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Issue Brief

DF-31AG Test and PLA Rocket Forces' Nuclear Choices

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Summary

The testing of DF-31AG ICBM shows both the success and vulnerabilities in China's nuclear choices. The mixed deployment of both liquid-fuelled and solid-fuelled ballistic missiles for nuclear deterrence indicates that the objective to move fully into solid-based mobile ballistic missiles is yet to be achieved.

The intensification of the US–China great power competition is fuelling China's efforts to strengthen its nuclear deterrence and signalling. Though China's nuclear forces modernisation is opaque with regard to the number of warheads or delivery vehicles, the sophistication in the testing of ballistic missiles in recent years shows that it is seeking to make its retaliatory capability against the US more credible. On 25 September 2024, China's PLA Rocket Forces (hereby Rocket Forces) conducted a DF-31AG[1] (solid-fuelled) inter-continental ballistic missile (ICBM) test. This test was significant since it was a full-range flight test (全程试验) that China did after a gap of 44 years. China's first ever full-range ICBM test was that of the DF-5, which was tested in 1980. In such a case, what does the DF-31AG test tell us about China's nuclear choices in a heightened nuclear environment when facing US nuclear superiority?

Analysts have indicated that the Rocket Forces tested the 'operational validation' and 'ISR capabilities' of the DF-31AG missile.[2] The timing of the test also led analysts to speculate that the Rocket Forces conducted the test to prove the reliability of their nuclear deterrence. The questions about the competency had risen when the Rocket Forces removed several high-ranking officials from the organisation for graft. In the last decade, CPC Chairman Xi Jinping had considerably expanded the importance of the Rocket Forces when he elevated the organisation from a branch to an independent service in 2015 and also appointed Wei Fenghe, a former commander as the Defence Minister of China in 2018. But in 2024, the CPC expelled Wei Fenghe over corruption.

Some analysts also argue that the test was a response to the US deployment of MRBMs in its neighbourhood after the US opted out of INF (Intermediate-Range Nuclear Forces) treaty in 2019. Philippines was the first country to deploy the US Typhoon missile system in 2024.[3] If the US had been still part of the INF Treaty, the deployment of mid-range missiles would have violated the terms and conditions of the treaty, which prohibits the development and deployment of ground-based mid-range ballistic and cruise missiles.

DF-31 AG Test: Key Characteristics

The PLA Rocket Forces carried out the DF-31AG ballistic missile test with a dummy warhead towards the high seas of the Pacific Ocean. The Ministry of Defence stated

[1] DF-31AG was first shown in the 2017 PLA Day parade at the Zhurihe training base in Inner Mongolia Autonomous Region.

[2] Greg Torode, **"Beyond the Politics: China's Missile Tests Reflects Military Needs"**, *Reuters*, 10 October 2024.

[3] **"China Resolutely Opposes US Deployment of Mid-Range Missile System in Asia-Pacific Region in Bid to Seek Unilateral Military Advantage: Chinese FM"**, *Global Times*, 18 April 2024. Also see **"US Army's Mid-Range Capability Makes Its First Deployment in the Philippines for Salaknib 24"**, U.S. Army Pacific, 15 April 2024; Xiaodon Liang, **"U.S. Missile Battery to Remain in Philippines"**, *Arms Control Today*, November 2024.

that China informed the "relevant countries" in advance and that the test was intended to assess the performance of the weapons and training level of the troops.[4] According to Chinese officials, the missile landed accurately in a pre-determined area, and achieved the intended target and purpose.[5] The DF-31AG ballistic missile, like the DF-41 (solid-fuelled) ICBM, uses a cold launch method and is equipped with rubber tube launch technology.[6] China conducts most of its ballistic missile tests, including ICBMs, from its missile testing ranges in the deserts through a high-trajectory test (高弹道).

In this case, the Rocket Forces opted out of a high-trajectory test and instead did a full-range test leading it to select the impact area of the missile in the Pacific waters. The test data would have been useful in verifying the performance of the ballistic missile from launch to the re-entry phase, trajectory and guidance control, stability and navigation performance as well as accuracy of the missile. The Rocket Forces are claiming that the test demonstrated that they have mastered the missile guidance, navigation and control systems of the ballistic missile and could accurately control the impact point.

The DF-31AG uses the Beidou navigation satellites making the tracking and control of the ballistic missile fully autonomous, and uses inertial guidance system that makes the missile more accurate.[7] Since the military reforms in 2015, the PLA has been pushing towards conducting military training resembling 'actual combat conditions' and a full-range flight test rather than a high-trajectory test that satisfies these conditions too.[8] The DF-31AG test completed its 12,000 kms flight in 20 minutes. The DF-31AG (an upgraded version of the DF-31A ballistic missile) has a high-mobility launch capability and can conduct operations without launch support, unlike the DF-31A ballistic missile, which needs to have launch support operations

[4] **"Ministry of National Defense: PLA Rocket Forces Successfully Launched One Intercontinental Ballistic Missile into the High Seas Maritime Space of the Pacific Ocean"** (**国防部：火箭**军向太平洋相关公海海域成功发射1发洲际弹道导弹), *Xinhua*, 25 September 2024; also see Xie Ruiqiang, **"China Publicly Released Photos of Launching Intercontinental Ballistic Missile into the Pacific Ocean: Four Key Pieces of Information Worth Paying Attention"** (**中国公开向太平洋**发射洲际导弹照片 这四个**关**键信息值得关注), *The Paper*, 26 September 2024.

[5] Zhao Lei, **"Missile Launch Test Achieved Desired Goals, PLA Says"**, *China Daily*, 26 October 2024.

[6] A cold launch is where the missile is ejected by gas and then ignited after it clears the launch system and the rubber tube launch technology helps in withstanding the pressure from the missile launch leading to launch operations without support systems. Li Yonghe, **"DongFeng Express: For What Reason It is Gaining Worldwide Recognition?"** (东风快递"为什么能实现全球"**包**邮"), *Science and Technology Daily*, 3 January 2025; also see Robert Glebocki and Mariusz Jacewicz, **"Sensitivity Analysis and Flight Tests Results for a Vertical Cold Launch Missile System"**, *Aerospace*, Vol. 7, No. 12, 2020, p. 168.

[7] Ibid.

[8] **"Unflinchingly Advance Actual Combat-Oriented Military Exercise – Chairman Xi Jinping's Important Speech at the Central Military Commission's Military Training Conference Has Given Rise To Strong Reaction"** (坚定不移推进实战化军事训练 - 习近平主席在中央军委军事训练会议上的重要讲话在全军部队引起强烈反响), *Xinhua,* 26 November 2020; **"Thoroughly Promote Actual Combat Military Exercises"** (**深入推**进实战化军事训练), National Defense University Military Management College, 16 February 2023.

such as pre-determined area and temporary concrete structures to withstand the launch of the missile.[9]

The 1980 DF-5 Test: Key Characteristics

First, the PLA required three years to conduct the 1980 DF-5 ICBM test. It required a vast support system and a task force made up of over 5,000 personnel.[10] The DF-5 ICBM test was conducted with the leadership organising the '580' mission (580任务), where the PLA Navy task force (18 ships and four helicopters) measured landing points and conducted oceanographic surveys to collect data of the missile test.[11]

Second, the then Second Artillery conducted the first test to fill the deterrence gaps in their nuclear capabilities. General Zhang Aiping,[12] who had supervised the Two Bomb and One Satellite (两弹一星)[13] programme, also set up the "three gaps" (三抓) tasks[14] in 1977. Gen Zhang Aiping initiated the "three gaps" (三抓) tasks with regard to nuclear deterrence—the development and testing of ICBMs, SLBMs and communication satellites by the early 1980s. The SLBM test was conducted in 1982 and the communication satellite was launched in 1984. The ICBM test was considered as the most important among the 'three gaps' initiative and therefore given immediate priority and required organisational mobilisation, construction of survey ships, selection of landing area, etc.

The 'three gaps' project happened after the biggest political turmoil in the CPC history, the Cultural Revolution, which disrupted defence programmes. In 1965,

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[9] **"What is Missile Launch Without Support? DF-41 Uses This Technology That Overweighs the Deterrence of DF-31"** (什么叫导弹无依托发射？东风41运用此技术，威慑力碾压东风31), *The Paper*, 25 October 2019.

[10] At that time, Liu Daosheng (刘道生), the first Deputy Commander of the PLA Navy led the mission. The task force also included 5, 360 cadres, scientific and technical personnel, soldiers from and outside the military present during the mission, and it was remarkable for breaking the first and second island chain to salvage the full-flight mission data. Liu Dengrui, **"Commemorating the 110th Anniversary of Zhang Aiping's Birth"** (纪念张爱萍诞辰110周年), Two Bombs and One Satellite History Research, *The Paper*, 9 January 2020; for more details, see Huanqiu Wang Junshi Luntan, **"Top-Secret Flight-The 30th Anniversary of My Country's 580 Missile Revealed"** (绝密航程！我国580任务30周年揭秘), *Global Times*, 19 May 2010.

[11] **"580 Mission Diary Entered the Collection of China Maritime Archive Library"** ("580"任务日记入藏中国海洋档案馆), *China Archives News*, 4 June 2020; Zhou Jinyu, **"The 580 Task Force 40 Years Ago"** (40年前的"580"特混舰船编队), *Party History Journal*, 10 July 2020.

[12] General Zhang Aiping served as the Vice-Premier, State Councilor and the Minister of National Defence. During the weapons programme, he was in the National Defence Science and Technology Commission overlooking the Two Bombs and One Satellite programme and the Three Gaps tasks. See Liu Dengrui, **"Commemorating the 110th Anniversary of Zhang Aiping's Birth"**, no. 10.

[13] The Two Bomb and One Satellite programme refers to the project to develop 'atom bombs, missiles and artificial satellites'. Later, the atom bomb meant having both atom and hydrogen bomb. China tested the nuclear weapons in 1964 (hydrogen bomb in 1967), developed the DF-2 ballistic missile and used it to test the nuclear warhead in 1966 and its first satellite was launched in 1970.

[14] Lu Qiming and Fan Minruo, **"Zhang Aiping and Two Bombs and a Satellite - Preface"** (张爱萍与两弹一星), *PLA Press*, April 2011.

Qian Xuesen[15] had proposed the 'Eight Year Four Missile' plan, where China was supposed to conduct the tests of DF-2 (IRBM/ICBM), DF-3 (intermediate range), DF-4 (intermediate to long-range) and DF-5 (ICBM) by 1972.[16] However, the Cultural Revolution disrupted the plan and when Zhang Aiping took over the reins of PLA's National Defence Science and Technology Commission in 1975 after his purge (he was imprisoned for six years), his 'three gaps' was designed to bring working order to the disrupted programmes. The DF-5 test, therefore, was a product of the success of the reorganisation and coordination of the missile and defence programmes.

Third, the 1980 ICBM test was a surprise test, unlike in September 2024 when China informed other countries in advance, which indicated a certain level of confidence about the outcome of the test as well as risking of missile test data leaks (presence of ships and radar stations of other countries during the flight path).

Rocket Forces' Deployment

The DF-31AG test is to signal China's nuclear deterrence capabilities to its adversaries, which shows to some extent the success of the streamlining of the priorities of the Rocket Forces. China has been developing its nuclear missile capability to deter the US from using its nuclear superiority to issue a nuclear threat during a potential conflict involving its core interests. The decision to test the DF-31AG in Pacific waters and exposing it to surveillance from its adversaries meant that China was keen on nuclear signalling.

The Rocket Forces are conveying that they are able to calculate real combat trajectories, missile guidance and hit accuracy, and the reliability of the missile through use of its naval, radar and satellite assets. It is intended to assure that their retaliatory strike is effective and that the Rocket Forces have reached technical maturity. If the Rocket Forces are attempting to convey their deterrence capability through the testing of DF-31AG, then what are the characteristics of their deterrence challenges?

A cursory look at China's ICBM development would reveal that it has always been a long-drawn process, where the Rocket Forces could only develop solid-fuelled ICBMs in the 1990s. The 1965 'Eight Year Four Missile' plan was to culminate in the development of solid-fuelled ballistic missiles. Although China achieved the long-range capability for delivering its nuclear weapons, the survival of its missiles became a priority. Hence, Gen Zhang envisioned to transform China's nuclear capabilities

[15] Qian Xuesen was the scientist and member of Chinese Academy of Sciences and one of the founding fathers of Two Bombs and One Satellite programme. He is generally considered as the 'Father of Chinese Rocketry'.

[16] In fact, only when China deployed the DF-5A in 1995, then the target set forth by Qian Xuesen was achieved.

from liquid-fuelled to solid-fuelled missiles, develop land-based and sea-based deterrence and move from silo-based towards mobile launch missiles.[17]

However, instead of completely replacing its liquid-fuelled ICBMs with solid-fuelled ballistic missiles, the Rocket Forces are upgrading more liquid-fuelled ICBMs such as the DF-5B and building more hardened silos.[18] China has been testing upgraded liquid-fuelled ICBMs such as DF-5B and constructing multiple ICBM silos to create uncertainty in the minds of the adversary about the number and location of its liquid-fuelled ICBMs. The silos are hardened to withstand damage from conventional firepower. Adversaries would have to hit all of their silos to make sure that all the liquid-fuelled ballistic missiles are destroyed. Moreover, the newer missiles are also being developed in a nuclear environment where the Chinese perceive that many major powers including the US are modernising their nuclear forces.[19]

The DF-41, which remains one of their few solid-fuelled ICBMs that can pose a credible threat to its adversaries, had initial deployment only in 2020. The DF-5B ICBM, though upgraded and difficult to destroy through conventional means, can be detected. Given that the DF-31AG ICBM has passed the verification of the full-range test, it can be expected to replace the ageing DF-31 missile series.

The testing of DF-31AG, therefore, shows both success and vulnerabilities in China's nuclear choices. The mixed deployment of both liquid-fuelled and solid-fuelled ballistic missiles for their nuclear deterrence indicates that the objective to move fully into solid-based mobile ballistic missiles has yet to be achieved. Even the testing of newer missiles such as the DF-5B (liquid-fuelled) ICBM attests to this strategy.

Conclusion

The DF-31AG does not need launch support, which means it does not have to rely on launch sites for support, or kept hidden underground to avoid detection or attack, which can ensure its survivability. The DF-31AG can also be used in counter-attack rapidly because it integrates transport, erector and launch (TEL) facilities for launch. Prior preparation such as hardened ground, duration of response such as the time needed to construct launch sites are not needed, and therefore is largely secure from US surveillance and reconnaissance.

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[17] Jiang Yue-yin, **"An Outstanding Leader in National Defence Science and Technology and Weapons and Equipment Construction – General Zhang Aiping"** (国防科技和武器装备建设事业的杰出领导者——张爱萍将军), China Academy of Engineering Physics, 28 March 2014.

[18] Matt Korda and Hans Kristensen, **"A Closer Look at China's Missile Silo Construction"**, Federation of American Scientists, 11 February 2021; **"Dongfeng-5B Nuclear Missile Formation Reviewed At Parade"**, *Xinhua,* 1 October 2019.

[19] Wei Liqun, **"Nuclear Powers Are Competing to Develop New Intercontinental Missiles: How Great is the ICBM of the Great Powers?"** (各核大国争相研发新型洲际导弹，大国长剑发展情况如何) **Part 1** and **Part 2**, *The Paper*, 2 October 2024.

The Rocket Forces were perhaps under pressure to signal the effectiveness of their nuclear deterrence against adversaries in a heightened nuclear environment unrestrained by both the unravelling of the ABM (Anti-Ballistic Missile) treaty and the INF treaty and modernisation of nuclear forces by other major powers. Simultaneously, the Rocket Forces continue to rely on liquid-fuelled ICBMs for nuclear deterrence. The DF-31AG is emerging as the ICBM of choice of their solid-fuelled capability.

Like the first test of DF-5, the DF-31AG represents the attempts of the Rocket Forces to streamline its organisational resources in a more efficient manner to counter vulnerabilities in its deterrence capabilities. The DF-31AG test might also be seen as an attempt to prove that the corruption scandals in the Rocket Forces have not affected their capabilities or to counter the notion that their missile dominance in its neighbourhood has weakened due to the US deployment of its MRBM systems. The DF-31 AG test is proof that China is continuously upgrading its deterrence capabilities while achieving its long-term goals of increasing the effectiveness of its retaliatory capabilities through solid-fuelled missiles.

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