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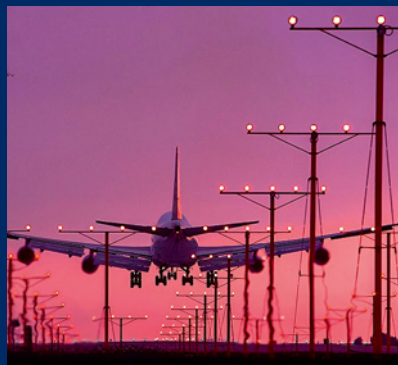
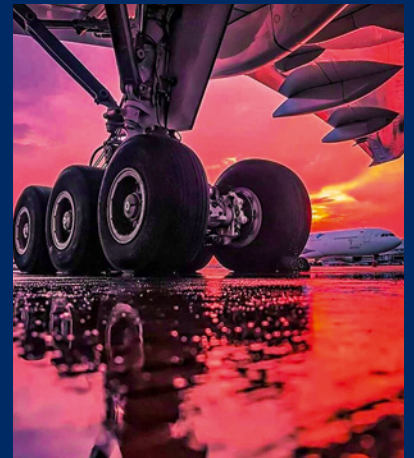
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SERGEI SHOIGU,
MINISTER OF DEFENSE
OF THE RUSSIAN FEDERATION

The most important issue of the Russian-Chinese military cooperation is the joint military exercises

JENS STOLTENBERG,
NATO SECRETARY GENERAL

China is very active in Africa, in the Western Balkans, and the Arctic. It makes massive investments in key infrastructure in Europe. In cyberspace, China is a key player. All this has a huge impact on our security

MICHAEL T. KLARE,
SENIOR VISITING FELLOW
AT THE ARMS CONTROL
ASSOCIATION

A new Iron Curtain has not yet come down. But if the presumed logic of the G7 and NATO meetings prevails, it will become increasingly difficult to prevent such an outcome in the years ahead

SERGEI LAVROV,
MINISTER OF FOREIGN AFFAIRS
OF THE RUSSIAN FEDERATION

Deepening of Russia-India military cooperation serves the national interests of both countries

ROE'S EXPORTS TO SUB-SAHARAN AFRICA REACH \$1.7B

DFNC.RU

ROSOBORONEXPORT (ROE), the state intermediary agency for Russia's exports/imports of defense-related and dual-use products, technologies, and services, announced that it has signed contracts estimated at more than \$1.7 billion with Sub-Saharan Africa. These contracts were signed in 2020 and the beginning of 2021.

"ROSOBORONEXPORT successfully continues to foster military-technical cooperation with Sub-Saharan African countries, which received a strong impetus during the Russia – Africa Forum in 2019. In 2020 and early 2021 alone, we signed contracts worth over \$1.7 billion in this region and brought the number of countries in Central, Western and Southern Africa in our order portfolio [from 12 in 2020] to 17," said Alexander Mikheev, Director General of ROE.

According to the SIPRI's arms transfer database, states in Africa accounted for 18% of Russian arms exports in 2016–2020 – an increase of 23% compared to the period between 2011–2015. SIPRI's data show that in the period between 2016–2020 Sub-Saharan Africa accounted for 26% of total African arms imports, compared with 41% in 2011–2015. Russia was the largest arms exporter to Sub-Saharan Africa in 2016–2020 with arms deliveries to 12 states represented 30% of total Sub-Saharan arms imports, compared with 25% in 2011–2015. ♦

were reduced. Marketing suffered seriously as well. For example, almost all international expo events were cancelled. There was one exception – our 'Army 2020' forum in Kubinka. This was the only major event that took place last year," the head of FSMTC said. ♦

SINO-RUSSIAN MILITARY EXERCISES SIGNAL A GROWING ALLIANCE

U.S. NAVAL INSTITUTE

Driven by "reduced bilateral military tensions, overlapping external security conditions, converging leadership perceptions, and harmonious defense economic conditions," Beijing and Moscow have prioritized strengthening their military-to-military relationship [...], defense ties have matured to the point that some analysts claim the relationship constitutes a "de-facto military alliance."

China and Russia held their first joint military exercise in 2003 and have conducted more than 30 since. During that time, the frequency, complexity, and geographic scope has steadily increased, reflecting the growth in the overall bilateral defense relationship.

Joint military exercises contribute to China and Russia's security partnership in three ways, according to the Congressional testimony of Richard Weiss in 2019. First, they help Beijing and Moscow's armed forces improve their tactical and operational capabilities and increase their interoperability, enhancing their ability to conduct joint operations. Second, the exercises serve a mutual reassurance function, affirming China and Russia's "commitment to military cooperation as an important dimension of their evolving relationship." Third, joint military exercises signal to third parties – particularly the United States – China and Russia's strong commitment to each other's security interests. ♦

RUSSIA-QATAR MILITARY-TECHNICAL COOPERATION

DFNC.RU

Military-technical cooperation between Qatar and Russia continues to grow, Qatar is comprehensively considering cooperation with Russia in terms of weapons systems. This was announced by the ambassador of Qatar to Russia, Sheikh Ahmed bin Nasser bin Jasim Al Thani, in an interview with Kommersant.

"We have many areas of military cooperation, in particular in the field of personnel training, and there are corresponding agreements in this area. Military cooperation continues to develop," he said.

On the matter of purchasing the Russian air defense system S-400, the Qatari Ambassador noted that so far "there is no progress

NEWS NEWS NEWS



RUSSIA UNDER UNPRECEDENTED PRESSURE IN MILITARY-TECHNICAL COOPERATION

TASS

The Federal Service for Military-Technical Cooperation (FSMTC) of Russia is up against unprecedented pressure, its head Dmitry Shugayev said during a meeting with the President Vladimir Putin, adding that Russia's partners are also facing a lot of heat.

"However, certainly, a fierce competitive environment exists here, and we have to work under very, very difficult conditions. Especially considering that our competitors, even despite the general difficult situation, have stepped up their pressure on our partners, first and foremost," Shugayev underscored.

He revealed that military-technical cooperation had suffered significantly due to the pandemic.

"I mean our relations with our partners, because, due to the totally objective circumstances, our interactions and our contacts



on this issue, but Qatar is comprehensively considering issues related to cooperation with Russia on weapons systems.”

He added that agreements in the military field are not only about contracts for the supply of weapons, but about agreements of a legal, principled nature, noting that “some of them have already been signed, and on some the necessary work is underway to prepare them for signing.”

According to Sheikh Ahmed bin Nasser bin Jasim Al Thani, representatives of the armed forces of the State of Qatar, including a large number of officers, will arrive to Russia in August 2021, where they will take part in a joint training with the Russian Armed Forces and in the International Army Games 2021.

“We started with economic cooperation. Then we added security cooperation, as well as military cooperation. Our relationship is transparent. Contacts between the special services are getting stronger. There is close active and positive cooperation between all security services of the two countries,” he commented. ♦

RUSSIAN MOD INVITES REPRESENTATIVES OF MILITARY DEPARTMENTS OF 133 COUNTRIES

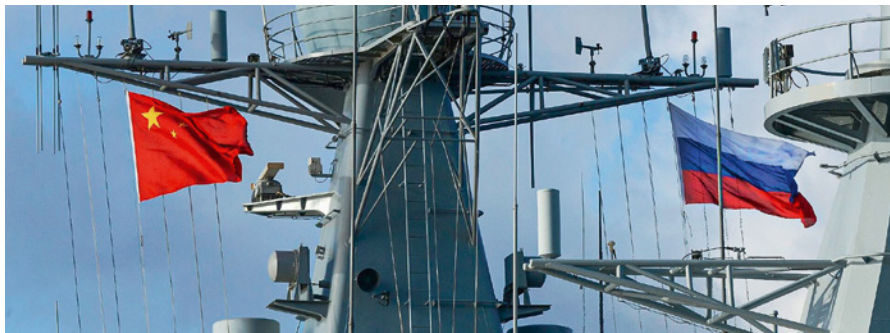
TASS

The Russian Defense Ministry has sent invitations to representatives of 133 foreign military departments to participate in the VII International Military-Technical Forum ‘Army-2021’, said Russian Defense Minister Sergei Shoigu.

“Invitations were sent to 133 defense departments, of which 74 confirmed their participation,” Shoigu said on June 25 at a meeting of the board of the Russian Defense Ministry.

According to him, more than a thousand enterprises and organizations have already expressed their desire to participate in the forum. The Minister noted that for the first time for foreign partners on August 23 and 24, the Days of Military-Technical Cooperation (MTC) will be held at the Alabino training ground and the Kubinka airfield. “A new specialized exposition ‘Arctic’ will also be presented with a display of promising models of military equipment used in northern latitudes,” Shoigu said.

He noted that more than 180 scientific and business events are planned to be held on the sidelines of the forum on topical issues of military construction, development of the domestic defense industry, a wide range of cooperation with foreign partners. One of the central events will be the fifth conference ‘Artificial Intelligence Technologies for the Defense and Security of the State’, the Minister said.



“It is expected that about 1.5 million people will visit the forum between August 22–28,” Shoigu added. ♦

NATO CHIEF WARNS OF ‘NEW DANGERS’ FROM RUSSIA-CHINA RAPPROCHEMENT

EURACTIV

Growing political and military cooperation between Russia and China poses “new dangers” for NATO and threatens multilateralism, the head of the military alliance said in an interview published on June 8, 2021.

“The rules-based order, the basis of multilateralism, is under threat,” NATO Secretary General Jens Stoltenberg told Italy’s La Repubblica newspaper.

“Russia and China have recently been cooperating more and more, both at a political and a military level. This is a new dimension and a serious challenge for NATO. New dangers are arising.

“Moscow and Beijing are increasingly coordinating their respective positions in decisions taken in multilateral organizations like the UN.

“In addition, both countries conduct joint military exercises, test long-range flights with fighter planes and (conduct) maritime operations together, but also carry out an intense exchange of experiences on weapons systems and internet control,” he warned. ♦

RUSSIA’S MILITARY-TECHNICAL COOPERATION EXCEEDED \$15 BILLION IN 2020

TASS

The financial volume of Russian military-technical cooperation totaled over \$15 billion in 2020, said the Director of the Federal Service for Military-Technical Cooperation Dmitry Shugaev. The portfolio of export orders for Russian defense products remains above \$50 billion, he stressed. “This is one of the main indicators offering confidence for the future to our companies, and to the entire military-cooperation security system,” he added.

Russia is strengthening its position in the global arms market, the agency executive said. “We have held on to the regions with which we interact, primarily our partners

from Asian and African regions. At present, we maintain ties with more than 100 states and have delivered our products to 51 countries,” Shugaev noted.

Russian air force and air defense equipment enjoys enormous demand, the official said. “The key thing that we are talking about is multi-billion dollar supplies right now. First and foremost, [our] top-notch equipment in our air force and, certainly, air defense, is the one enjoying the greatest demand. Nevertheless, we are not turning a blind eye to our army and naval equipment, all these items are also in demand,” he added. ♦

TURKEY, AZERBAIJAN SIGN ‘SHUSHA DECLARATION’ TO BOOST DEFENSE COOPERATION

ANADOLU AGENCY

Turkey’s President Recep Tayyip Erdogan and Azerbaijani president Ilham Aliyev signed the ‘Shusha Declaration’. “With the ‘Shusha Declaration’, we determined a road-map of our relations for the new period,” Erdogan said.

Turkey and Azerbaijan declared the expansion and deepening of bilateral relations by examining all aspects, according to the declaration signed between Ankara and Baku. Both sides will support each other in case of a threat or attack by a third country on their independence or territorial integrity, stated the ‘Shusha Declaration’. The parties emphasized that Turkey’s contribution plays a significant role in the activities of a joint Turkish and Russian center at Azerbaijan’s liberated land. It was noted that with the opening of the Zangezur corridor, the Nakhchivan-Kars railway line will contribute to the further enhancement of relations between Turkey and Azerbaijan.

The declaration also mentions that the military and political cooperation between Turkey and Azerbaijan is not against any third state. Turkey and Azerbaijan will boost cooperation, especially against terrorism, organized crime, drug trafficking, and illegal immigration. The security councils of the two countries will regularly hold joint meetings on national security issues, according to the ‘Shusha Declaration’. ♦

RUSSIA'S MILITARY-TECHNICAL COOPERATION – 2020

In 2020, due to the pandemic-related restrictions, for a number of foreign clients the terms of delivery of military products and implementation of contracts for overhaul and maintenance of weapons and military and special equipment were put off and rescheduled. The impossibility to ensure duly transfer of basic payment documents from customers led to delays in the currency earnings flow and in settlements with cooperation contractors and suppliers, which resulted in cash gaps. This was stated by the Deputy Minister of Defense of the Russian Federation Alexander Fomin at the end of December last year.

Author Olesya Zagorskaya

At the same time, it is claimed that Russia has fulfilled all its export responsibilities despite the intrinsic problems. For example, the CEO of the Rostec State Corporation Sergey Chemezov declared that “based on the results of 2020, we have practically reached the same delivery level as in 2019. We fulfilled all the previously signed contracts,” and the Director of the Federal Service for Military-Technical Cooperation (FSMTC) Dmitry Shugaev noted that “the year was successful.”

Objective and accurate evaluation of Russia's military-technical cooperation (MTC) is not an easy task, made even more

difficult by the fact that in 2016 President Vladimir Putin signed the decree No.614, expanding the list of information classified as the state secret to include “information about certain measures for the implementation of principal guidelines of the State policy in the sphere of military-technical cooperation.”

MILITARY-TECHNICAL COOPERATION IN NUMBERS

By the end of 2020, Russia's exports of military products were estimated at about \$13

billion, of them \$7 billion was reached as early as August of that year. The portfolio of orders for Russian weapons remained at the level of \$50–55 billion, and it is known that new contracts valued at \$5 billion were signed by August, as the International Military-Technical Forum ‘Army-2020’ alone brought in export contracts for another \$380 million.

In general, the impact of the pandemic on the arms market is still being assessed with great caution. It is assumed that the slowdown in the pace of the global economy development will entail a reduction in



compared to 2019. On the other hand, it is stated that the influence of the pandemic on this figure may be only partial – along with changes in demand and supply relating to national purchase cycles, interruptions in military product deliveries, as well as economic factors not related to the pandemic. Moreover, a number of countries showed growth rates; for instance, Australia imported more weapons in 2020 than in any other year between 2011–2019.

According to SIPRI's estimates, Russian armament exports decreased considerably in 2019–2020. Experts believe that the drop is caused by 53% decrease in India's imports of Russian weapons, but the contracts signed with India in 2020 can "straighten up" the figures. Besides, Russian experts have questioned SIPRI's methodology, and often public officials deny the data provided by the Swedish institute.

Traditionally, RosBiznesConsulting (RBC group) experts conduct annual analysis of the data provided by the Federal Customs Service of Russia, paying special attention to exports coded SSSS in the reports (these include armaments, military equipment, aircraft, and certain nuclear materials). According to the Federal Customs Service of Russia (FCS), exports coded SSSS decreased by 15.6% in 2020, estimated at \$11.48 billion. However, at this time, such decrease is not to be considered critical, since a number of companies have announced that their deliveries planned for 2020 were rescheduled to 2021. For example, the Kalashnikov Concern moved 25% of its contracts – the company's representatives explained that this was caused by shipment delays relating to the pandemic one way or other.

Algeria, China, India, and Egypt remained the largest importers of Russian products, according to FCS. Summarizing the last year's results, the Minister of Defense of the Russian Federation Sergei Shoigu called these countries, among others, priority partners in the military technical cooperation field, and his Deputy Alexander Fomin deplored that they appeared to be "among those countries that the pandemic hit the most."

Speaking of regional specifics, it should be added that Northern African and Middle Eastern countries traditionally accounted for the most part of military products exported from Russia and, as an average for the last five years, deliveries to those countries amounted to about \$6 billion. This region also accounts for 40–50% of the total portfolio of Russia's export orders. At the same time, African countries, including Sub-Saharan states, signed contracts worth \$1.5 billion in 2020. It was noted that cooperation with African

countries has become significantly more active due to the Russia – Africa Economic Forum.

CHANGES IN THE SYSTEM OF MTC

The main international military-technical event of 2020 became the 'Army' Forum that was held at the end of August, 2020. On the plenary session of the Forum, the Head of ROSOBORONEXPORT Alexander Mikheev stated that, as of today, the main task of the MTC system is to introduce new weapons and military and special equipment and to develop industrial partnership programs – not only selling licenses and technologies, but also implementing joint R&D and establishing joint ventures.

Development of such forms of cooperation requires strengthening protection of intellectual property rights in the process of implementing MTC. ROSOBORONEXPORT continued its work in this direction that was started in 2019. The company obtained a certificate of international registration for the ROSOBORONEXPORT trade mark in 45 countries within the framework of the Madrid system and submitted applications to 13 countries outside the Madrid system, including the Persian Gulf states.

ROSOBORONEXPORT and the Vega Concern (part of the Ruselectronics Holding) signed a cooperation agreement in the field of protection of intellectual property rights and their commercialization in the course of MTC. Earlier, similar agreements were signed with United Shipbuilding Corporation (USC), Russian Helicopters Holding, the Almaz – Antey Concern, and Kalashnikov Concern.



ALEXANDER MIKHEEV,
GENERAL DIRECTOR
OF ROSOBORONEXPORT

.....
We notice that many states see military and military-technical cooperation with Russia as the way to ensure their security and sovereignty. The scope of cooperation with our foreign partners demonstrate a stable positive trend and allows for optimistic forecasts

defense budgets. According to some estimates, by 2022 global military expenditure will decline by 8% and the global arms exports, by 4%. However, the latest data published by the Stockholm International Peace Research Institute (SIPRI) show an opposite trend: by the end of 2020, global defense expenditure as a whole increased by 2.6% compared to 2019, amounting to \$1.981 trillion.

SIPRI's assessment of armament exports for the first year of the pandemic is also ambiguous. On the one hand, they speak of 16% decrease in the volume of deliveries



VIKTOR KLADOV,
DIRECTOR FOR
INTERNATIONAL
COOPERATION AND REGIONAL
POLICY AT THE ROSTEC
STATE CORPORATION

.....

Everyone is tired of the pandemic and isolation. In the last year, we surely got adapted to the restrictions. Many negotiations and presentations were moved to online platforms. But nothing will replace live meetings and live communication

The consulting group for intellectual property rights protection within the framework of MTC took measures to counteract counterfeit and unfair competition in the field of military-technical cooperation. For instance, in 2020 two Ukrainian companies, "Motor Sich" and "Aviakon", were included in the list of aircraft overhaul companies carrying out illegitimate overhauls of Russian-made helicopters after it had become known that two helicopters Mi-17V-5 belonging to Afghanistan Air Force have been overhauled at the Ukrainian enterprises. In a similar case, Slovakia was nailed for illegal overhaul of helicopters of the same type in 2019. In that same year, Ukraine stuck out; Russia received an order for the overhaul of MiG-29 fighters that had been upgraded by a Ukrainian enterprise that did not have an up-to-date technical documentation.

Among other important developments there can be mentioned: approval of the Plan for the Implementation of the Strategy for Military-Technical Cooperation of the Russian Federation with Foreign States until 2025; the expansion of powers of the Head of the General Staff pertaining to approval of performance tactical and technical characteristics of weapons and military and special equipment set for export, as well as export configurations of such armaments, and R&D of military products.

Significant attention has been paid to optimizing work with foreign customers and eliminating unnecessary bureaucratic barriers. Efforts were mainly focused on enhancing the effectiveness of after-sales service programs and simplifying delivery procedures for weapons and military and

special equipment from inventory of the Ministry of Defense. The Rostec has established a company for servicing exported aircraft – previously, after-sales services were provided by the United Aircraft Corporation (UAC), Russian Helicopters Holding, United Engine Corporation (UEC), and the Concern of Radio-Electronic Technologies (KRET). The President of the Russian Federation signed the Decree No. 491, "On Introducing Amendments to Some Acts of the President of the Russian Federation Related to Military-Technical Cooperation between the Russian Federation and Foreign States," expanding rights of developers and manufacturers of military products and management companies of integrated structures to carry out international economic activities. The Committee for the development of international economic activities relating to military products was established in the Union of Machine Builders of Russia (SoyuzMash) in order to handle legal, organizational, and financial matters in the process of implementing military-technical cooperation.

Other legislative initiatives in the area of developing Russia's military-industrial complex (MIC) and military-technical cooperation were prepared by ROSOBORONEXPORT, the Legal Department of the Russian Ministry of Defense, and the Institute of State and Law of the Russian Academy of Sciences. These initiatives were put forward on the sidelines of the conference held as part of the 'Army-2020' forum; relevant proposals were submitted to stakeholders among state authorities.

Following the results of collaboration between ROSOBORONEXPORT, SoyuzMash, and the Defense Enterprises Support League, a decision was taken to cooperate with regions to create a "library of offset projects" that would allow to promptly include Russian companies in the process of tenders for potential customers.

Significant work has been done in terms of marketing and preparation of the export modifications of weapons and military and special equipment. In 2020, export passports were issued to the unified combat platform Boomerang and an armored personnel carrier based on it, also, work started on the export variant of the T-14 tank based on the Armata platform, and on the registration permits for the AK-19.

Likewise, a promotion campaign in the arms market was launched for the 59N6-TE mobile three-range radar, the P-18-2 Prima high-mobility 2D surveillance and acquisition radar, and security equipment for law-enforcement agencies. Showcases of products for foreign customers were presented, including: showcasing of the

heavy flamethrower system TOS-1A; self-propelled howitzer Msta-S modernized for NATO-standard 155-mm caliber; Kupol-PRO and Luch-PRO portable anti-drone systems; UAV detection and counteraction transportable systems Rubezh-Avtomatika and Bastion-Avtomatika, and the portable anti-UAV complex Pishal.

ROSOBORONEXPORT signed an agreement on the joint promotion of civilian products with USC; an agreement on cooperation for increasing export volumes and expanding the range of military, civilian and dual-purpose unmanned systems with JSC Kronshtadt; and the program for promoting exports of aircraft simulators for 2020–2022 with JSC Technodinamika.

CONTRACTS AND DELIVERIES

ROSOBORONEXPORT, according to its Director General, Alexander Mikhhev, started to return to its usual working mode as early as in August 2020, including business trips and "live" negotiations. However, even in the period of global self-isolation, the MTC system managed to adapt to the "new reality": in order not to paralyze cooperation, alternative sources of supply were found out so as to replace imported components. Also, individual logistic solutions for delivery of ready production were developed in a limited communication environment, and even marketing and presentations went online.

A significant role during this period was played by the possibility to expand project financing schemes and provision of export credits. Not everything went successfully in the end, but a lot has been done.

The need to combat the pandemic has set new trends in the field of MTC: there was high demand in the global market on medical equipment for diagnostics, treatment, and localization of infections produced by the enterprises of the military-industrial complex. Thus, for example, KRET delivered lung ventilators to Serbia, Italy, Kazakhstan, Uzbekistan, Belarus, and Kyrgyzstan. Test batches of the Tiokraft air disinfection devices were supplied to Belgium, the United Kingdom, Germany, Serbia, Croatia, Hong Kong, and South Korea. Medical equipment made by Shvabe Holding was exported to nine countries in the CIS, Europe and South-east Asia regions. At the beginning of the pandemic, there was a great demand for fully-equipped field hospitals.

There was also another trend: development of cooperation in the area of civilian products and services. KAMAZ transferred a batch of fire trucks to Uzbekistan, Serbia received UAZ Patriot cars, and URAL trucks were delivered to the Philippines.

In Kazakhstan, construction of plants for production of KAMAZ components commenced, an export contract for the supply of inspection and security systems was signed with an unnamed customer. The amphibious aircraft Be-200ES-E helped in extinguishing fires in Turkey – the UAC expects that this will stimulate Turkish partners to purchase these aircraft. As part of the test operation program, Mi-8AMT helicopters took part in extinguishing fires in Indonesia. A batch of Genesis high-precision receivers and base stations was delivered to Kyrgyzstan. Optical sights and samples of sporting and hunting weapons were delivered to a number of countries.

New contracts for traditional weapon export items were signed. A contract was signed with Turkey for supply of the second regiment of the S-400 air defense missile systems; another contract was signed with Belarus for supply of four Mi-35M helicopters and two battalion sets of the BTR-82A. An agreement was signed with Armenia on the modernization of four Su-25 aircraft belonging to the Armenian Air Force. Besides, licensed assembly of the AK-103 assault rifles was also launched in Armenia. A cooperation agreement was signed by 'Natspromleasing' and the Aircraft Repair Plant No. 405 (ARZ-405) in Kazakhstan: according to this agreement, the former will supply its partners with components for helicopter overhaul and other aviation equipment. In addition, licensed assembly of the 'Ansat' and Mi-171A2 helicopters is discussed with Kazakhstan. The first export contract for the supply of multipurpose middle-class helicopters Mi-38T was signed. It is rumored that a contract for the supply of the T-90MS tanks was signed with Egypt, but there was no official confirmation so far.

Work is being continued on the contracts already sealed. There is information about the overhaul of Algerian Su-30MKI(A) in Russia – the engine replacement work is likely underway already. According to a 2019 contract, work on the Yak-130 for Vietnam has probably started. Overhaul of the Il-78 tanker aircraft supplied to China by Ukraine is being carried out. Furthermore, work is continued on the development of the high-thrust engine PD-35 for the Russian-Chinese long-range wide-body aircraft, and an agreement is being finalized regarding joint design of the Advanced Heavy Lifter (AHL) helicopter for the Chinese market.

In India, construction of the Russian project 11356 frigates has kicked off, the ships will be built with the support of Russian experts, and partial transfer of technology is planned. Two more frigates for the Indian Navy are being built at the Yan-tar Shipbuilding Plant. Additionally, works

are continued on the Ka-226T helicopter for the Indian Ministry of Defense; a set of design documentation has been completed according to requirements of potential customers and transferred to the plant.

It is expected that a contract for supply of assembly sets of the T-90S MB will be signed – in 2019, an agreement on licensed assembly of these tanks was extended until 2028 and their number was increased to 409 units. It is expected that a plant for overhauls of transport helicopter engines will be launched – the equipment for the center has already been delivered to India. A contract is also expected to be signed for the production of the AK-203 assault rifles in India. According to some sources, negotiations are underway for the purchase of light amphibious tank Sprut-SDM1 – the testing has not been completed yet but it is expected that the tanks can be transferred to India for a series of field tests. UEC-Klimov has signed the first life cycle contract for engine maintenance in India, for the five-year test period for the time being.

IEMZ KUPOL conducted work for two foreign customers. The company announced the upcoming work on the delivery of the Tor-M2E air defense missile system according to a new contract. TS-NIITochMash informed about supply of special small and underwater weapons to an Asian country, as well as about negotiations with a number of countries on the establishment of licensed production facilities and delivery of finished products.

Foundations have been laid down for the future as well: negotiations were held with Indonesia to validate the TV3-117 engine type certificate, and with Canada to validate the 'Ansat' helicopter type certificate. At a meeting with representatives of Peru, which is the largest operator of Russian helicopters in Latin America, the simplification of the procedure for validating equipment, including 'Ansat' and Mi-171A2, was discussed. The VK-2500PS-03 engine was certified by South Korea, also similar certifications have already been obtained in India, China, Brazil, and Colombia. Certificate validation in China resulted in a contract for delivery of almost 100 VK-2500PS-03 engines in 2021–2022. And last but not least, the Mi-171A2 helicopter was certified in South Korea. Interestingly enough, Russia came up with a proposal to deliver helicopters to South Korea as a repayment of the state debt.

Deliveries of aircraft weapons, as well as other contracts for delivery of finished product and service contracts were discussed with the CSTO countries. Moreover, the CSTO announced plans for the joint production of weapons and military and special equipment. Preliminary agreements have been reached concerning the

overhaul and maintenance of the Mi-171E helicopters previously supplied to the Argentinian Air Forces. LLC Military Industrial Company (VPK) planned to ink the first export contract for delivery of the VPK-Ural armored vehicles with a Middle Eastern country. Besides that, lifting the UN weapons embargo from Iran in October 2020 opened great opportunities for Russia's MTC with Iran.

It goes without saying that what has been mentioned is not all, but the most significant results of Russia's military-technical cooperation in 2020. The final results of MTC in 2020 will be announced after the report of the Committee for Military-Technical Cooperation with Foreign States is submitted to the President Vladimir Putin. The last meeting of the Committee took place on April 9, 2020. Probably, after the next meeting that will be held after more than a year break, figures of the Russian arms export for 2020 will be more elaborate. ♦



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Doubtlessly, the novel coronavirus pandemic has significantly weakened the global economy.

According to experts, in 2020–2021 a decrease in the global GDP by 4–5% is possible, compared to 2019. Unfortunately, among the most affected countries there appeared to be Russia's main partners in the field of military-technical cooperation – Algeria, Egypt, India, China, and others. We do not base cooperation with our partners on the position of strength, we do not threaten them with sanctions or rejecting financial or economic projects. In other words, cooperation through blackmail is unacceptable for us. Russia develops relationships with its partners on equal terms. And such an attitude is the most viable today

RUSSIA'S MILITARY-TECHNICAL COOPERATION

COUNTRY	CONTRACT SUBJECT	NUMBER OF UNITS	DELIVERIES COMPLETED IN 2020
ALGERIA	Tanks T-90SA	–	–
	Su-24 modernization to Su-24M2	6	Modernization takes place at the site of Aircraft Repair Plant 514 in Rzhev
	BMPT-72 'Terminator-2' and simulators for them	–	Based on open source data https://diana-mihailova.livejournal.com/5072615.html , https://armstrade.sipri.org/armstrade/page/trade_register.php
	ATGM 9M120 'Ataka'	–	According to 2016 contract
	MiG-29M/M2	2	According to 2019 contract
BELARUS	Modernization of T-72B3	5	Delivery of the next batch
	Route radar 'Sopka-2M'	1	Purchased and installed for the first time, commissioning is being carried out
	Mobile radar 59N6-E 'Protivnik-GE'	7	According to 2014 contract
VENEZUELA	Maintenance of Mi-17V-5	–	Repaired in Russia
VIETNAM	'Klintsy' Truck crane	–	A large batch of special equipment for engineering units of the People's Army of Vietnam
EGYPT	Multipurpose fighter Su-35	5	–
	Multifunction fighters MiG-29M and missiles R-73 and R-77 for them	–	Deliveries according to a 2015 contract completed (total of 52 units delivered)
INDIA	Diesel engine YaMZ-238	–	For installation on the 250 Casspir-6 APC made in South Africa. Under a 2016 contract, deliveries completed
	Jet bomb system RBU-6000	–	For installation on Indian-made Kamorta frigates (Project-28). Under a 2003 contract, deliveries completed
	9M119 AGTM	–	For T-90 and T-72 tanks. Deliveries are underway according to a 2013 contract
	AL-31 Aircraft engine	–	For modernization of combat aircraft Su-30MKI; deliveries underway
ITALY	Field hospital with standard medical equipment and accessories	1	As part of humanitarian aid
	Optical sights and brackets for sport and hunting arms	–	Several batches, models PO4x24, PO3-9x24 and PO6x36, PKU-2 and PK1
KAZAKHSTAN	Training system for Mi-171A2 helicopter	–	As part of a contract for delivery of the first Mi-171A2 to Kazakhstan
	Multifunction assault helicopter Mi-35M	4	–
	Multipurpose fighter Su-30SM	–	Delivery of the next batch according to a 2018 firm contract. Engineering and technical personnel of the customer underwent full retraining at the manufacturer's plant
	Mi-8AMT helicopter sets	2	As part of licensed production
CHINA	Mi-1716 / Mi-171E helicopter	5	–
	Mi-17V-7 helicopter	2	–
	AK-176 shipborne artillery gun mount	–	For Chinese-made frigates Type-056. Deliveries underway according to a 2010 contract
	AL-31 Aircraft engine	–	According to contracts of 2014 (AL-31F-M2 modification for Chinese-made J-20), and of 2016 (AL-31FN modification for Chinese-made J-10)
	D-30 Aircraft engine	–	For Chinese-made H-6K aircraft and Y-20 transport aircraft
LAOS	Air Force training center	1	Opening was held
	T-72B tank	–	From inventory, modernization up to the T-72B1 version. Completed deliveries according to a 2018 contract
MEXICO	'Ansar' helicopter	1	–
MYANMAR	Checkpoint inspection and security system	1	The first delivery of a new type inspection and security system by Ruselectronics and the first contract for equipping checkpoints in South-East Asia with Russian inspection equipment

COUNTRY	CONTRACT SUBJECT	NUMBER OF UNITS	DELIVERIES COMPLETED IN 2020
NIGERIA	Mi-171E helicopter	2	–
	Mi-35M helicopter	2	–
	9M114 AGTM	–	For Mi-35M helicopters
UAE	Robotic policeman	–	Developed by the Perm-based company Promobot. It was granted financial and non-financial support as part of the national project 'International Cooperation and Export'
	9M133 'Kornet' AGTM	–	Deliveries underway according to a 2017 contract. Deliveries completed, approximate contract value \$709 million
PERU	Modernization of Su-25	1–4	The next batch consisting of 1–4 units delivered. Works with assistance of the Russian side are carried out at the facilities of SEMAN
PAKISTAN	RD-93 MA Aircraft engine	–	Modification of RD-93 MA for Chinese-made aircraft
REPUBLIC OF SERBIA (BOSNIA AND HERZEGOVINA)	'Ansat' helicopter	1/3	The first of the three 'Ansat' helicopters (medical configuration). Training of technical personnel and pilots is arranged
SENEGAL	Semi-trailer trucks KAMAZ-6460-21 and KAMAZ-65806-93, four-axle rear-side dump semi-trailer TONAR-952363	–	For test trials. Transferred to the Senegalese company West African and Russian Industrial Group (WARIG)
	KAMAZ-43119 Military trucks	18	First batch
SERBIA	'Pantsir-S1E' anti-aircraft missile and gun system	6	Deliveries according to a 2019 contract completed
	57E6 missiles	150	For anti-aircraft missile and 'Pantsir-S1E' gun system
	UAZ Patriot cars	> 60	For military police and land forces
	Modernized T-72MS White Eagle tanks	11	First batch, delivery as part of military and technical aid
SYRIA	9M133 Kornet ATGM	100	Modification of 9M133FM-3, according to a 2019 contract
	MiG-29 multipurpose fighters	–	Second batch delivery, probably from the inventory of the Ministry of Defense
SUDAN	UK-307 training ship – boat	–	From Russian Navy equipment, delivered as part of military and technical aid
TURKEY	Robotic policeman	–	–
	9M133 'Kornet' AGTM	–	For Turkish anti-tank systems Kaplan-10, deliveries underway according to a 2018 contract
	9M96E2 AGTM	–	For S-400 'Triumph' air defense missile system. Turkey is probably the first foreign recipient of such systems
UZBEKISTAN	Mi-35M helicopters	8	–
PHILIPPINES	Ural NEXT Trucks	37	The batch was purchased through an official dealer of the Ural Truck Plant "Ural" in the Philippines
CAR	BRDM-2 APC	20	Delivered in two batches as part of military and technical aid





EXPORT OF AVIATION EQUIPMENT IN THE RUSSIAN-CHINESE MILITARY-TECHNICAL COOPERATION

The military-industrial complex (MIC) of the People's Republic of China is rapidly developing, but still cannot manage to meet all its needs without foreign aids. In the context of a current political situation becoming even more complicated, Beijing has fewer and fewer opportunities to import foreign samples of military equipment.

Author Roman Koshkin

In September 2018, the United States imposed sanctions on China for conducting military-technical cooperation (MTC) with the Russian Federation. One of the weak points of the Chinese defense industry is still the production of manned aircraft and engines for them. In this regard, the import of technologies from the Russian Federation is of considerable interest to the state and military leaders of the People's Republic of China.

INITIAL POINTS OF COOPERATION

The military-technical cooperation of the USSR and China in the field of aviation technologies began before the Second World War. From 1937 to 1942, to combat Japanese aggression, China received from the USSR about 840 combat aircraft: I-15, I-16, I-153 fighters, and SB, DB-3 and TB-3 bombers. In 1941–1942, a plant near the Chinese city of Urumqi was operating, and more than one hundred I-16 fighters were assembled using Soviet components and parts. The extent of Soviet aids and assistance level increased in 1950, after the victory of the communist party led by Mao Zedong in the civil war. La-

11, Yak-11, MiG-9, MiG-15 fighters, Tu-2 and Tu-16, Il-28 bombers were delivered to the People's Republic of China, the drawings of MiG-17 and MiG-19 fighters were supplied for production purposes. The An-2, An-12 aircraft were also delivered.

When the war on the Korean Peninsula was over, the emphasis of the Soviet-Chinese aviation cooperation shifted towards technological assistance to the aviation industry of the People's Republic of China. Using Soviet licenses, China launched serial production of aircraft of various types and purposes: in 1957, production of MiG-17 fighters ("Jian-5" (J-5)), then in 1959 of MiG-19 ("Jian-6" (J-6)) was launched.

In the late 1950s, relations between the two countries soured. The Chinese leaders managed to detain the MiG-21 aircraft of Soviet supplies to Vietnam fighting against the United States. The Chinese version of this fighter, named "Jian-7" (J-7), was designed using the unlicensed copying method. This aircraft has become one of the most large-scale series in the industry of the People's Republic of China and in service with the fighter aviation of the Air Forces of the People's Liberation Army (PLA) of China.

Under a license of the Soviet Union, China launched serial production of Il-28 ("Hong-5" (H-5)) front-line bombers. On the basis of the design and technical documentation supplied before the collapse of the Soviet-Chinese military-technical cooperation, Chinese aircraft manufacturers launched the production of long-range Tu-16 bombers ("Hong-6" (H-6)), as well as An-24 and An-12 transport aircraft ("Xian-7" (Y-7), and "Xian-8" (Y-8)).

These aircraft formed the main part of the Air Forces aircraft fleet of the People's Liberation Army until the end of the 1980s, and the latest modifications of the "Hong-6", "Xian-7" and "Xian-8" aircraft are still in service and capable of performing combat missions.

China has also become an importer of Soviet unmanned target aircraft developed by the Design Bureau named after Lavochkin – La-17 (they were produced in the USSR in several modifications from 1954 to 1992). The first flight of a UAV produced in the People's Republic of China took place in 1966. The Chinese version of the La-17 aircraft was designed by the Nanjing Institute of Aeronautics with the use of a reverse en-

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There are two polar positions in the People's Liberation Army Air Force. The first one: in order to maintain combat readiness level, it is necessary to purchase Russian weapons. Imports from the Russian Federation, in fact, are the only opportunity to replenish arsenals with modern aviation equipment, since the sanctions introduced in 1989 are still in place. The second position protects the interests of the Chinese defense industry: it is important to develop your own production, stop focusing on the capabilities of the Russian Federation, produce your own equipment and sell it to foreign markets. However, despite the active development of its own defense industry, the People's Republic of China still purchase fighters and engines produced in Russia

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The Chinese-Pakistani fighter JF-17 'Grom' can be considered a successful product. However, its "Soviet ancestor" MiG-21 performed its first flight back in 1956. JF-17 fighters fly thanks to Russian RD-93 engines. Pakistani aircraft technicians do not have sufficient qualifications and experience to perform repairing work, so the aircraft have to be transported to the aircraft plant (city of Changsha) in the People's Republic of China. Objectively, the Chinese aviation industry has overtaken the Russian industry only in the UAV production segment: its production is large-scale and inexpensive due to large-size batches. More than 15 countries purchase combat UAVs from the People's Republic of China

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Despite the statements about the achievement of military-technical independence in regard of the Russian Federation, in the nearest future China will remain the main buyer of Russian military-purpose products and technologies for the aviation sector. An example of a successful Russian-Chinese deal is the export of 24 Russian Su-35 fighters to China. As a result, the balance of forces over the Taiwan Strait was adjusted in favor of the People's Republic of China

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Chinese engineers are looking for ways to develop their combat aviation sector: they have independently developed and produced aircraft of the 4++ generation; they are currently working on the development of fifth-generation fighters: J-20 and J-31. But among promising aircraft, only the J-20 fighter can be considered to be a fifth-generation fighter. The J-31 uses units and assemblies of the 4+ fighters. Regarding J-20, which embodies the full potential of the Chinese aviation industry, its real combat readiness is a distant prospect. This fact is supported by the available experience of working on similar machines in the USA and other countries

gineering method. After the termination of cooperation with the USSR, Chinese industry started developing its own UAV. Its main difference from the La-17 aircraft was the use of the WoPen-6 turbojet engine (a copy of the Soviet RD-9 turbojet engine).

COOPERATION DEVELOPMENT

Military-technical cooperation was resumed not long before the collapse of the USSR. In 1991–1997, 50 Su-27 fighters (38 Su-27SK units and 12 Su-27UBK units) were exported to the People's Republic of China amounting to about \$1.7 billion. From that moment on, by mutual agreement of the parties, the content of the contracts, including their value, is not disclosed, and the data available in open sources can only be used for an estimation.

In 2000–2001, 38 multipurpose Su-30MMK fighters were delivered under the 1999 contract with a value of about \$1.5 billion. In 2000–2002, 28 units of Su-27UBK fighters were delivered to China under the repayment of the state debt of the Russian Federation. In 2003, the second contract for 38 Su-30MMK aircraft was completed. In the

autumn of 2004, the delivery of 24 Su-30MK2 units for the PLA Navy was completed.

In total, about 180 Su-27/Su-30 fighters have been delivered to China from 1991 to 2011, including 38 Su-27SK single-seat fighters, 40 Su-27UBK two-seat combat training aircraft, 76 Su-30MMK multipurpose fighters, and 24 Su-30MK2 fighters. In 2015, the Rostec State Corporation announced the conclusion of a contract for the delivery of 24 Su-35 fighters to the People's Republic of China (China has become the first foreign purchaser of these aircraft). The contract value is estimated by experts at \$2.5 billion.

PRODUCTION OF RUSSIAN FIGHTERS IN THE PEOPLE'S REPUBLIC OF CHINA

In 1996, China acquired a license to produce two hundred Su-27SK fighters without the right to re-export them to third countries. The contract was valued at about \$2.5 billion. The fighters were assembled at a plant built as part of a Russian project in the city of Shenyang (Liaoning province). Equipment for this plant was also manufactured by the Russian Federation.

By the end of 2007, 105 aircraft were assembled from Russian vehicle kits. China refused the remaining 95 kits for assembling the Su-27SK aircraft, giving as a reason that it had designed its own version of the "Jian-11" fighter plane (J-11, Shenyang). Taking into account 105 Su-27SK units assembled under the license, the total number of Su-series fighters in China amounted to about 280 aircraft.

After that, the Russian Federation supplied China with spare parts and weapons for the aircraft and provided assistance in aircraft maintenance and repair operations.

COOPERATION IN THE FIELD OF TRANSPORT AVIATION

In 1993, the Russian Federation exported ten Il-76M military transport aircraft to China. In 2005, a contract was signed for the purchase of 34 more Il-76 aircraft and four Il-78 refueling aircraft with a total value of about \$1.5 billion. However, the order was not completed due to some problems with the aircraft production at the Tashkent Mechanical Plant JSC (Uzbekistan).

TRANSFERS OF AVIATION EQUIPMENT FROM THE RUSSIAN FEDERATION TO CHINA IN THE PERIOD OF 2011–2020

EAR	SUBJECT OF THE CONTRACT	QUANTITY	DELIVERY (YEAR)	CONTRACT VALUE (MILLION DOLLARS)
2011	Aviation engine AL-31F	150	2011 – n/a	about 500
	Aviation engine AL-31FN	123	2011–2013	about 500
	Aviation engine AL-225-25F	250	n/a	250
	Aviation engine D-30KP-2	184	2012–2015	about 500
2012	Aviation engine AL-31F	140	2013 – n/a	about 500
2014	Aviation engine RD-93	100	2015–2016	300
2015	Fighter Su-35	24	2016–2018	2500
2016	Aviation engine AL-31F	100	n/a	650
	Aviation engine D-30KP-2	224	2017–2020	about 660
	Hydroplane Be-200ChS	2	2018	n/a
2017	Hydroplane Be-200ChS	2	2018	n/a
	Hydroplane Be-103	2	n/a	n/a
	Helicopter Mi-17IE	7	2017–2018	60
	Helicopter Ka-32A11VS	2	2017	34
	Helicopter 'Ansats'	5	2017–2018	n/a
2019	Helicopter Mi-17IE	68	2019 – n/a	n/a
	Helicopter Mi-17ISh	18	2019 – n/a	n/a
	Helicopter Mi-17I	14	2019 – n/a	n/a
	Helicopter 'Ansats'	21	2019 – n/a	n/a
2020	Helicopter Mi-17I	5	n/a	n/a
	Helicopter Mi-17IE	2	n/a	n/a
	Aviation engine AL-31	n/a	n/a	M
	Aviation engine D-30	n/a	n/a	n/a

Sources: reports of the Russian Federation to the UN Register of Conventional Arms; reports of the Rostec State Corporation

At the end of 2011, the Russian Federation and the People's Republic of China agreed on the delivery of three used Il-76MD aircraft, in 2012 the number of aircraft increased to ten. According to the information available in the open sources, they were purchased by ROSOBORONEXPORT in the Russian Federation, and then underwent modernization in Belarus.

EXPORT OF AVIATION ENGINES TO THE PEOPLE'S REPUBLIC OF CHINA

The largest military-technical cooperation programs involve delivery of aircraft engines of various types from the Russian Federation to China. Thus, in 2005–2010, ROSOBORONEXPORT signed a contract with China valued at \$238 million for the delivery of 100 RD-93 engines (export version of RD-33) for JF-17 fighters (FC-1, 'Thunder') of the Chinese-Pakistani joint production, as well as spare parts and maintenance services.

In 2009–2010, the Russian Federation exported 43 more RD-93 engines to China, and in 2014 signed a contract for the delivery by the end of 2016 of the next hundred RD-93 engines, and also maintenance and repair services for them. In addition, the Moscow Engineering Enterprise named after V.V. Chernyshev (part of the United Engine Corporation (UEC)) and the Chinese CATIC (China National Aero-Technology Import and Export Corporation) signed a contract for the modernization of the RD-93 engine.

In 2009–2011, the NPO Saturn JSC completed a contract for delivery of 55 D-30KP-2 aircraft engines to China (for Il-76, "Hong-6" bombers and "Xian-20" transport aircraft). In 2012–2015, under a contract signed in 2011, the NPO Saturn JSC has delivered 184 D-30KP-2 engines to China. The cost of this order was more than \$500 million.

In 2011, China purchased 150 AL-31F engines (used on Su-27 fighters and Chinese "Jian-11") and 123 AL-31FN engines (to equip Chinese "Jian-10" aircraft). In 2012, Beijing and Moscow signed a large contract for the delivery of 140 AL-31F aviation engines. The contract value was \$700 million. According to the estimates of the ROSOBORONEXPORT experts, in 2012 aviation engines amounted to about 90% of all Russian military export volume to China.

In 2016, the United Engine Corporation JSC signed contracts with CATIC, AVIC International and Tianli companies for delivery of spare parts, provision of technical support services for operation and maintenance of aircraft engines, with a total value of more than \$65 million.

EXPORT OF HELICOPTER EQUIPMENT

In 2016, the governments of the Russian Federation and China signed the Intergovernmental Agreement on Cooperation within the program on designing a prospective civilian heavy helicopter. Within the signed agreements, the Russian Helicopters JSC would assist the Chinese state-owned company AVICOPTER in the development

of a heavy helicopter for its series production in the People's Republic of China. The Russian Helicopters JSC also signed contracts with Chinese companies Qingdao Helicopter, Jiangsu Baoli, Easy Best Group, Wuhan Rand Aviation Technology Service, Jiangsu Baoli Aviation Equipment for the delivery of 14 Ka-32A11VS and Mi-17I helicopters in 2017–2018.

The Russian Helicopters JSC signed a framework agreement with the Chinese companies AVIC International Holding Corporation and CITIC Offshore Helicopter Corporation to establish a maintenance and repair center for Russian-made helicopters on the territory of China.

In 2019, the Rostec State Corporation certified the VK-2500 helicopter engine in the People's Republic of China. In 2020, the Civil Aviation Administration of China validated the 'Ansats' helicopter type certificate issued by the Federal Air Transport Agency. From now on, the power plants will be operated as part of Russian helicopters on the territory of the People's Republic of China, which will expand the geography of sales and operation of Russian 'Mi' and 'Ka' helicopters.

DEVELOPMENT DIRECTIONS

The Russian-Chinese cooperation in the field of joint development and technology exchange continues. Long-term negotiations are being carried on in some areas, for example, regarding aforementioned agreement on the joint development of a heavy helicopter. This contract set a record in its discussion time period. The Russian Fe-

deration and China started negotiations in 2008–2009, but only by May 2016 a framework agreement was signed on the helicopter joint works.

At the beginning of 2017, the Russian and Chinese parties made statements about their readiness to sign a contract for the design of a helicopter with a take-off weight of 38 tons and a payload capacity of 15 tons by the end of 2017, but so far the contract has not been signed.

Another major joint dual-purpose project on a wide-body long-haul aircraft (ShFDMS, Chinese designator – C929) has gained a faster pace. The parties agreed to establish a joint venture called China-Russia Commercial Aircraft International Co., Ltd. (CRAIC) at the end of 2016. In 2017, a memorandum of cooperation was signed on the development of a gas turbine engine for the prospective wide-body long-haul aircraft. In November 2018, during the Airshow China international aviation exhibition held in Zhuhai (People's Republic of China), the United Aircraft Corporation PJSC and the Chinese corporation COMAC jointly presented a full-scale model of a wide-body long-haul aircraft CR929, the first deliveries of which are planned for 2025–2027. Preparations are underway for the development of a joint engineering center in Russia and the company's headquarters in Shanghai. The parties agreed to develop and produce PD-35386 engines for the project.

CONCLUSIONS AND RECOMMENDATIONS

The analysis of the Russian-Chinese cooperation history in the field of aviation equip-

ment deliveries allows us to make the following conclusions and summary:

1. The evolution of the Chinese defense industry largely depends on Soviet and Russian products and technologies. China needs these to maintain the impetus that the Chinese defense industry has received in the 1990s by copying and modernizing Russian technologies. Import of products from the Russian Federation is actually the only opportunity available to Beijing to replenish its national arsenals with modern weapons, including aviation arms. The sanctions regime introduced by the United States and NATO countries in 1989 against the People's Republic of China is still in force, so China doesn't have opportunities to purchase Western military and dual-purpose technologies.

2. The Soviet-Chinese cooperation in aviation was largely focused on providing technological assistance to the Chinese aviation industry. In China, under Soviet licenses, serial production of aircraft of various types and purposes has been launched: "Jian-5" (MiG-17), "Jian-6" (MiG-19), "Jian-7" (MiG-21), "Hong-5" (Il-28), "Hong-6" (Tu-16), "Xian-7" (An-24), "Xian-8" (An-12). They formed the basis of the People's Liberation Army Air Forces aircraft fleet until the end of the 1980s. In mid-2021, after undergoing a large-scale modernization process, the "Hong-6" bombers, "Xian-7" and "Xian-8" transport aircraft still continued to perform combat missions for the Chinese Air Forces.

3. Taking into consideration the fact that the Soviet-Russian equipment historically was often put in service in the People's Liberation Army, the Chinese side should

rather purchase the latest Russian technologies, not the Western ones. The Russian manufacturers are able to offer the Chinese Air Forces a wide range of weapons and technologies. In turn, it is essential for the domestic defense industry that the Chinese side is still quite financially reliable.

4. The defense industry of the People's Republic of China cannot operate to its full extent without Russian assistance. The Chinese aircraft manufacturers have not managed to overcome the lag behind Russia and technologically advanced European countries in the field of electronic systems, engine engineering, and aviation power supplies. Therefore, nowadays the cooperation of these two countries is concentrated on the delivery of some series of helicopters, in particular Mi-171 and 'Ansar', from the Russian Federation to China.

5. The experience of the Russian-Chinese military-technical cooperation shows that the transfer of Russian technologies can result in some losses: The People's Republic of China often reproduces foreign developments by adapting them to its domestic needs and demands, and after that doesn't need imports any more. This practice requires introduction of some adjustments to the terms of licensing agreements.

To increase the scale of the military-technical cooperation between the Russian Federation and the People's Republic of China, the system of relationships with Chinese partners should be revised: to make a transition to the joint development of high-tech weapons, to envisage the sale of weapons production technologies and establishment of licensed production facilities on the territory of the People's Republic of China. ♦





INTERNATIONAL EXERCISES OF THE RUSSIAN ARMED FORCES IN 2020 AN OVERVIEW

Author Olesya Zagorskaya

Military exercises are one of the most important elements of military readiness. They serve several key purposes, including practicing new ways of using troops, verifying command and control capabilities, trying out new ways of organizing and conducting combats, and testing the latest weaponry. International exercises broaden the range of objectives: they increase trust between participating nations and facilitate the development of common approaches to international security.

International military cooperation plays a significant role in the activities of the Russian Armed Forces. This is evidenced by statements of senior defense officials, as well as the actual practice of international contacts.

In 2020, the coronavirus pandemic and its associated restrictions have required adjustments of the Armed Forces' activities in terms of the international cooperation. Due to the unfavorable epidemiological situation, a number of activities were reduced, postponed or cancelled. In particular, the Shanghai Cooperation Organization (SCO) anti-terrorist exercise 'Mirnaya Missiya 2020' (Peace Mission), the exercises 'Rubezh 2020' (Border), 'Vzaimodejstvie 2020' (Interaction) and 'Poisk 2020' (Search) within the framework of the Collective Security Treaty Organization (CSTO), the Russian-Laotian exercise LaRos 2020, and the first Russian-Indonesian naval exercise Orruda 2020 have not been held. However, most of the planned bilateral and multilateral exercises were conducted.

The largest exercises took place from July to September. On the one hand, this may be due to the peculiarity of the academic year in the Russian army: it does not coincide with the calendar year and lasts from December 1 to October 31. Thus, the largest exercises are a kind of 'exam' for the Armed Forces and as such sum up the academic year. On the other hand, a number of exercises were shifted to the autumn period due to the unfavorable epidemiological situation – the situation was expected to stabilize by autumn, so the intensity of the exercises increased towards the end of the calendar year.

THE 'KAVKAZ 2020' STRATEGIC COMMAND AND STAFF EXERCISE: A FINAL TEST FOR THE ARMED FORCES

The major exercise to enhance the combat readiness of the Armed Forces in 2020 was the 'Kavkaz 2020' strategic command post exercise, during which the preparation and conduct of operations to combat illegal armed formations (IAF) of international terrorist organizations was practiced. The aim of the exercise was to train troops in conducting combat operations under modern conditions and to increase the interoperability of military command bodies of the armed forces of the Russian Federation and partner States.

These large-scale exercises take place annually in a rotation of the four military districts. Thus, in 2017, the 'Zapad 2017'

(West) exercise was held in the Western Military District (MD), and in 2018, the 'Vostok 2018' (East) exercise was held in the Eastern MD, and in 2019, the 'Tsentr 2019' (Center) exercise was held in the Central MD. The previous Kavkaz exercise was held in the Southern MD in 2016. The 'Kavkaz 2020' Strategic Command and Staff Exercise (SCSE) was also held in the Southern MD.

Soldiers from Armenia, Belarus, China, Iran, Myanmar, Pakistan, South Ossetia, and Abkhazia (a total of up to 1,000 personnel) took part in the 'Kavkaz 2020' SCSE. India and Azerbaijan were also expected to participate in the exercise; however, India refused to participate (officially, due to coronavirus; according to Indian media reports, because of China's participation in the SCSE), and Azerbaijan was only represented by an observer group. Indonesia, Iran, Kazakhstan, Sri Lanka and Tajikistan also participated as observers.

The 'Kavkaz 2020' exercise featured a variety of episodes. Experience from contemporary armed conflicts was taken into account in the preparation and conduct of the exercise. In this regard, emphasis was placed on countering cruise missiles and UAVs, fire and electronic warfare against the "enemy", and the use of 'vertical envelopment', meaning an airlift into the rear of the enemy.

A tank unit of the Southern MD worked on disrupting the "enemy's" offensive: acting from an ambush, T-90A tank crews opened salvo fire on columns of "enemy's" armored vehicles on targets at a distance of 700 to 2200 m, after which they changed positions under a smokescreen. As the episode continued, motorized rifle units of the Southern MD together with an airborne assault brigade of the Airborne Troops (VDV) stopped the "enemy": first, a troop used Mi-8AMTSh Terminator helicopters to land in the "enemy's" rear, to destroy their armored vehicles. Then Tornado-G multiple launch rocket system (MLRS) and Msta-S self-propelled howitzer (SPH) opened fire in order to prevent the deployment of "enemy" reserves. Fire support from the air was provided by crews of Mi-28N 'Nochnoy Okhotnik' (Night Hunter) helicopters and a wing of Su-25 attack aircraft. The episode was concluded with a counterattack: motorized infantry units on BMP-3 and Tunguska surface-to-air missiles (SAM), as well as crews of T-90A tanks "destroyed" the main forces of the "enemy". Some 2,000 troops and about 100 pieces of equipment took part in the episode.



VLADIMIR PUTIN,
PRESIDENT
OF THE RUSSIAN
FEDERATION

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In the course of combat training, weapons and equipment with elements of artificial intelligence, including robotic complexes, unmanned aerial vehicles, and automated control systems, should be more actively mastered and tested. Such weapons greatly enhance the combat potential of units and formations, and not only today, but in the near future they will largely determine the outcome of combat

Soldiers of the engineering troops and CBRN defense units of the Southern MD used a "fire wall" with a combination of fire bombs and anti-tank mines to stop the "enemy" tanks from breaking through. The landmines were detonated over an area of more than three hectares, and more than 500 servicemen and about 70 pieces of equipment were involved in the episode.

Snipers from a motorized rifle unit of the Southern MD "destroyed" the "enemy" manpower moving to reinforce the main grouping using large-caliber ASVK and SVD rifles.

Anti-aircraft gunners of a motorized rifle unit of the Southern MD and a separate airborne assault unit of the VDV using the Tunguska-M1 SAM system and the Verba SAM system repelled an air and UAV attack by the "enemy", destroying target missiles at heights of up to 2 km.

As part of the main episode of the exercise, which was observed by the Commander-in-Chief of the Russian Armed Forces, the landing of Russian VDV and Pakistan Special Forces equipment as well as amphibious assault troops was practiced. During the episode, the paratroopers on Mi-24 helicopters carried out the seizure of landing sites to ensure the landing of the main forces, after which Mi-26 helicopters car-



YUNUS-BEK YEVKUROV,
DEPUTY MINISTER
OF DEFENSE OF THE RUSSIAN
FEDERATION

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The participation of military contingents of foreign states in Strategic Command and Staff Exercise (SCSE) 'Kavkaz 2020' is a unique opportunity to gain invaluable experience on practicing the actions of formations and military units in difficult geographical and climatic conditions, including in the mountain and desert areas, in isolation from the main forces and on a broad front

ried out the landing of troops on protected Typhoon vehicles, and Mi-8 helicopters carried out the transfer of guns and ammunition for D-30 howitzers on an external sling. More than 1,170 paratroopers, up to 40 vehicles and more than 80 army aviation helicopters took part in this episode.

For the first time as part of the exercise, ten BMD-4Ms were simultaneously landed from IL-76MD military transport aircraft.

The Caspian Flotilla marines used small arms and BTR-82AM to practice "destroying" the "insurgents" in the coastal zone, which took place at night.

At sea, the ships of Caspian Flotilla 'Tartarstan', 'Velikiy Ustyug' and 'Astrakhan' along with Iranian Navy missile boats 'Joshani' and 'Paykan' performed elements of joint maneuvering and practiced firing at sea and aerial targets. A joint search and rescue operation was also conducted.

Crews of the Black Sea Fleet ships 'Pavel Derzhavin' and 'Dmitry Rogachev' as well as anti-sabotage boats practiced searching for and blocking the sea supply channels of illegal armed groups and destroying their surface assets. The crew of the submarine 'Kolpino' of the Black Sea Fleet launched a Kalibr missile from an underwater position at a shore-based target.

The training ranges in Armenia, Abkhazia, and South Ossetia trained episodes of

joint operations against IAFs under separate scenarios. In Armenia, at the Alagyaz firing range, the direct control of units during joint operations was practiced; in Abkhazia, at the Tsabal and Nagvalou firing ranges, they carried out the task of engaging a simulated enemy in the mountains and on the coastline; in South Ossetia, at the Dzartsemy firing range, search operations in difficult terrain were carried out as well as the blockage and destruction of IAFs and sabotage groups of the "enemy".

A combined unmanned aerial vehicle team comprising Forpost, Orlan-10 and Eleron-3 UAVs was set up during the exercise to detect "enemy" defense systems and strike at ground targets.

In the exercise, 19 new types of weaponry have been tested, as well as the use of wind and solar generators.

The Russian Ministry of Defense specified that a total of about 80,000 people took part in the 'Kavkaz 2020' SCSE, while the number of military personnel in the exercise conducted under one operational command did not exceed 12,900.

CSTO MULTILATERAL EXERCISES

CSTO military exercises have been conducted on the territory of member states since 2004. In 2020, joint CSTO exercises were planned for all regions. Exercise plans, locations, and preliminary participants were agreed upon during the first staff talks, which took place via videoconferences on June 3–5.

The CSTO exercise was planned mainly for the autumn period, but it was agreed at the time, that the timing and preparation of the exercise could be adjusted to take into account the epidemiological situation in the CSTO states. As a result, only three of the planned exercises were conducted.

'ECHELON 2020'

Exercises with the forces and means of logistics of the Collective Security Treaty Organization (CSTO) 'Echelon 2020' took place on August 17–20 at the Kapustin Yar training range in the Astrakhan region, which was one of the stages of a large-scale rear special exercise of the Russian Armed Forces. Soldiers from Armenia, Belarus, Kazakhstan, Kyrgyzstan, Russia, and Tajikistan took part in the exercise.

Participants in 'Echelon 2020' practiced the tasks of deploying a logistics command post, organizing logistics during a joint CSTO operation to localize a border armed conflict, transporting military troops, and protecting and defending command posts. Also, for the first time during the exercise, units of the South MD deployed a point to maintain a reserve supply of drinking water capable of delivering up to 30 cubic meters of water per hour.

'NERUSHIMOE BRATSTVO 2020'

The 'Nerushimoe bratstvo 2020' (Unbreakable Brotherhood) exercise, in which issues of preparing and conducting a peacekeeping operation were practiced, took place on October 12–16 at the Losvido firing range in the Republic of Belarus. The aim of the exercise was to delineate



the roles and responsibilities between the command of the peacekeeping force and their mission. Military personnel from Armenia, Belarus, Kazakhstan, Kyrgyzstan, Russia, and Tajikistan took part in the exercise in the Eastern European region of collective security.

During the 'Nerushimoe bratstvo 2020', peacekeeping operations were practiced, including patrolling terrain, escorting convoys, blocking and searching of populated localities in the area of responsibility, and interaction with the police and rescue units.

At the final stage of the exercise, the peacekeepers used the Silok anti-drone system against a swarm of improvised UAVs: it was set as follows – according to "reconnaissance data", one of the opposing sides planned to destroy the bridge set up by the peacekeepers by dropping bombs from the UAVs, thereby "cutting off" the settlement. The use of the system made it possible to preserve the crossing and deny the area above the buffer zone to drones. There was also a response to an ammonia tanker explosion detected by a UAV of the Republic of Belarus while on an aerial reconnaissance mission. In addition, for the first time in Belarus, the delivery of humanitarian cargo on the external sling of a helicopter was practiced. Previously this method had only been used in Russian strategic exercises. The humanitarian cargo, weighing 3 tons, was placed on a fixed Mi-8 helicopter platform. Russian Mi-24 attack helicopters and Belarusian Armed Forces Mi-8 helicopters provided cover and fire support for the cargo delivery.

COMMAND AND STAFF TRAINING EXERCISE OF THE KSOR CSTO COMMAND

On November 11–12, one of the Russian VDV's formations in the Moscow Oblast hosted a training session with the CSTO Collective Rapid Reaction Force (KSOR) Command, during which a decision was made to conduct a joint operation. The purpose of the exercise was to test the prospective structure of a CSTO KSOR command post deployment based on an airborne command post. Representatives of the Ministries of Defense and the Ministries of the Interior and Emergency Situations of the CSTO member states participated in the CSTE.

BILATERAL EXERCISES

Military cooperation on a bilateral basis is also important. The Russian Defense Ministry not only maintains cooperation with

its traditional partners, but also seeks it outside of the scope.

ABKHAZIA

In October, a joint exercise of the Southern MD and the Abkhaz Defense Ministry was held at the Tsalal and Nagvalou training ranges of Abkhazia. The goal of the exercise was to improve the cohesion of the forces engaged in joint combat missions. The scenario of the exercise was reminiscent of the 'Kavkaz 2020' exercise, which had taken place a month earlier, as it was set in the mountains and sea-side regions: the troops of the joint group practiced maneuverable defense of the shoreline against a maritime landing by a simulated "enemy". The joint forces practiced maneuvering the defense at the shoreline and defeated the "enemy's" surface asset.

ALGERIA

A Russian-Algerian air defense exercise was held at the Ashuluk training range in the Astrakhan region on August 25 to 28. As part of the exercise, training sessions were held on driving combat vehicles, loading the launcher, operating the automated air defense control systems Universal-iE and Fundament, and repelling a massive missile air strike. The Algerian military studied the organization of combat planning, equipment maintenance and its preparation for combat use. The main event of the exercise was a live firing. Even though the scale of the exercise was quite modest, the Russian Defense Ministry noted the importance of Russian-Algerian cooperation.

ARMENIA

In February, military reconnaissance units of the two countries trained at the Pambak training range in the Republic of Armenia, where special and tactical training tasks were practiced, armored vehicles were driven, and training firing was carried out. Special attention was paid to individual reconnaissance training and the use of technical reconnaissance equipment.

In March, a special fire-fighting exercise of fire brigades from the Russian military base and the Armenian Emergencies Ministry was held at the Gyumri military garrison's military compound.

In July, during a routine exercise in Armenia as part of the Joint Air Defense System, soldiers of the two countries practiced countering reconnaissance and attack drones of the "enemy".

BELARUS

The first Russian-Belarusian exercise in 2020 took place on February 18–21 at the Strugi Krasnye and Zavelichye training ranges and the Kislovo landing site in the Pskov Oblast. During the joint exercise between the Russian VDV and the Special Operations Forces (SOF) of Belarus, a landing, capturing an object, carrying out a raid, and engaging in defensive combat were practiced. First, the combined unit landed on an airfield seized by the "enemy", destroyed its control room and combat outpost, and blocked the reserve from reinforcing the main forces. Then they carried out an offensive, blocked a simulated insurgency, and finally seized and held an advantageous line against the "enemy" to prevent the deployment of its main forces. There were also firing exercises with hand-held grenade launchers and small arms, with BMD-2 weapons, and tank crews firing a 100-mm cannon and a twin machine gun.

The Russian-Belarusian exercise 'Slavyanskoe bratstvo 2020' (Slavic Brotherhood) took place on September 14–25 at the Brest, Gozhsky and Ruzhansky training grounds in the Republic of Belarus. It was a counter-terrorism exercise aimed at



RUSTAM MINNEKAYEV,
MAJOR GENERAL,
RUSSIAN FEDERATION
SENIOR MILITARY
CONTINGENT AT CSTO
'NERUSHIMOE BRATSTVO
2020' (UNBREAKABLE
BROTHERHOOD) EXERCISE

At these exercises there was no enemy, there was no division of "friend" and "foe". The main task was to stop the bloodshed and foil any attempts at provocation. I think this exercise demonstrated a high level of readiness of the participants for peacekeeping operations. That is not only my position, but also that of the CSTO leaders who observed the practical actions



YUNUS-BEK YEVKUROV, DEPUTY MINISTER OF DEFENSE OF THE RUSSIAN FEDERATION

For the purpose of proper organization of military training and the performance of tasks set by the Minister of Defense and the Chief of general staff, new methods in various kinds of fighting are being widely introduced. Experience of modern armed conflicts, including that in the Syrian Arab Republic, is applied. At the same time, we continue to preserve and use invaluable information on the course of military operations received during the Great Patriotic War

practicing interaction between units, carrying out joint tasks. Soldiers from the Republic of Serbia have also been planning to join the exercise, but were pressured by the European Union to refrain from joining any military exercises for six months. While 'Slavyanskoe bratstvo' took place against the backdrop of the unstable internal political situation in Belarus, it had long been planned and was not related to the current political situation. On the Russian side, paratroopers from the Pskov, Ivanovo, and Tula VDV units took part in the exercise; on the Belarusian side, units of the Republic's SOF took part.

During the exercise, military personnel from the two countries carried out a number of tasks involving blockading of a populated area and the destruction of suspected "insurgents". The training exercises included firing D-30 howitzer's and 2S9 Nona-S self-propelled guns (SPG) at "enemy" command posts and firing points, hostage rescue and building seizure tasks, searching for and detaining "terrorists" in the surrounding area, providing first aid and evacuating the "wounded".

There was training in the parachute landing of troops and equipment from IL-76MD aircraft in unknown terrain with the subsequent seizure of "enemy" targets. In particular, the seizure of the hydro-technical junction was carried out. A water way was

crossed with the support of the army aviation: paratroopers from the two countries trained in crossing the Mukhavets River using Russian BMD-4M and BTR-MDM Rakushka as well as Belarusian BTR-80 armored personnel carriers.

In addition, as part of the exercise, Russian Tu-160 missile carriers flew along the borders of Belarus to practice operational cooperation with the Belarusian Air Force's fighter aviation to provide air cover for actions of a joint tactical group on the ground. Six Tu-22 bombers bombed "enemy" targets on the ground during a flight over the republic's territory.

EGYPT

As the first one for the Black Sea region, the Russian-Egyptian Exercise 'Most Druzhby 2020' (Bridge of Friendship) took place in the Black Sea: in Novorossiysk and at the Black Sea Fleet's training ranges. The aim of the exercise was to develop military cooperation between the Egyptian and Russian navies and to exchange experience in repelling threats in areas of heavy shipping. Crews of the frigate 'Admiral Makarov', the destroyer 'Orekhovo-Zuyevo', the patrol ship 'Dmitry Rogachev' and the rescue tug 'Professor Nikolay Mur' took part in the exercise on the Russian side, while crews of the frigate 'Alexandria', the corvette 'El-Fateh', and the missile boat 'M. Fahmi' participated on the Egyptian side.

The exercise, which took place on November 17–24, had a coastal and offshore phases. In the coastal phase, divers from the Egyptian and Russian Navy conducted an underwater inspection of the hulls of the vessels participating in the exercise prior to putting to sea. A pre-exercise conference was also held to discuss the exercise episodes and the organization of communication and interaction. In the offshore phase, participants repelled an attack by small "enemy" vessels, guarded and defended the ships, and fired at naval and air targets and "enemy" floating mines. They also practiced in overcoming simulated minefields by escorting the ships behind trawls. In addition, the participants practiced assisting a ship in distress, Search and Rescue (SAR) tasks, and resupply at sea using ropes stretched between the ships, and actions to search suspicious vessels.

INDIA

Even before India's refusal to participate in the 'Kavkaz 2020' SCSE (September 4–5), the Russian-Indian naval exercise 'Indra Navi 2020' was held in the Andaman Sea

and the Bay of Bengal. It aimed at strengthening the interoperability of the navies of the two countries and improve interaction in conducting multilateral maritime operations. The Russian Navy was represented by the destroyers 'Admiral Vinogradov' and 'Admiral Tributs' and the large naval tanker 'Boris Butoma'. The Indian Navy engaged the destroyer 'Ranvijay', the frigate 'Sahyadri' and the tanker 'Shakti'.

In the exercise, the crews practiced communication, joint maneuvering, and resupplying ships from tankers while on the move. The ships conducted artillery firing at sea and air targets and also "destroyed" an "enemy" submarine with rocket-propelled depth charges. In addition, Russian and Indian helicopter crews conducted cross-flights with landings on the decks of the Indian and the Russian destroyers.

On December 5, a one-day exercise was held in the Bay of Bengal involving the missile cruiser 'Varyag', the destroyer 'Admiral Panteleyev' and the medium sea tanker 'Pechenga' of the Pacific Fleet and the frigate 'Shivalik' and the corvette 'Kadmatt' of the Indian Navy. In this exercise, the two sides conducted communication training and practiced joint maneuvering. The exercise was aimed at enhancing interoperability between the fleets and sharing experiences.

CHINA

For objective reasons, 2020 was not the most eventful year in terms of military cooperation between Russia and China. In September, Chinese servicemen took part in the 'Kavkaz 2020' CSTE, and on December 22, the two sides conducted a combined air patrol in the Sea of Japan and the East China Sea, which was their second joint air patrol. The air group from the Russian Air Force side included two Tu-95MS strategic bombers, and from the PLA Air Force side four H-6K (架轰-6K) strategic bombers. The objective of the patrols was to deepen and develop Sino-Russian comprehensive partnership relations, to further enhance the level of interaction between the two countries' armed forces, improve joint warfare capabilities, and enhance global strategic stability.

MONGOLIA

Mongolia is one of Russia's traditional military partners. On October 27–31, the thirteenth 'Selenga 2020' Russian-Mongolian exercise was held at the Burundi training range in the Republic of Buryatia and Doitim An in Mongolia. In the exercise, military personnel from the two



countries practiced eliminating suspected illegal armed groups. Due to pandemic-related restrictions, Russian and Mongolian troops trained on their own territories, with the exercise being commanded from the Burundi training range, where a team of Mongolian military officers arrived, and practical actions were monitored by online video surveillance.

In this exercise, new methods and techniques of countering insurgency were tested. For example, for the first time at 'Selenga', Russian troops used modern reconnaissance equipment and UAVs to collect data on a simulated enemy, after which they struck "enemy" control centers and depots using Tornado-G MLRS and Akatsiya SPH, supported by Su-25 and Mi-24 helicopters. Tank crews of the Eastern MD applied the experience of modern armed conflicts and fired at "enemy" targets at maximum range from closed firing positions with their T-72B tanks. A Pole-21 radio suppression system was used to suppress "enemy" UAV control channels. A tank bridge-builder was used to practice crossing a minefield and a moat, and Mi-8AMTShs underwent training in evacuating the "wounded" from the battlefield with an external sling.

A special task formation of the Mongolian Armed Forces also monitored the exercise at the Burundi training range. Units at the Doitim An training range, having received information about the location of the "enemy", "destroyed" an illegal armed group.

PAKISTAN

Russian and Pakistani militaries have a mutual interest in developing military co-

operation and therefore conduct exercises in both multilateral and bilateral formats. On November 5–21, at the training range of the Pakistani Armed Forces in Tarbela as well as at the Pakistani National Centre in Pabbi town, a joint Russian-Pakistani 'Druzhba 2020' exercise was held in which the sides exchanged with their experience and practiced cooperation in operations to eliminate suspected IAF.

In the preparatory phase, the two countries' servicemen conducted individual and group training of personnel. The next stage included training and preparation for joint operations in a counter-terrorist operation. The exercise concluded with joint missions to eliminate suspected insurgents.

Participants in 'Druzhba' conducted firing exercises using standard SOF weapons at targets at a distance of 100 meters. For the first time, Russian servicemen used weapons and equipment of the Pakistani Army, including Glock pistols, M4 assault rifles, radios and equipment. Russian and Pakistani snipers also shared their experience, as they trained together to eliminate "enemy" targets at distances of up to 600 meters.

In preparation for the final stage of the exercise, a landing from Pakistan Air Force Mi-17 helicopters was performed. After the landing, the troops practiced defending the landing area and repelled an attack by would-be terrorists at the landing site.

The main event of the exercise was an assault on the "enemy" base, which was conducted with the fire support of armored vehicles and aircraft of the Pakistani Armed

Forces. In the exercise, the commandos of Russia and Pakistan practiced in liberating a town from terrorists – after having landed in a mountainous and heavily wooded area, the participants marched to the site and stormed more than 20 buildings with the "elimination" of suspected terrorists. The participants also performed first aid and "casualty" evacuation in the course of the operation. As part of the exercise, the Pakistani side conducted demonstration performances by the Army troops.

SYRIA

Four joint Russian-Syrian exercises are known to have taken place in 2020.

On January 18 to 20, an exercise was held to defend the port of Tartus, where the Russian naval base is located. The exercise involved searching for mines near the port, and a combined Russian-Syrian unit have "neutralized" an underwater sabotage group of suspected terrorists. Another exercise was reported on May 25 in the port of Tartus: Russian and Syrian navies once again practiced joint actions to protect the port from a group of "saboteurs". The exercise involved a group of "saboteurs" attempting to plant an improvised explosive device on the seabed. The anti-sabotage gunboat 'Raptor' and the gunboat 'Kinel' arrived at the alleged location of the "enemy" and the fairway for gunboats was cleared by the minesweeper



SERGEI SHOIGU,
MINISTER OF DEFENSE
OF THE RUSSIAN FEDERATION

Russian-Chinese exercises are by no means new, they have been held several times on land, as well as in the Shanghai Cooperation Organization (SCO) and bilateral formats. The current exercise was an air and space force exercise.

They are not directed against Japan; they are simply intended to test the combat readiness of the aviation forces that ensure the security of the borders of the Russian Federation and the People's Republic of China



**COLONEL ALEXANDER
LEPESHKIN,**
DEPUTY HEAD OF THE
'DRUZHBA-2020' EXERCISE

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Terrorism has no nationality, religion or state affiliation, and no borders. Situations can arise when it will be necessary to carry out missions to annihilate terrorist groups jointly. If such a situation arises in the fight against international terrorism, we will definitely save a lot of time in preparing a joint operation



'Ivan Antonov'. Syrian Navy minesweepers and missile launchers also took part in the exercise.

Another defense exercise of the Russian naval base in Tartus, in which the joint actions of ground forces, navy, and aviation with the aim to find and neutralize a group of saboteurs were practiced, took place on December 24. In addition, an "attack" by an "enemy's" UAV was repelled with the use of Tor and Pantsir-S1 SAMs.

In addition, on August 21, it became known that a similar exercise was conducted in the port of Benias: while patrolling the waters, a suspicious vessel that did not respond to requests from shore, was "discovered". Afterwards, the vessel was boarded to seize the crew and inspect the ship. In the course of the exercise, artillery fire was fired at a simulated enemy from Russian and Syrian ships, and the "destruction" of an "enemy" UAV was practiced.

Exercises to protect and defend the ports of Tartus and Benias are conducted regularly.

TAJIKISTAN

The 201st Military Base of Russia is stationed in Tajikistan; it is part of the Central MD and is the largest ground unit of the Russian Armed Forces carrying out tasks outside the country. Military specialists of the 201st Base not only participate in training of Tajikistani soldiers but also regularly conduct joint exercises.

One of Russian-Tajikistani exercises aimed at strengthening interaction between units and ensuring unified approaches to the conduct of actions took place on November 20–28 at Liaur, Sambuli and Khabr-Maidon training ranges in Tajikistan. During the march to the ranges, Russian servicemen practiced moving as part of a convoy, navigating in unfamiliar terrain. During the joint practical part, the units carried out protecting and defending facilities and blocking and destroying insurgent groups.

In one of the episodes at the Sambuli training range, Orlan-10 UAVs in co-operation with reconnaissance units, while monitoring the terrain, detected a border violation by a suspected insurgent group. After the decision was taken to destroy the group, the tasks of simultaneous use of Sani mortars, Gvozdika SPH and Mi-24 helicopters with the support of BTR-82A were practiced. Joint operations were controlled using the Streletz reconnaissance, control and communications system.

In the course of the main stage of the exercise, tasks were carried out at the Khabr Maidon training range to destroy a IAF numbering 1,200 men, which had broken through the border. To complicate the "enemy's" offensive, engineering units deployed two 500-metre "fire walls", artillerymen fired Grad MLRSs, and an electronic warfare team uncovered the enemy's electronic facilities and UAVs using the Borisoglebsk-2 system. Then Russian and Tajik units launched a counterattack against the insurgent forces, which had been "drawn

into" the firing bag, using Grad and Uragan MLRSs and 2S3 Akatsiya SPHs. Using a "helicopter carousel" technique which involved Mi-24 helicopters, the participants "destroyed" enemy manpower and armored vehicles using S-8 unguided aerial missiles.

The exercise was based on the Syrian experience and have tested new ways of using equipment and weapons.

UZBEKISTAN

On December 9 to 13, a joint training of Special Forces of the Central Military District and the Armed Forces of Uzbekistan was held at the Termez firing range in Uzbekistan, in order to exchange experience in carrying out special operations to destroy insurgent groups. During the exercise, the sides practiced joint actions to capture an insurgent leader, as well as to clean up a populated locality occupied by militants.

In the training, the special forces of the two countries passed a complex special tactical obstacle course, practiced throwing knives and blades, as well as sparring in hand-to-hand combat. In the active phase, the troops carried out a joint operation behind "enemy" lines. According to the plan of the exercise, the insurgents, having crossed the border, seized a populated locality. After a reconnaissance mission using a UAV, the soldiers carried out an amphibious landing from a Mi-8 helicopter. After the landing, the special forces "destroyed"

the guards, and the mortar crew opened targeted fire at the captured village. These “preparatory” actions enabled the main forces of the joint force, which arrived in Typhoon armored vehicles, to clear the buildings and capture the leader of the “group”. The operation ended with the mine clearing units surveying and clearing the freed village.

JAPAN

The January 20–21 exercise near the Arabian Sea is not the first Russian-Japanese exercise involving units of the Baltic Fleet and Japan Maritime Self-Defense Force (JMSDF) ships in the area. The Baltic Fleet unit was represented by the patrol ship ‘Yaroslav Mudry’, the tanker ‘Yelnya’ and the sea tug ‘Viktor Konetsky’, while Japan’s ISAF unit was represented by the destroyer ‘Harusame’ (春雨).

On the first day after the kick-off conference, Russian and Japanese ships conducted joint training on maneuvering and signal exchange, including in the dark time of the day. The program for the second day was more intense: sailors from the two countries performed an episode involving the release of a vessel hijacked by suspected pirates. After encircling the hijacked vessel, the ‘Yaroslav Mudry’ and ‘Harusame’ took up positions to provide fire support and suppress firing points, while the assault teams seized the vessel

and disarmed the remaining “pirates” on board. The episode was concluded with a joint inspection of the freed ship. During the exercise, the two sides also conducted small artillery and large-caliber machine gun firing at naval targets, while helicopters from Russian and Japanese ships’ deck aviation carried out cross-flights with landings on the decks of the ship ‘Yaroslav Mudry’ and the destroyer ‘Harusame’ respectively.

CONCLUSION

The COVID-19 pandemic has not only posed new challenges but also aggravated existing problems and controversies, including those in the field of international security. Therefore, a significant number of international engagements in the difficult context of the coronavirus pandemic demonstrates the genuine interest of the Russian defense authorities and relevant authorities in partner countries. As noted above, such interaction helps to build confidence and develops common approaches to international security.

It is important that in the planned exercises an initiative could take place – this provides an opportunity to find new forms and ways of using troops, taking into account the experience of contemporary armed conflicts and development of armed struggle means. In addition, testing of military hardware in the exercises enables significant improve-

ments, while testing new and using already proven weapons in international exercises give partner countries an opportunity to study them in practice and, probably, to become interested in acquiring them.

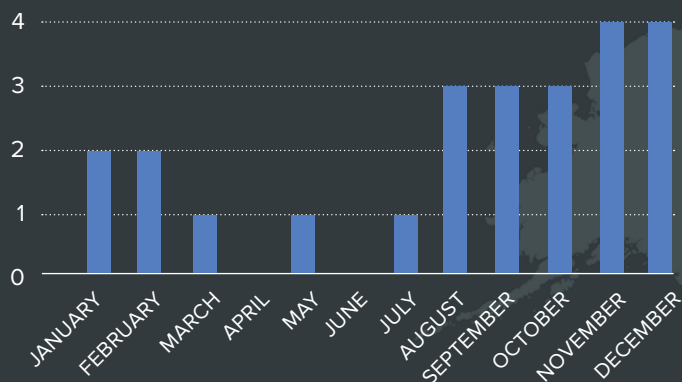
The international exercises of the Russian Armed Forces in 2020 were, as before, defensive in nature and not directed against third countries – most often, the conventional enemy was IFAs, terrorist groups, and pirate gangs. At the same time, Russia and her partners demonstrated openness and invited international observers, third-country defense representatives and military attachés to participate, and published information on exercises scenarios and numbers of participating servicemen and military equipment. Moreover, the Russian General Staff decided not to hold major military exercises near the borders of NATO member countries in 2020. The General Staff noted that this decision was aimed at continuing de-escalation of the situation in Europe and that in the future the Russian Armed Forces would be ready to adjust the exercise areas on a parity basis with NATO.

The combat training activity of the Russian Armed Forces in 2021 is expected to be no less than in 2020. A large number of bilateral and multilateral international activities are already planned and it is unlikely that the pandemic and its consequences will become a major obstacle to their implementation. ♦

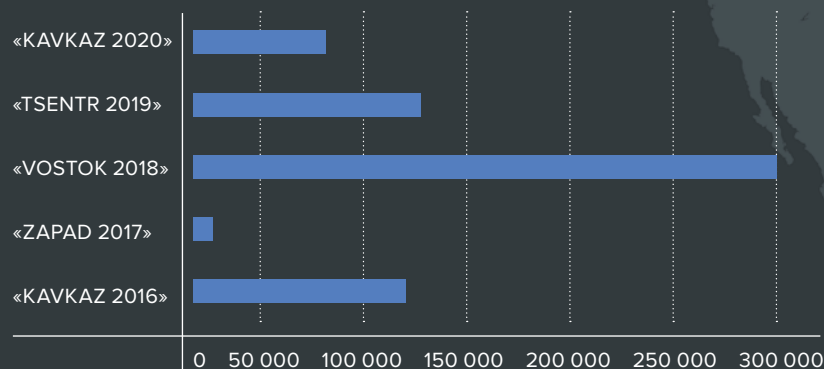


NUMBER OF EXERCISES CONDUCTED IN 2020

(REFERRED TO IN THE ARTICLE), BY MONTH

**TOTAL NUMBER OF PARTICIPANTS IN EXERCISES**

(PERSON)

**COUNTRIES THAT PARTICIPATED IN STRATEGIC COMMAND POST EXERCISES IN 2016–2020****2016** – RUSSIA**2017** – BELARUS, RUSSIA**2018** – CHINA, MONGOLIA, RUSSIA**2019** – INDIA, KAZAKHSTAN, KYRGYZSTAN, CHINA, PAKISTAN, RUSSIA, TAJIKISTAN, UZBEKISTAN**2020** – ABKHAZIA, ARMENIA, BELARUS, IRAN, CHINA, MYANMAR, PAKISTAN, RUSSIA, SOUTH OSSETIA**COUNTRIES THAT PARTICIPATED IN BILATERAL AND MULTILATERAL EXERCISES WITH RUSSIA IN 2020**

- ABKHAZIA
- BELARUS
- IRAN
- CHINA
- PAKISTAN
- UZBEKISTAN
- ALGERIA
- EGYPT
- KAZAKHSTAN
- MONGOLIA
- SYRIA
- SOUTH OSSETIA
- ARMENIA
- INDIA
- KYRGYZSTAN
- MYANMAR
- TAJIKISTAN
- JAPAN

RUSSIAN AND INTERNATIONAL EXERCISES OF THE RUSSIAN ARMED FORCES IN 2020

EXERCISE AREAS IN RUSSIA:

- ASHULUK (ASTRAKHAN REGION)
- KAPUSTIN YAR (ASTRAKHAN REGION)
- PRUDBOY (VOLGOGRAV REGION)
- ARZGIR (STAVROPOL TERRITORY)
- KOPAN (KRASNODAR TERRITORY)
- STRUGI KRASNYE (PSKOV REGION)
- ZAVELICHYE (PSKOV REGION)
- KISLOVO (LANDING SITE, PSKOV REGION)
- BURUNDI (BURYATIA)
- ARMAVIR (KRASNODAR TERRITORY)
- DYAGILEVO (RYAZAN REGION)
- ENGELS (SARATOV REGION)
- MOSCOW REGION
- WATER AREA OF THE BLACK AND CASPIAN SEAS

EXERCISE AREAS OUTSIDE RUSSIA:

- ALAGYAZ (ARMENIA)
- PAMBAK (ARMENIA)
- MILITARY BASE IN GYUMRI (ARMENIA)
- DZARTSEMI (SOUTH OSSETIA)
- TSEBELDA (ABKHAZIA)
- NAGVALU (ABKHAZIA)
- LOSVIDO (BELARUS)
- BRESTSKY (BELARUS)
- GOZHISKY (BELARUS)
- RYAZHENSKY (BELARUS)
- DOYTYM AN (MONGOLIA)
- TARBELA (PAKISTAN)
- PABBI (PAKISTAN)
- TARTUS (SYRIA)
- BANYAS (SYRIA)
- LYAOR (TAJIKISTAN)
- SAMBULI (TAJIKISTAN)
- KHABR-MAIDON (TAJIKISTAN)
- TERMEZ (UZBEKISTAN)
- THE ARABIAN SEA
- THE ANDAMAN SEA
- THE BAY OF BENGAL
- THE SEA OF JAPAN
- THE EAST CHINA SEA



UAV FUELS A FIGHTER IN THE AIR, FIRST TIME IN HISTORY / CBS NEWS

An unmanned aircraft successfully re-fueled a U.S. fighter jet in midair for the first time. A Navy F/A-18 Super Hornet and a Boeing-made drone were briefly connected by a hose as the drone transferred jet fuel to the aircraft in the skies over the Midwest during Friday's test flight. The test was conducted from Mid-America St. Louis Airport in Mascoutah, Illinois, and the Navy and Boeing said they plan to conduct tests on an aircraft carrier later this year.

The drone transferred 325 of the 500 pounds of fuel available during the approximately 4.5-hour test flight, Dave Bu-jold, Boeing's MQ-25 program director, said. "Unmanned systems alongside our traditional combatant force provide additional capability and capacity to give our warfighters the advantage needed to fight, win, and deter potential aggressors," said Captain Chad Reed, the program manager for the Navy's Unmanned Carrier Aviation program office. "The MQ-25 is that first step towards a future where the carrier-based fleet is augmented by unmanned systems." ♦



RUSSIAN MOD CREATES A DEPARTMENT TO WORK WITH ARTIFICIAL INTELLIGENCE / TASS

Russia's Defense Ministry will set up an Artificial Intelligence Department with its own budget by the end of this year, Mikhail Osyko, a member of the government's Military-Industrial Commission, revealed. "I can say that the Defense Ministry has made a decision to set up an Artificial Intelligence Department [...] All these measures should be completed by December 1 this year. Correspondingly, a customer for artificial intelligence will begin functioning in the Defense Ministry from next year," Osyko said at a conference on artificial intelligence being held as part of the International Industrial Forum in Sevastopol.

The Artificial Intelligence Department will have its own spending and deal with the tasks similar to the competencies of the Defense Ministry's Department for Advanced Inter-Discipline Research, he noted. "I believe that this will be a tremendous breakthrough we should take advantage of if we manage to launch this effort, carry out work and introduce results. The Defense Ministry will be a good engine in this process, especially from the viewpoint of practical application, something that is missing today," the expert added. ♦

US SECRETARY OF DEFENCE APPROVES JADC2 STRATEGY FOR FUTURE WARS / FEDSCOOP

U.S. Secretary of Defense Lloyd Austin has signed off on one of the biggest changes to how the military will fight future wars, approving the Joint All Domain Command and Control (JADC2) strategy that aims to fast-track the use of artificial intelligence and data sharing on the battlefield.

The strategy defines how the military services will approach connecting sensors in the air, land, sea, space, and cyberspace and use a networked approach to operations. Secretary Lloyd Austin signing the JADC2 strategy marks the beginning of implementing much of the nascent work the military has started, from testing new technologies and developing new concept of operations to use them.

JADC2 is intended to give the U.S. a greater military advantage by allowing for data sharing through a global, resilient network. Advocates of the new concept say that if a fighter jet can automatically share data with a soldier on the ground, the two units can coordinate more easily. Within the JADC2 framework, each military service has its own project. The Army has Project Convergence and the Air Force has the Advanced Battle Management System (ABMS). ♦



NEW NANO TECH TO MAKE MILITARY EQUIPMENT LIGHTER & STRONGER / FINANCIAL EXPRESS

Darwin Platform Group of Companies plans to provide army personnel with jackets, arms, and equipment based on molecular nano technology. An Indian Army soldier has to carry his bulletproof vest (3 kg), weapon (4 kg), ammunition (10 kg), resources like water (3 kg) and other protective wear – that's at least 20 kg – to perform his duty. Needless to say, this reduces their performance and can put them in danger. Military jackets based on molecular nano technology (MNT) are much lighter and have the same or more strength.

MNT is a scientific advancement where duplicates are created which are smaller, more functional, lighter and cheaper than the original copy. This type of technology can have major military applications.

To equip Indian defense with new-age military equipment, DPGC recently showcased the prototypes of indigenously designed and developed military equipment based on MNT. DPGC partnered with the Robotics Lab at Woxsen University, Hyderabad, for designing and developing these prototypes.

Under the project, the DPGC plans to provide three MNT-based equipment – military jackets, arms and ammunition & laser-guided munition and shields against laser guided bombs – to the Indian forces. ♦

EKATERINA SOLNTSEVA,
DIRECTOR FOR
DIGITALIZATION
AT ROSATOM

Today, it has become a pressing matter to ensure Russia's technological independence in the digital sphere, hence the need is growing to acquire effective solutions that could be used for the entire country

ELON MUSK,
TESLA CHIEF
EXECUTIVE

I think we should be very careful about artificial intelligence. If I were to guess like what our biggest existential threat is, it's probably that. [...] With artificial intelligence we are summoning the demon

RICHARD ABOULAFIA,
VICE-PRESIDENT OF
ANALYSIS AT TEAL GROUP

The Russians have always been clear that they're really good when it comes to building a high-end jet. They're never going to say, "You need to ask to use the keys before using [the] jet." They say, "We will always support you"



'OSTROTA': RUSSIA'S NEW HYPERSONIC MISSILE / IZVESTIA

Russia is preparing to start testing its new hypersonic missile 'Ostrota' for bombers in 2022. According to sources, aircraft armed with the new small-sized hypersonic missile will become part of the Russian non-nuclear deterrent force. The new missile will be used by long-range bombers Tu-22M3 and operational-tactical Su-34, according to sources in the defense department. The start of flight tests of the ammunition, which does not yet have an official designation, is scheduled for 2022. A ramjet engine, developed by PJSC Turaevo Machine-building Design Bureau "Soyuz", known as "article 71" has been developed specifically for the new super-high-speed rocket.

In February of this year, Defense Minister Sergei Shoigu said that it is the hypersonic systems of various bases that will be the basis of the Russian non-nuclear deterrent forces. The Minister held a meeting on additional purchases of such weapons, as well as long-range precision missiles. There was information earlier that the 'Gremlin' long-range hypersonic missile has also been developed for Tu-22M3 bombers, the tests of which should be completed in 2023. 'Ostrota' will have a shorter range compared to it. ♦



NATO'S PROPOSES NEW TECH INNOVATION CENTER / FINANCIAL TIMES

NATO is proposing a new tech innovation center bringing together military personnel with industry to foster digital defense start-ups. Some of these might be financed by a separate initiative, also set to be debated: a venture capital fund for innovation which member states could choose to opt in to.

The efforts are belated, as NATO Secretary-General Jens Stoltenberg himself acknowledged. "For decades, NATO allies have been leading when it comes to technology, but that's not obvious any more," he told the Financial Times in an interview.

Part of the problem is that western defense institutions have been slow to recognize the potential of innovation beyond their own industry.

"For decades, a lot of technological development would happen within the defense sector – the internet, nuclear, GPS, all of that was developed by the defense industry and then shared with the civilian sector," Stoltenberg said. "Now, it goes the other way around. It's a civilian sector which is leading in the development of artificial intelligence, quantum computing, and many of the new disruptive technologies." ♦



The 'Tactical Missiles Corporation' JSC – KTRV is an acknowledged world leader in the development and production of high-precision weapons and one of the 50 largest defense companies in the world. The Corporation comprises four dozen enterprises of Russian defense industry. Priority areas of the 'Tactical Missiles Corporation' are development, production, and modernization of tactical high-precision air-launched systems of various classes, unified seabornе weapon systems, rocket and space equipment, radio-electronic equipment, as well as high-tech dual-use products for various industries.



Boris V. Obnosov, Director General of KTRV

BORIS OBNOSOV: HYPERSONICS IS AN IMPETUS FOR SCIENCE AND TECHNOLOGY DEVELOPMENT

The 'Tactical Missiles Corporation' (KTRV) is one of the leading companies of Russia's military-industrial complex and a world leader in the development and production of high-precision weapons. Boris Obnosov, Director General of KTRV, talked to the 'New Defence Order. Strategy' journal about development of hypersonic technology, international cooperation, and export of KTRV's products.

Interviewed by Olesya Zagorskaya & Reem Mohamed

The meeting with the Head of the Corporation took place on the sidelines of the International Maritime Defense Show IMDS-2021 which was held in St. Petersburg on June 23–27, 2021.

– Mr. Obnosov, in the 1990s you worked with the Russian Ministry of Foreign Affairs as a security and disarmament adviser. In the light of this experience, how do you assess the current situation in the field of arms control and international security?

– As President Vladimir Putin has stated before, the process of normal negotiations needs to be restored, because when there are no adequate agreements that would regulate the rules of behavior for the superpowers, the situation becomes very sad. I believe that the recent meeting [of Russian President Vladimir Putin] with U.S. President Joe Biden in Geneva would at least give impetus to the restoration of confidence-building measures.

I happened to participate in the Vienna talks on transforming the CSCE into an

organization – the OSCE, and in the preparation for the Treaty on Open Skies (OST), and the Treaty on Conventional Armed Forces in Europe (CFE). There were many ongoing negotiations at that time, and there was a high level of trust and understanding. I would like the atmosphere that existed back then to be revived.

– In your opinion, is there ever going to be a separate treaty for hypersonic weapons? How could this area develop in the future?



– Hypersonic and supersonic technologies are very fashionable topics nowadays. Hypersonic weapons are the result of the development of human thought. They have an impact not so much on defense as on development of all areas of science and technology. If there were no hypersonic weapons, a hypersonic airplane would appear. Perhaps, hypersonic weapons are only the first stage, and in the future, we will witness creation of some other technology. Not that I would like to compare the case here with the atomic bomb, but remember that development of atomic energy began with a bomb, and today it would be difficult for many countries to ensure normal life without nuclear power plants.

Everything related to hypersonic technology requires development of all branches of science and technology – from materials science and engineering to mathematical and semi-realistic simulation. Many processes that occur during a hypersonic flight will not be fully investigated until we, as they say, feel them at our fingertips; only then will we start to understand them. We simply have not fully explored them yet. For example, at speeds over 6-7 Mach plasma is formed, the question here is: How will control systems work in a long-term flight under these conditions? It is not easy to fly out of the atmosphere and then return into it. It is yet more difficult to carry out a constant hypersonic flight in the atmosphere when it is necessary to maneuver and not make “jumps.” There is an entire array of issues to deal with here –

the engine, fuel, control systems, materials, etc. This is what gives impetus for development of science and technology.

– Do you see a potential for establishing a Center for Hypersonic Technology in the KTRV – something similar to centers of excellence that are being organized today in different enterprises?

– Of course, being a missile corporation we think in this direction but there is no specific decisions yet. We have many highly qualified specialists to carry out such a project, but this is too early to talk about now.

– What do you think is the most promising deployment for hypersonic missiles?

– A hypersonic missile is universal of course, which means that it can be launched from various platforms, such as mobile ground launches, ships, submarines, and aircraft. Air, land or sea deployment should not be considered separately. It all depends on what is being developed and what tasks are set.

– Which of KTRV's products are in high demand in the global market? How would you assess the possibility of exporting hypersonic weapons in the future?

– As you have seen, our stand at the IMDS has a large collection of products,

and there is not a single hypersonic missile there. Nevertheless, we have received good orders for presented samples. Trust me when I say that the outcome of future conflicts in case they – God forbid! – arise, will not be decided by hypersonic weapons. Priority will be given to control systems and situational awareness systems. The most important thing is information; it is important to know where to concentrate efforts and where to transfer and deploy forces.

Moreover, hypersonic weapons are not cheap. Therefore, to say that they will replace everything that exists today is an overstatement; it will take centuries before this happens, and by then there might be new principles for the weapons operation and new ideas will have appeared. Therefore, all the samples that we have presented [at IMDS] and will present at MAKS in July have great export potential.

– Weapons purchases should be justified, first of all, by expedience, and not by political motives or “fashion” trends. What's your comment on this?

– Of course! The cost-effectiveness criterion is essential and should be taken into consideration in any purchase. Without this criterion, one would simply buy a weapon system just for the sake of buying it and because one can afford it. But such a system would not solve any tasks in a real combat. Thus, the starting point should be to pinpoint the



tasks facing the armed forces of the involved country.

More important, we are fully aware of all international treaties and agreements that regulate the proliferation of a particular type of weapons. Russia abides by all these treaties in the strictest manner and is keen on fulfilling them with the greatest responsibility. We have repeatedly witnessed gross violations of these international agreements over the past decades, but, for some reason, only we are being blamed for their collapse. I am sure that Russia is meeting its obligations and is doing everything by the book. This is my personal belief.

– Regarding international cooperation, what projects are you developing?

– We are working on several international projects. And, as I always like to say, the perfect example of international cooperation is the BrahMos Joint Venture with India. This

is a case when both parties see an interest in a common cause, where there is no infringement of any rights and the ultimate goal is visible for both parties. Such projects are carried out so that both countries can benefit in terms of both security and defense and, perhaps in the future, in terms of financial gains when these products would be delivered to third countries.

– Are you considering similar cooperation with other countries?

– Such projects should be considered individually based on each case, there is no common answers here. It is necessary to study what kind of cooperation is proposed and how this might affect the future, and so on.

– You spoke about the importance of mathematical modeling in the development of new types of weapons, and recently KTRV hosted a meeting of the Military-Industrial Commission

where this idea has been discussed. Could you expand on that?

– It is very expensive to carry out all tests on full-scale samples. Digital Twins and modeling – everyone is talking about this today, but we are trying to translate words into deeds. We have come a long way – if we recall the Soviet times, there were not just dozens, but hundreds of full-scale samples for each type of a weapon. It was exorbitantly expensive to test weapons. Nowadays, weapons themselves are much more expensive, because they are based on different principles and therefore require completely different capital investments.

Getting to flight tests by means of mathematical and semi-realistic modeling in order to get a more reliable result is a very crucial task. But the main criterion is still carrying out full-scale tests, though it is necessary to reduce them to the minimum. ♦

HELD UNDER THE PATRONAGE OF HIS EXCELLENCY, PRESIDENT ABDEL FATTAH EL-SISI
THE PRESIDENT OF THE ARAB REPUBLIC OF EGYPT, THE SUPREME COMMANDER OF THE EGYPTIAN ARMED FORCES



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EKATERINA SOLNTSEVA: AT ROSATOM WE BELIEVE THAT DIGITALIZATION TAKES A LIFELONG COMMITMENT TO STAY ON TOP OF THINGS

ROSATOM not only leads digitalization in Russia, it is also a competence center for the Digital Technologies federal project, which is part of the Digital Economy of the Russian Federation national program. The scale of the tasks facing State Atomic Energy Corporation ROSATOM is impressive: digitizing the nuclear industry and other sectors of Russia's economy and launching in-house digital products into the open market. The "New Defence Order. Strategy" journal talked to Director for Digitalization at ROSATOM, Ekaterina Solntseva, who gave an insider's view into how these tasks are being handled.

Interviewed by Olesya Zagorskaya

– ROSATOM is a leader of digitalization in Russia and a center of competence of the Digital Technologies federal project that is included in the Digital Economy of the Russian Federation national program. How does it come about that the nuclear industry has had the possibility to create its own digital products? And what were the prerequisites for that?

– The national nuclear industry began in Russia's nuclear weapons complex, whose task was to create a second, deterring center of power in the world. For this reason, from the very beginning of its existence Russia's nuclear industry was able to rely on the results of its own R&D, even in the domain of information technology. We must never, under any circumstances, depend on external factors, such as political ones. That is why many ROSATOM enterprises would develop necessary digital products on their own. Of course, they were not called "digital" at that time, and computers back then were different from the ones we have today. This expertise has been building up since the middle of the past century.

Today, it has become a pressing matter to ensure Russia's technological independence in the digital sphere, hence the need

is growing to acquire effective solutions that could be used for the entire country. In this regard, ROSATOM has been able to offer many developments that can be used as the basis for universal solutions.

– Why is it that these universal solutions could not be found, say, in the IT market?

– The IT market is largely focused on regular corporate processes that are the same for any organization: there is always accounting, document flow, and human resources. Products for solving tasks in these areas naturally appeared in the market because IT companies understood the function of this or that product and could test it themselves.

Nonetheless, in order to create, for instance, a mathematical modelling software for industrial purposes, one needs to understand how engineering developments are implemented in practice. You need a production facility to be able to test the product in the making during the manufacturing process. Obviously, IT companies do not enjoy these advantages.

The nuclear industry enterprises that developed their own digital products, as a rule, had no intention to launch them into

the market. However, three years ago, ROSATOM set itself the task of doing so. We have state-of-the-art digital solutions for industrial purposes, and we are committed to making these solutions available to other businesses. And not only in Russia but also abroad.

– Digitalization is a broad multi-industry concept. How do you categorize digitalization projects at ROSATOM?

– Our fundamental document in the area of digital transformation and digitalization, the Uniform Digitalization Strategy, consists of several large sections. In the area of internal digitalization, we are working on enhancing the efficiency of the Corporation's activities. The broader task is to create commercial digital products for the open market. The most ambitious goal is to support the digitalization in the Russian Federation. In this case, our audience is the entire country and the government agencies that develop the digital economy. And finally, another key area of the strategy is the development of end-to-end digital technologies that will serve as the foundation for achieving all the set tasks. Furthermore, the strategy includes a number of supporting areas: the development of digital culture and digital competence in ROSATOM, organizational changes as



Ekaterina Solntseva, Director for Digitalization at ROSATOM

part of digital transformation, the pursue of partnering relationships with other market players and, of course, ensuring information security – that topic charges all areas of our work.

– You have said that all these elements are included in ROSATOM's Uniform Digitalization Strategy. To date, there are four revisions of this document. How is the fourth revision different from the previous ones and what has brought about these changes?

– The digital market is evolving and changing very quickly. New areas are emerging all the time. For instance, when we developed our Uniform Digitalization Strategy in 2018, it did not occur to us at all that we would be responsible for creating a quantum computer in Russia. The subject of developing a quantum computer was on the table, of course, but it was treated more like a science-related problem that was still far from implementation. Nonetheless, today we can already see the horizon of the transition to practical application of the newly created quantum computer.

Our strategy also suggests working together with the government on developing the country's digital economy. Changes are also underway in this area, and new

approaches are emerging. Thus, updating ROSATOM's Uniform Digitalization Strategy is our response to the changing environment. What is more important is that we analyze our own experience, learn from it and make adjustments to optimize our future work.

– How has the COVID-19 pandemic affected the digitalization processes at ROSATOM? Will this impact be reflected in the following revisions of the Uniform Digitalization Strategy?

– The pandemic has significantly affected our activities. The main outcome is that we were quick to find and assimilate the new approaches that could bolster the efficiency of our regular activities. Mastering these approaches would take much more time and resources in normal conditions. For example, remote meetings with the representatives of nuclear industry enterprises from all over the country have become a part of our everyday life. Such a format had been used previously but rather as an exception. Now, it is a common practice.

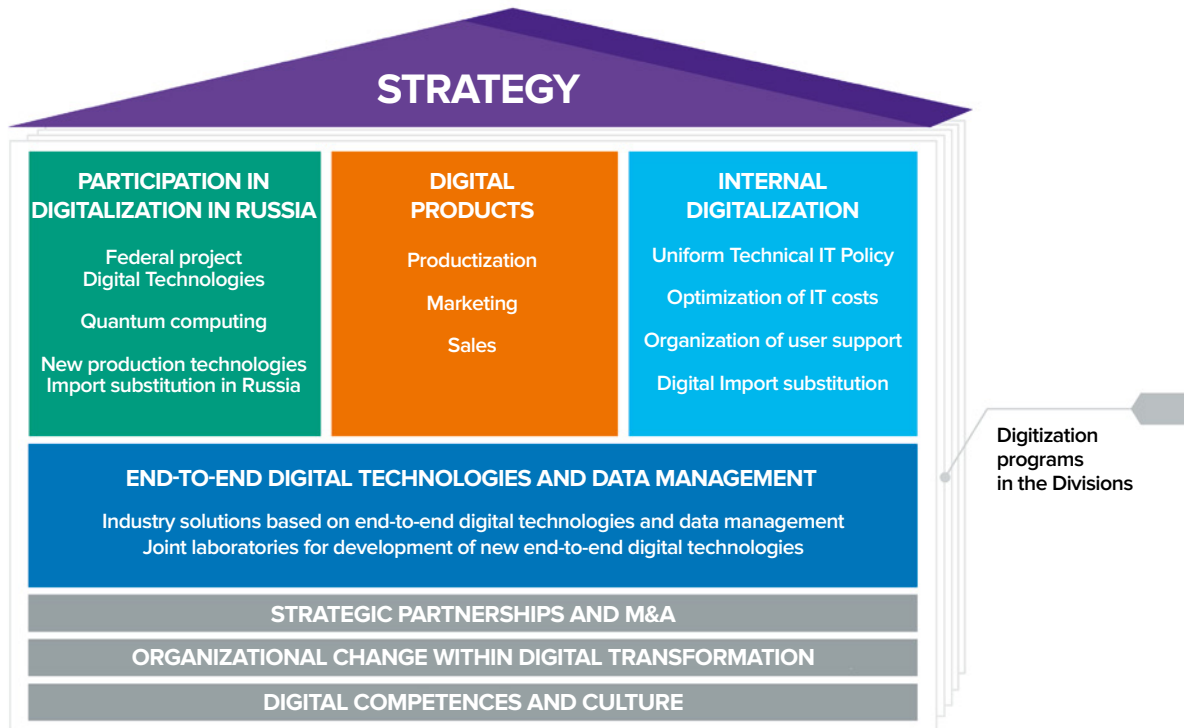
During the pandemic, both our employees and our management have come to appreciate the benefits of new technologies, such as the potential of virtual and aug-

mented reality. Now, we hold exhibitions and meetings not just online, but in virtual reality. Although this is not that critical for meetings, it is crucial for exhibitions. For instance, it is possible to place interactive stands that you can “visit” in a virtual space. Exhibition participants can move in the virtual space using digital avatars and communicate with one another just like in real life but safely and conveniently.

Also, amid the pandemic we have noticed a considerable increase in the interest of many Russian IT companies to cooperate with us. During the times of instability, businesses want large and, above all, stable, experienced and steadfast partners, and ROSATOM is certainly one of them. We welcome such partnerships. This kind of interaction gives us, for example, an opportunity to access promising developments that startups work on. In this way, we can resort to the experience and competencies of our partners to find solutions in certain areas, rather than make them ourselves from scratch.

New tools, technological developments, and new partnerships have been mentioned in the updated Uniform Digitalization Strategy 4.0 that was approved in December 2020. Notably, strategic partnerships have been designated as a separate area.

UNIFORM DIGITALIZATION STRATEGY 4.0



– You have said that one of ROSATOM’s areas of activity is the development of digital products for the commercial market, including the global one. It has been reported that a number of countries – in particular, India, Vietnam, and Egypt – are interested in establishing Data Centers within their borders.

– Yes, indeed, we are discussing such projects in these countries. Additionally, we are building up cooperation on data centers with Turkey and Uzbekistan. Foreign partners are interested in ROSATOM’s infrastructure solutions because we have already accumulated solid expertise in the construction and operation of data centers. Our flagship data center, the largest in Russia and one of the largest in Europe, operates near the Kalinin Nuclear Power Plant (NPP) in Tver Region, about 200 kilometers northwest of Moscow.

Many companies can now build a data center as a capital construction object. However, personnel, the availability and price of electricity, reliability, and a robust service system are much more important in digital infrastructure. This is where our advantage lies.

Rosenergoatom, which has very strong competencies relating to the operation of complex technological facilities, operates

our actively growing and geographically distributed network of data centers. We build backbone data centers near NPPs because it guarantees cheaper access to the most reliable energy resources.

It is important that data centers are located close enough to the users. Hydro-electric power plants are not always built at accessible locations. Meanwhile, for example, our Kalinin data center is conveniently situated between Moscow and St. Petersburg, at the crossroads of multiple communication channels, and has an uninterrupted power supply. This is the model that we offer to those countries where ROSATOM is either already building, or just starting to build NPPs.

– In one of your speeches you have mentioned that the countries that ROSATOM cooperates with to construct NPPs request documentation in digitized form. Is this a common practice?

– So far, it has been the case with some contracts, but it will soon become a common practice. Here we are not only talking about digitized documentation, but also about a digital deliverable where the customer receives a full-fledged 3D NPP model and can study the NPP as a whole or its individual elements, and simulate the construction process.

– Is it correct to say that in this case the “digital model” and “digital twin” concepts are not interchangeable?

– Correct. A digital model is not a digital twin yet, since it is not linked to the operation of a physical object in real time. A digital twin, on the other hand, “lives” and changes simultaneously with the object, has all the same data, and allows tracking technical characteristics.

– It is planned to use the Nuclear Power Plant Operation Template for Russia-designed NPPs in Russia and abroad. Could you elaborate?

– The NPP Operation Template is the next step after the digital model. NPP commissioning involves transfer of the operation template, which fixes the operation rules for that complex object. This tool allows the direct users of the NPP to quickly grasp the operation process and always have tips on what to do at any given time.

– The digital products created at ROSATOM can be used at other industrial enterprises, including those within the defense industry. Which Russian companies have already adopted ROSATOM’s products?

– Up till now, ROSATOM has launched eleven digital products into the market.

Our mathematical modelling system Logos has been quite popular among defense industry enterprises – they use it in designing high-tech products. Among our clients who chose Logos are defense industry leaders such as Sukhoi, KAMAZ, Russian Helicopters and ROSCOSMOS.

Evidently, each enterprise faces specific issues. For this reason, our specialists cooperate with the representatives of our customers and adapt the product to their particular needs and tasks. It is of utmost importance that our software product Logos can be integrated with other Russia-made systems. Our goal is to unite other CAE developers around ROSATOM: by integrating our efforts, we will be able to create a platform with which we can enter the international market.

Moreover, together with the enterprises of the defense industry we are launching a large program aimed at ensuring the country's digital sovereignty in the field of mathematical modelling systems. This program was presented to Deputy Prime Minister Dmitry Chernyshenko in April.

– The requirement to ensure technological independence makes the import substitution program all the more relevant. What are the barriers – be they technological or legal – that stand in the way of rolling out and deploying digital products in industrial enterprises?

– As a matter of fact, such barriers do exist. From the technological viewpoint, everything seems quite clear: any product developed at ROSATOM, for instance, Logos, needs to be adapted to the specific needs of the enterprise where it will be deployed. At the same time, as you deploy a product at different enterprises, it gains more adaptation capabilities, and hence it takes less effort to follow through each subsequent deployment. That is to say that, from the technological viewpoint, the answer to the task of the digital import substitution implies serious product reworking. This is a natural process. Yes, it does require resources, but we are prepared for it.

The second issue is an organizational, legal one. Russian legislation contains some inconsistencies. On the one hand, there are rather strict regulations on the use of Russian hardware and software. On the other hand, state-owned companies and companies partially owned by the state have to follow a requirement for the efficient use of public funds. This means that if they already have a foreign solution, they cannot buy a similar Russian one and

install it alongside with the first solution. First, they need to remove the imported product from the balance sheet in accordance with all the rules and only then install the domestic one.

Now, let's keep in mind that the Russian product still needs to be customized and deployed. When it comes to software for complex design developments, it must pass verification and validation that may take as long as one to three years. And the software cannot be used until that process is complete.

Here we have the following situation: we need to install a Russian software product at our enterprises as quickly as possible and start its verification, but if the enterprise already uses a similar foreign product, cross-verification must be done with that product. And if we are talking about new calculations, then full-scale testing and comparison of their results are required. All this takes time, and the enterprise or design bureau needs to keep working! And they cannot just give up the foreign software; they need to use two software products in parallel.

Today, our law does not allow government agencies to do this for it is regarded as an inefficient use of public funds. So, this is one of the conflicts that we need to resolve first. We brought this problem to the attention of the government and we hope that it will be resolved.

– To what extent does the success of digitalization depend on government support? What existing state support policies do you think are optimal?

– Digitalization is inevitable. The success of digitalization is the speed of its implementation. And this speed depends to a large degree on state support. The implementation of the national program Digital Economy, for which the Ministry for Digital Development is responsible, is already in full swing. Considerable funds are allocated for the program, and it is very important that these funds are used for the development of both existing and promising technologies. For example, the government subsidies play a key role in the development of quantum computers. ROSATOM invests its own resources in the creation of a domestic quantum computer. It would be impossible to organize this process without government support. This work would not have reached such a serious scale without it.

Besides that, the subsidies are allocated to the enterprises that implement Russian solutions. And these are significant

expenses, a lot of resources are required, and not all enterprises can afford it. In this case, subsidies as well as targeted and preferential loans considerably simplify and accelerate the digital import substitution. Without government support, the same work would be done much later.

However, government support is not only about money. It is important that the state also pays attention to streamlining processes and eliminating existing barriers, including regulatory ones. Personal attention of the leaders of the country to these matters is also very valuable. Minister of Digital Development Maksut Shadayev and his deputies are quite interested in the implementation of the Digital Economy program. Deputy Prime Minister Dmitry Chernyshenko, who is in charge of this area, is also deeply concerned with digitalization problems.

All this – the integrated approach, the financial resources, and the personal involvement of the leadership – gives ground for justified optimism regarding the digitalization of the country.

– Besides the evident advantages, digitalization also bears certain risks. What threats, especially in the area of security, do you see in the very process of digital transition?

– Any process brings risks with it if treated carelessly. You can even organize the cleaning of a room in such a way that everything in it will be ruined. Therefore, we must approach digitalization seriously, thinking the potential risks over in advance.

In general, I believe that digitalization considerably enhances security. It does not replace human work but adds to it; automation insures the human resources and the human resources insure information systems through monitoring. This mutual control is precisely what guarantees heightened security.

– How are requirements changing for the personnel involved in the digitalization process? How is this reflected in the activities of the ROSATOM Academy and ROSATOM-associated universities?

– Human resources are the most important aspect. We fully understand that digitalization is something to pursue throughout life, it needs to be done constantly, it is an ongoing process.

At ROSATOM, we work with human resources in two areas. The first one is de-

veloping the digital competences of our own staff. The ROSATOM Academy and the digital block of the corporation are responsible for this. Our specialists have designed special training programs. Some of them we deliver ourselves, and for others we invite external lecturers. In terms of the education format, they can be seminars or full-fledged courses ending with an exam and a certificate awarded.

The second area is the cooperation with the ROSATOM-associated universities. This includes training specialists for the nuclear industry, creating startups at the university level, and running projects where talented students can approve themselves. Students can learn by using prototypes and simulators under realistic conditions.

– What does ROSATOM do to organize and support in its search for “digital talents”?

– We are often invited to be partners of various contests and hackathons. The largest of them is Digital Breakthrough, we have been general partners to that event for three years. During this time, we have attracted a lot of talented young people, sometimes entire teams, and offered them interesting jobs.

In a number of areas, we act as partners of Skolkovo and other development institutions and foundations. We also have our own venture fund focused on digital startups.

More than that, enterprises of the nuclear industry, operating in various regions of the country, organize hackathons and contests, and provide platforms for startup development – if such a format of cooperation is acceptable from the security point of view.

– ROSATOM has a strategic goal to develop a 100-qubit quantum computer by 2024. Do you think that this goal is attainable? What has already been done to achieve it?

– We do believe that this goal is attainable. The implementation of the roadmap for the development of the high-tech area of Quantum Computing began in 2020; we pitched it in July and received the funds in December. However, we at ROSATOM had already known that we would be going after this goal. Therefore, the Corporation, ahead of schedule, at the beginning of the last year, allocated funds that were spent on the purchase of the most necessary equipment and the launch of the first projects.



Ekaterina Sointseva,
Director for Digitalization at ROSATOM

When we just started with the roadmap, 2-qubit systems had been designed in the country. This year, we are planning to present 4-qubit systems. And yes, our plan is to have a 100-qubit computer built in Russia by 2024.

– What will be the base technology for this computer? There is a talk about photons, ions, superconductors...

– It is still unclear which physical principle the computer will be designed on. There are four main platforms – superconductors, ions, neutral atoms, and photons. However, at the present time, in the whole world there is still no answer to which technology will be the leading one and whether such a leading technology can be determined in principle. It is possible that specific problems will be most efficiently solved on different platforms. For this reason, we are working in four major areas, while at the same time we are closely watching the potential of promising platforms – thanks to the quite deep integration of ROSATOM in the international quantum community.

Simultaneously, we are creating a software stack for working with quantum algorithms, and by 2024 we should have the complete set of hardware and software. This is, strictly speaking, what the concept of “quantum computer” includes.

– Speaking of future projects – let’s talk about the development of the Arctic. In 2019, ROSATOM initiated the Northern

Sea Transport Corridor project that aims at creating a new international route offering logistic services for cargo delivery via the Northern Sea Route (NSR). What projects is ROSATOM implementing for the digitalization of the NSR?

– The Arctic is a system with a unique potential, and ROSATOM plays a very important role in its development. Murmansk is a center of presence of the Corporation in the region, the city is the base for the nuclear icebreaker fleet. It is in Murmansk that the Headquarters of Naval Operations was established. This is an important control center for the NSR that allows for tracking vessel traffic, monitoring meteorological and ice conditions, and maintaining continuous communication with the crews. Besides, this system is integrated with the infrastructure of the Ministry of Emergency Situations for quick response to urgent situations.

At the same time, there is an understanding today that the Arctic requires a special approach that must be based on the integrated development of the region. And this is where our Smart City platform, which was designed for “atomic towns,” have already demonstrated its potential. When creating tools for urban and territorial management, we rely on our own experience, since ROSATOM bears full responsibility for everything that happens in “atomic towns.” These developments are already in use in many Russian cities, in particular, in Murmansk. And of course, they must be leveraged in the development of the Arctic regions along the entire NSR.

– ROSATOM has traditionally been an active participant in Russian national and international exhibitions. What solutions will ROSATOM present at the International Military-Technical Forum ARMY-2021?

– Traditionally, we introduce our software and hardware solutions for the defense industry at MAKS and ARMY. Thus, ROSATOM’s portfolio of digital products includes a mobile supercomputer data center mounted on the KAMAZ off-road undercarriage that can find way to any location, for example, a natural disaster zone or a future construction site, and provide full-range data processing literally “on the wheels.”

Active participation in defense industry events is one of our digital strategy priorities. We are always glad to join in new partnership projects! ♦

PILOT ACCESS CONTROL SYSTEM

The PILOT Access Control System is used for public events and secured facilities. A ROSATOM digital solution with an impressive history, it is a greatly appreciated and successful product that proved to be effective during international large-scale sports events, such as the 2017 FIFA Confederations Cup, the 2018 FIFA World Cup, and the 2019 Winter Universiade in Krasnoyarsk.



PILOT is designed to provide security at highly occupied facilities, including not only sports arenas, but also metro systems, airports, train stations, business centers, museums, exhibition venues, recreation sites and parks.

PILOT's unique feature is the ability to integrate multiple geographically dispersed facilities into one access control system providing support for about a million users in real time. During the 2018 FIFA World Cup, PILOT united twelve large sports stadiums in eleven Russian cities.

The system ensures security monitoring as much as it implements comfortable conditions for visitors at highly attended events and secured facilities. The system determines each visitor's right to access the controlled area using all known detection technologies, including biometric facial recognition. It registers entrance and exit activity, monitors the occupancy

rate of the facility and provides data exchange with external systems.

PILOT has a high capacity of 450 persons per hour for one entrance gate, and it can handle more than one million requests simultaneously.

PILOT fully complies with ISO/IEC 15408 and the Russian standards in the field of information security. It is important that this product has an embedded solution for protecting information from unauthorized disclosure, modification or loss.

In a contingent situation, the system is able to operate in a self-sustained offline mode using locally stored white and black lists, and to memorize more than 10,000 events. PILOT can be easily integrated with fire protection solutions, and the Anti-Panic option immediately unblocks all turnstiles at the entrance gates in emergency situations. ♦

THE ARCTIC AND RUSSIA'S NUCLEAR-POWERED ICEBREAKERS



“Russian power will augment with Siberia and the Northern Ocean...”

*Mikhail Lomonosov,
Russian Scientist, 18th century*

Russian transpolar territories are a strategic maritime artery connecting Europe and Asia, a vital route to the northern cities, and a reservoir of treasures both already discovered and only predicted by geologists.

Author **Dmitry Boltentkov**

It is a front ready to counter strategic bombers flying across the Pole or missiles launched from the waters of the Arctic Ocean.

Large industrial enterprises operate beyond the Arctic Circle, the Norilsk Nickel mining company alone making for 2% of the country's total GDP.

All factors, history, economics, geography, and politics, call for Russia's permanent presence in the waters of the Arctic Ocean.

LENIN VS. STALIN

Russia's icebreaker fleet has a century-long history. The key milestone in its development was the emergence of nuclear marine propulsion technology. The 'Lenin' nuclear-powered icebreaker was four times more powerful than the then strongest Soviet icebreaker, 'Joseph Stalin'. Thanks to the 'Lenin' icebreaker, the navigation time in the western region of the Arctic (between Murmansk and the Yenisey River) has been increased from three to eleven months. The Soviet Union went on to build six large Arktika class nuclear-powered icebreakers; the last of which, '50 Let Pobedy' (50 Years of

Victory), was commissioned in this century. Two more icebreakers were a joint project between the USSR and Finland.

The third millennium started with the implementation of major oil and gas production projects in the Yamal Peninsula, the Gulf of Ob, and in adjacent territories. Currently, Russia is planning to develop the Arctic Ocean shelf. In the meantime, service life of the Soviet nuclear-powered icebreakers is running out. They are being replaced by the next generation icebreakers: Project 22220 LK-60Ya (60 MW icebreakers with a nuclear propulsion plant).

Nuclear civilian ships (including Russia's "Sevmorput" LASH carrier) and their support vessels are managed by the Federal State Unitary Enterprise (FSUE) Atomflot. FSUE is part of State Atomic Energy Corporation Rosatom with its headquarters located in Murmansk; along with berthing facilities there are floating docks for icebreakers repair. The National Guard Naval Service Corps (a branch of the National Guard of Russia Rosgvardia) is in charge of the home base security.

Nuclear-powered icebreakers of the new generation are being built in St. Petersburg, at the Baltic Shipyard, part of the United Shipbuilding Corporation (USC).

THE STATE OF ATOMFLOT VESSELS

Only two icebreakers of the Soviet Project 10521 are still operational; the aforementioned '50 Let Pobedy' and 'Yamal'. Despite the fact that the icebreakers belong to one project, they have different icebreaking capabilities due to peculiarities of hull design.

'YAMAL' ICEBREAKER

- laid down at the Baltic Shipyard in 1986
- Launched on October 4, 1989
- Commissioned on October 27, 1992

Specification:

- Full displacement 23,460 tons
- Length 148 meters
- Width 30 meters
- Draft 11 meters
- Power 55 MW
- Capable of breaking through ice up to 2.25 meters

Table 1.

PROJECT 2220 ICEBREAKERS

NAME	LAUNCHED	SET AFLOAT	COMMISSIONED	CURRENT READINESS, %, AND STATUS
'ARKTIKA'	5 Nov 2013	16 June 2016	21 Oct 2020	IN OPERATION
'SIBIR'	26 May 2015	22 Sept 2017	31 Aug 2021	88, UNDER TESTING
'URAL'	25 July 2016	25 May 2019	30 Sep 2022	68, PREPARING TO MOORING TESTS
'YAKUTIA'	26 May 2020	November 2022	20 Dec 2025	15
'CHUKOTKA'	16 Dec 2020	May-June 2024	20 Dec 2026	0.98

'50 LET POBEDY' ICEBREAKER

- Laid down at the Baltic Shipyard in 1989
- Launched on December 29, 1993
- Commissioned on March 23, 2007

Specification:

- Full displacement 25,840 tons
- Length 160 meters
- Width 30 meters
- Draft 11 meters
- Power 55 MW

In the 1990s, building process of the icebreaker was suspended due to economic disturbances at that time. In 2003 construction was recommenced. The design of the bow of the '50 Let Pobedy' was modified, hence it has got better icebreaking capability than that of 'Yamal'.

Atomflot's fleet also includes two icebreakers built in Finland and additionally equipped at the Baltic Shipyard. These are Project 10580 vessels, 'Taymyr' and 'Vaygach'. In the 1980s, the Baltic Shipyard was building not only nuclear-powered icebreakers, but also nuclear-powered combat vessels. At that time, it was decided to build two icebreakers in Finland, but perform all processes related to nuclear power plants in the Soviet Union.

'TAYMYR' AND 'VAYGACH'**Specification:**

- Displacement 20,000 tons
 - Length 152 meters
 - Width 30 meters
 - Draft 8 meters
 - Power 35 MW
 - Capable of breaking 1.77-meter-thick ice
- Small draft allows the icebreaker to operate in estuaries of Siberian rivers.

Atomflot intends to keep the 'Yamal', '50 Let Pobedy', 'Taymyr', and 'Vaygach' vessels in service as long as possible.

STATE-OF-THE-ART RUSSIAN ICEBREAKERS

Universal nuclear-powered icebreakers of Project 22220 with innovative equipment have an icebreaking capability of 2.9 – 3 meters at a speed of approximately two knots.

Currently, four icebreakers of this project are under construction, two of them are being finalized afloat. The main icebreaker, 'Arktika', is already being used for convoy transportation.

PROJECT 2220 ICEBREAKERS**Specification:**

- Full displacement 33,500 tons
- Length 173 meters
- Width 34 meters
- Power 60 MW
- Capable of breaking 2.8-meter-thick ice

The vessels have variable draft from 8.5 to 10.5 meters. This feature enables their entry in river estuaries. The cost of such an icebreaker is estimated at about 50 billion rubles. General data on Project 2220 Icebreakers are given in Table 1.

In 2014, construction of 'Arktika' was suspended: Turboatom Plant of Kharkov (Ukraine) discontinued supplies of turbine generators. Production had to be arranged at Kirov Energomash plant in Saint Petersburg, which had not been manufacturing turbine generators of the required power for over a quarter of a century. The plant underwent a major modernization; however, the delivery date of the vessel moved from 2017 to 2020. Nevertheless, on October 3, 2020, the 'Arktika' icebreaker successfully reached the North Pole. The trip was the final stage of State trials, and on October 21, 2020, the flag was raised on the icebreaker.

Unfortunately, Project 2220 icebreakers are incapable of ensuring year-round operation along the Northern Sea Route. Therefore, Russia is developing an even more powerful icebreaker of Project 10510, also known as icebreaker 'Leader'.

HEAVY-DUTY ICEBREAKERS

Russia is building a high-performance shipyard – the Shipbuilding Complex Zvezda. The facility is located in the city of Bolshoy Kamen in the Far East. The contract for building of the main heavy-duty icebreaker was signed on April 23, 2020, the customer being the Atomflot, and the contractor,



VLADIMIR PUTIN,
PRESIDENT
OF THE RUSSIAN
FEDERATION

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In the coming years, navigation along the Northern Sea Route may become year-round, especially if to bear in mind the consequences of possible climate change



'Yamal' Icebreaker



'50 Let Pobedy' Icebreaker



'Vaygach' Icebreaker



Project 22220 Icebreakers



Project 10510 Icebreakers



IGOR TONKOVIDOV,
PRESIDENT AND CEO
OF SOVCOMFLOT

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Year-round navigation along the Northern Sea Route with icebreaker assistance can be practically implemented at this point.

The question here is whether the navigation will be cost-effective. The availability of year-round navigation depends on the delivery time of new generation of gas carriers with improved icebreaking capacity, on the system of organizing the navigation and icebreaker support in the eastern sector of the Arctic, as well as on the level of crew training and ice navigation experience

Zvezda. Steel cutting for the vessel started on July 6, 2020. The official launch was scheduled for September 28, but it did not take place. The company's management is allegedly expecting a visit from some high state officials or waiting for the Unified Ship-Laying Day.

The estimated construction cost is 127 billion rubles. The delivery of the ship, which has not yet been laid down, is planned for 2027. In 2023, two more such icebreakers are expected to be laid down.

PROJECT 10510 ICEBREAKER

Specification:

- Displacement almost 70,000 tons
- Length 209 meters
- Width 47.7 meters
- Draft 11.5 meters
- Power 120 mw
- Capable of breaking 4-meter thick ice
- Speed on open water 22 knots

A Project 10510 icebreaker has no counterparts. It has outstanding technical specifications. The nuclear vessel will be able to make a channel up to 50 meters wide, which will enable year-round navigation for vessels from 50 thousand tons of displacement, including the transit of large-tonnage gas carriers.

ATOMFLOT PROSPECTS

After 2030, Russia intends to continue reinforcing its nuclear icebreaker fleet. Probably, four more icebreakers will be ordered – Projects 22220 and 10510, two of each project.

Atomflot is now involved in a range of infrastructural and economic initiatives related to industrial companies and transport. Current and planned projects include Yamal LNG (liquefied natural gas plant), Arctic LNG-2, 'Arctic Gate', 'Zerno Sibiri', and

development of new ports and terminals – Kharasavey Port, Yenisey Port, Chaika Terminal, Bukhta Sever Port, Krugliy Port, Dudinka Port, and others. All the aforementioned are joint projects with major industrial companies – Gazprom Neft, Rosneft, Novatek, Nornickel, and VostokUgol.

ATOMFLOT IS RUNNING THE FOLLOWING CONTRACTS FOR ICEBREAKER SUPPORT:

- With JSC Yamal LNG until 2040, to ensure export of 17.4 million tons of liquefied natural gas per year;
- With PJSC Gazprom Neft until 2025, for transporting 8.5 million tons of crude oil per year;
- With PJSC MMC Norilsk Nickel until 2027, for transporting 1.3 million tons of non-ferrous and noble metals, as well as support cargoes per year.

Russia plans to increase the total cargo traffic up to 130 million tons per year. In 2020, nearly 33 million tons of cargo was delivered via the Northern Sea Route. The next steps are to reduce transit time down to 10 days and ensure year-round navigation, including the eastern part of the Arctic. Russia intends to make the Northern Sea Route an alternative to the Suez Canal.

Nowadays, only Russia has the technology for constructing large icebreakers, including nuclear ones. The country is vitally interested in developing these expensive ships to support its economic and military operations in the transpolar regions and waters of the Arctic Ocean.

Other Arctic countries (including the US and Canada) are yet incapable of producing comparable vessels. This means that so far Russia retains the leadership in the development of the region. ♦

Icebreaker concept project





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RUSSIAN UAV COUNTERMEASURES: ELECTRONIC COUNTERMEASURE EQUIPMENT

UAVs are used by both regular army forces and non-state formations. The presence of UAVs can often affect the outcome of a conflict, and only a complex system can counter them, one of the most important elements of this system being electronic countermeasure (ECM) equipment.

Autor Yuri Lyamin

They are not as well-known as EW means, but they help to solve some important tasks. The ECM means are especially effective for countering simple, widespread and barely-visible unmanned and remotely-piloted aircraft. The Russian defense industry is one of the world leaders in the development of ECM equipment. Countering UAVs pose a serious challenge to the air defense (AD) sector, the basic part of

which consists of air defense missile systems (ADMS). Large reconnaissance and combat vehicles are a standard target for air defense missile systems, but the large-scale use of small and relatively cheap “kamikaze” drones cannot be controlled by the equipment of preceding models. Small targets are difficult to detect, ADMS faces an overwhelming number of tasks, and the system runs out of ammunition

very quickly. Additionally, the cost of air defense missiles can be several times, or even by one order, higher than the cost of simple UAVs.

WEAK POINTS

The problem can be partially solved by modernizing air defense artillery, however even in this case these means might not be

sufficient. But any technology has its weak points. For example, UAVs depend on the operation of data collection systems, communication channels, and navigation systems. This makes them visible for electronic reconnaissance systems and vulnerable to electronic countermeasures equipment.

Unlike air defense, missile, and artillery systems, ECMs do not require any ammunition, but only electric power. Many electronic countermeasure means operate in a barrage mode over the area, and if the jamming mode is chosen correctly, they are able to neutralize entire groups of similar UAVs without even detecting each unit separately. Since means of ECMs do not destroy UAVs, such measures can be used in populated areas, and under certain conditions it is even possible to capture enemy UAVs. Most ECM systems can detect targets using passive means of electronic reconnaissance, and the systems themselves do not attract attention of the enemy until the electronic jamming mode is switched on.

ECM systems have their own drawbacks. An increase in the range requires a rapid increase in the power rate of the equipment and electric power consumption, and the performance capability depends on the terrain type – electromagnetic waves can not overcome obstacles well. Therefore, ECM systems operate best at a short distance, in the line-of-sight conditions. There is another problem, the reverse side of the ECM advantage. Operating across areas, such a system can affect friendly UAVs and communication systems. Therefore, the use of ECM systems requires detailed coordination with other systems and equipment.

ECM FORMULA

But the main feature of ECM systems is that they mostly affect not the aircraft itself, but its external communication, control and navigation channels. At the same time, a significant part of UAVs, especially ones used for military purposes, have well-protected anti-jamming channels

that cannot be easily jammed, and it is extremely difficult or impossible to break into or take control over them. Moreover, such equipment can perform tasks in the radio-silence mode, along a predetermined route, guided by an autonomous navigation and guidance system, which minimizes the ECM systems' capabilities. The silent groups of UAVs remain invisible for such systems. However, the use of UAVs in a completely autonomous mode significantly reduces their own performance rate as well.

All these patterns add up to a simple formula: the more difficult it is for the ECM system to deal with large reconnaissance and combat UAVs, the easier it is for them to counter small-sized cheap vehicles. This is because the advanced protection rate and jamming capabilities of communication channels, and the availability of reliable autonomous navigation and guidance systems require an increase in the size of UAVs.

"ANTI-DRONE RIFLES" PORTABLE COUNTER-UAV SYSTEMS

Electronic countermeasure systems are widely used when it is necessary to deal with commercial quadcopters and multicopters, the simplest drones. For this task, it is enough to have a compact-design ECM system, which provides directional suppression of satellite signals, control and communication channels in the line-of-sight area.

After a successful jamming attempt, a common-type commercial quadcopter may perform emergency landing, hover in place, or try to return to its initial position. In any case, its mission will be interrupted. To provide comfortable operation, ECM systems look like small guns, therefore they are often called "anti-drone guns" or "rifles". Obviously, these ECM systems have nothing to do with real small weapons.

The capabilities of "anti-drone guns" are limited regarding many parameters: both

in their ability to detect targets, and in the range and their impact force. But their small size, ease of operation and low cost make portable ECM systems essential for law enforcement activities. Therefore, "anti-drone rifles" are being developed and produced in many countries.

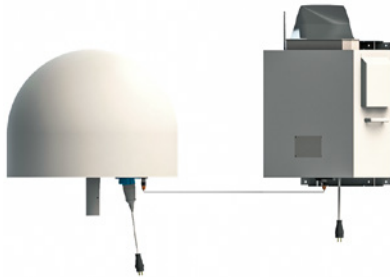
In Russia, portable directional UAV ECM systems are produced by different manufacturers. For example, "Pishchal-PRO", manufactured by Concern Avtomatika (part of the Rostec State Corporation), has a declared suppression range of up to 2 km; "REX-1" and "REX-2", manufactured by ZALA AERO GROUP (part of the Kalashnikov Concern), are capable of suppressing control and data transmission signals



SERGEI SHOIGU,
MINISTER OF DEFENSE
OF THE RUSSIAN FEDERATION

By the joint efforts of the Ministry of Defense, the scientists and military-industrial complex, since 2015, contemporary ground, air and sea-based jamming systems have been designed at all levels of command. It should be emphasized that many of these systems have no analogues in the world. At the stage of designing such systems, the prospects for development of command and control systems for troops and weapons of foreign armies have been taken into account. Putting this equipment in service made it possible to significantly expand the range of suppressed electronic means of a potential enemy





at a distance of up to 0.5 km, and signals of satellite navigation systems at a distance of up to 2 km. Other companies conduct similar development work.

UNDER A DOME PORTABLE/STATIONARY AND LIGHT MOBILE COUNTER-UAV SYSTEMS

Russian manufacturers also offer medium-power systems that provide detection and electronic countermeasures to control and navigation channels of small-size UAVs. Such systems are portable / stationary or mobile; they can be directional (like “an-

ti-drone guns”, but larger and more powerful than them) or can be designed to create a dome protecting against UAVs.

These systems are used in the law enforcement and civil segments, as well as in the security: they are designed to protect against photo and video imaging, to prevent terrorist attacks. Such ECM systems often consist of modules that can operate separately or can be combined into greater systems to protect a larger area.

There is a lot of these systems in the Russian Federation. To name only few: The development of the Vega Concern (Ruselectronics Holding, part of the Rostec State Corporation) named “Zaschita” provides suppression within a radius of 2 km. The “Ataka-DBS” complex produced by the Almaz Research and Production Enterprise (part of Ruselectronics) provides suppression within a radius of 1.5 km with the possibility of combining cell modules into a larger system. Another modular system for UAV countering, “Solaris-N”, was designed by the Sozvezdie Concern (also part of the Ruselectronics Holding).

The portable complex “Kupol-PRO” of the Avtomatika Concern provides suppression of control and navigation channels of UAVs with a declared operating range of at least 2 km, and the larger stationary complex “Rubezh-Avtomatika” guarantees efficiency at a distance of up to 4 km.

Avtomatika Concern also produces the “Sapsan-Bekas” mobile complex, which can be installed in a minibus or a large off-road vehicle. Its range of suppression of radio communication channels, control and satellite navigation channels is up to 4 km; furthermore, unlike most similar complexes, “Sapsan-Bekas” has an advanced UAV detection system. Detection is performed not only directly by the operator, including the use of electronic reconnaissance means, it is also performed with the help of a small radar station and an optoelectronic system.

HEAVY EQUIPMENT MILITARY ORIENTED SYSTEMS

Increase in the size, power, and complexity of ECM systems leads to the improvement of their capabilities, cost growth, and also imposes some restrictions on their operation in populated areas during a peacetime period. Therefore, powerful ECM complexes are used mainly by military forces; heavy chassis of trucks and tractors are required to move such systems.

Among the special-purpose ECM systems designed in the Russian Federation and intended for participation in combat operations, we can name “Repellent-1” developed by the Scientific and Technical Center for Electronic Warfare (part of the Defense Systems Group) and the “Shipovnik-AERO” complex developed by Vega Concern.

The developer of the “Repellent-1” system installed on a truck declares the range of electronic reconnaissance of telemetry and data transmission channels of small-sized UAVs to be up to 30 km within the line-of-sight area. After detecting the enemy, the complex can suppress signals from channels at the same distance: up to 30 km. At the same time, the “Repellent-1” complex is able to operate continuously for at least 24 hours. The “Shipovnik-AERO” complex, also installed on a truck, can detect and identify control signals of enemy UAVs at a distance of up to 10 km, after which a suitable jamming type is selected to suppress the signals.

ADDITIONAL FEATURES

In addition to special-purpose systems designed specifically to counter UAVs, many other military systems can affect the activities of drones one way or another. For example, we can take electronic countermeasure systems widely used in the Russian troops, such as the “Borisoglebsk-2” complex produced by the Sozvezdie Concern, automatic jamming stations R-330Zh “Zhitel” of the PROTEC Research and Innovation Compa-



YURI LASTOCHKIN,
CHIEF OF THE ELECTRONIC
WARFARE TROOPS
OF THE ARMED FORCES
OF THE RUSSIAN FEDERATION
.....

It should be noted that the objects of electronic warfare (EW) are radio-electronic systems of any type, and the unmanned aerial vehicle (UAV) are one of the most important parts of such systems. In fact, a UAV cannot perform tasks without support of the entire infrastructure, including takeoff and landing support systems, land and aerial command posts, data acquisition systems, land and space radio communication equipment, and navigation systems. And all these systems, as they say, is our specialization



ny (part of EGO-Holding), and “Pole-21M” of the Scientific and Technical Center for Electronic Warfare.

The “Borisoglebsk-2” complex is designed to detect enemy radio communication channels, signals from satellite navigation systems and mobile satellite communication systems. The “Borisoglebsk” stations are installed on the base of multi-purpose light-armored towing vehicles. Powerful jamming generators, extended frequency range of radio reconnaissance and electronic suppression equipment allow the complex to successfully identify and jam communication channels of unmanned aerial vehicles.

The exact technical parameters of the “Borisoglebsk-2” complex are unknown, but according to available data, it can counter UAVs located within a radius of up to 30 km.

The jamming station R-330Zh “Zhitel” installed on the base of a truck with a mobile container-trailer was originally designed to detect, analyze, and generate radio interference signals to subscriber terminals of INMARSAT and Iridium satellite communication systems, base stations, and devices of cellular communication of the GSM standard, as well as the equipment of users of the GPS satellite navigation system. The jamming range for ground-based consumers’ equipment is 20–25 km, for aircraft equipment, at least 50 km. Nowadays, according to available official information, this station is also successfully used during training operations to suppress satellite navigation and control channels of UAVs. However, it is not known exactly at what range the “Zhitel” complex can effectively counter UAV activities.

Another system – the “Pole-21” manufactured by the Scientific and Technical Center for Electronic Warfare – was designed for protection against targeted use of high-precision weapons, performance of which depends on satellite navigation systems. It is evident that the “Pole-21”

complex can also interfere with UAV operation as much as this operation depends on satellite signals. The “Pole” complex is especially dangerous for small “kamikaze” drones, which are one of the types of modern high-precision weapons. The suppression range of the “Pole-21E” modification is at least 25 km from each jamming module. The exact technical parameters of the new “Pole-21M” system, which enters service with the Russian forces, remain a secret, but the system is declared to be capable of monitoring airspace within a radius of more than 50 km.

Electronic countermeasure means for radar stations of enemy aircraft, such as systems of the “Krasukha” family of the Radio-electronic Technologies Concern (KRET, part of the Rostec State Corporation), can also successfully suppress radars installed on UAVs by reducing their performance parameters or interfering with the performance of their tasks.

EVERYTHING IN ITS PLACE

Talking about ECM equipment, it is important to remember that the decisive role is played not by the performance parameters of individual systems, but by the operation of the entire system consisting of several parts. It is useless to rely on electronic countermeasure equipment as a “magic weapon”, and it would be extremely wrong to think that individual systems can reliably and securely protect against all UAVs. The real task for specialists is to patiently design a system, inside of which different electronic warfare means operate in interaction with each other and with air defense systems, thereby creating a multi-layer protection against UAVs. This is exactly a kind of cooperation, in which each system fully reveals its potential capabilities. Long, medium and short-range air defense systems destroy large reconnaissance and combat drones, ECM equipment block out some small-sized vehicles, and those UAVs that still manage to break through are eventu-

ally destroyed by air defense artillery and short-range air defense missile systems.

Nowadays, the Russian Federation and other countries are developing special-purpose systems that combine electronic countermeasure equipment and means for physical destruction of UAVs. A laser can become one of the destruction means in such a system. But as of now, no army in the world possesses with such systems put in the military service. ♦



ALEXANDER LEONOV,
CHIEF OF THE AIR
DEFENSE FORCES
OF THE ARMED FORCES
OF THE RUSSIAN FEDERATION

Along with traditional UAV countermeasures, the most effective method was the joint, in other words, coordinated use of all available forces and means of combat arms of the combined-arms formation aimed at fighting an air enemy, including UAVs.

Such tactical methods of countering UAV should involve formation of mixed tactical groups for UAV countering, which include combined-arms units, air defense units and electronic warfare units. This allows to provide early detection and notification of UAV actions, electronic countermeasures to the UAV control system and echeloned fire effect



SPLAV: FIRE CONTROL

Joint-stock company SPLAV Scientific Production Association named after A. Ganichev is a leading enterprise in the development of multiple rocket launch systems (MRLS) both for the Army and the Navy. Our company is part of the management network of the Technodinamika Holding company of the Rostec State Corporation – the managing organization being the JSC Techmash SPC.

Through the years of its existence, SPLAV has developed outstanding systems such as Grad, Uragan, Smerch for the Army; Grad-M, Udav-IM, Ogon', Damba, RPK-8 for the Navy; as well as dozens of unique manufacturing techniques for rocket projectiles. Also artillery shell cases of calibers from 23 to 152 mm made of various materials have been elaborated. Today, our engineering developments and production techniques in the field of the rocket artillery and shell cases production are world-renowned.

Specialists of the company have developed modernization programs for Grad and Smerch systems. These programs have ensured execution of fire missions to destroy an enemy over a distance of 40 and 90 km correspondingly, enhancing capabilities

of fire engagement against typical targets, the computerization of the fire preparation and delivery, and upgrade of the launch vehicles.

JSC 'SPLAV SPA' named after A. Ganichev offers for international defense markets upgraded Grad and Smerch MRLSs, including various-purpose warheads rocket projectiles with a firing range of 40 and 90 km correspondingly, and upgrade of previously delivered launch vehicles for these systems; the state-of-the-art Tornado-G MRLS; rocket projectiles for TOS-1A MRLS; the new generation of the 80-mm unguided aircraft rocket armament: HE-fragmentation penetrating warhead unguided aircraft C-80FP rocket projectile equipped with a small-type high-energy solid rocket propellant

motor, and last but not least, the state-of-the-art Russian MRLS 9K515.

9K515 MRLS was designed on the basis of Smerch MRLS as a result of:

- Development of brand new guided missiles with a firing range up to 120 km, fitted with a control system that is built on a strapdown inertial navigation system with enabled onboard equipment of satellite navigation system and with the possibility to bring individual flight mission data to each missile;
- Upgrade of launch vehicles for Smerch MRLS, which ensures launch preparation and firing of both types of RPs (for Smerch MRLS and the newly developed



guided missiles) without the crew leaving the cabin;

- Equipping the launch vehicle with an autonomous topographic survey system and navigation system.

CURRENTLY, THE FOLLOWING SYSTEMS ARE AVAILABLE FOR THE EXPORT DELIVERIES:

GRAD MRLS:

I. 122-mm Rocket Projectiles (RPs):

- High-effect warhead 9M521 RP;
- HE-fragmentation separable warhead 9M522 RP;
- Shaped-charge fragmentation submunitions 9M218 RP.

2. 2B17-1 Launch Vehicle (LV) equipped with automated laying fire and control system (ALFCS).

TORNADO-G MRLS:

I. 122-mm Rocket Projectiles (RP):

- High-effect HE-fragmentation warhead 9M538 RP;
- High-effect separable HE-fragmentation warhead 9M539 RP;
- Shaped-charge fragmentation submunitions warhead 9M541 RP.

2. 2B17M launch vehicle equipped with ALFCS and ground launch preparation and firing equipment.

TOS-1A Heavy Flame Throwing System:

- 220-mm extended range MO.I.OI.O4M unguided RP.

SMERCH MRLS:

I. 300-mm RPs:

- Fragmentation submunitions warhead 9M525 RP;
- HE-fragmentation separable warhead 9M528 RP;
- Fuel-air explosive warhead 9M529 RP;
- Shaped-charge fragmentation submunitions warhead 9M531 RP;
- Sensor-fuzed submunitions warhead 9M533 RP.

2. 9A52-2 LV (on MAZ chassis), 9A52-2T LV (on Tatra chassis), 9A52-4 LV (lightweight KAMAZ chassis) equipped with ALFCS.

3. 9T234-2, 9T234-2T, 9T234-4 Transporter-Loaders.

4. 9F819 Arsenal Equipment.

5. 9F827 Training Aids.

6. 9F840 Training Set.

7. MP32Mi Unified Command and Staff Vehicle.

8. 1B44 Radio Direction-Finding and Meteorological Complex.

MRLS 9K515:

I. 300-mm Guided Missiles:

- Shaped-charge fragmentation submunitions 9M544 guided missile;

- Fragmentation submunitions 9M549 guided missile.

2. 9A54 Launch Vehicle equipped with automated laying fire and control system (ALFCS) and ground launch preparation and firing equipment (GLPE).

Specialists of the company have developed an upgrade algorithm for standard rocket projectiles for Grad, Grad-1 and Prima MRLSs, ensuring an increase in the maximum fire range of up to 40 km, as well as the repair documentation for overhauling Uragan MRLS rocket projectiles 9M27F and 9M27K with expired specified service life, so that they get guaranteed 10 years' shelf life after repair. ♦



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ADMS «Sosna» on BTR-82A Chassis

Air Defense Missile System «SOSNA»

Among short-range air defense missile systems created in Russia in the last few years, there is a new generation ADMS «Sosna», developed by the Nudelman Precision Engineering Design Bureau, housed within «Almaz-Antey» Air and Space Defence Corporation since 2020.

ADMS «Sosna» is intended to protect army units in any types of combat, including on the march, against almost all types of contemporary air attack and reconnaissance means, diving and flying at low and extremely-low altitudes. The System provides engagement of enemy aircraft, helicopters, UAVs, cruise missiles, high precision weapon means, as well as manpower, soft skin and light-armoured vehicles.

The System is designed on the base of new small-size high-efficient AAGM «Sosna-R» and high-precision jam-proof optronic control system (OCS).

Both AAGM and OCS are mounted on a rotary part (turret) with power drives for two packages of missiles in containers. The missile small weight and dimensions allow to accommodate on the launcher 12 ready-to-fire missiles, as well as to exclude a transport-loader vehicle from the System configuration.

The rotary part is designed as a combat compartment, which can be mounted on various carriers with load-capacity exceeding 3.5 tons, such as: BTR-82A, MTLB, BMP-3.

The rotary part is unmanned. It is made to increase protection of the crew and its com-

fort at work, as well as to decrease dimensions and inertia of the rotary part.

The System combat vehicle is provided with precise navigation equipment, radio station, and the equipment for receiving/transmitting data to the battery control post.

The AAGM «Sosna-R» has a two-stage configuration and consist of sustainer (projectile) and separable solid-propellant low-smoke engine with short operation time.

The missile is designed on the «Canard» aerodynamic configuration and two-chan-



1. Combat operation on the march
2. Firing at an air target
3. Overcoming of water barriers

nel aerodynamic guidance diagram, which is implemented with two pairs of orthogonally located aerodynamic drives.

The missile is stored in a sealed pressurized container. It doesn't require maintenance during its life time. The missile is launched from the container.

On the flight path, the missile rotates, its initial rotation is boosted inside the container and then sustained by the wing-mounted unit in the flight. The missile rotation is controlled by the gyroscope, which measures the angular roll altitude of the missile.

The missile guidance is implemented with high precision in the laser information field.

The missile payload includes the HE-fragmentation front warhead, the rod-fragmentation main warhead, the impact fuse, and the laser non-impact target sensor with circle emission diagram.

Optoelectronic control system consists of the gyro-stabilized platform with two-channel stabilization and guidance system, the TV-system, the thermal imaging channel, the target detection IR-channel, the missile laser beam control channel, laser range-finder, digital computing system, automatic tar-

get acquisition and tracking equipment, stabilization and guidance system equipment, display and control means.

The OCS provides detection, automatic acquisition and tracking of target, measuring of angular coordinates and range, as well as high-precision guidance of LBCC information field and range-finder laser beam on target at day/night time, in presence of natural or artificial interferences.

MAIN ADVANTAGES OF THE SYSTEM

1. Combination of high combat effectiveness (at a relatively low cost) with jamming immunity, operational security, and impossibility for the System to be destroyed with anti-radar missiles.
2. High efficiency of combat use against various types of targets, due to extremely minute errors of missile guidance and use of high efficient combat munition.
3. Ability to engage numerous types of hostile air targets, as well as the enemy's light-armored vehicles and manpower.
4. High accuracy of the missile targeting. It is provided by the accurate target tracking

and information field guidance; by the high accuracy self-determination of the missile current position in the information field, as well as by using special control algorithms, implemented in the on-board micro-DCS.

5. High jamming immunity of the System due to the use of the optical band, the narrow fields-of-view, due to generation of the focused laser information field, as well as the ability of the equipment to detect and track targets reliably using its signature on the background of pyrotechnical jamming.
6. Furtivity of the firing preparation process and high survivability of the System.

7. Ability to operate at day/night time and under difficult weather conditions.

8. Full automation of the combat operation work process.

9. Ability to fire on the move.

Combination of high performance capabilities of the missile and the control system provides large engagement zones during combat operations of the System. For operation in combat missions ADMS «Sosna» can be included in a battery composition, receiving target designations from a battery command post or command vehicle. Moreover, the system can operate autonomously without external target designation. ♦



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JSC “NC “KAZAKHSTAN ENGINEERING” – THE DRIVING FORCE OF THE DEFENSE INDUSTRY

A BRIEF OVERVIEW OF THE LARGEST INDUSTRIAL COMPANIES IN KAZAKHSTAN



JSC “Tynys”, founded in 1959, initially specialized in the production of acidic-type breathing equipment. Today, JSC “Tynys” is the only enterprise (copyright owner) for manufacture of 45 types of aircraft products that have been previously developed by the design bureau (DB) of the engineering plant “Nauka” (Moscow), DB of the mechanical engineering plant “Zvezda” (Tomilino), and DB of the mechanical engineering plant named after A.I. Mikoyan (Moscow).

The main activity of the company is production of components and assemblies for aviation equipment and aviation automatics for civil and military aircraft and helicopters of Russian design (heaters, fans, aviation fire extinguishers, relays, sensors, valves, electronic control units).

The enterprise has implemented an investment project for production of polyethylene pipes with diameter of 10 to 250 mm using the equipment of the German manufacturer Krauss Maffei, as well as it has launched production lines for polyethylene pipes with diameter of 110 to 1000 mm.

In 2013, JSC “Tynys” launched the foundry production of gasified patterns up to 1,000 tons per year. The enterprise has a workshop for sewing ammunition and personal protective equipment: it produces bulletproof vests, armored systems, shockproof shields for the security services of the Republic of Kazakhstan. There are plans to enter the foreign market. The enterprise is one of the main manufacturers of ammunition, personal protective equipment for the security services of the Republic of Kazakhstan. ♦



LLP “Kazakhstan Aselsan Engineering” is a modern high-tech company established for development and manufacturing of products and systems in the following areas: communications and information technology, radar and electronic warfare, electro-optics, avionics, weapons systems, modernization of command control systems, transport, security, traffic, automation, and healthcare.

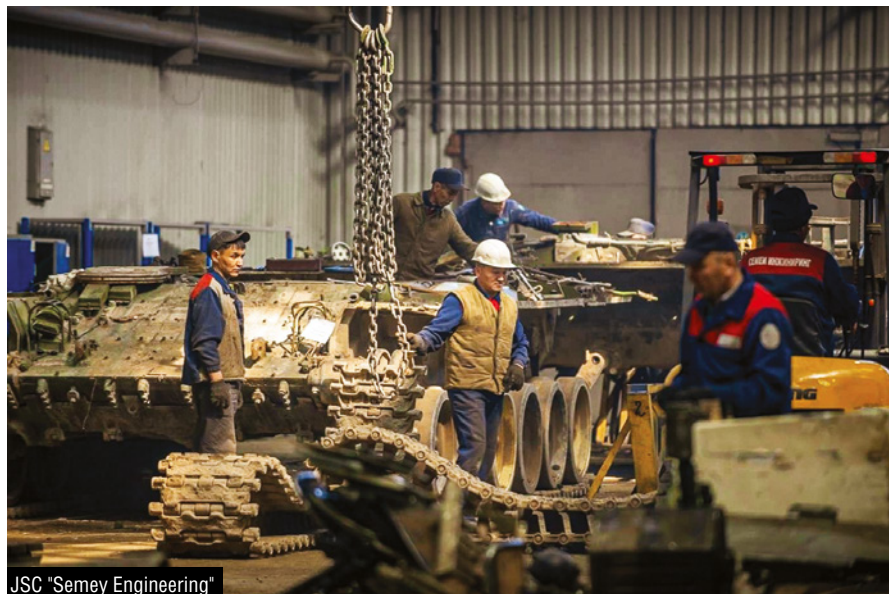
The plant is engaged in production of electro-optical devices, professional communication equipment, infrared lenses and electronic boards. In addition, the enterprise has organized development of remotely controlled combat modules, as well as of artificial lung ventilators. ♦



JSC "Tynys"



LLP "Kazakhstan Aselsan Engineering"



JSC "Semey Engineering"



JSC "Plant named after S.M. Kirov"



JSC "811 Auto Repair Plant KE"

**JSC "SEMey
ENGINEERING"****JSC "811 AUTO
REPAIR PLANT KE"**

JSC "Semey Engineering" in Semey, Republic of Kazakhstan, has been operating for many decades as a plant for repair of armored fighting vehicles.

The main activity of the company has always remained unchanged: this is the entire range of repairs of armored fighting vehicles. The company is the only enterprise in the region that carries out a full range of repairs for all armored fighting vehicles. ♦

JJSC "811 Auto Repair Plant KE" is a rapidly developing company, which is part of the military-industrial complex of the Republic of Kazakhstan and a subsidiary of JSC "National Company "Kazakhstan Engineering". The main specialization of JSC "811 Auto Repair Plant KE" is the overhaul of automobile and crawler vehicles. The enterprise manufactures vehicles of a heavy mechanized bridge with a bridge block and a pontoon-bridge park PBP with interior bay, as well as armored medical transporter-evacuators BMTE by way of modernizing the MT-LB multi-purpose light armored towing unit. JSC "811 Automotive Repair Plant KE" has mastered innovative production of unmanned aerial vehicles, in particular, serial production of an air target simulator. ♦

**JSC "PLANT NAMED
AFTER S.M. KIROV"**

JSC "Plant named after S.M. Kirov" is one of the largest companies in Kazakhstan with more than 90 years of history, which began in 1928. Originally, it specialized in manufacture of radio electronic products. Today, the plant named after S.M. Kirov produces components for oil and gas industries, and for railways.

The in-house design of JSC "Plant named after S.M. Kirov" – the security alarm system "KONVOY-P" is an automated complex for protection of stationary and mobile objects against unauthorized access or any other illegal actions.

In December 2016, JSC "Plant after S.M. Kirov" put into operation a modern line for production of printed circuit boards and became the first and only manufacturer of single- and double-sided printed circuit boards of 4-5 accuracy class in Kazakhstan.

In 2019, JSC "Plant named after S.M. Kirov" has started implementation of the project for producing domestic computer equipment ZIKComputers 'Made in Kazakhstan', namely: tablets, personal computers, and laptops. ♦

**KAZAKHSTAN ENGINEERING**
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COMPACT DOUBLE-ROTOR WIND TURBINE

Development of civilisation requires a significant consumption of electricity. Nowadays, traditional ways of power generation arouse harsh criticism aimed at emission of large amounts of carbon dioxide in the process. In this connection, the role of renewable energy sources (RES), such as hydroelectric power plants, solar panels, and wind turbines, is increasing.

Each type of RES has both positive and negative properties. In the wind power industry, a crisis is looming due to the following problems:

- in the most of existing wind turbines, power generation stops when wind speeds are high;
- extensive electrical networks are required to deliver energy;
- fibreglass components of wind turbines are practically impossible to be recycled after disposal;
- wind turbines pose a great danger to birds, animals, and humans due to open rotating parts and generation of infrasound.

Our company "Anter" has developed the design of a vertical axial, small scale, double-rotor wind turbine which does not have the above mentioned disadvantages.

The main design feature of our turbine is two coaxially positioned rotors with a vertical axis, the rotors rotating in a stationary housing (Fig. 1).

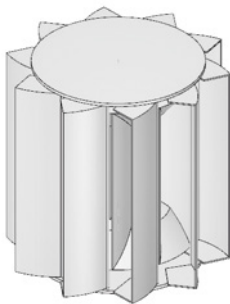


Fig. 1

The table shows some technical parameters of the wind turbine.

Outer diameter, mm	500
Height, mm	700
Weight, kg	8
Power, W	600
Price, roubles	50 000
Service life, years, not more than	10

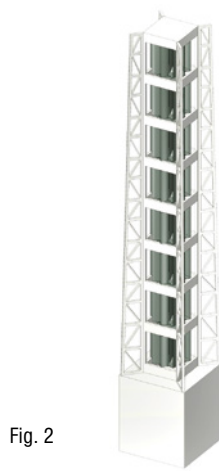


Fig. 2

Each wind turbine is equipped with a controller with integrated sensors (partially-AI) allowing the turbine to perform self-testing. All data are transferred to the cloud storage for the service department.

Competitive advantages of our wind turbine:

- No large areas for installation are required;
- No limitations on the maximum wind speed;
- No extended electrical networks are required;
- No large initial investments are required;
- Power generation can be increased as needed;
- Safety for people, birds, and animals;
- All components can be recycled upon disposal.

Based on these advantages, various options for application of wind turbines are possible:

- Wind turbines can be installed both as a single unit and as a component of a wind farm (Fig. 2) consisting of several wind turbines. All wind turbines operate independently. Bigger clusters can be formed of such wind farms – distributed microgeneration networks (Fig. 3);
- Wind turbines can be installed in the immediate vicinity or on the roof of residential buildings;
- They can be installed in distant and isolated areas, such as tundra, marshlands, deserts, islands, and mountains; in the areas of compact settlements, as well as in places

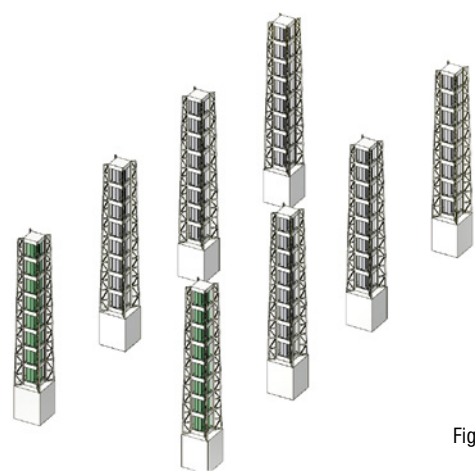


Fig. 3

of operation of geological field parties, and armed forces units;

- Wind turbines can be installed along highways;
- They can be placed on river banks, on coasts of large water bodies (such as lakes, seas, oceans).

As it is known, the wind load is higher at heights of more than 40 meters above the ground level. Thus, the most promising locations for the installation of our wind turbines can be as following:

- On the facades of high-rise buildings (more than 50 meters high);
- On the stack of CHP plants which are put out of operation. In this case there is no need to dispose of a large amount of concrete, which, among other things, can be radioactive.

The design of the wind turbine and methods of its application are patented in Russia, and the process of foreign patenting is underway. ♦

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‘ARMY-2021’: AIRCRAFT COME FIRST

Sergei Shoigu will begin his inspection from the aviation cluster. It is already an established tradition: aircraft are the first thing that attracts the attention of the Minister of Defence.

The VII International Military-Technical Forum ‘Army-2021’ will be held on August 22 to 28, 2021. The aviation cluster at the Kubinka airfield will become one of the key sites for demonstration of advanced (modernized) weapons and equipment.

This year, “even closer attention will be paid to it and commitment [is made] to its active development as a full-fledged platform for hosting events of international scale and importance,” as writes the Commander-in-Chief of the Aerospace Forces Colonel-General Sergei Surovikin in an official greeting to the guests and participants of the forum. According to Surovikin, “static expositions of aviation equipment will be demonstrated on the territory of the aviation cluster, a day of military-technical cooperation for foreign delegations will be held, and an expanded flight program of aircraft samples will be shown.”

The aviation cluster will become the first place at the ‘Army-2021’ to be visited by Minister of Defence of the Russian Federation Sergei Shoigu, together with experts from the Russian Ministry of Defence and representatives of foreign delegations.

“Within the framework of the forum, achievements of leading Russian defence enterprises will be presented, national expositions of foreign countries will be deployed. The exhibition area of the aviation cluster at the Kubinka airfield will be expanded,” the Minister of Defence promises.

According to Shoigu, the Unmanned Aerial Vehicles control competition is going to be one of the brightest events of the upcoming forum.

“... We will show the audience all those samples of modern aviation technology that are in service with the Russian Aerospace

Forces, and also those which will enter into service soon. These are Ka-52, Mi-28N, Mi-35M attack helicopters, the arctic version of Mi-8AMTSh-VA transport and combat helicopter, Su-35S, Su-30SM, MiG-31BM fighters, Su-34 bombers, and Su-25SMZ attack aircraft. Of course, we will present our strategic missile carriers Tu-160, Tu-95MS, the new Il-76MD-90A heavy military transport aircraft, modernized A-50U long-range radar detection and control aircraft, and many other types of aviation equipment. Industrial companies will demonstrate their advanced models which have not yet entered the service with aviation military units,” says Lieutenant General Sergei Dronov, Deputy Commander-in-Chief of the Russian Aerospace Forces.

In the demonstration pavilion and in the open air, there will be exhibited the latest developments in the field of aviation technology and weapons, unmanned aerial vehicles and their engines, as well as electronic equipment and ground control points.

The novelty of this year there will become engines for an advanced line of transport aircraft: PD-14, TV7-117ST, TV7-117V.

For the forum visitors, several static expositions will be organized dedicated to both modern aviation and retro aviation; and flight simulators will operate at another site.

The flight program of the aviation cluster will allow the participants of the demonstration block to present their latest aircraft models in action. This year, the forum guests – “Russkie Vityazy”, “Strizhi”, “Berkuty” aerobatic teams, and foreign aerobatic teams will take part in demonstration performances, and also the maiden flight of the Il-112V military transport aircraft will take place. ♦

PRESIDENT OF TURKISH SPACE AGENCY: TURKEY IS AGAINST THE WEAPONISATION OF SPACE



TURKEY IS COMMITTED TO THE PEACEFUL USE OF OUTER SPACE AND IS STRONGLY AGAINST THE WEAPONISATION OF SPACE, THIS WAS STATED BY THE PRESIDENT OF THE TURKISH SPACE AGENCY (TUA) SERDAR HÜSEYİN YILDIRIM, IN AN INTERVIEW WITH THE “NEW DEFENCE ORDER. STRATEGY” JOURNAL ON THE SIDELINES OF THE GLOBAL SPACE EXPLORATION CONFERENCE (GLEX-2021). YILDIRIM HEADED THE TURKISH DELEGATION FOR GLEX-2021, WHICH TOOK PLACE IN SAINT PETERSBURG, RUSSIA, ON 14–18 JUNE, 2021.

Interviewed by Reem Mohamed

“Space exploration, like any advanced technology, has two sides: either we can use this technology for the benefit of humankind, or we can choose to use it for war and destruction. Turkey is and will remain committed to the peaceful use of outer space. We are against the weaponisation of space, we do not want any wars or conflicts in space. Thus, precautions must be taken at the international level to prevent this from happening,” the president of Turkey’s Space Agency declared.

On February 9, 2021, the President of Turkey Recep Tayyip Erdogan unveiled the Turkey’s National Space Program, a roadmap based on realistic and competitive goals. According to this plan, the country intends to reach the Moon and send a Turkish astronaut over the span of the coming 10 years. In his speech at the launching ceremony, Erdogan noted that the program outlines Turkey’s 10-year vision, strategies, objectives, and projects on space policies.

The Turkish Space Agency (TUA) has developed Turkey’s National Space Program and is in charge of running it. President Erdogan said that Turkey is opening the door to the sky journey of its civilization that pioneered justice, morality, and peace in the world for centuries. As it was underlined by both Erdogan and Yıldırım, the objective of the Turkish National Space Program is to push Turkey forward in the space sector. “In order to reach that goal, we have designed a very ambitious program,” said Yıldırım.



RECEP TAYYIP ERDOGAN,
PRESIDENT OF TURKEY

.....
The national space program will carry our country to an upper league in the global space race... The primary and most important mission of the program is to make the first contact with the Moon in our Republic's centennial year [2023]



SERDAR HÜSEYİN YILDIRIM,
PRESIDENT OF THE TURKISH
SPACE AGENCY

.....
We cannot succeed without international cooperation. We should act as humanity, not as nations



ULF MERBOLD,
PHYSICIST AND FORMER GERMAN
ASTRONAUT

.....
We all stay on the shoulders of people who were before us. Yuri Gagarin is one of those people on whose shoulders we stand today

“The first and most important strategic goal of our National Space Program is the 1-Moon Mission. At the first stage, in 2023, we will establish the first contact with the Moon through rough landing. The second stage is planned to commence at the end of 2028 or the beginning of 2029, and this is when we will make a soft landing on the surface of the Moon,” added the head of the TUA.

The significance of this launch lies in the fact that it will be made in memory of the 100th Anniversary of the foundation of the Republic of Turkey. This launch will be made with a national and authentic hybrid-engine rocket that will be delivered to the orbit in 2023 through international cooperation. The spacecraft which will conduct this mission will be produced in Turkey with maximum possible domestic contribution, TUA president added.

According to Yildirim, Turkey is now preparing its own spacecraft with its domestically-built hybrid engine. This spacecraft, which weighs about 2 tons approximately, will be brought to the Low Earth Orbit (LEO) with the aid of international collaboration because Turkey does not have the capacity for that yet. The president of TUA informed us that it has not been decided yet who will carry out the Turkish spacecraft, but negotiations are active with potential companies.

“We have not yet decided which company will deliver our spacecraft onto the orbit, we are still in the process of negotiating with potential contractors. They will bring us to LEO and when there, we will turn on our own hybrid engine and head towards

the Moon, it will take 3-4 days to reach our destination,” Yildirim explained. “At this stage of the 1-Moon Mission, the hard landing, what really matters is the experience itself and the valuable information that the spacecraft will collect for the accomplishment of the final mission in 2028.”

It is worth mentioning that Turkey's 10-year vision lists 10 main strategic goals, one of them is to send a Turkish citizen to the International Space Station (ISS) on a scientific mission. Yildirim noted that the Turkish authorities are very keen on the idea of sending a Turkish citizen to space, and this will be done in the frame of a scientific mission to the ISS. However, the priority remains to be given to the Lunar mission, he emphasized.

“We chose to give priority to the 1-Moon Mission because manned space flights are in the capacity of only three countries – Russia, China, and the USA. Since the first human flight to the space 60 years ago, more than 500 people have travelled to the orbit, but always being accompanied by astronauts from these three countries. Therefore, we would not want to start our space project by going into space as tourists, we will just go to the ISS to conduct some research,” he elaborated.

The main goal is to conduct scientific research, mainly in biotechnology and composite material. “We are planning for at least three or four experiments over 15 days on the ISS,” Yildirim pointed out.

Currently, Turkish Space Agency expects to finalize in two months the details of

sending a Turkish citizen to space. And there is yet the decision to be made which company will carry out the mission. As stated by Yildirim, three main factors are taken into consideration when choosing between ROSCOSMOS and one of some potential American companies.

The first factor is timing. As mentioned earlier, 2023 is Turkey's centennial year, therefore, Turkey wants to achieve this goal of sending a Turkish citizen in that same year. According to Yildirim, ROSCOSMOS has a launch window open in 2024 so far, while potential American companies said that they could do the launch in 2023. “We have not reached any conclusions yet, we are still in the process of negotiating with all sides,” stressed Yildirim.

Another factor to consider is the size of the cargo that can accompany the Turkish scientific mission to the ISS. “The capability of bringing our research cargo to the ISS, and how much we can carry, what we can carry, what experiments we can do there, all these are crucial points to consider. And last but not least is the cost of the preparation, training, and the launch altogether.

“We will evaluate all these factors and decide in two months at most. That will be followed by the process of choosing our candidates, then the training phase will take at least one year, so we will eventually meet our goal in 2023. Thousands of people are expected to apply, but the process hasn't started yet,” he said.



SERGEI KRIKALEV,
ROCKET SCIENTIST AND FORMER
RUSSIAN COSMONAUT

Plans that are well optimised on the ground do not always work in space; flexibility is important, it comes with experience and can be shared with younger crew



FRANZ VIEHBOCK,
FORMER AUSTRIAN COSMONAUT

Yuri Gagarin had an impact on our lives in many ways... He saw the beauty of our planet... and he talked about how we need to protect our environment... and to stay here in peace. This message from 60 years ago is more valid today than ever



BILL NELSON,
NASA ADMINISTRATOR
AND FORMER ASTRONAUT

Although we sometimes have different positions we can work together in space

Answering our question about the potential of selecting a woman astronaut for this mission, Yildirim said that there is a high chance this could happen, but encouraged both female and male candidates to apply. At the same time, he made it very clear that “gender is not the main criteria here in the selection process.” He continued that “she or he who will be selected must have a scientific background, professional experience, good psychological and physical health conditions.”

WHAT IS THE PLAN AFTER TURKEY'S 10-YEAR VISION IS MET?

TUA's president stated that they have already put a program for a Turkish space port and that it is going to be a main competitor in the commercial space market. It is worth mentioning here that this spaceport cannot be located in Turkey because the country has not got suitable geographic conditions and landscapes for a launching ground.

Yildirim revealed that talks are ongoing with four countries for the establishment of this spaceport on their territory, but he did not name any of these countries. The only specification he gave was that “it has to be near the equator and open to the sea.”

There have been media speculations earlier about Somalia being selected for the location of this rocket launch site (spaceport) due its adjacency to the equator. In an interview with the BBC Turkey in February, the president of TUA declined to comment

on the matter. Other speculations referred to Qatar and Pakistan as well, but no official confirmation was made in this regard either from any of the sides.

COOPERATION WITH RUSSIA

On the second day of GLEX-2021, the Turkish Space Agency held a bilateral meeting with the ROSCOSMOS Space State Corporation. Yildirim described this meeting as being fruitful. “Although it has been a much belated meeting because of the pandemic, we have finally managed to make it happen. I am very positive as I see many areas where we can cooperate with ROSCOSMOS,” he added.

On another aspect of international cooperation, the head of TUA expressed the agency's interest in participating in the International Lunar Research Station (ILRS). For the time being, the agency is planning and evaluating the project in general and studying the prospects of producing some subsystems for the station and becoming a partner in the project.

“We are already partners in several projects. Regardless of the size of our participation, what matters for us at this stage is to learn and be more involved in new international projects because we strongly believe in the importance of international collaboration,” he said.

The International Lunar Research Station is a planned lunar base currently being developed by the ROSCOSMOS State Space Corporation of Russia and the China National Space Administration (CNSA). Rus-

sia and China revealed the roadmap for the ILRS at one of the plenary sessions of GLEX-2021.

“We cannot succeed without international cooperation. We should act as humanity, not as nations. I cannot stress enough the idea that we should not be in a race, let us be together without feeling the urge to compete. Competition brings hostility, and hostility is the last thing we need in space. I truly believe that global peace will be eventually achieved through space activities,” concluded the president of TUA.

Yildirim accented his agency's readiness to work with the private space sector saying that “all doors are open for the private sector because we do need them.” ♦



TUA
Turkish
Space Agency



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I CAN SEE YOU

A REVIEW OF THE GLOBAL MARKET OF THE EARTH REMOTE SENSING PRODUCTS

THE DISCUSSION ABOUT SPACE COMMERCIALIZATION USUALLY BEGINS WITH THE UPSTREAM SECTOR – DEVELOPMENT AND DESIGN OF SPACECRAFT AND THEIR LAUNCH INTO ORBIT. THIS PART OF THE WORK IS BEFORE THE PUBLIC EYE, IT IS UNDERSTANDABLE AND LOOKS EFFECTIVE, AND IT IS CLEAR WHY MOST OF THE RECENT STARTUPS OF THE NEW SPACE MOVEMENT ARE GOING TO BE INVOLVED PRECISELY IN THE DESIGN OF LAUNCH VEHICLES OF DIFFERENT CLASSES, PRODUCTION OF SATELLITES AND CUBESATS AND THEIR LAUNCH INTO ORBIT. IT IS SIMPLE, STRAIGHTFORWARD, AND EFFECTIVE.



THE TOTAL VOLUME OF THE GLOBAL SPACE MARKET HAS ALREADY COME CLOSE TO \$400 BILLION A YEAR. BUT THE MARKET VOLUME FOR COMMERCIAL LAUNCHES OF SPACE VEHICLES MAKES FOR ONLY 2–4 PER CENT OF THIS AMOUNT

Author **Mikhail Kotov**

QUALITY LIMIT

Unfortunately, as usual, most financial resources are located not in the sectors with bright ideas and a lot of participants willing to earn money by designing a new rocket. While the total volume of the global space market has already come close to \$400 billion a year, and according to some estimates has even exceeded this value, the market volume for commercial launches of space vehicles makes for only 2–4 per cent of this amount. At the same time, the great part of the market share belongs specifically to the downstream sector – namely, sales of TV broadcasting services, broadband satellite Internet, satellite com-

munications and, of course, Earth Remote Sensing (ERS) data.

The market for Earth remote sensing data is evolving at a tremendous rate. More and more spacecraft launched into orbit are designed to monitor and survey the surface of our planet. In 2014–2015, the experts even predicted that the global satellite survey coverage of the entire planet would reach a daily rate by 2020. The forecast almost came true, as after the launch in July 2020, Planet Labs announced the possibility of monitoring the entire planet on daily basis.

Simultaneously with the increase in the frequency of images, the world ERS market

is currently aiming at improving the quality and resolution of images. The images of the Earth's surface with a resolution of 3–5 meters per pixel, which were very popular five to ten years ago, are becoming a thing of the past. Modern spacecraft are capable of providing commercial images with a resolution of 30–50 centimeters per pixel, which is close enough to the theoretical quality limit. According to NASA studies conducted in the 1970s, the theoretically calculated quality limit for images of the Earth's surface is about 10 centimeters per pixel.

A more precise resolution is not very realistic due to the presence of a dense atmosphere layer near the Earth's surface, which



inevitably distorts the data received by the satellite. Perhaps, in the future, there will be attempts to solve this problem by using burst-mode image shots with subsequent data processing with neural networks, but so far surveying with such a precision is impossible. For commercial spacecraft, the best image quality is 30 centimeters per pixel. Images with a resolution of 30 centimeters to 1 meter per pixel are considered to be of the ultra-high resolution quality.

DAILY COVERAGE

There are two companies recognized as the leading companies in this field – Maxar and Airbus. Nowadays, they provide more than two-thirds of the total market value of the Earth's remote sensing space data. The main competitors of these two giants are Spacewill and the Planet Labs (which originally worked with lower resolution parameters, but then launched the SkySat ultra-high resolution constellation). This segment also includes the following companies: 21AT (China), SIIS (Korea), ISI (Israel), CG Satellite (China).

In Russia, at the moment, there is no commercial company having its own operating spacecraft constellation capable of presenting ultra-high resolution imaging of the Earth's surface. Talking about state space vehicles, these conditions are met by the 'Resurs-P' satellite imaging system. It can get images with a resolution of 1 meter per pixel using a panchromatic camera

For a long time, images with high (from 1 to 2.5 meters) and medium (from 2.5 to 20

meters) resolution have been considered as a standard. However, nowadays there are a lot of images with such resolution in the market and several companies, including Airbus and Planet Labs, have announced their gradual withdrawal from this segment. Although the leaders in this sector still remain Airbus company with the Spot constellation and a huge data archive, and Planet Labs with the Dove constellation of the previous generation.

Axelspace (Japan) and Orbita Aerospace (China) are among the new participants in the international market. Orbita Aerospace owns 12 satellites (with a planned constellation size of 34 satellites). Among the spacecraft, there are satellites with hyperspectral cameras, and there are plans to introduce spacecraft for radar imaging and satellites equipped with infrared cameras.

Axelspace is the satellite operator for the AxelGlob constellation. The company has been creating its own constellation since 2015 and initially planned to include more than fifty spacecraft in it. Based on the needs of customers, the first GRUS-1A satellite was launched in 2018. In March 2021, four more GRUS spacecraft were launched with the help of the Russian 'Soyuz-2' rocket.

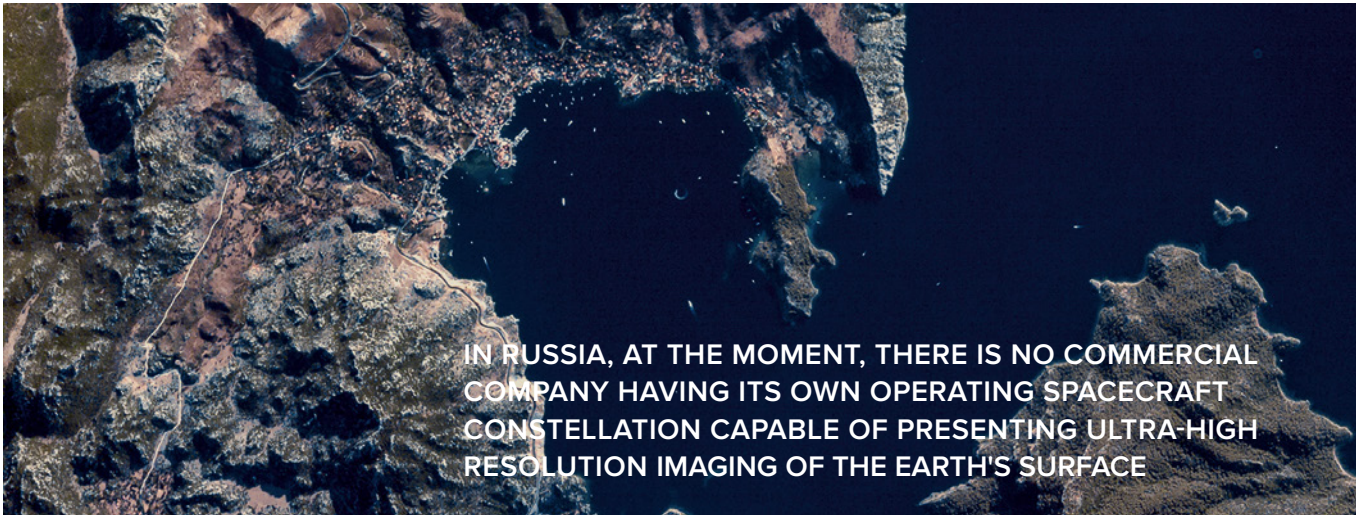
In the future, an annual increase of the constellation size is expected. Regarding the specification, AxelGlobe is similar to RapidEye, but provides improved spatial resolution (2.5 m in panchrome mode, 5 m in multispectrum mode, with 55-km swath). The constellation of five vehicles will pro-

vide daily coverage in some parts of the world by the end of 2020.

In Russian segment, the main type of space vehicles providing such data is the Canopus. A series of Russian satellites for remote sensing of the Earth is designed by the VNIIEM Corporation JC in coopera-

UPSTREAM & DOWNSTREAM

The terms "upstream" and "downstream" came to the space industry from the oil industry and refer to the production sectors. "Upstream" is the exploration of new fields and deposits, the design of derricks and their installation. "Downstream" refers to all the factories that are engaged in oil processing and refining, a network for products distribution to retail customers. With regard to the space industry, "upstream" is design and development of rockets and spacecraft, as well as their operational maintenance in orbit. "Downstream" refers to processing data received from space vehicles, data verification, and selling the data to the end users.



IN RUSSIA, AT THE MOMENT, THERE IS NO COMMERCIAL COMPANY HAVING ITS OWN OPERATING SPACECRAFT CONSTELLATION CAPABLE OF PRESENTING ULTRA-HIGH RESOLUTION IMAGING OF THE EARTH'S SURFACE

tion with the British company the Surrey Satellite Technology Limited. The satellites operate for Roskosmos, the Ministry of Emergencies, the Ministry of Natural Resources, the Roshydromet, the Russian Academy of Sciences; they are used for mapping, monitoring emergency situations, including fires, and operating surveillance of specified areas.

WHITE ON WHITE

Another potentially promising segment can be ERS satellites operating beyond the visible range. These are radar and infrared-range surface surveys. The fact is that the images in the visible range, which look very similar to our eyes, are not always suitable for work. For example, when it is necessary to determine the state of the surface covered with layers of ice or snow of the same white color, or when monochrome green fields are being surveyed.

The particular feature of radar data is that they can be obtained regardless of weather conditions. For example, in the presence of dense clouds, imaging with conventional cameras is practically useless. In this case, radar surveying can provide more sensible information.

For many years, the E-Geos company remained in the leading position for this segment, and it has recently launched a new generation of Cosmo-SkyMed satellites, which are absolutely identical to vehicles of the first generation. As the previous constellation is still operating, customers can

receive information from eight satellites at once. In 2019, Maxar company launched a constellation of three radar satellites of the Radarsat Constellation type into orbit.

The issue of radar surveying is of great importance for Russia. In the upcoming years, it is planned to launch several spacecraft capable of operating over the Arctic area – in the zone of monochromatic landscapes and high clouds.

COUNTING ELEPHANTS. TRENDS IN THE GLOBAL ERS DATA MARKET

When several companies reached a resolution of about 30 centimeters per pixel, it became evident that this was the standard that all commercial market players would reach in the upcoming years. The customers are increasingly willing to get detailed surface images.

The main factors for developing a competitive offer are the following:

- data completeness and area coverage
- price of images
- image delivery speed and possibility to obtain the most relevant information
- possibility to work with small orders, flexibility and convenience of the data obtaining process

Commercial organizations are more likely to meet these requirements. Therefore, state governments often form the ERS mar-

ket by purchasing the required information from private companies. This form of co-operation is used by the US Department of Defense. The direct benefit is clear in this case: there is no need to launch a new ERS satellite or to re-target an existing one to the relevant military area. And the highest efficiency can be achieved in this case.

The subsequent processing of the received satellite data is becoming an important and expensive service. This task requires the operation of specially-trained ultra-precise neural networks capable of data labeling and automatic searching for and marking information that is important and significant for the user. A system of this type is capable of processing satellite data obtained from some reserved area in the automatic mode and determine, for example, all objects that can be identified as elephants. After that, an additional check is carried out, which would take several dozens or hundreds of hours in case of human work. In the nearest future, these complex and sophisticated services will become the basis for companies selling ERS data.

An increasing part of this work will be subordinated to the downstream sector, where the main profit is generated. Nowadays, the most important thing is not how many satellites and of what type you have on orbit, but rather how successfully and profitably can you sell the information received from these satellites. ♦

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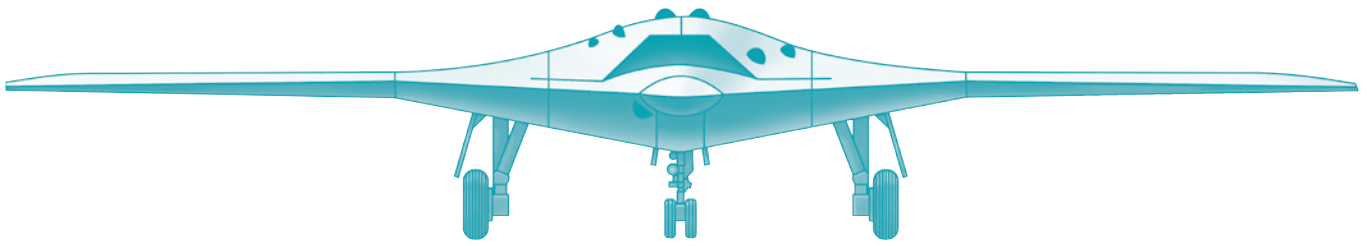
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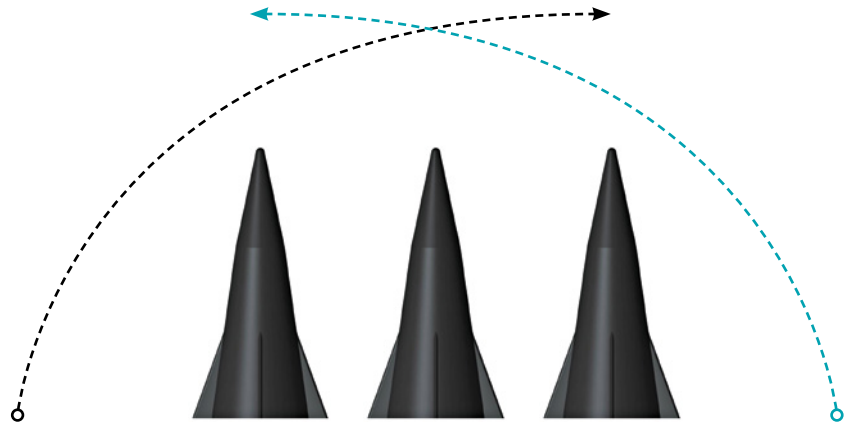
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TODAY, THE RUSSIAN ARMY OPERATES OVER 2,000 UNMANNED AERIAL VEHICLES

1

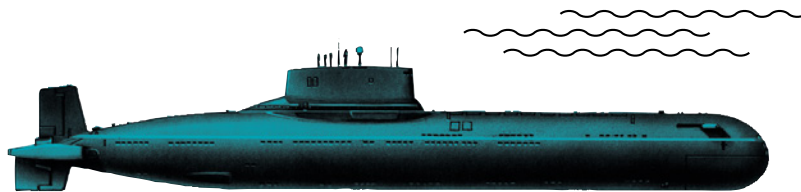
They are joined into 67 different squadrons. Russia ranks second in the number of combat UAVs its army operates. Israel ranks first, and the USA, third. However, Pentagon experts speak of about 11,000 aerial robots operated by the U.S. Army, but this includes micro-UAVs, which analysts from other countries do not include in the count



2

THE SPEED OF THE LATEST LONG-RANGE HYPERSONIC MISSILE (LRHW) DEVELOPED IN THE US IS 17 TIMES FASTER THAN THE SPEED OF SOUND

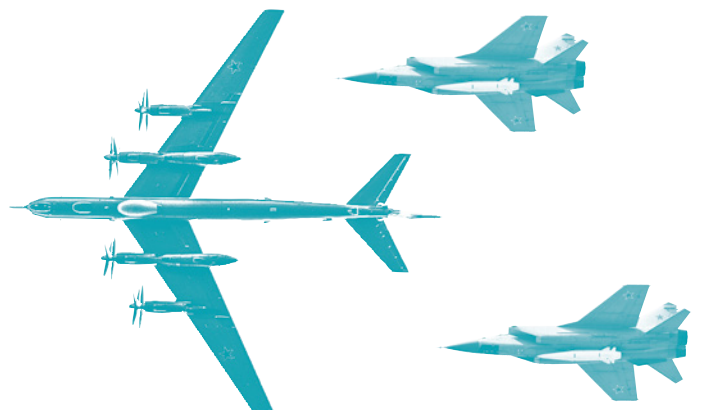
This aerial vehicle would cover the distance between Washington and Moscow in approximately 20 minutes, but its flight range is only one third of the distance between the two capitals: 2.8 thousand kilometers. Thus, both Moscow and Washington experts still speak of the supremacy of the Russian hypersonic technology



RUSSIA IS READY FOR THE FIGHT OVER THE ARCTIC, ITS ARSENAL IN THE REGION IS LETHAL, A COLUMNIST OF THE NATIONAL INTEREST NOTES

3

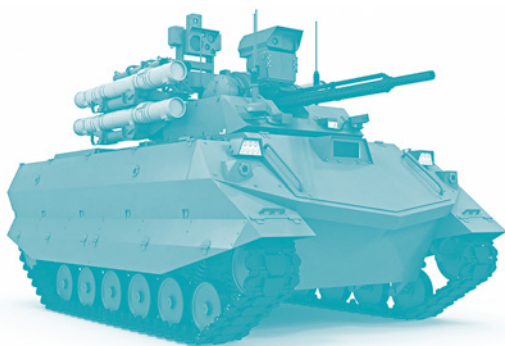
The publication lists five factors ensuring Russia's supremacy: the world's largest icebreaker fleet, project Akula submarines, MiG-31 fighters, Tu-95 bombers, and the anti-submarine aircraft Tu-142. The article also mentions the Russian 'Spetsnaz' special forces ready to operate in the extreme conditions of the far North



4 SERIAL PRODUCTION OF COMBAT ROBOTS COMMENCED

Not just experimental prototypes have appeared, but robots that can actually star in Sci-Fi films, capable of fighting independently

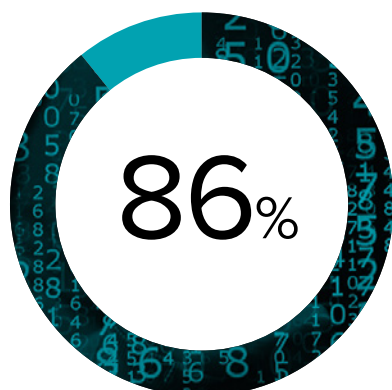
*Sergei Shoygu,
Minister of Defence of the
Russian Federation
(May 21, 2021)*



THE YEAR 2020 SAW A RECORD NUMBER OF SUCCESSFUL CYBER ATTACKS

6

According to CyberEdge, 86% of companies and organizations in the world have been under attack. This figure increased by 5% compared to 2019. Also, 87% of world organizations talk about a lack in qualified IT personnel, this is another record number in the entire history of the industries



BIOLOGICAL WEAPONS CONVENTION CANNOT BE IMPLEMENTED BYPASSING THE UN, THE CSTO FOREIGN MINISTERS DECLARED IN MAY 2021

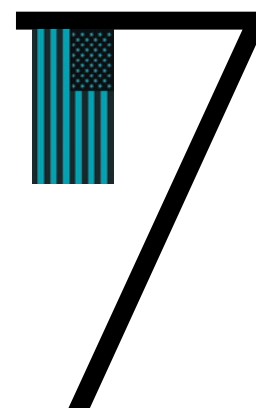
5

The very fact that such a resolution was adopted demonstrates that the CSTO member states see the threat of new structures appearing, willing to control biological and toxin weapons. It would seem, however, that the international community had come to a common solution to this problem almost a hundred years ago, when the Geneva Protocol was signed



US DIPLOMATS EXPERIENCE UNNATURAL VERTIGO AND EAR PAIN WHEN BEING IN CUBA AND CHINA

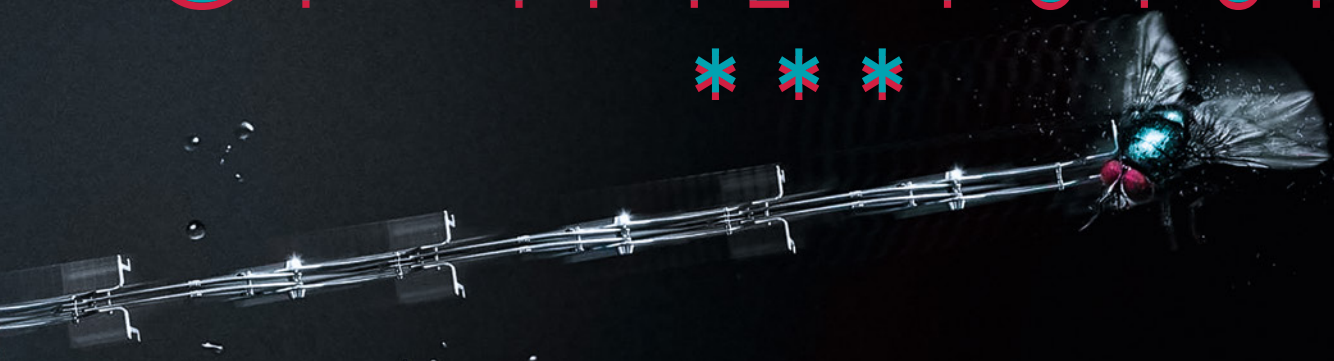
If the article published by The Washington Post is to be believed, the cause of this distress is the influence of secret electromagnetic weapons developed in Russia. However, it is difficult for the reader of this article to determine the exact nature of this influence: whether it is electromagnetic or informational





LIQUIDATION OF THE FUTURE

* * *



FUTURE
WAR
IMAGES

Author Alexander Yatsurenko

A HYPERSONIC MISSILE THAT CAN DESTROY AN ENTIRE MILITARY BASE WITH ONE HIT DOES STRIKE NOT ONLY THE ENEMY, BUT ALSO THE IMAGINATION. A REAL WAR IS ALWAYS A COMPLICATED SYSTEM OF ECONOMIC, MANAGERIAL, TECHNOLOGICAL, AND INFORMATIONAL FACTORS.

**WAR IS NOT
A MANIFESTATION
OF HUMAN CRUELTY.
NEITHER PERSONAL
UPBRINGING, NOR
THE ENHANCEMENT
OF INTERNATIONAL
INSTITUTIONS CAN
PREVENT NEW CONFLICTS.
A CONFLICT BEGINS
WHERE AN INSUPERABLE
CONTRADICTION
IS PRESENT**



Short-term forecasts of the development of the future seem to be quite logical as they stem from the present. However, genuine futurology can often be perplexing and sometimes irritating, since it talks about phenomena that are strange not only to our times, but also to the consciousness of the modern human being.

Nevertheless, the presence of a point of forecast laying beyond the bounds of the future allows to draw a beam into the present and place all probable and improbable events on it. Strategic development is impossible without such a scale.

GROUND FOR WAR

In the second half of the 20th century, the world changed yet again. Political advisor to the U.S. Department of State and Department of Defense Edward Luttwak wrote that the West took the USSR's refusal of total control over the territory of Afghanistan as a sign of poor training of recruits.

However, later on, military experts learned about an order by the Soviet command instructing to prevent human losses at any cost. It was this decision that restricted the Soviet Army's actions.

The value of human life has been an important factor in the recent decades. But, unfortunately, this is not a constant. And the development of technology does not make the world any more humane.

"In 50 years, war will be a war of machines. However, they will not battle with other machines, but with people armed with the Kalashnikov machine guns (I am sure they will still be popular even in 100 years). It will be an extremely asymmetric war. We will come to zero mortality for one of the parties: a drone can be killed but no one will mourn over a robot. This technology is humane on the one hand, and devilish, on the other. If you do not suffer any losses, you are tempted to continue war," – warns Arseny Kumankov, Deputy Dean for Research at the faculty of Humanities of the National Research University Higher School of Economics.



War is not a manifestation of human cruelty. Neither personal upbringing, nor the enhancement of international institutions can prevent new conflicts. A conflict begins where an insuperable contradiction is present.

“Modern wars are fought over resources, in a broad range between the possibility of exploiting minerals to the ability to strengthen one’s position or impose one’s conditions on someone. All other things, such as historical rights and natural freedoms, look like decorations. But they look like that only in part, since processes may acquire their own weight and begin to dictate their own logic,” – believes the conflict expert Vladimir Nosov.

BATTLEFIELD

Africa and the Middle East are most often named as the places where the next large-scale war will unfold. It is not difficult to make such a prediction. In recent decades, it is in these regions that armed conflicts have claimed the most lives. “A spike [in armed conflicts] in the 2010s occurred after the calm 2000s. It can be assumed that these areas will continue to be hot spots in the nearest future,” – Arseny Kumankov says.

But there is also a less evident forecast, given by the Head of the “Designing the Future” research group, Nikolay Yutanov: “The Arctic will be the main area of conflict. We are nearing a local climatic optimum, the Arctic is already melting, the Arctic Ocean is turning into a new Mediterranean that once was a cradle of civilizations. Bordering the Arctic Ocean are Canada, Northern Europe, and the Russian Federation. Cargo transportation across the Northern Pole is the most convenient and economically feasible method. And a trade route is always an area that all global players strive to control.”

It is clear that most of the Arctic was a lifeless desert over the previous centuries. But the concept of the desert differs at various historical development phases. One period only needs spaces for arable land, another wants land for industrial production, a third one requires a territory that can take in the maximum number of information flows. In the latter case, temperature is not that important.

Russia is actively developing the Arctic at all levels. The United States’ movement to the north is much slower, even Norway or Sweden have a higher potential in the region. We are the only country that has an icebreaker fleet. Soon it will be equipped with the Ritm-200 small water reactor. Russia’s dominance here is undeniable.

STRONGHOLD

However, any modern war, be it offensive or defensive, needs not only specific technical means but, rather, a powerful infrastructure. “It became clear in the 20th century that war is the construction of a fortified area and the routing of railroads (both radial and ‘rockade’, running along the frontline). This means that fast construction technology is the key. A war boils down to a matter of who will construct a fortified area faster, and it must be the area that has not only strategic, but also economic significance, namely, is capable to bring money,” – Nikolay Yutanov explains.

It is somewhat similar to the description of a popular real-time strategy computer game. Mines produce resources, a stronghold allows construction, turrets kill anyone who comes closer than the range of a shot. This is how the game industry depicts the upcoming reality in its own language.

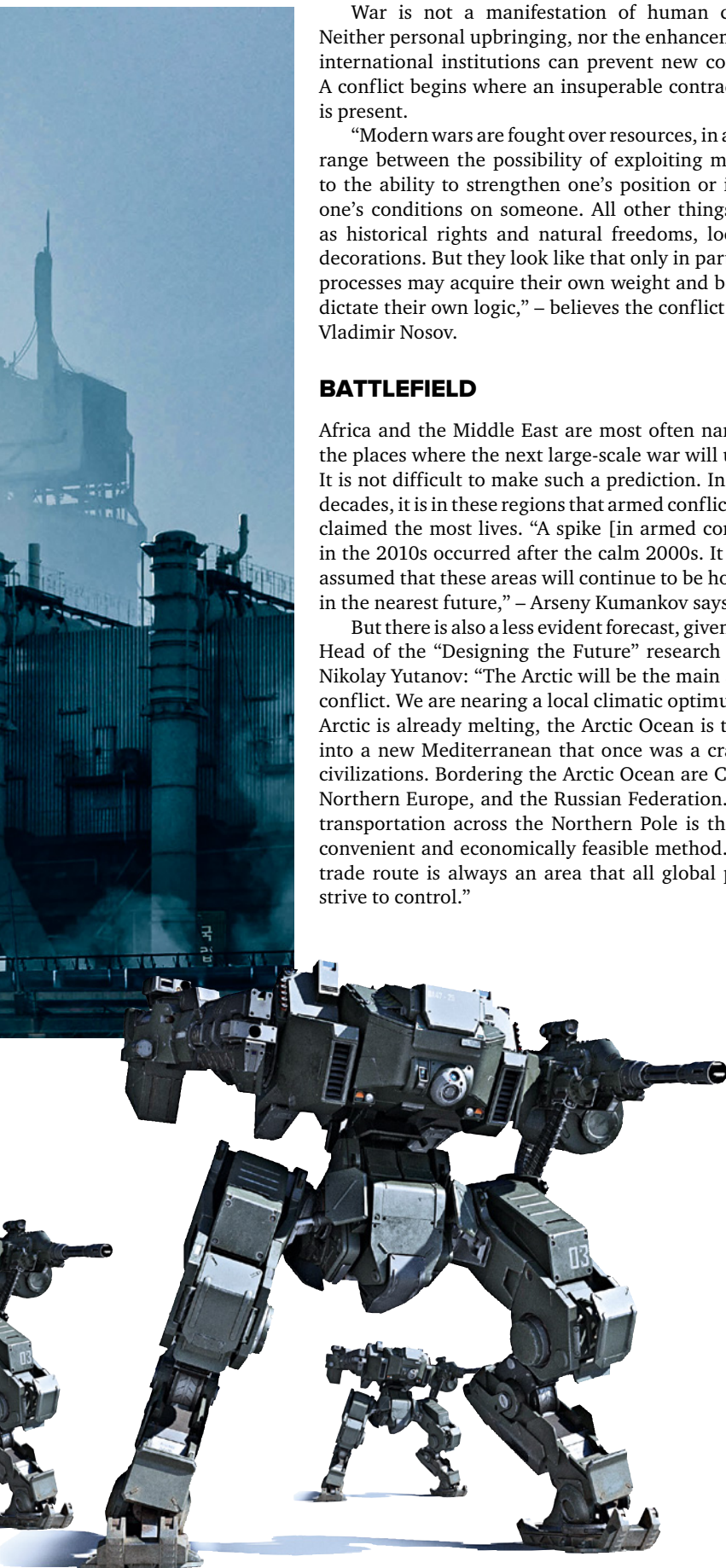
And, much like in a game, the commander of the fortified area gains absolute power over his part of the front – land, water, air, and space. Railroads can be strung (this possibility was discussed at the last Arctic Forum), optical communication will be replaced with a quantum one, but specific technical innovations will not affect the structure of the citadel and the principles of front management.

“The war of the future involves the formation of a new type of military experts: those capable of simultaneously keeping in mind multiple environments in which the war is being waged; economic, informational, and technological. Imagine the manager of a territory who has several dozens thousands of drones and three or four global artificial intelligences under command,” – Nikolay Yutanov suggests.

A network of satellites provides comprehensive information about the region, supercomputers process huge data volumes and offer the commander event development scenarios. Such an unapproachable line of defense only has two vulnerable areas. The first is often considered as an advantage, and that is the full robotization of processes. The second vulnerable area of the citadel is a man himself.

ROBOT BATTLES

Let us start with robots – this subject has been the most popular one for the last century. “The mass use of



unmanned aerial, sea, and ground vehicles can change the centuries-old perception of a state as a community of people, the more of which – the better, since they are both working hands and potential soldiers. Robots break the traditional scheme because they replace people at workplaces and in the army. A model of a state that is strong with its robots rather than people is something for which we are not yet ready,” – says futurologist Yevgeni Kuznetsov, head of the representative office of Singularity University in Moscow.

Robots scare people for many reasons. But it is not as difficult to cope with them as it seems, the military already ascertains this today. “A UAV cannot perform tasks without the support from an entire infrastructure, including takeoff and landing support systems, ground and aerial command posts, data acquisition systems, land and space radio communication equipment, and navigation systems. And this is all our profile, as we say. We are aware of current trends in the development of foreign robotic weapons, we are enhancing our own methods of countering them,” – warns Yuri Lastochkin, head of Russian Electronic Warfare troops.

Among other things, the Lieutenant General talks about neural networks controlling drone groups. But, the war machine of the future cannot be completely entrusted to artificial intelligence. The goal is always set by a human, only a human being has the necessary experience and conceptual apparatus.

“In order to be able to consider various scenarios and their results and assess how realistic they are, a robot must understand millions of common sense rules – simple laws of physics, biology, and human behavior, which we take for granted. Moreover, it must understand causality and anticipate the consequences of certain actions. A person masters these laws over decades of personal experience... Robots do not take part in the vast majority of communication and interaction situations in which personal experience is born,” – Michio Kaku, a famous physicist and popularizer of science, explains.

By the way, it is for the same reason that we can be free from the fear of a machine uprising, although it is often predicted by science fiction writers and scientists. Even in Stanislaw Lem’s book some out-of-control artificial intelligence destroys everything unnecessary on the planet. Bill Gates, Elon Musk, and Stephen Hawking unanimously warn us about the same thing.

But Michio Kaku does not agree: “To enter into the machine all the equations necessary for destroying the human kind is an incredibly difficult task. To avoid the killer robot problem, we actually need to prevent everyone from programming the robots for goals that may harm people.”

GENERAL OF THE HACKER TROOPS

Again, it all comes down to the human, in this case the programmer. Their task at the future war is to make it so that a swarm of drones operates on our side, not the opposite one. The interception of the control of robots in many ways depends on the human factor: a duel of engineers begins. And these are not some hackers

indirectly linked to governments, of whom they scare us in cyberwar articles. They are actual soldiers of a new type. The most important prerequisite for their victory will be good mathematical education.

While the officer of the first type, the stronghold commander, controls the information and financial flows of a defense system, the officer of the second type tries to take control of it; perhaps, from another continent, using the latest scientific developments.

The need to work with Big Data, incredible amounts of information, has generated a great demand for mathematicians around the world. Private Russian companies dealing with global positioning and drone production have entire scientific departments.

Training of mathematicians is one of Russia’s strategic advantages, albeit one that has almost been lost. Today, Russian language can be heard in the lobbies of leading universities and research centers in the U.S.

Viktor Pelevin’s short story “Air Codes of Al-Efesbi” describes NATO drones controlling Afghanistan. Their main vulnerability is not the combat unit (it is perfectly protected), but the unit responsible for the PR part of the Afghan war. Perfect aircraft are downed by information rather than anti-aircraft weapons.

Pelevin could hardly be called a futurologist, he usually makes forecasts for half a year or, less often, several years after the book is published. However, the story about anti-aircraft code was written in 2010 (10 years before the last war in Karabakh), when UAVs had not yet gained much attention in the media. The writer perfectly noted the main law of the war of the future: control over information is more important than the firepower of drones.

TEMPLE WARRIORS

Today, it is easier and safer to persuade someone rather than kill or wound them. For this reason, means of persuasion become an actual war machine.



**A MODEL OF A STATE
THAT IS STRONG WITH
ITS ROBOTS RATHER
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“As a matter of fact, a war of icons or undermining the collective self-control of rivals has been underway for a long time... This is a genuine electric battle of information that surpasses in depth and obsession the old hot wars of industrial iron. The ‘hot’ wars of the past used weapons that incapacitated the enemy in turn, one after another. Even the ideological confrontation of the 18th and 19th centuries was based on compelling individuals to accept new points of view – one viewpoint at a time. By contrast, electric persuasion utilizing photography, cinema, and TV works by immersing the entire population in a new world of imagination. Full awareness of this technological change descended on Madison Avenue [the center of the US advertising industry] when it changed its tactics and switched from promoting an individual product to collective involvement in a ‘corporate image’, which has now been replaced by a ‘corporate position’,” – wrote the first theorist of electronic means of mass communication Marshall McLuhan.

Futurologists call the scope of such an influence ‘liquidation of the vision of the future’ for entire nations. This means that it needs regulation. It is possible that, in the foreseeable future, the international community will discuss all information war possibilities at the same level of detail that it uses now to sign and keep agreements on non-proliferation of nuclear weapons and the prohibition of chemical weapons. Then, each statement in foreign mass media

(as well as the spread of social media to foreign canonic territory) will be regulated by multilateral agreements and, probably, taken as an act of defense or aggression comparable with a missile launch, a hacker attack, or creating an electromagnetic interference on the territory of a partner country.

But this does not eliminate the need of personal protective equipment. While at service, a person can control hundreds of robots and dozens of computing machines. And during their free time, these persons will watch the same films, play the same computer games, read the same books as everyone else. Any piece of information inevitably affects the individual; in order to not lose war, a future officer must develop professional resistance to information influence, develop critical thinking, and also recognize and deactivate desires as necessary. This is approximately what orthodox asceticism teaches us. Perhaps, its use at officer courses will be one way to explain the rapprochement between the army and the church.

BLACK DEATH

The COVID-19 pandemic demonstrated another vulnerability of our world: even the most powerful states are not protected against biological threats. This means that biotechnology will surely be used in future wars. Europe’s fear of the chemical attacks after the World War I is still expressed in the main political plots. Declaring that the enemy used poison



is the worst accusation at the modern media scene. And the Europeans' concerns are largely justified. "...a new biological weapon, for instance, airborne immunodeficiency viruses or Ebola Hemorrhagic Fever, is a real possibility. This alone could wipe out over 98% of people off the face of the Earth", – Michio Kaku states.

Yet, the opposing sides are interested not so much in a massive defeat as in a targeted strike at the specialists who make strategic decisions. Imagine that the hormonal balance of a person is affected by that. A sharp rise in adrenaline levels would increase the probability of making a spontaneous decision. A serotonin drop would result in decreased willingness to live. Or simply, their head starts aching, reducing attention. In a world war, the consequences of such experiences will be global. But biological weapons still leave a person the chance to fight against interference with their body.

RAIN OF OBLIVION

Some religions believe that God recreates the world every instant. Thus, our memories are not the reflection of actual events, but a set of images that have just appeared in our head. And this happens every second.

A person hit by a nanoweapon can have a similar experience. At one moment he is a CIS electronic warfare troops general, then suddenly synapses leap, and now he thinks that he is a NATO colonel. He even remembers in detail how he gave a speech before the allies in Brussels and received a Medal of Honor of the Congress for his achievements. Neither willpower, nor mental training would counteract such an influence.

"Floyd fingered the little glass vial in his pocket. It contained a harmless-looking silvery-grey fluid, tasteless and odourless. But slipped into the right person's diet, it would infect their body with a billion tireless machines, which would identify and cure almost any illness known to Slasher science. It was bottled immortality," Alastair Reynolds writes in his novel "Century Rain". Scientists do not share fiction's optimism: nanobots will not cure people. At the Global Catastrophic Risks Conference at Oxford University, experts predicted that the probability that nanotechnology will become the cause of the humanity demise is 5%. Artificial intelligence accounts for the same probability, and conventional wars – for a probability by 1% higher. A swarm of nanobots capable of self-reproduction was named the "gray goo" in the culture.

A WORLD WITHOUT BOUNDARIES

Sociology has another image of a future conflict, no less astonishing than a human-caused catastrophe. When we describe a war, we speak, as a rule, of confrontation between countries, and their alliances. But the concept of the modern state is only several centuries old. And, similar to any social construction, it has a limited timespan. It is possible that in a few

hundred years, there will emerge networking systems of citizens and institutions, consolidated not by a territory, but by common economic interests or views of the world. Means of communication, virtualization of finances, and simplification of production are bringing this time closer.

Ensuring the security of social structures will be a more difficult task than keeping common boundaries because a member of the other system, a bearer of opposite values, can live next door to you. There is a possibility of war between the old type state and a new networking system. And even the most insightful futurologists cannot yet predict how exactly we will negotiate with our neighbor.

INCOMPLETE TIME

Images of the future come from science fiction, and people who determine the strategy for the development of humankind also read it. Perhaps, it is for this reason that the forecasts made in science fiction come true.

In *The Secret of Two Oceans*, Grigory Adamov describes in detail how to overcome the resistance of the environment – water or air. The creator of the "Pioneer" submarine enclosed its hull in a layer of hot steam, allowing it to reach incredible speed.

Hypersonic missile designers came to the same decision, although they needed a cocoon consisting of plasma, not steam.

In the series *Battlestar Galactica*, rebellious androids get hold of all networks controlling human technology. Only one star-cruiser, the commander of which has refused to modernize the ship in due time, stands against the machines.

The actions of small mobile groups not connected to a common center are becoming an important tool of war. They are autonomous, so they cannot be detected, redirected or deactivated.

In his novel *Starship Troopers*, Robert Heinlein predicts that infantry will be the main striking force of space wars. Yes, it will be the one equipped with exoskeletons and jetpacks.

In the conditions of political uncertainty, actions of terrorist organizations and proxy groups, the situation cannot be handled without the landing forces. Sometimes a cudgel turns out to be a more effective weapon than the Tsirkon missile. Nothing disappears in the humanity history, and archaic methods of warfare will always exist along with high-tech ones.

In the Strugatsky brothers' *Inhabited Island*, the main weapons are towers, the beams of which evoke certain emotions in people. Although, the



radiation does not reach enemies. The technology has to be used in internal politics.

At the time when the story was published, it seemed that it was about the television, about familiar propaganda methods. Today, we realize that such towers can directly change the psychophysiological condition of a human being. For example, they can affect the pupil's dopamine receptors, activate sounds inaudible to the ear, or to launch nanobots.

The main character of Alaster Reynolds' novel *Century Rain* released the silver dust from the jar; thus nanobots entered human body. The writer believed that nanomachines would cure us.

Scientists regard this technology as a lethal weapon, rather than a way to cure the human kind.

Stanislaw Lem, in his *Summa Technologiae*, wrote that means of futurology are not enough to predict a war. The analyst's view goes over facts from the world of technology, economics, and culture. Meanwhile, fundamental scientific works always become the future's starting point.

Present-day investigations show that analysts' predictions come true 49% of the time. Tossing a coin would be more reliable. ♦

**PROBABILITY THAT
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RUSSIA EXITS OPEN SKIES TREATY, MIRRORING U.S. DEPARTURE / THE MOSCOW TIMES

Russian President Vladimir Putin signed a law on June 7 formalizing Russia's exit from the Open Skies Treaty, an international pact that allows surveillance flights over fellow members' military facilities, after the United States' withdrawal last year. The United States left the treaty in November 2020, accusing Russia of non-compliance. Russia's exit from the Open Skies Treaty takes effect six months after Putin's signing.

Russia and the U.S. have long accused each other of breaching Open Skies, with Moscow blaming Washington for cold-shouldering its proposals to retain the treaty's viability.

Lawmakers in Russia's two-chamber parliament had approved legislation on the treaty's renunciation in less than a month since Putin first submitted it on May 11, 2021.

The Open Skies Treaty, which was signed in 1992 and came into force in 2002, allows its three dozen members to conduct joint unarmed short-notice observation flights over countries' territories to monitor potential military operations. ♦



GLOBAL NUCLEAR ARSENALS GROW AS STATES CONTINUE TO MODERNIZE / SIPRI YEARBOOK 2021

The nine nuclear-armed states – the United States, Russia, the United Kingdom, France, China, India, Pakistan, Israel, and the Democratic People's Republic of Korea (North Korea) – together possessed an estimated 13,080 nuclear weapons at the start of 2021. This marked a decrease from the 13,400 that SIPRI estimated these states possessed at the beginning of 2020. Despite this overall decrease, the estimated number of nuclear weapons currently deployed with operational forces increased to 3,825, from 3,720 in the last year. Around 2,000 of these – nearly all of which belonged to Russia or the USA – were kept in a state of high operational alert. [...]

Russia and the USA together possess over 90 per cent of global nuclear weapons. Both have extensive and expensive programs under way to replace and modernize their nuclear warheads, missile and aircraft delivery systems, and production facilities. [...] All the other seven nuclear-armed states are also either developing or deploying new weapon systems or have announced their intention to do so. ♦

NATO LEADERSHIP REJECTS AN INVITATION TO MOSCOW SECURITY CONFERENCE / TASS

NATO has rejected Russia's invitation to the alliance's leadership to participate in the Moscow Conference on international security on June 22–24. "The Russian side's invitation to take part in the Moscow Conference on international security has been met with a refusal. What can better testify to the true intentions of NATO and its Secretary-General [Jens Stoltenberg]?" Russian Foreign Ministry Spokeswoman Maria Zakharova said at a briefing ahead of the conference remarked.

Russian Deputy Defense Minister Colonel-General Aleksandr Fomin has said that Russia's Defense Ministry had invited the NATO leadership to the Moscow conference on security.

"We are open for a dialogue with the alliance. The convocation of a Russia-NATO Council meeting is needed only if the discussion focuses on the specific issues aimed at easing military tensions. This will undoubtedly require the participation of the military. But we know well that NATO is a military and political bloc, and so there is nothing illogical in that," said Zakharova. ♦



RUSSIAN HYPERSONIC WEAPONS: WHAT, WHEN AND WHY?

Over recent years, hypersonic weapons have occupied a central position in discussions on new technologies affecting international security. Moreover, it should be noted that the quality of a discussion often leaves much to be desired. We will attempt to rectify the situation, at least as it relates to Russian armaments.

Author **Dmitry Stefanovich**, Researcher at the Institute of World Economy and International Relations, Russian Academy of Sciences (IMEMO)

WHY ARE HYPERSONIC WEAPONS HIGHLY IMPORTANT?

Guided hypersonic flight of delivery vehicles in the atmosphere presents a serious challenge both for the designer and the operator. For the owner of such a weapon, its development and operation is an extremely complex technological task. It is virtually impossible for a “receiving side” to understand where the hypersonic missile or its warhead is flying and what their target is.

In principle, in the expert community there is a common understanding of the fact that, for a weapon to be called “hypersonic”, it must possess two main defining characteristics: a speed exceeding Mach 5 (i.e. five times the speed of sound in a medium), and the ability to perform maneuvers (both vertical and horizontal) while moving at this speed in the atmosphere.

It is believed that the combination of these two qualities is also augmented by sufficient precision and the impossibility to determine the type of the payload (i.e. whether the hypersonic weapon carries a nuclear or conventional warhead), as well as an hard to define target (in the case of long range weapons).

This, in turn, creates the key threat of hypersonic weapons, for both internation-

al and national security: misperception of targets, and provoking political and military responses, often leading to new rounds of escalation.

It should be noted that at present time it is practically impossible to intercept “traditional” intercontinental ballistic missiles (ICBM) and medium range missiles, taking into account the highly sophisticated missile defense penetration aids. Supersonic cruise missiles, commonly used as anti-ship missiles, also pose a serious challenge to anti-aircraft and anti-missile defense systems. At the same time, hypersonic boost-glide vehicles (HGV), cruise missiles, and aeroballistic missiles will make missile defense even more difficult.

As far as hypersonic boost glide vehicles are concerned, it should be remembered that their speed at the final trajectory segment is significantly lower than that of “traditional” ICBM warheads, therefore, it is likely that the air and missile defense assets of the protected object are quite capable of intercepting approaching gliders, particularly considering their large dimensions. Additionally, the size of the boost glide vehicle and its heating during flight inside the atmosphere can simplify the task of detecting and tracking it using the infrared sensors of the satellites of the early-warning system. Nevertheless, the plasma “cloud” forming around the boost

glide vehicle will make it more difficult to provide target designation.

Simultaneously, the speed and maneuverability of hypersonic weapons result in very serious technological problems for their guidance and structural integrity. It can be assumed in general that maneuvers will be performed using very large radii (up to several hundred kilometers for weapons of intercontinental range). The “high precision” of hypersonic weapons is also not unconditional. Maneuvers lead to an accumulation of errors, while speed makes even the slightest mistakes highly critical.

Another big question relating to the technological aspects of the development, production, and use of hypersonic weapons goes as follows: is it possible “to communicate” with them when in flight and how can this be done? This process is significantly affected by plasma fields generated around the weapon during the hypersonic flight in the atmosphere. In order to solve this problem, several options can be resorted to; for example, decelerating, “jumping” from the atmosphere to space, or using satellite transmitters. Nevertheless, there is no open data about how communication is established in practice with hypersonic weapons currently being developed and deployed.

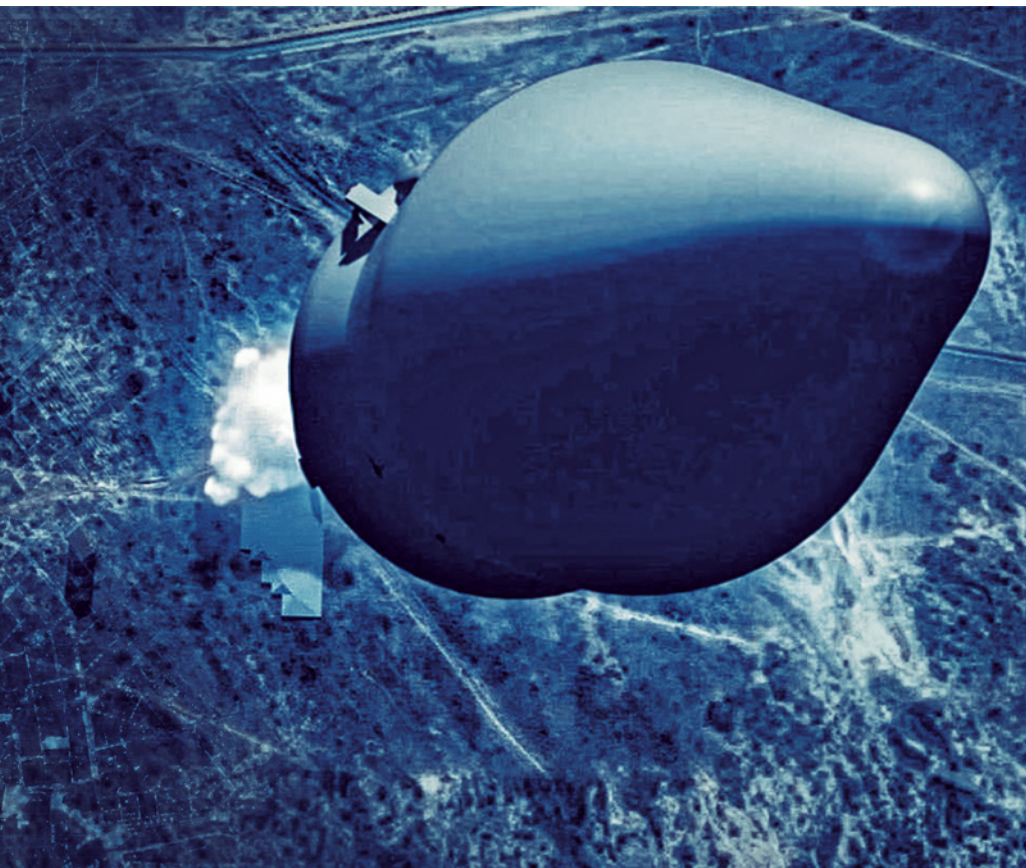
Traditionally, there are two main types of hypersonic weapons: hypersonic glide



VLADIMIR PUTIN,
PRESIDENT
OF THE RUSSIAN
FEDERATION

.....

Now we have a situation that is unique in modern history: when they are trying to catch up with us. Not a single country has hypersonic weapons, let alone hypersonic weapons of intercontinental range



vehicles (HGV) and hypersonic cruise missiles. In addition to that, it seems appropriate to single out yet another conventional subcategory – hypersonic aeroballistic missiles.

Today, there are two types of hypersonic weapons deployed in Russia: boost-glide vehicles as part of the Avangard strategic delivery system, and hypersonic aeroballistic missiles as part of the Kinzhal aerial missile system.

WHAT PROJECTS IS RUSSIA IMPLEMENTING?

To begin with, it is worth trying to formulate why Russia needs hypersonic weapons. The main declared task is the guaranteed delivery of nuclear warheads in the context of the US developing missile defense system (in terms of capability and geography) and persisting dominance of the United States in the field of conventional weapons, primarily with regard to high precision weapons, as well as the dominance of the U.S. Navy in the World Ocean. For this reason, assets are required both for overcoming missile defense and for the physical destruction of missile defense elements of various basing modes. One must not also forget the potential of lobbying on the part of the military-industrial complex, design bureaus, etc.

Russia's capability in the development of hypersonic weapons resulted in that they are among the most advanced, thanks, in part, to its huge research and technical experience, and the availability of all the infrastructure necessary for testing.

So far, Russia has deployed two models of hypersonic weapons:

1. The Avangard strategic delivery system with boost-glide vehicles, deployed since December 2019, in the ranks of four regiments in the 13th Orenburg Red Banner Rocket Division. The renowned UR-100NUTTKh intercontinental ballistic missile is used as a boost stage. This project has been under development with varying degrees of intensity for several decades. Furthermore, it should be emphasized that it became known in December 2019 that its minimum range is 6,000 kilometers. As a matter of fact, this should end all discussions regarding the potential use of the Avangard in limited or regional conflicts. It is also important to remember that Avangard entered service as part of the Strategic Missile Forces, the ground-based leg of Russia's strategic nuclear triad. The main – if not the only – task of the strategic missile forces is strategic nuclear deterrence, so one can confidently say that Avangard will be exclusively nuclear.

2. The sub-strategic missile system Kinzhal, an airborne hypersonic air-

launched ballistic missile, uses the modified MiG-31K interceptor as a carrier and/or boost vehicle. The missile itself is presumably related to the quasi-ballistic missile of the 9M723 family which is part of the operational-tactical Iskander-M missile system. It is likely that about 10 units have been on experimental combat duty since December 2017 in the Southern Military District, they fly on combat patrol missions over the Caspian Sea and the Black Sea, and also in cooperation with the Long-Range Aviation (a branch of the Russian Aerospace Forces). Tests are underway for the use of the system in the Arctic. It has also been announced that MiG-31K has been deployed in Krasnoyarsky Kray. The range of the Kinzhal missile system is up to 2,000 kilometers (possibly, including the range of the carrier aircraft).

3. Furthermore, in recent years there have been quite a few reports about the sea-based (and, as it was recently confirmed officially, land-based) hypersonic missile 3M22 Tsirkon. According to current plans, it will be put into service as early as in 2021–2022; primarily for new frigates (project 22350) and the nuclear submarines of the Russian Navy (project 885/885M). According to existing information, Tsirkon is being developed taking into account the possibility of using the standard “cells” of the universal

ship borne firing system, also used for the Kalibr cruise missile family (3M14 and anti-ship 3M54), and the supersonic anti-ship missile 3M55 Oniks. Presumably, the launcher for the land version of this complex will also be unified with the ground-based Kalibr, the development of which was announced in connection with the withdrawal from the Treaty on the Elimination of Intermediate-Range and Shorter-Range Missiles (INF Treaty). At the same time, while the technologies behind the Avangard and Kinzhal are more or less clear (in fact, the first one is an enhanced maneuvering reentry vehicle, and the second one, an advanced airborne ballistic missile), the situation with the Tsirkon remains uncertain, despite the video footage of test launches released in the fall of 2020. The declared maximum range of the Tsirkon is up to 1,000 km, but, according to public data, the actual range demonstrated during the tests has not yet exceeded 500 kilometers.

The speeds, trajectories, and precision of all these systems remain unknown, as does their reliability. At the same time, it is important to emphasize that, for Russia, the main declared mission of hypersonic weapons is the delivery of nuclear weapons, while the United States focus on the capabilities of the “conventional” non-nuclear strike. Thus, precision requirements for the American program could be significantly higher.

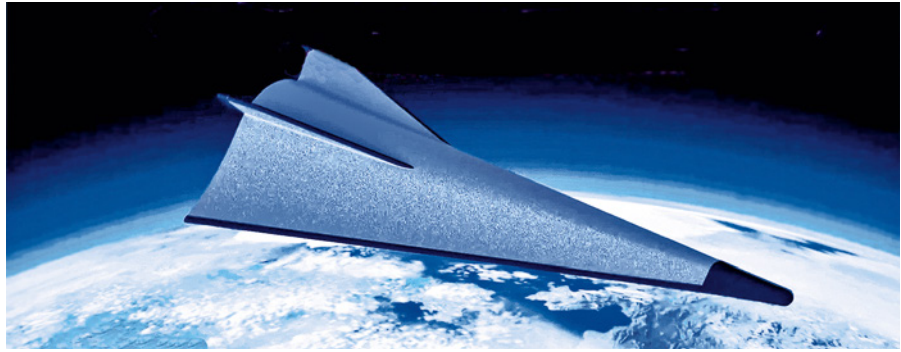
Here we need to emphasize that the deployment of the Avangard, Kinzhal, Tsirkon, and future versions of the hypersonic weapon does not lead to revolutionary changes in Russia’s overall missile potential. Russian intercontinental ballistic missiles have been and remain to be a reliable shield against any existing threat. Supersonic and subsonic cruise missiles, as well as tactical ballistic missiles make for a serious argument in terms of non-nuclear deterrence, among other things.

However, as we enter the “hypersonic era”, the early deployment of such systems will allow the Russian Armed Forces and industry to better understand operational problems and eliminate any “rough edges” and “teething troubles” that may only be found in the process of continuous combat duty.

Sub-strategic weapons, such as Kinzhal and Tsirkon, could play an even bigger role: they enhance the deterrence potential related to the naval superiority of the United States and the NATO.

WHAT IS NEXT?

A hypersonic arms race scenario is quite possible, for both military and political reasons. As far as the military aspect is



concerned, such weapons do not lead to a revolution but they can ensure a relative advantage, particularly against enemy targets protected by layered air and anti-missile defense systems. From the political point of view, thanks to the hype surrounding this technology, it is quickly becoming a symbol of status. In such a situation, the main problem for those who want to obtain hypersonic weapons will be the infrastructure needed for developing, testing, manufacturing, and deploying them. It is likely that the emergence of hypersonic weapons on the markets of military products is not far off.

If the proliferation of hypersonic weapons technology becomes a reality, it will exacerbate the existing problems associated with the proliferation of “traditional” ballistic and cruise missiles, providing state and ultimately non-state actors with even better chances for carrying out high-precision strikes at long ranges. Besides that, it will stimulate investments in missile defense by all countries that may feel threatened, and as a result, we may see overlapping provisional “bubbles” of defensive and offensive potentials in various regions of the world. Of course, these “bubbles” will have significant “holes”, but the most important conclusion is that the inextricable link between offensive and defensive systems as basic elements of mutual deterrence, which was realized by Russia and the USA at the strategic level long ago, is also becoming a regional reality.

At the same time, the scale of a potential hypersonic arms race will be limited. In the long run, these weapons are very expensive and mass production will not necessarily lead to significant cost optimization. Moreover, the number of sufficiently valuable targets for such weapons also seems to be very limited.

WHAT SHOULD BE DONE?

In order to minimize the possible negative role of hypersonic weapons in the context of international security, several proposals can

be formulated. First and foremost, transparency regarding intended missions and types of payload for hypersonic weapons is extremely needed here. Some countries may think that such openness could somehow undermine the perceived deterring effect of hypersonic weapons, but, it seems that this is an area where “ambiguity” can lead to catastrophic miscalculations.

Furthermore, it is advisable to hold events in various formats and prepare reports on the subject of hypersonic weapons, this helps increase awareness, eliminate some false and hazardous narratives and provide venues for the discussion of problems and intentions. Such activities are already being carried out, in particular, by the United Nations Office for Disarmament Affairs (UNODA), the United Nations Institute for Disarmament Research (UNIDIR), the Pugwash Conferences on Science and World Affairs, the Missile Dialogue Initiative of the IISS supported by the German Federal Foreign Office, the Vatfor Project, and others.

And last but not least, and in order to enhance the effectiveness of the dialog, at least at the expert level, it would be beneficial to develop a coordinated set of definitions, a glossary for analysis related to hypersonic weapons.

To sum up, we should emphasize that hypersonic weapons are just another page in the book of the development of weapons and military equipment – not the most modern one, in fact. Concepts and even some projects were born many decades ago. Despite declarations of the contrary, these weapons will not change the nature of military-political relations on a global scale and do not, in any way, illustrate the intentions of the countries developing them. With or without hypersonic weapons, we live in a dangerous world and the only way to make it less dangerous is to seek joint solutions that address the concerns of all nations. ♦



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ISRAELI MILITARY CONSTRUCTION: THE FINANCIAL ASPECT



The Israeli political leadership has traditionally paid serious attention to financing the national military establishment. Evidently, it is maintaining a high alert level that enables the Israeli to quickly respond to emerging challenges and national security threats.

Author Roman Koshkin



ISRAEL'S MILITARY BUDGET

According to "The Military Balance", the annual review of countries' military potential, the Israeli military budget in 2018 amounted to \$15.69 billion, which is 3.4% more than in 2017 (and 20% more than in the beginning of the period in question). In 2018, the Ministry of Defense accounted for 85.9% of the expenses of the military budget, while other ministries and establishments accounted for 14.1%.

The total amount of the state expenses for military purposes is characterized by total military expenditure (TME). In 2018, Israel's total military expenditure amounted to \$17.9 billion. In general, an increase in total military expenses was observed in 2014–2018. They were estimated at \$18.8 billion in 2019, and \$19.9 billion in 2020. On average, military expenditure accounted for 4.9% of the country's GDP during 2014–2018. Total military expenditure accounted for 12.8% of the state budget of that period on average.

Besides its own military financing sources, Israel has fairly large foreign ones. The major foreign resource has been the annual non-repayable military aid granted by the USA. Since 1999, the funds have been provided on the basis of the "Memorandum of Understanding" between the USA and Israel governments, in a decade cycle format. In particular, a new package for \$38 billion (for 2019–2028) was signed in September 2016 (with regard to the regular agreement expiry in 2018).

Since these funds are targeted, received from a foreign country within the framework of military-technical cooperation, they are not included in the total military expenses. Along with that, they can be considered for estimating the total amount of funds for the construction and maintenance of the Israeli armed forces.

According to the Stockholm International Peace Research Institute (SIPRI), US military aid is provided to Israel according to two main programs: Foreign Military Financing, FMF, administrated by the US Department of State, and Israel Missile Defense, IMD, through the American Department of Defense. Some part of the funds – 25–30% – are used for financing R&D activities and military product procurement from the Israel defense industry, the other part is used for direct deliveries of weapons and military equipment and other military products from the USA. These deliveries are carried within the framework of the following programs:

TABLE 1.
MILITARY CONSTRUCTION FUNDING IN ISRAEL (USD billion)

INDICATOR	YEARS						
	2014	2015	2016	2017	2018	2019	2020
TOTAL MILITARY EXPENSES	15,0	15,5	15,5	17,4	17,9	18,8	19,9
US MILITARY AID	3,8	3,7	3,6	3,8	3,6	3,8	3,8
FOREIGN MILITARY FINANCING (FMF)	3,1	3,1	3,1	3,2	3,1	3,3	3,3
ISRAEL MISSILE DEFENSE (IMD)	0,7	0,6	0,5	0,6	0,5	0,5	0,5
COMBINED FINANCIAL RESOURCES FOR MILITARY PURPOSES	18,8	19,2	19,1	21,1	21,5	22,6	23,7

- Foreign Military Sales, FMS;
- Direct Commercial Sales, DCS;
- Excess Defense Articles, EDA.

The amount of military aid to Israel from the US government for the last five years is estimated at \$18.5 billion.

Taking into account these amounts, allocated on a de facto legislative basis, and at the same time coming from external sources, in regard to Israel we can talk about such a concept as combined financial resources for military purposes. The use of this indicator is necessary for estimating the real amounts of funding for construction of the country's forces. SIPRI experts think that Israel's combined financial resources for military purposes amounted to \$22.6 billion in 2018 and were increased by \$1.1 billion in 2020 (Table 1).

STRUCTURE OF MILITARY EXPENDITURE

Research materials of the Strategic Studies Institute (USA) allow to argue that a number of peculiarities is typical for the targeted expenses structure of the Israeli Ministry of Defense. Military personnel expenditures increased by 15.1% in 2014–2018, amounting to \$5.5 billion. Civil personnel expenditures increased by 15.2%, amounting to \$1.1 billion in 2018. Also, the percentage of military and civil staff expenditures in the Ministry of Defense budget grew consistently during this period. This trend will be maintained in the nearest future, which is a result of the implementation of armed forces development plans.

Military training and logistic support costs increased by 4.8% during the period in question, amounting to \$5.4 billion in 2018; military facility construction expenses grew by 9.1%, reaching \$0.3 billion. At the same time, their percentage in the Ministry of Defense budget remained unchanged throughout the entire period. The Israeli Armed Forces technical equipment expenses (the sum of weapons and military equipment procurement costs and R&D expenses) in the Ministry of Defense budget amounted to \$3.1 billion in 2018. Along with that, the total amounts of funds for these purposes reached \$6.2 billion, and the USA military aid accounted for a large part of that sum – 50.2% (\$3.1 billion). This trend, with insignificant fluctuations, remained during the period in question. The percentage of the costs of technical equipment of the Armed Forces in the Ministry of Defense budget somewhat decreased during this period.

Among different armed forces, a large part of the military budget is allocated for land forces maintenance – 48% in 2018. Air Force expenses amounted to 45%. In general, during the period in question, the land forces and air forces percentages, as well as expenses not classified by armed force types, remained unchanged with slight fluctuations. In 2018, 6% of the budget was allocated to the Navy, a certain decrease of their percentage is observed during the period in question (Table 2).

In general, Israel's military and political authorities pay significant attention to national armed forces development. Annual increase of military construction financing can be an indicator of purposeful implementation of the tasks specified in the Gideon Plan ("The Plan of Armed Forces

Development in 2016–2020") by the Israeli leadership. The tasks are as follows:

- Optimization of Israeli armed forces staff numbers – provides for cutting of contract enlistees, non-combat units' manpower, conscription service term from 36 to 32 months, with simultaneous increase in the number of annual conscriptions from three to four; the personnel of staff and command structures of the Israeli armed forces by 6%;



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The Israeli army is considered to be one of the best and professional armies in the world in its own right. Both the willingness to serve in the Israeli Defense Forces and army support in the society still remain at a high level. Today, the army is much stronger and more professional than it was in the past. But the requirements have also grown sharply. Internal political disputes about ways to solve the Arab-Israeli and Israeli-Palestinian conflicts continue and will continue until these conflicts have been settled.

TABLE 2.
STRUCTURE OF ISRAEL'S MILITARY EXPENDITURE (USD billion)

INDICATOR	YEARS						
	2014	2015	2016	2017	2018	2019	2020
TOTAL MILITARY EXPENSES	15,0	15,5	15,5	17,4	17,9	18,8	15,0
MOD EXPENSES BY TARGET							
MILITARY PERSONNEL EXPENDITURES	4,7	5,1	5,1	5,4	5,5	5,6	5,8
CIVIL PERSONNEL EXPENDITURES	0,9	0,9	0,1	1,0	1,0	1,2	1,3
MILITARY TRAINING AND LOGISTIC SUPPORT	5,1	5,8	5,7	5,3	5,4	5,6	5,7
WEAPONS AND MILITARY EQUIPMENT PROCUREMENT	2,5	3,0	2,7	2,0	2,1	2,0	2,1
R&D	0,1	1,1	1,1	0,8	0,8	0,8	0,8
MILITARY FACILITY CONSTRUCTION	0,1	0,3	0,3	0,3	0,3	0,3	0,3

– Assistance to American-Israeli interaction on the matters of Israel's national defense industry complex development, as well as participation in joint projects for the development and implementation of state-of-the-art armament types in both countries' armies;

– Establishment of cyberdefense forces;

– Procurement of the multipurpose 5th generation aircraft F-35 and establishment of two fighting and bombing squadrons on their basis;

– Procurement of four K-130 project Braunschweig corvettes and establishment of a combat corvette squadron on their basis, with the home station at the main Navy base Haifa; besides that, acceptance of a sixth Dolphin-type diesel electric submarine into the Israeli Navy active inventory;

– Transition to an in-depth missile defense system including the Iron Dome, David Sling and Arrow-3 complexes.

MILITARY INDUSTRY

Thanks to a stable military budget, Israel formed a military industry that not only has state-of-the-art R&D and high-tech production base for the manufacture of weapons and military equipment, but is also an important component of the Israeli economy.

The country has over five hundred military product manufacturers, with a total staff number of approximately 140 thousand persons. Along with that, about 130 companies act as direct suppliers of armaments and military equipment for the country's armed forces, as well as for export. Most

manufacturers of military products are small and medium enterprises (up to 100 persons) mostly owned by commercial companies with various state participation percentages. The military production sector also includes design bureaus, research institutes, and laboratories. By forms of ownership, the enterprises are divided into state- and private-owned ones and joint ventures with participation of Israeli and American private capital.

Israel's defense industry complex is characterized by an effective management system, a high level of production facility management, predominance of development, manufacturing high-tech and science-intensive products, as well as by export oriented military products.

The structure of Israel's military industry management system provides for direct participation of the Ministry of Defense at all stages of the armaments and military equipment life cycle, starting with terms of reference development, R&D arrangement, mass production, and ending with delivery control and military equipment operation in the field. Besides that, MoD structures perform functions of export products package content and quality control, have the right to carry out negotiations with foreign customers, to issue export licenses, to interact with the Ministry of Foreign Affairs in consideration of political aspects in the armaments export area. The list of terms of reference for the development and production of new weapons and military equipment types has to be approved by the Ministry of Defense.

Due to a shortage of raw materials and limited material and logistic base possibilities for production of heavy arms, the

Israeli military industry is mostly oriented at the development and manufacture of high-tech science-intensive products, first and foremost radio and electronic equipment. The availability of a well developed R&D base and sufficient amounts of highly skilled personnel, in both civil and military industry, helps a lot.

DEFENSE INDUSTRY ENTERPRISES

For a long period of time, three state corporations were included in the main military product manufacturers, by the number of their employees, production and sales volumes: Israel Aerospace Industries (IAI), Israel Military Industries (IMI), Rafael Advanced Defense Systems, as well as the largest private corporation Elbit Systems. These corporations also supplied the most products to meet the demand of Israel's national armed forces and exports.

However, in 2018, as a result of a privatization process, the main part of the facilities of the state corporation IMI was purchased by the private corporation Elbit Systems, which significantly expanded its production capabilities and strengthened its position at the armaments market. Some of production facilities (manufacturing aircraft, missiles, and firearms) was included in other corporations and companies. In particular, missile weapon production was transferred to the Rafael corporation and the firearms division Magen Light Weapons Division was purchased by SK Group and renamed to become the Israel Weapons Industries (IWI). The transfer of some state-owned production facilities to private corporations and redistribution of production facilities among the leading defense industry complex corporations

allowed to optimize their activities and ensure more efficient functioning of each military products manufacturer, while keeping the production range and scope.

The Israeli government regards privatization and restructuring of defense complex enterprises as an acceptable way to enhance military production efficiency. The question of optimizing the activities of the state corporations IMI, IAI and Rafael through their privatization and establishment of two large holdings has already been discussed earlier. The first of these holdings was to join the production facilities of IAI and Elbit Systems for manufacturing of missile/space and aircraft systems, while the other one was to combine IMI and Rafael and focus on the manufacture of armored vehicles, artillery weapons, and firearms, as well as ammunitions.

To enhance the effectiveness of defense industry enterprise functioning, Israel's government aids to broad participation of companies in joint defense projects with foreign manufacturers and armament manufacturers.

The restructuring did not introduce any significant changes in the structure of the leading weapon manufacturers of the Israeli defense industry complex. Now, it is represented by two largest state corporations and one private corporation. The same corporations provide up to 90% of deliveries according to export contracts.

The state corporation Israel Aerospace Industries is the largest company of the Israeli defense industry complex. Its area of activities includes development, manufacture, overhaul and modernization of missile/space systems, UAV, a large assortment of electronic, optical and electrooptical equipment, as well as land-based and shipborne missile defense and anti-aircraft systems. The corporation is a leader at the global market of modernization of various types of foreign aircraft and has a staff of approximately 16,000 employees.

The state corporation Rafael is a joint-stock company, in 1948 it was known as Israel's National Research and Development Defense Laboratory, and was renamed as Rafael Advanced Defense Systems Ltd. in 2007. The corporation enterprises develop and manufacture a wide assortment of armaments, including state-of-the-art near- and medium-range anti-missile and anti-aircraft systems, shipborne missiles, airborne weapons, electronic warfare equipment, electrooptical systems, night vision devices, computer and telemetry systems, as well as active defense systems



for AFVs. The corporation's staff includes about 6,500 employees. The company has foreign branch offices practically in all the regions of the world.

The private corporation Elbit Systems is the second leading Israeli manufacturer and exporter of armaments and military equipment. The company produces a large assortment of military and dual purpose products, including long-, medium- and low-range state-of-the-art UAVs; aircraft and ship simulators; navigation equipment; electrooptical systems for civil and military aviation; and communication equipment. The corporation has about 20 subsidiaries operating abroad. The corporation's staff includes about 12,000 employees.

Israel's military-industrial complex has a completely industry-based structure. The missile and space, radioelectronics, armored vehicles, as well as artillery and firearms industries are the most important.

MISSILE AND SPACE INDUSTRY

The industry base of the Israeli missile and space industry includes five enterprises – four are for production and one, for overhaul.



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The force buildup program became possible thanks to the approval in 2019 of a new decade plan of US financial support in the amount of \$38 billion. According to the plan, Israel will receive annual support in the amount of \$3.3 billion, as well as \$500 million for anti-missile defense. In addition to that, according to the National Security Strategy, until 2030 an increase in defense expenses by 0.3% of the GNP has been planned





The plant of the IAI Systems Missiles and Space Group division in Lod manufactures the operational/tactical missiles Jericho and LORA (Long-Range Artillery Missile), medium-range ballistic missiles Jericho-3, anti-ship missiles Gabriel-3, anti-tank guided missiles (ATGM) LAHAT and Nimrod, antimissiles Arrow-3. Besides that, the three-stage space launch vehicles Shavit are produced, used for delivering the Ofeq and TecSar satellites (also manufactured at this facility) to the orbit.

The Haifa-based plant belonging to the Rafael corporation produces aerial guided missiles Python-5 and Derby, various modifications of the ATGM Spike, missiles Tamir for the missile defense system Iron Dome and Stunner, as well as the ship-borne near-range vertical launch system Barak. The other plant of this corporation in Yodefat has facilities for manufacture of aerial guided missiles Popeye, established in cooperation with the American Lockheed Martin Corporation.

Elbit Systems' plant in Ramet-Hashiron manufactures tactical missiles LAR-160 for artillery rocket systems, as well as the launchers. The plant has also facilities for

the production of the ATGM MAPATS and cruise missiles Delilah.

AVIATION INDUSTRY

The aviation industry base is formed by 20 enterprises, 16 of which deal with production, and the rest with the products' overhaul. Eight production enterprises assemble armaments and military equipment, while seven manufacture the needed components. One plant specializes on aircraft engine production.

Israel's aviation industry does not have facilities for combat aircraft manufacture, only for their overhaul and modernization. At the same time, the industry enterprises develop and produce unmanned aerial vehicles, by the manufacture of which Israel holds leading market positions among the world's manufacturers.

Thus, Aeronautics Defense Systems in Yavne develops and produces the Aerostar, Orbiter and Dominator series UAVs and security systems. Its plant employs 680 persons.

The Malat division of Israel Aerospace Industries in Lod produces the UAV Ranger, Hunter, Heron, etc. The attack UAV (loitering ammunition) Harop and Harpia are produced at the IAI Systems Missiles and Space Group plant at the same location. Mini-UAVB are designed by Bluebird Aero Systems Ltd.

Another priority area for Israel's aviation industry enterprises is manufacturing of aircraft components, as well as aircraft overhaul and modernization. The enterprises of this industry mainly specialize in the modernization of Soviet (Russian), American, and French aircraft operated by Eastern European, Asian, and African countries.

Thus, Israel's aviation industry has limited capabilities. The existing facilities allow the companies of the industry to carry out aircraft overhaul and modernization for the national Air Forces and foreign clients. The priority area of production activities of Israel's aviation industry is development and manufacture of a wide range of unmanned aerial vehicles. Their production volumes meet the national armed forces' demand, as well as large export demands.

ARMORED VEHICLES INDUSTRY

The armored vehicles industry base is formed by fourteen enterprises, four of which deal with overhauls. Elbit Systems' enterprise in Lod produces various modifications of the tanks Merkava and armored heavy infantry vehicles Namer. The Carmor plant manufactures the Wulf series armored personnel carriers.

The facilities of the armored vehicle overhaul plants allow to carry out overhaul and modernization of the AMX13, AMX30, M41, M47, M48, M60, PT-76, T-54, T-55, and T-62 tanks; M3, M113, V100 and V150, BTR-50 armored personnel carriers; and BMP-1 armored infantry vehicles. Conversion of vehicles including the T-54 and T-55 tanks to armored personnel carriers is being carried out.

In general, Israel's armored vehicles industry has sufficient capabilities for manufacture of state-of-the-art armored vehicles, it meets the demand of Israeli armed forces and successfully promotes its products at export markets.

ARTILLERY INDUSTRY

The manufacturing of artillery armaments and firearms is one of the most advanced areas of Israel's military industry: it in-



cludes eight plants, two of which specialize in overhauls.

The main manufacturer of artillery armaments is Soltam Systems' plant in Yokneam, which produces 155-mm self-propelled and towed howitzers, anti-tank guns, 60-, 81-, 120- and 160-mm mortars (including automated systems based on the 120-mm mortar (Computerized Autonomous Recoil rapid Deployed Outrange Mortars, CARDOMs)), 120-mm tank guns for the main combat tanks and 60-mm guns for armored combat vehicles.

The main manufacturer of firearms in Israel is the private company Israel Weapons Industries (IWI). Since 2005, after privatization of the IMI Magen Small Arms Division, the company became part of the private corporation SK Group. So, 5.56 and 7.62 mm machine guns, 9-mm pistols/machine guns, 5.56 and 7.62 mm attack rifles, semi-automatic sniper rifles SR-99 and 9-mm pistols are produced at this company's plant in Ramat. At the present time, a modern production complex with 560 employees has been built in Kiryat Gat. The overhaul plants in Ashdod and Jerusalem allow to overhaul a wide range of artillery weapons and firearms for the national armed forces.

AMMUNITION INDUSTRY

The ammunition industry includes fourteen enterprises. The Israel Military Industries (IMI) corporation's plants manufacture all necessary types of firearms and artillery weapon ammunition for the national armed forces: 5.56 mm, 7.62 mm, 9-mm and 12.7 mm cartridges, 20-, 30-mm shells for anti-aircraft guns; 75-mm shells for the tank guns M50; 76-mm shells for ship guns; 90-, 105-, 106-mm shells for non-recoil guns; 120-mm armor-piercing shells; 130-, 155- and 175-mm artillery shells; 52-, 81-, 120- and 160-mm mortar mines.

Besides the plants, ammunitions are produced at artillery and firearms industry plants. Thus, Soltam Systems' plant in Haifa produces ammunitions for the howitzers and mortars manufactured there. Private companies manufacture explosives and gunpowders for ammunition, make igniters and detonators.

In general, the ammunition industry enterprises have sufficient production facilities capable of completely meeting the national armed forces' demand.

SHIPBUILDING INDUSTRY

Israel's ship-building industry is represented by three production enterprises



and one specialized ship-overhaul plant. The 500-strong shipyard belonging to the Israel Shipyards company forms the foundation of this industry. This is one of the largest ship-building and ship-overhaul yards in the Eastern part of the Mediterranean Sea. The yard is capable of building guard ships (corvettes), missile and patrol boats. Ramta Division's plant manufactures small guard boats, and a small enterprise belonging to Elbit Systems produces unmanned underwater craft.

In the nearest future, it is evident that the shipbuilding production base will not undergo any significant changes in its structure due to the absence of need to build large ships and watercraft for Israel's Navy. Navy's demand for necessary military watercraft will be met by imports.

RADIOELECTRONICS

The radioelectronic industry has 28 enterprises, most of which are independent companies based on a single enterprise. This industry, along with the missile, space, and aviation industries, is one of the leaders of Israel's military industry.

The largest enterprise of the radioelectronic industry is Elta Systems' plant in Ashdod, with approximately 3,500 employees. The plant manufactures a wide range of radar equipment, communication means, and electronic warfare equipment, such as the



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In the longer run, a "limited confrontation" between Iran and the Jewish state is possible. The Israeli Defense Forces (IDF) is preparing for such a scenario. In a situation with potential military escalation, the Israelis must only count on themselves, and only after that on their closest ally – the USA – or on support from tactical partners in Arab capitals



airborne electronic warfare and radar systems EL/L-8300, external jamming pods EL/L-8222, etc.

The other plant, Tamam in Yahud, produces gyrostabilized pods for UAV and aviation, radio communication equipment, night vision devices, and navigation equipment.

The leading manufacturers of the equipment in question also include Elisra Electronic Systems (part of the Elbit Systems corporation), employing over 1,500 people. The company develops and produces communication equipment (radio stations CNR 900/9000, GRC-400, etc.), shipborne and airborne navigation systems, airborne long-range phased-array detection systems, as well as land electronic warfare stations.

One of important areas of activity of the enterprises of this industry is development and manufacture of optical and optoelectronic equipment. Thus, Opgal Optronic Ind Ltd. specializes in production of optical equipment for armed forces, including periscopes, sights, etc.

The radioelectronic industry is one of the most advanced and promising industries of Israel's defense industry complex, its products are highly competitive at the global market. In order to concentrate the financial and production resources necessary for development of new types of military products, increasing export volumes and expanding sales markets, this industry underwent various structural changes as a result of mergers and acquisitions of certain production divisions.

CONCLUSIONS

The research of Israel's armed forces financing allows to come to the following conclusions and generalizations:

1. The main goal of plan implementation is to bring the national armed forces in line with the present-day requirements of the changing military and political environment in the Middle-East region.
2. Thanks to stable financing, Israel's defense industry complex is capable of manufacturing high-tech and science-intensive military products in virtually the entire range of armaments necessary for meeting the demand of the national armed forces and export deliveries. A favorable environment has been created in Israel for further defense industry development. Besides that, the present-day military industry is the leading branch of Israeli economy, that nets a considerable export profit to the state.
3. It should be expected that in the foreseeable future Israel's leadership, based

on economical feasibility and for the sake of political ambitions, will support and develop the national military industry, take measures for enhancing the armaments and military equipment export system, diversifying its sector and geographic structure, searching for new market niches, strengthening its effort for redivisioning the market for its own benefit.

Further increase of defense industry complex effectiveness, particularly in the state sector, implies carrying out organizational reforms, changing forms of property, including privatization of individual industries and production types. Stakes will be placed on expanding own capabilities in the development and manufacture of high-tech types of weapons and military equipment.

4. A significantly export-oriented advanced military industry has been established and is successfully functioning in Israel. The country's leadership makes all the efforts necessary to preserve and enhance the military industry potential. Dual purpose technologies and civil developments are actively used in the production, the industrial and research base is being actively developed in the strongest sectors, predominantly in the radioelectronic, aviation, as well as missile and space industries. In short and medium terms, further advancement of Israel's national military industry is expected; it can be predicted that it will preserve its status at the global market of armaments and military equipment. ♦



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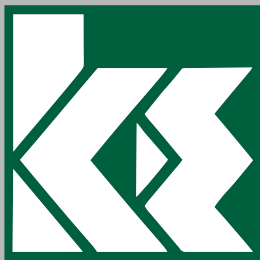
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