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Current and Projected Growth of China's Nuclear Arsenal

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Preface

A great deal of attention is being paid to China today: its security goals and objectives; the expansion of its global political, economic, and military footprint; and its extensive military buildup in nuclear and conventional forces. While there is a growing consensus that China is America's greatest national security threat, public information on the threat is inadequate.

In June 2024, Captain (Ret.) James Fanell, former Senior Intelligence Officer for the U.S. Pacific Fleet, told Congress that, "For a generation, the IC [Intelligence Community] failed national security decision-makers, and the American people, regarding the growth of China's capabilities and intentions," systematically engaging in what he referred to as "threat deflation."[1] In particular, he noted that, "The rapid, yet still opaque growth of the PRC's [People's Republic of China's] nuclear arsenal may very well exceed the U.S.'s by 2030, if not sooner. Beijing already possesses more tactical nuclear weapons and theater forces than does the U.S."[2] His analysis is sobering and should receive serious attention.

The two most frequently cited estimates of Chinese nuclear warheads, the Department of Defense (DoD) annual China military report and the Federation of American Scientists (FAS) China nuclear report, both appear to significantly underestimate the Chinese nuclear threat. This paper will focus on the DoD's China reports because they are the most detailed unclassified treatments on this subject and are more authoritative than the FAS reports. However, the post-Cold War decline in nuclear expertise in the United

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[1] "Congressional Testimony of James E. Fanell, CAPT USN (Retired)," House Committee on Oversight and Accountability, June 26, 2024, pp. 3, 6, available at https://oversight.house.gov/wp-content/uploads/2024/06/Fanell-Testimony.pdf.

[2] Ibid., p. 6.

States has been dramatic and has led to degraded threat assessments.[3]

Other than the DoD report, unclassified intelligence community (IC) publications provide little detail on Chinese nuclear capabilities. The media often treat reports by left-of-center non-governmental organizations (NGOs) that advocate for "Minimum Deterrence" policies and, thus, tend to deflate the threat, as authoritative. They are not. The best analysts of Chinese nuclear weapons policy are generally ignored. In the context of an increasingly aggressive Chinese foreign policy and its military and nuclear buildup, this is dangerous.

It is noteworthy that the 2012 Global Zero Commission report based its recommendation that the United States reduce its deployed nuclear force to 450 warheads on the belief that, "The risk of nuclear confrontation between the United States and either Russia or China belongs to the past, not the future," and that China would not "ramp up its nuclear weapons production to exploit the opportunity to achieve parity or even supremacy" with the United States.[4] This mentality still exists and impacts threat assessments. This study will help shed light on the full scope of the Chinese nuclear threat.

I would like to thank the National Institute Public Policy for contributing to the funding of this study. In particular, I would like to express my great appreciation to Dr. Keith B.

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[3] I have heard intelligence analysts dismiss technical advice from experienced nuclear weapons designers. I would note that when I worked at the Pentagon I once turned down management responsibility for the China report because I believed it was a lost cause for the reasons Captain Fanell voiced. In 2010, China expert Brad Roberts, then a Deputy Assistant Secretary of Defense, asked me to review a recent National Intelligence Estimate on Chinese nuclear forces. I was appalled by its lack of understanding of post-Cold War U.S. nuclear weapons policy. It was a classic example of Captain Fanell's critique.

[4] General (Ret.) James Cartright, Chair, *Global Zero U.S. Nuclear Policy Commission Report* (Global Zero, 2012), pp. 5, 17, available at https://www.globalzero.org/wp-content/uploads/2018/09/gz_us_nuclear_policy_commission_report.pdf.

Payne, the Hon. David J. Trachtenberg, Richard Fisher, and James R. Howe for their extensive comments, suggestions and substantive contributions to this publication. Finally, I would also like to thank Amy Joseph who turned the many drafts into a coherent publication, my wife, Vivianne, who not only put up with me but helped edit the work and made countless useful suggestions on its substantive content, and my daughter, Anne, who kept the computer working.

Executive Summary

For years, some of the highest ranking members of the U.S. military have warned about the growing Chinese nuclear threat. Indeed, in June 2024, a senior White House official said China was increasing its nuclear warheads at a "breakneck pace" and, in response, the United States may have to increase its nuclear warheads. Recently, a retired Pacific Fleet Senior Intelligence Officer told Congress that the Intelligence Community (IC) "failed national security decision-makers, and the American people," by engaging in Chinese "threat deflation." He noted that China's nuclear arsenal may "exceed the U.S.'s by 2030, if not sooner," and that China already had more tactical nuclear weapons.[5]

The annual DoD Chinese military power reports are the most authoritative open source accounts of Chinese military developments. However, they have a poor track record assessing Chinese nuclear weapons. Prior to 2020, they provided little indication that China was planning a major buildup. Yet, there was significant open source evidence of this even 15-20 years ago. DoD estimates that China possessed 500+ warheads in May 2023, and will possess 1,000+ warheads in 2030 and about 1,500 in 2035 are questionable. Indeed, 500+ in 2023 is *mathematically impossible* even with extremely unrealistic assumptions (e.g., no MIRVing, despite the fact the report and other DoD sources indicate there are three deployed Chinese MIRVed missiles—the DF-5, the DF-41 and the JL-3). The DoD's assumption that China is building launchers faster than it is building missiles and building missiles much faster than warheads creates the potential for large undercounting.

Even if the DoD's warhead projections are correct, China will achieve rough numerical parity with the United States in the mid-2030s. If the Defense Department is wrong,

[5] "Congressional Testimony of James E. Fanell, CAPT USN (Retired)," op. cit.

China could achieve superiority—possessing several thousand nuclear weapons—within a few years.

There is nothing in open sources that would support the low DoD numbers. The Defense Department is assessing fewer warheads on the new Chinese MIRVed missiles than other open sources suggest. Indeed, in 2017, the People's Liberation Army Rocket Force (PLARF) indicated that the DF-41 ICBM with a 14,000-km range could carry: 1) one 1,600-kg warhead of 5.5 megatons; 2) six 250-kg warheads of 650 kilotons; or 3) 10 165-kg warheads of 150 kilotons. (The DoD says three warheads.) It said the JL-2A SLBM had a 12,000-km range with either one 250-kiloton warhead or three 60-kiloton warheads. (The DoD says one warhead.)

The Chinese numbers appear credible in light of what is known about its nuclear testing (which may be continuing) and its nuclear espionage. The 1999 Report of the Select Committee on U.S. National Security and Military/Commercial Concerns with the People's Republic of China (the "Cox Committee") revealed that China "*…stole classified information on every currently deployed U.S. Intercontinental ballistic missile (ICBM) and submarine-launched ballistic missile (SLBM)* [nuclear warheads]," which may include "*classified U.S. nuclear weapons computer codes….*"[6] (Emphasis in the original). The Cox Committee and *The New York Times* reported China's DF-31 ICBM warhead is based on the advanced U.S. W-88 warhead.

The DoD's reports indicate that China is deploying low-yield nuclear weapons as well.

Additionally, China has reportedly tested a neutron bomb and has the technology to build directed output weapons (i.e., those that enhance or suppress nuclear effects

[6] Select Committee, House of Representatives, *Report of the Select Committee on U.S. National Security and Military/Commercial Concerns with the People's Republic of China*, Volume I (unclassified), May 1999, pp. 68–69, available at https://www.congress.gov/105/crpt/hrpt851/CRPT-105hrpt851.pdf.

such as prompt radiation and reduce fallout), including "Super-EMP weapons."

Since 2020, the DoD's reports have estimated an increase of about 100 nuclear weapons per year, declining to about 70 per year through 2030 and returning to about 100 per year between 2030 and 2035. Production of 100 per year may be based on a *ten year old* estimate of Chinese fissile material "pit" production capability. However, this could have been substantially increased to allow China to arm its new MIRVed missiles.

In 2021, Dr. John A. Swegle and Dr. Christopher Yeaw, both noted experts on nuclear weapons, estimated China had enough plutonium from its military reactors for 1,300 nuclear weapons. In 2019, noted nuclear expert James R. Howe concluded that China had enough fissile material for 3,878 nuclear warheads and, with its increased fissile material production, China would have 1,643-2,022 nuclear warheads by 2025, and 3,390-3,740 warheads by 2035. In 2021, Henry Sokolski, former Deputy for Nonproliferation Policy in the Office of the Secretary of Defense, estimated that China could produce 1,270 warheads by 2030, and, "If Beijing instead chooses to develop single-stage nuclear weapons using boosting, highly enriched uranium (HEU) or composite plutonium-HEU warhead designs, it could easily exceed this number by a factor of two or more."[7]

In 2012, Russian Colonel General (Ret.) Viktor Yesin assessed China had a much larger fissile material holding than Western estimates, saying that China's "…nuclear arsenal may consist of up to 1800 warheads."[8]

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[7] Henry D. Sokolski, "Introduction: China's Civil Nuclear Sector: Plowshares to Swords?," **i**n Henry D. Sokolski ed., *Civil Nuclear Sector: Plowshares to Swords?*, Occasional Paper 2102 (Arlington, VA: Nonproliferation Policy Education Center, March 2021), p. 3, available at https://npolicy.org/wp-content/uploads/2021/10/2102-Chinas-Civil-Nuclear-Sector-3.29.pdf.

[8] Viktor Yesin, "On China's Nuclear Potential without Underestimates or Exaggeration," Washington, D.C., Georgetown University, May 12, 2012, p. 3, available at https://www.strategicdemands.com/wp-content/uploads/2015/01/YESIN-China-s-Nuclear-Potential_2012.pdf.

China's nuclear modernization is continuing. The 2023 DoD report indicated that China was developing the DF-27, a dual-capable 5,000-8,000 km range missile. The *South China Morning Post* and the 2024 Federation of American Scientists (FAS) China nuclear report indicated it has been deployed for years. China expert Richard "Rick" Fisher says Chinese sources report the development of a new mobile ICBM, "[s]ometimes called the DF-45 or DF-51, [and] it is clearly intended to outperform the DF-41."[9] Military journalist Bill Gertz reported, "The DF-45 would have a takeoff weight of 112 tons and a payload weighing 3.6 tons and be armed with seven 650-kiloton warheads."[10] It is unclear whether the DF-45/DF-51 is one or two systems.

China's mobile MIRVed ICBMs create the possibility that it has a much larger force than the DoD knows about or is revealing publicly. These could easily be hidden in China's 5,000 kilometers of missile tunnels, known as the so-called Underground Great Wall. In addition, the pattern of Chinese modernization suggests a successor to the JL-3 SLBM—either an improved version or a JL-4—for the new 096 missile submarine.

China also has a large and growing bomber force. Fisher credits China with 150 H-6 bombers in 2023, growing to 250 H-6 and new H-20 stealth bombers in 2035. The DoD's low warhead numbers must assume that China has only a handful of air-launched nuclear weapons and no nuclear cruise missiles, despite the fact that in 2021 then Vice Chairman of the Joint Chiefs of Staff General John Hyten said China was rapidly building them.

The best analyses of current Chinese nuclear capabilities and/or future potential are those by Swegle, Yeaw,

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[9] Bill Gertz, "China building new generation of mobile ICBMs," *The Washington Times*, March 6, 2024, available at https://www.washingtontimes.com/news/2024/mar/6/exclusive-china-building-new-generation-of-mobile-/.

[10] Ibid.

Sokolski, Fisher, and Howe. Together they provide a more detailed and ominous assessment than is depicted in the DoD or the FAS reports. Due to its nuclear testing and nuclear espionage, China should be capable of fielding advanced nuclear weapons deployable in substantially larger numbers than estimated by the DoD or the FAS. With civil reactor plutonium, China should have enough fissile material to deploy thousands of nuclear warheads by 2035, if not before.

The numbers presented in the DoD and FAS reports appear to undercount the Chinese nuclear arsenal because there seems to be an analytical disconnect between the rapid visible growth in Chinese delivery systems and the slower assessed growth in deployed nuclear warheads. The DoD assessed only 500+ Chinese nuclear warheads in May 2023 despite crediting China with 350 ICBMs, two types of multiple warhead ICBMs and 72 deployed SLBMs, which alone add up 422 warheads without even assuming a single MIRVed missile. This leaves only about 100 assessed warheads to cover China's MIRVed ICBMs, MIRVed SLBMs, non-strategic nuclear warheads (medium- and intermediate-range ballistic missiles), and air-delivered nuclear weapons. Any one of these categories could push China's number above 500+ and in combination the total should be substantially higher. Questionable assumptions in both the DoD and FAS reports include: 1) a large number of China's ICBM silos are complete but empty; 2) less capable DF-31 ICBMs are probably being deployed in the new silos; 3) China's numerous H-6K bombers are not nuclear-capable; 4) China lacks nuclear-capable short-range ballistic missiles, 5) China has no nuclear-capable cruise missiles. These assumptions contradict many open sources including statements by senior U.S. generals and admirals and, in some cases, previous DoD China reports.

The apparent effort to downplay the size and capabilities of the Chinese nuclear arsenal is extremely

troubling and has significant implications for U.S. deterrence strategy. Ignoring this threat is both shortsighted and dangerous. In light of growing concerns over China's aggressive posture, it is high time for a realistic assessment.

Introduction

In 2021, the then Commander of U.S. Strategic Command Admiral Charles Richard stated, "We are witnessing a strategic breakout by China….The explosive growth in their nuclear and conventional forces can only be what I described as breathtaking."[11] In March 2024, the U.K.'s Defense Ministry stated that, "China is rapidly increasing its warhead numbers and expanding its range of delivery systems."[12] In June 2024, Pranay Vaddi, Special Assistant to the President and Senior Director for Arms Control, Disarmament, and Nonproliferation at the National Security Council, said China (and Russia and North Korea) "…are all expanding and diversifying their nuclear arsenals at a breakneck pace—showing little or no interest in arms control." He further added that as a result the United States may have to increase the number of its nuclear weapons.[13]

The legally mandated annual Department of Defense reports on Chinese military power are the most authoritative accounts available in open sources. However, they have a poor track record on the treatment of Chinese nuclear weapons. Prior to 2020, they gave little indication that China was planning a major buildup. The DoD's 2020 estimate of China's total nuclear arsenal was so low (the low-200s) that even China's Communist Party English

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[11] Bill Gertz, "EXCLUSIVE: China building third missile field for hundreds of new ICBMs," *The Washington Times*, August 12, 2021, available at https://www.washingtontimes.com/news/2021/aug/12/china-engaged-breathtaking-nuclear-breakout-us-str/.

[12] United Kingdom Ministry of Defence, "Delivering the UK's Nuclear Deterrent as a National Endeavour," London: United Kingdom Ministry of Defence, March 2024, available at https://assets.publishing.service.gov.uk/media/6622702b49d7b8813ba7e576/Defence_Nuclear_Enterprise_Command_Paper_v6.pdf.

[13] "Adapting the U.S. Approach to Arms Control and Nonproliferation to a New Era," The Arms Control Association, June 7, 2024, available at https://www.armscontrol.org/2024AnnualMeeting/Pranay-Vaddi-remarks.

language publication *Global Times* challenged it.[14] Yet, significant evidence of Chinese nuclear expansion plans existed in open sources 15-20 years ago. The 2010 minority report on the New START Treaty authored by Republican Senators pointed out that, "China could have on the order of 500 to 1,000 warheads…."[15] This author in 2008 detailed the open source evidence on Chinese plans to MIRV its strategic missiles.[16] If one accepts the 2022 and 2023 DoD China reports as accurate, every previous version understated the Chinese nuclear threat.

In combination, the 2022 and 2023 DoD reports stated that China had 500+ "operational" nuclear warheads in May 2023, growing to 1,000+ "operational" warheads in 2030, and is "on track to exceed previous projections," i.e., about 1,500 warheads in 2035; these numbers may also be significant understatements.[17] It is *mathematically impossible*

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[14] Hu Xijin, "Pentagon report aims to suppress China's nuclear deterrence," *Global Times*, September 2, 2020, available at https://www.globaltimes.cn/content/1199683.shtml.

[15] Senate Foreign Relations Committee, "TREATY WITH RUSSIA ON MEASURES FOR FURTHER REDUCTION AND LIMITATION OF STRATEGIC OFFENSIVE ARMS (THE NEW START TREATY)," Senate Foreign Relations Committee, December 1, 2010, p. 111, available at https://nuke.fas.org/control/ns/sfrc.pdf.

[16] Mark Schneider, "The Future of the U.S. Nuclear Deterrent," *Comparative Strategy*, 27(4), July 1, 2008, p. 350, available at http://dx.doi.org/10.1080/01495930802358539.

[17] Mark B. Schneider, "Will the Pentagon Ever Get Serious About the Size of China's Nuclear Force?," *RealClearDefense*, December 15, 2022, available at https://www.realcleardefense.com/articles/2022/12/15/will_the_pentagon_ever_get_serious_about_the_size_of_chinas_nuclear_force_870335.html; Department of Defense, *Military and Security Developments Involving the People's Republic of China 2023* (Washington, D.C.: Department of Defense, October 2023), pp. VIII, 55, 59, 67, 104, 110, 111, 188, available at https://media.defense.gov/2023/Oct/19/2003323409/-1/-1/1/2023-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF; and, Department of Defense, "Military and Security Developments Involving the People's Republic of China 2022" (Washington, D.C.: U.S. Department of Defense, 2022), p. 98, available at https://media.defense.gov/2022/Nov/29/2003122279/-1/-1/1/2022-MILITARY-AND-SECURITY-DEVELOPMENTS-INVOLVING-THE-PEOPLES-REPUBLIC-OF-CHINA.PDF.

for China to have as few as 500+ warheads in May 2023 because the report itself states China has 500 ICBM launchers, 350 ICBMs, 72 armed SLBM launchers, 250 IRBM launchers, and 500 nuclear-capable IRBMs.[18] The ICBM and SLBM forces alone add up to 422 nuclear warheads, even if one assumes that *all of them are single warhead missiles*. Yet, the 2023 DoD report and other government sources list three deployed MIRVed systems, the DF-5, the DF-41 and the JL-3.[19] In March 2023, STRATCOM Commander General Anthony Cotton said that "…the Chinese.…CSS-10 Mod 2 ICBM [DF-31A]…is capable of ranging the continental United States (CONUS) with multiple independently targetable reentry vehicles (MIRVs)."[20] This was never mentioned in the DoD reports despite the fact this information was reported in open sources. General Cotton's revelation is important because it implies that China has advanced nuclear weapons technology because of the small size and throw-weight of this missile. Moreover, China has air-delivered strategic nuclear weapons and non-strategic nuclear weapons. China's non-strategic nuclear weapons alone should put China above 500+ warheads. China expert Richard Fisher has discussed many more types of Chinese non-strategic weapons than have been discussed in the DoD and FAS reports and indicates they *may all be dual capable*.[21] This could mean a force of almost 1,000 non-strategic

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[18] *Military and Security Developments Involving the People's Republic of China 2023*, op. cit., p, 67.

[19] Ibid., pp. 67, 107-108.; Schneider, "Will the Pentagon Ever Get Serious About the Size of China's Nuclear Force?," op. cit.

[20] General Anthony Cotton, "STATEMENT OF ANTHONY J. COTTON COMMANDER UNITED STATES STRATEGIC COMMAND BEFORE THE SENATE COMMITTEE ON ARMED SERVICES 9 MARCH 2023," p. 6, available at https://www.armed-services.senate.gov/imo/media/doc/2023%20USSTRATCOM%20Congressional%20Posture%20Statement%20-%20SASC.pdf.

[21] Richard D. Fisher, Jr., "Taiwan: Theater nuclear missile deceptions," *Taipei Times*, March 4, 2024, available at https://www.taipeitimes.com/News/editorials/archives/2024/03/04/2003814406.

nuclear missile warheads.[22] Additionally, in June 2024, Bill Gertz reported the Chinese fractional orbital bombardment system may carry multiple warheads.[23]

A good indication of how low the DoD's estimates may be is evidenced by a 2011 Taiwanese Defense Ministry report; it said that China's Second Artillery, now called the Rocket Force, had between 450-500 nuclear weapons.[24] Other estimates go as high as 3,000.[25] The 2023 DoD China report made multiple assumptions that tended to minimize the assessed number of Chinese nuclear warheads. It stated that, "The PRC probably completed the construction of its three new solid-propellant silo fields in 2022, which will cumulatively contain at least 300 new ICBM silos and has loaded at least some intercontinental ballistic missiles (ICBMs) into these silos."[26] Yet, no nuclear nation has ever built missile silos faster than it is building missiles; built missiles much faster than it is building warheads; or armed these silos with its least capable modern ICBM. Indeed, China's DF-31 ICBM is older and less capable than the DF-41, which can be deployed in these silos.[27]

The 2023 DoD report assumed very low warhead loadings for the new MIRVed Chinese ICBMs and SLBMs. It asserted that the DF-41 is armed "with no more than three

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[22] Ibid.

[23] Bill Gertz, "China weighs use of nuclear weapons in space," *The Washington Times*, June 12, 2024, available at https://www.washingtontimes.com/news/2024/jun/12/inside-ring-china-weighs-use-of-nuclear-weapons-in/.

[24] Taiwan Ministry of Defense, "National Defense Report," Taipei: Republic of China, Ministry of National Defense, 2011, p. 82, available at https://china.usc.edu/sites/default/files/article/attachments/taiwan-2011-national-defense-report.pdf.

[25] Schneider, "Will the Pentagon Ever Get Serious About the Size of China's Nuclear Force?," op. cit.

[26] *Military and Security Developments Involving the People's Republic of China 2023*, op. cit., p. 104.

[27] Ibid., pp. 104, 107.

warheads per missile."[28] This contradicts almost all open sources (with the exception of the FAS annual China nuclear report and sources that cite it) which generally credit the DF-41 with 10 warheads.[29] Indeed, then Vice Chairman of the Joint Chiefs of Staff General John Hyten said that the DF-41 could carry 10 warheads.[30] Journalist Bill Gertz has written that, "If 10 warheads are deployed on the DF-41s in the new silos, China's warhead level will increase to more than 4,000 warheads on its DF-41s alone."[31]

Even if the DoD's growth assessments are correct, the bipartisan United States Strategic Posture Commission pointed out that, "…at China's current pace, it will reach rough quantitative parity with the United States in deployed nuclear warheads by the mid-2030s."[32] The Commission's conclusions were based upon the DoD's assessments of Chinese programs. If these assessments are wrong, China could achieve superiority with several thousand nuclear weapons within a few years.

This paper addresses many of the key issues in assessing the future growth of China's nuclear capability, including: 1) the level of Chinese nuclear weapons technology; 2) the implications of Chinese nuclear testing and nuclear espionage; 3) Chinese nuclear weapons production capability; 4) the quantity of Chinese fissile material; and 5)

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[28] Ibid., p. 107.

[29] Schneider, "Will the Pentagon Ever Get Serious About the Size of China's Nuclear Force?," op. cit.

[30] John Grady, "Hyten: China's 'Unprecedented Nuclear Modernization' Chief Concern," *USNI News*, September 14, 2021, available at https://news.usni.org/2021/09/14/hyten-chinas-unprecedented-nuclear-modernization-chief-concern.

[31] Gertz, "EXCLUSIVE: China building third missile field for hundreds of new ICBMs," op. cit.

[32] Madelyn Creedon and Jon Kyl, et al., *America's Strategic Posture* (Alexandria, VA: Institute for Defense Analyses, 2023), p. 8, available at https://www.ida.org/research-and-publications/publications/all/a/am/americas-strategic-posture.

in a summary fashion, the implications of Chinese strategic missile programs beyond the DF-41.

Chinese Nuclear Weapons Technology

In 1964, China tested a nuclear bomb and, within a short time, tested missile-deliverable fission and thermonuclear weapons. By the end of the Cold War, China had apparently achieved a nuclear weapons technology level roughly comparable to that of the United States just prior to its development of MIRVs. Reportedly, the high-yield Chinese warheads developed by about 1990 were about 500 kg and yielded hundreds of kilotons.[33] (The yield of the DF-31 single warhead was reported to be 500 kilotons.)[34]

Yu Min, described by *Xinhua* as the "architect of the country's first H-bomb," claimed that China's key nuclear capabilities are "on a par with the United States and the former Soviet Union."[35] This may have been an exaggeration, but China clearly has made substantial progress. Unlike the United States, which ended improvements to its nuclear weapons at the end of the Cold War, China did the opposite. In 2007, Zhan Wannian, Vice Chairman of China's Central Military Commission (the main government defense decision body), reportedly told the Commission that there would be "further upgrading, and further development [of Chinese nuclear weapons] from 2001 to 2009."[36] This included the development of MIRVed warheads.

While China is normally highly secretive about its nuclear capability, in an open briefing in 2017, the People's

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[33] Jeffrey Lewis, "Mass and Yield of Chinese Nuclear Warheads," *Arms Control Wonk.com*, April 25, 2004, available at https://www.armscontrolwonk.com/archive/200141/mass-and-yield-of-chinese-nuclear-warheads/.

[34] Yesin, "On China's Nuclear Potential without Underestimates or Exaggeration," op. cit., p. 3.

[35] Quoted, in Mark Schneider, "The Nuclear Doctrine and Forces of the People's Republic of China," *Comparative Strategy* 28(3), July 22, 2009, p. 253, available at http://dx.doi.org/10.1080/01495930903025276.

[36] Quoted in Schneider, "The Future of the U.S. Nuclear Deterrent," op. cit., p. 350.

Liberation Army Rocket Forces (PLARF) revealed unprecedented information about some of its strategic nuclear weapons. Its briefing slides were photographed and posted on the internet but have been largely ignored except by China expert Richard Fisher. They indicate that China has a substantially more advanced level of nuclear weapons technology than what is apparently credited in the DoD's China reports and in the much less authoritative annual report of the FAS.

The PLARF indicated that the DF-41 had a range of 14,000 km and three warhead options: 1) one 1,600-kg warhead of 5.5 megatons; 2) six 250-kg warheads of 650 kilotons; or 3) 10 165-kg warheads of 150-kt.[37] The JL-2A SLBM was described as having a range of 12,000 km and either one warhead of 250 kilotons or three warheads of 60 kilotons.[38] The older JL-1 SLBM apparently was said to have a 200-kiloton warhead.[39]

The information about the DF-41 is particularly significant because it lists the warhead weight, the yield, and the number of warheads the missile carries. If one compares it with the declared U.S. and Soviet warhead numbers and missile throw-weight for ICBMs and SLBMs in the START Treaty Memorandum of Understanding and the reported yields of their nuclear warheads,[40] the PLARF

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[37] Colonel (Ret.) Vinayak Bhat, "#China #PLARF ppt slide #DF41 range14000km 1,6or10MIRVs yields 1x1600kg 5.5megaton," March 6, 2017, available at https://x.com/rajfortyseven/status/838921803057758208.

[38] "China Ballistic Missiles and Nuclear Arms Thread," *Sino Defense Forum*, September 25, 2017, available at https://www.sinodefenceforum.com/china-ballistic-missiles-and-nuclear-arms-thread.t5881/page-233.

[39] Ibid.

[40] *START Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Reduction and Limitation of Strategic Offensive Arms Signed in Moscow July 31, 1991* (Washington, D.C.: U.S. Department of State, October 1991), Supplement No. 5, pp. 120-121; "Complete List of All U.S. Nuclear Weapons," *Atomic Archive*, March 30, 2023, available at https://nuclearweaponarchive.org/Usa/Weapons/Allbombs.html; Ministry of Defence of the Russian Federation, "Intercontinental ballistic missile R36M2 Voivode," Moscow, Ministry of Defence of the Russian Federation, no date,

disclosures appear to be credible. The PLARF numbers suggest a DF-41 throw-weight of over 3,200 kg, if one assumes the historical norm that the weight of the MIRV bus is about half of the throw-weight.[41] This is reasonable in light of the reported size and weight of the DF-41.[42] The data imply that Chinese nuclear weapons technology is not quite as good as that of the United States and Russia but sufficient to allow China to deploy the higher numbers of MIRVed warheads that are often reported in open sources. They imply that Chinese nuclear weapons technology is substantially better than what is apparently being assumed in the DoD's China reports.

The DoD's China reports do not normally provide warhead yield assessments except for the multi-megaton DF-5C.[43] The 2024 FAS China report, without sourcing, credits *all* Chinese strategic and non-strategic nuclear missiles, with the exception of the four-to-five megaton DF-5A and the JL-3 (for which no number is given) with yields between 200-300 kilotons.[44] While there is evidence China has warheads in this yield range, it is unlikely that nearly *all* Chinese missile weapons have the same yield because: 1)

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available at https://eng.mil.ru/en/structure/forces/strategic_rocket/more.htm?id=10357430@morfMilitaryModel; and, Ministry of Defence of the Russian Federation, "Intercontinental ballistic missile UR-100NUTTKh," Moscow: Ministry of Defence of the Russian Federation, no date, available at https://eng.mil.ru/en/structure/forces/strategic_rocket/more.htm?id=10365660@morfMilitaryModel.

[41] Pavel Podvig, "How many warheads?," *Russian Forces.org*, May 7, 2007, available at https://russianforces.org/blog/2007/05/how_many_warheads.shtml.

[42] Center for Strategic and International Studies, "DF-41 (Dong Feng-41 / CSS-X-20)," Washington, D.C.: Center for Strategic and International Studies, April 23, 2024, available at https://missilethreat.csis.org/missile/df-41/.

[43] *Military and Security Developments Involving the People's Republic of China 2023,* op. cit., p. VIII.

[44] Hans M. Kristensen, Matt Korda, Eliana Johns, Mackenzie Knight, "Chinese nuclear weapons, 2024," *Bulletin of the Atomic Scientists*, January 15, 2024, p. 50, available at https://thebulletin.org/premium/2024-01/chinese-nuclear-weapons-2024/.

the mission of each of these missiles, particularly the non-strategic missiles, is different; and 2) from the standpoint of reliability it is risky to have only one warhead type and the reported yield of one of them was 660 kilotons.[45]

The FAS report suggests that the authors are assuming that these missiles, including the MIRV systems, carry the DF-31 warhead, which implies no technical progress in about 20 years. In this regard, the PLARF numbers are more credible. They suggest technical improvements and appear consistent with the 2023 DoD China report which states, "The PLA seeks a diverse nuclear force, comprised of systems ranging from low-yield precision strike missiles to ICBMs with multi-megaton yields."[46] Keep in mind that all warhead yields cited above are apparently maximum yields.

The 2023 DoD report indicates that China was deploying low-yield nuclear weapons.[47] Before the end of the Cold War, China reportedly tested a neutron bomb,[48] which implies advanced nuclear technology. This also suggests that China has the technology to build other types of directed output weapons (i.e., those that enhance or suppress nuclear effects such as prompt radiation and reduce fallout) including "Super-EMP weapons," which were reported by the late Dr. Peter Pry.[49]

There is apparently substantial, credible, open source information on Chinese non-strategic nuclear weapons that has never appeared in the DoD or FAS reports. The 2006

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[45] "China's Nuclear Tests," *Atomic Archive.com*, no date, available at https://www.atomicarchive.com/almanac/test-sites/prc-testing.html.

[46] *Military and Security Developments Involving the People's Republic of China 2023*, op. cit., p. 109.

[47] Ibid.

[48] Schneider, "'The Nuclear Doctrine and Forces of the People's Republic of China," op. cit., pp. 253-255.

[49] Dr. Peter Vincent Pry, *CHINA: EMP THREAT* (Washington, D.C.: EMP Task Force on National and Homeland Security, June 10, 2020), available at https://apps.dtic.mil/sti/pdfs/AD1102202.pdf.

China Defense Ministry white paper on national defense stated the Second Artillery (now the PLARF) has "tactical operational [short range] missiles of various types."[50] Russian Colonel General (Ret.) Viktor Yesin has characterized the DF-15 and the DF-11 as China's operational tactical nuclear missiles, and noted that China has five-to-20 kiloton nuclear warheads for the DF-15A, the DF-15B, the DF-11A, the DH-10 cruise missile and Chinese fighter aircraft.[51] A Taiwan Defense Ministry official said that the Chinese M-11 (DF-11/CSS-7) missile "…can fire a variety of warheads ranging from nuclear and chemical warheads to electromagnetic pulse warheads."[52] A Russian publication credits this missile with nuclear warheads with yields of two, 10 and 20 kilotons.[53] Open source data are insufficient to determine whether low-yield Chinese warheads are fixed or variable yield. Another Russian publication says that the yield of Chinese tactical and operational tactical nuclear weapons is 90-100 kilotons.[54] For non-strategic high-yield options this number is more credible than the FAS assessment of 200-300 kilotons because higher yield is not necessarily an advantage.

Even the 2024 FAS report credits China with nuclear bombs and projects a nuclear cruise missile.[55] These

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[50] "China's National Defense in 2006," *China.org.cn*, December 2006, available at http://www.andrewerickson.com/wp-content/uploads/2019/07/China-Defense-White-Paper_2006_English-Chinese_Annotated.pdf.

[51] Yesin, "On China's Nuclear Potential without Underestimates or Exaggeration," op. cit.

[52] *Section II. Minimum Deterrence: Fragile Hope of a Constant and Benign Threat Environment* (Fairfax, VA: National Institute for Public Policy, September 2014), p. 49, available at https://www.esd.whs.mil/Portals/54/Documents/FOID/Reading%20Room/Litigation_Release/Litigation%20Release%20-%20Section%20II%20Minimum%20Deterrence%20Fragile%20Hope.pdf.

[53] Ibid.

[54] Ibid., pp. 49-50.

[55] Kristensen, Korda, Johns, Knight, "Chinese nuclear weapons, 2024," op. cit., p. 50.

weapons do not appear in the 2023 DoD report. Yet, in 2013, the Commander of the U.S. Global Strike Command said that the Chinese CJ-20 was a nuclear air-launched cruise missile (ALCM).[56]

[56] Lieutenant General James M. Kowalski, "Air Force Global Strike Command," May 7, 2013, p. 5, available at http://fas.org/programs/ssp/nukes/nuclearweapons/AFGSC-CommandBrief-May2013.pdf.

Chinese Nuclear Testing

Despite great advances in computers, simulation, and other areas of science and technology, nuclear testing remains a critical element in the development of nuclear weapons. Nuclear testing provides the ultimate proof that a nuclear weapon works and furnishes important data that improve computer modeling and simulation.

In more than three decades of overt nuclear testing, China reportedly conducted 47 (some say 45) nuclear tests.[57] However, this number excludes the low-yield hydronuclear tests that China reportedly conducted.[58] There is also a possibility that sub-kiloton Chinese nuclear tests were conducted but not detected or made public. By comparison, Britain, with an advanced nuclear weapons technology, reportedly conducted 45 nuclear tests.[59] Britain benefited from nuclear cooperation with the United States. China apparently achieved similar benefits from its nuclear espionage against the United States.

China conducted nuclear tests in the 1990s after the cessation of U.S. nuclear testing, some in anticipation of the Comprehensive Nuclear Test Ban Treaty (CTBT) and related to Chinese plans for nuclear modernization and expansion. A number of highly redacted intelligence reports on Chinese nuclear testing in the 1990s have been declassified. These reports are important because they were never intended to be made public and, hence, are less likely to have been impacted by "Inside the Beltway" political correctness.

Among the conclusions of these reports were: 1) A nuclear test at Lop Nor in 1990 "may be related to

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[57] "China's Nuclear Tests," op. cit.

[58] Thomas C. Reed and Danny B. Stillman, *The Nuclear Express* (Minneapolis: Zenith Press, 2009), p. 64.

[59] "United Kingdom's Nuclear Tests," *Atomic Archive.com*, no date, available at https://www.atomicarchive.com/almanac/test-sites/uk-testing.html.

development of a warhead for a Chinese short-range ballistic missile";[60] 2) Accelerated Chinese testing expected by 1996 may also be related to "tactical systems to be developed in the future";[61] 3) "China could be seeking to confirm the reliability of a nuclear artillery shell designed in advance of a nuclear test ban" in order to defend against Russian invasion or an amphibious landing and it "may have been a gun assembled uranium device";[62] 4) China's nuclear tests in 1993 were driven "by its need to modernize its nuclear force, built largely using 1960s and 1970s technology";[63] 5) China planned seven nuclear tests including "testing for new SLBM and ICBMs warheads, by 1996";[64] 6) China was developing new nuclear weapons that "may use more advanced concepts such as aspherical primaries and possibly a type of IHE [Insensitive High Explosive]";[65] 7) Chinese testing was also aimed at developing "a cruise missile warhead and may involve safety upgrades to existing systems";[66] and 8) A Chinese nuclear test planned for 1994 was aimed at "…the completion of warhead development for new intercontinental and submarine launched ballistic missiles

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[60] Director of Central Intelligence Agency, "China New Nuclear Test," *Science and Weapons Review*, July 31, 1990, available at https://nsarchive2.gwu.edu/NSAEBB/NSAEBB200/19900731.pdf.

[61] Director of Central Intelligence Agency, "China: Accelerated Nuclear Test Schedule," *National Intelligence Daily*, February 19, 1993, available at https://nsarchive2.gwu.edu/NSAEBB/NSAEBB200/19930219.pdf.

[62] Ibid.

[63] Director of Central Intelligence, "Reaction to Chinese Nuclear Test" and "China More Nuclear Tests Likely," *National Intelligence Daily*, October 7, 1993, available at https://nsarchive2.gwu.edu/NSAEBB/NSAEBB200/19931007.pdf.

[64] Director of Central Intelligence, "China: Response to Moratorium Noncommittal," *National Intelligence Daily*, July 8, 1993, available at https://nsarchive2.gwu.edu/NSAEBB/NSAEBB200/19930708.pdf.

[65] Director of Central Intelligence, "Reaction to Chinese Nuclear Test" and "China: More Nuclear Tests Likely," op. cit.

[66] Director of Central Intelligence, "China Nuclear Test [Deleted] Nuclear Test," *National Intelligence Daily*, March 7, 1995, available at https://nsarchive2.gwu.edu/NSAEBB/NSAEBB200/19950307.pdf.

and the development of technologies to enhance confidence in warheads for an enduring stockpile under a nuclear test ban."[67]

Half of these reports relate to systems that are *not discussed* in either the DoD China reports or the FAS China nuclear weapons reports. As noted above, Chinese short-range non-strategic nuclear-capable missiles and nuclear-capable ALCMs are described in open sources, and China said it had short-range nuclear missiles in 2006. This may be a commentary on how incomplete the DoD and FAS reports are.

Assessments of covert Chinese nuclear testing were apparently impacted by the politics of arms control compliance because of the supposed Chinese moratorium on nuclear testing after 1996. The 1999 Report of the Select Committee on U.S. National Security and Military/Commercial Concerns with the People's Republic of China of the House of Representatives (the "Cox Committee") concluded that "…nuclear tests related to development of the PRC's next generation of thermonuclear warheads may be continuing at the PRC test site at Lop Nur."[68] In May 2006, *Chinese Defense Today* reported possible "low yield nuclear tests" after 1996.[69] The 2009 report of the Congressional Commission on the Strategic Posture of the United States stated that, "Apparently Russia and possibly China are conducting low yield [nuclear] tests."[70] In 2009,

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[67] Central Intelligence Agency and the Defense Intelligence Agency, "Chinese Nuclear Testing: Racing against a Comprehensive Test Ban," *Joint Intelligence Memorandum*, October 5, 1995, available at https://nsarchive2.gwu.edu/NSAEBB/NSAEBB200/19940930.pdf.

[68] Select Committee, House of Representatives, *Report of the Select Committee on U.S. National Security and Military/Commercial Concerns with the People's Republic of China*, Volume I (unclassified), May 1999, pp. 69–76, 241, available at https://www.congress.gov/105/crpt/hrpt851/CRPT-105hrpt851.pdf.

[69] Cited in Schneider, "The Future of the U.S. Nuclear Deterrent," op. cit., p. 351.

[70] William J. Perry and James R. Schlesinger et al. *America's Strategic Posture* (Washington, D.C.: The United States Institute of Peace Press, 2009), p. 83, available at

the government of India reportedly regarded reports of Chinese hydronuclear tests as important to Indian nuclear testing policy.[71] The State Department's 2020 arms control compliance report stated China's:

> …high level of activity at its Lop Nur nuclear weapons test site…its use of explosive containment chambers, extensive excavation activities at Lop Nur, and lack of transparency on its nuclear testing activities—which has included frequently blocking the flow of data from its International Monitoring System (IMS) stations to the International Data Center….raise concerns regarding its adherence to the 'zero yield' standard adhered to by the United States, the United Kingdom, and France in their respective nuclear weapons testing moratoria.[72]

Blocking the IMS implies testing yields were high enough to allow possible IMS seismic detection, which, in turn, implies at least sub-kiloton or possibly higher yields.

The lowest yield nuclear tests are called "hydronuclear." According to the *Omaha World – Herald*, "The hydronuclear tests have been used by U.S. nuclear weapons engineers to verify that their bombs will operate as designed and to monitor them for possible deterioration. The experiments call for detonating a mock nuclear

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https://www.usip.org/sites/default/files/America%27s_Strategic_Posture_Auth_Ed.pdf.

[71] "India: New Delhi's Reservations on CTBT Likely To Reflect at New York Conference Report by Ramesh Ramachandran: 'India Focus on Disarmament as CTBT Debate Revs Up,'" *The Asian Age Online,* September 13, 2009. (World News Connection.)

[72] U.S. Department of State, *Adherence to and Compliance with Arms Control, Nonproliferation, and Disarmament Agreements and Commitments* (Washington, D.C.: State Department, June 2020), p. 49, available at https://www.state.gov/wp-content/uploads/2020/06/2020-Adherence-to-and-Compliance-with-Arms-Control-Nonproliferationand-Disarmament-Agreements-and-Commitments-Compliance-Report-1.pdf.

warhead that releases only a small amount of nuclear energy."[73]

Advocates of the CTBT argued for zero yield despite the inability to verify it (see below). Yet, in 2016, Dr. John Foster, former Director of the Lawrence Livermore National Laboratory (LLNL) and perhaps the greatest U.S. nuclear weapons designer, said that hydronuclear tests "of less than one ton" yield could provide "high confidence" in the "performance [of nuclear weapons] at low yield."[74] Russian experts have also said that hydronuclear tests are very important.[75]

The next level of nuclear testing above hydronuclear tests is sub-kiloton tests, which are largely undetectable by seismic means if there is an effort to hide them. According to Dr. Paul Robinson, former Director of the Sandia National Laboratory and the Chief U.S. Negotiator of the CTBT, the national nuclear laboratories told the Clinton Administration that sub-kiloton testing was necessary and stated in Congressional testimony that "…if adversaries conduct experiments up to the threshold of international detectability, we will be at an intolerable disadvantage."[76]

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[73] Paul Godsell, "Exon: Hydronuclear Tests Would Promote Spread of N-Weapons [Sunrise Edition]," *Omaha World – Herald*, July 26, 1994, available at https://dialog.proquest.com/professional/professionalnewsstand/docview/400879205/abstract/18F8C506201DB7FD76/1?accountid=155509&accountid=155509&site=professionalnewsstand&t:ac=18F8C506201DB7FD76/1&t:cp=maintain/resultcitationblocksbrief&t:zoneid=transactionalZone_f894587884ecc6.

[74] Dr. John S. Foster, "FUTURE POSSIBLE PATHS FOR THE NUCLEAR WEAPONS COMPLEX," January 22, 2016, mimeo, p. 9.

[75] Mark B. Schneider, "Yes, the Russians Are Testing Nuclear Weapons and It Is Very Important," *RealClearDefense*, August 8, 2019, available at https://www.realcleardefense.com/articles/2019/08/08/yes_the_russians_are_testing_nuclear_weapons_and_it_is_very_important_114651.html.

[76] Dr. Paul Robinson, "Statement of C. Paul Robinson, Director Sandia National Laboratories United States Senate Committee on Armed Services October 7, 1999," pp. 17-23, available at http://armedservices.senate.gov/statemnt/1999/991007pr.pdf; and, Paul Robinson, John Foster, and Thomas Scheber, "The Comprehensive Test Ban Treaty: Questions and Challenges," Lecture No. 1218 (Washington, D.C.: Heritage Foundation, November 7, 2012), available at

In 1995, the *Los Angeles Times* reported that the DoD wanted to "…resume underground testing…with maximum yields of 500 tons of TNT…."[77] Permission was denied. A 1995 JASONS group study (run by the MITRE Corporation) concluded that 500-ton yield testing "…would allow studies of boost gas ignition and initial burn, which is a critical step in achieving full primary design yield."[78] It continued, "Testing with nominal yields up to a 100-ton limit permits examination of aspects of the pre-boost fission process."[79]

Under some circumstances, nuclear tests of up to 10 kilotons can be carried out without detection, if conducted in a manner to minimize the seismic signal and away from known test ranges.[80] Colonel Igor Tokarev, Chief of Russia's 12th Main Directorate of the Ministry of Defense, Russia's nuclear weapons organization, said that means of hiding nuclear tests "…include a reduction in the power of nuclear charges, testing [in] massive materials that reduce the intensity of seismic waves, testing at a deep depth, testing in seismic zones, where the tracking is difficult, etc."[81] Siegfried Hecker, former Director of the Los Alamos National Laboratory (LANL), stated, "[M]ost [new] designs

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http://www.heritage.org/research/lecture/2012/11/thecomprehensive-test-ban-treaty-questions-and-challenges.

[77] Ralph Vartabedian, "Pentagon Seeks to Resume Underground Nuclear Tests : Defense: Experiments are necessary, officials say. But others contend they could set back arms control efforts," *Los Angeles Times*, June 17, 1995, available at https://www.latimes.com/archives/la-xpm-1995-06-17-mn-14111-story.html.

[78] Sidney Drell, Chair, et al., *Nuclear Testing: Summary and Conclusions,* JASON report JSR-95-320, The MITRE Corporation, August 3, 1995, available at https://rlg.fas.org/jsr-95-320.htm.

[79] Ibid.

[80] Kathleen Bailey and Thomas Scheber, *The Comprehensive Test Ban Treaty: An Assessment of the Benefits, Costs, and Risks* (Fairfax, VA: National Institute for Public Policy, 2011), p. 16, available at http://www.nipp.org/wp-content/uploads/2014/12/CTBT-3.11.11-electronicversion.pdf.

[81] "Methods to Hide Nuke Tests Being Developed Abroad - Russian MoD," *Sputnik News*, May 11, 2018, available at https://sputnikglobe.com/20180511/methods-nuke-tests-abroad-1064349262.html.

could be adequately tested at yields between one and ten kilotons."[82]

In 2023, *The New York Times* reported, "In the remote desert where China detonated its first atom bomb nearly 60 years ago, a drilling rig recently bored a deep vertical shaft that is estimated to plunge down at least a third of a mile. It is the strongest evidence yet that Beijing is weighing whether to test a new generation of nuclear arms that could increase the lethality of its rapidly expanding missile force."[83] If China resumes high-yield nuclear testing, this would be a large step toward near-term Chinese deployment of thousands of nuclear weapons. It would also represent a significant change in the military balance, if the United States fails to respond.

[82] Quoted in Baker Spring and Michaela Dodge, "Keeping Nuclear Testing on the Table: A National Security Imperative" (Washington, D.C.: Heritage Foundation, February 27, 2013), available at https://www.heritage.org/node/11938/print-display.

[83] William J. Broad, Chris Buckley and Jonathan Corum, "China Quietly Rebuilds Secretive Base for Nuclear Tests," *The New York Times*, December 20, 2023, available at https://www.nytimes.com/interactive/2023/12/20/science/china-nuclear-tests-lop-nur.html.

China's Cooperation with Other Nations

China reportedly facilitated Pakistan's and North Korea's nuclear weapons development, including transferring the design of China's Chic-4, a 1,180-kg 10-kiloton missile warhead to Pakistan, which in turn was proliferated to North Korea.[84] Former Secretary of the Air Force Thomas Reed said that, in 1990, China tested an improved Pakistani version of the Chic-4.[85] According to Richard Fisher, "Indian sources credit China as the source of the new [Pakistani] ABABEEL warhead multiple reentry vehicle technology and it is indeed plausible Pakistan passed such Chinese-origin technology to North Korea."[86] The relatively small size of the North Korean thermonuclear bomb tested in 2017 (North Korea released a photograph) may suggest Chinese involvement. If so, China is likely getting test data from North Korea and North Korea may even be testing Chinese designs.

In a landmark book on nuclear proliferation, Thomas Reed and former chief of intelligence at LANL Danny Stillman, reported that China staged "hydronuclear and effects tests" for France and that French nuclear weapons scientists were present in China.[87] China obviously obtained the data from these tests. One of Stillman's Chinese hosts said that French scientists were "very cooperative" and another said that, "China has learned some very clever

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[84] Mark Schneider, "The North Korean Nuclear Threat to the U.S.," *Comparative Strategy*, 33(2), April 28, 2014, p. 110, available at https://www.tandfonline.com/doi/abs/10.1080/01495933.2013.840203.

[85] Chidanand Rajghatta, "China tested nukes for Pakistan, gave design," *Times of India*, September 5, 2008, available at http://timesofindia.indiatimes.com/articleshow/3447395.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst.

[86] Anders Corr, "Chinese Involvement In North Korea's Nuclear Missile Program: From Trucks To Warheads," *Forbes*, July 6, 2023, available at https://www.forbes.com/sites/anderscorr/2017/07/05/chinese-involvement-in-north-koreas-nuclear-missile-program-from-warheads-to-trucks/.

[87] Reed and Stillman, *The Nuclear Express*, op. cit., p. 239.

nuclear weapons designs from the French nuclear weapons scientists."[88] Reed concluded that, due to its underground nuclear testing, China had achieved nuclear parity and "…now stands in the first rank of nuclear powers."[89]

Furthermore, there is a possibility of significant Russian assistance to the Chinese nuclear weapons program. There are recent reports that Russia is providing highly enriched uranium (HEU) to China[90] for its fast breeder reactors, which reportedly will produce weapons grade plutonium.[91] It is possible that the full scope of HEU sales to China is unknown and may be contributing to China's nuclear weapons development. It is also possible that China recruited impoverished Yeltsin-era Russian nuclear weapons designers.

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[88] Ibid.

[89] Quoted in, Rajghatta, "China tested nukes for Pakistan, gave design," op. cit.

[90] David Vergun, "Russia Reportedly Supplying Enriched Uranium to China," *DoD News*, March 8, 2023, available at https://www.defense.gov/News/News-Stories/Article/Article/3323381/russia-reportedly-supplying-enriched-uranium-to-china/.

[91] Bill Gertz, "With an assist from Russia, China's plutonium reactors fuel strategic arms buildup," *The Washington Times*, January 23, 2024, available at https://www.washingtontimes.com/news/2024/jan/23/with-assist-from-russia-chinas-plutonium-reactors-/.

Chinese Nuclear Espionage

China has conducted incredibly successful nuclear espionage for decades. In 1999, *The New York Times* reported that: 1) "China is close to deploying a nuclear missile with a warhead whose design draws on stolen American secrets, United States intelligence officials say"; 2) "China stole design information about America's most advanced warhead, the W-88"; and 3) "American officials believe that the technology suspected of having been stolen for use in the DF-31's warhead will help China achieve its goal of building a modern nuclear arsenal that relies on mobility to evade attacks…"[92] It also said that some American officials believe that China used design information "…from the 'primary' of the W-70 to help develop the advanced warhead that will be used on the DF-31 missile….The W-70 warhead is also known as the neutron bomb….But its 'primary' can be used in other nuclear weapons as well."[93] The W-88-based design is probably the warhead China tested in 1996, which a Chinese nuclear weapons designer called "a great spanning leap" that allowed miniaturization.[94]

The Cox Committee report confirmed *The New York Times* story and concluded that China was developing small nuclear warheads based on stolen U.S. weapons design information.[95] It detailed Chinese nuclear espionage, stating:

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[92] James Rissen and Jeff Gerth, "China Is Installing a Warhead Said to Be Based on U.S. Secrets," *The New York Times International*, May 14, 1999, available at https://archive.nytimes.com/www.nytimes.com/library/world/asia/051499china-nuke.html.

[93] Ibid.

[94] Schneider, "The Nuclear Doctrine and Forces of the People's Republic of China," op. cit., p. 253.

[95] *Report of the Select Committee on U.S. National Security and Military/Commercial Concerns with the People's Republic of China,"* op. cit., pp. vii-viii.

> *The PRC stole classified information on every currently deployed U.S. Intercontinental ballistic missile (ICBM) and submarine-launched ballistic missile (SLBM).* The warheads for which the PRC stole classified information include: the W-56 Minuteman II ICBM; the W-62 Minuteman III ICBM; the W-70 Lance short-range ballistic missile (SRBM); the W-76 Trident C-4 SLBM; the W-78 Minuteman III Mark 12A ICBM; the W-87 Peacekeeper ICBM; and the W-88 Trident D-5 SLBM. The W-88 warhead is the most sophisticated strategic nuclear warhead in the U.S. arsenal….
>
> In addition, in the mid-1990s the PRC stole from a U.S. national weapons Laboratory classified U.S. thermonuclear weapons information that cannot be identified in this unclassified Report….
>
> The PRC also stole classified information on U.S. weapons design concepts, on weaponization features, and on warhead reentry vehicles (the hardened shell that protects a warhead during reentry). The PRC may have acquired detailed documents and blueprints from the U.S. national weapons laboratories. (Emphasis in the original).[96]

Additionally, it said that:

> *The PRC may have also acquired classified U.S. nuclear weapons computer codes from U.S. national weapons laboratories*….Nuclear weapons codes are important for understanding the workings of nuclear weapons and can assist in weapon design, maintenance, and adaptation. The PRC could make use of this information, for example, to adapt stolen U.S. thermonuclear design

[96] Ibid., p. 68.

> information to meet the PRC's particular needs and capabilities.[97] (Emphasis in the original).

The report went on to state that, in the 1990s, China acquired U.S. "technical information about insensitive high explosives [IHE]."[98] (As noted above, one of the Chinese nuclear tests conducted in the 1990s possibly tested IHE, which is a major advance in nuclear weapons safety.) The report stated, "Such thefts almost certainly continue to the present," adding that the Clinton Administration prevented the Committee from publishing "additional information about PRC thefts…."[99] Indeed, the Clinton Administration's CIA seemingly attempted to downplay the significance of Chinese espionage. The Cox Committee pointed out it was more than "several" U.S. designs and the IC assessment did not even mention that China may have obtained the design codes.[100] The Cox report is far more credible. It concluded that, "While the PRC might not reproduce exact replicas of these U.S. thermonuclear warheads, elements of the PRC's devices could be similar."[101] This apparently is what happened.

A DF-41 warhead based upon the W-88 is hardly consistent with the DoD report's conclusion that the DF-41 can carry only three warheads. Even assuming the Center for Strategic and International Studies (CSIS) *Missile Threat* lower estimate of a DF-41 throw-weight of 2,500-kg, the warheads would be over 400 kg. The MK-5 RV/W-88

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[97] Ibid., p. 69.

[98] Loc. cit.

[99] Loc. cit.

[100] "Key Findings: The Intelligence Community Damage Assessment on the Implications of China's Acquisition of U.S. Nuclear Weapons Information on the Development of Future Chinese Weapons," April 21, 1999, available at https://sgp.fas.org/news/dci042199.html.

[101] *Report of the Select Committee on U.S. National Security and Military/Commercial Concerns with the People's Republic of China*, op. cit., p. 73.

reportedly weighs 175 kg.[102] Indeed, the PLARF statement that the DF-41 carries six 250-kg 650-kt warheads seems reasonably consistent with a heavier and higher yield derivative of the W-88. Similarly, a Chinese adoption of the MK-4 RV/W-76 (reportedly 95 kg and 100 kilotons[103]) or possibly the W-62 (reportedly 253 pounds [114 kg] and 170 kilotons[104]) seems reasonably consistent with the PLARF claim that the DF-41 can carry 10 165-kg 150-kiloton warheads. Moreover, General Cotton's revelation that the DF-31 carries MIRVs seems consistent with a Chinese warhead derived from the W-88 or any of the stolen U.S. missile warhead designs.

[102] John Harvey and Stefan Michalowskib, "Nuclear Weapons Safety: The Case of Trident," *Science and Security*, 1994, Volume 4, p. 303, available at https://scienceandglobalsecurity.org/archive/sgs04harvey.pdf.

[103] Ibid.

[104] "The W62 Warhead," *The Atomic Archive*, January 9, 2007, available at https://nuclearweaponarchive.org/Usa/Weapons/W62.html.

Chinese Nuclear Weapons Production Capability

The DoD China reports since 2020 have detailed an increase in Chinese nuclear weapons from the "low 200s" to 500+ "operational" warheads in May 2023, or about 100 per year.[105] The projected growth to 1,000+ in 2030 and about 1,500 in 2035 must assume a decline in the annual production rate to about 70 per year from May 2023 to 2030 and returning to about 100 per year between 2030 and 2035.[106] The production rate decline was not explained. This reduced production rate is contrary to the usual ramp-up in weapons production programs. Indeed, in October 2023, the DoD acknowledged that China was adding nuclear weapons faster than expected but did not provide a 2035 warhead number.[107] In fact, continuing at a rate of 100 per year would result in about 360 more warheads than the DoD's 2022 projection for 2035.

The growth of about 100 weapons per year from September 2020 to May 2023 may be based upon an estimate of Chinese nuclear "pit" production. A "pit" is the fissile material core of a fission bomb or the "primary" (fission trigger) of a thermonuclear weapon. In 2014, an excellent study by the late Colonel (ret.) Houston Hawkins published by LANL indicated that China could produce about 100 pits per year.[108] In light of the source, it appears to be an accurate

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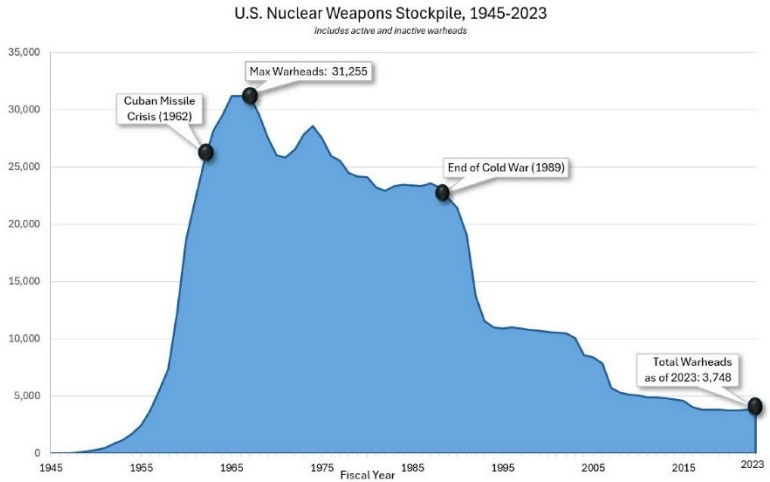
[105] Schneider, "Will the Pentagon Ever Get Serious About the Size of China's Nuclear Force?," op. cit.; *Military and Security Developments Involving the People's Republic of China 2023*, op. cit., pp. VIII, 101.

[106] Ibid.

[107] U.S. Defense Department, "Transcript: DOD Official Briefs on 2023 China Military Power Report" (Washington, D.C.: Department of Defense, October 18, 2023), available at https://www.defense.gov/News/Transcripts/Transcript/Article/3562254/dod-official-briefs-on-2023-china-military-power-report/.

[108] Houston T. Hawkins, *Rethinking the Unthinkable* (Los Alamos, NM: Los Alamos National Laboratory, July 23, 2014), p. 15, available at https://www.osti.gov/biblio/1148302.

account of the perceived Chinese production capability *in 2014*. Since this is a decade ago, China could have increased its production capability relatively easy. For example, U.S. nuclear weapons production increased from a handful in 1945 to thousands by 1958, as indicated in the following chart released by the Department of Energy.[109]



There is no apparent reason why China would massively expand its nuclear missile force and not make a corresponding increase in its nuclear weapons production capacity to arm its new missiles with MIRVs on a timely basis. China has been substantially increasing its defense spending for decades and its manpower costs are low.[110] To get numbers as low as 500+ warheads in May 2023, it is necessary to assume that most, if not all, Chinese MIRV-capable missiles carry only a single warhead. This is explicit

[109] U.S. Department of Energy, "Transparency in the U.S. Nuclear Weapons Stockpile" (Washington, D.C.: Department of Energy, no date), available at https://www.energy.gov/nnsa/transparency-us-nuclear-weapons-stockpile.

[110] Mackenzie Eaglen, "China's real military budget has quietly become almost as big as ours," *The Hill*, April 30, 2024, available at https://thehill.com/opinion/national-security/4624666-chinas-real-military-budget-has-quietly-become-almost-as-big-as-ours/.

in the 2024 FAS China nuclear weapons report, which says the Chinese JL-3 SLBM has "multiple warheads" but counts it as carrying a single warhead.[111]

MIRVs were developed because the cost of additional nuclear warheads is only a small percentage of missile costs. It is comparatively inexpensive to increase the force from hundreds to thousands of weapons. A fact sheet published by the Federation of American Scientists and the Union of Concerned Scientists, citing official sources, concluded that "…with a stockpile of some 500 warheads, the size and cost of the weapons complex would only be a little smaller than what is proposed for a stockpile of 3,000 to 3,500 weapons."[112]

Even without increasing its production capability, China could have started producing additional pits, and even weapons, years before its ICBM silo expansion program. The minimum estimate of the life of a pit is 45 to 60 years, with some estimates up to 150 years.[113] Hence, China would lose little by maximizing early pit production, which would allow a much faster warhead buildup.

China could increase pit production at its known facilities by going to two or three production shifts. With covert low-yield nuclear testing, the issue and cost of pit certification would be far easier and cheaper than for the United States under the U.S. "stockpile stewardship" program.

Would the United States have detected covert Chinese construction of production facilities over the last decade? Unfortunately, the answer may be "no." In addition to

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[111] Kristensen, Korda, Johns, Knight, "Chinese nuclear weapons, 2024," op. cit., p. 50.

[112] Cited in Keith B. Payne and James Schlesinger, *Minimum Deterrence: Examining the Evidence* (Fairfax, VA: National Institute Press, 2013), p. 67, available at https://nipp.org/wp-content/uploads/2021/05/Final-for-Distro-7.17.pdf.

[113] Hawkins, *Rethinking the Unthinkable*, op. cit., p. 17; "Plutonium at 150 years," Livermore, CA: Lawrence Livermore National Laboratory, no date, available at https://www.llnl.gov/article/38696/plutonium-150-years.

Chinese secrecy, there has been large scale Chinese construction of underground facilities. The 2023 DoD China report stated that, "The PRC has thousands of UGFs [Underground Facilities] and constructs more each year."[114] Imagery obviously provides much less information on the role of UGFs.

[114] *Military and Security Developments Involving the People's Republic of China 2023*, op. cit., p. 88.

Fissile Material Availability

Absent the development of pure fusion weapons, the availability of fissile material limits the size of a nuclear stockpile. There are significant uncertainties concerning China's fissile material holdings from its military production reactors and there are a variety of nuclear weapon design approaches available. However, there appears to be nothing in open sources that would support the DoD report's low warhead numbers.

The DoD reports have assessed China as having high-yield thermonuclear and low-yield nuclear weapons. In addition, China puts great emphasis on conventional strikes.[115] This mandates missiles with high accuracy and throw-weight. For example, the dual-capable DF-26 IRBM has a reported throw-weight of 1,200-1,800 kg, which is more than the reported weight of the HEU burning Chic-4.[116] With modern nuclear weapons designs, high throw-weight warheads can be optimized for low fissile material use, particularly in low-yield weapons.

Stillman has said that China's warheads are not one point safe (i.e., "one point safe" means an accidental detonation will not produce a significant nuclear yield).[117] He indicated that this permits "excess amounts of fissile material…to ensure that they will work properly."[118] This also allows the use of more high explosive to achieve high compression, reducing the amount of fissile material required. Indeed, technically primitive North Korea

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[115] Ibid., pp. VI, 38, 47, 68-69.

[116] Missile Defense Project, "DF-26," *Missile Threat*, Center for Strategic and International Studies, last modified April 23, 2024, available at https://missilethreat.csis.org/missile/dong-feng-26-df-26/.

[117] Dan Stillman, "Inside China's Nuclear Weapons Program," Boston: Massachusetts Institute of Technology, October 10, 2001, available at https://web.mit.edu/SSP/seminars/wed_archives01fall/stillman.htm.

[118] Ibid.

reportedly claimed that its first nuclear test (based on the Chic-4 design) used only two kg of plutonium.[119]

In 2021 (before DoD estimates dramatically increased), Dr. John A. Swegle and Dr. Christopher Yeaw, both noted experts on nuclear weapons, estimated that China had enough plutonium for 1,300 nuclear weapons, assuming four kilograms in each primary.[120] Even using the low estimate of China's plutonium inventory, this still results in 860 plutonium-based nuclear weapons.[121]

In 2019, noted nuclear weapons expert James R. Howe estimated that China had enough fissile material for 3,878 nuclear warheads.[122] He calculated that China could produce 12,931 kg of HEU per year and, when its new reprocessing plants come online, China could add 3,000 plutonium-based nuclear weapons.[123] His "very conservative" estimate was that China would have 1,643-2,022 nuclear warheads by 2025, and 3,390-3,740 warheads by 2035, with maximum yields between 20 and 200 kilotons.[124]

In 2021, Henry Sokolski, former Deputy for Nonproliferation Policy in the Office of the Secretary of Defense, estimated that China could produce 1,270 warheads by 2030 and further noted that, "If Beijing instead chooses to develop single-stage nuclear weapons using

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[119] "N. Korea says used 2 kg of plutonium in 2006 nuke test: source," *Kyodo News Agency*, June 28, 2008, available at https://freerepublic.com/focus/f-news/2038037/posts.

[120] Dr. John Swegle and Dr. Christopher Yeaw, "CHINA'S HISTORICAL PLUTONIUM PRODUCTION" (Omaha: National Strategic Research Institute at the University of Nebraska, March 24, 2021), p. 16, available at https://nsri.nebraska.edu/-/media/projects/nsri/docs/academic-publications/2021/march/china-historical-plutonium-production.pdf.

[121] Ibid.

[122] James Howe, "Chinese Strategic Nuclear Force Posture: Current and 2035 Forecast," *YouTube*, 2019, available at https://www.youtube.com/watch?v=TH1xLRezJzA.

[123] Ibid.

[124] Loc. cit.

boosting, highly enriched uranium (HEU) or composite plutonium-HEU warhead designs, it could easily exceed this number by a factor of two or more."[125]

In 2012, Russian Colonel General (Ret.) Viktor Yesin wrote that China could have 1,800 nuclear weapons based on China's estimated production of "up to 40 tons of weapons-grade uranium" and "about 10 tons of weapons-grade plutonium" manufactured as of 2011.[126] He is one of a number of noted Russian experts who believe that China has a much larger nuclear force than is reported in the West. For example, in 2012, noted Russian expert Major General (Ret.) Vladimir Dvorkin stated that China had about 1,600 nuclear weapons.[127]

The low estimates of Chinese fissile material do not assume that China would use plutonium from civilian nuclear power reactors for nuclear weapons.[128] Indeed, in 2017, China stopped reporting its "…separated plutonium inventory to the International Atomic Energy Agency."[129]

There is persuasive evidence to support the assessments of Swegle, Yeaw, Howe and Sokolski. According to the Union of Concerned Scientists, a "sophisticated implosion weapon" requires two-to-four kg of plutonium.[130] Even the primitive World War II Fat Man bomb, designed with slide rules and electronic adding machines, used only 6.2 kg of

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[125] Sokolski, "Introduction: China's Civil Nuclear Sector: Plowshares to Swords," op. cit., p. 3.

[126] Yesin, "On China's Nuclear Potential without Underestimates or Exaggeration," op. cit., p. 2.

[127] "China may have 1,600-1,800 nuclear munitions – experts," *Interfax*, September 28, 2012. (Translated by World News Connection.)

[128] Sokolski, "China's Civil Nuclear Sector: Plowshares to Swords?," op. cit.

[129] Kristensen, Korda, Johns, Knight, "Chinese nuclear weapons, 2024," op. cit., p. 53.

[130] "Sophisticated implosion weapon" (Washington, D.C.: Union of Concerned Scientists, 2004), available at https://www.ucsusa.org/sites/default/files/2019-09/nuclear_terrorism-fissile_materials.pdf.

plutonium.[131] Declassified documents indicate that the amount of fissile material in U.S. weapons was substantially reduced by the early 1950s.[132] A document in the Oppenheimer papers in the Library of Congress indicates the United States was developing composite pits (plutonium and HEU) which reduced the plutonium requirement in the same time frame.[133] After the first full yield test of Britain's first nuclear weapon, the Blue Danube, it was repeatedly tested with reduced amounts of fissile material to increase the number of Britain's bombs.[134]

The first Russian nuclear bomb (Joe-1/RDS-1), a copy of Fat Man, introduced an improved pit design. Declassified Soviet documents indicate that Joe-1 had a hollow pit and another stated that a 1953 Soviet nuclear test achieved a five-to-nine kiloton yield from two kg of plutonium.[135] Hawkins revealed that Russia likely gave China the design of its 38-kiloton Joe-2.[136] Hawkins also said Joe-2 was a tritium-boosted nuclear bomb (using fusion neutrons to increase yield and efficiency), which China tested without

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[131] "Harold Agnew with the Plutonium Core," *Atomic Archive.com*, no date, available at https://www.atomicarchive.com/media/photographs/tinian/alvarez-core.html.

[132] Chuck Hansen, *U.S. Nuclear Weapons: The Secret History* (Arlington, TX: Aerofax, 1988), pp. 32–33.

[133] "Section I, Weapons," Oppenheimer Papers, Library of Congress, Washington, D.C.

[134] "'Hurricane', 'Totum,' and 'Buffalo': Testing Blue Danube," *Airplane*, December 2023, p. 33.

[135] Pavel Podvig, "Details of the RDS-1 device," *Russian Forces.org*, May 1, 2013, available at https://russianforces.org/blog/2013/05/detailed_description_of_the_rd.shtml; Pavel Podvig, "Interesting document about Soviet nuclear tests in 1953," *Russian Forces.org*, October 1, 2012, available at https://russianforces.org/blog/2012/10/interesting_document_on_soviet.shtml.

[136] Houston Hawkins, "History of the Russian Nuclear Weapon Program," LA-UR-13-28910 (Livermore, CA: Lawrence Livermore National Laboratory, November 19, 2013), p. 34, available at https://nuke.fas.org/guide/russia/lanl-history.pdf.

boosting at 20 kilotons yield in its first test.[137] China reportedly developed a boosted version of this device, the 596L.[138] Thus, Russia provided the basic design approach that would evolve into the modern primary.

China's nuclear arsenal likely includes weapons based upon HEU. China told Stillman:

> …that China's first seven nuclear weapon tests all used highly enriched uranium (93.5% U-235) [HEU] as primaries because the Soviets had pulled their support for China's plutonium production reactor. China's third test was China's first use of thermonuclear material. By the sixth test, China had developed a thermonuclear weapon with a yield of 3.3 megatons.[139]

Plutonium is used in most modern high performance nuclear weapons because it has a lower critical mass and, hence, allows smaller and lighter weapons. However, HEU is fine for high throw-weight non-strategic missile warheads, single warhead strategic missiles, bombs, and low-yield nuclear weapons. Indeed, there is an advantage in using HEU in low-yield tactical nuclear weapons because it produces somewhat less dangerous fallout.

China is increasing its fissile material and tritium stockpile. According to the 2024 FAS China nuclear report, "In 2023, China…reportedly began operating two large new centrifuge enrichment plants [for HEU production], and also took a significant step forward with its domestic plutonium production capabilities."[140] It also says China is

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[137] Ibid.

[138] Hui Zhang, "The short march to China's hydrogen bomb," *Bulletin of the Atomic Scientists*, April 11, 2024, available at https://thebulletin.org/2024/04/the-short-march-to-chinas-hydrogen-bomb/.

[139] Stillman, "Inside China's Nuclear Weapons Program," op. cit.

[140] Kristensen, Korda, Johns, Knight, "Chinese nuclear weapons, 2024," op. cit., p. 52.

building two new plutonium extraction plants.[141] The DoD's 2023 China report indicates that China is increasing its capability to produce tritium and that its two new fast breeder reactors are "each capable of producing enough plutonium for dozens of nuclear warheads annually."[142] Thus, the DoD's projection through 2030 seems entirely based upon the two reactors. However, these reactors are each reported to produce plutonium for 50 bombs a year.[143]

The DoD's warhead numbers appear to ignore important Chinese nuclear options discussed by Sokolski. In 2020, Sokolski pointed out that China could covertly construct plutonium processing and uranium enrichment facilities and that it could have thousands of nuclear weapons by 2030, dwarfing the then-existing intelligence estimates of 300-600 weapons.[144] These options appear consistent with some of the higher reported numbers for China's strategic and non-strategic nuclear arsenal. Thus, there is the possibility of a considerable undercounting of Chinese warheads.

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[141] Ibid.

[142] Loc. cit.; and, *Military and Security Developments Involving the People's Republic of China 2023*, op. cit., pp. 109-110.

[143] Prachi Patel, "China's New Breeder Reactors May Produce More Than Just Watts," *IEEE Spectrum*, December 28, 2022, available at https://spectrum.ieee.org/china-breeder-reactor.

[144] "Henry Sokolski, 20th Nuclear Triad Symposium," Cyber Innovation Center, December 11, 2020, available at https://www.youtube.com/watch?v=1p19jE1vb7M&list=PLb29CJUVYXmUEPC3n0dg7LmaUKlM0DwxI&index=2.

Chinese Nuclear Delivery Vehicle Modernization and Warhead Numbers

Recent press reports maintain that the new silo-based Chinese ICBMs are fueled with water due to Chinese corruption, and, thus, are of no concern.[145] Chinese corruption is real, but this is *technically impossible*. Except for 20 old silos armed with liquid fueled DF-5s, all Chinese ICBMs are solid fueled with no fuel tanks that can be filled with water.

China has created a nuclear Triad and is expanding it. Unfortunately, the DoD's China reports do not provide a timely description of China's long-term nuclear modernization plan. They mostly reference weapons that were previously discussed in open sources.

The 2023 DoD report states that "…sources indicate a 'long-range' DF-27 ballistic missile is in development. Official PRC military writings indicate this range class spans 5,000-8,000 km, which means the DF-27 could be a new IRBM or ICBM."[146] The *South China Morning Post* says it can attack all major U.S. Pacific bases and *has been operational for four years*.[147] If correct, this is another instance of the DoD report being years behind press reporting. Indeed, the 2024 FAS China nuclear report states "…a US intelligence assessment of February 2023 notes that 'land attack and antiship variants [of the DF-27] likely were

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[145] Heather Williams, "China's Waterlogged Missiles Don't Matter," Center for Strategic and International Studies, January 25, 2024, available at https://www.csis.org/analysis/chinas-waterlogged-missiles-dont-matter.

[146] *Military and Security Developments Involving the People's Republic of China 2023*, op. cit., p. 67.

[147] Minnie Chan, "China's advanced DF-27 hypersonic missile which can strike parts of US has been in service for several years, source says," *South China Morning Post*, May 20, 2023, available at https://www.scmp.com/news/china/military/article/3221198/chinas-advanced-df-27-hypersonic-missile-which-can-strike-parts-us-has-been-service-several-years.

fielded in limited numbers in 2022….'"[148] It also noted a Chinese exercise that may have featured the DF-27.[149]

If the DF-27 has a range of 8,000 km, it is probably a follow-on to the DF-31, which was apparently designed against Russia but could reach targets in Hawaii and Alaska. Reportedly, the DF-27 is the first dual-capable ICBM and also carries a hypersonic vehicle with an anti-carrier role.[150] Although these characteristics are significant, it apparently is not a major driver of Chinese nuclear weapons numbers.

There is a reported new Chinese ICBM program not mentioned in the DoD and FAS China reports (although there is a reference to a new ICBM in General Cotton's 2024 Congressional testimony) with a potential to expand the Chinese strategic nuclear force well beyond the DoD's projected warhead numbers.[151] Fisher says Chinese sources indicate the development of a new mobile ICBM, "[s]ometimes called the DF-45 or DF-51, [and] it is clearly intended to outperform the DF-41."[152] Bill Gertz reported, "The DF-45 would have a takeoff weight of 112 tons and a payload weighing 3.6 tons and be armed with seven 650-kiloton warheads. The new missile's estimated range would be 7,456 to 9,320 miles."[153] Presumably, it can carry the other DF-41 warhead packages indicated in the PLARF briefing slide. One Western press report credits the DF-51 with 14

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[148] Kristensen, Korda, Johns, Knight, "Chinese nuclear weapons, 2024," op. cit., p. 64.

[149] Ibid.

[150] Missile Defense Advocacy Alliance, "DF-27," *Missile Defense Advocacy Alliance*, April 2023, available at https://missiledefenseadvocacy.org/missile-threat-and-proliferation/todays-missile-threat/china/df-27/; George Allison, "America has the medicine for the DF-27 'aircraft carrier killer' hypersonic missile," *Telegraph.com*, March 4, 2024, available at https://www.telegraph.co.uk/news/2024/03/04/usa-hypersonic-missile-defence-htbss-satellites-aegis-gpi/.

[151] Gertz, "China building new generation of mobile ICBMs," op. cit.

[152] Ibid.

[153] Loc. cit.

warheads.[154] In traditional arms control terminology, this is a "heavy" ICBM. It is unclear whether the DF-45/DF-51 is one or two systems.

China's mobile MIRVed ICBMs create the possibility that China has a much larger force than the DoD knows about or is revealing publicly. The Defense Department provides no numbers for the MIRVed DF-41. The 2024 FAS China report says there are 28 deployed missiles, which seems low, since the report admits that China paraded 18 launchers in 2019.[155] In addition to the road mobile DF-41, Fisher projects up to 100 rail-mobile DF-41s by about 2030.[156] China's 5,000-km of missile tunnels, the so-called Underground Great Wall, can hide thousands of mobile ICBMs.[157]

the pattern of Chinese modernization suggests a successor to the JL-3 SLBM—either an improved version or a JL-4 SLBM for the new 096 missile submarine. The DoD report mentions two 096 submarines, but Fisher predicts they may build six with 14 missiles each.[158]

China also has a large and growing bomber force. Fisher credits Beijing with 150 H-6 bombers in 2023, growing to 250 bombers in 2035, including the H-20 stealth bomber.[159] There is no real dispute about the number of current Chinese bombers or their ALCM capability (Fisher says 950

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[154] "Why has the Dongfeng-51, which has a range of 15,000 kilometers and carries 14 warheads, become a nightmare for the West? Can't intercept at all?," *INF News*, June 2, 2024, available at https://inf.news/en/military/42b0da027e7d87d73d57140c8d6de592.html.

[155] Kristensen, Korda, Johns, Knight, "Chinese nuclear weapons, 2024," op. cit., pp. 50, 64.

[156] "23rd Nuclear Triad Symposium," *YouTube*, July 22, 2022, available at https://www.youtube.com/watch?v=3-77jWb8mH8.

[157] Dr. Phillip Karber, "Strategic Implications of China's Underground Great Wall" (Washington, D.C.: Georgetown University Asian Arms Control Project, September 11, 2011), available at https://nuke.fas.org/guide/china/Karber_UndergroundFacilities-Full_2011_reduced.pdf.

[158] "23rd Nuclear Triad Symposium," op. cit.

[159] Ibid.

in 2023, growing to 1,700 in 2035),[160] but the DoD's low overall warhead numbers must assume that China has only a handful of air-launched nuclear weapons and no nuclear cruise missiles (despite the fact that in 2021 then Vice Chairman of the Joint Chiefs of Staff General John Hyten said they were rapidly building them).[161] This is explicit in the 2024 FAS report, which indicates China has only 20 nuclear bombs and air-launched nuclear ballistic missiles.[162] In July 2024, China released a photograph of the H-6K carrying four (possibly nuclear capable) ballistic missiles.[163] Thus, the potential for warhead undercounting is very high.

China's non-strategic nuclear systems will be improved through modernization, but its arsenal is already so large that the key issues are the types that are dual capable and what percentage are nuclear. Again, the potential for undercounting is quite high.

China has a nuclear force sufficient to carry thousands of warheads. The following chart from the October 2023 DoD China military report provides estimates of the number of Chinese land-based nuclear missile launchers

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[160] Loc. cit.

[161] John A. Tirpak, "New Threats Demand Nuclear Modernization," *Air and Space Forces.com*, March 2, 2021, available at https://www.airandspaceforces.com/new-threats-demand-nuclear-modernization/.

[162] Kristensen, Korda, Johns, Knight, "Chinese nuclear weapons, 2024," op. cit., pp. 50, 67. At one point. it says up to 20 nuclear bombs.

[163] "China's H-6K Bomber Displays High Ballistic Missile-Carrying Capacity," *Sputnik News*, June 3, 2024, available at https://sputnikglobe.com/20240702/chinas-h-6k-bomber-displays-high-ballistic-missile-carrying-capacity-1119218676.html; Thomas Newdick, "China's H-6K Bomber Seen Firing Air-Launched Ballistic Missile For First Time," *The War Zone*, May 1, 2024, available at https://www.twz.com/air/chinas-h-6k-bomber-seen-firing-air-launched-ballistic-missile-for-first-time.

and missiles.[164] Military journalist Bill Gertz writes that most of these missiles are dual capable.[165]

CHINA'S ROCKET FORCE			
System	Launchers	Missiles	Estimated Range
ICBM	500	350	>5,500 km
IRBM	250	500	3,000-5,500 km
MRBM	300	1,000	1,000-3,000 km
SRBM	200	1,000	300-1,000 km
GLCM	150	300	>1,500 km

The chart indicates that through the level of IRBMs, China has two-five reload missiles per launcher. Yet, it assesses 150 empty ICBM launchers and apparently no reload missiles for mobile ICBMs. This creates the possibility of considerable undercounting in DoD's estimate of 500+ warheads in May 2023.

Many of the differences among the alternative estimates of the growth of China's nuclear warheads are based upon different assessments of the number of warheads on Chinese MIRVed ICBMs and SLBMs. These are illustrated in the following chart:

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[164] *Military and Security Developments Involving the People's Republic of China 2023*, op. cit., p. 67.

[165] Bill Gertz, "U.S. keeps artificial intelligence away from nuclear control; China, Russia uncertain," *The Washington Times*, August 13, 2024, available at https://www.washingtontimes.com/news/2024/aug/13/us-will-not-let-automated-ai-system-decide-on-nucl/.

MAXIMUM WARHEAD LOAD FOR CHINA'S MULTIPLE WARHEAD (MIRVed) MISSILES

Type Estimates	DoD	FAS	Alternative Estimates	Sources for Alternative
DF-5	5	5	6	Fisher
DF-41	3	3	10	General Hyten, Admiral Richard, Liberation Army Rocket Force
DF-45/DF-51	n/a[a]	n/a[a]	7-14	Gertz, Fisher, other press reports
DF-31A	1[b]	1	3?[c]	General Cotton[d]
JL-2A	1[b]	1	3	People's Liberation Army Rocket Force, Asia press reports
JL-3	1[b]	"multiple warheads"[e]	3-10	Fisher, Defense Intelligence Agency says "multiple warheads"

a Does not mention the DF-45/DF-51. May be one type of missile or two.
b Does not list it as a MIRVed missile.
c No nation has built a MIRVed missile that carries less than three warheads because of the weight of the MIRV bus.
d General Cotton indicated it was MIRVed but gave no warhead number.
e While the FAS attributes "multiple warheads" to the JL-3, it counts it as one in its warhead chart.

Regarding the actual expected growth in China's nuclear warheads through 2035, the following chart compares the DoD and FAS estimates of Chinese nuclear weapons numbers from 2023 through 2035 with the alternative credible estimates.

ESTIMATES OF CHINESE NUCLEAR WEAPONS NUMBERS

Year	DoD	FAS	Alternative Estimates
2023	500+[a]	500[c]	1,570-2,206 – Fisher (2023)[b] 976 – Yeaw (2024)
2030	1,000+[a]	n/a[d]	1,000-1,500 – Creeden (2023)
2035	~1,500	n/a[d]	6,108 – 6,734 – Fisher (2023)[a] 3,390 – 3,740 – Howe (2019) 3,584 – Yeaw (2024)[e]

a "Total Operational."
b Strategic only. The numbers are calculated using open source numbers from both Chinese and Western sources concerning the MIRV potential of Chinese ICBMs, SLBMs and the nuclear ALCM delivery potential of Chinese bombers.
c Of the 500, the FAS says 440 are "operational."
d The 2024 FAS report discusses the DoD numbers but does not explicitly support or deny them.
e Estimates are for 2034. See, Dr. Christopher Yeaw, "Geopolitical Nuclear Force Context with a Focus on China," *Triad Symposium*, Louisiana State University Shreveport, June 20, 2024.

Conclusion

The two most frequently cited estimates of Chinese nuclear warheads—the DoD China and the FAS China nuclear reports—appear to significantly underestimate the Chinese nuclear threat. The 2023 DoD report's low estimate of 500+ Chinese warheads is *mathematically impossible* even with unrealistic assumptions. The DoD's projections for 2030 (1,000+) and 2035 (1,500) are apparently what Captain Fanell calls "threat deflation."[166] In 2020, when the Defense Department said China's total nuclear force was in the "low 200s" and on track only to double, then STRATCOM Commander Admiral Charles Richard stated that "…China is on a trajectory to be a strategic peer to us by the end of the decade."[167]

In congressional testimony in September 2022, Madelyn Creedon, a senior official in the Obama Administration, and subsequently Chairman of the Congressional Strategic Posture Commission, stated that, "Although estimates vary, China is projected to have between 1,000 and 1,500 nuclear weapons by 2030."[168]

DoD's handling of the MIRVed JL-3 SLBM deployment is classic "threat deflation." Prior to November 2022, the Pentagon's reports gave no indication that China's type 094/JIN-class submarines carried JL-3s.[169] Yet, in August

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[166] "Congressional Testimony of James E. Fanell, CAPT USN (Retired)," op. cit., p. 3.

[167] "Interview with Mitchell Institute for Aerospace Studies Web Series," Mitchell Institute, July 2020, available at https://www.stratcom.mil/Media/Speeches/Article/2300365/interview-with-mitchell-institute-for-aerospace-studies-web-series/.

[168] "Madelyn Creedon Testimony before the Senate Committee on Armed Services US Nuclear Strategy and Policy," September 20, 2022, available at https://www.armed-services.senate.gov/imo/media/doc/Creedon%20Opening%20Statement%20SASC%20Hearing%209-20-222.pdf.

[169] "Military and Security Developments Involving the People's Republic of China 2022," op. cit., p. 4.

2021, Admiral Richard said that there were "…six second-generation JIN-class ballistic missile submarines with JL-3 SLBMs…."[170]

The best analyses of current Chinese nuclear weapons capabilities and/or future potential are those by Dr. John A. Swegle, Dr. Christopher Yeaw, Henry Sokolski, Richard Fisher and James R. Howe. Together they provide the most detailed credible information on China's existing and future capabilities.

- Russian estimates of Chinese nuclear weapons numbers may be high, but they should not be dismissed out of hand. Russia may have better insight into Chinese nuclear programs.
- Fisher has an incredible ability to find Chinese sources on its nuclear programs and presents useful calculations on possible Chinese nuclear forces in 2035. It appears his emphasis on the role of Chinese deception in influencing Western estimates of China's nuclear weapons numbers is well founded.[171]
- Howe has done the best analysis of what types of nuclear weapons the Chinese could have consistent with even the lower estimates of Chinese fissile material availability.
- Sokolski's analysis of Chinese use of civil reactor plutonium in weapons and on China's ability to construct covert facilities that could greatly increase their holdings of fissile material is a vital study.

In 2012, Dr. Phillip Karber and his graduate students produced an insightful analysis of China's Underground Great Wall potential for hiding Chinese missiles (possibly

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[170] Admiral Charles Richard, Speech at "2021 Space and Missile Defense Symposium," August 23, 2021, available at https://www.stratcom.mil/Media/Speeches/Article/2742875/2021-space-and-missile-defense-symposium/.

[171] "23rd Nuclear Triad Symposium," op. cit.

3,000 nuclear warheads). [172] The DoD reports barely mentioned Chinese underground facilities until 2023.

The numbers presented in the DoD and FAS reports appear to undercount the Chinese nuclear arsenal because there seems to be an analytical disconnect between the rapid visible growth in Chinese delivery systems and the slower assessed growth in deployed nuclear warheads. The DoD assessed only 500+ Chinese nuclear warheads in May 2023 despite crediting China with 350 ICBMs, two types of multiple warhead ICBMs and 72 deployed SLBMs, which alone add up to 422 warheads without even assuming a single MIRVed missile. This leaves only about 100 assessed warheads to cover China's MIRVed ICBMs, MIRVed SLBMs, non-strategic nuclear warheads (medium- and intermediate-range ballistic missiles), and air-delivered nuclear weapons. Any one of these categories could push China's number above 500+ and in combination the total should be substantially higher. Questionable assumptions in both the DoD and FAS reports include: 1) a large number of China's ICBM silos are complete but empty; 2) less capable DF-31 ICBMs are probably being deployed in the new silos; 3) China's numerous H-6K bombers are not nuclear-capable; 4) China lacks nuclear-capable short-range ballistic missiles; and 5) China has no nuclear-capable cruise missiles. These assumptions contradict many open sources including statements by senior U.S. generals and admirals and, in some cases, previous DoD China reports.

The Department of Defense places emphasis on the need for Chinese nuclear transparency. Yet, the lack of Chinese transparency is hardly the only issue. Hitler was transparent about his intentions. However, even in the rare instances where China was transparent, Washington's

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[172] Amy Zegard, "Meet the Nuclear Sleuths Shaking Up U.S. Spycraft," *Politico*, January 19, 2022, available at https://www.politico.com/news/magazine/2022/01/19/nuclear-sleuths-shaking-up-us-spycraft-527319.

"threat deflation" community downplayed or ignored it. When China's *Global Times* took issue with the Pentagon's 2020 "low-200s" nuclear warhead estimate,[173] this was essentially ignored by Washington. Yet, this is still apparently the baseline from which estimated Chinese warhead increases are calculated. Indeed, in 2011, when the DoD estimated a few hundred Chinese nuclear weapons, it assessed the Chinese missile force as only a small fraction of its current estimate.[174] In 2017, when the PLARF made an unprecedented disclosure about its MIRV capability, this revelation was also discounted or ignored in Washington.

Basing projections of Chinese nuclear weapons numbers on the assumption that China is building launchers faster than it is building missiles, and building missiles much faster than warheads, creates the potential for massive undercounting. There is nothing in open sources that supports the low DoD and FAS numbers. Due to its nuclear testing and nuclear espionage, China should be capable of fielding advanced nuclear weapons deployable in substantially larger numbers than estimated by the Pentagon or the FAS. With civil reactor plutonium, China should have enough fissile material to deploy thousands of nuclear warheads by 2035, if not before.

The apparent effort to downplay the size and capabilities of the Chinese nuclear arsenal is extremely troubling and has significant implications for U.S. deterrence strategy. Minimizing the reality of this threat is both shortsighted and dangerous. In light of growing concerns over China's aggressive posture, it is high time for a realistic assessment.

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[173] Xijin, "Pentagon report aims to suppress China's nuclear deterrence," op. cit.

[174] Mark B. Schneider, "The Chinese Nuclear Threat," *RealClearDefense*, October 24, 2020, available at https://www.realcleardefense.com/articles/2020/10/24/the_chinese_nuclear_threat_581838.html.

About the Author

Dr. Mark B. Schneider is a Senior Analyst with the National Institute for Public Policy. He joined National Institute in September 2004 and specializes in missile defense policy, nuclear weapons, deterrence, strategic forces, and arms control issues.

Before his retirement from the Department of Defense, Dr. Schneider served in senior positions in the Office of Secretary of Defense for Policy including, Principal Director for Forces Policy, Principal Director for Strategic Defense, Space and Verification Policy, Director for Strategic Arms Control Policy and Representative of the Secretary of Defense to the Nuclear Arms Control Implementation Commissions. He also served as a member of the State Department Policy Planning Staff, the Professional Staff of the Senate Select Committee on Intelligence, the Department of Energy, the Energy Research and Development Administration and the Atomic Energy Commission. Prior to his government career, Dr. Schneider served as a policy analyst with the Stanford Research Institute and taught at the University of Southern California.

Dr. Schneider served as a member of the DoD Compliance Review Group. He chaired several working groups of the START and INF Treaty Implementation Commissions (JCIC and SVC) in Geneva, negotiating many implementation agreements with the successor states of the former Soviet Union. He most recently served as Acting Chairman of the U.S.-Russia Working Group on Missile Defense.

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Dr. Schneider earned his Ph.D. in history at the University of Southern California and Juris Doctorate from George Washington University. He was admitted to the Bar of Washington DC in 1977 and Maryland in 1978. He is the author of many books and articles on arms control, nuclear deterrence, strategic forces and intelligence issues.

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