ANALYSIS

Tactical nuclear weapons in the modern nuclear era

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EXECUTIVE SUMMARY

As the major nuclear powers continue to modernise their nuclear forces, advances in technology are making tactical nuclear weapons more precise and sophisticated. In theory, more robust and credible nuclear arsenals will strengthen deterrence among the major nuclear powers — the United States, Russia, and China. However, these technological advances also make low-yield tactical nuclear weapons more 'usable' in a wider variety of scenarios, potentially endangering strategic stability and encouraging an arms race.

Nuclear use remains a remote possibility compared to the Cold War. Still, technological change is driving the proliferation of advanced conventional military capabilities. Today, more states than ever have the ability to launch long-range precision strikes with nuclear-capable cruise and ballistic missiles. Other conventional military systems that are capable of having strategic effects are also becoming factors in nuclear deterrence dynamics as the major nuclear powers continue to modernise their nuclear arsenals. How these conventional and nuclear programs will interact, and whether the international community can incorporate them into future arms control efforts, will determine their potential effect on strategic stability in the modern nuclear era.

In recent years, the major nuclear powers have been capitalising on advances in technology to improve the accuracy and sophistication of their tactical nuclear weapons. This has led to renewed debate within the strategic communities of some of these countries about the role of tactical nuclear weapons in both deterrence and war fighting. Other nuclear powers emphasised tactical nuclear weapons in their nuclear messaging during periods of international tension. There is a risk that the modernisation of tactical nuclear weapons could encourage a new arms race among nuclear powers and potentially even have an impact on strategic stability in the modern nuclear era.

Russia continues to upgrade its tactical nuclear delivery systems and increase its targeting capability, and may be investing in a revitalised tactical nuclear warhead program. The United States is also examining options for modernising its tactical nuclear arsenal. Debate in China over the role of nuclear weapons ebbs and flows, but its technical ability to wage a limited nuclear war within its region is growing.

This Analysis examines recent developments in technology and military doctrine with respect to tactical nuclear weapons, focusing on the three major nuclear powers — the United States, Russia and China. It assesses the implications of these developments for global strategic stability and argues that the international community needs to pursue a new round of arms control and transparency initiatives focused on tactical nuclear weapons.

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THE EVOLUTION OF TACTICAL NUCLEAR WEAPONS

There is no agreed definition of what constitutes ‘tactical’ nuclear weapons, also known as non-strategic nuclear weapons. Many attempts have been made to define the category using, variously, yield and range of the weapon, delivery vehicle, intended target, and even “national ownership”.[1] This Analysis considers tactical nuclear weapons as those designed to be used on the battlefield in counterforce targeting, or for degrading an enemy’s military capability or “capacity for aggression”.[2] For the sake of simplicity, ballistic missiles, such as the Trident D5 operated by the United States and the United Kingdom, are not considered to be tactical nuclear weapons. Strategic nuclear weapons are those that are intended to be used solely for deterrence away from the battlefield.

Another key term used in this paper is ‘strategic stability’. This refers to a situation in which nuclear weapons are unlikely to be used “deliberately, by accident or in an unauthorised way” by the key nuclear powers discussed in this Analysis.[3]

Two key technological trends are changing the way that tactical nuclear weapons could affect strategic stability: the evolution of precision strike weapons and the proliferation of advanced area-denial capabilities and credible ballistic missile defence.

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THE EVOLUTION OF PRECISION STRIKE WEAPONS

The three key nuclear powers are investing in their ability to conduct precision strike operations with cruise missiles and, in the future, hypersonic weapons. Russia and China have recently debuted a new dual-capable (conventional and nuclear) cruise missile, while the United States is currently considering investment in a new-generation weapon of this type. China and Russia are relatively new players to precision strike warfare. Their efforts to construct a "reconnaissance-strike complex", or combine precision-guided weaponry with modern sensors, intelligence, and communications, have been steadily improving since the United States first demonstrated the extent of its capabilities in this area during the Gulf War in 1991.[4]

The United States pioneered the integration of both laser targeting, and then receivers for the Global Positioning System (GPS), into air-dropped munitions and cruise missiles during the later stages of the Cold War.[5] This integration created numerous advantages, including allowing aircraft to engage a wider array of targets from longer (and safer) distances, allowing aircraft to engage more targets with fewer munitions (the force multiplier effect), and increasing the number of sorties strike aircraft can conduct.[6] The efficiency and effectiveness of this capability was demonstrated in the first Gulf War, where there was a "qualitative" change in the way precision-guided weapons were utilised against Iraq's military and infrastructure.[7] This was achieved, in part, due to a combination of technologies and concepts that began to achieve maturity during this period, including GPS. Since then, the accuracy and sophistication of US precision warfare has steadily improved, demonstrated partly by the decreasing ratio of precision-guided munitions needed per target in operations from Desert Storm through to Iraqi Freedom.[8]

China has been steadily building an increasingly capable regional intelligence, surveillance and reconnaissance (ISR) infrastructure as part of a drive to win "local wars under informatized conditions".[9] This infrastructure has included over-the-horizon radars, passive electronic surveillance systems, and other regional-based capabilities.[10] These capabilities have also been supplemented by a sustained investment in air and space-based systems, including an independent and reliable satellite position, navigation and timing (PNT) capability, the BeiDou satellite constellation.[11] Some publicly released scientific test data suggests that the BeiDou system is capable of providing accuracy to within 1 metre in some conditions.[12] These systems, in combination with data fusion centres, will give the People's Liberation Army (PLA) the ability

to conduct coordinated and precise strikes from a multitude of ballistic and cruise missiles.[13]

Russia has also made progress in this area since it commenced its significant military modernisation efforts at the turn of the century.[14] This progress was demonstrated in Syria in late 2015. In particular, the Russian Navy launched cruise missiles from submarines and surface vessels in the Caspian and Mediterranean Seas against targets in Syria.[15] Russia's indigenous PNT system, GLONASS, was critical to its ability to operate and target these missiles. The system regained full operational capability in 2011 after falling into disrepair during the 1990s.[16] The full constellation of 24 satellites provides global coverage for Russian military forces.[17] The accuracy of the data GLONASS provides is also reportedly expected to increase as the system is further modernised. Currently, GLONASS is estimated to be accurate to within 1.4 metres and is expected to improve to 0.6 metres by 2020.[18]

What impact the proliferation of credible "reconnaissance-strike complexes" will have on strategic stability has not been thoroughly considered. During the Cold War, the line between nuclear and conventional weapon use was "relatively bright and unambiguous", owing mainly to the indiscriminate nature of nuclear weapons.[19] Nuclear weapons helped to provide strategic stability because generally they could not be used without causing catastrophic and indiscriminate destruction. However, as technology has advanced in terms of missile capability, ISR, and warhead design, discriminate use of nuclear weapons may become a credible military option. Advanced precision capabilities, in combination with low-yield warheads, could, for example, potentially allow states to use tactical nuclear weapons in an attempt to dissuade a conventionally superior opponent from escalating their attacks.[20] Improving precision warfare capability may also tempt defence planners to contemplate the use of low-yield nuclear warheads for particularly difficult targets that are buried underground and protected by advanced area-denial capabilities. Other types of warheads, such as so-called "clean" nuclear weapons (fusion reactions that result in minimal radiation fallout) are also challenging the traditional distinction between conventional and nuclear warfare.[21]

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The evolution of technology is also raising the prospect of decapitation strikes in a crisis or conflict situation. Decapitation strikes, where the political and military leadership and command and control facilities of a nuclear power are eliminated before they are able to order a retaliatory attack, were a significant element of Soviet anxiety during the Cold War.[22] The advent of increasingly credible precision strike technology, cruise missile capabilities, global strike delivery platforms, and hypersonic weapons have all made such strikes more feasible.[23] Indeed, there are some indications that Russia's improved submarine-borne nuclear-capable cruise missile capability may already be playing a role in nuclear deterrence dynamics between Moscow and the Washington.[24]

Additionally, a lesson that emerged from the Cold War period is that the competing nuclear modernisation programs of the United States and the Soviet Union were "interactive", in that both sides feared "being placed at a disadvantage in crises or a breakdown of deterrence".[25] For strategic stability, this can lead to a cycle of improvement and investment in nuclear arsenals that can become more "diversified and filled out" and can turn force structures into ones seemingly "suited for war-fighting rather than deterrence". During the Cold War, this became more obvious through an "increasing emphasis on flexibility, 'nuclear options'" and other similar dictums.[26] The increasing technological capability of all three major nuclear powers to launch sophisticated tactical nuclear weapon strikes may also provide incentives for similar arms race dynamics.

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ANTI-ACCESS/AREA-DENIAL AND CREDIBLE BALLISTIC MISSILE DEFENCE

A second set of technological developments that is affecting strategic stability is the development of anti-access/area-denial capabilities and credible ballistic missile defence.

Over the last 20 years, Russia and China have developed and fielded advanced anti-access/area-denial capabilities while the United States has established an increasingly credible ballistic missile defence system. These capabilities are part of the "strategic balance" between the three established nuclear powers.[27] But they also provide incentives for the modernisation of each country's tactical nuclear weapons.

The fielding of anti-access/area-denial capabilities and their associated doctrinal strategies by Russia and China is playing a role in the debate regarding the future of Washington's nuclear arsenal, particularly the need for a new nuclear-capable cruise missile and bomber. At a basic level, anti-access/area-denial capabilities are conventional military systems that (a) endeavour to prevent the entry of military forces into a given theatre of operations and (b) disrupt the freedom of action of those forces if they gain entry to a certain geographic area.[28] The US Department of Defense has used the anti-access/area-denial "challenge" as a reason for the modernisation of US nuclear-capable cruise missile capability.[29] General Robin Rand, Commander of the US Air Force Global Strike Command, stated recently that the current US nuclear-capable cruise missile would be unable to survive in the present "anti-access, area-denial environment".[30] The Pentagon sees these strategic conventional capabilities as a threat to both its ability to control and maintain escalation superiority if deterrence fails.[31] However, it is clear from some of the details released so far regarding the United States' proposed next-generation nuclear-capable cruise missile that a significantly more capable and precise tactical nuclear weapon capability is being sought.[32]

In a similar vein, US investment in credible ballistic missile defences is influencing the development of nuclear-capable cruise missiles and other

tactical nuclear weapon capabilities in Russia and China. Cruise missiles are more likely to evade missile defence capabilities because of their ability to be launched from multiple directions and multiple platforms, to approach targets below radar, and to deliver payloads with a high degree of accuracy. While Moscow's nuclear-capable cruise missile programs can trace their roots to the Soviet era, NATO's build-up of missile defence capabilities in Europe has seen Russia direct greater investment towards these capabilities.[33] There is also evidence that ballistic missile defence deployments in South Korea and Japan have influenced Beijing's strategic calculus.[34] The US THAAD missile system that will be deployed to South Korea has been the subject of cyberespionage originating from China, and Beijing has continued to modernise and build both conventional and nuclear capabilities that could effectively penetrate US ballistic missile defence systems.[35] Further, the United States has also recognised both the proliferation of cruise missile capabilities and its own weakness in terms of defence technologies against them.[36] Regardless, it is clear that strategic ballistic missile defence has had a role in an evolving action-reaction dynamic concerning nuclear-capable cruise missiles and tactical nuclear weapons.

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COUNTRY PROGRAMS

The technological advances driving the resurgence of tactical nuclear weapons are not uniformly impacting the way that the major nuclear powers might use such weapons. Differences in technological capability as well political and strategic circumstances, among other factors, all shape the approach each nuclear power takes in the modernisation of their respective nuclear forces.

RUSSIA

After the fall of the Soviet Union, nuclear weapons were the most important means Russia had for offsetting the qualitative and quantitative military advantages of other global powers, most notably the United States but also China. The 2014 Ukraine crisis, however, demonstrated what some analysts saw as a growing willingness by Moscow to use nuclear weapons as a coercive tool against other countries.[37] Moscow's "hybrid warfare" campaign and annexation of Crimea were supported by threats that Russia would use the "full spectrum of military capabilities".[38] For example, Russia's Foreign Minister, Sergei Lavrov, stated on 9 July 2014 that Moscow has a doctrine of national security that is "very clear" on what action would be taken in response to any aggression against its "territory" in Crimea.[39] Lavrov also asserted in December 2014 that the country had the right to station nuclear weapons in Crimea if it chose to do so.[40] And Russia stepped up nuclear bomber patrols and exercises outside Russian territory during the crisis.[41]

By some estimates Russia maintains the largest inventory of tactical nuclear weapons in the world. Concrete information regarding the status

of Moscow's tactical nuclear capabilities and warhead numbers is, however, elusive. A recent estimate puts Moscow's tactical nuclear warheads that are assigned for delivery at just below 2000.[42] A competing study, published in 2012, projected Russia's tactical arsenal at only 1000 nuclear warheads that are ready for use.[43] A WikiLeaks report detailed a classified NATO briefing given in 2009 that estimated Russia still possessed between 3000 and 5000 tactical nuclear weapons.[44] Whatever the figure, it is agreed that a large number of Russia's tactical nuclear weapons are in storage, either awaiting dismantlement or held in reserve. There are also numerous systems in the Russian military capable of delivering these warheads, from cruise missiles and artillery to anti-submarine systems and a variety of aircraft.[45]

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NATO's military campaign in Yugoslavia in 1999 was a turning point for Russia in terms of its interest in tactical nuclear weapons. While the United States had demonstrated its precision strike capabilities during the Gulf War in 1991, it was the air campaign in Yugoslavia, in the face of opposition from Moscow, that changed the Russian debate about tactical nuclear weapons.[46] According to one account, during a Russian Security Council meeting in 1999, chaired by the then Council Secretary, Vladimir Putin, discussion quickly turned to the role of "non-strategic nuclear weapons … in dealing with intervention threats from modern conventional, precision strike forces".[47] During the meeting, Russian media reported that President Boris Yeltsin had authorised the upgrading of Russia's nuclear research sector and the development of a new doctrine for the use of non-strategic nuclear weapons.[48] This doctrine and new research into tactical nuclear weapons would give Russia the ability to "carry out precision, low-yield 'non-strategic' strikes anywhere in the world".[49]

Russia was in a good position to carry out this new nuclear research: the last nuclear weapon the Soviets worked on was a low-yield high-radiation tailored device.[50] However, publicly available evidence about this research program and how much progress it has made is thin. Sporadic public statements from Russian government officials and media reports suggest that Moscow embarked on a new tactical nuclear weapon design program during the late 1990s. Many of these statements come from the late Viktor Mikhailov, a senior nuclear scientist and former head of Russia's military nuclear program. Mikhailov suggested in a 1996 report that Russia could develop tailored or low-yield nuclear devices without having to conduct explosive testing.[51] It has been reported that in 1998, Mikhailov resigned from his Ministry of Atomic Energy position to direct "the development of a new generation of low-yield nuclear weapons" to counter NATO expansion.[52] The status of this supposed program has been the subject of debate within the US intelligence community and between US nuclear experts.[53] Given that Russia is improving its tactical nuclear weapon delivery capabilities, concurrent work on new warheads would be logical.

There is also evidence that Russia may not have carried out all of its commitments regarding the decommissioning of tactical nuclear weapons. As part of the Presidential Nuclear Initiatives (PNIs) agreed to by President Mikhail Gorbachev in October 1991, Russia committed to eliminate all nuclear artillery munitions and nuclear warheads meant for use in "tactical missiles" and "a portion" of the sea-based and air-launched tactical nuclear stockpile.[54] These pledges were reconfirmed by President Yeltsin.[55] However, since then, Russian officials have argued that the PNIs only committed Russia to "removing" nuclear weapons from its ground forces, rather than "eliminating" them.[56] Russian officials have made contradictory statements regarding the status of Russia's tactical nuclear warhead program, particularly its land-based elements.[57] It is also worth noting that Russia's commitment to the PNIs was not ratified by the Russian parliament, meaning the stand-down was never set within a legal or public framework. This raises further questions regarding Moscow's continuing adherence to the PNIs, as any change to Russia's tactical nuclear weapon posture would not require any legal revision.[58]

While many of Russia's tactical nuclear systems date from the Soviet era, Moscow has demonstrated several new capabilities. In December 2015, as part of its intervention in support of the regime of Bashar al-Assad, Russia launched its new Kalibr cruise missile at targets in Syria from a submarine in the Mediterranean.[59] Shortly after the launch, the Kremlin published a statement from President Putin in which he praised the effectiveness of the missiles and noted that these are "highly effective high-precision weapons that can be equipped either with conventional or special nuclear warheads".[60] The Kalibr (which also has an air-launched version) has a reported range of 2000 kilometres, giving Russia a modern and precise theatre nuclear attack capability.[61] In addition to this demonstration of the Kalibr's precision strike capabilities, there is growing evidence that Russia may be equipping its attack submarines and their cruise missiles with tactical nuclear warheads while on patrol, including off the eastern seaboard of the United States.[62]

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The increasing precision and capability of Russia's sea-based tactical nuclear cruise missiles is a significant cause for concern regarding strategic stability. This development could encourage the planning of a decapitation strike scenario, limited nuclear strikes on command and control networks, and an action-reaction dynamic involving increased investment in missile defence and conventional forces.[63]

Shortly before Russia's operational use of the Kalibr missile in Syria, US media, citing Pentagon officials, reported that Russia was working on a new underwater weapon with a nuclear warhead, Status-6.[64] The weapon is essentially an underwater drone designed to attack coastal cities and harbours with a thermonuclear weapon specially designed to spread large amounts of radioactive fallout.[65] Slides of the nuclear drone later 'accidentally' appeared on Russian television, but quickly disappeared from the Russian media. There is reason to be sceptical about the status

and progress of the program but other elements of the system, such as the submarines designed to launch the drone and the container that houses it, are being constructed.[66] The Soviet Union had started a similar project in the late 1980s. If this project is indeed proceeding, the development of the specialised and highly radioactive warhead needed for the delivery vehicle would be yet more evidence that Russia has been working on new nuclear warhead designs.

Alongside evidence of a revitalised Russian tactical nuclear weapons program, there have been mounting questions about changes to Russian nuclear doctrine.

Alongside evidence of a revitalised Russian tactical nuclear weapons program, there have been mounting questions about changes to Russian nuclear doctrine. There have been signs since the end of the Cold War that the threshold for any decision by Moscow to use such weapons was being lowered, in large part out of fear of NATO's conventional forces. For example, *The Basic Provisions of the Military Doctrine of the Russian Federation*, released in 1993, saw Moscow abandon the Soviet Union's commitment to no first use policy. Other Russian military documents published in 1998 and 2003 tasked Russia's nuclear forces with "deterring regional conventional conflicts".[67] Russia justifies the use of nuclear weapons in defence of threats to the state.[68] However, as some analysts have pointed out, what constitutes a threat to the state has been left undefined and is likely "ambiguous by design".[69]

One key indicator that Russia's threshold for the use of nuclear weapons may be lower than for other states is its so-called policy of 'de-escalation'. This is where Russia would make limited use of nuclear weapons in a situation in which it was facing a technologically or conventionally superior adversary to inflict "damage [that is] subjectively unacceptable to the opponent [and] exceeds the benefits the aggressor expects to gain as a result of the use of military force".[70] In the Russian view, the limited use of nuclear weapons would, paradoxically, de-escalate any conventional conflict by forcing Russia's opponents to cease their attacks.[71] Russian military thinkers envision that the limited use of nuclear weapons would range from "demonstration" strikes in unpopulated areas to the targeting of low-value military targets as a way of signalling and controlling escalation.[72]

THE UNITED STATES

The United States is fast approaching a time when it will need to make significant decisions concerning the composition of its nuclear arsenal. Options being discussed include warhead modernisation, the development of new delivery platforms, and the upgrading of command and control mechanisms as well as supporting infrastructure. This modernisation is not in and of itself necessarily harmful to strategic stability. Some of the new capabilities under consideration, however, arguably go beyond the principles outlined in the 2010 Nuclear Posture Review, which proposed a national security policy that was less reliant on nuclear weapons.[73]

A debate over the shape of the US nuclear arsenal has been sharpened by geopolitical developments, including a resurgent Russia, a rising China, and the increasing anti-access challenge for the United States globally. At multiple levels in Washington, including the armed forces, the Department of Defense, former officials, military officers, and strategic and defence policy experts have argued that a more "flexible" and "dynamic" nuclear arsenal is needed for deterrence, but also for use in limited regional scenarios if necessary.[74]

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Officially, the United States designates only one type of weapon in its nuclear arsenal as tactical: the B61 nuclear gravity bomb. The B61 has three modified sub-strategic variants: the B61-3, B61-4, and B61-10. Two other variants, the B61-7 and B61-11, are designated as strategic weapons. The United States has 500 B61 bombs in its arsenal, with 180 of these forward deployed to five European countries and Turkey. These forward deployed weapons are the B61-3 and B61-4 variants, which have reported yields of 0.3–170 kilotons and 0.3–50 kilotons, respectively.[75] A further 2740 tactical warheads are in storage.[76]

The proposed modernisation plans for the B61 will see a drop in the number of officially designated tactical nuclear weapons held by the United States. But it will also result in a more capable and potentially usable weapon.[77] The Obama administration's proposal to "modernise to downsize" these weapons will see the creation of a single new B61 variant — the B61-12. The result will be a new version of the bomb with a dialable yield and other enhanced capabilities. The most controversial aspect of the B61-12 is the addition of a guidance tail kit, upgrading the gravity weapon's accuracy. There is some speculation that the weapon might also be upgraded with a GPS capability, making it potentially accurate within a 5 metre radius.[78] This, together with the weapon's low yield, will increase the range of potential targets that the weapon could be used against.[79]

The development of the Long-Range Standoff (LRSO) air-launched cruise missile also raises questions about the future employment of nuclear weapons by the United States. The LRSO is intended to replace the existing nuclear-capable air-launched cruise missile, the AGM-86. Significant controversy surrounds the LRSO, specifically regarding cost but also its intended mission.[80] While the United States lists the nuclear-armed variant of AGM-86 as a strategic weapon, public statements by US defence officials have suggested that the LRSO will have a more tactical role. For example, a letter from the Pentagon to Congress in May 2016 states that the nuclear-armed LRSO is a necessary requirement for future US presidents, as they may require "lower yield options" in response to "limited" attacks against US or allied forces overseas, "even if a conventional weapon could also destroy the target".[81] Another letter signed by Under Secretary of Defense Frank Kendall stated that the missile will provide "flexible options across the full range of threat scenarios".[82] Public statements by officials have reinforced this

perception. US Assistant Secretary of Defense Robert Scher in congressional testimony has said the LRSO will provide options for "controlling and limiting escalation throughout all stages of a potential conflict". He also noted that the missile would increase the "accessible space of targets that could be held at risk".[83] In 2014 Major General Garrett Harencak, then Assistant Chief of Staff for Strategic Deterrence and Nuclear Integration for the US Air Force, described a "nuclear use" phase before actual nuclear war in which bombers would use nuclear weapons against regional and near-peer adversaries.[84] Analysts have pointed to these statements as evidence that the LRSO is thought of not only in terms of its deterrence capability, but also as an "offensive nuclear strike weapon".[85]

One motivating factor in the development of the LRSO is the evolution of anti-access capabilities. In particular, it appears that the Pentagon considers its next-generation bomber, the B21, armed with the nuclear version of the LRSO, as a key weapon to defeat the anti-access and area-denial capabilities of both Russia and China. In a letter to Congress, the Pentagon cited the 2012 US defence posture document *Sustaining US Global Leadership: Priorities for 21st Century Defense.* The intention was to remind readers that in the strategy, the president "reaffirmed the need for US forces to project power and hold at risk any target at any location on the globe, to include anti-access and area-denial environments".[86] The US Air Force has repeatedly stated that while the next-generation bomber is essential to "penetrating" these denial capabilities, the nuclear standoff capability that the LRSO will provide is also "vital . . . to effectively conduct global strike operations in anti-access and area-denial environments".[87]

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Alongside these modernisation efforts, a growing chorus of US strategic and defence policy experts, mostly former government officials, have been arguing for a shift in US nuclear doctrine and capability. These views provide support for those within government arguing for an upgraded B-61 and the LRSO. For example, the Project Atom report published in 2015 by the Center for Strategic and International Studies argued that the United States required the ability to forward deploy "a robust set of discriminate nuclear response options" and "special-effects warheads" including "low collateral, enhanced radiation, earth penetration, electromagnetic pulse" and other weapons.[88] Such weapons would support a 'measured response strategy' designed to control escalation, even at the "lower end of the nuclear continuum".[89] Others have argued that the United States requires both "limited and decisive" nuclear options for potential conflicts against nuclear-armed adversaries.[90] These arguments have been set within the context of an eroding US conventional military advantage, where the imperatives to rely on nuclear weapons, and in particular tactical nuclear weapons, will increase.[91]

CHINA

To date, China has shown relatively little interest in deploying tactical nuclear weapons or changing its nuclear doctrine to one based on nuclear war fighting. This is consistent with Beijing's long-standing minimum deterrence posture that relies on a relatively small number of intercontinental and medium-range ballistic missiles. Minimum deterrence has been paired with a pledge of no first use, which has been upheld by successive Chinese leaders and looks unlikely to change in the near term.[92]

Open-source information on the development of China's nuclear program makes it clear Beijing has possessed the capability to manufacture low-yield tactical nuclear weapons for some time. In 1972, a declassified US intelligence assessment reported that the testing in November 1970 of a low-yield device with a "boosted plutonium primary", including static land-based tests and drops from a military aircraft, "marked a new phase" in Beijing's nuclear program.[93] Additionally, the Central Intelligence Agency has assessed that the last phases of Chinese nuclear testing during the 1990s were geared towards the development of miniaturised warheads for a cruise missile and possibly a nuclear artillery shell.[94] Recent studies support the view that some of these tests also explored specialty warhead designs, primarily an enhanced radiation weapon or neutron device, motivated by an anxiety within Beijing about the modernisation programs of US and Soviet nuclear forces.[95] Nevertheless, most experts agree that while China likely has the ability to produce these warheads, there is no evidence that they have been deployed or mated with a delivery vehicle.[96]

While there is no evidence China has produced tactical nuclear warheads, Beijing has significantly improved the capabilities necessary to field them. China has been developing a nuclear-capable cruise missile and has introduced new nuclear-capable medium-range ballistic missiles into its strategic rocket forces. China's nuclear-capable cruise missile, the DH-10 (and its variants), has been under development for some time.[97] Ground- and air-launched versions of the cruise missile have been developed (the CJ-10 and KD-20, respectively) and deployed, with a 2009 US Department of Defense report stating that the PLA had 150–350 of the ground-launched version in service.[98] These weapons have ranges of (depending on the source) 1500 to 2500 kilometres and an anti-ship version is also being developed.[99] Although most of these cruise missiles produced to date are likely to be armed with conventional warheads, a small number are reputedly "reserved" for nuclear missions.[100]

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China has also recently introduced the H-6K, a heavily redesigned version of its H-6 bomber. The H-6K, which is capable of carrying six to seven KD-20s, has modern electronics, an improved airframe, and Russian designed engines that will allow it to conduct precision strike missions.[101] The KD-20, combined with the upgraded H-6K and an increasingly capable C4ISR infrastructure,[102] could conceivably allow China to conduct

long-range, nuclear precision strike missions. This is a capability that only Russia, the United States, and France have maintained since the Cold War.[103]

China's other advance is this area has been in the field of intermediate- and medium-range ballistic missiles (IRBMs and MRBMs, respectively). Beijing has multiple nuclear-capable IRBMs and MRBMs, notably the road-mobile and solid-propellant DF-21 with a reported range of 2500 kilometres and the recently revealed DF-26, a derivative of the DF-21 with a range of 3000–4000 kilometres.[104] Paraded at Beijing's 3 September 2015 commemorations marking the 70th anniversary of Japan's surrender to China, officials claimed that the "DF-26 can perform medium-to-long-range precision attack on both land and large-to-medium-sized maritime targets".[105] If true, the DF-26 would allow China to use nuclear weapons in a theatre precision strike role.[106] In practice, as with China's cruise missiles, most of these missiles will be equipped with conventional warheads with likely only a few reserved for nuclear use.

Ultimately, China's commitment to no first use will be shaped by its perception of its strategic environment and, in particular, by its relationship with the United States.

In terms of doctrine, there is evidence of at least interest within the PLA of the role of nuclear weapons in conventional conflict.[107] So far, however, opinion seems firmly on the side of not altering China's nuclear doctrine.[108] In 2005 Zhao Xijun, former Deputy Commander of the Second Artillery Corps, argued China should not just have "strategic nuclear forces but also campaign and tactical nuclear forces". He also noted that China's tactical missile force could "carry a nuclear warhead or a special warhead according to the needs of the task and strike targets".[109]

Zhao's reasoning also suggests why China might change its nuclear posture in the future. Discussing China's long-standing no first use policy, Zhao laid out several scenarios. One was a conventional war in which the "enemy threatens to implement conventional strikes against . . . [China's] strategic targets, such as the nuclear facilities". In order to protect these assets, Zhao argued, "and to arrest the escalation of conventional war to nuclear war, one should employ nuclear weapons to initiate active nuclear deterrence against the enemy".[110] Senior PLA officers have also expressed an interest in the usefulness of electromagnetic pulse weapons and other speciality warheads in "hi-tech local war".[111] Other Chinese military publications have explored different nuclear doctrine strategies, particularly those that differentiate between a "large-scale nuclear and a small-scale nuclear counter-attack campaign".[112]

Ultimately, China's commitment to no first use will be shaped by its perception of its strategic environment and, in particular, by its relationship with the United States. Chinese strategists are watching closely for any "changes in the strategic posture of the United States that could threaten China's retaliatory capability".[113] US and Chinese nuclear modernisation programs, as well as the continuing development by both countries of advanced conventional military systems that are capable of strategic effects, could lead to an arms race between the two countries. If China

broadened the "roles its nuclear weapons are intended to play beyond deterring nuclear attacks or coercion" as a result of concerns about the modernisation of the US nuclear arsenal, the United States would in turn face increased pressure to maintain its "strategic primacy".[114] The application of limited nuclear war-fighting doctrines in Asia would have significant consequences for the region's strategic stability.

IMPLICATIONS

Technological changes in the area of tactical nuclear weapons means they are increasingly accurate and reliable, and therefore usable. A range of geostrategic factors could incentivise the three key nuclear powers to reconsider the role of such weapons in their military strategies, including in plans for conventional or limited nuclear warfare. And as one or more of these countries modernises their strategic arsenals or changes their war-fighting doctrine, the others are likely to follow. The risk of a return to a nuclear arms race is very real.

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It is important not to be alarmist about these developments. Some of the programs mentioned above may never be realised, defeated by technological obstacles, budgetary pressures, or domestic politics. Militaries may well incorporate tactical nuclear weapons into their conventional war-fighting plans, but the political and psychological threshold for political leaders actually deciding to use these weapons remains high. Using a nuclear weapon in the arcane world of military theorising is still a lot easier than using one in real life.

The fact that war fighting with tactical nuclear weapons remains largely a potential problem rather than a present one provides an opportunity for the international community to mitigate the risks associated with these weapons. One option would be a new international arms control treaty covering tactical nuclear weapons.

Currently, the international treaties and agreements governing some aspects of tactical nuclear weapons are the PNIs and the Intermediate-Range Nuclear Forces Treaty (INF Treaty). As outlined above, there are serious doubts regarding Russia's continued adherence to its PNI commitments. In 2004 Moscow declared that it was no longer bound by them and that they were a "goodwill gesture rather than an obligation".[115] The INF Treaty is also under pressure. The US State Department has claimed that Russia has violated the Treaty by testing a land-based cruise missile with a range of between 500 and 5500 kilometres.[116] The US government has not, however, publicly released any detailed information on the test.[117]

One such proposal for a new international agreement in relation to tactical nuclear weapons is for a treaty setting a minimum-yield threshold for tactical nuclear warheads.[118] The authors of this proposal contend that establishing an international norm against low-yield tactical nuclear

weapons would be an important first step towards a ban on tactical nuclear weapons.[119] An international treaty for minimum-yield nuclear weapons has merit. Blurring the threshold between conventional and nuclear weapons is one of the greatest dangers concerning strategic stability and tactical nuclear weapons. As precision strike capabilities improve, incentives may develop for nuclear weapon states to take advantage of these new technologies by further lowering the yield of tactical nuclear weapons. This would allow for a more credible deterrence and for greater escalation control or dominance if deterrence were to fail. Working to establish a treaty that would ensure the clear separation of conventional and nuclear weapons, and therefore reinforce the nuclear-use taboo, would be an important element in strengthening strategic stability among the major nuclear powers.

Short of a major new arms control treaty on tactical nuclear weapons, the international community should focus on promoting greater transparency about these weapons. Aside from the statements made during the PNIs, there is no verified data on the true extent of the world's stock of tactical nuclear warheads. Greater transparency regarding the size of tactical nuclear stockpiles would be an important first step towards establishing international norms against their modernisation. Transparency is critical to any efforts to establish trust-building measures between nuclear-armed states, a "component … and prerequisite" of the disarmament process.[120] The United States has been relatively open about the number and specifications of its tactical nuclear warheads. More international pressure should be applied to Russia to disclose the shape and character of its tactical nuclear arsenal. Greater transparency with regard to the modernisation of tactical nuclear capabilities by the key nuclear powers would also be helpful. As was evident during the Cold War, transparency can help "mitigate the risk that emerging technologies will endanger strategic stability by triggering arms races …".[121]

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For Australia, the renewed interest in tactical nuclear weapons deserves greater consideration, especially as the strategic dynamics in Asia evolve. The *2016 Defence White Paper* mentions nuclear weapons in the context of failed states and non-state actors, as well as the instability risks emanating from South Asia and North Korea. However, there is no mention of great power nuclear competition, including in Asia. The technological forces that are propelling more precise tactical nuclear weapon capabilities are unlikely to abate in the near or medium-term future. China's ability to project power is expanding throughout the Asia-Pacific region, including to Australia's northern reaches.[122] Also, recent developments in Beijing's nuclear arsenal suggest it may be responding to advances in US counterforce capabilities and missile defences.[123] These evolving dynamics directly affect Australia's national security in a number of ways, such as whether Canberra should use the Navy's new air warfare destroyers in a joint missile defence network with the United States.

Australia has a long history of international advocacy on arms control, including through the Canberra Commission on the Elimination of Nuclear Weapons and the International Commission on Nuclear Non-proliferation and Disarmament. However, there are signs that Canberra's position on arms control is shifting. Recently, Australia led a group of 14 "umbrella states", each of which rely on extended nuclear deterrence provided by the United States, in opposition to a proposal at the United Nations to bring forward negotiations for a global ban on nuclear weapons.[124] Internal documents released by the Department of Foreign Affairs and Trade pursuant to a freedom of information request suggest that Australia is concerned about the impact of such a negotiation on US extended nuclear deterrence. As one briefing note states, "as long as nuclear weapons exist, Australia will continue to rely on US nuclear forces to deter nuclear attack on Australia".[125]

…there are signs that Canberra's position on arms control is shifting.

Any reservations held by the current government about a global ban on nuclear weapons would not preclude it from supporting "practical, realistic measures" for nuclear disarmament. Neither a minimum-yield treaty or a total ban on tactical nuclear weapons would significantly undermine Australia's reliance on extended deterrence and would, in fact, contribute to strategic stability. Australia, as a non-nuclear weapon state, can play a substantial role in both raising the issue of tactical nuclear weapons in international forums and building momentum towards a tactical nuclear weapons treaty.[126]

CONCLUSION

Technological advancements are having an impact on the modernisation and capability of the major powers' nuclear arsenals. The proliferation of precision strike systems and infrastructure has also raised the possibility that this capability may affect the nuclear sphere. Other dynamics, stemming from area-denial and credible ballistic missile defence systems, are also leading to more precise and sophisticated means of delivering tactical nuclear weapons. Indeed, there is already evidence that submarine-borne nuclear-capable cruise missiles are playing a role in the nuclear deterrence dynamics between the United States and Russia.

These developments raise questions about the future of strategic stability between the world's major nuclear powers. Nuclear use remains a remote possibility compared to the time of the Cold War era. However, technology is changing the way states may consider tactical nuclear weapons in the future. The blurring of the threshold between conventional and nuclear weapons is a serious possibility with low-yield warheads and precision warheads. The same can be said of the potential for decapitation or targeted strikes against high-value targets during a conflict or crisis situation, as well as the potential for arms races. States such as Australia with an interest in arresting any potential weakening of strategic stability between the major nuclear powers have a role to play in contributing to strategic stability in the modern nuclear era.

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