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Russia's devastating impact on critical infrastructure during the hybrid war in Ukraine

Introduction

The armed conflict that lasts from 2014 onward in Ukraine has resulted in Europe starting to experience the problems of war and more carefully look into what war in the 21st century means. 2014 was the year in which Europe came to the realization that this conflict comprises hybrid features and this is the component that makes this conflict unique.

Chief of the General Staff of the Russian Federation, general Valery Gerasimov presented a view during his lecture at the University of Moscow in 2013, about a new method of conducting an armed conflict, where the usage of new technology, guerilla forces, psychological warfare and misinformation are all combined to form a cohesive hybrid method. This was a key element of conducting the armed conflict in Ukraine. Many experts, throughout the years, looked at the conflict in Ukraine as a hybrid war defined by general Gerasimov. Few people noticed that Gerasimov and other decision-makers in the Russian Federation changed the priorities in the views on future wars and drew conclusions from those conflicts that Russia have participated in.

At the beginning of 2019 the building of War Sciences Academy held Valery Gerasimov's presentation of a significantly reformed concept of war, during the conference about the development of war strategies in modern world conditions, that the most important representatives of the presidential office, Ministry of Defense, Parliament, government, key universities and national security research institutes participated in. During his analysis of modern strategies Gerasimov emphasized the need for active utilization of the fifth column in order to destabilize the enemy with simultaneous airstrikes on the crucial complexes. He called the new Russian strategy an "active defense strategy". It focuses on simultaneous and complex usage of political, economic, informational and other non-martial tools. However, the most important element of this strategy would be proper preparation and handling of conventional armed forces. Other additional tools create conditions for the usage of armed forces and have an influence on the proceedings of war. Each one of these tools has a different and unique strategy, but proper coordination and governance of all of them at once plays a crucial part in the process. Strategies should predict future characteristics of war as well as future actions and their consequences.

The new strategical concept of war that Russia presents, sets new priorities. Even though the element of surprise, cautious decision-making and continuity of actions are still valid and the skill of accurate prediction of scenarios is still important, the concept has been drastically altered. There is no battle for the souls nor emphasis on psychological actions as it was set down during Gerasimov's conference in 2013. Currently, the modern technology and newest arms are the priorities. When it comes to the ways of conducting the warfare, the primacy was given to the war conducted outside of country borders. The fundamental element is the creation of independently acting tactical groups, that are characterized by high mobility and capability of performing the hardest of tasks. These might be the aerospace groups, such as the ones deployed in Syria.

The purpose of this concept is the establishment and development of the system of integrated forces of intelligence, strike force and the governance of the army and military means. The basis would lie in modern information and telecommunication technologies. The main task is detection, pointing targets and conducting strikes on specific paramount targets, mainly those of critical infrastructure, with the operation of strategic, operational and tactical means of the nonatomic weaponry. In the future, the system of complex strikes on the enemy's most important assets should be developed. Therefore, unmanned aerial vehicles, the whole variety of war robots, the means of radioelectronic fight that give different opportunities of choice and influence, depending on the assets type, structure and importance, will be used.

According to the concept of Gerasimov one of the characteristics of modern armed conflicts is destabilization of national security via diversion and terroristic acts. It predicts those attacks from the enemy's side on the territory of Russia as well. Therefore,

Gerasimov postulates creating the complex system of defense and protection of national infrastructure assets. Gerasimov predicts the increase of importance and development of the informational abilities of Russia. In the new conditions the war is going to take place mostly in that sphere. Information technologies are the most prospective type of arms. Information sphere works regardless of borders, enables secret influence on critical infrastructure and society of the hostile country. Therefore, digital technologies, robotization, unmanned systems and radioelectronic fight are the priorities of the development of Russian strategy. Increase of the martial abilities of Russian armed forces was oriented on those objectives.

War in Ukraine

The war in Ukraine that was firstly started in Crimea, later expanding to Donbas in February of 2014 greatly differs from the one that started in February of 2022. However, there are plenty of similarities as well. Both of them started with wide usage of fight in cyberspace and attack on the most important military devices, which disabled Ukrainian systems of command and communication. In Crimea, the very first actions taken, were the ones of Russian special forces, which took control over the most important infrastructure assets. These were immediately captured and secured by soldier forces with no intent of destroying them. It enabled bloodless paralysis of the area and a hasty seizure of Crimea. In Donbas, throughout several years of war, Russians and rebels completely dominated the aerial sphere. They took control over all significant assets of critical infrastructure, successfully blocking transmission of Ukrainian television programs for years.

The strategy of Gerasimov presented in 2019 was almost fully implemented in 2022. This war as it was set down by the general, started with cyberspace attacks. The main military assets of critical infrastructure, commandment and communication were attacked, only to strike with informatic technology moments later. The conventional tools were also used, including: air force, artillery and missile troops, which resulted in significant losses of important military bases and airports. Russian forces destroyed 90% of all Ukrainian military airports at that time. Which was done with the intention of paralyzing the Ukrainian army.

Next stages of war were mainly focusing not only on the direct fights with Ukrainian armed forces but also on simultaneous pointwise destruction of important military installations, ammunition and fuel storages and other components of logistic support, in different parts of country. Ukrainian officials did not inform about this, but from the information acquired unofficially directly from Ukraine,¹ the Ukrainian military losses were very high at that time. Russians have chosen the concept of

¹ Information obtained during contacts with representatives of the Armed Forces of Ukraine during their visits to Poland.

conducting the war in the eastern part of Ukraine with simultaneous destruction of significant infrastructure in the whole country, causing a downgrade of the potential of Ukrainian army and imposing a scattering of Ukrainian forces, that had to be ready to defend assets in different parts of the country. When Russian authorities realized that their aggression was not going to end with quick victory, due to support for Ukraine from the majority of Western countries and after USA had declared a policy of significant weakening of Russian state, they changed the actions. It was decided to weaken or even destroy Ukraine with economic means, leading to its complete fall. However, the actions undertaken in order to fulfill this goal do not aim for the destruction of the whole country but only the main critical infrastructure assets, which are the brain and nervous system that gives life to the state. From the beginning of the war until the end of 2022 the Russians have destroyed more than 35,000 Ukrainian facilities, 702 of which are critical infrastructure.²

Energetics was and still is one of the main targets of Russian attacks on Ukrainian critical infrastructure. Already on February 15 the new type of virus was used which was supposed to intercept part of the critical infrastructure of Ukraine. The attack targeted 60 different institutions, including the Ministry of Energy. Since February 24, so since the beginning of the open war, a significant number of power plants were damaged, destroyed or captured by the Russian forces. The strategy of blocking energy supply from the cities, through destruction of the industrial infrastructure, as a mean to break the defenses, was used in the sieges of Mariupol and Sumy.³ Moreover, the thermal power plant in Okhtyrka that was supplying Sumy with electricity was completely destroyed.⁴ Another damaged power plant that was situated in the north of the country was the one in Chernihiv.⁵ Furthermore, thermal power plant in Shchastia, supplying Luhansk region, was struck even before the main offensive, which resulted in the fire there.⁶ In the first days of the offensive, the power plant was lost

² В Україні з початку повномасштабного вторгнення РФ уражено понад 700 об'єктів критичної інфраструктури, – Євгеній Спін, Портал MBC, 28.12.2022, <https://mvs.gov.ua/uk/news/v-ukrayini-z-pocatku-povnomasstabnogo-vtorgnennia-rf-urazeno-ponad-700-objektiv-kriticnoyi-infrastrukturi-jevgenii-jenin> [accessed: 29.01.2023].

³ J. Greig, *Ukrainian cities hit with blackouts after attacks on energy infrastructure*, ZDNET, 4.03.2022, <https://www.zdnet.com/article/ukrainian-cities-hit-with-blackout-after-attacks-on-energy-infrastructure/> [accessed: 16.10.2022].

⁴ C. Carella, *Ukraine: the war fought on the energy front*, Florence School of Regulation, 4.04.2022, <https://fsr.eui.eu/ukraine-the-war-fought-on-the-energy-front/> [accessed: 16.10.2022].

⁵ А. Бондаренко, *Атака на системы теплоснабжения также является целью россиян в войне против Украины – эксперт*, Prompolitinform, 30.07.2022, https://prompolit.info/2022/07/30/ataka-na-sistemy-teplosnabzheniya-takzhe-yavlyaetsya-tselyu-rossiyan-v-bojne-protiv-ukrainy-ekspert/?fbclid=IwAR2_Z62PIFFWdOPp7Rs9GWFEMaMFTDB63QS6cb6QGGyqJ1H2nkqE8y48S-U [accessed: 16.10.2022].

⁶ *Luhansk TPP (DTEK Energy) is under constant shelling*, DTEK.com, 23.02.2022, <https://dtek.com/en/media-center/news/dtek-luganska-tes-perebuvaet-pid-postiynimi-obstrilam/> [accessed: 16.10.2022].

to the military of Russian Federation.⁷ Similar fate was faced by the biggest thermal power plant, situated in Svitlodarsk near Donetsk.⁸ Due to the fights the power plant in Sievierodonetsk, Luhansk region, was almost completely destroyed. In the central part of the country the power plant in Kremenchug was damaged. Due to the strikes, some of the buildings within the complex were destroyed which resulted in lacks of energy and hot water supplies to Poltava.⁹ Missile strike was also conducted on the power plant in Trypillia, which served the energy to the region of the capital city of Ukraine.¹⁰ The situation in the southern part of the country was the most serious. Within the first days of the offensive Russian military have captured hydro power station in Nova Kahovka near Kherson.¹¹ Furthermore, the situation in Enerhodar, where the biggest nuclear power plant in Europe is situated, is changing dynamically. Since the beginning of August 2022, the territory of power station have been stroke several times.¹² Both sides of the conflict blame each other for that. Situation was considered so serious by International Atomic Energy Agency that the special mission, led by Rafael Grossi, was sent there to evaluate the danger of catastrophe caused by military actions. This mission postulates for the complete demilitarization of the zone around the power plant and designated two independent experts to stay on the site and report with current data.¹³ Since October 2022, Russia has started to destroy Ukraine's energy infrastructure in a planned and systematic manner. Almost 40 of 84 rockets launched on October 10, 2022 hit their target and seriously destabilised the electricity grid for the first time across half the country. The targets of most of the shelling were high-voltage nodal switching stations. On November 23, 2022 firing forced the Ukrainian operator to suspend operation of all nuclear power plant units for the first time ever. The Ukrainian authorities had a certain stock of spare parts and

⁷ C. Carella, *op. cit.*

⁸ *Uglegorsk thermal power plant liberated from Ukrainian army units — LPR People's Militia*, TASS.com, 27.07.2022, <https://tass.com/politics/1485709> [accessed: 16.10.2022].

⁹ *1 killed, 7 injured in missile attack on thermal power plant, refinery in Kremenchuk*, Ukrinform, 25.04.2022, <https://www.ukrinform.net/rubric-ato/3466664-1-killed-7-injured-in-missile-attack-on-thermal-power-plant-refinery-in-kremenchuk.html> [accessed: 16.10.2022].

¹⁰ Б. Зайка, *На Трипольской ТЭС произошел взрыв, оккупанты захватили Каховскую ГЭС — Минэнерго - новости Украины*, LIGA.net, 24.02.2022, <https://biz.liga.net/ekonomika/tek/novosti/na-tripolskoy-tes-proizoshel-vzryv-okkupanty-zahvatili-kahovskuyu-ges-minenergo> [accessed: 16.10.2022].

¹¹ *Ukraina: Uzbrojeni ludzie zajeli Elektrownię Kachowską*, wGospodarce.pl, 24.02.2022, <https://wgospodarce.pl/informacje/108078-ukraina-uzbrojeni-ludzie-zajeli-elektrownie-kachowska> [accessed: 16.10.2022].

¹² G. Brumfiel, J. Hayda, D. Wood, *Here's just how close the war in Ukraine has come to Europe's largest nuclear plant*, NPR, 10.08.2022, <https://www.npr.org/2022/08/10/1116461260/ukraine-zaporizhzhia-nuclear-plant-russia-war-satellite-images> [accessed: 16.10.2022].

¹³ *IAEA Issues Report on Nuclear Situation in Ukraine*, VOA News, 6.09.2022, <https://www.voanews.com/a/iaea-to-report-on-nuclear-situation-in-ukraine-/6732773.html> [accessed: 16.10.2022].

transformers, but despite their declarations, the repair services were unable to make repairs at a sufficiently rapid pace.¹⁴ The percentage of ruined energy infrastructure is steadily increasing and, according to the project “Europe – Poland – Ukraine. Re-build Together” already exceeded 60% by mid-December 2022. Russia is thus attempting to weaken the will to fight of the entire Ukrainian people, as well as to prevent industry from operating.¹⁵ Apart from the conventional attacks on power plants, there was also an attempt to disturb their work with malware. According to British National Cyber Security Centre (NCSC) in many cases, cyber-attacks were supportive to kinetic effects. On November 24, 2022 Russia launched powerful cyber-attacks to cause a maximum blackout, in tandem with waves of missile strikes on Ukraine’s energy facilities that at the time had forced all the country’s nuclear plants offline.¹⁶ One of cyber-attacks, with the usage of the Industroyer2 malware, was foiled.¹⁷ After the success of the other one, the secret data of the biggest private energy supplier in Ukraine, DTEK, was leaked.¹⁸ To alleviate the annoyance of electricity problems, the authorities have taken steps to facilitate the supply of foreign power generation equipment. On November 9, 2022, the government passed a decree suspending duty and VAT for generators, transformers and their spare parts, as well as heating equipment and Starlink terminals. The concessions are to remain in force until May 2023. In addition, the permissible limit for storing fuel without the need to obtain the relevant licence was raised to 2,000 litres, making it easier for businesses to stockpile larger stocks. The adopted changes have resulted in a massive increase in generator imports: in November and December 2022 to 470,000 units.¹⁹ This will undoubtedly allow Ukrainians to get through the winter, but is far from a systemic solution. To reduce the severity of energy shortages, the Ukrainian authorities are planning to purchase 30–50 MW mobile power plants, using natural gas to generate electricity. These would allow critical infrastructure to be

¹⁴ S. Matuszak, *Na krawędzi – Ukraina wobec ostrzalu systemu elektroenergetycznego*, OSW, 18.01.2023, <https://www.osw.waw.pl/pl/publikacje/komentarze-osw/2023-01-18/na-krawedzi-ukraina-wobec-ostrzalu-systemu> [accessed: 29.01.2023].

¹⁵ Memorandum ZPP: *Stan ukraińskiej infrastruktury energetycznej w kontekście współpracy polsko-ukraińskiej*, ZPP, 18.01.2023, <https://zpp.net.pl/memorandum-zpp-stan-ukrainской-infrastruktury-energetycznej-w-kontekscie-wspolpracy-polsko-ukrainskiej/> [accessed: 29.01.2023].

¹⁶ D. Sabbagh, *Cyber-attacks have tripled in past year, says Ukraine’s cybersecurity agency*, The Guardian, 19.01.2023, <https://www.theguardian.com/world/2023/jan/19/cyber-attacks-have-tripled-in-past-year-says-ukraine-cybersecurity-agency> [accessed: 29.01.2023].

¹⁷ *Кібератака групи Sandworm (UAC-0082) на об'єкти енергетики України з використанням ухідливих програм INDUSTROYER2 та CADDYWIPER (CERT-UA#4435)*, CERT-UA, 12.04.2022, <https://cert.gov.ua/article/39518> [accessed: 16.10.2022].

¹⁸ V. Petkauskas, *Ukraine says Russia coordinated cyber and missile attacks*, Cybernews.com, 4.07.2022, <https://cybernews.com/cyber-war/ukraine-says-russia-coordinates-cyber-and-missile-attacks/> [accessed: 16.10.2022].

¹⁹ S. Matuszak, *op. cit.*

supplied under blackout conditions. Ukrainian analyses indicate that this should be a minimum of 10–14 units, but the demand of key cities is higher, reaching 800–900 MW.²⁰

Pipelines, storages and stations of fuel gas distribution were targets of attacks on critical infrastructure as well and were multiply damaged as a result of military actions. Example could be found in the damage of the Luhansk-Lysychanks-Rubizhne pipeline, which caused lacks of gas supplies in the Luhansk region,²¹ strikes on the gas storage and field in Sheblinka, Kharkiv region,²² or closing the distribution stations in that area. Due to the acts of war and attacks on critical infrastructure 56 of gas distribution stations in regions of Kharkiv, Luhansk, Donetsk and Zaporozhe were closed, which sums up to 60% of all of the stations in those regions.²³ What is more, Russian attacks on Ukraine have damaged 350 natural gas facilities.²⁴

Oil is another basic substance, essential to warfare and therefore it became another target for Russian attacks. Oil refineries in Kremenchug and Odessa's port were missile stroked. The former was completely destroyed and is no longer capable for usage.²⁵ Moreover the storages, both military and civil, which stored fuel were targeted by Russian army's attack. The storages of L'viv, Dubno, Dnipro²⁶ and Kalinovka²⁷ were

²⁰ О. Чайка, Україна знайшла 14 мобільних електростанцій, щоб ініціювати від блекаутів. Потрібно \$225 млн і мінімум місяць. Як це може працювати?, Журнал Forbes Ukraine, 26.12.2022, <https://forbes.ua/money/ukraina-znayshla-14-mobilnih-elektrostantsiy-shchob-shvidshe-ogovtuvatis-vid-blekautiv-potribno-225-mdn-i-minimum-misats-yak-tse-mozhe-pratsyuvati-26122022-10743> [accessed: 29.01.2023].

²¹ GTSOU reports damage to the gas pipeline in the Luhansk region, TSOUA, 3.03.2022, <https://tsoua.com/en/news/gtsou-reports-damage-to-the-gas-pipeline-in-the-luhansk-region/> [accessed: 16.10.2022].

²² R. Watts, Dramatic video: Fire ravages Ukraine gas facility after 'targeted' Russian attack, Upstream, 14.03.2022, <https://www.upstreamonline.com/production/dramatic-video-fire-ravages-ukraine-gas-facility-after-targeted-russian-attack/2-1-1184186> [accessed: 16.10.2022].

²³ State of Ukrainian gas transmission system operation as of May 3, 2022: due to shelling, ten gas distribution stations in the Kharkiv region were shut down, TSOUA, 4.05.2022, <https://tsoua.com/en/news/state-of-ukrainian-gas-transmission-system-operation-as-of-may-3-2022-due-to-shelling-ten-gas-distribution-stations-in-the-kharkiv-region-were-shut-down/> [accessed: 16.10.2022].

²⁴ Ukraine's Naftogaz says Russian attacks damaged 350 gas facilities, Reuters, 07.12.2022, <https://www.reuters.com/business/energy/ukraines-naftogaz-says-russian-attacks-damaged-350-gas-facilities-2022-12-07/> [accessed: 29.01.2023].

²⁵ S. Rao, Ukraine Kremenchug refiner destroyed after attack-governor, Reuters, 3.04.2022, <https://www.reuters.com/world/europe/ukraine-kremenchug-refiner-destroyed-after-attack-governor-2022-04-03/> [accessed: 16.10.2022].

²⁶ О. Роціна, Dnipropetrovsk region: missiles destroy oil depot, factory catches fire, Ukrayinska Pravda, 6.04.2022, <https://www.pravda.com.ua/eng/news/2022/04/6/7337499/> [accessed: 16.10.2022].

²⁷ Russia says destroyed Ukraine's largest military fuel storage site, The Economic Times, 25.05.2022, <https://economictimes.indiatimes.com/news/defence/russia-says-destroyed-ukraines-largest-military-fuel-storage-site/articleshow/90439917.cms> [accessed: 16.10.2022].

destroyed due to the strikes. As a result of all of those attacks, the whole process of oil refinery performed by Naftogaz in Ukraine has stopped.²⁸

Telecommunication was mostly targeted by cyberattacks, just as it happened to thousands of Ukrainians when they lost the connection with internet provided by KA-SAT satellite.²⁹ During the siege of Sumy, cyberattack blocked internet telecommunication in the whole region, resulting in successful blockade of information exchange via internet.³⁰ Conventional methods of fight were used to disturb Ukrainian telecommunication as well, just as it happened with the strikes on the TV towers, regardless of the civil character of those assets. As an outcome of those attacks for some time TV and radio stations stopped broadcasting and in the case of others there was some disturbance³¹. At the beginning of the year UN reported that Ukraine will need at least USD 1.79 billion to restore its telecommunications sector to pre-war levels. According the report Russia had “destroyed completely or seized” telecom infrastructure in more than 10 of Ukraine’s 24 regions. It also alleges that Moscow unilaterally switched Ukrainian dialing codes to Russian ones and that there had been 1,123 cyber-attacks against Ukraine.³²

What is more Russian forces have used water infrastructure as an element of the war strategy, that aimed to weaken the enemy and strengthen own position. In the region of Kherson, Russians exploded the dam on North Crimean canal, leading to the rise of water supplies to the Crimean Peninsula controlled by them.³³ Taking control over the water infrastructure enabled to block the supplies to sieged Mariupol and Nikolayev. In both cases it lead to the humanitarian crises, death of civilians and weakening of the defenses of those cities.³⁴ The citizens of Sumy, Chernihiv, Kharkov and region of Donbas became victims of the attacks on water infrastructure as well. It all

²⁸ С. Мельник, *В Україні повністю зупинено нафтопереробку – Вітренко*, Економічна правда, 22.06.2022, <https://www.epravda.com.ua/news/2022/06/22/688444/> [accessed: 16.10.2022].

²⁹ *KA-SAT Network cyber attack overview*, Viasat, 14.06.2022, <https://news.viasat.com/blog/corporate/ka-sat-network-cyber-attack-overview> [accessed: 16.10.2022].

³⁰ S. Moss, *Ukraine: Internet outages in Sumy and Vinnytsia Oblast*, Data Centre Dynamics, 14.03.2022, <https://www.datacenterdynamics.com/en/news/ukraine-internet-outages-in-sumy-and-vinnytsia-oblast/> [accessed: 16.10.2022].

³¹ *RSF refers Russian strikes on four Ukrainian TV towers to International Criminal Court*, RSF, 1.09.2022, <https://rsf.org/en/rsf-refers-russian-strikes-four-ukrainian-tv-towers-international-criminal-court> [accessed: 16.10.2022].

³² E. Farge, *UN releases report on Ukraine telecoms damage by Russia*, Reuters, 06.01.2023, <https://www.reuters.com/world/europe/un-releases-report-ukraine-telecoms-damage-by-russia-2023-01-06/> [accessed: 29.01.2023].

³³ *North Crimean Canal Fills With Water After Russian Forces Destroyed Dam*, The Moscow Times, 7.09.2022, <https://www.themoscowtimes.com/2022/03/04/north-crimean-canal-fills-with-water-after-russian-forces-destroyed-dam-a76755> [accessed: 16.10.2022].

³⁴ A. Zimmermann, *Russia’s war on water in Ukraine*, Politico, 29.05.2022, <https://www.politico.eu/article/russias-war-on-water-in-ukraine/> [accessed: 16.10.2022].

led up to the situation where in April 2022 1.4 million of people in Ukraine did not have an access to the clean fresh water.³⁵

The food infrastructure was damaged by the attacks on silos and fields and also by the theft of the grain by the Russian side. In coordinated attack on all of the food warehouses in Brovary 50 thousand tonnes of food was destroyed.³⁶ The usage of cluster bombs to destroy the crops on fields was observed as well.³⁷ Moreover, the Ukrainian government have accused Russia of theft of several hundred thousand tonnes of grain.³⁸

Heating systems were also attacked as a part of critical infrastructure. Central heating stations of some cities were destroyed and regardless of active renovations, they might not be functional before the winter, due to the still ongoing hostilities.³⁹

In view of the critical situation in a number of areas in Ukraine, the authorities have set up so-called "steadfastness points" (Ukr. пункти незламності) in the form of stationary or mobile premises designed for a maximum of 500 people and equipped with access to heating, water, electricity and internet and mobile communications. They have been set up since November throughout the country – by the end of 2022, there were 11,500 of them.⁴⁰

According to the estimation of World Health Organization since February 2022 Russian forces have conducted at least 700 attacks on medical care facilities (the highest number of attacks was registered in March 2022 at 375. According to the monitoring, most attacks were caused by the use of heavy weapons),⁴¹ in which

³⁵ P. Saidel, *The Russia-Ukraine War: April 13, 2022*, WSJ, 13.04.2022, <https://www.wsj.com/livecoverage/russia-ukraine-latest-news-2022-04-13/card/war-jeopardizes-water-supply-for-millions-in-ukraine-F8CqJe111CnGTYX7Z9u6> [accessed: 16.10.2022].

³⁶ C. Welsh, J.S. Bermudez Jr., J. Jun, E. Dodd, *Spotlight on Damage to Ukraine's Agricultural Infrastructure since*, CSIS, 15.06.2022, <https://www.csis.org/analysis/spotlight-damage-ukraines-agricultural-infrastructure-russias-invasion> [accessed: 16.10.2022].

³⁷ D. Bennet, *Ukraine's farmers become the latest target of Russian missiles*, Washington Post, 19.07.2022, <https://www.washingtonpost.com/world/2022/07/19/ukraine-farmers-grain-russia-airstrikes/> [accessed: 16.10.2022].

³⁸ *Is Russia stealing and selling grain from Ukraine?*, Al Jazeera, 9.06.2022, <https://www.aljazeera.com/news/2022/6/9/is-russia-stealing-and-selling-grain-from-ukraine> [accessed: 16.10.2022].

³⁹ L. Alderman, D.I. Sanchez, *As Russia Threatens Europe's Energy, Ukraine Braces for a Hard Winter*, The New York Times, 2.08.2022, <https://www.nytimes.com/2022/08/02/business/ukraine-russia-energy-europe.html> [accessed: 16.10.2022].

⁴⁰ *Офіц президента заявляє про розгортання "пунктів незламності" по всій Україні*, Українська правда, 23.11.2022, <https://www.pravda.com.ua/news/2022/11/23/7377666/> [accessed: 29.01.2023].

⁴¹ L. Schlein, *WHO: Russian Attacks on Ukraine Infrastructure Target Critical Health Care*, VOA News, 20.12.2022, <https://www.voanews.com/a/who-russian-attacks-on-ukraine-infrastructure-target-critical-health-care/6884045.html> [accessed: 29.01.2023].

at least 100 people died.⁴² Additionally more than 170 of attacks affected medical supplies. Some of the hospitals in the cities sieged by the army of Russian Federation, such as Nikolayev,⁴³ Mariupol⁴⁴ or Kharkov⁴⁵ were completely destroyed.

One of the elements of critical infrastructure that was excessively severely affected by Russian attacks is transportation. According to the estimations of Ukrainian government entity, since the beginning of invasion until June 2022, 24 thousands of kilometers of roads and 300 bridges were destroyed.⁴⁶ Moreover, Russian forces attacked 12 civil airports,⁴⁷ not only in the region of fights but also in the Western part of the country, as the ones in Vinnytsia⁴⁸ and Ivano-Frankivsk.⁴⁹ According to the data provided by Russian government within two weeks of invasion 90% of Ukrainian military airports was destroyed.⁵⁰ The losses in railway infrastructure were to be seven thousands of kilometers of railways, 21 stations and 49 bridges by Ukrainian Ministry of Infrastructure. Furthermore, the naval

⁴² N. Turak, A. Macias, *Ukrainian forces begin counter-offensive to retake Kherson; UN nuclear inspection team “on its way” to Zaporizhzhia plant*, CNBC, 30.08.2022, <https://www.cnbc.com/2022/08/29/russia-ukraine-live-updates.html> [accessed: 16.10.2022].

⁴³ N. Slawson, M. Belam, S. Lock, *Attack on Mykolaiv hospital described as ‘cynical terrorism’; Moscow bans 39 Britons including Keir Starmer – as it happened*, The Guardian, 1.08.2022, <https://www.theguardian.com/world/live/2022/aug/01/russia-ukraine-war-live-news-moscow-moving-troops-towards-kherson-zelenskiy-says-uk-property-register-to-crack-down-on-oligarchs> [accessed: 16.10.2022].

⁴⁴ A. Sparrow, *Russian Attacks on Ukrainian Hospitals Are War Crimes*, Foreign Policy, 15.04.2022, <https://foreignpolicy.com/2022/04/11/putin-targeting-ukrainian-hospitals-war-crime/> [accessed: 16.10.2022].

⁴⁵ Ukraine: *Unlawful Russian Attacks in Kharkiv*, Human Rights Watch, 17.08.2022, <https://www.hrw.org/news/2022/08/16/ukraine-unlawful-russian-attacks-kharkiv> [accessed: 16.10.2022].

⁴⁶ A. Kaul, *Ukraine claims 24,000 km of roads, 300 bridges destroyed by Russia’s forces*, Republic World, 3.06.2022, <https://www.republicworld.com/world-news/russia-ukraine-crisis/ukraine-claims-24000-km-of-roads-300-bridges-destroyed-by-russias-forces-articleshow.html> [accessed: 16.10.2022].

⁴⁷ J. Field, *Ukraine Crisis: Russia Has Destroyed 12 Airports Since The Start of the War*, Aviation-Source News, 25.05.2022, <https://aviationsourcenews.com/news/ukraine-crisis-russia-has-destroyed-12-airports-since-the-start-of-the-war/> [accessed: 16.10.2022].

⁴⁸ 8 rockets launched by Russia destroy Ukraine’s Vinnytsia airport: Zelenskyy, Business Standard, 6.03.2022, https://www.business-standard.com/article/international/8-rockets-launched-by-russia-destroy-ukraine-s-vinnyscia-airport-zelenskyy-122030600749_1.html [accessed: 16.10.2022].

⁴⁹ O. Roshchina, *Russians have almost destroyed Ivano-Frankivsk airport – mayor*, Ukrayinska Pravda, 13.03.2022, <https://www.pravda.com.ua/eng/news/2022/03/13/7330917/> [accessed: 16.10.2022].

⁵⁰ 90 Percent of Ukraine’s Military Airports Destroyed: Can It Go On Fighting Without Them?, Military Watch Magazine, 9.03.2022, <https://militarywatchmagazine.com/article/90-percent-of-ukraine-s-military-airports-destroyed-would-new-fighters-have-anywhere-to-take-off> [accessed: 16.10.2022].

infrastructure was also affected, since Russian forces took control of four ports on Black Sea and all of them on Azov Sea.⁵¹

Attacks on energy infrastructure might have an aim of destroying Ukraine by lacks of supplies of electric energy, resulting in dysfunction of the devices depending on it. It might as well aim to downgrade the quality of life of Ukrainian civilians and make it dependent on the supplies from Russian side. Undamaged and captured power plants might be used as sources of cheap energy for the territories under Russian control.⁵² In the case of the damage to the gas fuel infrastructure it is possible that the purpose was similar to the case of energetic one, so the downgrade of quality of life and dependency on Russian supplies. Attacks on oil infrastructure aim to slow down Ukrainian military actions and force Ukrainian government to limit the fuel to the civilians, as it happened in March 2022.⁵³ Telecommunication became a target of attacks in order to disturb the transmission of the information on the Ukrainian side, successfully inhibiting conduction of war actions and to create disorientation among Ukrainian society.⁵⁴ In the case of the destruction of the dam on the North Crimean canal, the purpose of this action was to supply the peninsula with the source of fresh water.⁵⁵ Attacks on Ukrainian water infrastructure and blockade of access to fresh water for Mariupol aimed to force the defendants to surrender.⁵⁶ For the same reasons the attacks on the food storages and crop fields were conducted.⁵⁷ In the sale of stolen grain Russian Federation might have found the way to increase the income and strengthen the national economy. Attacks on medical facilities might be caused by the strategy of destruction of the potential to rebuild Ukraine in both military and civil sphere. Blockade of the opportunity to heal might lead to the epidemics and death of the injured, which would result in weakening of Ukrainian opportunities to defend its territory. In the cases of airport strikes, both civil and military, the aim was to block the opportunity of aerial fight and to gain domination in this sphere of warfare.⁵⁸

⁵¹ В. Подорожная, *В Украине разрушены 11 аэропортов и 21 ж/д вокзал*, Корреспондент.net, 3.06.2022, <https://korrespondent.net/amp/4483500-v-ukrayne-razrusheny-11-aeroportov-y-21-zhd-vokzal> [accessed: 16.10.2022].

⁵² J. Parkinson, D. Hinshaw, *Russia's Goal in Attack on Nuclear Plant: Take the Electricity*, Ukraine Says, WSJ, 14.08.2022, <https://www.wsj.com/articles/russia-goal-ukraine-nuclear-plant-take-electricity-11660505601> [accessed: 16.10.2022].

⁵³ *Russia destroying oil depots and food warehouses: Ukrainian official*, Al Arabiya English, 27.03.2022, <https://english.alarabiya.net/News/world/2022/03/27/Russia-destroying-oil-depots-and-food-warehouses-Ukrainian-official-> [accessed: 16.10.2022].

⁵⁴ *Russia downed satellite internet in Ukraine: Western officials*, Al Jazeera, 10.05.2022, <https://www.aljazeera.com/news/2022/5/10/russia-behind-cyberattack-against-internet-net-work-in-ukraine> [accessed: 16.10.2022].

⁵⁵ *North Crimean Canal Fills With Water...*, op. cit.

⁵⁶ A. Zimmermann, op. cit.

⁵⁷ C. Welsh, J.S. Bermudez Jr., J. Jun, E. Dodd, op. cit.

⁵⁸ *90 Percent of Ukraine's Military Airports Destroyed...*, op. cit.

Most probably Russia is going to continue the destruction of the energetic infrastructure, following the earlier adapted strategy.⁵⁹ It is possible that the frequency and severity of those attacks are going to drop, due to the retardation of Russian offensive and focusing the firepower on military assets.⁶⁰ Nuclear power plant in Enerhodar, which Russia seeks to completely take control over, might be used by them as a source of cheap energy and the possibility to force Ukraine to buy more expensive energy from EU. It is possible that this power plant is going to be connected with the electric system of Crimea.⁶¹ In the cases of attacks on gas and oil fuels infrastructure, there is a chance of the drop in frequency and severity of them, similarly as it was with energetic assets. This might be affected by the active Ukrainian guerilla forces in the occupied regions, that successfully disturb in conducting of war actions.⁶² When it comes to the telecommunication, the biggest threat for the Ukrainian side are the hacker attacks conducted from time to time. They might result in Russia getting the informational advantage or disturbance of functioning of the most important Ukrainian national institutions. The destruction of water infrastructure most probably is still going to be one of the strategies of Russian side, since it gives an advantage and was already used by them in Syria.⁶³ War actions conducted in the agricultural areas might result in even further losses of food.⁶⁴ Medical facilities, due to the significant damage caused by the war, might not be able to provide healthcare on the same level as it was before invasion. It might lead to the long-term effects e.g. epidemics among civilian population.⁶⁵ The elements of transportation infrastructure are actively fixed and rebuilt but implementation of those actions nationwide will only be possible in the future.⁶⁶ Due to the war there is no aviation traffic over Ukraine. Restoring it will be only possible if necessary repairs of the airports are performed and the active war actions end.⁶⁷ According to Ukrainian Prime Minister Denys Shmyhal's declarations at a cabinet meeting on January 27, 2023, Ukraine will need an additional USD 17 billion this year for the rapid restoration of energy supplies, humanitarian demining, housing reconstruction and critical infrastructure.⁶⁸

⁵⁹ C. Carella, *op. cit.*

⁶⁰ K. Hird, K. Stepanenko, G. Barros, F.W. Kagan, *Russian offensive campaign assessment*, Institute for the Study of War, 24.08.2022, <https://www.understandingwar.org/backgrounder/russian-offensive-campaign-assessment-august-240> [accessed: 16.10.2022].

⁶¹ J. Parkinson, D. Hinshaw, *op. cit.*

⁶² K. Hird, K. Stepanenko, G. Barros, F.W. Kagan, *op. cit.*

⁶³ A. Zimmermann, *op. cit.*

⁶⁴ D. Bennet, *op. cit.*

⁶⁵ A. Sparrow, *op. cit.*

⁶⁶ A. Kaul, *op. cit.*

⁶⁷ J. Field, *op. cit.*

⁶⁸ U.S. Security Assistance to Ukraine, Congressional Research Service, <https://crsreports.congress.gov/product/pdf/IF/IF12040> [accessed: 29.02.2023].

Conclusion

The deliberate strikes against critical infrastructure and subsequent lack of access to energy is causing wide-ranging humanitarian impacts, and massive displacement of civilians. Absence of heating, access to water and functioning sewage systems can cause serious public health risks. Lack of electricity also impacts healthcare, education and livelihoods of Ukrainian civilians. Moreover, the paralysis of critical infrastructure prevents production and the functioning of industry. War in Ukraine confirms the execution of the strategic concept presented by general Gerasimov in 2019. Critical infrastructure is the essential element, that carries great value for the defender and main target of the aggressor's attack.

This situation creates a questions: How to prepare a country to defense and protection of critical infrastructure in the time of war? What tasks should the armed forces perform in that sphere and what should civil structures of the country do?

The experience provided by the war in Ukraine in that realm is extremely important and worth harnessing in the future. Indications suggest that the attacks on critical infrastructure are going to be a leading objective of aggressors in potential future conflicts. Poland is undoubtedly better prepared for such situations possessing other resources and with critical infrastructure protection systems in place, but in view of a possible global war, drawing from experience of Ukraine can be very effective and helpful for us.

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*Russia's devastating impact on critical infrastructure
during the hybrid war in Ukraine*

Abstract

The article attempts to present the Russia's devastating impact on critical infrastructure during the hybrid war in Ukraine. In order to present a broader context regarding the process, a timeline of the Ukraine-Russia war is presented, starting with the seizure of Crimea, the separation of Donbass, the beginning of the invasion and the Kiev phase, the positional war, and ending with the Kharkiv and Kherson counter-offensives. It goes on to analyse the targets and magnitude of Russian attacks on critical infrastructure, including such as medical and energy infrastructure. Authors point out that many times the overriding aim is to make life difficult for the civilian community, presumably to trigger signs of discontent and opposition to the Ukrainian authorities. The article also identifies the risks in the area of destruction of critical infrastructure in possible future conflicts and points to the need to take measures to strengthen the resilience of societies and states enabling their undisturbed functioning.

Keywords: hybrid war, critical infrastructure, war strategy of Russia, war in Ukraine, concept of Gerasimov