China has upheld its nuclear policy of maintaining a minimum deterrent with a no-first use pledge and avoiding a nuclear arms race since its first nuclear explosion in 1964. Following the guiding principles of its nuclear policies, the main purpose of China's nuclear modernization is to assure what it considers to be a "limited," "reliable," and "effective" counterattack nuclear capability for deterring a first nuclear strike. To maintain an "effective nuclear deterrent," China will continue to modernize its nuclear force posture accordingly along with other countries' military developments and the international security environment. However, the nuclear force will likely be kept at the minimum level Beijing feels is required to deter a nuclear attack. China could have the smallest arsenal of nuclear weapons and stocks of fissile materials for weapons among the five original nuclear weapon states.

### Status of China's Nuclear Forces

Estimates of Chinese nuclear force are difficult, given the fact that China has revealed little information about its nuclear force posture. However, based on the intentions of China's nuclear modernization and Western government and non-government estimates, China has a total inventory of approximately 170 nuclear warheads including approximately 110 operationally deployed nuclear missiles (mainly land-based nuclear ballistic missiles, of which approximately 35 can reach the continental United States), approximately 60 warheads stored for its submarine-launched ballistic missiles (SLBMs), and bombers (see table 1). Each of those nuclear ballistic missiles carries a single warhead. The warheads are separated from the missiles under normal circumstances.

To make a reasonable estimate of China's nuclear force, it is necessary to understand the intention of China's nuclear modernization. Under the guideline of China's no-first use doctrine and the principle of a "lean and effective" (jinggan youxiao) nuclear force, the main goal of China's nuclear modernization, initiated in the 1980s, is to secure a limited and reliable second-strike nuclear force to deter a nuclear attack. Unlike the United States' focus on counterforce targeting policy, which needs a large arsenal to eliminate the adversary's nuclear force, China has a retaliatory countervalue posture for which China believes a small force is enough. In 1978, Deng Xiaoping provided the guidance for the future development of China's nuclear force. He emphasized that China's strategic weapons "should be updated (gengxin) and the guideline [for their development] is few but effective (shao er jing). Few means numbers and effectiveness should increase with each generation." The gengxin (upgrade) means here mainly replacing the older ones by new, "better" ones. Mao Zedong once also remarked that one should "have a little bit (of nuclear weapon), keep (the weapons) a little bit, make (the weapons) a little bit better" (you yidian, shao yidian, hao yidian). This "yidian" (a little bit) policy has been kept by the several generations of Chinese leaders.

To have a small arsenal capable of counterattack, China's nuclear modernization has been focusing on the quality over the quantity of its nuclear arsenal during the past three decades. As professor Hu Side, the former president of Chinese Academy of Engineering Physics (the Chinese Los Alamos) emphasized, "China's nuclear modernization [is conducted] under the guideline of China's nuclear policy, maintaining the principle of counterattack in self-defense and avoiding [an] arms race," and one feature of China's nuclear modernization is that "China's nuclear modernization is impossible and unnecessary to be accomplished through simple increase of the number of nuclear weapons." Specifically, China's nuclear modernization has been focusing on increasing the survivability of its nuclear force by replacing older, liquid-fueled missiles with solid-fueled, mobile ballistic missiles and constructing underground tunnels that can act as missile bases. The pace of China's nuclear modernization efforts has been slow and gradual for the past three decades. It should be noted that since the Taiwan strait crisis in 1996, the secondary artillery has emphasized modernization of conventional missiles as well and increased significantly the size of the conventional arsenal (in particular the DF-21 C missiles). However, there is no obvious increase of nuclear warheads.

#### Delivery systems

**Land-based ballistic missiles**

Given that China has no reliable operational air-based (bomber) or sea-based (SSBN) nuclear force, China's nuclear modernization since its initiation in
1980 has focused on increasing the survivability of its limited land-based strategic missiles by the People’s Liberation Army Second Artillery Force (PLASAF). As its recent Defense White Paper states, “Following the principle of building a lean and effective force, the PLA Second Artillery Force (PLASAF) strives to push forward its modernization and improves its capabilities in rapid reaction, penetration, precision strike, damage infliction, protection, and survivability, while steadily enhancing its capabilities in strategic deterrence and defensive operations.”

Based on the intention of China’s nuclear modernization and Western publications, it is estimated that China could have approximately 110 land-based, nuclear-capable ballistic missiles, including up to 20 silo-based, liquid-fueled DF-5A (CSS-4) intercontinental ballistic missiles (ICBMs); approximately 10 solid-based, road-mobile DF-31 ICBMs; approximately 15 solid-based, road-mobile DF-31A ICBMs; approximately 10 liquid-fueled, limited-range DF-4 ICBMs; approximately 5 liquid-fueled DF-3A intermediate-range ballistic missiles; and approximately 50 road-mobile, solid-fueled DF-21 medium-range ballistic missiles (MRBMs).

The US Department of Defense (DoD) has reported consistently that China has 20 DF-5A—a liquid-fueled, two stage, silo-based ICBM with a range beyond 13,000 kilometers, which can reach the continental United States. It can deliver a 4-5 megaton warhead. China began to develop the DF-5A in the late 1980s, mainly in order to enhance the range of DF-5s that had entered service in 1981. The DF-5A was deployed in the 1990s. After this, China had the capacity to target the continental United States. It has been reported that it takes up to two hours for launch preparation. Given that it is silo-based and has extensive fueling requirements, the DF-5A could be vulnerable to a first strike. One focus of the modernization programme is to replace those older, liquid-fueled ICBMs with the new solid-fueled DF-31A ICBMs. In 2006, the DoD reported that China had about 20 DF-5A before it started to deploy the DF-31A in 2007. As the DF-31A starts to deploy over the coming years, it may be reasonable to expect that at least some DF-5A will be replaced. However, China’s underground great wall project initiated in 1985—aimed at increasing the survivability of those land-based missiles through underground tunnels to shield them—could motivate China not to replace all those DF-5As so quickly. Based on those considerations, the author assumes China could have less than 20 DF-5A by 2011.

As a key part of Chinese second generation ICBMs, the DF-31A achieved initial operational capability (IOC) in 2007. The DF-31A is a solid-fueled, three stage, road-mobile ICBM with a range over 11,200 kilometers. It can deliver a 200–300 kilotons warhead. The DF-31A is carried on a six-axle transporter-erector-launcher. Based on the DoD report, China deployed less than 10 DF-31As in 2008 and between 10-15 DF-31As in 2009. However, the 2011 DoD report did not provide the specific number deployed in 2010. It noted “additional CSS-10 Mod 2s” will appear by 2015. The Federation of American Scientists report estimated China deployed 10-20 DF-31As by 2011. It is reasonable to assume China has approximately 15 DF-31As.

Based on China’s minimum deterrence policy—it “will limit its nuclear capabilities to the minimum level required for national security”—approximately 15 DF-31As with about 20 DF-5As (thus a total 35 longer-range ICBMs) would meet its “minimum need.” It should be noted that while Beijing does not disclose the specific number of its “minimum need,” a nuclear force with approximately ten warheads reaching a target country may be considered enough to inflict “unacceptable damages” (as discussed in the following sections). As more DF-31As are deployed, it could be expected that more DF-5As would be phased out. However, the total amount of around 35 should be not changed significantly.

One major target for this longer-range ICBM would be the continental United States. If China thought 20 ICBMs were enough to deter a US first strike in the 1980s and 1990s, the minimum nuclear force capable to reach the target after surviving the first strike would be around 10 warheads, which could inflict unacceptable damages for United States. However, with the development of US satellite surveillance capabilities and the increased accuracy of its nuclear weapons, the survived weapons would be much lower than the needed minimum level. To maintain the “needed” minimum nuclear force, China started the underground great wall project in 1985, which can protect most of its missiles. Thus, a total of 20 longer-range missiles could be enough to deter a US nuclear attack without a missile defence system. However, facing a ground-based midcourse missile defence system currently deployed by the United States (with about 30 interceptors), a total of around 35 ICBMs would meet its “minimum needed” weapons. Assuming most of those Chinese missiles would survive a first strike due to the protection from the underground great wall, and that every two interceptors of missile defence can kill each incoming ICBM, and then around 10 ICBMs would reach their target. In addition, decoys and missile defence countermeasures would help those missiles to overcome the midcourse missile defence system.

China also has the older, first generation DF-4. The DF-4, deployed in 1980, is a liquid-fueled, two stage, limited-range ICBM (5,400+ km). It is stored in cave bases and needs to be pulled out to the fixed prepared-launch site for launch. It is being replaced by the new solid-fueled DF-31 and DF-21A. The DoD reported China had about 16-24 DF-4S in 2006 when the DF-31 was first introduced. The DoD estimated China had 15-20 DF-4S in 2009. The Military Balance report of
the International Institute of Strategic Studies (IISS) estimated China had approximately 10 DF-4s in 2010. It is reasonable to assume China has approximately 10 DF-4s.

The DF-3 is a solid-fueled, three-stage, road-mobile ICBM with a range of 7,200 kilometers. As with the DF-3A, the DF-31 is carried on a six-axle transporter-erector-launcher. It can cover targets in Russia and Asia. Based on the DoD report, China deployed less than 10 DF-31 by 2009. IISS estimated China had approximately 12 DF-31s in 2010.

Based on China’s principle of “minimum needs,” it is reasonable to assume China has approximately 10 DF-31s by 2011. Thus, a total of 20 DF-31 and DF-4s could meet China’s minimum needs. As more DF-31s are deployed, more DF-4s would be replaced. However, the total ICBMs in this category (in term of range) would not be increased significantly according to the current analysis of China’s security. The main target of the DF-4 during the cold war was Moscow. As with the DF-5A, about 20 weapons would have an effective deterrent. Given that China and Russia have improved their relations significantly, China has no rational to have a significant increase in this category of missiles. While those missiles can target India, the DF-21 could also reach India if needed. In addition, given China's focus on countervalue targeting policy (i.e. population centers), the US Guam military base would not be a focus for China's strategic weapons.

China is phasing out its oldest and near-retired DF-3A. The liquid-fueled, single-stage, medium-range DF-3A with a range over 3000 km is being replaced by the DF-21. It is mainly for regional “deterrence”. The 2011 DoD report estimated China has 5-20 DF-3As. IISS estimated that China had about two DF-3As by 2010. The 2008 DoD report expected the DF-3A to be retired by 2010. Most of the DF-3As could be replaced by the DF-21s. China could have approximately five DF-3As by 2011.

The DF-21 family is the most important MRBM system of the Second Artillery for regional nuclear deterrence. This family includes the DF-21 (CSS-5 Mod 1), DF-21A (CSS-5 Mod2), DF-21C, and DF-21 D. However, only the DF-21 and DF-21A are for nuclear mission. This mobile and solid-fueled missile has a range of more than 1750 km. China began serious deployment of the DF-21 in 1991. After its deployment for two decades, the DF-21 could replace most of those DF-3As. The DoD estimated that China had about 19–50 in 2005 and 40–50 in 2006 nuclear-armed CSS-5 Mod 1 and CSS-5 Mod 2MRBMs. The 2011 DoD report estimated China had 75-100 missiles of the whole DF-21 family, including conventional mission missiles as well (e.g. DF-21C).

However, there is no evidence to show that China has a rationale to significantly increase its DF-21s with nuclear missions during such a short period. In fact, after about 15 years of deployment of DF-21s (1991–2005), its deployment for nuclear mission should be nearly accomplished. Most likely, the new increase in the DF-21 family is contributed by its conventional missions. In fact, the Second Artillery has emphasized its dual missions (nuclear and conventional) since the early 2000s.

A study of the Project 2049 Institute also emphasized that “[d]espite a significant expansion of Second Artillery’s missile brigade infrastructure over the last 15 to 20 years, a review of China’s nuclear warhead storage and handling system offers no obvious signs of a significant increase in China’s nuclear stockpile.” Furthermore, “Much of the missile infrastructure expansion, beyond short range ballistic missile brigades deployed opposite Taiwan, appears to accommodate new brigades equipped with DF-21 (CSS-5) medium range ballistic missiles, including the terminally-guided DF-21C and perhaps the DF-21D maritime variant in the near future.” The Project 2049 Institute report further stated that “the absence of a clear sign of nuclear warhead growth and expansion of missile infrastructure could indicate an extension of Second Artillery’s conventional mission.” In short, as a conservative estimate, China could have no more than 50 DF-21 MRBMs that are nuclear capable.

Submarine-launched ballistic missiles

After about two-decades’ worth of efforts, the People’s Liberation Army Navy started to operate its sole Xia-class SSBN (Type-092) in early 1980. It is equipped with 12 JL-1 SLBMs (Julang-1, “Great wave-1”). Each JL-1 missile has a single warhead and a range of 1700 km. However, the 2011 DoD Report states, “The operational status of China’s single XIA-class ballistic missile submarine (SSBN) ... remains questionable.” It is reported that the Xia-class has never conducted a deterrent patrol. In fact, the DoD recent reports do not count the JL-1 in the Chinese missile forces.

This old, first generation Xia and its JL-1 is being replaced with the second generation Jin-class SSBN (Type-094) and the new JL-2. The Jin-class SSBN can carry 12 JL-2 SLBMs with a much longer range (7400 km, a modification model of DF-31) than that of JL-1. As the deployment of the new Jin-class SSBNs with JL-2 SLBMs, it will further secure China’s second-strike capability.

Based on the 2011 DoD report and the FAS report, China built a maximum of three Jin-class SSBNs by 2010. The first one appears ready to enter service soon. However, it is uncertain when China will have the operational JL-2 and the combination of the Jin-class SSBN with the JL-2 SLBM. In addition, US naval intelligence projected in 2007 that China might build five Jin-class SSBNs. However, the US intelligence community often overstates China’s nuclear force, and the number of five is likely too high. China has maintained only one SSBN for the past three decades, and China’s nuclear modernization focus is mainly on updating its
old SSBM with higher quality ones, instead of generating larger numbers. Thus, China would have no intention to expand its sea-based nuclear force by such a large amount. Furthermore, if China can operate three SSBMs in the future, and even if only one-third of those SSBMs can survive a first strike, then China will still have about 12 SLBMs for counterattack, which would meet China’s “minimum need for deterrence,” as is the case for the land-based missiles. Meanwhile, if China feels confident about survivability of its land-based strategic nuclear force by the protection of its “underground great wall,” China would have no rationale to have more than three new SSBNs under current security circumstance. In short, the author assumes that China could have up to three Jin-class SSBNs with 36 JL-2 SLBMs. As the new SSBNs are fully deployed, those old Xia-class SSBM and JL-1 missiles will be fully phased out.

It can be expected that, after its three-decade modernization programme, with a focus on increasing the survivability of its land-based missiles, China will speed up the modernization of its sea-based strategic force to secure a second-strike force in the coming years. As retired PLA General Xu Guangyu told Reuters in 2010, “International experience shows the most effective second-strike capability is submarines ... and upgraded missiles are a focus.”27 Indeed, China’s 2011 Defense White Paper states that “the PLA Navy (PLAN) endeavors to accelerate the modernization of its integrated combat forces, enhances its capabilities in strategic deterrence and counterattack, and develops its capabilities in conducting operations in distant waters and in countering non-traditional security threats.”28

### Bombers

China’s air-based nuclear force is the weakest leg among its triad. China’s aged strategic bomber force consists about 20 Hong-6 bombers (with a combat radius of approximately 3000 km, each with one bomb) based on the old design of the Soviet Tu-16 Badger bomber. This small arsenal could be used as a secondary mission for a small number of bombers.29 All current publications indicate China has no operational strategic nuclear bombers.

However, China could have no rationale to have a larger air-based nuclear force. Given their relatively short operating range and poor penetrability, those bombers would be very difficult to fly into an enemy’s heartland to destroy strategic countervalue targets, e.g. cities. Moreover, during the cold war, the major target of those bombers was the Soviet Union/Russia. However, the relationship between China and Russia has recently improved significantly. China has improved relations with other neighbors as well. Thus, there is no rationale to expend its air-based force due to geopolitical considerations.

That said, China will likely maintain a small arsenal of bombers in the near future, which will be consistent with its principle of a pursuit of “a small but inclusive” (xiao er quan) force. Zhou Enlai emphasized in 1970 that China “must build a certain number of [nuclear weapons] with a certain quality and a certain variety.”30 A “certain variety” of weapons means here to support a strategic nuclear triad, which Chinese leaders view as a symbol of China’s great-power status. Thus, China’s small arsenal of strategic bombers mainly has symbolic meaning and a minor “deterrent” effect.

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### Table 1: China’s nuclear forces 2011

<table>
<thead>
<tr>
<th>Type</th>
<th>NATO Designation</th>
<th>Year Deployed</th>
<th>Range (kilometers)</th>
<th>Yield (kilotons)</th>
<th>Number of warheads</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Land-based ballistic missiles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DF-5A</td>
<td>CSS-4</td>
<td>1990s</td>
<td>13,000+</td>
<td>4,000-5,000</td>
<td>&lt;20</td>
</tr>
<tr>
<td>DF-31A</td>
<td>CSS-10 Mod 2</td>
<td>2007</td>
<td>11,200+</td>
<td>200-300</td>
<td>15</td>
</tr>
<tr>
<td>DF-4</td>
<td>CSS-3</td>
<td>1980</td>
<td>5,400+</td>
<td>3,300</td>
<td>10</td>
</tr>
<tr>
<td>DF-31</td>
<td>CSS-10 Mod 1</td>
<td>2006</td>
<td>7,200+</td>
<td>200-300</td>
<td>10</td>
</tr>
<tr>
<td>DF-3 A</td>
<td>CSS-2</td>
<td>1971</td>
<td>3,000+</td>
<td>3,300</td>
<td>5</td>
</tr>
<tr>
<td>DF-21</td>
<td>CSS-5 Mods 1/2</td>
<td>1991</td>
<td>1,750+</td>
<td>200-300</td>
<td>50</td>
</tr>
<tr>
<td><strong>Subtotal:</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>110</td>
</tr>
<tr>
<td><strong>Submarine-Launched ballistic missiles</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>JL-1</td>
<td>CSS-NX-3</td>
<td>1986</td>
<td>1,000+</td>
<td>200-300</td>
<td>(n.a)</td>
</tr>
<tr>
<td>JL-2</td>
<td>CSS-NX-4</td>
<td>?</td>
<td>7,400</td>
<td>200-300 ?</td>
<td>(36)</td>
</tr>
<tr>
<td><strong>Bombers</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H-6</td>
<td>B-6</td>
<td>1965</td>
<td>3,100</td>
<td>---</td>
<td>20</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>166</td>
</tr>
</tbody>
</table>

Given the experience that China has had with its 12 JL-1 SLMBs for the sea-based leg of the triad for the past several decades, China may want to have a small arsenal of bombers with no more than 20 warheads/bombers—even if these weapons did not have an operational capability.

**Tactical nuclear weapons**

There have been rumors for many years that China has tactical weapons. In 1988 China tested a 1–5 kiloton nuclear device with an enhanced radiation yield, or a “neutron bomb.” Some CIA declassified documents also indicated that China pursued or possessed several types of non-strategic weapons, including ballistic missiles, cruise missiles, and artillery. However, Chinese nuclear experts argue that the deployment of tactical nuclear weapons is not consistent with China’s no-first-use policy. From the beginning of China’s nuclear age, Mao Zedong and the following generation of leaders have viewed nuclear weapons as strategic tools to deter nuclear threats or the the use of nuclear weapons against China, not as war-fighting tools. Chinese nuclear experts have argued that the “neutron bomb” test was for tracking and understanding its effect as part of defence studies. In practice, while it should not be difficult for China to have tactical weapons, China does not do so. In fact, the tests of low–yield weapons conducted before 1996, when China ended it tests, were reportedly mainly for “safety purposes” and the miniaturization of warheads, which would be used for the next generation of missiles.

**Fissile materials**

While China has not declared officially that it has ended highly enriched uranium (HEU) and plutonium production for weapons, based on new public information it is believed that China stopped production of HEU in 1987 and of plutonium by about 1990. All its previous military production facilities have been closed, converted, or are being decommissioned.

**Highly-Enriched Uranium (HEU)**

China has produced HEU for weapons at two facilities: Lanzhou gaseous diffusion plant (GDP), which began operating in January 1964 and provided HEU for China’s first nuclear test in October 1964; and Heping GDP, a “Third Line” facility that began operating in 1975. Based on new public information, it is believed that the Lanzhou and Heping GDPs stopped production of HEU in 1979 and 1987, respectively.

The total separative work units (SWUs)—the amount of separation achieved by the enrichment process—produced by the Lanzhou and Heping GDPs could have produced roughly 20 tons of weapon-grade HEU. Subtracting the SWU consumption for enriching uranium for non-weapon purposes, China’s military inventory of weapon-grade HEU would be about 16±4 tons of HEU for weapons. This new estimate is significantly lower than previous estimates, which range from 17–26 tons of HEU.

**Plutonium**

China has produced plutonium for weapons at two nuclear complexes: The first is the Jiuquan Atomic Energy Complex, near Yumen in Gansu province. This site includes China’s first plutonium reactor, which began operation in 1966, and the associated reprocessing facilities. The second is the Guangyuan plutonium production complex, located at Guangyuan in Sichuan province. This was the “third line” plant backing up the Jiuquan complex and also included a plutonium reactor and reprocessing facility. The reactor began operation in 1973. Based on new public information, it is believed that the Jiuquan and Guangyuan reactors stopped plutonium production in 1984 and 1989 respectively.

China’s two plutonium production reactors produced an estimated 2±0.5 tons of weapon-grade plutonium. It is estimated that about 200 kg of plutonium have been consumed in China’s nuclear tests. Thus, its current inventory of weapon-grade plutonium would be 1.8±0.5 tons available for weapons. The new estimates are significantly lower than most previous independent estimates, which range from 2.1 to 6.6 tons of plutonium.

The estimates show that China could have the smallest military stockpile of HEU and plutonium available for weapons among the five acknowledged nuclear weapon states, which is consistent with China’s “minimum nuclear deterrence” policy.

**Modernization: Guiding Principles and Drivers**

China’s government has repeatedly stated that it is pursuing a “self-defensive” nuclear strategy. As its 2006 White Paper on Defense states, the fundamental goal of China’s nuclear strategy is “to deter other countries from using or threatening to use nuclear weapons against China. China remains firmly committed to the policy of no first use of nuclear weapons at any time and under any circumstances.” China upholds the principles of “counterattack in self-defense and limited development of nuclear weapons,” and aims at building “a lean and effective nuclear force capable of meeting national security needs.” Furthermore, the government insists that “China exercises great restraint in developing its nuclear force. It has never entered into and will never enter into a nuclear arms race with any other country.” The 2007 fact sheet published by the Ministry of Foreign Affairs declared, “Among the nuclear-weapon states, China has performed the least number of nuclear tests and possesses the smallest nuclear arsenal.”

It can be expected that China’s future development of nuclear forces will follow China’s nuclear policy with
a no-first-use pledge and “minimum deterrence”. This strategy has been consistently embraced by top Chinese leaders, from Mao Zedong to the current leader, Hu Jintao, who believes a small arsenal capable of counterattack should be enough to deter a nuclear strike. As Mao stated a few months after China’s first nuclear test, “We don’t wish to have too many atomic bombs ourselves. What would we do with so many? To have a few is just fine.” Similarly, Deng Xiaoping once emphasized that China’s small number of nuclear weapons “is only to show that we also have what you have. If you want to destroy us, you yourself have to suffer some retaliation as well.”

While many experts and scholars suspect China’s no-first-use pledge is insincere or claim that it is just a declaratory policy, China has maintained a much smaller and simpler nuclear arsenal than the other nuclear weapon states and has de-mated its warheads from its missiles. The Second Artillery conducts war planning and training under the assumption that China will absorb a first nuclear blow and use its nuclear forces only to retaliate. The increased stockpiling of China’s conventional missiles by the Second Artillery could further enhance the credibility its no-first-use pledge. Furthermore, China’s nuclear force posture seems to be determined primarily by its strategy, not financial or technological constraints. China’s economic and technological development since the 1980s indicates that it could expand its nuclear force if it determined this to be in its strategic interest. Yet, China still has a very limited nuclear force and there is no evidence that China plans on changing it in the near future.

The Chinese government insists that China continues to modernize its nuclear force only in order to maintain a reliable second-strike retaliatory capability. Chinese president Hu Jintao has emphasized that China’s modernization programmes are designed to ensure that the “nuclear deterrent” is “safe, reliable, and effective” under “any” circumstance. Similarly, many Chinese officials and nuclear weapon experts argue that China’s nuclear modernization programme is to be conducted under the guidance of China’s nuclear policy, maintaining the principle of counterattack in self-defence and avoiding an arms race. The main features of China’s nuclear modernization programme, as emphasized by Professor Hu Side, include the beliefs that it is impossible and unnecessary to accomplish China’s nuclear modernization “requirements” through a simple increase of the number of nuclear weapons; that modernization will provide assurance of safety of its nuclear arsenal; that investment in modernization will be limited at very low level; and that modernization will be conducted without nuclear testing.

The main goal of China’s nuclear modernization is said to be increasing “survivability, reliability, and safety” for its small nuclear arsenal and maintaining an “effective” second-strike nuclear force. The following equation indicates the relationship between the “effectiveness” of China’s nuclear force and the level of armament the government says it requires for a “minimum deterrent”:

\[
N_{\text{effectiveness}} = N_{\text{minimum level}} / [(\text{survivability from a first strike}) \times (\text{penetrability of a missile defense})]
\]

\(N_{\text{effectiveness}}\) represents an “effective nuclear force” to meet China’s minimum requirement under different circumstance. The \(N_{\text{minimum level}}\) is the minimum nuclear force that will reach the target after surviving a first nuclear strike and penetrating a missile defence system. It would be relatively kept constant. Thus, the specific number of warheads required for an effective nuclear force \(N_{\text{effectiveness}}\) is dynamic and changeable, relying on a number of factors including survivability after the first strike and the penetration rate through an enemy’s missile defence system (if deployed). The minimum nuclear force \(N_{\text{minimum level}}\) itself, however, is constant and does not need to change. In short, to maintain an “effective nuclear deterrent,” China will continuously modernize its nuclear force according to its perception of international security circumstances.

China’s officials have never declared the specific number of weapons needed for its minimum nuclear force (i.e. the \(N_{\text{minimum level}}\)). Mao Zedong stated, “In any cases, we won’t build more atomic bombs and missiles than others.” He also said that “a few atomic bombs are enough (for China). Six are enough.” While six warheads is likely not the specific number in the mind of Chinese leaders, a minimum nuclear force with approximately ten warheads reaching a target country may be considered enough to inflict unacceptable damages. Based on a Natural Resources Defense Council study, the average number of fatalities per attacking weapon (e.g. the DF-5A with a 4.5 MT warhead) is about 800,000, and the average number of casualties per weapon is about two million for these nuclear airbursts. Thus, ten DF-5As would kill about 8 million people and incur casualties of 20 million. It is probable that Chinese officials would consider this enough to “deter” a nuclear first strike.

China’s nuclear modernization for the last three decades has focused on increasing the survivability of its strategic land-based missiles by measures such as developing new solid-fueled and mobile missiles and building underground tunnels to shield those missiles. These measures are mainly in response to the development of military capabilities of other countries, including the improvement of space surveillance to locate and target Chinese missiles, either fixed- or mobile-based; the increased accuracy of nuclear weapon attacks; and long-range conventional strike capabilities. Once China has confidence in its land-based missiles, it will likely speed up the modernization of its sea-based nuclear force.

Without concerns about US missile defence, China’s modernization programme would likely continue to...
focus on quality over quantity. However, US missile defence plans will be a major driver for China's nuclear weapon modernization. Some Chinese officials are concerned that even a limited missile defence system could neutralize China's smaller nuclear force. China is also concerned about US cooperation with Japan and Taiwan on missile defence systems. China's current arsenal of longer-range ICBMs (about 35 ICBMs) could meet its “minimum nuclear deterrent” facing the current US deployed missile defence system. However, China's plans could change significantly if the United States were to deploy a more comprehensive or more operationally successful missile defence system. This might include building more warheads that can overcome missile defences, in addition to developing decoys and missile defence countermeasures.

Washington's strategic nuclear intentions toward Beijing could also influence China's nuclear modernization plans. In particular, China worries that the United States could use nuclear weapons against China in a potential Taiwan conflict. The Bush administration's 2002 Nuclear Posture Review specifically mentions the possibility of using nuclear weapons during a conflict in the Taiwan Strait and the possible use of tactical nuclear weapons. From 1980 to 1995, China's nuclear modernization programme was conducted at a very modest pace because Beijing saw less of a nuclear threat from Washington. However, since the Taiwan crisis in mid-1990s, China has become more concerned about US threats. These days, many Chinese officials worry about the United States' strategic intention to shift the focus of its military strategy to the Pacific and East Asian region.

**ECONOMICS**

China does not release information about how much it has spent on its nuclear weapons. It is difficult to make an estimate. Chinese experts of nuclear weapons believe China invests at a very low level for its nuclear weapon programmes.

Beijing insists that it coordinates military modernization with national economic development. As stated in its recent White Paper, “China adheres to the principle of coordinated development of national defense and economy. In line with the demands of national defense and economic development, China decides on the size of defense expenditure in an appropriate way, and manages and uses its defense funds in accordance with the law.”

China's officially announced defence budget of 601 billion yuan (about 91.5 billion USD) for 2011 is an increase of 12.7% over the 533 billion yuan ($81.3 billion [USD]) authorized in 2010. However, many foreign analysts do not believe that the Chinese official data represent the real Chinese military-related spending. The 2011 DoD report estimated that China's total military-related spending for 2010 was over $160 billion, almost double the official Chinese estimates. The Stockholm International Peace Research Institute estimated that China spent $1.19 billion on defence in 2010, a 46% increase over Chinese official data.

It is even more difficult to estimate the spending on nuclear forces without knowing the specific portion of the overall military budget dedicated to nuclear weapons. Assuming that China consistently maintains 5% of its overall military expenditure for its nuclear weapons programme, as suggested by an Indian analyst, China would thus have spent between $4.5 and $9 billion on its nuclear programme in 2011. A recent report by Global Zero estimates that China's core nuclear cost to be $6.4 billion in 2011, and its full cost to be $7.6 billion.

**INTERNATIONAL LAW**

**Comprehensive Test Ban Treaty (CTBT)**

Its most recent white paper indicates that China “supports the early entry into force of the Comprehensive Nuclear Test Ban Treaty (CTBT)” and that it has “strictly abided by its commitment to a moratorium on nuclear testing and has actively participated in the work of the Preparatory Commission of the Comprehensive Nuclear Test Ban Treaty Organization, and is steadily preparing for the national implementation of the Treaty.” China signed the CTBT in 1996 but has not yet ratified it, partly because it was rejected by the US Senate in 1999. Most likely, Beijing's ratification of the CTBT will follow Washington's ratification of the Treaty.

In practice, the CTBT will constrain China's nuclear modernization the most among the NPT-recognized nuclear weapon states. China conducted only 45 tests before its testing moratorium commitment in 1996. This leaves China with a very limited number of tested warhead designs certified for deployment. The lack of test data would limit China to further develop new and smaller warheads.

Some analysts claim that China has deployed multiple independently-targeted reentry vehicles (MIRVs) on its new road mobile DF-31s and DF-31As or the JL-2 in order to defeat potential missile defences. However, China's limited nuclear test data indicate China would not be able to design sufficiently smaller warheads for MIRVing those missiles. While China is reportedly able to MIRV its older, liquid-fueled DF-5A ICBMs, China does not do it yet. Responding to a limited US missile defence system, China may prefer to take sim-
pler ways including decoys and missile defence count-
termeasures. As those DF-5A ICBMs are phased out, if
China wants to have the option to MIRV its new mobile
DF-31s and DF-31As, it would meet the technical con-
strains imposed by the CTBT.

It should be noted that MIRVing those land-based
ICBMs may be not consistent with China’s long-held
campaign for no-first-use, because MIRVs are more
appropriate for first-use nuclear attacks. However, the
further development of US missile defences could push
China to consider the option to MIRV its SLMBs. Once
again, it will be constrained by CTBT.

Fissile material cut-off treaty (FMCT)

In its recent White Paper, China’s government in-
dicated its supported for “the early commencement
of negotiations on the Fissile Material Cut-off Treaty
(FMCT) at the Conference on Disarmament (CD)”54

However, US development of missile defence will af-
fect China’s willingness to participate in FMCT nego-
tiations. Indeed, due to its concerns about US missile
defence and potential space weaponization technol-
ogy, China strongly indicated its preference to simul-
taneously address both the FMCT and the prevention
of an arms race in outer space (PAROS) during the
early 2000s. In recent years, China’s position has not
demanded simultaneous negotiations, though it con-
tinues to promote, with Russia, a draft treaty on pre-
venting space weaponization.

If Beijing remains concerned about US missile de-
defence, it might decide to build more ICBMs, which
would mean it would need more plutonium and HEU
to fuel those weapons. A calculation of this measure
would undermine possible Chinese support for FMCT
negotiations.

China currently has a military inventory of about
1.8 tons of plutonium and 16 tons of weapon-grade
HEU. It would not support an arsenal of more than
1000 warheads.55 In practice, part of the fissile mate-
rial stocks would be used as a reserve for future needs.
The other four of the five NPT-recognized nuclear
weapon states devote half or less of their fissile mate-
rials to their weapons. If this were the case for China,
the upper-boundary on its arsenal would be around
500 warheads. It should be noted that a recent study
by Georgetown Professor Phillip Karber suggests China
could have 3000 nuclear weapons based on assump-
tions that more underground tunnels means holding
more missiles and more nuclear weapons.66 Obviously,
China’s inventory of fissile materials is not able to fuel
such a huge arsenal.

China’s current fissile materials will likely provide a
sufficient amount for its current modernization plans.
However, as the United States expands its missile de-
defence system, China may seek to produce more fissile
materials, possibly going as far as to refuse to negotiate
and/or ratify an FMCT.

Nuclear disarmament

China’s official policy has always called for “the com-
plete prohibition and thorough destruction of nuclear
weapons,” as stated in its recent Defense White Paper.57
Furthermore, the White Paper emphasizes that in order
to “attain the ultimate goal of complete and thorough
nuclear disarmament, the international community
should develop, at an appropriate time, a viable, long-
term plan with different phases, including the conclu-
sion of a convention on the complete prohibition
of nuclear weapons.” China is the only country among
the five NPT nuclear weapon states to support on paper a
nuclear weapons convention (NWC). China is also the
only of these states to vote in favour of the annual UN
General Assembly resolution “Follow-up to the advis-
ory opinion of the International Court of Justice on
the Legality of the Threat or Use of Nuclear Weapons,”
which underlines “the unanimous conclusion of the In-
ternational Court of Justice that there exists an obliga-
tion to pursue in good faith and bring to a conclusion
negotiations leading to nuclear disarmament in all its
aspects under strict and effective international con-
trol,” and calls for the negotiation of an NWC.

However, China maintains that “countries possess-
ing the largest nuclear arsenals bear special and pri-
mary responsibility for nuclear disarmament” and thus
they “should further drastically reduce their nuclear
 arsenals in a verifiable, irreversible and legally-binding
manner, so as to create the necessary conditions for the
complete elimination of nuclear weapons.”

Before “the complete prohibition and thorough de-
struction of nuclear weapons,” China will continue to
modernize its nuclear force in order to assure a “lim-
ited, reliable and effective second-strike nuclear capa-
bility for deterring a first nuclear strike.” However, if
Washington and Moscow move forward to a deeper cut
of their nuclear force, China will have to reassure both
capitals that it will cap its arsenal at a low level (say 200
warheads).

PUBLIC DISCOURSE AND TRANSPARENCY

While many Western analysts complain that Beijing
keeps its nuclear force posture opaque, Beijing believes
the transparency of its nuclear strategy and nuclear
doctrine is more important than that of the force pos-
ture and that the opacity of its force posture can serve
to enhance the “deterrence effect” of its small nuclear
force. Beijing has not revealed the details of its plans
for modernization of its nuclear force; however, China’s
nuclear modernization programme will likely continue
to be guided by its nuclear policy, which is character-
ized by a no-first-use pledge and a commitment to
“minimum nuclear deterrence”.

If Beijing develops more confidence about the
survivability of its small nuclear force, the govern-
ment might become more open about its nuclear programmes. Increasing transparency and developing relevant and mutual confidence-building measures would certainly contribute to stabilizing the relationship between China and the United States, which is in everyone’s interests.

Beijing has made clear its nuclear policies by issuing defence white papers since 1998. However, the Chinese public gets information about its nuclear posture mainly through Western publications.

While some scholars and security analysts in China challenge the government’s official nuclear policies, in particular its unconditional non-first-use pledge, there are few civil society groups that engage in critical analysis of China’s nuclear weapons policies and programmes.

After US President Barack Obama declared on 5 April 2009 his vision of a nuclear weapon free world in Prague, debates have been stimulated in the Chinese public regarding whether or not China should follow suit. On 23 September 2009, the Global Times, an English-language website run by the Communist Party’s People’s Daily newspaper, conducted an online survey of the internet users. About 55% of respondents agreed to support the call for a nuclear free world, and 49% disagreed.58 The supporters believe complete dismantlement of nuclear weapons will eventually benefit China’s national interest, while others do not believe so.

The voices against China’s nuclear weapon programmes have been very weak in China. However, concerns about the safety of nuclear power plants, in particular in the wake of Japan’s Fukushima nuclear disaster in March 2011, are increasing along with the emergence of anti-nuclear movement in some local communities within China that host nuclear power reactors, through mainly online anti-nuclear campaigns.59

NOTES
5. John Lewis and Xue Litai, op. cit.
18. Ibid.
22. Stokes, op. cit.
23. Ibid.
25. See, e.g. Kristensen and Norris, op. cit.
29. Kristensen and Norris, op. cit.
33. Communications with Chinese nuclear expert, Beijing, December 2011.
38. Selection of Deng Xiaoping’s discussions on army building in the new period, Beijing: Bayi Publisher, 1993, pp. 44-45.

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41. John Lewis and Xue Litai, op. cit.
55. For a compact thermonuclear warhead, assuming the average numbers for US and Russian warheads, about 4 kgs of plutonium in the primary and about 20 kg HEU in the secondary, then 1.8 tons of plutonium, could produce about 450 warheads, which could also use about nine tons of HEU in their secondaries. The remaining seven tons of HEU might produce about 230 more warheads (assuming 10 kg of HEU for the primary and 20 kg for the secondary). Thus, a stockpile of 1.8 tons of plutonium and 16 tons of HEU could support about 680 thermonuclear warheads. Thus, even using all China’s fissile material inventory would not support an arsenal of more than 1000 warheads.
59. For instance, see the blog of China nuclear safety information center, chinanuclearsafetyinformationcenter.blogspot.com.