Open Nuclear Network's

UPDATE ON THE DPRK'S 600 MM MULTIPLE LAUNCH ROCKET SYSTEM

STRATEGIC DELIVERY VEHICLE DEVELOPMENTS SERIES

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KEY TAKEAWAYS

- The Democratic People's Republic of Korea (DPRK) acknowledged in 2020 that there were issues related to the production of the 600 mm calibre multiple launch rocket system (MLRS). The delivery of thirty such MLRS in December 2022 suggests that these problems have been resolved.
- The existing 600 mm MLRSs could fire around 220 guided rockets with either conventional or nuclear warheads in attempts to overwhelm targets in the Republic of Korea (ROK). With production problems seemingly resolved, at least in part, the number of 600 mm MLRSs will likely continue to increase.
- The 600 mm MLRS applies uncommon designs, demonstrating the capability of DPRK weapon designers to take inspiration from weapon systems around the world.

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I. BACKGROUND

The first known 600 mm MLRS test fire occurred in July 2019.[1] In March 2020, Open Nuclear Network published an early analysis on this MLRS, designated by the United States of America (United States) as the KN-25.[2] At the time of the publication, how the 600 mm rockets maintain their inflight stability was not clear. On 31 December 2022, a ceremony marking the reported delivery of thirty 600 mm MLRSs was held in front of the building of the Central Committee of the Workers' Party of Korea (WPK) in Pyongyang. Following the ceremony, the DPRK published information that included for the first time the diameter of its super large calibre MLRSs. This information and other information made available since the publication of Open Nuclear Network's initial report is analysed in this report to enhance understanding of the design and capabilities of this MLRS.

A. Production Issues Resolved

On 29 March 2020, in a 600 mm MLRS test fire to "verify once again the tactical and technological specifications of the launch system to be delivered to units of the Korean People's Army",[4] Ri Pyong Chol, the then-vice-chairman of the Central Committee of the WPK, reportedly "learned about relevant problems arising in delivering the weapon system to the units of the People's Army and set forth relevant tasks for the field of national defense science researches and munitions factories."[5] Given that the tracked chassis of the 600 mm MLRS is the largest that the DPRK has produced to date (Figure 1), it is likely that the chassis is the source of the production problems.

Figure 1. The tracked chassis of the 600 mm MLRS, with 10 road wheels on each side, is the largest of the new generation of short-range ballistic missile systems developed by the DPRK. In comparison, the tracked chassis of the KN-23 has eight road wheels on each side, while the tracked chassis of the KN-24 has six road wheels on each side.
Images: KCNA/Zaobao/Agence France-Presse[3]

The reported delivery in December 2022 of thirty 600 mm MLRSs suggests that the problems related to production have been at least partially resolved (Figure 2). At the delivery ceremony, Kim Jong Un praised the relevant industrial complex for being able to assemble one or even two such MLRSs every two days.[6]

Besides the 6-tube 600 mm MLRS on tracked chassis, at least nine 4-tube 600 mm MLRSs on 4-axle truck chassis have been showcased in previous military parades.[8] The DPRK's access to heavy duty trucks remains sanctions-limited; however, during the 8 February 2023 military parade, the DPRK showcased at least 16 missiles on 9- and 11-axle tracked chassis, indicating that the DPRK may have significantly improved its access to heavy duty trucks.

Figure 2. Approximately twenty 600 mm MLRSs are visible in this photo taken at the delivery ceremony on 31 December 2022.
Image: KCNA[7]

B. Potential Nuclear Payload

The 600 mm MLRS is the largest of its kind in the world. It is reasonable to assume that such a large diameter is determined by the requirement of its payload, which, as reportedly claimed by Kim Jong Un, could be a tactical nuclear warhead.[9]

In the only available DPRK nuclear weapon classification known to exist, the DPRK divided nuclear weapons into tactical weapons, battlefield weapons and strategic weapons, based on their means of delivery and the strike distance, rather than the yield and size of the warheads.[11] While this classification is not necessarily consistent with the current, official DPRK nuclear weapon classification, it does present one possibility that a DPRK "tactical" nuclear device does not have to be necessarily smaller in diameter and size than a "strategic" one. Thus, the DPRK's nuclear claim regarding the 600 mm MLRS could be seen as a general reference for estimating the size of a DPRK implosion device currently in its arsenal (Figure 3).

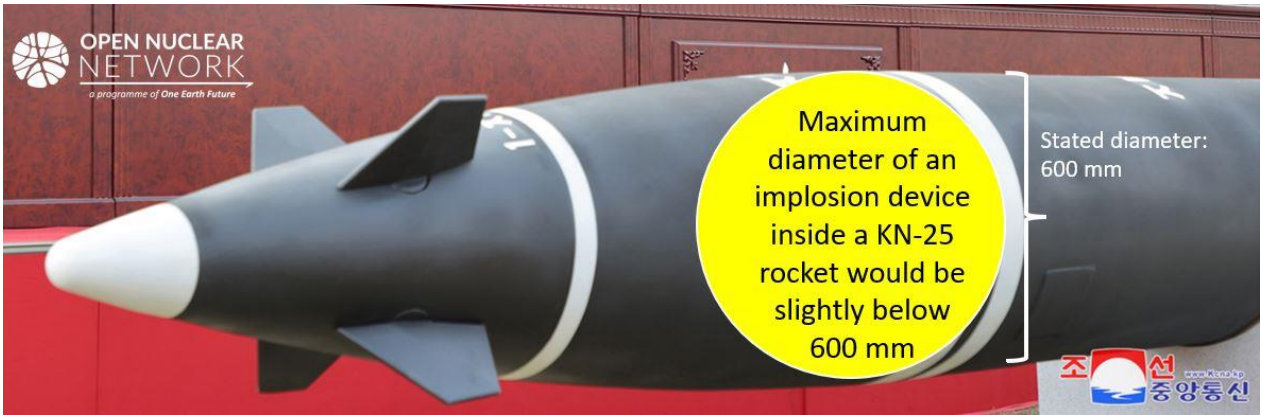

Figure 3. An implosion device inside a KN-25 rocket would be limited to below 600 mm in diameter. Image: KCNA[10]

C. Design Features

The DPRK 600 mm MLRS rockets have six wraparound tail fins that are folded in opposite directions. This design is rarely seen in other MLRS rocket designs and would seem to cancel out each other's spin motion, while most MLRS rockets rely on the spinning motion to maintain inflight stability. Some Soviet-designed rolling-body, anti-tank guided missiles (ATGMs) employ wraparound fins in opposite directions; however, how this unusual design maintains the required spin rate is not clearly described in available literature.[12] In the design graphic of the Soviet 9M114 "Shturm-Ataka" family ATGM, the fins on the top right and bottom left are slightly longer than the fins that are folded in the opposite directions (Figure 4), indicating the asymmetry in wingspan might be able to maintain the spinning of the missile.[14] The DPRK may have adopted this particular design based on similar considerations.

On 11 October 2021, the DPRK held a defence development exhibition entitled "Self-Defence-2021" in Pyongyang, during which three pairs of wraparound fins were displayed that seemed to be installed on a rotating sleeve around the nozzle of the KN-25.[15] By employing the rotating sleeve, the projectile itself does not spin during flight and its stability is achieved through the spinning of its tail fins alone.[16] This could potentially offer a more favourable working environment for the guidance and control section and the fuse-warhead section.

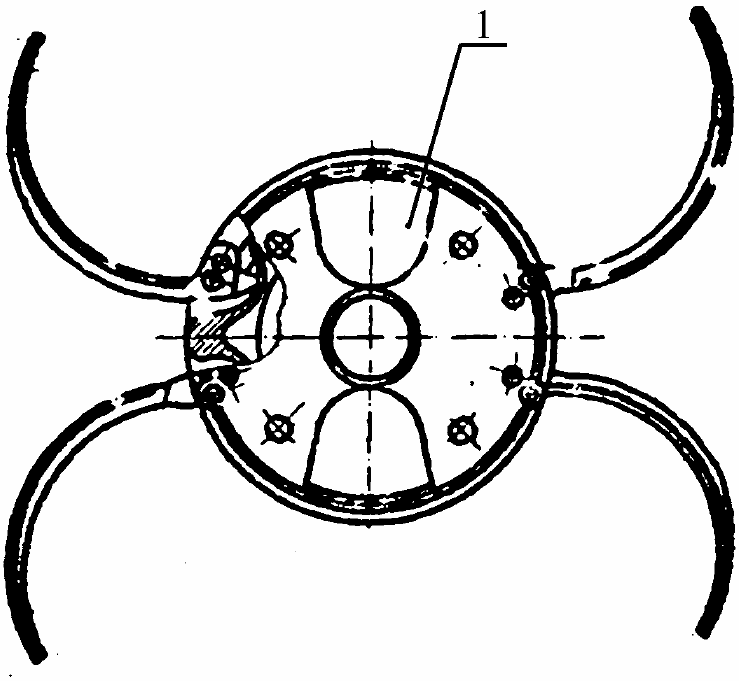

Figure 4. Wraparound fins of the Soviet 9M114 "Shturm-Ataka" family ATGM.
Image: Penza Artillery Engineering Institute,[13]
courtesy of R.A. Then

II. IMPLICATIONS

If the 600 mm MLRS rockets are indeed nuclear capable, a total of thirty 600 mm MLRSs on tracked chassis and nine 600 mm MLRSs on truck chassis could potentially launch up to 216 guided rockets with either conventional or nuclear warheads in a short amount of time. Additionally, if the production issues have been resolved, these numbers are likely to continue to increase. Such a rapid launch capacity has the potential to overwhelm targets in the ROK – in comparison, a similar effect would be achieved by a salvo of a total of 216 SCUD launch vehicles, which is considerably more demanding to logistics, coordination, command and control.

Alternatively, the MLRSs could be used in an attempt to saturate or distract the ROK's missile defence systems, thereby clearing the way for other nuclear weapon delivery mechanisms capable of performing evasive manoeuvres, such as the KN-23 and KN-24.[17]

Finally, the uncommon design of the MLRS rockets demonstrates the ability of the DPRK weapon designers to take inspiration from different weapon systems around the world and create unique solutions.[18] These technical and engineering abilities, demonstrated also in the novel experimental launch of a ballistic missile from an underwater canister in a reservoir, could be applied in other strategic weapon systems.[19]

Special thanks to R.A. Then, author of the Soviet armour blog Tankograd (https://thesovietarmourblog.blogspot.com/), who kindly shared publications on Soviet ATGMs with the author of this report.

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ENDNOTES

1 Supreme Leader Kim Jong Un Guides Test-Fire of New-type Large-caliber Multiple Launch Guided Rocket System, KCNA, 1 August 2019, available at: http://kcna.kp/en/article/q/5661315b276bc183038f4abc823684b1.kcmsf

2 Tianran Xu, Analysis of the KN-25 Multiple Rocket Launcher System after the 9 March 2020 DPRK Test, Open Nuclear Network, 23 March 2020, available at: https://opennuclear.org/publication/analysis-kn-25-multiple-rocket-launcher-system-after-9-march-2020-dprk-test

3 Military Parade Marks Founding Anniversary of WPK, KCNA, 10 October 2020, available at: http://kcna.kp/en/article/q/f12dfdeb1dd09085df5fcd34d1257e74.kcmsf.
朝鲜再次发射数枚疑似短程导弹的飞行器 [DPRK again launched several presumed short range projectiles], Zaobao, 14 April 2020, available at: https://www.zaobao.com.sg/realtime/world/story20200414-1045429

4 Test-Fire of Super-large Multiple Rocket Launchers Conducted in DPRK, Rodong Sinmun, 30 March 2020, Rodong Sinmun, available at: https://kcnawatch.org/newstream/1585550420-899255361/test-fire-of-super-large-multiple-rocket-launchers-conducted-in-dprk/

5 Test-Fire of Super-large Multiple Rocket Launchers Conducted in DPRK, Rodong Sinmun, 30 March 2020, Rodong Sinmun, available at: https://kcnawatch.org/newstream/1585550420-899255361/test-fire-of-super-large-multiple-rocket-launchers-conducted-in-dprk/

6 Respected Comrade Kim Jong Un Makes Reply Speech at Ceremony of Donating 600mm Super-large Multiple Launch Rocket System, KCNA, 1 January 2023, available at: http://kcna.kp/en/article/q/50ef67e21e186c3c6c68b1dad2067290.kcmsf

7 Gift of Loyalty to Plenary Meeting of Great WPK from Munitions Industrial Workers Ceremony of Presenting 600mm Super-Large Multiple Rocket Launchers Held with Splendor, KCNA, 1 January 2023, available at: http://kcna.kp/en/article/q/62e6b8bc2246e848838a1467933d43fc.kcmsf

8 Military Parade Marks Founding Anniversary of WPK, KCNA, 10 October 2020, available at: http://kcna.kp/en/article/q/f12dfdeb1dd09085df5fcd34d1257e74.kcmsf

9 Respected Comrade Kim Jong Un Makes Reply Speech at Ceremony of Donating 600mm Super-large Multiple Launch Rocket System, KCNA, 1 January 2023, available at: http://kcna.kp/en/article/q/50ef67e21e186c3c6c68b1dad2067290.kcmsf

10 Gift of Loyalty to Plenary Meeting of Great WPK from Munitions Industrial Workers Ceremony of Presenting 600mm Super-Large Multiple Rocket Launchers Held with Splendor, KCNA, 1 January 2023, available at: http://kcna.kp/en/article/q/62e6b8bc2246e848838a1467933d43fc.kcmsf

11 Tianran Xu, Backgrounder: Previous DPRK Nuclear Tests, Open Nuclear Network, 17 June 2022, available at: https://opennuclear.org/publication/backgrounder-previous-dprk-nuclear-tests

12 It is stated that this form allows for folding in the fins on the cylindrical body. These fins then create lift, stabilize the missile and maintain the rotation on its trajectory. However, the text did not go into detail on exactly how the fins achieve these effects. See: S.V. Partala, V.I. Alchinov, V.V. Burlov, S.V. Mikhalets, A.G. Moiseev, M.I. Anfalova, Конструкция средств поражения, боеприпасов, взрывателей и систем управления средствами поражения (Конструкция и функционирование ПТУР) [Design of means of destruction, ammunition, fuses and control systems for means of destruction (Design and operation of ATGM)], Penza Artillery Engineering Institute, 2004, p. 113. The publication was kindly shared with Open Nuclear Network by R.A. Then, author of the Soviet Armour Blog Tankograd (https://thesovietarmourblog.blogspot.com/).

13 S.V. Partala, V.I. Alchinov, V.V. Burlov, S.V. Mikhalets, A.G. Moiseev, M.I. Anfalova, Конструкция средств поражения, боеприпасов, взрывателей и систем управления средствами поражения (Конструкция и функционирование ПТУР) [Design of means of destruction, ammunition, fuses and control systems for means of destruction (Design and operation of ATGM)], Penza Artillery Engineering Institute, 2004, p. 232.

14 “The rolling moment in conventional wrap-around fins is a result of the pressure difference between sides of the fins, so that it can be avoided by configuring the fins in an opposite arrangement …” See: A. Bagheri, M. Pasandidehfard, S.A. Tavakoli Sabour, Numerical investigation of aerodynamic effects of opposite wrap-around fins at supersonic speeds, Proceedings of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, 2019, 233(7):2410-2425. Conversely, the asymmetry in wingspan might be able to cause the desired pressure difference that could impart the spin moment.

15 Tianran Xu, Brief on the Defence Development Exhibition of the Democratic People's Republic of Korea, Open Nuclear Network, 18 October 2021, available at: https://opennuclear.org/publication/brief-defence-development-exhibition-democratic-peoples-republic-korea

16 The rotating sleeve can be seen on a number of foreign missiles and projectiles to provide inflight stability. Those missiles and projectiles include but are not limited to the SA-8 surface to air missile developed by the Soviet Union; the Sea Oryx surface to air missile developed by Taiwan, and the US GMLRS rockets. See: Carlo Kopp, NIEMI 9K33 Osa/Romb Self Propelled Air Defence System / SA-8 Gecko, Air Power Australia, 4 July 2009, available at: http://www.ausairpower.net/APA-9K33-Osa.html; 謝金興 [Hsieh Kinhsing], Rolling of Sea Oryx tail section, 2015, available at: https://www.youtube.com/watch?v=z-fdcuCV6Ls&ab_channel=%E8%AC%9D%E9%87%91%E8%88%88; Promotional video for 1400-ton corvette concept, National Chung-Shan Institute of Science and Technology, 2018, available at: https://www.youtube.com/watch?v=fb9RFVidjwo&t=25s&ab_channel=%E5%9C%8B%E5%AE%B6%E4%B8%AD%E5%B1%B1%E7%A7%91%E5%AD%B8%E7%A0%94%E7%A9%B6%E9%99%A2%E5%AE%98%E6%96%B9%E9%A0%BB%E9%81%93; Soldiers conduct live fire of GMLRS rockets at White Sands Missile Range, 2022, available at: https://www.youtube.com/watch?v=Eo15aqC9QqA&ab_channel=DefenseNow

17 For a detailed assessment of the combined threat posed by the new generation of SRBMs developed by the DPRK, see: Stéphane Delory, Antoine Bondaz, Christian Maire, GEO4i, North Korean Short Range Systems, Military consequences of the development of the KN-23, KN-24 and KN-25, Fondation pour la Recherche Strategique (FRS), available at: https://www.nonproliferation.eu/hcoc/north-korean-short-range-systems/

18 The 600 mm MLRS rocket also appears to be a further development on the basis of the KN-09 MLRS rocket of ~300 mm calibre. The KN-09 rocket has wraparound fins of identical layout. However, contrary to the 600 mm MLRS, there are clearly visible spin rails on the lunch tubes of the KN-09, indicating that the KN-09 rocket might not have a rotating sleeve and might be stabilized by the spin of the rocket body. The wraparound fins of KN-09 could also be seen in the KCNA video report: Marshal Kim Jong Un opens the National Defence Development Exhibition "Self-Defence - 2021", KCTV, 12 October 2021, available at: https://www.youtube.com/watch?v=yrEGqIPtl7s&ab_channel=PaektusanRevolutionaryArmy

19 Tianran Xu, Analysis of the DPRK's Ballistic Missile Launch Campaign in September/October 2022, Open Nuclear Network, 14 October 2022, available at: https://opennuclear.org/publication/analysis-dprks-ballistic-missile-launch-campaign-septemberoctober-2022

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