



Chinese Nuclear Force Modernization and Doctrinal Change

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▶ Key Takeaways

- Dating back to the first test in 1964, the Chinese nuclear force modernization process is motivated by other nuclear powers' modernization across the years, mostly from the United States and the Soviet Union, but also by domestic factors such as economic debates and tensions in the scientific community.
- At first, technical difficulties and a greater investment in conventional forces prevented the development of a 'lean and effective arsenal'. However, the end of the Cold War and better economic conditions allowed China to improve its weapons toward a greater duality and mobility, thus reflecting the first tensions between the Chinese no-first-use doctrine and its growing technical capabilities and ambitions.
- Nowadays, the Chinese nuclear arsenal is bigger than ever, ranking third in size amongst nuclear global powers and with an estimated 1,000 warheads in 2030. The weapons' efficiency is also reportedly higher, aiming at a fully functioning triad. Furthermore, doctrinal debates are still ongoing, with potential consequences on arms control and risk management.

Introduction

Recent discoveries of missile silo fields in China,¹ coupled with the testing of a Fractional Orbital Bombardment System from a hypersonic glide vehicle has sparked debate that Beijing may no longer be content with a retaliatory nuclear force.² Indeed, the 2021 United States (US) report on Chinese military power predicts a quadrupling of nuclear forces by 2030.³ Could China's nuclear modernization be indicative of an emerging first strike or damage limitation capability? If so, this would represent a radical assault on China's declared nuclear philosophy of restraint and minimalism. Discomfortingly, in its 2013 Defense White Paper, China omitted reference to No First Use (NFU), raising external concerns that it had dropped the pledge.⁴ Back then, the Chinese government was quick to re-iterate adherence to NFU. However, as China's nuclear modernization bears evermore fruit, more alarm bells will ring.

The expert community remains divided as to whether China's current nuclear force modernization reflects major doctrinal change. But, on this they may all agree – China is today the most powerful nuclear armed state it has ever been since testing in 1964, now ranking third in size as a global nuclear power, above France and the United Kingdom.⁵ At this impasse, it may be useful to recast our analysis of China's nuclear force modernization.

One way to do this is to introduce a sharper sense of time into analysis.⁶ Rather than treating modernization as existing on a continuum since 1964, when China first tested a nuclear device, or since the 1990s, when wider military modernization gained momentum, this paper argues that there have been three phases to China's nuclear force modernization. Modernization may be driven by internal and external forms of political and bureaucratic competition, as well as considerations of prestige and safety. As Kristensen notes, "once countries acquire nuclear weapons, they also acquire a never-ending requirement to demonstrate and improve the credibility of their capabilities to their potential nuclear adversaries".⁷ Another way of recasting analysis is to consider China's nuclear force modernization as more than a reaction to the United States. This is

My thanks to Dr Alex Leveringhaus, Dr Henrik Hiim and H lo se Fayet for their comments and external anonymous reviewers.

1. H. M. Kristensen and M. Korda, "China Is Building A Second Nuclear Missile Silo Field", *Federation of American Scientists*, July 26, 2021, available at: fas.org.

2. M. Kroenig, "China's Nuclear Silos and the Arms-Control Fantasy", *The Wall Street Journal*, July 7, 2021.

3. US Office of the Secretary of Defense, Annual Report to Congress, "Military and Security Developments Involving the People's Republic of China 2021", November 3, 2021, available at: media.defense.gov.

4. J. M. Acton, "Debating China's No-First-Use Commitment: James Acton Responds", Carnegie Endowment for International Peace, April 22, 2013, available at: carnegieendowment.org.

5. H. M. Kristensen and M. Korda, "Chinese Nuclear Weapons, 2021", *Bulletin of the Atomic Scientists*, Vol. 77, No. 6, pp. 318-336.

6. There remains, to date, a lack of scholarly inquiry into the term modernization and what it means in distinct military domains (such as nuclear), and how it is practiced across different sets of countries.

7. H. M. Kristensen, "Nuclear Weapons Modernization And Nuclear Proliferation Triggers" in: S. Squassoni (ed.), *The Next Fifty Years of Nuclear Proliferation*, Washington D.C.: The George Washington University, 2021.

not to diminish palpable concern in Beijing since the 1990s over US missile defense in Asia,⁸ and more recently, US conventional high precision weapons, including intermediate missiles following the termination of the Intermediate Nuclear Forces Treaty in 2019.⁹ Yet, as this paper will show, domestic actors (especially scientists and engineers), bureaucratic/organizational factors,¹⁰ and internal economic debates also shape Chinese nuclear force modernization.

This briefing will proceed as follows. The first section will introduce the earliest phase, from the mid to late 1980s to the early 2000s. The paper will then examine the second phase of China's nuclear force modernization from 2002 to 2015. In these early phases, nuclear modernization reinforced a restrained, retaliatory doctrine. The third section of the paper will focus on the current phase, which has yet to conclude. The final section will consider likely future nuclear modernization and its impact on Chinese nuclear doctrine.

Early Chinese Nuclear Force Modernization

The early nuclear weapons development process was a tortuous experience for China. A series of domestic debates took place, forcing military figures behind the bomb project like PLA (People's Liberation Army) Marshall Nie Rongzhen to justify development.¹¹ These debates focused on the economic value of strategic weapons, and whether they would conflict at an ideological level with People's War.¹² To complicate matters further, the mass economic, social and humanitarian failures that were the Great Leap Forward (1958-1962) and the Cultural Revolution (1966-1968) derailed development of China's first nuclear forces. For example, the Submarine Launched Ballistic Missile (SLBM) project (JL-1) was heavily delayed by the Cultural Revolution.¹³ Set for completion by 1967, it was not finished until 1988. Another project, the gravity bomb, started in the 1970s but was never completed.¹⁴ One of the few 'successes' was the land-based Intercontinental Ballistic Missile (ICBM) project (DF-5). Set for completion by 1972, the DF-5 was ready for deployment in 1981. Without a small handful of ICBMs in the 1980s, China would not have a weapon credible enough for nuclear deterrence.

8. J.-D. Yuan, "Chinese Responses to US Missile Defenses: Implications for Arms Control and Regional Security", *The Non Proliferation Review*, Vol. 10, No. 1, 2003, pp. 75-96.

9. J. Vidhammer Berge, "Nuclear Arms for Conventional Threats: China's Nuclear Modernisation and Emerging Technologies", *IFS Insights*, 2022, available at: ifs.brago.unit.no.

10. D. C. Logan, "Are They Reading Schelling in Beijing? The Dimensions, Drivers, and Risks of Nuclear-conventional Entanglement in China", *Journal of Strategic Studies*, November 12, 2020.

11. E. A. Feigenbaum, *China's Techno-Warriors: National Security and Strategic Competition from the Nuclear to the Information Age*, Stanford: Stanford University Press, 2003.

12. Particularly notable debates took place in 1959, 1965 and 1971. See A. L. Hsieh, "Communist China and Nuclear Warfare", *The China Quarterly*, Vol. 2, June 1960, pp. 1-15.

13. J. Hymans, "How Did China's Nuclear Weapons Project Succeed?", paper presented at the ISA conference in New Orleans and shared with author, 18 February 2010.

14. J. Ray, "Red China's 'Capitalist Bomb': Inside the Chinese Neutron Bomb Program", *China Strategic Perspectives*, Vol. 8, 2015.

In the 1980s and early 1990s, a new appreciation of warfare emerged among China's top leaders that: a) all-out nuclear war was becoming less likely and that b) China's non-nuclear forces were not up to the task of fighting limited wars of the future.¹⁵ This ultimately translated into a new Chinese military doctrine known as 'Winning Local Wars under High-Technology Conditions' in the early 1990s.¹⁶ The inadequacies of the PLA in winning these types of wars was clear. For example, in the run-up to China's decision to go to war in Indochina in 1979, Deng Xiaoping made a compelling case for PLA military modernization.¹⁷ By the time of the 1991 Persian Gulf War, there was thus a longstanding view in Beijing that military modernization was urgent.¹⁸ In short, the political imperative was to prioritize non-nuclear, rather than nuclear, force modernization.

However, that did not mean nuclear modernization was an impossible dream. In the 1980s and 1990s, there was academic debate in domestic journals as to which capabilities China should pursue.¹⁹ At higher levels, China's top leader, Deng Xiaoping, took advice from leading voices in national science and military fields. Among these were PLA Marshall Nie Rongzhen, and the missile scientist Qian Xuesen.²⁰ Less well appreciated was the role of Defense Minister Zhang Aiping who considered China's siloed DF-5 'graves' vulnerable to attack. As a solution, he suggested "[China] should develop mobile missiles instead of fixed missiles".²¹ Another influential figure was nuclear scientist Zha Guangya, described by his former peers as a 'scientist with a strategic vision'.²²

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15. D. Shambaugh, *Modernizing China's Military: Progress, Problems, and Prospects*, Berkeley: University of California Press, 2003.

16. For more on this, see M. T. Fravel, *Active Defense China's Military Strategy since 1949*, Princeton: Princeton University Press, 2019, chapter 6.

17. X. Li, *The Dragon in the Jungle: The Chinese Army in the Vietnam War*, Oxford: Oxford University Press, 2020.

18. This is the opinion of China's leading nuclear weapons scientists: J. Wu, X. Sun and S. Hu in "The Impact of Revolution in Military Affairs on China's Defence Policy", Institute of Applied Physics and Computational Mathematics, 2003 (paper in author's possession); and D. Cheng, "Chinese Lessons from the Gulf Wars" in: A. Scobell, D. Lai and R. Kamphausen (eds.), *Chinese Lessons from Other People's Wars*, Carlisle, Pennsylvania: Strategic Studies Institute, 2011.

19. A. I. Johnston, "China's New 'Old Thinking': The Concept of Limited Deterrence", *International Security*, Vol. 20, No. 3, 1995-1996, pp. 5-42.

20. E. A. Feigenbaum, *China's Techno-Warriors: National Security and Strategic Competition from the Nuclear to the Information Age*, Stanford: Stanford University Press, 2003 and N. Horsburgh, *China and Global Nuclear Order: From Estrangement to Active Engagement*, Oxford: Oxford University Press, 2015.

21. L. Liu, "Dog-beating Stick: General Zhang Aiping's Contribution to the Modernization of China's Nuclear Force and Strategy since 1977", *Cold War History*, Vol. 18, No. 4, 2018, pp. 485-501. See also J. Sun, 孙家栋, "The Outstanding Leader in the Cause of the National Defense Science and Technology—In Memory of General Zhang Aiping" 国防科技事业的杰出领导者——深切怀念老领导张爱萍同志, *Military History*, 军事历史, 2010 (01), pp. 23-25. In 1984, during an official visit to the United States, Zhang was supposedly impressed with MX missiles and the improved Minuteman, as well as the 1983 Strategic Defence Initiative (SDI), laser and particle-beam weapons, precision guidance technology, and stealth fighters. See Liu Zhanqing, "Our Nuclear Weapons Are Good Enough as 'Dog Bats'", *Military Digest*, Vol. 21, 2020, pp. 17-21.

22. L. Tsung-dao quoted in "Pioneer of China's Nuclear Science Passes Away", *PKU News*, February 26, 2011, available at: english.pku.edu.cn. See also F. Cunningham, "Maximizing Leverage: Explaining China's Strategic Force Postures in Limited Wars", unpublished MIT PhD thesis, 2018, pp. 138, available at: dspace.mit.edu.

The above-mentioned figures advocated a minimalist ‘lean and effective’²³ form of nuclear force modernization. In this first phase, three main goals emerged. The primary goal was *greater speed* in reprisal: initially, China would satisfy this by shifting from liquid-fuel to solid-fuel for its ballistic missiles. This would significantly shorten the time to get missiles ready for launch and China would be able to respond more quickly to a nuclear attack, not weeks after the event. A second goal was *greater mobility*: in practice this would mean new missiles, eventually the DF-31 and DF-31A, would be road-ready, rather than what Zhang termed fixed ‘graves’ in the ground like the DF-5.²⁴ A third goal was *greater concealment* of forces. As evidence of this, in 1995 the Second Artillery Corps (SAC) – now known as the PLA Rocket Forces (PLARF) – completed a major project that resulted in the construction of caves and tunnelling to improve the survivability of nuclear forces.²⁵ During this first phase, China also started several other programs, such as the JL-2 SLBM. In addition, China started to push ahead with shorter range weapons systems like the DF-25, DF-15, DF-11 and DF 8610. These projects were either second-attempts at failed projects (JL-2 SLBM) or attempts to develop new regional platforms such as the DF-25.

Yet progress was painfully slow. China’s first phase was delayed by internal events – notably the Tiananmen Square protests in 1989, as well as a drought in funding that lasted until the mid-1990s.²⁶ As a consequence, early versions of the JL-2, DF-31 or DF-41 – all decided upon in the 1970s and 1980s – were not actually deployed until many years, even decades, later than intended. For example, the DF-41 was earmarked for development at China’s Academy of Launch Vehicle Technology (CALT)²⁷ from 1986 onwards and scheduled for completion in 1999. Yet the DF-41 was only flight tested in the mid-2010s, and ultimately unveiled at the 70th anniversary parade in 2019.²⁸ Another missile, the DF-31, was redesigned and tested in the 1980s, yet was not deployed until 2006.

In this first phase, the main target for nuclear force modernization was not initially the US, but the Soviet Union. Following the Sino-Soviet border conflict of 1969, the threat of a Soviet invasion came to dominate the thinking of the Chinese strategic community,

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23. On the genealogy of this term, see: M. T. Fravel, *Active Defense China’s Military Strategy since 1949*, Princeton: Princeton University Press, 2019, p. 262.

24. J. G. Lewis, “Chinese Nuclear Posture and Force Modernization”, *The Nonproliferation Review*, Vol. 16, No. 2, 2009, pp. 202.

25. J. Lewis, *The Minimum Means of Reprisal: China’s Search for Security in the Nuclear Age*, Cambridge, Massachusetts: American Academy of Arts and Science, 2007, pp. 33.

26. M. T. Fravel and E. S. Medeiros, “China’s Search for Assured Retaliation: The Evolution of Chinese Nuclear Strategy and Force Structure”, *International Security*, Vol. 35, No. 2, 2010, pp. 78.

27. An important domestic institution for military modernization set up by Qian Xuesen.

28. On this, see CSIS Missile Threat database, DF-41, available at: missilethreat.csis.org; and Xinhua, “China Unveils Most Advanced Dongfeng-41 Intercontinental Strategic Nuclear Missiles”, *The State Council of the People’s Republic of China*, October 1, 2019, available at: english.www.gov.cn.

and the 1987 military handbook *Zhanlue Xue* 战略学 (*Science of Military Strategy*) was set against the background of a Soviet invasion. Yet in the mid-1980s, an early US threat to China's deterrent also started to emerge, in the form of the President Reagan's US Strategic Defense Initiative (SDI).²⁹ In 1984, Chinese Premier Zhao Ziyang commissioned the Beijing Institute for International Studies to study the implications of SDI for China. The report concluded SDI represented an effort by the United States to regain nuclear supremacy over the USSR. Unfortunately, in the process SDI could potentially neutralize China's nuclear deterrent, exposing China, once again, to nuclear blackmail.³⁰

Phase 2: Countering the United States and Securing Taiwan

A second phase in China's nuclear force modernization emerges in the early 2000s as Beijing reflects upon on some of its past nuclear choices. Of note here is the growing tension between older nuclear ideas such as NFU and growing technical capabilities and ambitions, especially as China now had the financial means to plough into military modernization. Yet an internal debate around NFU ultimately did not result in change to the declaratory pledge.³¹ The guiding principle of 'lean and effective' was also preserved in official documents, albeit with goals shifting slightly towards greater penetrability and precision, but still within the bounds of survivability for an assured retaliation posture. Indeed, in 2008, China made public a system of underground tunnels, known as the "Great Wall nuclear counterattack project", to ensure survivability.³² A plethora of military textbooks were published, including *Science of Second Artillery Campaigns* (2004),³³ *The Science of Military Campaigns/Operational Studies* (2000 and 2006), and *Science of Military Strategy* (2005)³⁴ advocating that China's nuclear forces be focused on survival and retaliation. As General Jing Zhiyuan, then commander of China's nuclear forces, said: the need was to maintain an effective and retaliatory nuclear force.³⁵

29. Z. Yang, "Zhongguo zhanlue hewuqi fazhan yu Meiguo zaoqi ABM bushu jihua" [The Development of China's Strategic Nuclear Weapons and the United States' Early ABM Plans], *Dangdai Zhongguo yanjiu* [Contemporary China History Studies], Vol. 11, No. 1, January 2004, pp. 36-42.

30. Z. Qubing, "Space and Strategic Defence: A Chinese View", *Survival*, Vol. 27, No. 1, 1985, pp. 35-38.

31. The best account of this debate, which was not necessarily sanctioned or led by the China's top leaders, can be found in Fiona Cunningham's unpublished PhD thesis, pp. 180-183.

32. R. Hsiao, "China's 'Underground Great Wall' and Nuclear Deterrence", *China Brief*, Vol. 9, No. 25, 2009, pp. 1-2.

33. Renmin Jiefangjun [People's Liberation Army], *Di er paobing zhanyi xue* [Science of Second Artillery Campaigns], Beijing: Jiefangjun Chubanshe, 2004, pp. 297-316.

34. P. Guangqian and Y. Youzhi (eds.), *The Science of Military Strategy*, Beijing: Military Science Publishing House, 2005.

35. J. Zhiyuan and P. Xiaofeng, "Jianzhe zhongguo tese zhanlue da diangdan budui" [Building a Strategic Missile Force with Chinese Characteristics], *Qishi* [Seeking Truth], No. 3, 2009; see also Xinhua, "Top Nuclear Generals: 'Strategic Deterrence' Enhanced in Information Age", *People's Daily Online*, February 2, 2009, available at: en.people.cn and Embassy of the People's Republic of China in the Hellenic Republic, "China To Modernize Military While Pursuing Peaceful Development", January 20, 2009, available at: gr.china-embassy.gov.cn.

In understanding the drivers behind this period of nuclear reflection in China, and how it ultimately reinforced pre-existing ideas behind nuclear force modernization, it is useful to consider a series of wider developments in the 1990s and early 2000s. The first of these is an improvement in China's relations with Russia, with both signing a mutual NFU and de-alerting agreement in 1994.³⁶ A new friendship with Russia would eventually become useful for Chinese military modernization, especially since Beijing faced a series of US and EU sanctions following Tiananmen in 1989. A concrete outcome of this relationship was the establishment of the Russia-China Mixed Intergovernmental Commission on Military-Technical Cooperation for technical collaboration with Liu Huaqing as chairman on the Chinese side.³⁷ A second, contrasting, development was the worsening of relations with the United States. China clashed with the United States over Taiwan in 1995-6, as well as during the Kosovo War following the accidental NATO bombing of China's embassy in Belgrade in 1999, and then the EP-3 spy plane incident in 2001. A 1999 Congressional Cox Report also accused China of espionage,³⁸ resulting in the termination of the US-China nuclear lab-to-lab program that the Chinese considered a success in the 1990s.³⁹ A final point of contention was missile defense. Throughout the 1990s and 2000s, US missile defense arrangements with Asian allies expanded. Officially, the target was North Korea, yet China's small deterrent was also impacted.⁴⁰

A second, contrasting, development was the worsening of relations with the United States

The shifting relationship with the United States is a defining feature of the second phase of China's nuclear force modernization. In the 2001 US Nuclear Posture Review (NPR), a new triad was proposed, based around new capabilities, including National

36. While the US dismissed the significance of this declaration, China, who maintained a similar policy, took the declaration more seriously. See H. Catudal, *Soviet Nuclear Strategy from Stalin to Gorbachev: A Revolution in Soviet Military and Political Thinking*, NJ: Humanities Press International, 1988, pp. 112-116; and R. Yu and P. Guangqian, "Nuclear No-First-Use Revisited", *China Security*, Vol. 5, No. 1, Winter 2009, pp. 81-90.

37. L. Yu, "Contending Chinese Perspectives on China-Russia Military Partnership: A Strategic Guarantee for China's Rise", *Communist and Post-Communist Studies*, Vol. 53, No. 4, 2020, pp. 240-259.

38. M. May (ed.), "The Cox Committee Report: An Assessment", *Center for International Security and Cooperation*, December 1999. The US Jeremiah Commission also later established that the 'theft' had not significantly enhanced China's nuclear deterrent. The US also accused and sentenced to jail a Los Alamos scientist, Wen Ho Lee, for apparently spying for the Chinese in the 1990s. On China's reaction, see Government of People's Republic of China, "Shishi sheng yu xiongbian huangyan by gong zip o- zai bo 'kao ke si baogao'" [Facts speak louder than words and lies will collapse by themselves], July 15, 1999; and Zhu Feng, "Kao ke si baogao: neirong he yingxiang – Meiguo wumie Zhongguo 'he qiemi shijian fenxi'", [Cox Reports: Content and Effects – The United States Slandered the Chinese 'Nuclear Theft' Event Analysis], *Shijie jingji yu zhengzhi* [World Economics and Politics] No. 7, 1999, pp. 35-41.

39. N. Prindle, "The U.S.-China Lab-to-Lab Technical Exchange Program", *The Nonproliferation Review*, Spring-Summer 1998, pp. 111-118.

40. In August 1999, the United States and Japan signed a five-year agreement for joint research on advanced sea-based technologies. See B. Zhu, "Chinese Foreign Ministry Spokesperson Answers Questions on US-Japan TMD Joint Research Program at News Briefing", December 31, 1998; and X. Yan, "Theatre Missile Defense and Northeast Asian Security", *The Nonproliferation Review*, Spring-Summer 1999, pp. 65-74.

Missile Defense (NMD). According to the 2001 NPR, China “could be involved in an immediate or potential contingency” and was placed on the nuclear targets list.⁴¹ China later featured in a US war plan in 2005, known as the OPLAN 5077, to include the use of nuclear weapons over a crisis involving Taiwan.⁴² Then, in 2003, the United States abrogated the Anti-Ballistic Missile (ABM) treaty, freeing itself to pursue NMD. The Chinese particularly lamented the loss of the ABM, which they considered a “cornerstone of strategic stability”.⁴³ Chinese officials like Liu Jieyi also remained unconvinced that China was not the target of US missile defense plans.⁴⁴

Yet the second phase did not result in drastic deviation from past modernization plans. Although China likely had the technical capabilities to do so, it decided not to deploy multiple warheads (MIRVs) in this period. Instead, during this phase of modernization, emphasis was placed on *greater duality*: developing large numbers of intermediate range ballistic missiles with conventional warheads, especially DF-21 and DF-26; and *greater mobility*: upgrading missile systems like the DF-31AG and DF-41 to make them off-road capable.

Why was China restrained on the nuclear front? One explanation is that the first phase of nuclear force modernization was still not complete: legacy projects like the

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DF-41, JL-2 and DF-31 had yet to make their way towards deployment. Put crudely, perhaps there were too many hangovers from phase one for any drastic change in the early 2000s. A second explanation is that, as before, China continued to prioritize advanced conventional capabilities – including maritime projects – over nuclear forces in its overall military modernization. This was followed by strong emerging military interests in space and cyber modernization from the early

2000s within China.⁴⁵ A third explanatory factor is that China had other priorities. By the late 1990s, China had tied its hands institutionally and at a reputational level by tethering itself to the nuclear non-proliferation regime in the 1990s. It did so most notably by signing the Non-Proliferation Treaty (NPT) in 1992, and the Comprehensive Test Ban Treaty (CTBT) in 1996. China’s engagement with these treaties served to build a positive

41. Z. Feng, “He taishi pinggu baogao yu Zhongguo – Meiguo weisheme yao chongxin tuixing dui Zhongguo de he weishe zhengce?” [Nuclear Posture Review and China – Why the United States Re-introduction of China’s ‘Nuclear Deterrent’ Policy?], *Guoji zhengzhi yanjiu [Studies of International Politics]*, Vol. 2, May 2002, pp. 82-91; and G. Xiaobing and S. Ru, “Meiguo he mou ba zhanlue pingxi” [Analyzing US Strategy for Nuclear Hegemony], *Xiandai guoji guanxi [Contemporary International Relations]*, Vol. 7, 2006, pp. 50-55.

42. H. Kristensen, R. S. Norris and M. C. Mckinzie, *Chinese Nuclear Forces and US Nuclear War Planning*, Washington D.C.: Federation of American Scientists and Natural Resources Defense Council, 2006, pp. 19.

43. Xinhua, “China Urges Preservation of ABM Treaty”, *People’s Daily*, February 21, 2001, available at: en.people.cn.

44. L. Jieyi, Statement at the 4th China-US conference on arms control, disarmament and non-proliferation, March 14, 2002, available at: www.fmprc.gov.cn

45. F. S. Cunningham, “Maximizing Leverage: China’s Strategic Force Posture Choices in the Information Age”.

image of China, of which its pledge NFU was an important part (China started to promote an international NFU treaty again in the 1990s). This self-branding of China as a responsible nuclear actor⁴⁶ was also facilitated by a growing arms control and non-proliferation expert community within its military academies, foreign ministry and think tanks. Among these experts was Sun Xiangli, a scientist at the China Academy of Engineering Physics (CAEP). According to Sun, China's nuclear modernization was limited and focused on the development of mobile ICBMs.⁴⁷ Another influential voice, Xia Liping, argued that China's approach to modernization was one of "utmost restraint."⁴⁸ Hu Side, former president of Chinese Academy of Engineering Physics, also contributed to this debate, stating that China's nuclear modernization was unchanging, focused on retaliation and minimalism.⁴⁹ Academics Li Bin and Wu Rui argued that China's modernization was geared towards maintaining a strategic balance rather than numerical parity with the United States.⁵⁰

Current Phase of Chinese Nuclear Force Modernization

In the mid-2010s, a third phase to China's nuclear force modernization can be discerned. China's top leader Xi Jinping has elevated the status of nuclear forces domestically by starting his term in office with an important speech in 2012 on the importance of China's strategic deterrent maintained by the Second Artillery Corps.⁵¹ In 2016, another speech by Xi to China's nuclear forces called for a speeding up of the modernization process.⁵² Xi later singled out the importance of modernizing China's nuclear naval forces in 2018⁵³ and 2021.⁵⁴ At a bureaucratic level, in December 2015, Xi elevated the service status of China's nuclear forces and renamed them the PLA Rocket Forces.⁵⁵ China's Defense White Papers in the Xi era (published in 2015 and 2019 respectively) have also contained a fair

46. N. Leveringhaus and K. Sullivan de Estrada, "Between Conformity and Innovation: China's and India's Quest for Status as Responsible Nuclear Powers", *Review of International Studies*, Vol. 44, No. 3, 2018, pp. 482-503.

47. Sun, "China's Nuclear Strategy: Nature and Characteristics", pp. 23-29.

48. X. Liping, "Lun Zhongguo he zhanlue de yanjiang yu goucheng", [On the Structure and Evolution of China's Nuclear Strategy], *Dangdai yatai [Contemporary Asian Pacific]*, No. 4, 2010, pp. 124-5.

49. S. Hu, "The Road toward China's Nuclear Weapons," *Global Science*, No. 12, 2007 (in Chinese).

50. L. Bin and W. Rui, "The Impact of US Regional and Global Nuclear Policies on China – A Strategic Perspective", paper presented at workshop on Prospects for East Asia nuclear Disarmament, Japan, 2004, shared with author.

51. W. Feng and Z. Haiyang, "Second Artillery Commander and Political Commissar: Strive to Build a Strong Informationized Strategic Missile Force", December 13, 2012, available at: politics.people.com.cn.

52. "Xi Jinping: Keep in Mind the Historical Mission, Improve Strategic Capabilities, and Strive to Build a Powerful Modern Rocket Army", *People's Daily Online*, September 27, 2016, available at: politics.people.com.cn.

53. "CCTV Exclusively Explores the Troops That Xi Jinping Liked Twice", CCTV, June 17, 2018, available at: military.cctv.com.

54. On the statements, see T. Zhao, "China's Silence on Nuclear Arms Buildup Fuels Speculation on Motives", *Bulletin of Atomic Scientists*, November 12, 2021, available at: thebulletin.org.

55. This bureaucratic decision can be seen as a way to reduce inter-service rivalry for smoother modernization but can also be understood as an attempt to improve the overall social standing of the PLARF – much like the decision of the 1990s to expand the SAC mission (to include conventional missions). Here the renaming of the PLARF was likely also about service morale, and retention and prestige too.

amount of information on force modernization, highlighting areas on which to focus, from innovation, safety, medium and long-range precision strike capabilities to improvements in strategic early warning, command and control, missile penetration, rapid response and survivability.⁵⁶

In this third phase, prior themes for China's nuclear force modernization like *duality* continue, but also the pursuit of *greater infrastructure* to support emerging capabilities. This is evident in the massive construction of missile silo fields which is likely an expensive endeavor for China. An example of greater diversity in this period is the eventual deployment of MIRVs on warheads since the mid-2010s⁵⁷ as well as hypersonic glide (HGV) testing. The HGV project is making progress, with the 2021 test demonstrating that China could use a rocket to propel a hypersonic glide vehicle over the south pole, circumventing US missile defense systems. Elsewhere, in 2017, the PLA Air Force (PLAAF) re-invigorated a dormant nuclear mission (previously based on the Xian H6), with an expected version of the DF-21 for air launch by 2025. Like HGV technology,

this air launched missile is billed to counter US missile defense. At sea, improvements to China's SLBMs are also part of this phase, with a longer-range JL-3 first tested in 2018. Some of these projects, including an H-20 bomber, remain more vanity projects for Beijing to showcase that it can afford and technically develop a fuller Triad of nuclear forces through modernization.

Launch on Warning (LOW) is another interesting capability that China could actively pursue. LOW might not necessarily foreshadow

major doctrinal change towards a first use capability since China could continue to maintain its political pledge of NFU. Instead, like earlier systems (DF-41 or JL-2) discussed here, it is a capability that has been long discussed.⁵⁸ LOW requires at least two different early-warning systems, such as satellites and radar, to minimize the risk of false alarms.⁵⁹ China does not have these yet and may need time to develop them. It currently has a few land-based phased-array early warning radars in remote parts of China like Shuangyashan

In this third phase, prior themes [...] continue, but also the pursuit of *greater infrastructure* to support emerging capabilities

56. The subsequent and most recent defense paper, issued in 2019, has less information on modernization goals, suggesting the principles set out in 2015 remain largely unaltered. See Chinese State Council Information Office, '中国的军事战略' [China's Military Strategy], People's Republic of China, May 26, 2015; and Chinese State Council Information Office, '新时代的中国国防' [China's National Defense in the New Era], People's Republic of China, July 24, 2019.

57. F. Ruixiang, Z. Bing and Z. Shuhui, "Multi-warhead Separation Technology of Foreign Strategic Missiles and Its Development" 国外战略导弹多弹头分导技术及其发展, *Missile and Space Vehicle Technology*, No. 5, 2013. See also J. G. Lewis, "China's Belated Embrace of MIRVs" in: M. Krepon et al. (eds.), *The Lure and Pitfalls of MIRVs: From the First to the Second Nuclear Age*, Stimson Center, 2016.

58. The best account of Chinese discussions of LOW remains G. Kulacki, "China's Military Calls for Putting Its Nuclear Forces on Alert", *Union of Concerned Scientists*, January 2016, available at: www.ucsusa.org.

59. Both Russia and China have been working in recent years towards developing software for space-based and terrestrial components of an early warning system.

(north-east of the country) and more recently in Yiyuan County, Shandong Province.

Future Nuclear Force Modernization in China

Future Chinese nuclear force modernization will face some difficult choices and pressures, exacerbating existing tension between constraining (but still valuable) political statements like NFU and growing technical capabilities to provide more options (strategic and tactical) for its nuclear doctrine. Several external and internal factors will determine the shape of future modernization and whether doctrinal transformation occurs.

China's concerns about the US nuclear arsenal, from missile defense to the expansion of new advanced conventional capabilities (especially since the end of the INF treaty) will be exacerbated by a deepening of new security arrangements between the United States, Australia (through AUKUS) and allies like Japan and South Korea. Beyond the United States, Russia has been important to China's wider military modernization since the 1990s and 2000s, and might be useful in a wider pursuit of new capabilities like LOW in the future. Prior to Russia's invasion of Ukraine, China and Russia were reportedly working not only on a missile launch detection system, but also considering future collaboration on hypersonic technology and nuclear submarines.⁶⁰ How cooperation in these areas will be impacted by the war in Ukraine is unclear.

North Korea's development of nuclear weapons capabilities since 2017 represents another external factor shaping future Chinese nuclear force modernization. China may already be thinking about how best to fortify civil defense in Chinese northern areas that border North Korea, fearful perhaps of accidental use of weapons, or even the prospect of collateral damage in a conflict involving the United States and North Korea. China must also consider unsettling regional proliferation dynamics at the time of writing in 2022. Many of these dynamics are not only a direct reaction to North Korea's nuclearization, but also to China's own military modernization processes and wider behavior in the region. These include recent nuclear sharing ideas in Japan, testing the reliability and future of US nuclear umbrellas in Asia⁶¹ and grumbling public support for indigenous nuclear weapons in South Korea amid declining popular support for China since the THAAD incident in 2016, when China imposed punitive economic embargoes on Korean companies and business sectors.⁶²

60. V. Kashin, "Tacit Alliance: Russia and China Take Military Partnership to New Level", Carnegie Endowment for International Peace, October 22, 2019, available at: [carnegiemoscow.org](https://www.carnegiemoscow.org).

61. On Abe's nuclear sharing idea, see "A New Nuclear Debate in Japan", *The Wall Street Journal*, March 1, 2022. Earlier debates in Japan are plentiful, see E. D. Bakanic, "The End of Japan's Nuclear Taboo", *Bulletin of the Atomic Scientists*, June 9, 2008.

62. T. Dalton, K. Friedhoff and L. Kim, "Thinking Nuclear: South Korean Attitudes on Nuclear Weapons", *The Chicago Council on Global Affairs*, February 2022, available at: www.thechicagocouncil.org.

Internally, Xi Jinping's agenda for national rejuvenation will be on the clock as the CCP's 100th centenary nears in 2049.⁶³ Xi will be at pains to deliver in the most visible, material terms possible, that China is a 'rich country with a strong army' (*fuguo, qiangbing*) under his leadership and that he has not stained Mao and Deng's legacies. Part of this vision includes incorporation of Taiwan into the mainland. Viewed through this domestic politics lens, any major drawdowns in China's military modernization – including its nuclear forces – or reductions through arms control are therefore highly unlikely from a political perspective before 2049.

However, should Xi embark on more drastic changes to its nuclear force modernization, there are several potential indicators to look out for: (1) the *restarting of a dedicated plutonium production program* rather than diversion from existing civilian production sources.⁶⁴ This would be used to develop a much larger number of new nuclear warheads and fill those new missile silo fields currently under construction, fulfilling US expectations that China's nuclear forces will quadruple by 2030.⁶⁵ Once production is re-started, China could develop more advanced types of ICBMs than it currently has. Beijing

US expectations that China's nuclear forces will quadruple by 2030

may even see the need to leave the CTBT and re-start testing, which it stopped in 1996. China had only completed 45 tests by 1996, compared to 1,054 for the United States and 715 for the Soviet Union. (2) *Deeper bureaucratic changes* to China's nuclear forces might be necessary. This could include the introduction of an umbrella organization that brings together command and control over emerging capabilities in the PLARF, Air Force PLAAF, and Navy PLAN.⁶⁶ How Chinese SSBNs will maintain a de-alerting

posture, and whether pre-launch authority will be granted is debated. Certainly, as nuclear capabilities grow, inter-service rivalry is likely to become a bigger issue for Beijing. (3) *Introduction of low yield nuclear weapons*⁶⁷ possibly for the DF-26, which is already in service, and mass produced. Although China does not classify the DF-26 as a tactical weapon, the pursuit of tactical weapons has long been debated and speculated by outside sources, rather than in open sources within China itself.

63. On the significance of upcoming dates like the PLA centennial, see: B. Hart, B. S. Glaser and M. P. Funaiolo, "China's 2027 Goal Marks the PLA's Centennial, Not an Expedited Military Modernization", *China Brief*, Vol. 21, No. 6, March 26, 2021, available at: jamestown.org.

64. This deviates from US DOD reports on China and claims that China could divert from its civilian program. My thanks to Dr Henrik Himm for his thoughts on this section of the Briefing.

65. G. Kulacki, "Strategic Command Sounds Questionable Alarm on Chinese Nuclear Buildup", *All Things Nuclear*, April 13, 2022, available at: allthingsnuclear.org.

66. This was hinted at in E. Heginbotham *et al.*, "China's Evolving Nuclear Deterrent: Major Drivers and Issues for the United States", RAND Corporation, 2017, available at: www.rand.org.

67. There is a wider debate about what is a low-yield weapon, such as the US debate over the W76-2.

- What do the above options mean for China's NFU? It is important to remember that NFU is a political statement. As such, the better question is not how force modernization affects NFU, but rather under what domestic political circumstances would China see the need to publicly abandon NFU? Put differently, when would NFU become a political liability for the CCP and its political elite? There are several scenarios for this. One involves a Chinese military use of force to take Taiwan, and a conditioning of its pledge to allow for possible nuclear use. A second scenario concerns 'mutual vulnerability' with the United States. If this term comes into accepted use, it could offer, in the future, a diplomatic exit for China to abandon NFU. This is because the requirements for maintaining 'mutual vulnerability' are not fixed. They might involve the pursuit of first strike technologies. However, as part of its distinctive nuclear branding, China will likely try to hold onto NFU for as long as is politically, and technically, possible. Ultimately, China's NFU is cheap to maintain, but costly to abandon.
- What about disarmament, arms control and proliferation? The relationship between space, cyber and nuclear modernization technologies will be ever more crucial to future Chinese military modernization, with implications for crisis escalation and arms control.⁶⁸ Entanglement concerns over China's emerging nuclear and non-nuclear forces are already being debated in earnest in the United States.⁶⁹ If China's nuclear modernization leads to a first strike posture against the United States and NFU is abandoned, this would be a setback for disarmament. Yet not all would be lost. China will likely remain wedded to the promotion of disarmament and arms control even after gaining a first-strike capability, since it would arguably be negotiating from a stronger position, and there would be a new urgency to negotiate.⁷⁰ There would also be strong diplomatic condemnation against China, especially among regional powers such as Japan, India and Australia. This condemnation may also put pressure on China to come to the arms control table.

Conclusion

This *Briefing* has identified three phases to China's nuclear force modernization. In the first (1980s-2001) and second phases (2002-2015), China's nuclear force modernization, much like its weapons development story between the 1950s and 1970s, has been beset with political delays, economic pressures and technical challenges. This is not uncommon for nuclear armed states. Yet in the Chinese case, the first two phases of nuclear force

68. L. Saalman, "Navigating Chinese–Russian Nuclear and Space Convergence and Divergence", *EU Non-Proliferation and Disarmament Consortium*, No. 78, May 2022, available at: www.nonproliferation.eu.

69. J. M. Acton, "Escalation through Entanglement: How the Vulnerability of Command-and-Control Systems Raises the Risks of an Inadvertent Nuclear War", *International Security*, Vol. 43, No. 1, 2018, pp. 56-99.

70. My thanks to Héloïse Fayet for her thoughts on this point.

modernization struggled to get funding and make technological advances. The DF-41 program is one such example. In these earlier phases, China's modernization of its nuclear arsenal remained limited and restrained, with no major reshaping of doctrine. Yet the third, and current, phase of modernization, likely underway since the mid-2010s, remains incomplete and more ambiguous. In contrast to earlier phases, this current phase faces a tougher, more demanding regional environment as well as pressured domestic context in which nuclear weapons are more highly prized than ever and have been woven into wider projects for national rejuvenation under Xi Jinping. Time will tell whether this phase, or the next, is transformative to China's overall nuclear doctrine. For now, alarms are periodically sounding, but whether these are false alarms or red flags remains to be seen.

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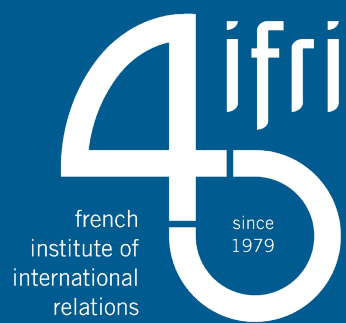
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