Understanding space-technology aspect in Russia's newest Oreshnik missile

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Introduction

On 21 Nov 2024, Russia fired an Intermediate-Range Ballistic Missile (IRBM) on Dnipro in Ukraine. The hypersonic missile has been named as 'Oreshnik' meaning 'Hazelnut Tree' in Russian and was launched from the Russian region of Astrakhan, situated at 700 kms. The missile was said to be equipped with multiple independently targetable reentry vehicles and targeted industrial enterprises and critical infrastructures in Dnipro.[1] This missile is being touted as a new weapon and there are various speculations about the capabilities of this missile being floated around. Since, the attacks were launched in the night time without any clear video-footage, there is no common consensus on what the projectile actually was. The description of this missile is somewhat blurry due to the differing Western, Ukrainian and Russian claims.

Western assessment

British media confirmed six bright flashes in the night, which points towards a cluster of six individual projectiles hitting. They said President Putin has placed emphasis on Oreshnik's hypersonic speed.[2] The United States (US) Department of Defence has speculated that Oreshnik is an experimental IRBM, most likely based on Russia's RS-26 Rubezh Inter-Continental Ballistic Missile (ICBM). Since Oreshnik has been designated as experimental, therefore its impact is also being studied by the US.[3] Others argue that it does not make sense for Russia to attack Dnipro with Oreshnik since it is costly to build such missiles with capabilities described and Russia could obtain similar results by using cheaper Iskander missiles. The claim of being experimental is also getting doubted because in such trials the testing/target sites collect data, warheads trajectories are monitored, and onboard systems are validated which cannot happen in real combat strikes.[4]

Even if it is based on the RS-26 Rubezh, it signals that Russia has resumed developing the inactive missile projects since RS-26 project was discontinued in 2018.[5] United Kingdom's (UK) Ministry of Defense stated that the development of Oreshnik could have occurred before Russia's 2019 withdrawal from the Intermediate-Range Nuclear Forces Treaty.[6] Britain based Chatham House military expert Mathieu Boulègue states that while Oreshnik is not really a game-changer, "In terms of psychological warfare, it works great" to scare the West. Since Russia has revised its nuclear doctrine to launch nuclear strikes even against conventional attack by any nation that is supported by a nuclear power, the fear of Oreshnik's impact is immense, especially in Europe since it can carry both conventional and nuclear warheads.[7] The Oreshnik is being compared to the US based Minuteman III ICBM by some but there is a huge range difference as Minuteman III has 13,000 kms range.[8] Instead, Oreshnik's range can cover the entire Europe but not the US as per Pavel Podvig, director of the Russian Nuclear Forces Project.[9]

Ukraine's version

Ukraine's Military Intelligence Chief, Kyrylo Budanov, claimed that the Russian missile is called 'Kedr' which was designed to carry nuclear warheads and Oreshnik refers to the missile research project instead. He stated that only two prototypes of Kedr have been produced by Russia.[10] Charred fragments containing mangled wires and a large snow tire sized airframe

was recovered from the blast sites.[11] The debris indicated that the circumference of Oreshnik could be 92 cm for it to travel at shorter distance of 3,410 miles, compared to RS-26 Rubezh which can reach anywhere.[12] Ukraine's Main Directorate of Intelligence stated that the missile flew at Mach 11 or over 13,000 kmph and hit Dnipro in 15 minutes.[13] A military expert told Izvestia newspaper that Oreshnik's range could be around 3,000-5,000 kms.[14] Another Ukrainian media source claimed that the targets of the attack had minimal damage as per satellite images.[15]

Russia's assertion

After the strike, President Putin asserted that Oreshnik is a non-nuclear hypersonic ballistic missile and currently no means to intercept it exists. As per him Oreshnik attacked the targets at Mach 10, which is a velocity of 2.5-3 kms per second.[16] He emphasised that Oreshnik could rival the destructive power of nuclear weapons. Russia's Commander of the Strategic Missile Forces, Sergei Karakayev, said that the launch was carried out under combat conditions and the results from the launch confirmed design correctness, engineering, and technological solutions embedded, which contradicts the western assessment that it is still under development. Further Russian officials assured that import substitutions were resolved, which can lead to the commencement of mass production.[17] President Putin further stressed that Oreshnik was somewhat related to Russia's domestic space rocket industry which possibly signals that Russia's space industry may have contributed to its development.[18] Russia also plans to keep testing Oreshnik in combat conditions and has a stock ready for use which differs from the Ukrainian version that only two prototypes have been built till now.[19]

Space-technology usage in Oreshnik

Russia's space agency Roscosmos' General Director, Yuri Borisov, in an interview to Russian television VGTRK acknowledged that they have worked on Oreshnik project for the last 2 years. As per Roscosmos, since the Oreshnik was designed as a carrier rocket/launch vehicle it uses environment friendly fuels like liquid methane and oxygen which makes it ideal for quick preparation and launch. It is also said to have a lofted trajectory, typical of test launches. This could indicate that Oreshnik could have both civilian and military applications.[20] Now if we compile the three speculations of Oreshnik capabilities and type from Russia, Ukraine and the West, the most probable parameters of the missile is estimated. Speed could be 10-11 Mach; time of flight is 15 minutes or 900 seconds. The lofted trajectory theory to escape exo-atmospheric interception will give the maximum altitude similar to 700 kms range which seems impossible for a launch vehicle.

The distance from Astrakhan to Dnipro is the range of projectile which is roughly around 700 kms. The Russian parameters of Mach 10 and initial angle of launch as 89 degree gives range of 41,854 m, attitude of 5,99,455 m and time of flight as 700 seconds. The Ukrainian assumption of Mach 11 provides a range of 50,643, altitude of 7,25,341 m and total time as 769 seconds. If we take the American estimate of RS-26 whose terminal speed could be Mach 20, then the parameters exceed the current values. As of now, it can be deducted that Oreshnik could have a speed upwards of 12 Mach during its initial launch and more than 20 Mach at its terminal phase to cover 700 kms within 15 minutes at an unspecified angle of launch. It is best to consider Oreshnik as a hybrid combination of several existing space technologies and weapon systems as far as its engines and stages are concerned which enables it to reach a medium range while achieving a maximum altitude more than any typical ICBM.[21]

Implications in Russia-Ukraine conflict

Oreshnik is a new challenge to the western allied nations that have been supporting Ukraine since it is a new system and not much concrete data is available. Its impact has been devastating since it has implications for underground targets. This also is a message for the US as most of its Minuteman based ICBMs are hidden deep inside silos. The second challenge is the accuracy with which it has hit the targets.[22] Although the West is confident that the The Terminal High Altitude Area Defense (THAAD) system can counter the Oreshnik its simply seems impossible since the THAAD operates at missile range of 200 km and an altitude range of 150 km which is below the operating threshold of Oreshnik.[23] Other experts suggest that Oreshnik can be shot down using anti-missile systems such as Patriot and SAMP/T.[24]

But in response President Putin has already challenged the West to provide any air-defence system to Ukraine and indulge in a 21st Century-style high-tech 'Missile Duel' with any location in Kiev being the target.[25] Russia already had plans to launch Oreshnik against Ukraine for the second time.[26] Russia also has plans to deploy Oreshnik in Belarus in 2025 which can alter the military balance in the region.[27] As per Russian ambassador to UK, Oreshnik strike has forced UK to take a more cautious approach regarding long-range weapon strikes deep inside Russia.[28] Russian confidence can also be gauged from their intention to mass produce Oreshnik missiles in the near future.[29]

Conclusion

The global discussions regarding the capabilities of Oreshnik IRBM have again demonstrated the Russian ability to quickly launch new systems in the midst of a war with extreme sanctions in place. Most of the Western and Ukrainian assessment as of now is blurry and falls short of perfectly specifying the missile on a launch and impact parameter basis. The challenge posed by Russian Oreshnik to the West and the US is a stark reminder of the technological arms-race from the cold-war era. Finally, the most favourable and concrete conclusion which can be drawn from the Oreshnik discussions is the involvement and importance of Russia's space technology to develop missiles.

Endnotes:

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Ajay Kumar Das, Independent Researcher and Analyst of International Affairs and Security Studies.

Article uploaded on 31-12-2024