizing the 5V27D missile to the 5V27D-M1 and 5V27D-M2 standards equipped respectively with semi-active and active seeker heads.

The package encompasses improvements to all the key components and subsystems, including the UVN radar post, high-frequency receiving devices, radio command transmitters, TV/optical sighting equipment; 5P73 launcher; 5V27D missile; and a new booster motor replacing the 5C45.

Upgrade package for the 5V27D missile includes a Customer-selectable semi-active/active seeker head and a fully redesigned missile guidance electronics set.

Other upgrades for the 5V27D missile include electrically driven steering gear and ailerons in place of air-driven ones to achieve a weight saving and improve control properties; adding a platformless inertial navigation system; an improved radio signal receiver; integration of a radar proximity fuse using new microelectronics hardware; replacing the missile control unit with a more current-generation counterpart.

The 5V27D-M1 uses a combined guidance method (radio-inertial guidance in the mid-course and semi-active radar homing in the terminal phase)

enabling the missile's kill envelope to be extended to 40 km for high speed maneuverable targets and to 45 km for low-speed targets.

Other upgrades are to the UNV-M antenna post and UNK-M cabin to enable tracking of 3 targets simultaneously; and upgrades to the missile's line-of-sight radio command transmitter would increase the number of missiles being guided simultaneously to six missiles or more.

The 5V27D-M2 uses radio-inertial guidance in the mid-course and active radar homing in the terminal phase. This would enable extended kill envelopes of 40 km for high speed maneuverable targets and 45 km for low-speed (≤ 300 m/s) targets. The upgrade would replace the UNV-M cabin on each launcher with a 36D6 radar station. The 3D radar supports tracking of up to 8 targets simultaneously, and up to 16 missiles will be able to be guided simultaneously due to upgrades to the launcher control equipment.

The upgrades would keep the 5V27D missiles in service for another ten years.

OSA-AKM SAM SYSTEM

The BM 9A33BM2 (BM3) Osa-AKM is one of the most common and successful army air defense systems in current use. It is meant to provide air defense cover for motor-rifle (tank) divisions in all kinds of combat scenarios. The Osa-AKM can operate in severe jamming environments, providing effective protection against low RCS, low flying threats.

This is quite a lethal system armed with six 9M33M3 missiles. Despite having been developed in the second half of the 20th century, the Osa proved its worth in fighting Russia-back insurgents in Eastern Ukraine. But it can have its capabilities improved and expanded through upgrades offered by Ukrainian defense industries.

Thus, several domestic companies, among them Ukroboronprom holding's Ukradarproekt LLC and Defense Technologies LLC offer a package to upgrade the BM 9A33BM2 (BM3) Osa-AKM to the more capable BM 9A33BMD standard that would enable improved technical and operational performances along with an extended lifespan.

The BM 9A33BMD upgrade package includes among other things:

- improved detection and engagement capabilities against small-sized targets, cruise missiles, and UAVs, including low flying ones;
- enhanced immunity to passive/active jamming attempts due to the introduction of digital signal processing techniques;
- implementing an automatic downlink from an external control center at ranges 45 to 90 km, with the target detection envelope enhanced due to achieving an increased receiver system gain and shifting to digital signal processing;
- service life extended by up to 12 years and the mean time between failures by up to 1,500 hours due to analog-to-digital replacement;
- introduction of data communication between the BM 9A33BMD and a higher command center.

The upgrade would enable a 20 per cent increase in the detection and engagement capabilities against targets with RCS of 0.1 to 0.01 sq. m., while the altitude engagement envelope would be risen to 7.0 km. Simultane-

ously, the BM 9A33BMD would be able to engage targets travelling at 700 m/s on pursue courses and 350 m/s on lead-collision courses (an increase of respectively 200 m/s and 50 m/s as compared to the original version).

Analogue-to-digital replacement of the moving target selection equipment would help achieve a 20-fold increase in compensated interference with the functional checkout equipment. The BM 9A33BMD additionally includes an automated workstation for the operating crew leader, equipped with a modern computer with GPS and radio modem.

Also packaged is a TV/optical sight, with optical and infrared images of objects displayed on an LCD screen monitor. This would enable targets to be searched and tracked without the use of additional radars, thus reducing the probability of the system being exposed by enemy assets.

ZSU-23-4 "SHILKA"

Another proven air defense weapon that has received a second lease of life in Ukraine is the ZSU-23-4 Shilka. Developed as a self-propelled anti-aircraft (AA) weapon system, it is intended for AA defense of ground forces and military facilities, and for shooting down air targets flying at altitudes up to 1,500 m and ranges up to 2,500 m, as well as land (surface) targets at ranges out to 2,000 m, while on short stops or on the move.



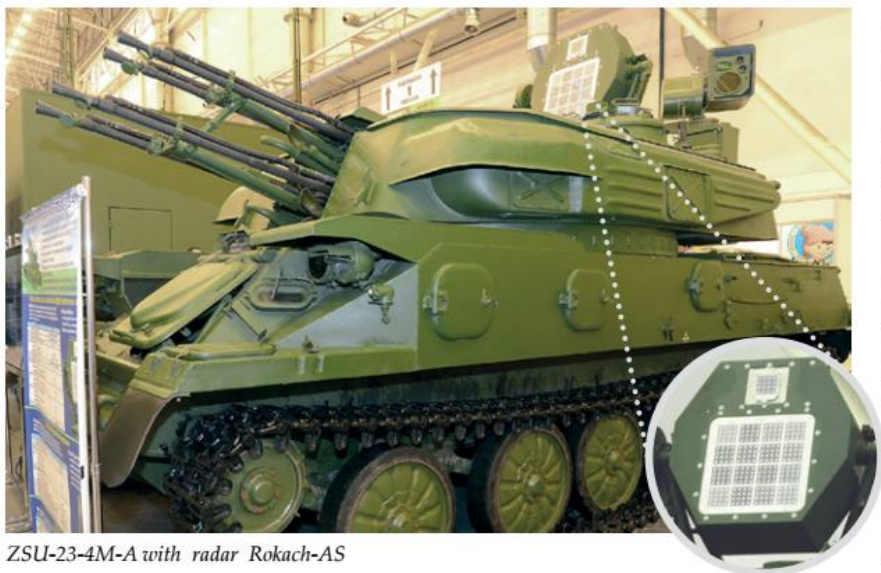
Osa-AKM SAM System

The Arsenal Factory, Kyiv, has developed a comprehensively upgraded version of the ZSU-23-4 "Shilka" anti-aircraft gun system.

Arsenals' Shilka upgrade, known under designator ZSU-23-4M-A, includes a multirole digital phased array radar Rokach-AS replacing the 1RL33M radar in the original version; a new optical location system; the addition of a missile guidance channel; a new fully digital computing system in place of the old analog computing device; integration of advanced weapon control algorithms; and replacement of other components with more up-to-date counterparts. Future improvements will include replacement of the currently used gas turbine power unit with a more economical electric power supply source.

Arsenals' Rokach-AS radar is undoubtedly the key element in the upgrade. It offers three-mode operation for 360-degree surveillance, air search and autotracking in an integrated package.

The radar Rokach-AS has the capability to pick up and track low-observable UAV targets with RCS as low as 0.01 sq. m, at ranges out to 7 kilometers. It far exceeds its predecessor in almost every area. Compared to the original radar, which could scan a 15-degree sector and track targets within its 1-degree FOV beam, the Rokach-AS has coverage angles of 18 degrees, both in azimuth and elevation, and it can →



ZSU-23-4M-A with radar Rokach-AS

search and detect targets much quicker than its predecessor.

Finally, when compared to the 1RL33M original that occupied the entire perimeter of the turret inside the "Shilka" vehicle, the Rokach-AS is a compact device accommodated in a container on top of the vehicle, with the resulting benefit of a considerable amount of internal vehicle space released to improve the comfort for the crew and passengers, and enabling the installation of additional equipment like HVAC.

The ZSU-23-4M-A upgrade additionally includes the installation of an optical location system integrating television and thermal imaging cameras with a laser rangefinder. The upgrade would offer detection and autotracking capabilities along with a capability for automatic/semi-automatic generation of target location coordinates for the digital computing unit. The upgraded system would also support air surveillance and engagement control missions. It would be able to detect targets at ranges up to 12 km, and to capture and automatically track them at ranges out to 10 km.

The upgraded ZSU-23-4M-A Shilka would be able to defeat targets at ranges up to 5 km away, which is twice the range achieved with the previous-generation system.

2K22 TUNGUSKA

Defense Technologies LLC, Ukraine, offers an upgrade for the Soviet designed 2K22 Tunguska – a self-propelled air defense system that

combines a rapid-fire automatic cannon power and surface-to-air missile (SAM) capability. The upgrade includes life extension overhaul and replacement of the key subsystems and assemblies, including the cannon, missile launcher, and carrying chassis.

Defense Technologies also offers a more comprehensive package for the Tunguska, which additionally addresses upgrades to the electronics set, ergonomics, and operator workstations (new screen monitors and communication facilities, reduced number of display indicators).

For upgrading the Tunguska, Defense Technologies has developed a range of technical solutions based on modern microelectronics hardware that can ensure benefits in terms of more energy efficient operation, a reduced requirement for system alignment, and high reliability of operation with minimum human intervention. As well as the Tunguska, this "modular" method is suitable for upgrading other Soviet legacy SAM weapons like the Buk, S-300P or S-300V1.

Defense Technologies has also developed new

display indicator units, and operator workstations can be upgraded with new VGA monitors.

The package also includes an electronic-optical system with a video processing capability to enable the detection and automatic tracking of airborne targets in all weathers and at all times of the day as well as to achieve a high kill probability, especially for the SAM part of the system. Another benefit achieved with the integration of the EO detection and tracking capability would be an increased efficiency of the system's use even with low-trained operators.

But any significant enhancement in the system's combat capabilities can only be achieved with new missiles in place of those currently used with the Tunguska. Ukrainian defense industries, among them Luch Design Bureau and Arsenal Factory, are looking to develop what would be Ukraine's indigenous missile for short-range air defense. This is about a bi-caliber missile that could be developed within a short timeframe leveraging the technical and technological expertise the two companies had acquired with developing their earlier missile products. In 2018 Ukrainian export company "Spetstechnoexport" achieved new arrangements with the Indian state-owned company Bharat Electronics Limited (BEL). Henceforth, the "Spetstechnoexport" will take part in tenders for joint modernization of air defense systems, such as ZSU-23-4 "Shilka", P-125 "Pechora" and others in India. [UDR](#)

Anton MIKHENKO,
UDR



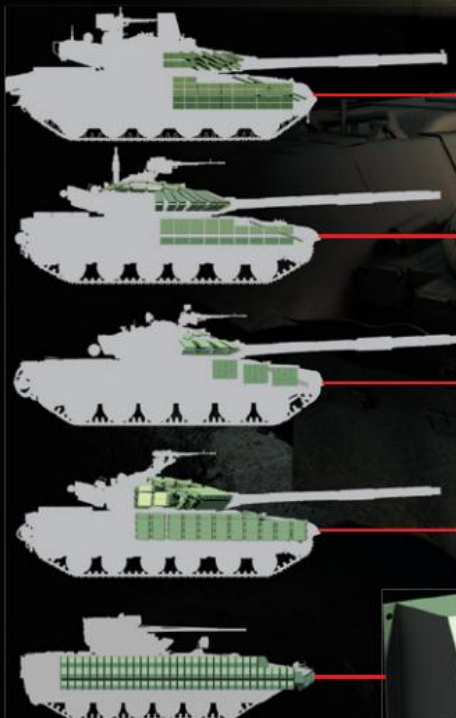


UKRAINIAN ADVANCED MICROTECHNOLOGIES

named after V. O. KHYTRYK

Explosive reactive armour elements

LLC "Ukrainian Advanced Microtechnologies named after V.O. Khytryk" is a private Ukrainian company specialized in development, modernization and production of explosive reactive armor elements and systems for protection of armored vehicles.



Armour piercing capability reduction

	NIZH-LM (with HKChPWSH element)	4S20U	4S22U	NIZH-1M (with HKChPWSH element)	DUPLET-2M (with HKChPWSH element)
Antitank grenade launchers					
PG-7V, PG-7VM, PG-7VS, PG-9V, PG-9VS	≤ 80%	≤ 90%	≤ 90%	≤ 90%	≤ 95%
PG-7VL	-	≤ 50%	≤ 50%	≤ 70%	≤ 80%
PG-7VR (tandem warhead)	-	-	-	≤ 30%	≤ 70%
Shape charged (HEAT) projectiles					
BK-14M	-	≤ 80%	≤ 80%	≤ 80%	≤ 90%
BK-18M	-	≤ 70%	≤ 70%	≤ 70%	≤ 80%
Antitank guided missile (ATGM)					
TOW-1	-	≤ 60%	≤ 60%	≤ 70%	≤ 80%
TOW-2 (tandem warhead)	-	-	-	-	≤ 60%
Kornet-E (tandem warhead)	-	-	-	-	≤ 50%
Explosively Formed Penetrator (EFP)					
TM-83	-	-	-	≤ 40%	≤ 80%
Armour-piercing projectiles					
BM-15, BM-22, BM-26	-	-	≤ 60%	≤ 80%	≤ 90%
DM-23, M111, BM-29	-	-	≤ 30%	≤ 40%	≤ 60%
BM32, BM42 (Mango), DM-33, M829	-	-	≤ 20%	≤ 50%	≤ 60%

BARYER V | EXTENDED RANGE ATG MISSILE AND LAUNCHER OPTIMIZED FOR USE FROM AERIAL PLATFORMS



BARYER | VEHICLE-CARRIED LOG-RANGE ATG MISSILE SYSTEM



KOMBAT | GUIDED MISSILE ROUND



KONUS | GUIDED MISSILE ROUND



FALARICK 105 | 105 MM GUIDED MISSILE ROUND



STUGNA | GUIDED MISSILE ROUND



FALARICK 90 | 90 MM GUIDED MISSILE ROUND



KORSAR | MAN-PORTABLE ATG MISSILE AND LAUNCHER



DEVELOPER OF ANTI-TANK SYSTEMS IN UKRAINE



7,5 km



800 mm

5 km



800 mm

5 km



750 mm

5 km



700 mm

5 km



550 mm

5 km



550 mm

4 km



550 mm

2,5 km



550 mm

Armor penetration capability



Light portable
missile system
Corsar



Man-portable
rocket grenade
launcher



Man-portable
ATGW system Skif



IN SEARCH OF TARGETS

NEW GUIDANCE UNITS FOR WELL KNOWN MISSILES

In the domain of missile armaments, Ukraine has substantial R&D and production capacities for upgrading Soviet legacy systems and creating innovative products both for the domestic and export markets.

GUIDANCE UNITS FOR AIR-TO-AIR MISSILES

Ukraine is a major supplier of the medium-to-long-range R-27/AA-10 Alamo missiles to export markets, with the biggest markets being the countries operating substantial inventories of Soviet legacy MiG-29 and Su-27 jet fighters and their respective modifications. The producer of R-27 missiles is Kyiv-based Artem, a State-owned joint-stock holding company that used to be the leading air-to-air missile company in the former Soviet Union.

In Ukraine, the R-27 is produced in versions fitted with *semi-active radar (SAR)* homing and *infra-red (IR)* homing guidance units. The SAR version is the R-27R (radio-inertial guidance in the mid-course and semi-active radar homing in the terminal phase) equipped with the Kyiv Radar Factory's RGS-27 guidance unit that is capable of up to 25 km lock-on ranges. Guidance is assisted with the Novator's RLPK-29 radar sighting system with the N019/N019M Saphir-29/29M radar on the MiG-29 fighter and the RLPK-27 sighting system with the N001 Mech radar on the heavier Su-27 ground attack fighter.

The IR homing version is the R-27ET. It carries the Arsenal Factory's *Mayak-80M/MK-80M* guidance unit that is advantageous for its ability to work uncooled for periods

Ukraine is a proven supplier of semi-active radar (SAR) and infra-red (IR) homing guidance heads for R-27/AA-10 Alamo air-to-air missiles



of up to three hours, although at a cost of some reduction in lock-on range.

Arsenal has recently developed the **MR-2000**, an advanced guidance system for IR guided members of the R-27 family of missiles. The Designer has stated the following specifications about the MR-2000: max lock-on range – 30 km; field of view – ± 50 degrees; elevation – ± 40 degrees; angular velocity while tracking targets – up to 40 deg/sec; caliber 200/230 mm. For operation in complex ECM environments, the A3-10 modification has been developed, which features a dual band multi-element infrared detector with a digital data processing capability. The A3-10 comes with specifications as follows: max lock-on ranges – 30 km in the fore hemisphere and 100 km in the aft hemisphere; tracking angle/elevation – $\pm 60/\pm 50$ degrees; angular velocity while tracking targets – up to 40 deg/sec.

GUIDANCE UNITS FOR SURFACE-TO-AIR MISSILES

Radionix, Kyiv, has developed an upgrade package for the S-125M "Pechora" SAM System, which includes modernizing the 5V27D missile to the 5V27D-M1 and 5V27D-M2 standards equipped respectively with *semi-active* and *active seeker heads*.

The 5V27D-M1 uses a combined guidance method (radio-inertial guidance in the mid-course and semi-active radar homing in the terminal phase) enabling the missile's kill envelope to be extended to 40 km for high speed maneuverable targets and to 45 km for low-speed targets.

The package also includes upgrades to the UNV-M antenna post and UNK-M cabin to enable tracking of 3 targets simultaneously; and upgrades to the missile's line-of-sight radio command transmitter would increase the number of missiles being guided simultaneously up to six missiles and more.

The 5V27D-M2 missile uses radio-inertial guidance in the mid-course and active radar homing in the terminal phase. This would enable extended kill envelopes of 40 km for high speed maneuverable targets and to 45 km for low-speed (≤ 300 m/s) targets. The upgrade would replace the UNV-M cabin on each launcher with a



Radionix offers an upgrade to the S-125 Pechora Air Defense System, featuring the 5V27D SAM missile modernized with a new semi-active/active seeker head

36D6 radar station. The 3D radar supports tracking of up to 8 targets simultaneously, and up to 16 missiles will be able to be guided simultaneously due to upgrades to the launcher control equipment.

As well as the 5V27D-M1/2 missiles, Ukrainian industries have developed seeker upgrades for MANPAD missiles too. Thus, Arsenal SDP SE, Kyiv, offers options to upgrade the Strela and Igla MANPADS to more capable STRELA-2MM and IGLA-1M configurations.

Capability improvements in the two Soviet

legacy MANPADS are achieved by means of replacing their original IR guidance units with more up-to-date alternatives. The key elements of the upgrade packs are the optical seekers **OGS 36-45** for the STRELA-2MM and the **OGS UA-424** for the IGLA-1M, which both have already been showcased at international defense exhibitions.

The upgraded STRELA-2MM is a head-on attack missile that is effective against both fixed-wing and rotary-wing targets. The missile's new optical seeker integrates technologies enabling it to defeat IR decoy →



Arsenal SDP SE offers upgrades to the Strela and Igla MANPADS, featuring new IR guidance heads

flares and natural interference, and it is especially efficacious in severe clutter and ECM environments.

The optical seeker *OGS UA-424* on the IGLA-1M missile provides enhanced capabilities against IR countermeasures. It boasts an improved single-launch kill probability and, most importantly, offers a far extended range as compared to the original missile while attacking its targets head-on.

The Arsenal's 336-24 package for the IglA-M1 upgrade incorporates a newly-designed guidance unit replacing the 9E418 IR seeker used in the original IGLA missile. The new seeker would improve the missile's performances to levels much higher than those found in the established MANPAD systems such as the STINGER, IGLA-1 or IGLA, and far more superior than the STRELA-2M's. In particular, the IglA '336-24' has a kill probability of 0.4-0.6 while operating in heavy ECM environments, as compared to 0.1 for the IglA. The 336-24 upgrade offers a maximum effective range of 5,200 m.

SMART ANTITANK WEAPONS

State-run Progress R&D and Production Complex has developed the Kvitnyk, a 152mm semi-active laser-guided antitank round. The

Kvitnyk is designed to be deployed from artillery guns, including towed D-20, self-propelled 2S3 Acacia, and 2S19 Msta-S. Unlike other HE rounds that are effective against area targets only, the Kvitnyk can engage targets with lethality when fired from defilade positions, with high first round accuracy and without the need for adjusting fire.


With a length of 1.2 m and a mass of 48 kg (including a 8-kg HE charge), the projectile is available in 152mm and 155mm calibers. As maintained by the Designer, the munition can engage targets at ranges from 4 to 20 km with a first-round hit probability of 90%. Guidance is by inertial navigation in the midcourse stage, followed by a semi-active laser for the terminal phase to increase the probability that the target (like a tank, for example) will be hit in its most vulnerable, upper section. The range of targets that can be engaged with the Kvitnyk projectile includes field fortifications, light armored vehicles (both static and moving at up to 40 km/h), artillery, MLR and rocket launcher emplacements, but it is effective especially against tanks due to its top attack capability.

Guidance is performed with the *new 9E431* seeker head developed by Progress in collaboration with TsKB

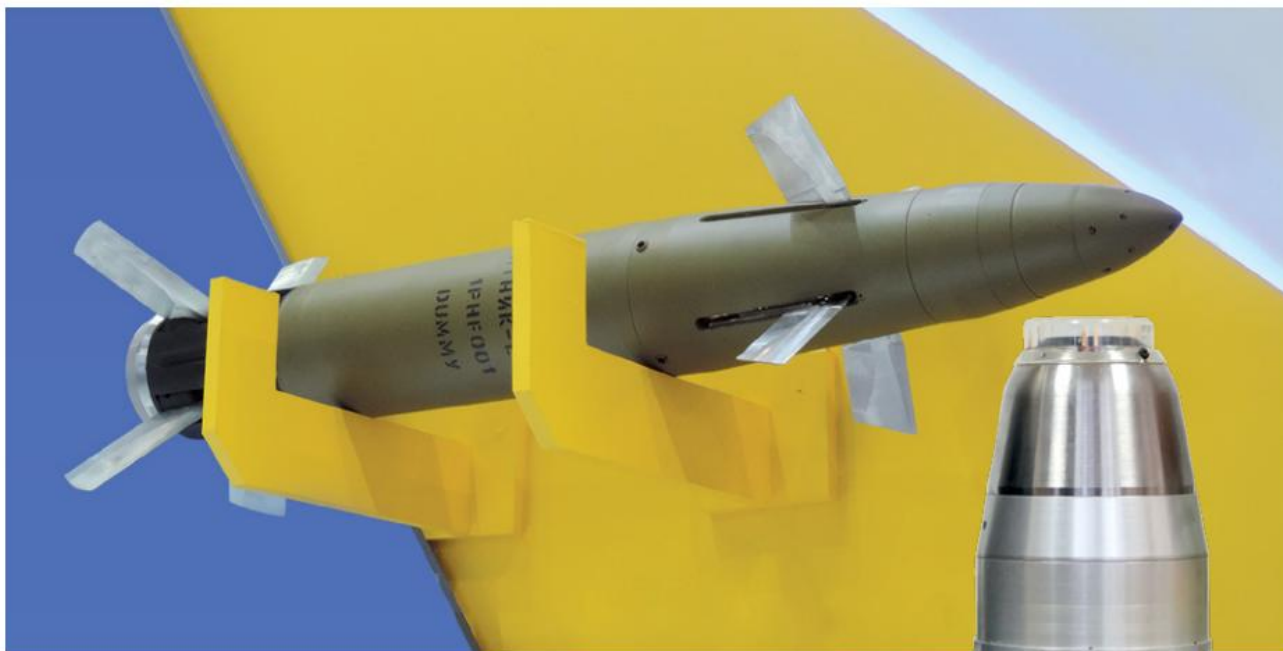
Tochnist. With a length of 156 mm, a diameter of 114 mm and a mass of 2.5 kg, the 9E431 guidance unit is universally applicable to munitions of calibers ranging from 120 to 155 mm.

The 9E431 is a gyroscopic tracking device that continuously combines the optical axis of the sensor that receives the laser beam reflected from the target with the direction to this target. It has a variable field of view, with the target being searched within a 30° FOV. At the same time, the missile's lock-on sector invariably exceeds its expected blast radius, and amounts to 2,200 meters in range and 1,000 meters in width.

Once a target (or, more specifically, a laser beam reflected from it) is detected, the projectile switches over to self-guided flight mode and the target is locked on for autotracking. The field of view is reduced to 5-6° for enhanced ECCM performance.

These are only few of the missile guidance technologies developed in Ukraine, but they are representative of the R&D and production capacities the country has to create modern, highly competitive arms technologies. 

Volodymyr TKACH,
Defense Express



Kvitnyk, a 152mm semi-active laser-guided antitank round, from Progress R&D and Production Complex

STATE ENTERPRISE PLANT 410 CIVIL AVIATION

70 years in Aircraft MRO Business



This is courtesy of State Enterprise Plant 410 CA

Ukrainian President Petro Poroshenko praised the State Enterprise Plant 410 CA while speaking at a ceremony of another one repaired aircraft handover to Ukrainian Air Force

Founded in 1948, the State Enterprise Plant 410 Civil Aviation (CA) has an impressive history full of achievements and victories. Over its years in business, the Company has overhauled about 7,000 airplanes and 40,000 aircraft engines for customers in over 50 countries worldwide, which is a proof of trust and impeccable reputation among the aviation community.



Plant 410 CA is a regular exhibitor at international trade shows, exhibiting under the auspices of its holding company – the State-run Ukroboronprom defense industries group

Being part of the State-run Ukroboronprom defense industries holding company, the State Enterprise Plant 410 CA – due to the availability of well-developed industrial infrastructure, modern equipment, and advanced aviation technologies, as well as the experience and expertise gained by its engineering and technical staff – can carry out, at a high level of quality, aircraft MRO work and maintain leadership in the domestic aviation MRO market.

The State Enterprise Plant 410 CA is a certified maintenance, repair and overhaul (MRO) provider for the Antonov An-24, An-26, An-30, An-32, An-72, and An-74 airplanes, Mi-8MSB helicopters, and D-36 engines.

SE PLANT 410 CA provides the following services:

- extends the service life of Antonov family aircraft;
- carries out CRW1, CRW2, CRW3 on AN-74 aircraft and CRM on AN-72 aircraft at the flight testing station;

- refurbishes and modifies aircraft cabins to increase their comfort;
- paints aircraft equipment at customer's request, including business jets painting with high-quality materials;
- supplies aircraft components and spares.

The State Enterprise Plant 410 CA cooperates with ministries of defense who are military aircraft operators, as well as with the world's top aircraft manufacturers, while being at the same time open to cooperation with new business partners. The Company is intensively setting up partnerships with worldwide leading manufacturers and suppliers of aircraft and related systems. The enterprise provides maintenance service support for modern aircraft and equipment.

For more information, please visit our official website at www.arp410.kiev.ua.

You are welcome to cooperate with us!



Another general meeting came as a welcome boost to India-Ukraine cooperation

FLYING MACHINES FROM “ANTONOV”



Antonov is seeking to forge and intensify its international cooperation. The Company is currently promoting its most recent developments, the An-178 and An-132, which have already found international customers

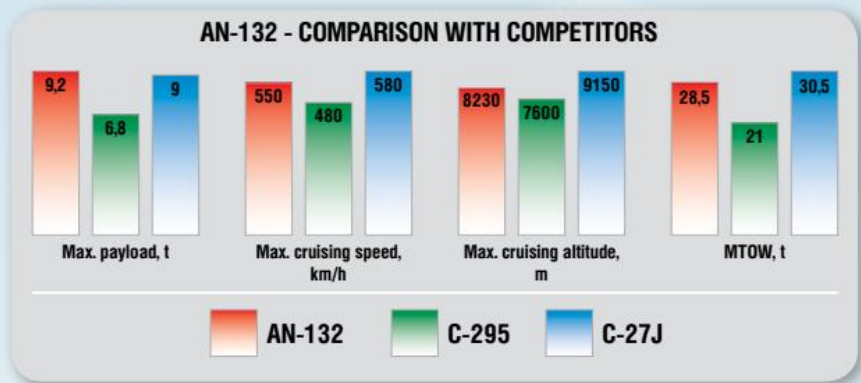
AN-132 - PROSPECTS LYING IN COOPERATION

An-132 is a light multi-purpose turboprop cargo aircraft developed by Antonov to replace the An-32, which is renowned for its unique operating capabilities in high temperature/high altitude environments.

The An-132 is Ukraine’s first indigenous aircraft to have been built without the use of Russian-supplied components. It features Pratt & Whitney Canada PW-150A engines and avionics equipment from suppliers in Canada, USA and the European Union. With cargo carrying capacity of 9.2 tons, the An-132 will be able to deliver payloads to a max range twice as long as that of the An-32.

In May 2015 Antonov and Taqnia Aeronautics signed partnership agreement on the development and production of the An-132 transport airplane.

Under the terms of the agreement, King Abdulaziz City for Science and Technology (KACST), Taqnia Aeronautics Company and Antonov will redevelop the existing An-32 aircraft to produce a new variant with improved payload, range and takeoff characteristics. The program will also encompass the development of a new cockpit with state-of-the-art US- and EU-made navigation systems, which will allow the crew to efficiently operate the aircraft in adverse conditions. The Kingdom owns a 50% share of the intellectual property invested in the design of the An-132.



The DEMO airplane - An-132D, was unveiled to the public in a ceremony on December 20, 2016. It is designed with capabilities to operate in different climatic conditions and especially from high-temperature/high-altitude airfields and from improvised runways. The An-132 is advantageous for its capability to operate from sand runways.

In 2018 Ukraine and Saudi Arabia have been finalizing an agreement on production of the Antonov An-132 at a facility in the city of Taif, Western Region, KSA.

"In order to assess commercial prospects of the An-132 series production project at a facility in Taif, our Saudi partner, TAQNIYA Aeronautics has commissioned a feasibility study from a reputed European engineering firm. The Saudi partner estimates that the project feasibility study being carried out by the Spanish subcontractor is 80-85 percent completed so far, with

full completion expected in July", Antonov’s Press Office said.

The An-132 aircraft production localization in Saudi Arabia will proceed incrementally, with workshare allocated to the Saudi side not exceeding 10 percent at the initial stage of collaboration, while the remainder 90 percent will be allocated to the Ukrainian side. As the project proceeds, the workshare ratio will reverse to 80:20 percent in favor of the Saudi side.

The deal also includes construction of an An-132 production line at an Antonov’ facility in Kyiv, which will be used for assembling a preproduction batch of the aircraft. "The level of this preproduction batch will be decided based on the Feasibility Study findings. Being the Design Authority for the An-132 aircraft, Antonov will be eligible to receive royalties for each aircraft sold", the Press Office said.

In Saudi Arabia, An-132 airplanes will be manufactured at a facility to be

constructed by Antonov as part of a science and technology development program for the city of Taif. The Taif Technology Park will be a collaboration with the King Abdulaziz Science and Technology Center – a key partner in the An-132 program. The Park will include an airfield, a solar panel factory, and a solar thermal power station alongside the An-132 production facility.

Construction is scheduled to begin in 2019 and to be completed nine months later so that production could start in 2021.

Ukraine has recently completed life extension overhaul of the Indian Air Force's An-32 airplanes, under a contract between SpetsTechnoExport and India's Ministry of Defense. As this deal has been successfully concluded, Ukraine is offering potential Indian customers the An-132 airplane as a future replacement for the An-32s after the end of their expected lifetime.

AN-178 - EXPANDING CAPABILITIES

The An-178 military transport is another program of key priority for Antonov. It was unveiled on 16th April 2015, and made its maiden flight on 7th May the same year. Inauguration ceremony for the An-178 took place at Gostomel airfield, near Kiev; after about an hour in the sky, the airplane made a successful landing.

The An-178 is designed for transportation of medium to maximum payloads from 15 to 18 tons. This segment of the marketplace is virtually vacant thus far, except for aging or obsolete An-12 and C-160 airlifters which all need a replacement. The new aircraft can find itself in the heavier payload category than the An-74 or Europe's C-27J and C-295.

The cargo compartment floor area of An-178 is amounted to 40 sq. m with loading ramp or 33 sq. m without it. In its cross section, the cargo bay in the An-178 is 2,746mm wide and 2,750mm high, which is clearly optimized for standard 2,440 x 2,440 mm shipping containers. If compared to the An-158 on which basis the An-178 was designed, the latter will have its center wing section enlarged and expanded.

The cockpit is designed for a crew of two pilots. The An-178, like each

and all of Antonov-series military transport aircraft, can operate both on unpaved and concrete runways no shorter than 915 meters.

As part of its flight testing program, the An-178, in 2016, successfully completed type certification tests at high angles of attack (HAA), including stall tests at different altitudes and with different positions of flap extension and landing gear.

During Q3 and Q4 2016, and Q1 2017, the An-178 was successfully tested with respect to loading/unloading of various cargo types. Three M1097A2 military HMMWVs (High Mobility Multipurpose Wheeled Vehicle) were used in the tests in August 2016, and shipping containers and pallets in February 2017. The tests verified compliance with the specs in terms of loading/unloading, vehicle ingress/egress, and arrangement/fastening of shipping containers and pallets.

To present time, the An-178 has made more than two hundred flights. Production preparations for the An-178 began in the middle of 2016 at Antonov.

There is a firm order in place for ten An-178 aircraft from Azerbaijan's Silk Way Airlines, and preliminary agreements have been reached to supply 25 airplanes to China's Beijing A-Star Aerospace Technology Co, 30 to Saudi Arabia's Taqnia Aeronautics, and one to an Iraqi customer.

Ukrainian experts estimate the market for the An-178 at about 800 airplanes within the next 10 to 12 years.

It should be noted, at Farnborough Airshow 2018, Ukroboronprom defense industries group's Antonov Company and a division of Boeing – Avial Services, Inc. – signed a general terms agreement on cooperation in the production of the upgraded An-148, An-158, An-178 families.

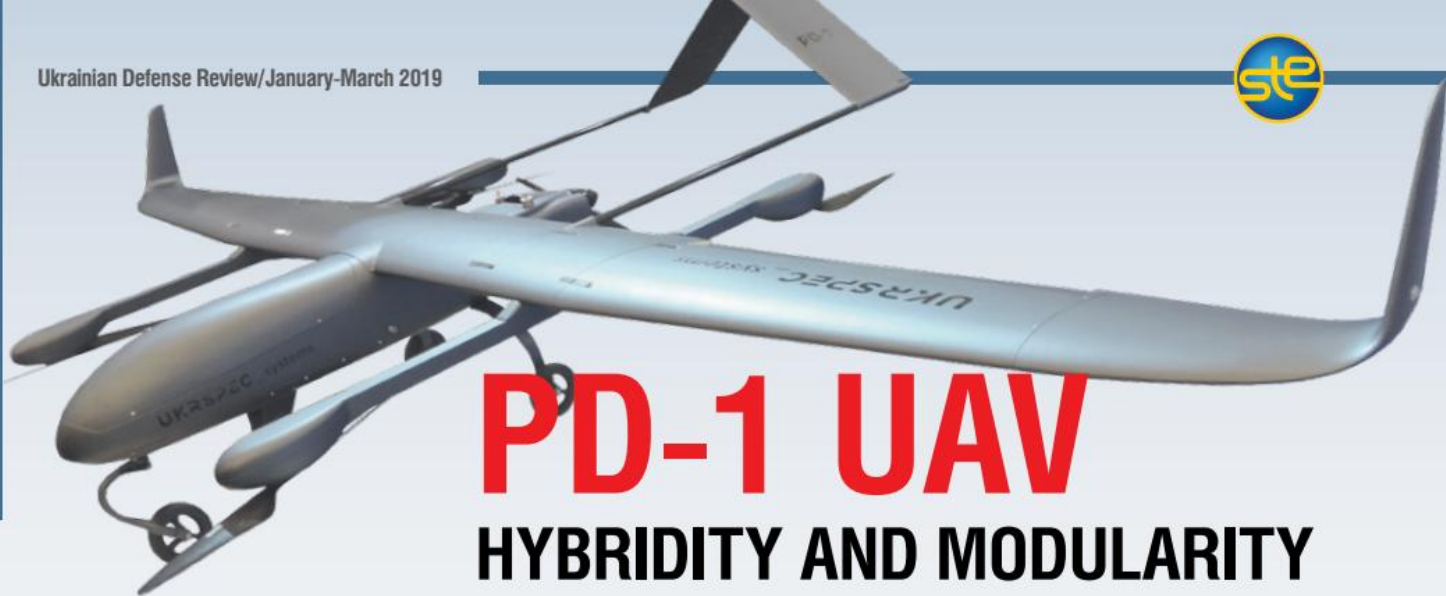
Within this cooperation, Avial Services, Inc. will support supply chain, procurement and delivery of vendor items on behalf of Antonov to support the production of the mentioned newest aircraft and to provide further after-sale support. So now, Antonov customers all over the world will get new level of service of Ukrainian aircraft of these three types, including An-178.

The aircraft made its debut at the 2015 Paris Air Show. After that it also took part in DefExpo-2016 (India), ILA Berlin Air Show-2016 (Germany), Farnborough Air Show 2018 (Great Britain) and Eurasia-2018 (Turkey).

Indeed, the Antonov aircraft can successfully compete with currently known similar class aircrafts. Besides, they became more attractive for potential buyers after integration of components from well-known world manufacturers.

Oleksiy SERDYUK,
for UDR





PD-1 UAV

HYBRIDITY AND MODULARITY

People's Drone PD-1, otherwise known as the 'First People's UAV System', is a modular unmanned aerial vehicle platform developed by The People's Project – Ukrainian Nationwide Volunteer Center in collaboration with UkrSpecSystems.

Drone PD-1 is a modular unmanned aerial vehicle platform developed by Ukrainian company UkrSpecSystems.

From the time the first sample was released in 2015 till this day, the PD-1 system remains to be comprised of 4 integral components: a minibus for transporting the UAV platform and associated equipment; UAV platform with an internal combustion engine; gyrostabilized EO/IR gimbal, and a ground control station.

Initially developed in a fixed-wing configuration, the PD-1 was designed to be catapult launched or needed a runway to take off and land. But this has now been updated to conform to current trends in UAV technology development. An upgraded and updated configuration, the PD-1 VTOL was unveiled at the Arms & Security Exhibition held in Kyiv in October 2018. The upgrade features additional electric motors in easily swappable modules to enable a helicopter-style takeoff method to be employed as needed. At this stage, a VTOL capability has been added to enable the drone to take off like a quadcopter. The PD-1 can be reconfigured from fixed-wing to VTOL flight in just 15 minutes, UkrSpecSystems says.

Due to its modular design, where modules are secured together using Fastlink locks, the PD-1 does not need any tools to assemble or disassemble.

This allows it to be easily and quickly reconfigured for different missions by swapping airframe and payload modules in an out as needed.

Rated for payloads of up to 8 kg, the PD-1 can endure flight durations from 7 to 10 hours depending on the payload package carried.

High-resolution still images and video sequences can be obtained with a 30x optical zoom EO camera and IR imaging camera sensors integrated in a gyro stabilized gimbal. With this high zoom capability in place, sharp and clear images can be captured from up to 3,000 meter-high altitudes. The UAV platform is fitted with image stabilization to reduce blurring associated with the motion of the camera during exposure to wind and turbulence.

The PD-1 drone has an autopilot function enabling it to fly fully autonomous missions following a prepro-

grammed flight path, even in the absence of GPS connectivity. It has seen operational use in real-world combat situations in Eastern Ukraine's Donbas Theater of operations, where it proved its excellent ECCM performance. **UDR**

UAV PD-1

Key Specifications:

Flight route	Programmable
Takeoff and landing	Automatic
Auto-return	In case of GNSS or control signals loss
Wing-span, m	5
Long endurance fuel tank, L	12
Payload capacity, kg	7
MTOW, kg	45
Flight time, h	7+
Service ceiling, m	2500
Encrypted real-time Full HD video, km	90
Encrypted datalink, km	95
Satellite navigation	GPS
Satellite datalink	Optionally



For marine propulsion

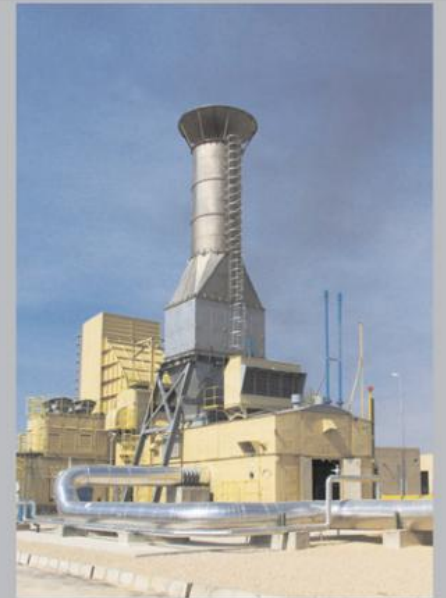


60 MW

45 MW

25 MW

For gas industry



16 MW

10 MW

6 MW

5 MW

3 MW

2,5 MW

For power generation



UKRAINIAN GAS TURBINES



ZORYA-MASHPROEKT

www.zmturbines.com

RAM UAV

FLY TO KILL



RAM UAV Loitering Munition

Key Specifications:

Wingspan, m	2.3
Length	1.78
Launch method	catapult
Airspeed, km/h	70
Max take-off weight, kg	8
Warhead weight, kg	3
Range, km	≤30
Endurance, min	≤40
Prep time from unpack to launch, min	10

Defense & Electronics Technology Company (CDET) LLC, Kyiv, unveiled its latest RAM UAV/loitering munition at the 3rd edition of IMEX-2018 International Unmanned Systems Exhibition & Conference held in Abu Dhabi, UAE, from 25 to 27 February 2018.

The new loitering munition has now been fielded and successfully used as intended.

SpecTechnoExport is promoting RAM UAV for export.

RAM UAV is meant to search and attack air defense batteries and armored targets to be located in the target area on land or at sea.

The RAM UAV kamikaze drone is built with extensive use of composite materials, which its designer claims makes it very low-observable to enemy air defenses. Propelled by a low acoustic signature electric motor, the RAM UAV can covertly attack by surprise, even from a short distance from the target.

An electric motor enables it to fly to 30 km at 70 km/h cruising speed. Launch is catapult assisted.

The drone takes only 10 minutes to go from unpack to launch. It can stay aloft for up to 40 minutes, which is quite enough to get a target detected and destroyed by lethality.

The RAM UAV has an integral flight controller capability which supports the functionality that includes

autonomous preprogrammed flight, live video streaming, and guiding the munition to a target once it is located.

The loitering munition measures 1.78 m long and with a 2.3 m wingspan and has a maximum take-off weight of 8 kg, including a warhead weighing up to 3 kg depending on the type of killing agent used.

The munition comes with three options for warhead depending on the types of targets to be attacked:

- thermobaric warhead will be used to defeat enemy personnel sheltered in buildings and fortifications, and to destroy light armored vehicles with crews and infantry passengers;

- High Explosive Anti-Tank (HEAT) warhead will be used against armored targets on land or at sea;

- High Explosive Fragmentation (HEF) warhead will be used against personnel targets encountered in open-area engagements.

The UAV RAM has been tested in real-world combat scenarios as part of the Joint Forces Operation (renamed from Anti-Terrorist Operation as of 1 May 2018) against Russian military aggression in Eastern Ukraine, and showed very high immunity against enemy jamming attempts.

Loitering munitions provide small ground units and special operations forces with a precision guided attack capability at a relatively low cost, which makes them increasingly demanded among military customers

worldwide, and this gives hope that the RAM UAV will have a success in the global UAV market.

Current-generation suicide kamikaze drones can be deployed in complex battlefield environments, including urban areas and otherwise challenging terrains and, also, in close-combat situations involving a high risk of casualties among friendly forces and uninvolved parties, but they are especially useful where conventional artillery or missiles cannot be used because of reasons that include among others excessive workloads on commanders and the specifics of projectile/missile trajectories.

Only few countries are currently developing and producing Kamikaze drones or procuring them for own militaries. Among them are Israel, Iran, China, South Korea, Poland, the USA, and Turkey among several others, and Ukraine has now entered that circle of countries. [UDR](#)

Denis PONOMARENKO,
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ARMS AND SECURITY

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ROBUST CUPOLA

A viation Systems of Ukraine (ASU), a privately-run R&D and production company, is a developer and manufacturer of high-quality drag chutes for deceleration of front-line airplanes while landing.

Over the years since 2014, Ukrainian industries have been challenged to provide domestic replacements for the components, assemblies, and products that had been sourced from Russian suppliers prior to the onset of

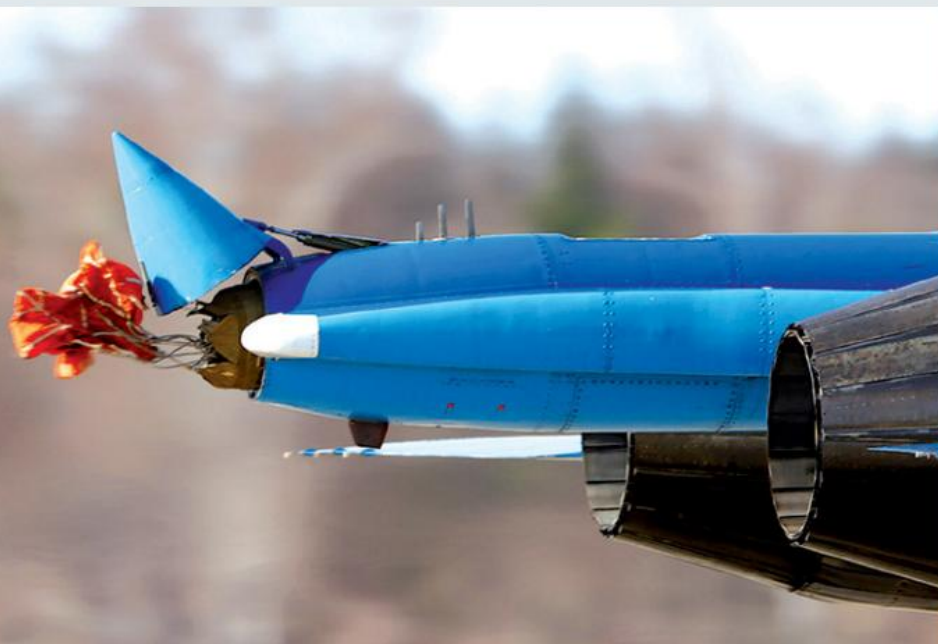
Russian military aggression in Eastern Ukraine. Aviation Systems of Ukraine has met this challenge by producing indigenous replacements for aircraft deceleration chutes and airdrop systems. The Company has thus entered the export market with products that compete in quality and price with the ex-Soviet and Russian brands that used to dominate that marketplace previously.

Founded in May 2006, the 'Aviation Systems of Ukraine' R&D and Production Company is focusing on design

engineering, prototype production and industrial production of replacement and assembly parts for aircraft and related systems. Being a full-cycle company, ASU provides a complete design and production package, from concept design to product development, production and marketing. In 2017, the Company obtained certification verifying compliance with quality management requirements according to ISO 9001:2015, which guarantees that the in-house quality management system is committed to providing the highest quality of the products and services provided.

The extensive experience and expertise ASU has in the aviation industry enables it to remain aware of the latest technology and market development trends, to adequately prioritize its business activities, participate in global, future-oriented projects, and to respond, in a flexible and timely manner, to market needs. One of the Company's principal areas of expertise is in the development and production of braking parachute systems for fighter jet airplanes.

With a braking parachute, the landing run of an airplane is reduced by 1.5-2 times, resulting in a substantial reduction in the tire and brake wear and tear. Deceleration parachutes are advantageous in that the parachute produced drag force is unaffected by the runway's current status due to



meteorological conditions: no matter whether it is icy or wet concrete runway, the parachute will do its job anyway. A deceleration parachute has a light weight and takes little space when packed.

ASU offers aircraft deceleration parachutes that are made from modern, high-quality foreign-brand fabrics based on high modulus para-aramid fibers (Kevlar®, Twaron®). ASU parachutes are reliable and easy to operate, and offer an increased service life compared to rival brands.

The *ASU PTK-29SK* parachute was developed to decelerate the *MiG-29* fighter jet to 310...180 km/h during landing. With a mass of 8 kg, it is rated for 40 deployments during an estimated 8-year life.

For the *Su-25* attack aircraft, the Company offers the *PTK-25SK* parachute that helps to reduce the landing speed to 285...160 km/h. Weighing no more than 20 kg, the parachute is rated for 50 deployments during 8 years of its operational lifespan.

The *PTK-10SK* parachute was developed to be used for deceleration of the *Su-27* and *Su-30* fighters to 300...180 km/h while landing. It weighs no more than 24 kg and is rated for 50 uses over a 5-year lifespan.

For the *Su-24* strike aircraft, ASU offers the *PTK-6M* parachute that helps reduce the landing speed to 300...180 km/h. Weighing under 40 kg,

it is rated for 60 unfoldings during an estimated 12-year service life.

The braking parachute system *PTK-10240-65 Series 2* is designed to decelerate the landing speed of *MiG-25* and *MiG-31* fighter jets to 330...200 km/h. With a mass of under 52 kg, the system is rated for at least 30 openings over a 12-year lifespan.

Aircraft braking chutes are based on a functional concept that is much the same for different types of airplanes. The parachute system is activated once the airplane touches a runway with its main wheels. A shutter in the parachute container is opened (or the container cap removed) to release a spring that causes parachute cupola to unfold. The inflated cupola produces aerodynamic drag that reduces landing speed and run of the airplane. Towards the end of landing run, before or just as the aircraft clears the runway, the chute is 'jettisoned' and left on the runway edge. It is collected later on and reused. Any type of parachute, regardless of its weight or size, can be packed in roughly 10 minutes using a packing press or 20 minutes without using a packing press. A packed parachute is transportable by any mode of transportation, to any distance, and at any suitable speed or altitude.

The *PTK* family of aircraft braking parachutes are designed to be operational with the *MiG-25*, *MiG-29*,

MiG-31, *Su-24*, *Su-25*, *Su-27*, and *Su-30* airplanes, at temperatures in the parachute container ranging from -60 °C to + 80 °. It is recommended that the parachutes should be repacked at least every six months and stored in dry, well-ventilated areas, at air humidity of 30-80% and temperatures ranging between -30 °C and + 30 °C.

As well as aircraft deceleration chutes, ASU is also focusing on the development of *MKS-350-9*-type military cargo chutes rigged with 'Shelf' or *P-7* shock absorbers. This method of cargo delivery was first employed by the U.S. Marines to supply their base at Khe Sanh, Vietnam, where more than 8,000 tons of supplies were delivered by parachuting from *C-130* transports during 78 days in January-March of 1968. Since threats to modern military aircraft come mostly from surface-to-air missiles, cargoes can be airdropped from high altitudes, where aircraft can fly above SAM engagement envelopes. This technique allows the aircraft to fly through hostile skies without endangering itself and the load, and the cargo to travel safely to its destination. Military forces worldwide, and especially NATO are developing a growing interest in precision airdrop systems, and this is where ASU can showcase its capabilities, both to the Ukrainian and international marketplaces. **UDR**



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CLOSING AIR COVERAGE GAPS

Ukraine is among the ten countries in the world developing and producing radar technologies. Following the demise of the USSR the country has been able to retain a nearly self-sufficient radar R&D and production industry and manufacturing capacities for radar electronic hardware and associated subsystems. Ukrainian industries have been producing new radar products while upgrading and updating already proven technologies.

ST-68UM2 (36D6M2). The portfolio of radar technology products of R&D and Production Complex Iskra's, a State-run company incorporated with the Ukroboronprom defense industries group, includes the ST-68UM2 (36D6M2), a vehicle-carried 3D air-space surveillance radar system. It is meant to be used as a part of modern automated Air Defense systems and SAM batteries, and to search low-flying aerial targets in various active and passive jamming scenarios, as well as to support Air Traffic Control operations for both military and civilian purposes.

The ST-68UM2 (36D6M2) is an upgrade to the proven, Soviet-legacy 35D6 technology. The upgrade adds modern capabilities for data pre-processing/reprocessing and for data transmission and mapping; and increases the number of operator workstations. The use of advanced signal processing capabilities like the IBM-PC enables dramatic improvements in the

System's performance and reliability, and would make the product more competitive on the international marketplace. The ST-68UM2 (36D6M2) has been adopted by the Ukrainian Air Forces to serve as the core type of SHF radar.

Upgrading the 35D6 technology to the ST-68UM2 (36D6M2) standard includes the following:

- capabilities to make the Operator's Workstation more informative and to enable the generation and mapping of target tracking data;

- System reliability increased up to 800 hours of mean-time-between-failures;
- improved receive chain sensitivity;
- radar range extended to 360 km;
- increased number of Operator Workstations, equipped with color raster-scan displays;
- new IMB PC-compatible computer with new software;
- world-class FoF identification system;
- 6UF25 subsystem to enable coordination with air defense units and weapons.

ST-68UM2 (36D6M2) SURVEILLANCE RADAR

Key Specifications:

Operating frequency range	S
Scan sectors:	
range, km	90,180,360
azimuth, deg	360
elevation, deg (two rounds)	0,5...30
Scanning interval, s	5.1
Detection range for a 1m ² RCS target:	
at 100 m altitude, km	42
at 1,000 m altitude, km	110-115
RCS – 0,1 m ² (cruise missile)	
at flight altitude 50, km	27
Antenna type	Mirror
MBTF, hours	800
Antenna rotation rate, rpm	6 and 12
Level of jamming suppression, dB	20
Track throughput	>256
Number of vehicles required for transportation	2
Deployment/stow time, min	30





P-18MR RADAR

Key Specifications:

Operating frequency range, MHz	145 – 175
Dimensions being found	azimuth, range
Target detection distances, km	4 – 400
Detection distance for a 1m ² RCS target with ha=6.35m and a 0.5 probability of success, km:	
at 100 m altitude	35
at 500 m altitude	60
at 5,000 m altitude	120
at 10,000 m altitude	240
at 15,000 m altitude	360
Rate of antenna rotation, rpm	3/6
Target location error:	
- range, m	180
- azimuth, deg	0.4
Resolution:	
- for range, m	1,200
- for azimuth, deg	6
Level of active jamming suppression, dB	20

The key advantages the 36D6 upgrade has over its 35D6 predecessor include high probability of success against low-RCS targets and hovering helicopters, including those low flying tangentially to the radar antenna;

highly accurate location finding capability; enhanced immunity against enemy jamming attempts; ability to spot the location of enemy jammers; automatic association of echo signals with return signals of the built-in IFF equipment; high reliability and mobility performance. The 36D6 upgrade is expected to extend the system's operational life by another 20 years.

Besides the 36D6 radar upgrade, Ukraine offers upgrades for other proven legacy technologies. Thus, Radionix, Kyiv, has upgraded the proven P-18 technology to the P-18MR configuration that has been unofficially nicknamed "hunter for the stealth".

The **P-18MR** upgrade is provided with the capabilities for automatic target search and tracking, and for finding range and azimuth of the targets being tracked. It has not changed much from the baseline original in composition, consisting of a mast-mounted antenna array, power supply unit and equipment shelter – all accommodated on domestically produced KrAZ-6322-type truck vehicle platforms.

The upgrade includes substantial improvements to the System's characteristics and performance parameters, with the target detection range extended to 400 km and a capability added to counter active jamming in addition to passive jamming. These improvements have been enabled by adding a solid state transmitter-receiver and introducing digital processing of return signals among other things.

To counter noise jamming, the upgraded radar employs pseudo random frequency hopping within the full 145-175MHz operating frequency range.

The radar is controlled by an automated workstation equipped with a dedicated computer for secondary processing of target data and a color display for showing the current air picture. If deployed in field conditions, the radar can be controlled remotely from a remote workstation. In this case, control will be via a modem communication link using the ASTERIX data format (CAT001, 002,034, 048), via HDLC, RS232C or Ethernet. →

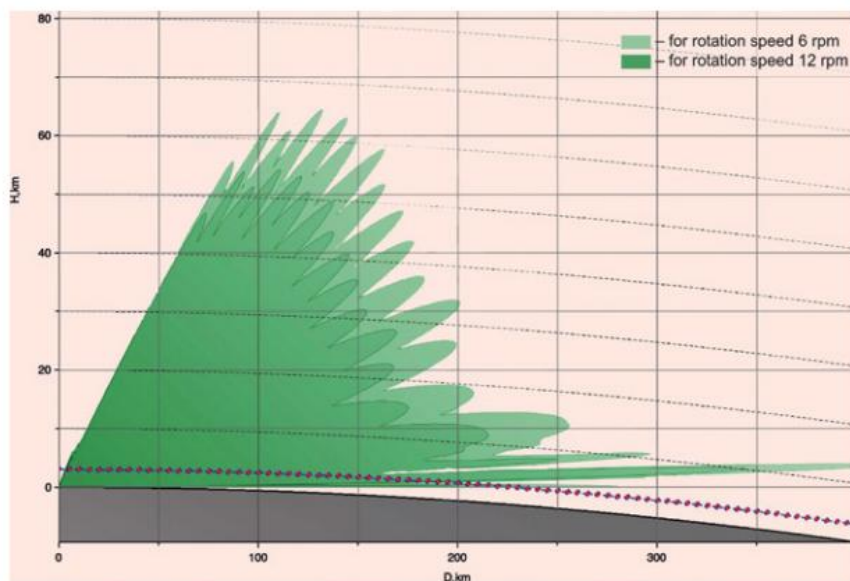


The **80K6T** – a three-dimensional, 360-degree Ground Controlled Interception (GCI) air defense search radar – provides a broad range of target search and location finding capabilities; it is able to function effectively even in the presence of substantial environmental and electronic countermeasures influences.

The 80K6T product integrates technology solutions for high-resolution search, detection and tracking of aerial threats of various kinds. Being a digital active phased array radar, the 80K6T enables targets to be searched and tracked with ultra-high resolution while simultaneously providing a three-dimensional measure-

ment solution for range, azimuth and elevation in an integrated package. It is able to detect aerial threats out to ≤ 500 km in range and ≥ 40 km in altitude, and track up to 500 targets simultaneously.

The radar antenna rotates at the rate of 12 rpm, thus enabling target data to be updated in every five seconds, while the radar's 70-degree elevation capability enables early detection of short-range tactical missile attacks. The technology furthermore uses advanced radar output processing algorithms for highly effective search of low-RCS threats and highly maneuverable cruise missiles while flying on extremely low-altitude trajectories.



80K6T detection envelopes for MIG-29 sized targets, at 6/12 rpm rotation, with 35 degree FOV

80K6T RADAR

Key Specifications:

Operating frequency range	S
Maximum radar operation limits:	
in range, km	500
in azimuth, deg	360
in elevation, deg	0...70
in altitude, km	40
Scanning interval, s	5, 10, 20
Target detection range, RCS=3m2 (at P=0,8 F=10-6): at flight altitude 10...30km	350
Transmitter type	Solid State
Transmitter peak power, kW	30
Antenna type	DAPAR
Number of beams	16
Clutter suppression, more, dB	50
Jamming cancelling, more, dB	20
Track throughput, more than	300
IFF equipment	built-in
Number of transport units	2

The 80K6T radar technology is fully compatible with the SAM capabilities currently operational with Ukraine's Armed Forces, and it is suitable for use also during Air Force operations.

To ensure high tactical mobility, the 80K6T radar is carried on two truck vehicle platforms accommodating operator workstations and power supply units, and radar control equipment respectively. The radar moves from stowed to ready configuration in 10-15 minutes.

For strategic mobility, the 80K6T is designed to be air transportable with light military transport aircraft. **UDR**

1L221E COUNTER-BATTERY RADAR

The modern military conflicts are recognized with wide use of cannon and missile artillery, which can cause the significant damage in combat crew units.

The problem of long-range detection and accurate destruction of cannon and missile artillery positions (counterbattery activity) is of interest nowadays. Furthermore, the reconnaissance UAVs that can be operated as combat UAVs are used in combat operations in increasing frequency. For these reasons, the problem of UAV detection has the highest-priority these days.

Counter-battery Radar 1L221E is one of the modern developments of SE SPC Iskra. 1L221E is a Radar complex, equipped with the digital active phased antenna array (DAPAA).

Complex provides the reliable and high-accuracy detection of coordinates for the first shot (launch) for the entire fire depth, issues the target detections for automated fire control systems, can adjust artillery and missile systems, verifies the shooting systems classes (mortars, artillery, tactical missiles), detects the coordinates of impact point for mines, shells or missiles, provides the detection and tracking of low RCS targets of UAV type. 1L221E Radar complex maintain the reconnaissance and spotting modes simultaneously in azimuth sector.

Radar complex 1L221E is composed of two transport units: antenna-hardware vehicle and control vehicle with personnel workstations. Such

construction improves the personnel protection against antiradiation missiles and bombs in warfighting conditions. The other advantage of such design is the possibility to operate the Radar just with one main vehicle as it is equipped with remote workstation.

Equipment of 1L221E Radar is located at Ukrainian manufacturing vehicle chassis of 8x8 configuration, providing the high-mobility of the complex. Radar complex is operating at any weather in different climatic conditions and in conditions of intense radio countermeasures.



Radar vehicle in operation position

Radar complex 1L221E can be used in large-scale conflicts, in a wide concentration of forces and weapons, in a difficult radioelectronic and targeted conditions, so as at necessity of limited interventions to suppress the widespread fire means and to detect the hit-and-run weapons location. Radar can be used in peacekeeping operations to control the cease-fire mode on a large area. **UDR**

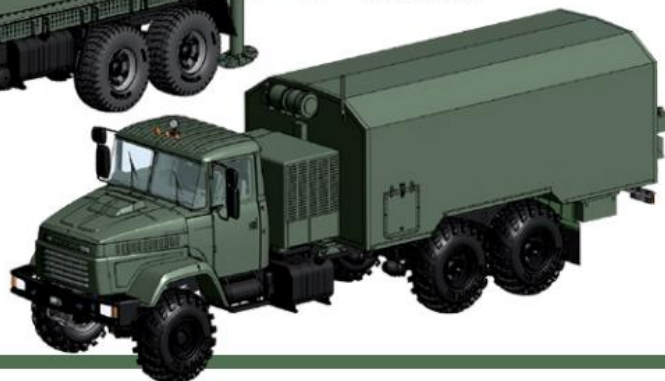
SPECIFICATIONS

Band	S
RANGE	
- mortars	25 km
- artillery	28 km
- MLRS	45 km
- tactical missiles	80 km
ELECTRONIC SCANNING SECTOR	
- in azimuth	60° (±30°)
- in elevation	40° (+25°/-15°)
Antenna type	DAPAA
Accuracy	0.35% in range
Productivity	≥80 target /min
Deployment/closing	
down time	5/5 min
Crew	4 persons
Transport units	2
Power Supply	Diesel-generators or 380Vx50Hz



Radar vehicle in transport position

Vehicle with personnel workstations



UKROBORONPROM
Ukrainian Defence Industry

This is courtesy of SE SPC Iskra



State Enterprise Specialized Foreign Trade Firm

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SEE IT ALL

MOBILE PERIMETER SECURITY SURVEILLANCE RADAR SYSTEM HARZA



Low-RCS drones flying in the air, as well as targets on land and at sea are easily detectable with the mobile Perimeter Security Surveillance Radar (PSSR) system named "Harza". The Harza PSSR is predominantly applied in – but not restricted to – perimeter control and security protection of strategic facilities like e.g. command and control headquarters, communication nodes, ammunition and equipment depots, and power plants – by way of detecting and alarming about subversive/recon intrusions and drone threats.

The Harza PSSR is provided with the capabilities for the detection of (slow) moving targets against the background of stationary surroundings; detection of low-RCS aircraft in low-altitude airspace; finding out data of detected targets, including azimuth, range, radar cross section (RCS), radial velocity, and Doppler spectrum width, with a target height finding capability provided as an optional extra. The radar output data can be integrated with geographic information system (GIS) data to allow all weather, 24-hour security surveillance of a facility's perimeter, territory, and approach routes.

The Harza PSSR has been developed as an effective, adequate response to the most challenging threat posed by unmanned air-

craft that are designed to deal with a wide variety of tasks ranging from reconnaissance, surveillance, and intelligence gathering to air-to-ground attacks. A drone threat cannot be neutralized or destroyed before it is detected and its position is accurately localized. But this, as it turns out, isn't so easy to achieve. The larger the RCS of a given target, the easier it is for a radar to detect the target. Relatively large aircraft have larger RCS and hence are more visible to a radar. But the threat detection problem is seriously complicated where the threats are modern, low-RCS combat UAVs and especially quadcopter drones built with an extensive use of plastic materials. Furthermore, targets like e.g. quadcopter drones are designed such as to fly at low speeds, making their detection even more challenging.

The Harza technology team have been able to handle all the challenges pretty well. Having completed the required trials and evaluation cycle, the Harza PSSR has already found markets both in and outside of Ukraine, thus proving its high competitive ability. The new radar is →



Technical Observation Post with a hardware/software package

effective against targets in the air, on the ground, and at sea. In particular, it can detect a small, 0.01 sq.m. RCS drone from 7 km, a human being from 18 km, and a vehicle-sized target from 30 km away while being able at the same time to automatically track up to 200 targets simultaneously.

The Harza PSSR system consists of an automated Technical Observation Post (TOP) and a hardware/software package for system control and data processing. The technology is advantageous for its compact design, allowing integration onto a single-axle car trailer to facilitate fast, low visibility movement. The system takes just 7 minutes to go from stowed to ready configuration.

The Harza PSSR has been developed by the State-run Progress Import/Export Trade Firm, in a collaboration with the Ukrainian Academy of Sciences' Institute of Radio Astronomy.

The mobile Perimeter Security Surveillance Radar (PSSR) system "Harza" is designed to perform the tasks as follows:

- all weather, 24-hour security surveillance of a facility's perimeter, territory and approach routes by scanning a full 360-degree sector or a specific sector of interest;
- detection of slow moving targets, on land or at sea;
- detection of low-RCS, low-altitude drone threats;
- finding out data of detected targets, including azimuth, range, radar cross section (RCS), radial velocity, and Doppler spectrum width.



HARZA PERIMETER SECURITY SURVEILLANCE RADAR

Specifications:

C-BAND RADAR

Operating principle	Pulse-Doppler
Operating frequency range, GHz	7.9 +/- 0.1
Typical detection range, at a ≥0.9 probability of success and scan rate of 50o/s:	
- human being (with 0.5 sq. m RCS), km	≥ 15.0
- heavy duty truck (with 10 sq. m RCS), km	≥ 28.0
- unmanned air vehicle (with RCS ≥ 0.01 sq.m), km	≥ 6.0
- helicopter (with 5 sq. m RCS), km	≥ 25.0
Mean max. transmitted power, W	25
Pulsed frequency, kHz	3 - 25
Type of signal	Pulsed
Elevation scan sector, deg.	20 (-5...+15)
Azimuth scan sector, deg.	360
Target location accuracy (azimuth), deg.	1
Radar power supply, W	300

EO SENSOR MODULE

Object/target detection range with a TV camera, in day/night conditions, with good air visibility*:	
- human being, km	≥ 7/5.5
- vehicle, km	≥ 9/7.5
Object/target detection range with a thermal imaging camera, in day/night conditions, with good air visibility*:	
- human being, km	≥ 6/5.5
- vehicle, km	≥ 8/7

Elevation scan sector, deg.	75 (-30...+45)
Azimuth scan sector, deg.	360

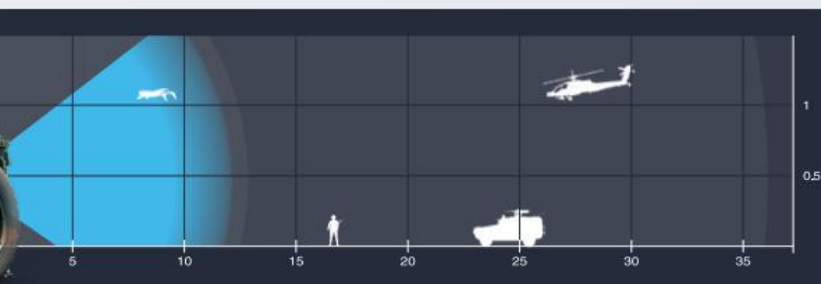
CARRYING VEHICLE

Crew	2
Time into and out of action, min	≤10/10
Total radar system weight will vary with the availability and configuration of command-and-control unit, kg	From 800 to 1.500 (+/- 5%)
Radar antenna/EO module's height above base platform, m	≥ 5
Max. tolerable wind speed, with the radar array lifted up, m/s	≤40
Max. number of objects (targets) being tracked simultaneously	≤200
Mode of object (target) detection/tracking	Automatic Manual

The Harza PSSR will come with operational capabilities for the following:

- automatic detection and classification of moving targets, including low-RCS aircraft threats while flying at 10-15 to 600 m altitudes, using radar surveillance;
- automatic slew-to-cue of EO camera sensors based on radar track;

- automatic target tracking;
- display of target icons and radar fields on the surveillance area map (digital map);
- visual/audio alarm signal generation if an incoming threat is detected;
- archive search by date, target class or operator's comment. **UDR**





PLASTUN-RP 3000

MOBILE TACTICAL DIRECTION-FINDING SYSTEM

25–3000 MHz

Frequency range

Accurate geo-localization of:

- military and civil VHF and UHF radios;
- ECM systems (anti-drone, communication disruption systems, etc.);
- satellite navigation jamming and disruption systems;
- UAV and data-transmission system.

28 kg (61.7 lbs)

Man-packed

36 hrs

Battery-life

-20...+50°C, IP65

Field-repairable

ABOUT INFOZAHYST

Infozahyst R&D and Production Center has been successfully working in the field of security and defense systems since 2001.

The Company creates, using its own resources, software and hardware solutions tailored for the needs of Ukraine's military and other government services. It provides technical protection services to government and Private Sector customers in Ukraine, including the Ministry of Defense, General Directorate of the National Police, and State Property Management Department to name a few. Infozahyst is the Ukrainian leader in information security and holds leadership positions in the research, development and production of innovative technologies.

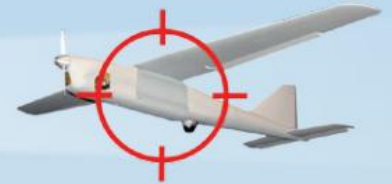
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MADE IN
UKRAINE

COUNTER-DRONE WARFARE CAPABILITIES



Drone Jammer Hortyca-R



Ukraine. The summer of 2014 saw the beginning of sort of contest between Ukrainian air defense and ECM systems and Russian UAV forces. This contest proceeded with varying success, for the Ukrainian military had lacked the technique or training in countering this new threat prior to the onset of the Russian invasion in 2014. Russian UAVs were countered largely by air defenses rather than by electronic countermeasure capabilities, which had been effectively absent in Ukraine at the time. But this has changed over time with the emergence of indigenously developed anti-drone systems built around capabilities for jamming control uplinks and data downlinks, and for GPS jamming.

UkrSpecTechnika was among the first Ukrainian companies to get engaged in the counter-drone warfare domain even before the onset of the Russian military intrusion in Ukraine, when it had developed its GPC/GLONASS satellite navigation jamming system "Anklav" (Ukrainian for "enclave"). Later on, the technology had been upgraded and updated based on lessons learnt from real-world combat deployments in Eastern Ukraine. At the current stage of development, the Anklav has had its functionality range expanded to include capabilities for jamming data communication links used in UAV and smart munition applications. With non-directional arrays deployed, the Anklav can jam GPS/GLONASS navigation within a 20-km radius,

Russia and its sponsored insurgent forces owe much of their success in fighting Ukrainian government forces during Russian military aggression in Eastern Ukraine to the extensive use of drones and unmanned aerial vehicles (UAVs), both for intelligence gathering and artillery fire adjustment roles. The lack of counter-UAV capabilities in Ukraine at initial periods of the crisis caused significant human and material losses, and affected

effective and efficient use of the available combat assets and capabilities. But this situation has changed with the emergence of indigenously developed counter-UAV technologies that began to be developed, produced and operated in Ukraine.

Russian-produced UAVs Orlan-10, Grusha, Zastava, Forpost, and others had long been used extensively and with impunity in south-eastern Ukraine's airspace, supporting Russian forces operations in this part of

which can be extended to 40 km by deploying directional arrays. It operates within frequency range from 400 MHz to 2,500 MHz. With the Anklav counter-UAV system active, it disables a UAV operator's ability to transmit commands, hence control the vehicle's behavior. The Anklav can be used with success for anti-drone protection of fixed military installations. In 2017, an upgraded modification of the Anklav was operationally deployed in the Donbas Theater of operations after successfully completing its departmental-level trials program.

UkrSpecTechnika has developed what is now known as "Anklav-Malyuk" ("Baby Enclave") – a reduced size, lighter weight derivative of the Anklav technology. Being much smaller and weighing about 15 kg, the Anklav-Malyuk has twice fewer jamming arrays, but instead has had its continuous autonomous operation time increased to 6 hours from 2 hours achievable with its older original. Development of this "baby" version was requested by a Ukrainian security service for use in urban settings.

The Company's portfolio of most recent counter-UAV products includes the *Polonez* ("Polonaise"). A mobile counter-drone warfare system, it was unveiled to the public in its full-scale configuration at the 2018 edition of the Arms & Security exhibition held in Kyiv in October. It integrates in a single package the



GPS/GLONASS satellite navigation jamming system "Anklav"

capabilities for the search and identification of drone threats and for neutralizing them by jamming GPS navigation and data communication links with their operators. The Polonez can communicate targeting data to command and control centers and gun batteries.

The Polonez system consists of:

- EHF radar *Lis-3M* for detection of drone threats;
- electronic-optical module that will capture and track detected tar-

gets in the thermal imaging/infrared regions of the spectrum;

- jamming antenna array for jamming operator-drone data communications;
- GPS/GLONASS signal jammer equipped with a set of jamming arrays.

The Lis-3M radar and the electronic-optical module are both mounted on a telescopic 5.5 m mast. The former is capable of detection ranges of 12 km for helicopters and 8 km for drones/UAVs, while the latter has line-of-sight range.

The Lis-3M would detect and identify drone threats automatically while scanning a 360-degree azimuth. Data communication and satellite navigation jammers are capable of ranges of 40 km with directional arrays and 20 km with non-directional arrays deployed. The Polonez is now undergoing testing and evaluation to determine whether it meets performance specifications required by the Ukrainian Armed Forces.

Nota ("Note") is another indigenous counter-UAV technology that made its first public appearance at the 2018 Arms & Security Exhibition. Developed by the privately-run *Tritel LLC*, it integrates jamming capabilities against hostile drones, cellular communications of all of the →



Counter-UAV system Polonez ('Polonaise')

most widely used standards adopted in Ukraine; hostile ECM, and counter-battery radars.

The Nota can use directional and non-directional arrays in a single mode of operation, thus allowing anti-drone perimeter protection of a military facility and surveillance in a specific narrow sector of interest to be performed simultaneously.

The system does not emit while on standby, which effectively makes it "stealthy" to enemy surveillance radars. Once a threat is detected, the Nota immediately turns active to make the threat jammed and disabled.

The Nota can detect hostile drones at ranges out to 20 km and neutralize them at ranges of at least 15 km away. Cellular communications can be jammed from distances up to 1,000 m. The full set of the Nota equipment weighs 250 kg and is served by a crew of two.

The Nota has already been operational with the Ukrainian military forces and other national security forces. In particular, it has been selected to provide anti-drone protection for the Ukrainian Army's munitions depots.

Another privately-run company, *Proximus LLC*, has developed the anti-UAV system *Bukovel-AD*, which already has been procured by the Ukrainian MoD for operational deployment in the Joint Forces Operation area.



Anti-drone system *Khmara-2*

The Bukovel-AD is designed with capabilities for long-range detection of hostile UAVs and jamming their GPS/GLONASS navigation and UAV-operator data communication links. A key element of this solution is a ground station, consisting of modules equipped for threat detection, System control, and jamming signal generation. The Bukovel-AD can be tripod mounted or integrated onto an off-road chassis. It is rated

for 15 km operational range, which is quite sufficient for providing robust anti-drone protection to munitions depots and other vulnerable facilities located close to hostile territory. The Bukovel-AD stands apart from domestic counterparts by way of employing a spoofing attack capability to increase the probability of a hostile drone being forced to land due to a control uplink failure.

CDET LLC has developed a technology solution, named *Khmara-2* ("Cloud"), which is meant for jamming operator-drone data and telemetry communication links. It operates within a frequency range from 230 Mhz to 3,000 MHz, using a passive radio location (passive radio direction finding) technique for detecting drone threats. The *Khmara-2* is capable of jamming drone control uplinks operating on all of the most widely used frequencies, alongside with Wi-Fi signals and GPS signals. It can jam GPS signals from up to 30 km and operator-drone communications from 15 km or less.

The *Khmara-2* is fitted with a capability for searching banned frequency ranges wherein the jamming power is restricted or blocked, and a room is



Counter-UAV system *Nota* ('Note')

reserved for a cellular communication jamming capability. The Khmara-2 employs a spot jamming technique for jamming a drone's communication link on competing frequencies.

Infozahyst has recently developed a counter-drone warfare technology project that received the codename *Hortyca-R*. Unveiled to the public at the 2018 edition of the Arms & Security Exhibition held in Kyiv in October, it offers the capabilities for the detection and location of hostile drones and their associated control centers. It automatically detects and locates an operator-drone communication link, performs identification, then automatically or autonomously turns on the jamming signal transmitter.

To boost the jamming effect and ensure maximum stealth, the jamming signal transmitter, unlike its currently existing alternatives, generates modulated pulses with a length very similar to that of the signals used for control of the target drone (it is most efficacious against drones that employ signal lengths of 2 ms or longer).

The system can be additionally equipped with a GPS/GLONASS/

Anti-drone gun Jammergun 3



GALILEO coordinate spoofing capability. Range data for the *Hortyca-R* technology has not been disclosed, but it is known that it operates within 25.0...6,000 MHz frequency range.

Infozahyst is hoping that its *Hortyca-R* technology would generate interest among the Ukrainian national security community as well as potential export customers.

At the 2018 Arms & Security Exhibition, Ukraine's *Conus Research & MFG Company* presented its anti-drone gun called *Jammergun 3*.

Portable enough to be carried in a backpack and be used by a single operator, the *Jammergun 3* interrupts

the link between drone and pilot and its navigation.

Directional waveguide antennas are mounted on a dedicated Picatinny rail and linked to the main unit via RF cables. The backpack, which has pockets for accessories and provides ease of use for the operator, is integrated with a cooling system, and protects from water and dirt getting inside. For convenience of use, a collimator sight can be stand mounted to facilitate more accurate aiming.

Weighing 10 kg, the *Jammergun 3* is able to reach 0.1-0.6 km away and to work continuously during 30 min.

In terms of its capability performances, the *Jammergun 3* can compete with foreign brands like *DroneGun Tactical* and *DroneDefender* (USA), *Rex-1* and *Stupor* (Russia), and *Groza-R* (Belarus).

So, we can see from the preceding comments that Ukraine has over the past few years made a significant progress in development and production of counter-drone warfare capabilities. A number of advanced technology products have been produced, which have the potential to reduce to a significant degree Russia's ability to deploy its drones over the territory of Eastern Ukraine, and they promise to become powerful game changers in how the military situation develops in that Ukrainian region.

Ukrainian industries have been able to produce technologies, some of which have already been operationally deployed with Ukrainian forces and have grown mature enough to face a strong competition on the global arms market. UDR



Anti-UAV system Bukovel-AD

Anton MIKHENKO,
Ukrainian Defense Review

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