China's Nuclear Force: Modernizing from Behind

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Summary

China's nuclear force is much smaller and far less capable than the nuclear force of the United States. China's current nuclear weapons modernization program will not change that situation, even if the United States does nothing.

China has been improving the quality and increasing the quantity of its nuclear forces since its first test of a nuclear-armed missile in 1966. The pace of these improvements has been steady but slow, especially when compared with the growth of China's economy. After a half-century of effort, China's nuclear arsenal remains smaller than the US nuclear arsenal was in 1950 (Kristensen and Norris 2013).

Creating a nuclear force requires three essential capabilities:

1. The capability to produce the fissile materials highly enriched uranium and plutonium.
2. The capability to use those materials to make warheads that are tested for reliable use as a weapon.
3. The capability to deliver these warheads to targets using missiles, airplanes or other vehicles.

Chinese capabilities in all three essential areas of nuclear weapons production lag well behind the capabilities of the United States:

1. China produced far less highly enriched uranium and plutonium than the United States.
2. China conducted far fewer nuclear weapons tests than the United States and consequently produced fewer nuclear warhead designs.
3. China has far fewer vehicles to deliver its nuclear warheads.

China's ongoing modernization program currently does not include efforts to produce more fissile materials or test new nuclear warhead designs. The only nuclear weapons-related capability China continues to improve is its delivery vehicles.

China does not currently deploy nuclear weapons on submarines or on aircraft. China's nuclear capability is concentrated in ground-based nuclear-capable missiles that are far fewer in number, and demonstrably less capable, than their US counterparts.

China's nuclear modernization program may eventually include plans to deploy a small number of submarine-launched ballistic missiles (SLBMs) and air-launched cruise missiles, but its primary focus appears to be making incremental improvements to the quality and quantity of China's ground-based ballistic missiles.

Unless the United States dramatically reduced the size of its nuclear arsenal, the limitations of China's current nuclear weapons modernization program guarantee an overwhelming US superiority in number and capability of nuclear forces.

The most effective means to allay US and allied concerns about the future size and capability of China's nuclear force are to:

- Prevent China from producing more of the fissile materials needed to make nuclear warheads.
- Prevent China from testing new nuclear warhead designs.

Both can be done using arms control agreements.

China's Fissile Materials

The International Panel on Fissile Materials (IPFM) estimates China has 14 ± 3 tons of highly enriched uranium and 2.9 ± 0.6 tons of weapon-grade plutonium (this includes the amount in current warheads and in stocks that could be used for additional warheads) (Zhang 2018). By comparison, the IPFM estimates the United States currently has 253 tons of highly enriched uranium and 38.3 tons of plutonium in or available for weapons—10 to 20 times as much (International Panel on Fissile Materials 2016).

Unlike the United States, China has not officially disclosed information about the fissile materials it produced. But the IPFM estimate is consistent with US intelligence reports as well as data compiled from official histories of China's nuclear weapons program, unofficial biographies of program personnel, and other Chinese publications and statements (Lewis 2014).

These sources indicate China halted the production of highly enriched uranium for weapons by 1987 and the production of plutonium for weapons by 1991. The facilities involved in the production of these materials were converted to civilian use and eventually decommissioned as China's nuclear industry shifted its focus from national security to economic development in accord with the comprehensive reorientation of Chinese foreign and domestic policy that began in the mid-1980s and continues today.

China's Nuclear Warheads

The number of nuclear warheads China can produce depends on the total amount of fissile material available and how much is needed for each warhead. The amount of fissile material in a nuclear warhead depends on its design.

Another important attribute of the design is the total mass of the warhead. A primary goal of a nuclear weapons program is to design nuclear warheads that are light enough to be carried long distances by ballistic missiles.

The ability to design nuclear warheads is acquired through nuclear testing. The more designers test, the greater is their ability to understand and control all the variables that go into the design, and build warheads that are small, lightweight, and use fissile material efficiently.

China conducted 45 nuclear explosive tests before it halted testing in 1996. The United States conducted 1,056 nuclear explosive tests before it stopped testing in 1992—nearly 25 times as many.

China's limited nuclear testing produced a small number of nuclear warhead designs. These warheads are believed to use a larger amount of fissile materials than US designs. One estimate, based on fallout data from a 1976 Chinese test of a warhead for its DF-5 liquid-fueled missile, indicated that warhead may have contained 7 kilograms (kg) of plutonium in the primary—a large amount compared to the US average of 4 kg (De Geer 1991). The design for the warhead China tested in its final nuclear tests in the 1990s likely uses less than 7 kg, but China may use relatively large amounts of plutonium in its designs as a way of reducing the amount of high explosives needed to ignite the weapon. Doing so would reduce the overall mass of the warhead (Lewis 2014).

Assuming China's weapons each use 4 to 6 kg of plutonium, then if the IPFM estimates of China's plutonium stocks are accurate, these numbers imply that it could produce a total of between 380 and 880 nuclear warheads. If reports that China uses more plutonium than average in its nuclear warhead designs are correct, the total could be in the low end of that range.

China's nuclear warheads are also heavier than comparable US warheads. Leaked US intelligence reports indicate the combined weight of the nuclear warhead and the re-entry vehicle for China's road-mobile long-range missile is 470kg (Gertz 2001). That is two-and-a-half times the mass of the US W88 warhead and its re-entry vehicle carried by US SLBMs, which has a comparable or larger yield (Gronlund and Wright 1992).

TABLE 1. **Chinese ICBMs**

Name	*Number*	*Payload (kg)*	*Propellant*	*Basing*	*Range (km)*
DF-4	10 -15	2,200	Liquid	Transportable	5,500
DF-5	~ 20	3,900	Liquid	Silo	12,000
DF-31	5 - 10	700	Solid	Road-Mobile	7,000
DF-31A	~ 15	700	Solid	Road-Mobile	11,200
DF-41	—	Under Development			

SOURCE: NATIONAL AIR AND SPACE INTELLIGENCE CENTER (NASIC)

China has a larger stockpile (approximately 14 tons) of highly enriched uranium (HEU) than plutonium. Using HEU as the primary of a two-stage nuclear weapon can increase the mass of a warhead, which is likely why China opted to use plutonium in designing smaller and lighter warheads for its road-mobile missiles before halting testing and signing the Comprehensive Test Ban Treaty (CTBT) in 1996.

The United States has approximately 4,480 nuclear warheads in its current arsenal (deployed and reserve) (Davenport and Reif 2017). It has enough plutonium in its military stockpiles to make more than 5,000 additional warheads. As noted above, the United States also has a much larger store of HEU than China.

China's Delivery Vehicles

The US Department of Defense (DOD) has identified several different types of missiles China can use to deliver its nuclear warheads.

INTERCONTINENTAL BALLISTIC MISSILES (ICBMS)

China currently fields four different types of ICBMs, which are missiles with ranges of 5,500 km or greater (Table 1). DOD estimates China now has a total of 75 to 100 of these missiles (Office of the Secretary of Defense 2017). All four can deliver Chinese nuclear warheads to targets within the sovereign territory of the United States, but only two are able to reach targets in the lower 48 states or Hawaii. A fifth Chinese ICBM is reportedly under development.

By contrast, the United States currently has 400 ICBMs. While only a small portion of China's ICBMs can carry more than one nuclear warhead, all US ICBMs were designed to carry three warheads. The Federation of American Scientists (FAS) reports that the United States currently has some 800 nuclear warheads that it could put on ICBMs (Kristensen and Norris 2017), while China may be able to deliver 83 nuclear warheads using ICBMs, a figure consistent with the DOD figure of 75 to 100. While only a portion of China's ICBMs can reach targets anywhere within the United States, all US ICBMs can reach targets anywhere within China.

SUBMARINE LAUNCHED BALLISTIC MISSILES (SLBMS)

China has produced two types of SLBMs. It currently has four ballistic missile submarines capable of carrying 12 of the later, long-range version (Table 2). An additional submarine is under construction.

When its fifth submarine is available, China may field up to 60 SLBMs. The United States has 248 SLBMs on 12 submarines. None of China's SLBMs

TABLE 2. **Chinese SLBMs**

Name	*Payload (kg)*	*Range (km)*	*Submarine Class*	*No. of Launchers*
JL-2	700	7,200	JIN	48

SOURCE: NATIONAL AIR AND SPACE INTELLIGENCE CENTER (NASIC)

can deliver more than one nuclear warhead. Each US SLBM is designed to deliver as many as 12 nuclear warheads, or a total of 2,976, although this number is limited to 1,152 by the New START treaty. Approximately 890 nuclear warheads are currently deployed on the missiles loaded on US submarines (Kristensen and Norris 2017).

US observers have been anticipating Chinese SLBM deployment for many years, but China's ballistic missile submarines have yet to begin conducting patrols. This could be because the submarines are noisy and therefore vulnerable. It could also be because China traditionally keeps its nuclear warheads separate from the missiles that deliver them. This nuclear posture, which is consistent with China's commitment to a no first-use policy, would be impossible to preserve with nuclear-armed ballistic missile submarines on patrol.

INTERMEDIATE-RANGE BALLISTIC MISSILES (IRBMS)

China has three IRBMs that can be used to deliver nuclear weapons (Table 3). The older, liquid-fueled missiles are being retired when they reach the end of their service life. The two solid-fueled, road-mobile IRBMs, while having a nuclear capability, are also important components of China's non-nuclear ballistic missile force. Estimates of the number of Chinese IRBMs assigned nuclear missions vary based on US observations of Chinese missile exercises and the content of related Chinese military publications. FAS recently estimated that China's nuclear-capable IRBMS can currently deliver approximately 80 nuclear warheads to targets in Asia, including US military bases in Japan, South Korea and Guam (Kristensen and Norris 2016).

The United States has no nuclear-armed intermediate-range ballistic missiles.

NUCLEAR-CAPABLE CRUISE MISSILE

China's bombers do not currently have a nuclear mission, although there has been some discussion about developing a nuclear mission for the Chinese Air Force in recent years. China does have two dual-capable land-attack cruise missiles—the ground-launched CJ-10 and the air-launched CJ-20—which could be assigned nuclear missions, but neither is considered to have a nuclear mission at this time (National Air and Space Intelligence Center 2017).

China may have several hundred cruise missiles that could carry nuclear warheads to targets in Asia

TABLE 3. **Chinese IRBMs**

Name	*Number*	*Payload (kg)*	*Propellant*	*Basing*	*Range (km)*
DF-21	~ 50	600	Solid	Road-Mobile	1,750
DF-26	?	?	Solid	Road-Mobile	3,000

SOURCE: NATIONAL AIR AND SPACE INTELLIGENCE CENTER (NASIC)

(Office of the Secretary of Defense 2016). The United States can deliver 528 nuclear warheads on air-launched cruise missiles to targets within Chinese territory. China also may have an unspecified number of nuclear bombs it can deliver to targets in Asia from bombers or fighter aircraft. The United States has 1,100 nuclear bombs it can deliver to targets in China from bombers or fighter aircraft.

Comparing nuclear delivery vehicles is more difficult than comparing fissile materials or nuclear warheads. But even this rough comparison demonstrates that Chinese capabilities lag far behind those of the United States.

Conclusion and Implications

China's nuclear force is less capable and much smaller than the US nuclear force. China's current nuclear modernization efforts will not change that, even if the United States does nothing.

The most effective way for the United States to restrict the growth of China's nuclear force is through diplomacy. China is unlikely to agree to restrictions on the future development of missile, aircraft, naval, cyber or satellite technologies, all of which could increase China's ability to deliver a nuclear warhead to a target. This is because these are dual-use technologies that also can be used for non-military purposes or to help deliver conventional munitions.

However, two international agreements that have been under discussion for decades could, if enacted into law, permanently cap the size and limit future improvements to the capabilities of China's nuclear arsenal:

- Entry into force of the Comprehensive Test Ban Treaty (CTBT) would prohibit China from resuming nuclear explosive testing, which would inhibit China from further reducing the mass and otherwise improving the capabilities of its nuclear warheads.
- Successful negotiation and entry into force of the Fissile Material Cutoff Treaty (FMCT) would prohibit China from resuming the production of fissile materials for nuclear weapons, making it impossible for China to increase the size of its nuclear arsenal beyond what is permitted by China's current fissile material stockpile.

China has already signed the CTBT. China has also expressed support for resuming negotiations on the FMCT during discussions of possible future nuclear arms control negotiations under the auspices of the UN Conference on Disarmament.

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