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Nuclear arms for conventional threats: China's nuclear modernisation and emerging technologies

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Takeaways

- **China's nuclear modernisation should be analysed relative to U.S. counterforce developments that threaten China's second-strike capability.**
- **The framework of nuclear deterrence is complicated by the emergence of new strategic non-nuclear weapons (SNNWs) enabled by technological development.**
- **SNNWs, such as ballistic missile defense, conventional high-precision weapons and ISR, are mutually reinforcing and enabling, and may be used for conventional counterforce operations. This complicates escalation dynamics and diminishes the distinction between conventional and nuclear force.**
- **The rules and practices of nuclear deterrence are changing along with technological development. This must be reflected both in scholarly thinking, military planning, and political efforts to facilitate regulations on SNNWs.**

Introduction

Between June and August 2021, civilian researchers made a series of startling discoveries concerning China's nuclear weapons development. Combined across three findings, commercial satellite imagery analysis seemingly revealed silo fields with a combined excess of 250 ballistic missile silos under construction in China. For a country that has historically relied on a nuclear arsenal of between 100-300 warheads, the addition of 250 silos may project a dramatic increase to its nuclear capabilities. Later, in October, reports surfaced indicating China having tested an advanced delivery system capable of entering earth orbit while carrying a hypersonic glider potentially armed with nuclear warheads – a fractional orbital bombardment system (FOBS). Such a capability would provide China with added

options in bypassing U.S. missile defenses, and the test been labelled by the chairman of the U.S. Joint Chiefs of Staff as "very close to a Sputnik moment".[1]

These discoveries are not isolated incidents but should rather be seen in the larger context of China's nuclear modernisation – a process involving both quantitative and qualitative developments. This modernisation has sparked increased concern surrounding China's military direction, with the latest U.S. projections expecting China's nuclear stockpile to quadruple from approximately 250 to 1000 between 2020 and 2030.[2] Additionally, U.S. Secretary of State Blinken has officially voiced his regard of China having "[deviated] from its decades-old nuclear strategy based on minimum deterrence."[3]

The aim of this IFS Insight is to shed light on the context surrounding China's nuclear modernisation, and to explore the latent questions surrounding it: why is China modernising its arsenal? What factors may be driving it? And finally, what lessons and implications may be drawn from the answers? I show that China's nuclear modernisation should be analysed relative to the factors that affect China's second-strike capability, the most important factor being U.S. counterforce developments. These counterforce developments are heavily influenced by the adoption of emerging technologies for military purposes, and threaten China's second-strike capability, thus creating incentives for China to arm themselves. This has resulted in a dangerous security dilemma dynamic capable of reducing both regional and global security, particularly due to the unregulated and potentially destabilising nature of these emerging technologies.

How has China developed its nuclear arsenal in the past?

Assessing contemporary phenomena such as China's nuclear modernisation is fruitless without a reference point – in this case, through historical context. Historically, China has developed its nuclear arsenal cautiously and sparingly. Following its first successful nuclear weapons test in 1964, China's arsenal grew slowly, reaching an estimated 75 warheads in 1976 and 151 in 1985.[4] Its arsenal was mainly composed of intermediate-range missiles and strategic bombers incapable of reaching continental U.S. – the historically most central focal point of its nuclear deterrence, along with the Soviet Union after the Sino-Soviet split. Instead, the targeting ranges of China's delivery vehicles constrained them to targets in the Asian-Pacific region, as well as some Soviet cities. Only after the 1981 deployment of its first intercontinental ballistic missile (ICBM), the DF-5, did China achieve the ability to target continental U.S. Throughout the remainder of the Cold War, however, the estimated number of DF-5s in operation stood only at four. Additionally, the entirety of China's nuclear forces was either deployed in static silos or caves, and their liquid fuel meant long-lasting preparation procedures making them ill-fitted for use in acute situations.[5]

The strategy underlining China's initial nuclear build-up was designed with two primary aims: deterring other states from launching nuclear attacks against China, and counter-coercion. In other words, the arsenal was constructed with inherently defensive use in mind, with no plans of the

1 Sorcher, S. & Demirjian, K. (2021, October 27th). Top U.S. general calls China's hypersonic test very close to a 'Sputnik moment'. *The Washington Post.* https://www.washingtonpost.com/nation/2021/10/27/mark-milley-china-hypersonic-weapon-sputnik/

2 Department of Defense (DoD). (2021, November 3rd). Military and Security Developments Involving the People's Republic of China 2021: Annual Report to Congress. U.S. Dept. of Defense. https://media.defense.gov/2021/Nov/03/2002885874/-1/-1/0/2021-CMPR-FINAL.PDF

3 Martin, P. (2021, August 6th). Blinken Warns Asian Nations of China's Growing Nuclear Ambitions. *Bloomberg*. https://www.bloomberg.com/news/articles/2021-08-06/blinken-warns-asian-nations-of-china-s-growing-nuclear-ambitions

4 Fravel, M. T. & Medeiros, E. S. (2010). China's Search for Assured Retaliation: The Evolution of Chinese Nuclear Strategy and Force Structure. *International Security, 35*(2), p. 54.

5 Lewis, J. W. & Hua, D. (1992). China's Ballistic Missile Programs: Technologies, Strategies, Goals. *International Security, 17*(2), p. 19.

weapons ever actually having to be used aside from deterrence failure. In fact, the day after its 1964 nuclear test, Chinese Premier Zhou Enlai publicly announced China to "at no time and in no circumstances be the first to use nuclear weapons" – the pledge of no first use has stood in effect since.[6] Furthermore, Mao's famous description of nuclear weapons as "paper tigers" further underlined the views of China's leadership on the weapons as political weapons and tools of deterrence rather than instruments for actual use in war.[7]

China exited the Cold War with a nuclear arsenal lean in both numbers as well as function. While its nuclear strategy arguably did not require great capabilities to be set in motion, there were genuine questions surrounding the credibility of China's ability to launch a nuclear retaliatory strike in the event of an attack – known as a second-strike capability.

From the 1990s onward, China began a military modernisation that included significant overhauls to its nuclear capabilities. Several factors could explain this. First, the military-technological gap between China and the U.S had grown significant, thus prompting a need to modernise. This became painfully clear through witnessing the 1991 Gulf War – the U.S. "revolution in military affairs" had produced capabilities exceeding Chinese expectations, and lessons learned from these observations would directly affect China's military-doctrinal move from "people's war" thinking to warfare under "high-technology conditions".[8] Second, the end of the Cold War fundamentally changed China's role as a global power, thus enabling the country in taking a larger role in a region no longer defined by U.S.-Soviet ideological interests. At this point, China's usefulness as a U.S. quasi-ally had diminished, rather growing to be viewed as a potential challenger for regional hegemony in the Asian-Pacific. Third, China's lengthy period of extreme economic growth beginning in the late 1970s alleviated the constraints imposed by its earlier resource scarcities, thus enabling more spending for military purposes. Given the altered post-Cold War security climate, an increased emphasis on building military power was required.

Of particular importance to the nuclear aspect of China's modernisation was the increased U.S. spending on ballistic missile defense (BMD) capabilities beginning in the mid-1990s. U.S. BMD pursuits were not only made for deployment on U.S. mainland, but also in East-Asia – mainly directed against North Korea – and were thus seen as a threat against China.[9] Having an already vulnerable arsenal, the idea of a functioning BMD neutralising Chinese missiles mid-air projected existential threats to its second-strike capability.

The sum of factors resulted in increased focus diverted to China's nuclear capabilities from the 1990s onward. Its DF-5 force quickly grew from four to 20 by the mid-1990s, and a new-generation of solid-fuelled ICBMs – the DF-31 and DF-41 – entered development stages. Particularly the road-mobile DF-31 would add an important layer to China's deterrent through its mobility when it was deployed in 2006, no longer constraining China's long-range capabilities to storage in static silos vulnerable to destruction in a first strike.[10] At the same time, renewed efforts were made to build a sea-based element in China's nuclear deterrent in the form of a ballistic missile submarine (SSBN). China had previously attempted to construct an SSBN from the late 1950s, but the project had ultimately failed. The new SSBN, a Jin-class submarine equipped with JL-2 ballistic missiles, would

6 Lewis, J. W. & Hua, D. (1988). *China Builds the Bomb.* Stanford University Press, p. 1.

7 Sheng, M. M. (2008). Mao and China's Relations with the Superpowers in the 1950s: A New Look at the Taiwan Strait Crises and the Sino-Soviet Split. *Modern China, 34*(4), p. 487.

8 Goldstein, A. (1997). Great Expectations: Interpreting China's Arrival. *International Security, 22*(3), p. 43.

9 Twomey, C. P. & Chase, M. S. (2015). Chinese Attitudes Toward Missile Defense Technology and Capabilities. In Kelleher, C. M. & Dombrowski, P. J. (eds.), *Missile Defense: The Fourth Wave and Beyond*. Stanford University Press.

10 Norris, R. S. & Kristensen, H. M. (2010). Chinese Nuclear Forces, 2010. *Bulletin of the Atomic Scientists, 66*(6), p. 136.

eventually be deployed in 2016, thus providing China with an additional layer of mobility in its deterrent.[11]

What is provoking further modernisation?

China entered the 1990s with an uncertain (at best) second-strike capability. Through modernisation, it addressed its weaknesses by adding additional numbers and mobility to its nuclear force structure, thus ensuring a credible second-strike capability by the 2010s. Despite this, recent developments such as the expansion of silo fields and FOBS test indicate that its nuclear modernisation has only expanded. Why is this the case?

The requirements of a credible second-strike capability are contingent on the capabilities of those one seeks to deter. In the case of China, the focal point of its deterrent is the U.S., and the capabilities necessary to ensure a credible second-strike capability vis-à-vis the U.S. are therefore contingent on the latter.

Analysing U.S. military developments over recent years show several factors that, both directly and indirectly, threaten China's second-strike capability. Consequently, they may act as factors driving a continued expansion of China's nuclear capabilities to account for its threats. In contrast with the primarily quantitative aspect of the Cold War arms race, these new developments are qualitative in nature, and are derived from emerging technologies. These primarily take the form of strategic non-nuclear weapons (SNNWs), defined as "weapons and enabling systems that can be used to compromise an adversary's nuclear forces using both kinetic and non-kinetic means that don't involve nuclear weapons".[12] I identify three SNNWs of particular importance: BMD, conventional high-precision weapons systems, and intelligence, surveillance, and reconnaissance (ISR) advancements, the latter serving to enable the former two.

U.S. efforts to develop a credible BMD system have been met with Chinese resistance since its inception. China regards BMD as an existential threat to its nuclear deterrent, and as a disruptive element incentivising arms racing[13] – the prospect of a BMD system neutralising China's retaliatory forces directly threatens China's second-strike capability, and the only logical way to ensure a credible deterrent is deploying more warheads to overwhelm the BMD capabilities.

While the current level of defense provided by U.S. BMD systems is uncertain, the systems are undergoing continuous testing and upgrades. The idea of U.S. BMD placed in East-Asia remains threatening to China, and BMD systems have already been provided to both Japan and South Korea. Although the official intent of BMD systems is countering "rogue states", – effectively North Korea or Iran – any system positioned to contain North Korea will likely by equally well positioned to contain China as well. In sum, greater U.S. BMD capabilities provide correspondingly greater incentives for China to compensate by arming themselves further.

The second SNNW, conventional high-precision weapons systems, is a threat further aggravated by the expiration of the INF. Having previously been legally constrained from building intermediate-range land-based weapons, the U.S. have begun heavily prioritising the funding of new strategic weapons. These weapons include hypersonic weapons systems – manoeuvrable weapons capable of travelling beyond five times the speed of sound – as well as conventional ballistic missiles and cruise missiles.[14] Various new conventional

11 Kristensen, H. M. & Norris, R. S. (2018). Chinese Nuclear Forces, 2018. *Bulletin of the Atomic Scientists, 74*(4), p. 292.

12 Zala, B. (2020). *Nuclear Submarines, Non-Nuclear Weapons and the Search for Strategic Stability.* Australian Strategic Policy Institute. https://www.aspistrategist.org.au/nuclear-submarines-non-nuclear-weapons-and-the-search-for-strategic-stability/

13 See Wu, R. (2014). *No Stability Without Limits on Missile Defense.* Bulletin of the Atomic Scientists. https://thebulletin.org/roundtable_entry/no-stability-without-limits-on-missile-defense/ ; Twomey, C. P. & Chase, M. S. (2015). Chinese Attitudes Toward Missile Defense Technology and Capabilities. In Kelleher, C. M. & Dombrowski, P. J. (eds.), *Missile Defense: The Fourth Wave and Beyond*. Stanford University Press ; Haynes, S. T. (2016). Chinese Nuclear Proliferation. Potomac Books.

14 Erästö, T. (2021). *New Technologies and Nuclear*

high-precision weapons systems are in development across all U.S. military branches, although their future capabilities remain uncertain. Moreover, the possible deployment of conventional INF-range weapons in the Asian-Pacific theatre has been voiced by U.S. leadership, China has responded in kind, with arms control official Fu Cong warning that "if the U.S. deploys missiles in this part of the world, at the doorstep of China, China will be forced to take countermeasures."[15]

An obstacle for U.S. propositions of deploying conventional weapons close to Chinese mainland is where they would be deployed. Any regional ally accepting U.S. counterforce capabilities on its soil would be met with intense Chinese diplomatic and financial repercussions, as South Korea experienced after acquiring U.S.-made BMD in 2017. However, if tensions arise between China and U.S. regional allies, as they have with Australia in recent years, the prospect of accepting U.S. capabilities may become increasingly likely.

The idea of these weapons is problematic due to their potential ability to replace the strategic function of nuclear weapons, possibly enabling conventional weapons for the use of counterforce, meaning the "targeting of a state's nuclear forces that a secure second-strike force aims to prevent."[16] With a lower threshold for using conventional weapons than nuclear weapons, utilising INF-range weapons for counterforce may be viewed as an appealing method for the U.S. to contain Chinese capabilities. This may be further enabled by deploying such weapon systems in the Asian-Pacific theatre, an idea announced by former U.S. Secretary of Defense Esper the day after the INF's expiration in 2019.[17] Prospects of counterforce below the nuclear threshold also raises questions surrounding the interpretation of China's non-first use pledge – would such an attack result in nuclear retaliation?

The third SNNW takes the form of ISR advancements threatening the ability for China to effectively conceal its nuclear forces, thus making them susceptible to counterforce. ISR capabilities exist in land, sea, air, and space, ranging from optical satellites to unmanned aerial vehicles. Notably, ISR is the most critical foundation of anti-submarine warfare (ASW). ASW is not a new phenomenon in and of itself; what is new is the shift from primarily relying on manned vehicles for conducting ASW operations to the reliance of unmanned systems. Particularly through increasingly sophisticated sensor technology, the development and deployment of both static and dynamic ASW vehicles threaten the ability for China to deploy its SSBNs freely, thus hampering their utility.

The strategic value of SSBNs comes mostly from their ability to navigate underwater far from its mainland, thus providing an insurance if land-based nuclear options are disabled. However, as waters are made transparent by ISR advancements, the utility of Chinese SSBNs diminishes, thus providing stronger incentives to develop both stealthier SSBNs as well as additional land-based targets to compensate. Simultaneously, land-based forces are threatened by increasingly sophisticated satellites, whose processing power and high-quality imagery make it possible to locate both static and mobile land-based nuclear capabilities from space. Additionally, as the early warning-systems essential to U.S. BMD relies on satellite sensors, space-based ISR developments further enhance the effectiveness of BMD systems as well.

Disarmament. SIPRI. https://www.sipri.org/sites/default/files/2021-05/2105_new_technologies_and_nuclear_disarmament_0.pdf, p. 11-12.

15 Martina, M. (2019, August 6th). China Warns of Countermeasures if U.S. Puts Missiles on its "Doorstep". *Reuters.* https://www.reuters.com/article/us-china-usa-defence-idUSKCN1UW044

16 Long, A. & Green, B. R. (2015). Stalking the Secure Second Strike: Intelligence, Counterforce, and Nuclear Strategy. *Journal of Strategic Studies, 38*(1-2), p. 39.

17 Ali, I. (2019, August 3rd). U.S. Defense Secretary Says he Favors Placing Missiles in Asia. *Reuters. https://www.reuters.com/article/us-usa-asia-inf-idUSKCN1UT098*

How is China responding?

U.S. military adoption of emerging technologies can be shown to threaten China's second-strike capability in several ways. This begs the following question: are the elements in China's nuclear modernisation logical responses to account for these threats, or do they imply a shift to a more aggressive nuclear strategy?

China's ongoing nuclear modernisation involves overhauls to all aspects of its nuclear force structure. Changes to its ICBM force has included upgrades in mobility, ranges, and the introduction of multiple independently targetable re-entry vehicle (MIRV)-capable missiles.[18] A MIRV capability is particularly useful in overcoming BMD, with each missile containing multiple warheads and decoys for BMD interceptors to neutralise, thus increasing the chances of warheads penetrating defenses. Another method of overcoming BMD is manoeuvrable weapons; Chinese intentions to add layers of manoeuvrability in its intercontinental-ranged arsenal can be seen through efforts to develop both nuclear-capable hypersonic gliders as well as the recent FOBS test.

The apparent expansion of missile silo fields furthermore indicates efforts to add redundancy to China's ICBM force; while silos are vulnerable against nuclear counterforce, their reinforced structure provides excellent protection against the growing threat of conventional counterforce in the wake of INF's expiration and the potential deployment of U.S. high-precision conventional weapons in the Asian-Pacific. As such, the combination of added silos and improved mobile ICBM forces provide multifaceted protection against ISR-enabled conventional and nuclear counterforce, as well as simply providing additional targets to strike in a potential U.S. first strike – this raises the demands for a successful first strike, making it both more costly and more easily distinguishable from a limited strike due to the sheer number of missiles required, positively affecting escalation dynamics.

China's expanding silo fields may seem indicative of the projected growth in its nuclear stockpile, estimated to reach an unprecedented 1000 warheads by 2030. There are many uncertainties involved in this projection. Concerning the silos, there is no way of knowing whether China intends to fill each silo with ballistic missiles. A possible "shell game", in which only a fraction of the silos is filled, would be a cost-efficient way of increasing survivability, provided no opponent is aware of which silos are filled. China has utilised a shell game before, when hiding its DF-5 ICBMs in the 1970s[19], and plans for a similar shell game were also set in motion for U.S. ICBMs under the Carter administration.[20]

Regarding the estimated growth to 1000 warheads, U.S. stockpile projections on China have been wrong many times before. Based on current estimates of Chinese fissile material availability, which is necessary for further nuclear armament, 1000 warheads within a decade seems unlikely.[21] However, if we accept the proposition of 1000 warheads as true, the relative increase is far more dramatic than the absolute numbers. China's nuclear stockpile has been an historic fraction of those of the U.S. and Russia, and even an increase to 1000 warheads would still result in less than a fifth of today's U.S. arsenal.

Aside from its land-based forces, further developments can also be seen in the sea-based leg of China's nuclear triad. The missiles aboard its SSBNs lack the targeting ranges necessary to target continental U.S. from Chinese waters, yet are constrained by hostile ISR from freely navigating to the proximity necessary. Developments have therefore begun on a new generation SSBN meant to be quieter as a way of mitigating the threat of ASW, as well as equipped with

18 Kristensen, H. M. & Korda, M. (2020). Chinese Nuclear Forces, 2020. *Bulletin of the Atomic Scientists, 76*(6), p. 448.

19 Lewis, J. W. & Hua, D. (1992). China's Ballistic Missile Programs: Technologies, Strategies, Goals. *International Security, 17*(2), p. 25.

20 Acton, J. (2021, July 27th). Don't Panic About China's New Nuclear Capabilities. *The Washington Post*. https://www.washingtonpost.com/politics/2021/06/30/dont-panic-about-chinas-new-nuclear-capabilities/

21 Ibid.

range-extended missiles capable of targeting the U.S. from Chinese waters.[22] This will therefore add layers of both redundancy and concealment to China's force structure. Its air-based leg is also subject to modernisation through the introduction of new strategic bombers; while the role of bomber aircraft in nuclear deterrence is diminished due to speed and fuel constraints, the addition of new bombers will bolster redundancy nonetheless.

A more ambiguous recent addition to China's nuclear arsenal is the DF-26, an intermediate-range ballistic missile capable of swapping between conventional and nuclear warheads.[23] This, along with its reported high precision, has caused U.S. concern regarding its potential use, as it threatens U.S. capabilities in the Pacific theatre as well as potentially its aircraft carriers – is it a weapon of deterrence or warfighting? Moreover, the uncertainty of whether it fires conventional or nuclear warheads may create confusion in the fog of war, effectively raising the risks of inadvertent nuclear escalation. Some have speculated that the recent trend of the U.S. prioritising low-yield nuclear weapons development indicates a lowered threshold for nuclear usage, and that the DF-26 is a way for China to respond in kind by enabling limited nuclear attacks on regional U.S. bases.[24] At the same time, in the wake of the U.S. threat to place both BMD, conventional high-precision weapons and ISR capabilities at China's doorstep in the Asian-Pacific theatre, the need for China to project regional nuclear deterrence may appear to grow more acute. The DF-26 arguably answers this need. However, especially combined with speculation regarding a possible move to a launch-on-warning doctrine, ambiguous developments such as the DF-26 show that there are elements of uncertainty involved in China's nuclear modernisation that need to be carefully monitored by analysts and scholars over the coming years.

Lessons and implications

Nuclear armament is rightfully concerning, particularly when paired with growing assertiveness and aggression in other arenas, as is the case with China. Yet, China's nuclear modernisation should not be regarded as a process implying aggression without cause. Current available evidence does not suggest that Chinese views on its nuclear weapons appear to have deviated meaningfully from its historical tradition. Instead, the requirements for projecting stable and credible deterrence, primarily vis-à-vis the U.S., seem to have changed, consequently creating a deficiency in capabilities currently being addressed.

As emerging technologies are absorbed into the military-strategic sphere, the theory of nuclear deterrence in the 21st century grows more convoluted, confusing, and demanding. Conventional weapon systems are in greater degree capable of taking on tasks previously reserved to nuclear weapons, and both land, sea, air and space grow more transparent following advancements in ISR. The prospect of a functioning BMD, previously regarded as unrealistic when first announced under the Reagan administration, now appears more reasonable, at least in the long term.

An important driver of these changes is the overarching absence of effective arms control concerning new technologies relevant for nuclear deterrence. Following the end of the INF and ABM treaties, no rules govern the placements of intermediate-ranged weapons or BMD systems. The legal structure concerning space-based assets is similarly vague. In sum, states are relatively free to pursue the military adoption of emerging technologies; a grim

22 Kristensen, H. M. (2021). China's Strategic Systems and Programs. In Smith, J. M. & Bolt, P. J (eds.), *China's Strategic Arsenal: Worldview, Doctrine, and Systems* (p. 110). Georgetown University Press.

23 Pollack, J. H. & LaFoy, S. (2020, May 17th). *China's DF-26: A Hot-Swappable Missile?* Arms Control Wonk. https://www.armscontrolwonk.com/archive/1209405/chinas-df-26-a-hot-swappable-missile/

24 Zhao, T. (2021, November 12th). China's silence on nuclear arms buildup fuels speculation on motives. *Bulletin of the Atomic Scientists.* https://thebulletin.org/2021/11/chinas-silence-on-nuclear-arms-buildup-fuels-speculation-on-motives/

proposition for continued strategic stability. The inclusion of SNNWs in arms control talks between the U.S. and China have proven difficult, with U.S. insistence on maintaining focus on numbers of warheads alone. This focus is not sustainable – SNNWs are potentially destabilising if left unregulated. It is therefore imperative for academic and military scholars, analysts, and policymakers to recognise SNNWs as core elements in contemporary nuclear deterrence, emphasising its need to be accounted for and regulated in line with numbers of warheads.

When left unchecked, the adoption of SNNWs can bring serious implications to states aiming to project credible nuclear deterrence, as seen in the U.S.-Sino dynamic. While China's second-strike capability was arguably credible in the late 2000s, U.S. military-technological development – and the belief that this will only continue as communicated through heavy funding – threatens to compromise this capability, thus incentivising armament and modernisation. China has acted upon these incentives, and accelerated a modernisation process, likely out of perceived need. While this modernisation may appear dramatic and expansive, it is important to balance such concerns with a critical view of why this process has occurred. At the same time, we must accept that there is a plenitude of knowledge involved in this case that we simply do not have. While the currently available evidence deems it insufficient to conclude that China is strongly deviating from its historic nuclear strategy, a healthy amount of uncertainty must be acknowledged. There is no need for alarmism, nor for complacency.

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Missile Defense Advocacy Alliance: Dong Feng-26