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China's Nuclear Arsenal: Status and Evolution

GREGORY KULACKI

China's Nuclear Arsenal

U.S. governmental and non-governmental assessments[1] indicate China currently possesses a small nuclear arsenal, with an estimated 155 nuclear warheads ready to be deployed on six different types of land-based missiles. Approximately 50 of those missiles can reach the continental United States.

We discuss below what is known about China's current nuclear arsenal, the policies governing its use, and the changes China is making to its nuclear arsenal. Many U.S. commentators have characterized these changes as a "nuclear modernization" program and some U.S. analysts have asserted this portends a Chinese "sprint to parity" with the United States and Russia as the two nuclear superpowers reduce the size of their respective arsenals. This characterization misrepresents the nature and vastly overstates the magnitude of the impending changes to China's nuclear forces.

Chinese Nuclear Forces in 2010

Warheads: Estimates of the current number of Chinese nuclear warheads vary, but China is believed to have manufactured a total of between 200 and 300 warheads, roughly 50 of which have been used for nuclear tests. Currently, approximately 155 of those are believed to be prepared for deployment.

China's stocks of military plutonium limit how much it could expand its arsenal without restarting plutonium production. Estimates of the size of China's existing plutonium stocks[2] are uncertain, but imply that the number of new warheads China could produce from existing stocks ranges from very few to possibly several hundred.

China has halted production of military plutonium but has not declared an official moratorium. Its dedicated military plutonium production facilities have been decommissioned. However, China recently began operating a pilot plant for reprocessing spent fuel from its commercial reactors and is discussing plans for a larger commercial reprocessing facility. These facilities extract plutonium that is created in the reactor from the spent fuel. China also operates an experimental fast breeder reactor, which is optimized to produce plutonium that would be used as fuel, and is considering purchasing two additional fast breeder reactors from Russia. If necessary, China could divert plutonium extracted from these experimental and commercial facilities for military use.

Satellite observations of the production facilities suggest they are not producing plutonium but they are well maintained. China officially supports negotiation of a Fissile Material Cut-off Treaty (FMCT) that would ban all future production for military use. This would cap China's capability to produce new warheads and place an upper bound on the size of its nuclear arsenal. Despite China's official support for the FMCT, long-standing Chinese concerns about U.S. missile defense systems are a source of uncertainty and hesitation, reducing Chinese support for advancing FMCT negotiations at the UN Conference on Disarmament.[3] China's leaders may be content to let efforts aimed at beginning negotiations stall as they consider whether China should maintain the option of future military plutonium production, which would allow it to increase its arsenal size in response to missile defense deployments.

> Claims about a Chinese "sprint to parity" misrepresent the nature and vastly overstate the magnitude of Chinese nuclear modernization.

China has conducted 45 nuclear tests.[4] This relatively small number of tests (the United States conducted 1,054 and the Soviet Union/Russia conducted 715) suggests there are a limited number of tested Chinese warhead designs certified for deployment. China accelerated the pace of its nuclear testing during the three years it took to negotiate the Comprehensive Test Ban Treaty (CTBT) in the mid-1990s in order to complete a series of tests on a smaller warhead design.[5] U.S. analyses of that final test series suggest this smaller warhead is still too large for China to

place multiple warheads on the long-range mobile missile designed deliver it, the DF-31.[6]

Following this test series, China signed the CTBT in 1996 and halted nuclear weapons testing, but has still not ratified the treaty. China is reported to be waiting until after the United States ratifies the treaty to see whether the U.S. Senate adds conditions as part of the ratification process.[7] Lack of testing restricts China's ability to develop and deploy new, smaller warhead designs.

Unlike other nuclear weapons states, China keeps all of its warheads in storage. China's nuclear warheads and nuclear-capable missiles are kept separate and the warheads are not mated to the missiles until they are prepared for launch.[8] Interestingly, for this reason under the counting rule for New START the number of Chinese weapons would be counted as zero.[9]

Table 1 China's Nuclear-Capable Missiles: 2010

Missile Type	Intermediate Range			Long Range		
Chinese Designation	DF-21	DF-3	DF-4	DF-31	DF-31A	DF-5
Range(km)/Payload(kg)	1,700/600	3,000/2,000	5,000/2,000	7,300/1,000	11,000/1,000	12,000/3,000
Fuel	Solid	Liquid	Liquid	Solid	Solid	Liquid
Basing Mode	Mobile	Mobile	Fixed	Mobile	Mobile	Fixed
Year first deployed	1993	1971	1975	2007	2007	1981
Number Deployed	50*	20	35	>15	>15	20

* China is estimated to have deployed approximately 130 of its nuclear-capable DF-21 missiles, but the remainder are armed with conventional warheads.

Delivery Vehicles: Estimates of the number, ranges, and payloads of Chinese nuclear-capable missiles vary. The estimates indicate China deploys approximately 150 land-based missiles that can carry nuclear payloads, fewer than 50 of which are long-range and can reach the United States. The nuclear-armed missiles China currently deploys are listed in Table 1.

China is not believed to currently place multiple warheads on its missiles. However, some sources say DF-4 and DF-5 missile tests have included testing of multiple re-entry vehicles.[10] These tests may allow China to replace the older, larger single warheads on these two liquid-fueled missiles with smaller warheads and penetration aids. Chinese reports indicate that these may be tests of dummy warheads and penetration aids designed to defeat missile defenses.[11]

China is experimenting with submarine-launched ballistic missiles but the one nominally operational nuclear-armed ballistic missile submarine it currently possesses does not patrol and Chinese experts describe it as a failure.[12] China built two new ballistic missile submarines and is rumored to be building more, but the nuclear-capable missile designed for deployment on those submarines failed initial flight tests.[13]

Tactical Nuclear Weapons: U.S. governmental and non-governmental reports indicate China possesses a stockpile of air-deliverable nuclear weapons but they have no "primary mission," according to U.S. assessments. Chinese cruise missiles can be armed with nuclear payloads but U.S. assessments state they are not. U.S. observations of China's military facilities, equipment, and training suggest China does not maintain a stockpile of tactical nuclear weapons.[14]

China's Nuclear Posture

The history of China's nuclear weapons program supports the idea that China's leadership operates under the assumption that nuclear weapons cannot be used successfully to fight and win an armed conflict. Chinese nuclear weapons experts believe the threshold for the use of nuclear weapons is extremely high.[15] Instead, the fundamental purpose of China's nuclear arsenal is to prevent or counter foreign military coercion. The goal of Chinese modernization efforts is to assure China's leaders that if attacked with nuclear weapons—or if their nuclear weapons are attacked with conventional weapons—a portion of China's nuclear arsenal could survive these attacks, giving China's leaders the option to retaliate with nuclear weapons. This credible ability to retaliate with nuclear weapons is what Chinese decision-makers believe is required to liberate them from the threat of foreign military coercion.

China declares it will never use nuclear weapons against a non-nuclear state, and never be the first to use nuclear weapons, under any circumstances. This implies that even if another nuclear weapon state were to attack China's nuclear arsenal with conventional weapons, China's leaders would still not respond with nuclear weapons.

Recently questions have been raised about China's commitment to this policy. China's Second Artillery, which is responsible for operating China's nuclear forces but does not have the authority to determine when or how they will be used, has developed educational materials for planning and training for the possible use of nuclear weapons. These materials indicate the Second Artillery imagines the possible coercive use of the threat to use nuclear weapons to prevent a foreign military from taking major conventional military actions against China, such as large-scale conventional bombings of Chinese urban population centers or the destruction of critical infrastructure such as the Three Gorges Dam.[16] A few Chinese military officers have made public statements to the same effect.[17]

The evolution of China's nuclear weapon systems has occurred more slowly and on a smaller scale than that of the United States and the Soviet

However, there is no indication that the political leaders who maintain control over the use of Chinese nuclear weapons share this view. And interviews in China indicate that China's leading nuclear weapons experts, including those responsible for the design and testing of China's nuclear warheads and re-entry vehicles, openly object to the Second Artillery's attempt to obfuscate China's No First Use policy.[18]

The small size and limited capabilities of China's nuclear arsenal make the threat of a first use of nuclear weapons against the United States or Russia highly unlikely and not at all credible, since it would invite massive nuclear retaliation as well as international condemnation. None of the improvements to China's arsenal that are currently underway would present Chinese decision-makers with a more credible ability to threaten the first use of nuclear weapons against the United States or Russia. Therefore, it is reasonable to assume that the improvements being made to the Chinese nuclear arsenal are limited to maintaining a credible threat to retaliate.

Chinese nuclear experts believe the risk that a nuclear-armed adversary would threaten to use nuclear weapons in an attempt to coerce China in some way is greatly reduced if this adversary doubts its ability to launch a strike that could eliminate China's ability to retaliate. China therefore values secrecy over transparency, since China believes transparency undermines its confidence in the survivability of its nuclear arsenal. Moreover, this confidence waxes and wanes in response to perceived trends in technological development. Technological improvements by a potential adversary that may increase its willingness to risk an attack against China with nuclear weapons, or an attack against China's nuclear weapons with conventional weapons, decreases Chinese confidence in its ability to retaliate. This precipitates requests by China's leadership to adjust or improve its arsenal.

Because of this sensitivity to technological change, China's defense scientists and engineers play a decisive role in determining China's nuclear posture. The open source literature published by this technically oriented community over the past several decades suggests it sees improvements in space and missile defense technology as the most significant and likely challenges to the credibility of China's ability to retaliate with nuclear weapons. For example, China is concerned that improvements in satellite reconnaissance may reveal the location of Chinese weapons and command and control facilities, and may increase the ability of adversaries to track and target mobile weapons. Or that missile defenses may increase the willingness of foreign adversaries to threaten a strike against China's nuclear arsenal, thus exposing Chinese leaders to the "nuclear blackmail" their arsenal is designed to prevent.

The Evolution of China's Nuclear Forces

Since China first deployed nuclear weapons, it has had a "modernization" program to develop capabilities pioneered decades earlier by the Soviet Union and the United States, such as solid-fueled road-mobile missiles, and submarine-launched missiles. A comparative look at China's arsenal relative to the arsenals of its principal rivals reveals that the evolution of China's nuclear weapon systems has occurred more slowly and on a smaller scale than that of the United States and the Soviet Union/Russia.

China's modernization efforts are focused on developing solid-fueled missiles that can be deployed on mobile platforms, to reduce the likelihood its missiles could be destroyed in a first strike, compared to its original liquid-fueled missiles at fixed launch sites. In the past few years it has started to deploy mobile, solid-fueled long-range missiles, the DF-31 and the DF-31A, to complement and

possibly replace the liquid-fueled missiles it designed in the 1970s. But the pace of the development of these missiles has been slow—it started in the 1980s and has been underway for nearly 30 years. As noted above, the DF-31 and the DF-31A cannot carry more than one of China's smallest warhead. Fewer than 30 of these missiles have been deployed.

China produces nuclear-capable missiles in small batches and introduces small modifications to improve the performance of existing designs. Reports on China's recent missile tests indicate China still continues to produce, test, and improve both the DF-4 and the DF-5 missiles.[19]

China is also deploying a 1,700-km range nuclear missile, the DF-21, which is mobile and uses solid fuel. As with China's other missiles, the nuclear-capable DF-21 has been produced in small batches and progressively modified to accommodate different conventional military objectives, such as to launch the anti-satellite interceptor China tested in 2007 and the anti-ship ballistic missile that is reportedly under development.

The fundamental purpose of China's nuclear arsenal is to assure potential nuclear adversaries that China can retaliate in response to an attack.

As mentioned earlier, Chinese efforts to develop a submarine-launched nuclear missile, despite decades of effort, have yet to produce a deployable capability. This may be in part because it is not a high priority. Based on the history of Soviet submarines, if these first-generation submarines are eventually deployed they are expected to be noisy enough to be easily detectable at sea, which would restrict them to patrolling in shallow areas around the Chinese coast inside its territorial waters and beyond interference from U.S. forces.

Moreover, should China eventually begin to deploy submarine-launched missiles, deployment would require placing both the warheads and missiles on the submarine, giving the commander greater responsibility and independence under conditions in which continuous secure and reliable communications with the political leadership are more difficult to maintain than with China's land-based missiles. This would be a major change, and could be seen as weakening the Chinese leadership's tight control over its nuclear arsenal; this could lead to high-level resistance to this basing mode.

Most of China's missile buildup over the past few years has been focused on short-range missiles (300 to 600 km range) that carry conventional warheads, not nuclear. These missiles are too short range to reach the main islands and population centers of Japan. Some of the newer missiles are estimated to have a range of 850 km, which could reach South Korea and U.S. military bases in Okinawa.

Because of the lack of nuclear testing, China is not modernizing or improving the design or nuclear components of its warheads. If China needs to manufacture warheads for the new nuclear-capable missiles it is deploying, these warheads would be manufactured according to existing, tested warhead designs certified for deployment before it stopped testing in 1996. As noted above, the size of China's existing stocks of military plutonium will place a limit on how many additional warheads it could build without producing more plutonium.

Conclusion

The small size and slow pace of development of China's nuclear forces are consistent with China's view of the military utility of nuclear weapons. That view is that the fundamental purpose of China's nuclear arsenal is to assure potential nuclear adversaries that China can retaliate in response to an attack. China's nuclear strategy therefore focuses on how to preserve a credible ability to retaliate, not on detail requirements for how much damage that retaliation should cause to specific targets.

China's view is that preserving this credibility rests on its ability to deliver warheads that are certain to detonate on targets in the countries that might contemplate the use of nuclear weapons against China, and does not depend in detail on the damage done by these retaliatory strikes. China's nuclear weapons experts have a very high degree of confidence that their nuclear warheads will detonate as tested. They have far less confidence in the survivability of China's delivery vehicles and its command and control facilities. This concern appears to be driving current improvements in China's arsenal, which are focused on its delivery systems.

In order to be confident those warheads can reach their targets, China's leaders need to be confident defenses cannot intercept the much smaller number of warheads that could be launched in retaliation after a first strike. Therefore, in addition to improving the survivability of its missiles, China has put a great deal of effort into the development and testing of penetration aids. The development of these aids may be responsible for the

increase in Chinese missile testing observed by U.S. satellites during the past decade.

China's defense science community is responding to the strategic challenges of improved space technologies by increasing the number of missiles and by making them harder to locate, track, and destroy. They are also developing counter-space weapons[20] that could be used to disable or destroy foreign space systems that might be used to target and attack China's nuclear arsenal, or to direct missile defense systems. China's leaders believe that developing systems that could reduce the effectiveness of foreign satellites provides decision-makers with an option for increasing the credibility of China's nuclear retaliatory capability without requiring a large increase in the size of its nuclear arsenal.

It is important to remember that while China has the money and technology to build a large number of nuclear-tipped missiles, the number of warheads it can build is capped by its existing stocks of fissile material, which experts believe is quite limited. As a result, it cannot engage in a rapid or sudden "sprint" to numerical nuclear parity with the United States and Russia. A massive build-up would take time and the signs—including resumed production of plutonium for weapons—would be observable.

Entry into force of the FMCT and CTBT would be an effective way to inhibit such a build-up and warhead modernization. As discussed above, the number of Chinese warheads is capped by the amount of plutonium it possesses, a limit that would be fixed by the FMCT. Moreover, the types of warheads China can certify for deployment is limited by a lack of nuclear testing—a limitation that would be strengthened if the CTBT were ratified and entered into force.

References

[1] Office of the Secretary of Defense, "Military and Security Development Involving the People's Republic of China 2010," May 2010, pp. 34-35. http://www.defense.gov/pubs/pdfs/2010_CMPR_Final.pdf (accessed 2 February 2011). National Air and Space Intelligence Center, "Ballistic and Cruise Missile Threat 2009," NASIC-1031-0985-09 (April 2009), http://www.fas.org/programs/ssp/nukes/NASIC2009.pdf (accessed 2 February 2011). Federation of American Scientists and Natural Resources Defense Council, "Chinese Nuclear Forces and U.S. Nuclear War Planning," Federation of American Scientists and Natural Resources Defense Council, November 2006, http://www.fas.org/nuke/guide/china/Book2006.pdf (accessed 2 February, 2011).

[2] International Panel on Fissile Materials, *Global Fissile Material Report 2010: Balancing the Books,* http://www.fissilematerials.org/ipfm/site_down/gfmr10.pdf, p.98 (accessed 2 February 2011).

[3] Interviews conducted in China, February, 2011.

[4] Nuclear Threat Initiative (NTI), "China's Nuclear Tests: Dates, Yields, Types, Methods, and Comments," http://www.nti.org/db/china/testlist.htm (accessed 2 February 2011).

[5] Jeffrey Lewis, *The Minimum Means of Reprisal: China's Search for Security in the Nuclear Age*, MIT Press, Cambridge 2007, p. 25.

[6] One U.S. assessment of China's capability to place multiple independently targetable reentry vehicles (MIRVs) on its mobile nuclear-capable long and intermediate range missiles (presumably the DF-31 and the DF-31A), was conducted by a former Chairman of the Joint Chiefs of Staff General John M. Shalikashvili at the request of the President in preparation for further consideration of the CTBT. It reported that China's "inability to test above detectable levels would impede future efforts to put multiple warheads on mobile missiles" (U.S. Department of State, *Findings and Recommendations Concerning the Comprehensive Nuclear Test Ban Treaty*, (January, 2001), http://www.fas.org/nuke/control/ctbt/text/ctbt_report.html#report (accessed 4 February 2011)). A second assessment from the U.S. Director of National Intelligence claimed it would be difficult and costly for China to MIRV its long- and intercontinental-range mobile missiles. (National Intelligence Council, *Foreign Missile Developments and the Ballistic Missile Threat Through 2015,* December 2001, http://www.dni.gov/nic/PDF_GIF_otherprod/missilethreat2001.pdf (accessed 4 February 2011)). A third assessment contained in a National Academy of Sciences report indicated China would require additional nuclear testing to develop a warhead small enough to place multiple warheads on its existing long- and intercontinental-range mobile missiles. (Committee on International Security and Arms Control, National Academy of Sciences, *Technical Issues Related to the Comprehensive Test Ban Treaty,* Washington, 2002, http://www.nap.edu/catalog.php?record_id=10471 (accessed 4 February 2011)).

Sources familiar with the raw intelligence on which all three of these assessments are based told UCS privately that data obtained from observations of Chinese nuclear weapons tests and Chinese missile tests indicate that the re-entry vehicle or warhead for the DF-31 and DF 31A are estimated to weigh between 450kg and 480kg and that the maximum deliverable payload of these two missiles is approximately 500kg, making it virtually impossible for China to MIRV these missiles. This conclusion is implicitly supported by the most recent Pentagon report, which stated China might be developing a new mobile missile, the DF-41, to carry multiple warheads. If China's existing missile could achieve this objective, it would not be necessary for it to develop a new missile for that purpose. (Office of the Secretary of Defense, *Military and Security*

Development Involving the People's Republic of China 2010, May 2010, pp. 34-35,
http://www.defense.gov/pubs/pdfs/2010_CMPR_Final.pdf
(accessed 2 February 2011)).

[7] Chinese arms control analysts who participated in the CTBT negotiations and continue to be engaged in internal Chinese debates on ratification explicitly communicated this to UCS on multiple occasions during interviews conducted in China over the past several years. According to these analysts, the Chinese government is concerned about conditions or reservations the U.S. Senate may attach to the U.S. resolution of ratification of the treaty.

[8] Lewis, *The Minimum Means of Reprisal*, p. 111-135.

[9] The New START treaty counts warheads that are deployed on delivery vehicles; by this way of counting the United States currently has about 2,000 warheads (and will eventually have fewer than 1,550) and China has zero.

[10] The Chinese encyclopedia Baidu Baike entries for both missiles claim there were multiple warhead tests
(http://baike.baidu.com/view/2994067.html and
http://baike.baidu.com/view/2994260.html (both accessed 3 February 2011)).

[11] China.com—an established mainland news and information website—discusses recent tests in a December 2009 article
(http://military.china.com/zh_cn/history4/62/20091230/15757486.html (accessed 3 February 2010)) and a January 2010 article
(http://military.china.com/zh_cn/history4/62/20100111/15771069.html (accessed 3 February 2010)).

[12] Two Chinese intelligence officers called the Jin-class submarine a failure during an interview in November 2010.

[13] China's single Jin class submarine is designed to carry 12 JL-1 nuclear-armed missiles that carry a single warhead and have a range of 1,000km. The two Xia class submarines China has produced are designed to carry 12 JL-2 nuclear-armed missiles that carry a single warhead and have a range of 4,500km. NASIC lists them as "Not Yet Deployed" (National Air and Space Intelligence Center, *Ballistic and Cruise Missile Threat 2009*, NASIC-1031-0985-09, April 2009, p. 25.
http://www.fas.org/programs/ssp/nukes/NASIC2009.pdf
(accessed 2 February 2011)).

[14] The most recent annual Pentagon report does not include tactical nuclear weapons in its list of China's nuclear weapons capabilities (Office of the Secretary of Defense, *Military and Security Development Involving the People's Republic of China 2010*, May 2010, pp. 34-35.
http://www.defense.gov/pubs/pdfs/2010_CMPR_Final.pdf
(accessed 2 February 2011)). However, a classified Chinese textbook used to train China's Second Artillery contains a discussion of a Chinese "triad" that includes nuclear weapons controlled and operated by the Chinese air force and the Chinese navy (于际训，主编，第二炮兵战役学，解放军出版社，2004 年3 月 (Yu Jixun, Chief Editor, Second Artillery Operational Studies, People's Liberation Army Press, Beijing, March 2004)). While the reference to the navy could be to SLBM forces that are not yet deployed, there is no air-force-delivered Chinese nuclear weapons system described in the Pentagon report. Jeffrey Lewis discusses the development and early testing of nuclear-armed gravity bombs but notes they have never been deployed (see Jeffrey Lewis, *The Minimum Means of Reprisal,* p. 81).

[15] A discussion of Chinese views of the "nuclear taboo" can be found in Li Bin and Nie Hongzhen "An Investigation of Chinese – U.S. Strategic Stability"
(http://www.ucsusa.org/nuclear_weapons_and_global_security/international_information/us_china_relations/china-nuclear-arms-control.html (accessed 13 May 2001)).

[16] 于际训，主编，第二炮兵战役学，解放军出版社，2004 年3 月 (Yu Jixun, Chief Editor, Second Artillery Operational Studies, People's Liberation Army Press, Beijing, March 2004) pp. 294-296.

[17] A summary of the most discussed statements by Chinese military officials can be found in Stephanie Lieggi, *Going Beyond the Stir: The Strategic Realities of China's No First Use Policy, Nuclear Threat Initiative*, December 2005,
http://www.nti.org/e_research/e3_70.html (accessed 3 February 2011).

[18] Personal communications, Beijing, fall 2010.

[19] A web-based history of the DF-4 testing program on China.com details recent tests in 2002, 2004, 2005, 2008 and 2009
(http://military.china.com/zh_cn/history4/62/20100111/15771069.html (accessed 3 February 2010)). An earlier article on the same website written by an unidentified "former deputy-commander of the Second Artillery" details the history of improvements to the DF-5 including flight testing that began in the early-mid-1990s and continued throughout the next decade
(http://military.china.com/zh_cn/history4/62/20091230/15757486.html (accessed 3 February 2010)).

[20] Office of the Secretary of Defense, *Military and Security Development Involving the People's Republic of China 2010*, May 2010, pp. 7, 28, and 35.
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For more information contact
Gregory Kulacki at 909-267-0434

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