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THE WAR IN UKRAINE: NUCLEAR WAR SCENARIOS AND NORMAL ACCIDENT THEORY

Abstract: *Russia started its nuclear war threats with the commencement of its war in Ukraine. In the current case of the war in Ukraine, the most critical question is whether the Russian Federation, the aggressor in this war, would use nuclear weapons. The purpose of this brief paper is to examine the scenarios that are available to Russia to carry out its threat. The theoretical framework employed here is that of Normal Accident Theory (NAT), one of the most prominent theories of catastrophe. Normal Accident Theory explains how Moscow's use of nuclear weapons can trigger a global catastrophe that could bring the international system down. There are scenarios according to which the decisions that may result in the destruction of the international system may cascade fast, and there are scenarios in which such cascading events may be avoided or delayed.*

Keywords: *Nuclear war, nuclear weapons, Normal Accident Theory, NAT, Russia, war in Ukraine*

As the Russian armed forces started invading Ukraine, Russian political leaders and pundits commenced threatening the West with a nuclear attack. The nuclear war threats have continued since the war began -- an unprecedented process of international blackmail involving nuclear weapons that calls for a reexamination of all Cold War-era nuclear arms treaties. The purpose of this brief paper is to examine the scenarios that are available to Russia to carry out its threat. This study is put into perspective with the help of Normal Accident Theory (NAT), one of the most prominent theories of catastrophe. In simple terms, the argument proposed is that in the context of the international system of states, Normal Accident Theory explains how Moscow's use of nuclear weapons can result in a global catastrophe that could bring the international system as a whole down. There are scenarios of using nuclear weapons in which the decisions that would destroy the international system cascade fast, and there are scenarios in which such cascading events may be avoided or at least delayed.

1. NORMAL ACCIDENT THEORY

According to Charles Perrow's normal accident theory, extreme events occur when two or more failures occasionally come together unexpectedly in a system. They are accelerated and increased in severity if the system is tightly coupled, and grow to catastrophic proportions when the system has catastrophic potential (Perrow, 1999). In the current case of the war in Ukraine, the most critical question is whether the Russian Federation, the aggressor in this war, would use nuclear weapons. This they can do to defeat the West, without which Ukraine cannot win this war, or at least to deter the West from further supplying Ukraine. Russian political leaders, including President Putin, have threatened to use nuclear weapons several times since the beginning of the war. President Putin has even promised "global catastrophe" if third parties become involved directly in the conflict, specifically members of NATO (*Al Jazeera*, 2022).

The states normally fight wars and conduct military operations as they are the main units or actors of the international system. Relations of power among them composes the structure of the system, and this relational element or the structure is more important than the states or the actors of the system (Waltz, 2010). Nuclear weapons systems (nuclear warheads combined with their delivery, targeting, and guidance elements) represent the ultimate expression of actors' power in relation to other actors. For the stability of the international system, this relational

aspect is more crucial than individual states. Power is a relational phenomenon – a state is more or less powerful than another state or a group of states. At the same time, it should be noted that nuclear weapons are in a weapons class of their own with the ability to bring the entire system down.

Perrow primarily studied industrial accidents that triggered catastrophic consequences. He started in 1979, when a Three Mile Island nuclear power reactor in Pennsylvania experienced a series of unexpected accidents resulting in the reactor's meltdown. In 1984, Union Carbide's Bhopal plant in India released deadly gas, injuring over 200,000 people and killing about 4,000. In April 1986, a nuclear power plant in Chernobyl, Ukraine, experienced a catastrophic collapse exposing more than 600,000 people to dangerous radiation levels. This paper attempts tests if Perrow's theory of catastrophe can be applied to international threats of war involving nuclear weapons. In his studies Perrow found that in the industrial accidents, most catastrophes were triggered by human action or decision-making errors (Perrow, 1999). Likewise, if nuclear weapons were to be used to trigger a catastrophe on a planetary scale, it would inevitably involve decision-makers and their actions.

Perrow identified four aggregation levels in the systems he studied: units, parts, subsystems, and complete systems. He argued that linkages among parts of a system were more important than the individual parts. He noted that "two or more failures, none of them devastating in isolation, come together in unexpected ways and defeat safety devices – the definition of a "normal accident" or system accident." He further concluded that if the system were also tightly coupled, meaning a system with highly interdependent parts or units, "these failures can cascade faster than any safety device or operator can cope with them, or they can even be incomprehensible to those responsible for doing the coping." Tightly coupled systems “have more time-dependent processes: they cannot wait or stand by until attended to” (Perrow, 1999: 93). Two or more accidents propagating through a system of interdependent units magnify in intensity or severity and can bring the entire system down. According to Perrow, "if the accident brings down a significant part of the system, and the system has catastrophic potential, we will have a catastrophe (Perrow, 1999: 356-357)." This he called "Normal Accident Theory."

For the purposes of the analysis below, the international system of states corresponds to Perrow's complete system, while the immediate theater of military activities, Eurasia, is a

subsystem. Sovereign states are parts of the system, while power relations among them represent linkages. This latter should be understood within the context of neorealist analysis of international politics, according to which the argument "everybody's strategy depends on everybody else's" presupposes the existence of a structure of power relations within the system *(Waltz, 1959: 201). Tightly coupled processes in this context are decision sequences made by great powers, namely the Russian Federation and the United States, regarding their nuclear arms and various scenarios for their use. Decisions made about using nuclear weapons by one state are interdependent with the other in the sense that to perform their primary function of deterrence weapons, their quantitative and qualitative characteristics, as well as their operations, have to be roughly symmetrical. The failures that can cascade into a catastrophic collapse are those decisions that would authorize nuclear strikes without rationally considering all the consequences of such decisions.*

2. SCENARIOS FOR NUCLEAR ATTACK

As the Russian troops suffer setbacks on the battlefields of Ukraine, and as they will experience them further in the coming weeks, the Kremlin is more likely to use extraordinary measures to arrest the deterioration of the Russian armed forces. Such measures may range from using energy resources and distribution systems as a weapon against Ukraine and its Western allies to using nuclear weapons. Mobilizing more personnel and adding more equipment to the war efforts will not help Moscow achieve its stated political goals, that is, dismantling the state of Ukraine.

The stakes for Moscow in this war are much higher than the setbacks caused by the lost battles. Historically, the lost wars in Russia have been followed by severe national crises often accompanied by internally generated regime changes. To avert this eventuality, the Kremlin has to avoid further losses on the battlefield, solidify its gain in southeastern and southern Ukraine, and force Kyiv and its Western supporters to recognize Moscow's war gains by ceasing hostilities and signing a peace agreement. None of these can be achieved through conventional force warfare because the Russian army has structural deficiencies that cannot be solved in short to medium term. In addition, due to strong Western support, Ukraine has achieved technological superiority over Russia in weapons, communications technology, and logistics.

In late September 2022, Moscow started adding more personnel to its depleted forces fighting in Ukraine by calling for "partial mobilization" of the reservists. According to the official Kremlin version of events, the "special military operation" in Ukraine was progressing smoothly and without a diversion from the plan. At the same time, the Kremlin refused to acknowledge huge manpower losses in the war. In his televised address on September 21 2022, President Putin did call the "special military operation" a war. According to him, Russia is engaged in war with the West, and to win it, Russia needs hundreds of thousands of more military reservists. For months, Putin was against military mobilization for political reasons. In September 2022, he had to acknowledge in a televised address to the Russian people that the Russian military leaders had no choice but to call-up military reservists. This, however, cannot change the outcome of the battlefield. Even if the reservists were better prepared, equipped, and trained, which they are not, the technological superiority of the other side will negate their advantages in the personal skillsets necessary to win battles. Only when facing underequipped enemies or insurgents, such as those in Chechnya or Syria, the better preparation and professionalism of the ground forces can carry the day. Instead, in Ukraine, the Kremlin's forces are facing a determined professional army, which is properly led and equipped.

The Russian military hardliners demanded military mobilization from the very start of this war. They had a point: the Russian army sustained significant losses from the first days of the war, and its general staff had no strategic reserve. By the end of the first week of the invasion of Ukraine launched by the Kremlin on February 24 2022, it became clear to most military observers that the Russian armed forces could not overcome Ukraine’s resistance without a significant addition in manpower and resources. This was the period in the war when Ukraine was only getting Western anti-armor weapons and Turkish-made drones. However, instead of changing strategy, Russian politicians and pundits started talking about potentially using nuclear weapons against a not yet clearly defined enemy. The tide of war turned slowly in favor Ukraine, as the country gradually received more heavy weapons from the West, while Moscow delayed strategic changes for seven months. Starting to create new units seven months into the war was too late for achieving success through conventional military means. It would take several months to equip appropriately and train the reservists. Even then, they may be just enough to replace Russia's losses on the battlefield and to allow for more frequent rotations of the frontline fighters.

According to some estimates, the Russians destroy about 20 civilian infrastructure objects in Ukraine for every destroyed military target. The Russian military leadership proved to be so committed to attacking civilian infrastructure in Ukraine that it continued such attacks even during the hasty retreat from northeastern Ukraine. This was done instead of trying to slow down the Ukrainian troop advances against the Russian defensive positions. Moscow consistently targeted the energy infrastructure of Ukraine to break the fighting spirit of its people while using its gas and oil distribution systems to punish Europeans for their support of Ukraine. The main objects of Russia's long-range attacks in Ukraine: power generating facilities, the power grid, the energy sector, hydropower dams, and communication links. However, one significant limiting factor to the Kremlin's desire to wreck as much of Ukraine as possible has been the shortage of missiles. The Russian armed forces have huge weapons reserves, but they are not unlimited. At the same time, the Russian air force has avoided flying into Ukraine's airspace since they lost too many aircraft in the initial phases of the war. The Russians primarily attack targets in Ukraine from outside Ukraine’s airspace, with about a couple dozen ground and sea-based missiles and about three dozen air-to-surface missiles daily.

Cold winters during wartime are a norm in Europe, but the old continent is now threatened by a winter of a different nature, specifically that caused by the explosion of nuclear bombs. With the success of the Ukrainian armed forces the threat of Moscow using nuclear weapons in its bid to force Ukraine and its Western supporters to recognize Russia's territorial gains is increasing is not diminishing. President Putin confirmed this on September 21 2022 in his televised address announcing “partial mobilization” of Russia’s military reservists. In fact, the Russian leadership started this war believing that it held an advantage in nuclear weapons systems over its Western rivals. There has been much said about Russia's nuclear arms since Putin's 'three-day' blitzkrieg failed in northern Ukraine, some of its sensible but most of it misguided. Regardless, it is worth emphasizing that Russia is unlikely to attack Ukraine itself with nuclear weapons. Instead, one of the European members of NATO is much more likely to become its target, a small country, geographically farther away from Russia.

Russia has three general modes for launching a nuclear strike. One has been the subject of many discussions and bilateral treaties between the United States and the Soviet Union. This mode implies some form of employment of the strategic triad. Within this mode, nuclear

weapons delivered by either land-based, sea-based, or long-range aircraft-launched missiles. These types of launches can be detected and tracked by the other side. This means that, at least in theory, such missiles can be intercepted as well, especially if a country launches one or two such vehicles. The greater the number of strategic missiles launched, the more likely it is that some of them will avoid interception and reach their targets. Further, such an attack can invite a launch-on-warning response: the other side, in this case, the United States, will respond in kind as soon as missiles are launched. This will likely result in mutual suicide by the Russian Federation and the United States, and this is what most people would imagine to be the most likely scenario when they insist Mr. Putin to be bluffing, and as a pragmatic person, he would never use nuclear weapons. This line of thinking is partially correct as far as the scenario starting with a massive strategic first strike is concerned. However, the strategic triad is not the only mode of delivery of nuclear weapons. Although clearly suicidal, this is certainly an option for Moscow if Mr. Putin decides to strike first, but it is not the only one that he has. Nevertheless, we can call this Option A.

The second mode of delivery for nuclear warheads is generally known as "tactical," which does not mean that these weapons are less destructive. Since tactical nuclear weapons have been the main subject of discussion by those who talk about the Russian nuclear arsenal, it has been erroneously assumed that Moscow would use a tactical weapon in Ukraine. This error stems from the fact that the concept of "tactical" is normally associated with battlefield applications. This association is certainly correct for conventional, non-nuclear weapons, but not necessarily for nuclear ones. One of the main reasons these weapons are identified as "tactical" is the fact that they have been excluded from many of the previous, and especially the most recent "strategic arms reduction" treaties between the United States and the Russian Federation. It is true that historically "tactical" also meant short-range, hence their association with battlefields, but the most recent missile technology developments make this assumption obsolete.

The Kremlin's preferred vehicle for launching tactical nuclear warheads are *Kalibr* and *Klub* cruise missiles. The range of the *Kalibr* missile exceeds 2,000 kilometers. The improved version of the missile is expected to exceed the 4,000-kilometer range (Osborn, 2022). A missile with an operational range as this can cross continents, and can certainly cover the entire European theater of operations. The launch of these missiles can be detected, and if they are so

equipped when reaching their intended targets, the mushroom cloud will be visible to all, but it is impossible to track them – they are guided missiles and fly very low to the surface. Russia has fired hundreds of *Kalibr* missiles in this war against Ukraine that were not equipped with nuclear but conventional warheads. If Russia were to decide to fire warning nuclear shots toward Europe with using this missile, they might launch one or two warheads targeting a forest or a rural area. They can even attack a small town or a city somewhere in Europe. This will be a surprise attack – it will eliminate the launch-on-warning retaliation response. Regardless, the United States will have the option of retaliating in kind, but it could only be done from a sea-based or an air-based platform. The United States has not had land-based tactical nuclear weapons systems in Europe since the Cold War. The most famous of similar American weapons is the sea-based *Tomahawk* cruise missile, which is older and slower but works in a very much similar manner to *Kalibr*. Mr. Putin has been very proud of his *Kalibr* missiles – many times, he has emphasized their advanced characteristics that are not matched by any other weapon anywhere in the world. We can call this his Option B.

Putin and his people may be tempted to use this option because of a couple of assumed advantages it gives to Russia. The *Kalibr* launches are detected by the United States – indeed, a couple of dozen such missiles are launched from Russia toward Ukraine every day. However, one of such missiles, seemingly aimed at a target in Ukraine but armed with a nuclear warhead, can cross Ukraine and detonate over a small NATO country. It would not be immediately clear what happened and this will give Russians time to sow confusion: they may deny the responsibility and blame others. Or they may call it an "accident," apologize and offer compensation. In any event, with Option B Moscow may win a day or two, after which it will be difficult for the American president to retaliate and risk an all-out war with the Russians. Public opinion in the United States and Europe will be divided because if the United States retaliates, it will have to be done with strategic weapons, i.e., Option A, which can be both detected and tracked. Or it can be done, after some preparation, from a sea or air-based platform, which will still be an obvious act that Russians can monitor. If this were to happen, Moscow could launch on warning, resulting in a cascading sequence of events that can produce genocide on a planetary scale.

The *Kalibr* missiles can fly very low, as low as 50 meters above the land surface, and 20 meters if flying over water. They can be shot down – it is not easy, but it is possible – the Ukrainians have shot down close to 50 percent of the *Kalibrs* launched at them (Graff, 2022). However, to do this, one has to expect them and know where they are coming from, and have the intercept weapons on their flying path. In any case, if this "accident" were to take place, it may trigger another "accident" this time by the United States. The Kremlin may convince itself that Washington would not use Option A, or an obvious version of Option B, but again, Washington may decide to do it regardless. If Washington retaliates in kind, the first target will not be Russia itself but one of its close allies or satellites, e.g., Belarus, Chechnya, or Crimea. This would be done to give the Kremlin a chance to stand down, and it may, in fact, end with an exchange of single nuclear attacks, provided the United States attacks so that the Russians cannot detect and intercept the launch.

The third and the most dangerous mode of delivery for nuclear warheads that the Russians possess is not formally classified, but it essentially represents a covert delivery mode. We can call it Option C. To start with, all missile systems with a range longer than 50 kilometers, manufactured in the late Soviet period and contemporary Russia, are capable of carrying nuclear warheads. Long-range artillery can fire shells with nuclear warheads as well. Further, Soviet and Russian-made long-range drones not explicitly designated for this purpose can also deliver nuclear warheads. There is evidence from the war in Ukraine that at least one such drone flew from Ukraine all the way to Croatia and crashed just outside Zagreb after running out of fuel. On March 10 2022, a Russian or a Ukrainian drone TU-141 *Strizh* flew more than 550 kilometers (340 miles) without being detected by the air defense systems of three NATO countries: Romania, Hungary, and Croatia. Reportedly, it carried a bomb, which fortunately did not explode upon the drone's crash (*The Guardian*, 2022).

If Moscow were to decide to use Option C or a covert delivery system for its nuclear warheads, the launch could be neither detected nor the flight of the delivery system tracked. Therefore, just like in Option B, if such a thing were to explode somewhere in Europe, it would not be immediately certain what happened and who was responsible. The Kremlin may or may not acknowledge an "accident," but in any case, such an explosion would produce much fear, confusion and uncertainty. Again, it would be very difficult for the American president to

retaliate in kind if a NATO country were to be attacked and damaged by Russia in this way, especially if he had no direct proof that Moscow did it. The American political leadership will have a hard time explaining to the American people why they should risk American cities for the destruction of an unknown European town in a minor European country without any proof of who originated the attack and how.

On the other hand, the North Atlantic Treaty would lose all its credibility if the United States decided not to retaliate for an attack on a NATO ally, which, without a doubt, would be much damaged by such a devastating attack. The Kremlin will win in this case: its main objective in this war against Ukraine is to destroy or weaken NATO, and this they can achieve by driving a wedge between the United States and Europe. If Washington decides not to act in defense of its minor ally, Article 5 and the Treaty itself would lose their meaning and Moscow would win. However, if Washington decided to respond with Option A, or with an obvious Option B, it would result in devastating planetary destruction. However, if the United States were to exercise its Option C by attacking a close Moscow ally (that is, if Washington were to have such a mode of delivery, which it does not), the nuclear exchange might not go any further than that.

Finally, in Option D, Moscow can deploy one of its intercontinental ballistic missile warheads for a high-altitude detonation. High-altitude detonations are those that are conducted more than 10 kilometers above the surface of the planet. Both the Soviet Union and the United States tested the effects of high-altitude detonations between 1958 and 1962. The most damaging of them was a detonation conducted in 1962 two hundred fifty kilometers “above” Kazakhstan. If the Russians resort to this option, they will detonate a nuclear warhead high above Europe and/or Ukraine to generate an electromagnetic pulse (EMP) that can knock out most of Europe's economic infrastructure. A high-altitude EMP attack would damage or destroy Europe's power, communications, and transportation systems as well as disable banks, hospitals, and other sectors of the continent's economy. If Washington responds in kind, the exchange will disable the economy of most of the planet, triggering fires and all sorts of other emergencies with multitudes of casualties.

3. CONCLUSION

If the Russians decide to pursue Option A in their quest to defeat the West, the collapse of the international system will be sudden and dramatic. In this scenario, the nuclear attacks will not be limited to a subsystem (Eurasia) or two subsystems (Eurasia and North America), but will engulf most, if not all, great powers. European nuclear powers, France and the United Kingdom, will not be able to stay neutral even if they proclaim their neutrality. As they are informally part of the West, and formally part of NATO, allied with the United States, Moscow would not allow them to wait and bide their time. Other nuclear powers, such as China and India, will have to take a side in this option; otherwise, they would risk nuclear attacks from both sides. Further, those conventional powers allied with the United States that possess competent conventional forces, e.g., Turkey and Finland, would also be attacked by Moscow: Russia would become very vulnerable to an invasion by conventional forces even if they "win" the nuclear war with the United States.

If the Russians resort to Option B, a catastrophic collapse of the system may be avoided, but the subsystem which hosts the military activities will be much damaged, and with excellent prospects for long-term instability and chaos. In this scenario, if Moscow were to attack a minor NATO ally, Washington may retaliate with an attack on a Russian ally. This may end the nuclear strikes, but it will not resolve the Russia-NATO standoff. Instead, it will make the United States more committed to European survival and the Europeans more eager to seek protection from Washington. On the other hand, fewer countries would remain closely allied with Russia, while Moscow may become more desperate and brazen, hatching plans for future attacks and revenge.

Similarly, Option C may not result in a systemic collapse, but it will seriously alter international security and trigger a new arms race. The existing non-proliferation regime will end, and more countries will start developing both nuclear arms and systems for a covert nuclear attack. Potentially all countries with some form of technological know-how and weapons-manufacturing capabilities could arm themselves with nuclear weapons. This will negate the advantages held by states like China and Russia over their neighbors, as they would become more vulnerable to retaliatory attacks by them.

Option D is not likely to work satisfactorily on its own for either side but instead trigger a cascading set of failures to one of the options discussed above. However, in the unlikely case of

Russia and the United States limiting themselves by knocking out each other's energy systems, satellites, communications grids, etc. the economic damage will be so significant and the confusion surrounding military activities so great that the high altitude attacks will most certainly transform the Russia-Ukraine war into a more general conflict encompassing the entire system.

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