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Patriots vs Iskanders and Kinzhals Over Kyiv – A Game Changed?

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For many years, we have maintained that modern ballistic missiles pose very demanding targets for missile defence. Firstly, high velocities of these missiles usually give defensive systems a very short time for detecting, tracking and calculating fire solutions for interceptors. Secondly, some types of modern ballistic missiles feature manoeuvrability high enough to make performing intercept sequences even more challenging. And thirdly, modern ballistic missiles are routinely equipped with penetration aids designed to overcome defences. Thus, our most general observation was that existing missile defence cannot work well against the most modern ballistic missiles.

However, some recent developments in the missile war over Ukraine seem to undermine this fundamental belief, as the Ukrainian air defence shot down a number of Russian *Iskanders* and *Kinzhals*. Was our assessment of the effectiveness of missile defence against modern ballistic missiles wrong all along, or maybe something has changed recently? This analytical piece is supposed to shed some light on that matter, although we must admit in

advance that available knowledge is too limited to allow for conducting a comprehensive investigation, so the following assessment should be considered a guestimate or informed reading tea leaves at best. Thus, we will first briefly describe the weapons involved and then report known and guessed facts about recent missile defence engagements in Ukraine. Finally, we will attempt to assess these facts and the consequences of what happened.

Dramatis Personae

Since the first weeks of the war, stand-off attacks against the Ukrainian targets have become a strategy of choice for Russians. After it became apparent that the war would not end quickly and the Ukrainian air defence remained highly effective, the Russian fixed-wing aircraft were withdrawn from long-range strike missions. This way, ballistic and cruise missiles had to take over attacking targets outside the range of conventional and rocket artillery. However, the ongoing Russian missile campaign has been countered with considerable success by the Ukrainian Soviet-era defence systems supported by a growing, but still limited, number of modern Western-provided air systems.

Among several types of long-range weapons used against Ukraine, only ballistic missiles were able to act with impunity due to their intrinsic advantages against air defence. Save limited use of the old *Tochkas*, the *Iskander* and *Kinzhal* missile systems were frequently deployed against Ukrainian targets. Particularly interesting is that Russians advertised the *Kinzhal* as the most modern weapon, unstoppable due to the new principles of hypersonic design it employs. This impunity of ballistic missiles seemed to end in May this year, at least over Kyiv, which received a protective umbrella of the most modern *Patriot* air defence system featuring dedicated missile defence capability. Following is a short description of these three weapons.

Iskander is a missile system fielded by the Russian ground forces and designed for tactical and operational use. It includes two types of missiles launched from a common high-mobility wheeled platform. *Iskander K* is a cruise missile with an official range of 500 km, but it is likely that at least some variants of this missile have a longer range. *Iskander M* is a single-stage solid fuel-propelled short-range ballistic missile (SRBM) with an official range of 500 km, which probably is somewhat greater. The latter is what interests us, so when we use the name *Iskander,* we will mean *Iskander M* unless otherwise stated. This weapon is likely highly manoeuvrable, as for ballistic missile, and equipped with penetration aids. If so, it represents a very difficult target for missile defence, at least we have believed so thus far. According to available data, some 750 *Iskanders* were launched against targets in Ukraine until January 2023. According to the official Ukrainian sources, not even one was reported shot down until May 2023.

Kinzhal is often defined as a hypersonic missile, although this designation is as misguided as widely used; in 2019, we described this discrepancy in detail. In short, hypersonic speed

means a velocity of Ma5 and higher. But every ballistic missile must reach this burn-out speed if it is going to fly to a range of 300-500 km and beyond. This way, EVERY ballistic missile capable of reaching such distances is a hypersonic weapon *per se* as it travels in hypersonic speed (In fact, even the German V-2 used in WWII was "almost" a hypersonic weapon as its max speed was Ma4.7). The accurate use of the term "hypersonic weapon" refers to two kinds of weapons built along new design principles and featuring new capabilities: (1) unpowered glide vehicles (hypersonic glide vehicles, HGVs) accelerated to hypersonic speed and released to glide to their target and (2) constantly powered cruise missiles capable of achieving velocity Ma5 and higher (hypersonic cruise missiles, HCMs). *Kinzhal* is certainly none of them, as it is basically an air-launched version of *Iskander* with which it shares fundamental design features. Thus, *Kinzhal*'s proper designation is "air-launched ballistic missile" (ALBM); it is also sometimes referred to as "aeroballistic missile". Thus, it is certainly NOT a "hypersonic missile", according to the meaning of this term in the military aviation vocabulary. *Kinzhal*'s attack range is longer than *Iskander*'s because it is fired from a carrier flying at several hundred kph at a relatively high altitude; it can probably travel up to 1000 km. Note that *Kinzhals*'s range is usually reported as 2,000 km or more, but this figure includes the operational range of its carrier, MiG-31 K, which is probably around 1,000 km. *Kinzhal* is certainly a potent weapon, more versatile and likely faster than *Iskander,* and it has been used in Ukraine on many occasions, although in much smaller numbers than *Iskander*. According to existing information, since the first launch on March 19, 2022, some 20 of them were launched until March 2023. Since then, no more than 15 were used, but no comprehensive account exists. No *Kinzhal* was destroyed until May 2023.

Patriot is the American air defence system with dedicated anti-ballistic capabilities. Two batteries have operated in Ukraine since April 2023, one donated by the United States and the second by Germany; the latter likely includes two additional launchers delivered by the Netherlands. It is not known how many launchers these two batteries consist of, as a *Patriot* battery may include 4 to 8 launchers. Americans typically use a 6-launcher battery configuration, while German usually consists of 4 launchers. Assuming that both countries supplied Ukraine with standard batteries, plus two launchers from the Netherlands and two additional launchers from Germany shipped in August, the Ukrainian air defence possesses 14 fire units capable of carrying 56 PAC-2 multipurpose missiles or 224 PAC-3 anti-ballistic missiles. It is not exactly known where these batteries are located, but at least one or maybe both defend Kyiv. *Patriot*'s range while engaging ballistic missiles is 30-37 km relative to a missile variant.

May/June 2023 – Missile Battles Over Kyiv

As it has already been noticed, *Iskanders* and *Kinzhals* were attacking Ukrainian targets with impunity until May 2023. It was certainly due to their features as modern ballistic missiles but also to the fact that they were confronted mainly with old Soviet-era air defence weap-

ons. Some of these weapons, most notably S-300s, were believed to have limited anti-missile capabilities, but still, they were unable to score any success against modern ballistic missiles. Everything changed when the *Patriots* were deployed for the defence of the Kyiv area at the end of April 2023. As far as it is known, at least five separate engagements occurred in May and June 2023, in which the *Patriot* system proved to be very effective against *Iskanders* and *Kinzhals*. At a glance, it represents a major game-changer in missile defence operations and a tectonic shift in understanding missile defence capabilities.

Even before the *Patriots* were deployed in Ukraine, it was apparent that they would become a primary target for the Russian forces. Firstly, because they would represent a substantial addition to the Ukrainian air defence, which the Russians would like to see reduced for obvious reasons. Secondly, even more importantly, the destruction of the *Patriots* would humiliate the Americans, uplift the tarnished prestige of the Russian military, and undermine Ukrainians' faith in Western-provided technology. Following is the account of Russian attempts to destroy the *Patriot* batteries in the Kyiv area based on existing open-source information and our guesses and interpretations. Note that it is a very preliminary assessment and should be treated as such.

The first engagement in the Russian campaign against the *Patriots* took place on May 4, when one *Kinzhal* attacking the *Patriot* battery was shot down. It is plausible that the single *Kinzhal* attacked the battery radar station to knock out the whole system in one blow.

The night of May 15/16 saw the biggest battle when Russian forces attempted to attack the *Patriot* battery using multiple cruise and ballistic missiles. The Russian side subsequently announced the destruction of the *Patriot* system, so it is obvious that it was an intended target of the attack. 6 *Kinzhals* and 3 *Iskanders* were fired that night, and none reached the target, although two undisclosed components of the battery were slightly damaged, probably by the debris from the destroyed missile. Nevertheless, the battery remained operational. The attack, executed by multiple types of assets and from several directions, was a clear attempt to saturate the *Patriot* defences and then destroy the battery or at least disrupt its operations. The battle probably involved other Ukrainian air defence systems, although *Kinzhals* and *Iskanders* were undoubtedly engaged by the *Patriots.*

Another series of attacks, most likely directed against the *Patriot* batteries, took place at the end of May. Firstly, on May 29, after a wave of some 80 missiles launched at the Kyiv region at night, 11 *Iskanders* (*M* and *K* variants) were fired in a surprise daytime attack, likely directed against the *Patriots*. All were destroyed by the defence. The next attack of that type occurred on the night of May 31, when 7 *Iskanders M* and 3 *Iskanders K* purportedly tried to destroy the *Patriot* site – again, all attacking missiles were defeated.

The last of the engagements in which *Patriot* batteries apparently were the main target took place on June 16. 6 *Kinzhals* and several cruise missiles were fired with no success – all were shot down by the *Patriots*.

Summarizing our interpretation of the existing pieces of information, from May 4 to June 16, the *Patriot* batteries in Kyiv were attacked five times. All 13 *Kinzhals* used were destroyed, along with 18 of 18 *Iskanders* (some of this number could have been *Iskanders K*, due to incomplete information on the May 29 engagement).

No Game Changer After All

The defeat of *Kinzhals* and *Iskanders* over Kyiv, which amounts to the total obliteration of the attacker's forces and an unprecedented humiliation of the Russian military, spurred many comments which hailed the purported advantage of missile defence over ballistic missiles. The optimistic narrative referred particularly to *Kinzhals,* previously hyped as a *wunderwaffe*. It is, however, way too early to declare a total victory of missile defence because of a very specific tactical situation in which the engagement took place.

The battles we have described above were self-defence engagements of anti-ballistic systems against ballistic missiles. It is, however, just one situation that can happen in combat as missiles may attack other places some distance away from the defending system. Missiles may also attack from various vectors, entering or crossing the missile defence kill zone at various angles. Of all these situations, a direct attack against the defending battery is the most favourable for the battery and most challenging for the missile.

Let us describe it in detail. A ballistic missile, even if it has the ability to manoeuvre in the terminal phase of an attack like *Iskander* or *Kinzhal* purportedly do, cannot change its course during the last seconds of its flight because otherwise it would not be able to hit the target. Mind that it may speed at 1-2 km/sec, which means that every manoeuvre needs many kilometres to be performed. Thus, the attacking missile does not have time to make extensive evasive actions in the last seconds and kilometres of its flight. Consequently, from the point of view of a defender, a target missile does not have a significant angular velocity relative to the defending anti-missile launcher; in essence, for the battery, it seems relatively unmoving, even if it closes fast. Therefore, guiding an interceptor in such a situation is much easier than if the ballistic missile attacks a distant target and its angular velocity relative to the defensive battery is high due to the missile's high speed. In short, attacking an air defence site with an airborne asset is always its most demanding mission.

In summary, the general assessment that modern ballistic missiles pose a formidable challenge even for the most sophisticated defence systems stands. The ability of a defence system to defend itself does not implicate that it is actually able to defend the whole area of its responsibility. Bluntly speaking, the *Patriots* did defend themselves against an onslaught of ballistic missiles, but no one knows if they are able to defend an object located, say, 5 or 10 km from the battery. We should see more battles over Kyiv to assess the Patriot's effectiveness against *Kinzhals* and *Iskanders* in a broader context. Note that since the May/June engagements, the Russian ballistic missiles have been used on several occa-

sions, and only two were destroyed. One *Iskander* was downed in unspecified circumstances on September 6, and one *Kinzhal* was defeated over Kyiv on August 11 during the attack of four missiles of that kind against the airfield in the Ivano-Frankivsk region, some 500 km west of Kyiv. In the latter case, it is unknown if the missile that fell over Kyiv had gone astray from its original target or had been intentionally directed there; whether it was attacking the *Patriot* site or not is also enigmatic.

On the other hand, it must be noted that modern ballistic missiles failed to prove completely unstoppable. The engagements we have described above show that even *Iskanders* and *Kinzhals*, the paragons of their kind, may be defeated by sophisticated air defence systems, at least in some situations. However, we must again strongly stress that the anti-ballistic capabilities of the *Patriot* were relatively well tested only in one and a very favourable combat situation. To prove its worth, the *Patriot* will have to show not only the ability to defend itself against ballistic missiles but also to fend off attacks against targets located away from the battery. It is very likely that this Autumn and Winter, we will have the opportunity to witness such battles when the expected Russian onslaught against energetic infrastructure commences.