sipri

NEW TECHNOLOGIES AND NUCLEAR DISARMAMENT

Outlining a Way Forward

TYTTI ERÄSTÖ

STOCKHOLM INTERNATIONAL PEACE RESEARCH INSTITUTE

SIPRI is an independent international institute dedicated to research into conflict, armaments, arms control and disarmament. Established in 1966, SIPRI provides data, analysis and recommendations, based on open sources, to policymakers, researchers, media and the interested public.

The Governing Board is not responsible for the views expressed in the publications of the Institute.

STOCKHOLM INTERNATIONAL PEACE RESEARCH INSTITUTE

HIROSHIMA PREFECTURE

NEW TECHNOLOGIES AND NUCLEAR DISARMAMENT

Outlining a Way Forward

TYTTI ERÄSTÖ

sipri

STOCKHOLM INTERNATIONAL
PEACE RESEARCH INSTITUTE

May 2021

Contents

Acknowledgements

The author would like to thank the Hiroshima Prefectural Government for its generous funding of this paper. She is also indebted to several reviewers who provided valuable feedback on the report: external reviewers Professor Andrew Futter and Dmitry Stefanovich, as well as SIPRI colleagues, including Dr Ian Anthony, Dr Sibylle Bauer, Dr Lora Saalman, Dan Smith, Dr Petr Topychkanov, Pieter D. Wezeman and Robert E. Kelley.

Dr Tytti Erästö

Summary

This report analyses the prospects for nuclear disarmament in light of recent military-technological advances, focusing on precision-strike weapons and missile defences. While many of the technologies employed in these advanced weapon systems cannot be described as new, their application to strategic military uses represents a more recent development whose impact on nuclear deterrence and, in particular, nuclear disarmament remains poorly understood.

The report argues that the tension between deterrence and disarmament can be bridged through a 'transitional approach' which acknowledges both the urgent need for progress towards a nuclear weapon-free world and the security-related challenges in its way. It views the resumption of bilateral arms control between Russia and the United States as the most important step towards disarmament at the present moment, as a broader process involving all nuclear-armed states is hardly possible without prior and significant reductions in the largest nuclear weapon arsenals. To enable such reductions, these two countries should move away from their cold-war era nuclear doctrines that seek an ability to win a nuclear war. Instead, they should pursue a policy of 'minimal nuclear deterrence' focused on deterring a nuclear attack. If these two countries were to adopt such a policy—and, ideally, also make a nuclear no-first-use (NFU) pledge—this would constitute a crucial intermediate goal towards comprehensive nuclear disarmament.

Although disarmament ultimately means giving up nuclear deterrence, the intermediate goal of minimal nuclear deterrence would not require consensus on the feasibility of the end goal of nuclear abolition. Instead, the shared goal of nuclear risk reduction might be a sufficient motivation for Russia and the USA to embark on significant nuclear weapon reductions.

They could begin such cuts by removing nuclear weapons from regional conflict dynamics, meaning that they would no longer serve as a deterrent against conventional aggression. Such a change—which could involve a ban on non-strategic nuclear weapons in Europe—would not undermine regional deterrence. This move, the report argues, would not undermine regional deterrence, as each side already has robust conventional forces comprised of precision-strike weapons and other advanced military systems. Together with the abandonment of cold war-era nuclear doctrines focused on extensive counter-force targeting, this would open the door for significant reductions of nuclear stockpiles.

Such progress, however, would be complicated by current challenges to strategic stability posed by US missile defences and long-range precision-strike weapons, notably hypersonic weapons. These systems have raised the bar for credible nuclear deterrence by creating uncertainty about US adversaries' second-strike capabilities. To address this problem, the report proposes treaty-based limits on strategic missile defences and strengthened international norms against both nuclear and conventional aggression, in particular against preventive war. Together with a clear stigma against nuclear weapons, such measures could also pave the way for the kind of systemic change that is required for further progress towards a nuclear weapon-free world.

Abbreviations

ABM Treaty	1972 Anti-Ballistic Missile Treaty
ASAT	anti-satellite
C3	command, control and communications
CPGS	Conventional Prompt Global Strike
GBI	ground-based interceptor
ICBM	intercontinental ballistic missile
INF Treaty	1987 Intermediate Range Nuclear Forces Treaty
MDR	Missile Defense Review
NATO	North Atlantic Treaty Organization
New START	2010 Treaty on Measures for the Further Reduction and Limitation of Strategic Offensive Arms
NFU	no first use
NPR	Nuclear Posture Review
NPT	1968 Treaty on the Non-Proliferation of Nuclear Weapons
RMA	Revolution in Military Affairs
SALT	Strategic Arms Limitations Talks
SDI	Strategic Defense Initiative
SLBM	submarine-launched ballistic missile
START I	1991 Treaty on the Reduction and Limitation of Strategic Offensive Arms
TPNW	2017 Treaty on the Prohibition of Nuclear Weapons
WMD	weapons of mass destruction

1. Introduction

Much of the current analysis on the impact of ongoing technological evolution on nuclear deterrence is driven by concerns about strategic stability. Reflecting the view that this impact is predominantly negative, the attribute 'disruptive' is often used to refer to new kinds of destabilizing weapons, or to technologies that potentially enable their development.[1] While specific weapons types are sometimes identified as representing new technologies, the issue is perhaps best understood in terms of a general trend towards greater precision, speed, manoeuvrability, stealth and tracking capabilities of contemporary military systems, as well as non-kinetic means of attack, notably in the cyber realm.[2]

This trend poses a challenge to strategic stability.[3] More specifically, new technologies may create 'crisis instability' through their potential to increase the risk of nuclear escalation, for example through miscalculation and the entanglement of nuclear and conventional weapons.[4] A related problem is that—insofar as they are able to destroy hardened and concealed targets—modern conventional systems could be used to forcefully disarm an adversary.[5] Together with improvements in strategic defences that could neutralize the effects of retaliatory strikes, these emerging capabilities are weakening deterrence by undermining nuclear-armed states' confidence in their ability to launch a retaliatory second strike.[6] By driving nuclear-armed states to engage in new armament dynamics to preserve their second-strike capability, new technologies are thus also undermining 'arms race stability': the other key pillar of strategic stability.

Focusing in particular on the latter aspect of strategic stability, this report analyses the pitfalls and possibilities that such weakening of deterrence presents for nuclear disarmament. On the one hand, it starts from the assumption that the arms race instability created by new technologies will likely complicate efforts to cut nuclear weapon stockpiles. Illustrative of the pitfalls, China and Russia have already responded to the emerging United States' strategic capabilities by reinforcing their nuclear arsenals in an effort to maintain mutual deterrence. On the other hand, the report considers the possibilities for harnessing the current military-technological evolution to facilitate disarmament, notably by exploring the idea of substituting nuclear deterrence with conventional deterrence.

[1] Roberts, B., 'Emerging and disruptive technologies, multi-domain complexity, and strategic stability: A review and assessment of the literature', Lawrence Livermore National Laboratory, Center for Global Security Research, Feb. 2021.

[2] Futter, A., 'The risks posed by emerging technologies to nuclear deterrence', eds B. Unal, Y. Afina and P. Lewis, *Perspectives on nuclear deterrence in the 21st century*, Chatham House Research Paper (Royal Institute of International Affairs: London, Apr. 2020).

[3] Strategic stability has been defined as consisting of crisis stability and arms race stability. Crisis stability is defined as a situation in which leaders are not incentivized 'to strike first, in particular with nuclear weapons, to avoid suffering the consequences of an enemy's first move'. Arms race stability refers to 'the absence of perceived or actual incentives to augment a nuclear force—qualitatively or quantitatively—out of the fear that in a crisis an opponent would gain a meaningful advantage by using nuclear weapons first'. See Brustlein, C., 'The erosion of strategic stability', Institut Français des Relations Internationales (IFRI), Proliferation Paper no. 60 (Nov. 2018); and Acton, J. M., 'Reclaiming strategic stability', eds E. A. Colby and M. S. Gerson, *Strategic Stability: Contending Interpretations* (US Army War College Press: Carlisle Barracks, PA, Feb. 2013), pp. 117–45.

[4] See. e.g. Boulanin, V. et al., *Artificial intelligence, strategic stability and nuclear risk* (SIPRI: June 2020); and Acton, J. 'Escalation through entanglement: How the vulnerability of command-and-control systems raises the risks of an inadvertent nuclear war', *International Security*, vol. 43, no. 1 (2018).

[5] 'Hardening' is a common practice to protect nuclear weapon facilities by placing them deep underground and by reinforcing them with materials that can withstand the effects of potential counterforce strikes. 'Concealment'—notably though the deployment of nuclear-armed missiles in submarines or mobile land-based launchers—provides such protection by making location and tracking difficult. See e.g. Lieber, K. A. and Press, D. G, 'The new era of counterforce: Technological change and the future of nuclear deterrence', *International Security*, vol. 41, no. 4 (spring 2017).

[6] Futter (note 2).

In line with the broad definition of new technologies presented above, the analysis is not limited to any specific newly emerged or emerging weapon type. Rather, the report focuses on existing but continuously evolving advanced conventional systems—notably precision-strike weapons and missile defences—that are increasingly shaping strategic dynamics among nuclear-armed states. These systems rely on various technologies, in particular digital information technology that has enabled the modern command, control and communications (C3) underlying much of the recent advancements in weapon accuracy and speed. While not entirely new, the application of such systems to strategic military uses represents a more recent development whose impact on nuclear deterrence and, especially, on nuclear disarmament still remains poorly understood.

This report consists of three parts. Chapter 2 discusses the prospects of overcoming the persistent security paradigm of nuclear deterrence, drawing from previous discussions on minimal and conventional deterrence, as well as the general requirements for a nuclear weapon-free world. On this basis, the report argues for a 'transitional approach' that acknowledges pragmatic concerns regarding security-related obstacles to disarmament but at the same time aspires for a profound systemic change in the international nuclear status quo towards a nuclear weapon-free world.

Chapter 3 considers ways in which recent advances in conventional precision-strike weapons and missile defences affect the prospects for further nuclear weapon reductions by Russia and the USA. It argues that the adoption of the policy of 'minimal nuclear deterrence' by these two largest nuclear weapon possessors would be a crucial intermediate goal towards a nuclear weapon-free world. As noted in chapter 4, the current strategic instability created by advanced conventional weapons also affects other nuclear-armed states and the prospects for multilateral disarmament. In addition, chapter 4 considers ways in which new technologies could, in theory, be used to facilitate nuclear disarmament. Finally, chapter 5 contains policy recommendations for short- and medium-term measures to address some main bottlenecks to nuclear disarmament identified in the report and chapter 6 provides conclusions.

By combining both the pragmatic and visionary perspectives on nuclear disarmament, the report seeks to narrow the gap between abolitionism and deterrence-focused approaches that marks current debates related to the 1968 Treaty on the Non-Proliferation of Nuclear Weapons (Non-Proliferation Treaty, NPT), and the 2017 Treaty on the Prohibition of Nuclear Weapons (TPNW).[7] At the same time, it sheds light on the impact of new technologies on both nuclear deterrence and disarmament, to which those debates have thus far paid relatively little attention.

[7] Erästö, T., 'The NPT and the TPNW: Compatible or conflicting nuclear weapon treaties?', SIPRI WritePeace Blog, 6 Mar. 2019; and Treaty on the Non-Proliferation of Nuclear Weapons (Non-Proliferation Treaty, NPT), opened for signature 1 July 1968, entered into force 5 Mar. 1970, INFCIRC/140, 22 Apr. 1970; and Treaty on the Prohibition of Nuclear Weapons (TPNW), opened for signature 20 Sep. 2017; entered into force 22 Jan. 2021, A/CONF.229/2017/8.

2. The nuclear deterrence paradigm: An enduring challenge to disarmament

Despite the NPT-based international consensus on the need for disarmament and non-proliferation of nuclear weapons, several countries claim a right to possess and threaten to use such weapons to deter aggression. In addition to ensuring national security, these countries often also perceive nuclear deterrence to be essential for maintaining international stability.[8] Although the majority of the world's countries do not subscribe to this paradigm, the nine nuclear-armed states and those 30 non-nuclear weapon states that rely on extended nuclear deterrence are deeply invested in it.[9] This chapter considers ways to overcome this dependence on nuclear deterrence. It explores how to manage insecurity within, and during, the transition towards a nuclear weapon-free world. It also discusses some mechanisms that have been proposed to maintain a nuclear weapon-free world.

I. 'Transitional' approach: Bridging the gap between deterrence and disarmament

While states that rely on nuclear deterrence often express support for nuclear disarmament as a long-term objective, they tend to highlight security-related obstacles that prevent any practical measures for moving towards that objective. This often leads to a cautious approach that rarely looks beyond modest steps, or even gives rise to complacency about the risks inherent in the prevailing status quo. Disarmament advocates, in contrast, tend to view this complacency as a key obstacle to reducing and ultimately eliminating nuclear weapons, and seek to address it by building political will and by strengthening the anti-nuclear weapon norm. Since the negotiation of the TPNW in 2017, many disarmament advocates have focused such efforts on supporting the treaty.[10]

The current political debates surrounding the TPNW sometimes give the impression that the objectives of nuclear deterrence and disarmament are irreconcilable; while the supporters of the TPNW highlight the urgency of nuclear abolition, its opponents warn of the dangers of weakening deterrence in an insecure world.[11] The contradiction can be traced to varying degrees of belief in the possibility of change in the global status quo, much in line with the realist and idealist International Relations traditions. While the deterrence-minded tend to be guided by the realist assumption that the propensity for conflict in the international system is relatively immutable, disarmament builds on the idealist belief in the prospects for change based on international cooperation and stronger international norms.[12]

Seen in these terms, the gap between deterrence and disarmament is bridgeable through a 'transitional' approach—meaning a gradual and managed, rather than a

[8] US Mission to the United Nations, 'Joint press statement from the permanent representatives to the UN of the United States, United Kingdom, and France following the adoption of a treaty banning nuclear weapons', 7 July 2017.

[9] In addition to the five nuclear-armed parties to the NPT (China, France, Russia, the United Kingdom and the United States), Israel, India, North Korea and Pakistan possess nuclear weapons. The 27 North Atlantic Treaty Organization (NATO) members that are defined as non-nuclear weapon states under the NPT all rely on extended nuclear deterrence provided by the USA, and five of them (Belgium, Germany, Italy, the Netherlands and Turkey) host US nuclear weapons. In the Asia-Pacific region, the USA has extended nuclear deterrence commitments to Australia, Japan and South Korea.

[10] See for example the International Campaign to Abolish Nuclear Weapons (ICAN) 'Cities Appeal' whereby cities are urging their governments to join the TPNW. See ICAN, '#ICAN Save My City', n.d.

[11] See e.g. Erästö (note 7).

[12] Brown, C., 'Structural realism, classical realism and human nature', *International relations*, vol. 23, no. 2 (June 2009).

sudden and revolutionary change towards a nuclear weapon-free world. Although an incremental approach has long been advocated by nuclear-armed states and their allies in the context of the NPT review process, their long-standing failure to match words with actions has undermined its credibility. In contrast, the transitional approach, as understood here, stresses the urgency of taking concrete steps to tackle obstacles in the way of further nuclear cuts and, ultimately, of universal disarmament. Although the gradual approach has become associated with complacency and apologism for nuclear deterrence, disarmament advocates would surely welcome any interim steps towards reducing nuclear weapon numbers and related risks if actually taken. In terms of reducing nuclear weapon numbers, the most important step would be for Russia and the USA to resume bilateral arms control negotiations, which have been deadlocked since the negotiation of the 2010 Treaty on Measures for the Further Reduction and Limitation of Strategic Offensive Arms (New START).[13]

II. Minimal deterrence: An interim step towards a nuclear weapon-free world

Progress on global nuclear disarmament depends to a large extent on Russia and the USA. These two countries' nuclear weapon stockpiles number in the thousands, while no other nuclear-armed state possesses more than China's 320 nuclear weapons.[14] Unlike Russia and the USA, the other nuclear-armed states have not seen the need for huge arsenals because their nuclear weapons mainly serve the purpose of deterring aggression. Reflective of this limited purpose, China, France and the United Kingdom base their postures on 'minimal nuclear deterrence'—that is, a policy of maintaining nuclear weapon numbers at the lowest possible level perceived necessary for a credible deterrent effect. While China 'keeps its nuclear capabilities at the minimum level required for national security' and the UK maintains a 'minimum, credible, independent nuclear deterrent', France 'applies the principle of strict sufficiency in maintenance of its nuclear deterrence capability'.[15]

Minimal deterrence can also be seen to underlie calls for major reductions in Russian and US nuclear stockpiles. Proponents of such reductions often argue that both countries could lower their arsenals to a few hundred while still retaining a viable nuclear deterrent.[16] Indeed, deterring aggression does not require large stockpiles, as even a small number of nuclear weapons can inflict unacceptable damage to the adversary. [17] Rather, the large Russian and US stockpiles are a legacy of cold war nuclear doctrines that were focused not only on deterring but also winning a nuclear war in case deterrence failed.

[13] In February 2021, Russia and the USA decided to extend the New START, with each stating their interest in follow-on negotiations, which have not yet begun at the time of writing. See Reif, K. and Bugos, S., 'USA, Russia extend New START for five years', *Arms Control Today*, Mar. 2021; and Russian–US Treaty on Measures for the Further Reduction and Limitation of Strategic Offensive Arms (New START), signed 8 Apr. 2010, entered into force 5 Feb. 2011.

[14] While Russia and the USA are estimated to possess 6375 and 5800 nuclear warheads, respectively, and China is believed to possess 320 nuclear weapons, the arsenals of the remaining six nuclear-armed states are all below 300. See Kile, S. N. and Kristensen, H. M., 'World Nuclear Forces', *SIPRI Yearbook 2020: Armaments, Disarmament and International Security* (Oxford University Press: Oxford, 2020).

[15] Chinese Ministry of National Defense (MND), *China's National Defense in the New Era* (MND: Beijing, 24 July 2019); British Government, *Global Britain in a Competitive Age: The Integrated Review of Security, Defence, Development and Foreign Policy*, CP403 (Stationery Office: London, 16 Mar. 2021); and French Ministry for the Armed Forces, *White Paper on Defence and National Security 2013* (French Directorate of Legal and Administrative Information: Paris, 2013).

[16] While the figure of 300 has been mentioned in past US debates as the basis for minimal deterrence, one Russian analyst recently argued that Russia and the USA could reduce their arsenals 'at least to 1000' as a next step in joint reductions. See Perkovich, G., *Toward accountable nuclear deterrents: How much is too much?*, Working paper (Carnegie Endowment for International Peace: Washington, DC, Feb. 2020); and Kortunov. A., 'Perspectives on the arms control agenda in 2021: Obstacles and opportunities', online panel discussion, SIPRI, 14 Apr. 2021.

[17] Perkovich (note 16).

This quest for nuclear supremacy revolved around efforts to achieve an ability to control and dominate escalation.[18] This was seen to require 'counterforce' targeting—that is, directing nuclear weapons against the adversary's respective nuclear forces and C3 systems. While sometimes portrayed as morally less reprehensible than 'counter-value' targeting—whereby nuclear weapons are aimed at high-value targets, such as population centres—the counterforce mission can hardly be described as such. Military targets are often located within or near civilian population centres and they are typically hard to destroy, therefore calling for the need to direct several nuclear weapons at a single location.[19] Counterforce targeting also highlighted the need to match the other side in terms of the number and quality of its nuclear weapons and to keep modernizing one's own forces so as to make them both more survivable and effective against the other side's protective measures.[20]

The worst-case scenario in US and Soviet nuclear thinking during the cold war was a surprise attack whereby one side would seek to disable the retaliatory capability of another, who might then try to pre-empt such an attack with a first strike of its own.[21] Yet, arguably a much greater risk was posed by the idea of limited nuclear war, which was most explicitly articulated in the North Atlantic Treaty Organization's (NATO) 'flexible response' strategy since the late 1960s. According to this strategy, a limited nuclear strike—whereby damage would be kept to a minimum by using relatively low-yield non-strategic nuclear weapons—provided a more credible alternative to the threat of massive nuclear retaliation in deterring conventional aggression in a regional context.[22] Even if deterrence failed and one would need to carry out the threat, the assumption, or hope, was that the other side would refrain from a nuclear response or respond in a limited way, so that an all-out nuclear war could be avoided. As several observers have noted, this theory might fail catastrophically if ever tested in reality.[23] Yet, the concept of limited nuclear war still underlies both US and Russian nuclear strategy today, providing a key rationale for their non-strategic nuclear forces.

Therefore calls for deep nuclear cuts to Russian and US nuclear arsenals are often accompanied with arguments on the need for doctrinal changes—notably for limiting the role of nuclear weapons to the sole purpose of retaliation in response to a nuclear first strike. If nuclear weapons would be limited to this retaliatory mission, there would be no need for any 'escalation management' or 'damage limitation' capabilities for fighting a nuclear war.[24] It would also mean that the additional missions envisaged in several nuclear-armed states' doctrines in the post-cold war period—notably the idea of using nuclear weapons to deter chemical, biological or cyber attacks—should be abandoned.[25]

Minimal deterrence based on a purely retaliatory capability would go hand in hand with a no-first-use (NFU) policy—that is, a declaratory policy renouncing the first use of nuclear weapons.[26] A NFU policy is also more credible if it is accompanied with a policy of minimal nuclear deterrence, as countries with small nuclear arsenals can be

[18] Perkovich (note 16).

[19] Perkovich (note 16).

[20] Perkovich (note 16).

[21] See Schelling, T. C., *The Reciprocal Fear of a Surprise Attack* (Rand Corporation: Santa Monica, CA, 1958).

[22] North Atlantic Treaty Organization (NATO), 'Final Decision on MC 14/3: Report by the Military Committee to the Defence Planning Committee on overall strategic concept of the North Atlantic Treaty Organization Area', MC 14/3(Final), 16 Jan. 1968.

[23] See e.g. Burr, W., 'Looking back: The limits of limited nuclear war', *Arms Control Association*, 29 Aug. 2008.

[24] Kristensen, H. M., Norris, R. S and Oelrich, I., 'From counterforce to minimal deterrence: A new nuclear policy on the path toward eliminating nuclear weapons', Occasional Paper no. 7 (Federation of American Scientists/The Natural Resources Defense Council: Washington, DC, Apr. 2009).

[25] Erästö, T. and Topychkonov, P., 'Towards greater restraint: Raising the threshold for nuclear weapon use', SIPRI Insights on Peace and Security no. 2020/6, May 2020.

[26] Yet, France and the UK—which claim to have a minimal deterrence policy—retain the right to the first use of nuclear weapons. See e.g. Erästö and Topychkonov (note 25).

considered less likely to start a nuclear war.[27] While the USA's extended deterrence requirements have been viewed as an obstacle to NFU, US President Joe Biden has previously supported a 'sole purpose' policy—which represents a somewhat weaker form of restraint highlighting the retaliatory function of nuclear weapons while not ruling out first use.[28]

While a NFU policy would outline the most straightforward path towards minimal deterrence, significant nuclear weapon reductions might also be compatible with the logic of escalation control. This is because Russia and the USA—in addition to their perceived need to match each other's nuclear arsenals—have a shared interest to prevent uncontrolled escalation leading to a global nuclear war. As the size of nuclear arsenals is proportional to the consequences of escalation, the most effective way to reduce the escalation risks would be for Russia and the USA to cooperatively reduce their arsenals while maintaining a rough parity between them.[29] Indeed, it might be a joint effort at managing nuclear risks that ultimately leads Russia and the USA to embrace minimal deterrence, rather than the desire to move towards the end goal of complete nuclear disarmament.

Were Russia and the USA to move towards minimal deterrence, this would open the door for multilateral arms control involving all nuclear-armed states. China frequently argues that it is ready to join the arms control process only when Russia and the USA substantially reduce their current stockpiles.[30] The other nuclear-armed states also tend to stress that the two largest nuclear weapon possessors are responsible for making initial progress towards disarmament.[31] Indeed, it seems that only at a point when all nuclear-armed states have in place a policy of minimal deterrence it becomes possible to engage in serious discussions on how to move beyond that intermediate goal. At least in theory, the absence of capabilities to wage a nuclear war, combined with a universal NFU policy, could make nuclear deterrence obsolete by ruling out the possibility of intentional nuclear war.

The Russian and US decision in January 2021 to extend the New START by five more years has created hope that the two parties might find a way to break the deadlock that has prevented further progress towards nuclear weapon reductions for over a decade.[32] However, this would require that they not only overcome the political tensions that have been building up since the Russian annexation of Crimea in 2014, but also address deeper-seated strategic issues that are closely linked with the recent military-technological evolution (see chapter 3).

III. Increasing reliance on conventional deterrence

While progress towards nuclear disarmament would require reducing reliance on, and ultimately giving up nuclear deterrence, the need for conventional deterrence can be expected to remain and increase during the process. As argued below, in some cases such a change would be logical from a security perspective, whereas in others

[27] Mohan, P., 'Is nuclear deterrence in the cards for India and China?', South Asian Voices, 9 Sep. 2020.

[28] While sometimes difficult to distinguish, no first use (NFU) represents a commitment never to use nuclear weapons for other than retaliating a nuclear attack, whereas 'sole purpose' policy—being a declaration of purpose rather than pledge to limit actions to that purpose—might still allow for such an exception. See Panda, A. and Narang, V., 'Sole purpose is not no first use: Nuclear weapons and declaratory policy', *War on the Rocks*, 22 Feb. 2021.

[29] Perkovich (note 16).

[30] Fu, C. (Director-General, Department of Arms Control, Chinese Ministry of Foreign Affairs), Interview with Kommersant, 16 Oct. 2020.

[31] Preparatory Committee for the 2020 NPT Review Conference, Third Session, 'Nuclear disarmament', Statement by France, 2 May 2019.

[32] Although New START was extended just before its expiry in February 2021, the 1987 Intermediate Nuclear Forces (INF) Treaty collapsed in 2019.

giving up nuclear weapons would be more likely to be seen to compromise national or international security.

To assess the prospects for reducing the role of nuclear weapons, one must first understand what role they are currently seen to be serving. Nuclear-armed states do not exclusively rely on nuclear weapons, but rather, their deterrence policies are based on a combination of conventional and nuclear forces. While the latter are reserved only for the most extreme situations, it is commonly assumed that conventional inferiority indicates greater reliance on nuclear deterrence. Indeed, a major driver for the proliferation of nuclear weapons has been their equalizing effect in asymmetrical conflicts, as the destructive nature of these weapons leaves little doubt about the retaliatory capacity of a state possessing them.

Conventional deterrence, in contrast, is based on a more complex set of factors not only having to do with the quality of weapons but also their quantity, military tactics, command structures, and morale. This is why conventional deterrence—even when based on seemingly superior military capabilities—is always contestable, meaning that the capacity of a state to carry out its threat is subject to doubt.[33] In addition to being viewed as a power equalizer by weaker states, nuclear weapons are also thought to reduce this uncertainty, thus augmenting conventional power.[34]

At the same time, the undeniably destructive potential of nuclear weapons is a downside for deterrence. As noted above, even limited nuclear strikes against nuclear-armed adversaries could lead to unintended escalation, which would be self-defeating for all sides. Gambling with this risk verges on insanity, which makes threats of nuclear weapon use lack credibility in all but the most extreme circumstances. Indeed, a careful consideration of the catastrophic consequences of nuclear weapon use suggests that the risks inherent in this kind of gamble far outweigh the dangers related to the uncertainties of conventional deterrence.[35]

A strong case can therefore be made that conventional deterrence is more credible and less risky than nuclear deterrence in preventing conventional aggression. To be sure, countries that view nuclear weapons as an essential power equalizer and guarantee against existential threats are unlikely to give them up despite the risks. Absent of major military asymmetry, however, confidence in one's conventional forces—combined with a realistic understanding of the risks of nuclear escalation—makes it logical to shift from nuclear to conventional deterrence.

Hence it would seem that the role of nuclear weapons could be most easily reduced in regional settings where such weapons serve to augment a strong conventional deterrent. This can be seen to be the case with the USA's extended deterrence commitments in Asia and Europe and—as argued in the next chapter—also with the current Russian deterrence policy vis-à-vis NATO. In practice, reducing the role of nuclear weapons in these cases would mean excluding the threat of a nuclear response against conventional aggression, in line with the NFU policy discussed in the previous chapter. Particularly when combined with negative security assurances—that is, the commitment by nuclear-armed states not to use nuclear weapons against non-nuclear weapon states—this would open the door for a significant reduction in nuclear arsenals.[36] (For resistance to NFU policy among US allies, see chapter 5.)

[33] See Wirtz, J. J., 'How does nuclear deterrence differ from conventional deterrence?', *Strategic Studies Quarterly*, vol. 12, no. 4 (winter 2018); and Brustlein, C., 'Conventonalizing deterrence: US prompt strike programs and their limits', IFRI, Proliferation Paper no. 52, Jan. 2015.

[34] ven Bruusgaard, K., 'Russian nuclear strategy and conventional inferiority', *Journal of Strategic Studies*, vol. 44, no. 1 (2021).

[35] See for example Mills, M. et al., 'Multidecadal global cooling and unprecedented ozone loss following a regional nuclear conflict', *Earth's Future*, vol. 2, no. 4 (14 Feb. 2014).

[36] Wolfsthal, J., 'America should welcome a discussion about NATO's nuclear strategy', *Bulletin of the Atomic Scientists*, 29 June, 2020.

In contrast, removing nuclear weapons from strategic relations among nuclear-armed states would be more difficult. As postulated by the 'nuclear peace' theory, it is possible that a nuclear weapon-free world would be more unstable than the current one as the major powers' tendency towards aggression would no longer be restrained by 'mutual assured destruction'.[37] In addition to more frequent, albeit less destructive wars, even minor conventional military asymmetries could be perceived as significant vulnerabilities, potentially triggering new armament dynamics.[38]

It should be noted that the alleged stability created by nuclear deterrence has always involved enormous risks and has failed to prevent armed conflict or conventional arms races. Yet, instability and perceptions of conventional vulnerability could ultimately make a nuclear weapon-free world unsustainable if some states reverted back to nuclear deterrence to address that problem once and for all. This can be seen to indicate a need to partially base international stability on a balance of power—that is, an equilibrium based on a roughly equal distribution of power among potential adversaries whereby no single country can dominate others.[39] However, military solutions alone can hardly ensure stability. In addition to a relatively stable balance of power, there is also the need for a more cooperative international society which can reduce mistrust and the potential for conflict in a nuclear weapon-free world.

IV. The need for a more cooperative international society

Achieving and maintaining a nuclear weapon-free world is hardly possible without a shift towards a more cooperative international society based on strong institutions and a firm commitment to shared norms. In addition to a comprehensive norm against nuclear weapons—presumably based on the TPNW—new norms would likely be needed to prevent aggression and to alleviate security concerns related to real and perceived military asymmetries.

As the creation of the United Nations after World War II and other international institutions shows, the evolution of international society can be advanced through sustained actions in support of multilateralism and shared norms. It is also possible to address persistent security dilemmas through diplomacy—including arms control and various security and confidence-building measures. Indeed, arms control and disarmament diplomacy can be expected to play a crucial role in the path towards global zero—not only by reducing nuclear weapons but also by transforming conflicts between nuclear-armed states and by building up trust though verifiable limits and reductions on their nuclear arsenals.[40]

In addition to political will, arms control and disarmament require innovative verification solutions, as demonstrated by the history of Russian/Soviet–US nuclear diplomacy. New nuclear disarmament verification solutions would be needed particularly when moving from limits on delivery vehicles to the elimination of nuclear warheads.[41] Although the first significant steps towards disarmament would likely take place in the context of bilateral Russian–US arms control, the requirements for verification would further increase with multilateral disarmament. Verifying global

[37] Sagan, S. D. and Waltz., K. N., *The Spread of Nuclear Weapons: A Debate Renewed*, 2nd edn (W. W. Norton: New York, 2003).

[38] Rajagopalan, R., 'Power balances and the prospects for a stable post-nuclear-weapons world', in Adwood, D. and Munro, E. J. (eds), *Security in a world without nuclear weapons*, Geneva Centre for Security Policy, 2013.

[39] Little, R., *Balance of power in international relations: Metaphors, myths and models* (Cambridge University Press: Cambridge, 2014).

[40] Müller, H., 'Security in a nuclear-weapons-free world: Thinking out of the box', in Adwood, D. and Munro, E. J. (eds), *Security in a world without nuclear weapons*, Geneva Centre for Security Policy, 2013.

[41] Several international initiatives, including the Quad Nuclear Verification Partnership and the International Partnership for Nuclear Disarmament Verification (IPNDV) are currently seeking to address the warhead verification challenge.

nuclear disarmament would require a rigorous monitoring system and significantly strengthened nuclear safeguards to ensure timely detection of any attempts at new proliferation or reconstitution of dismantled arsenals.[42]

In addition, it is often argued that a global nuclear disarmament verification system would require a credible enforcement mechanism allowing coercive measures against rule breakers.[43] In extreme cases, this could mean preventive, rather than just punitive, measures, taken collectively to destroy any emerging nuclear weapon arsenals in a nuclear weapon-free world. Reflecting the shortcomings of the current international system, the UN Security Council would likely not have either the legitimacy or ability to perform such a role. This could be seen to point to the need for institutional reforms, potentially based on a more representative 'concert' of major powers committed not only to disarmament but also other basic norms like respect for sovereignty and rejection of efforts at military domination.[44]

[42] Erästö, T., Komžaite, U. and Topychkanov, P., 'Operationalizing nuclear disarmament verification', SIPRI Insights on Peace and Security no. 2019/3, Apr. 2019.

[43] See e.g. Preparatory Committee for the 2020 Review Conference of the Parties to the Treaty on the Non-Proliferation of Nuclear Weapons, Second Session, 'Creating the conditions for nuclear disarmament: Working paper submitted by the USA', NPT/CONF.2020/PC.II/WP.30, 18 Apr. 2018.

[44] Müller (note 40).

3. New technologies and prospects for minimal nuclear deterrence in Russia and the United States

As noted above, a Russian and US shift towards minimal nuclear deterrence would be a crucial intermediate goal towards nuclear disarmament, but even small steps towards further nuclear reductions are currently complicated by political tensions as well as the increasing complexity of arms control due to recent military-technological evolution. This chapter focuses on the latter, more structural part of the problem, tracing it mainly to the USA's development of advanced conventional systems—precision-strike weapons and missile defenses—over the past two decades. The term 'new technologies' is used here with the caveat that these complex systems have evolved over a long time by integrating different technological solutions, such as satellites, radars, software and sensor technology. While some of these technologies can hardly be described as new, the ongoing evolution of advanced conventional weapons also involves certain emerging technologies—such as hypersonic weapons as a basis for the development of long-range precision-strike capability, or the exploration of high-energy lasers to increase the effectiveness of missile defences. From the point of nuclear deterrence, the most significant novel aspect of this evolution is the increasing effort to employ such systems for strategic military purposes. As argued below, this presents not only challenges but also some opportunities for nuclear arms control and disarmament.

I. Conventional precision-strike: Alternative to nuclear weapons?

Precision-strike and related C3 technologies have been employed in regional conflicts since the US-led intervention in the 1990–91 Gulf War—an operation often depicted as a watershed moment for the so-called Revolution in Military Affairs (RMA).[45] This chapter discusses the development of precision-strike weapons in the USA and Russia, and explores their effect on nuclear disarmament. In line with the previous argument about the need to reduce reliance on nuclear weapons in regional settings, precision-strike weapons can be seen to provide an opportunity for disarmament by increasing nuclear-armed states' or their allies' confidence in their conventional power. However, given their potential to undermine nuclear second-strike capabilities, long-range precision-strike weapons pose a challenge for strategic nuclear weapon reductions.

Opportunities for nuclear–conventional substitution by the United States

For about two decades following the end of the cold war, the RMA based on high-precision weapons provided the USA and its allies with an unmatched conventional capability. Together with the collapse of the Soviet Union, this conventional superiority facilitated a reduction of US nuclear weapons, including the withdrawal of most of the US non-strategic nuclear weapons from allied territories in the early 1990s.[46] Western countries nevertheless retained their first use doctrines and the NATO nuclear sharing policy, whereby five European allies host US non-strategic nuclear weapons despite their official status as non-nuclear weapon states.[47]

[45] Mahnken, T. G., 'Weapons: The growth & spread of the precision-strike regime', *Daedalus*, vol. 140, no. 3 (summer 2011).

[46] Credi, O., 'US Non-strategic nuclear weapons in Europe: Necessary or obsolete?', American Security Project, 2019.

[47] Coletta, D. V., 'Deterrence logic and NATO's nuclear posture', *Strategic Studies Quarterly*, vol. 7, no. 1 (spring 2013).

At the same time, deterrence among nuclear-armed states receded into the background while counterproliferation was central to the USA's threat perceptions.[48] As a result, in the 1990s and early 2000s, the focus shifted increasingly to the notion of preventive military action against the emerging capabilities of potential weapons of mass destruction (WMD) proliferators. For the first time, the 2001 US Nuclear Posture Review (NPR) envisaged a role for nuclear weapons in this counterproliferation mission, in particular by highlighting the need for low-yield nuclear weapons that can destroy hardened targets such as underground bunkers.[49] In general, however, conventional weapons were seen as more suitable for this new mission, given the high threshold for breaking the taboo on nuclear weapon use.[50]

These practical considerations also contributed to the US Conventional Prompt Global Strike (CPGS) programme, which also emerged in the early 2000s, and aimed to provide the USA with the ability to hit any target on earth within one hour.[51] By extending the range of its existing precision-strike weapons, the CPGS was to fill a perceived capability gap between US conventional and nuclear capabilities.[52] In particular, if CPGS weapons would be effective against hardened targets, they could provide a more acceptable alternative to earth-penetrating low-yield nuclear weapons.[53] CPGC weapons could also enhance the USA's ability to target mobile missile-launchers and anti-satellite weapons (ASAT), and to bypass advanced air and missile defences that are often depicted as key to the regional defence or so-called 'A2/AD' capabilities of China and Russia.[54] Thus, CPGS weapons—whose development has been criticized for the lack of a clear mission—could potentially serve various purposes, ranging from counterproliferation to ensuring the USA's advantage in regional conflicts against other major powers.[55] In practice, the CPGS programme has mostly focused on long-range hypersonic weapons.[56] The USA is also developing shorter-range hypersonic weapons as part of a general effort to bolster its conventional capabilities.[57]

Consistent with its disarmament agenda, President Barack Obama's administration stressed the potential of CPGS weapons to partly substitute nuclear weapons and thus pave the way for a nuclear doctrine that would be limited to the 'sole purpose' of deterring a nuclear attack.[58] Obama described the CPGS as part of a broader effort to ensure 'that our conventional weapons capability is an effective deterrent in all but the most extreme circumstances.'[59] These aspirations can be seen to be consistent with the goal of minimal nuclear deterrence. The Obama administration also explored a

[48] Counterproliferation refers to efforts to combat WMD and other weapons proliferation, for example through national law-enforcement and intelligence, as well as by military means. See e.g. National Defense University, *The Counterproliferation Imperative: Meeting Tomorrow's Challenges* (Center for Counterproliferation Research, National Defense University: Washington D.C, Nov. 2001).

[49] See e.g. Federation of American Scientists, 'Excerpts from classified Nuclear Posture Review', Nuclear Posture Review Report, 8 Jan. 2002.

[50] Gormley, D. M., 'The path to deep nuclear reductions: Dealing with American conventional superiority', IFRI, Proliferation Paper, 2009.

[51] Acton, J. M., 'Silver bullet? Asking the right questions about conventional prompt global strike' (Carnegie Endowment for International Peace: Washington, DC, 2013).

[52] Bunn, M. E. and Manzo, V. A., 'Conventional Prompt Global Strike: Strategic asset or unusable liability?', Institute for National Strategic Studies, National Defense University, Strategic Forum no. 263, 2011.

[53] For the problems related to earth-penetrating low-yield nuclear weapons, see e.g. Nelson, R. W., 'Nuclear Bunker Busters, Mini-Nukes, and the US Nuclear Stockpile', *Physics Today*, vol. 56, no. 11 (Nov. 2003).

[54] Brustlein (note 33); and Kofman, M., 'It's time to talk about A2/AD: Rethinking the Russian military challenge', *War on the Rocks*, 5 Sep. 2019.

[55] Sayler, K. M., 'Hypersonic weapons: Background and issues', Congressional Research Service (CRS) Report for Congress R45811 (US Congress, CRS: Washington, DC, 1 Dec. 2020).

[56] Acton (note 51); and Woolf, A., 'Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues', CRS Report for Congress R41464 (US Congress, CRS: Washington, DC, 16 Dec. 2020).

[57] Woolf (note 56).

[58] US Department of Defense (DOD), Office of the Secretary of Defense, *Nuclear posture review report* (DOD: Arlington, VA, 2010).

[59] Sanger, D. E. and Shanker, T., 'US Faces choice on new weapons for fast strikes', *New York Times*, 22 Apr. 2010.

NFU policy but ultimately decided against it based on security concerns expressed by US allies.[60] Indeed, a NFU policy by the USA would have had implications particularly for the part of extended deterrence that reserved the right for the first use of nuclear weapons against conventional aggression.

While apparently abandoning the idea of nuclear–conventional substitution, President Donald J. Trump's administration continued to support the CPGS programme.[61] At the same time, it accelerated efforts to apply precision-strike technology to develop new low-yield nuclear weapons.[62] The 2018 NPR argued that low-yield nuclear weapons were needed to enhance the credibility of deterrence against regional aggression and 'to penetrate adversary defenses'.[63] While the assumed military benefits of low-yield nuclear weapons have previously been linked to counterproliferation, the NPR presented their development as a response to the perceived threat from Russia.[64] The USA deployed low-yield W76-2 warheads on its Trident submarine-launched ballistic missiles (SLBMs) in early 2020.[65] Prior to that, the modification of the B61 warhead—which was part of the Obama administration's nuclear modernization efforts—had already provided the USA with a new low-yield nuclear option.[66]

At the time of writing, it appears that the ambitious goals of the CPGS programme still remain at the level of aspiration; while the USA continues to develop both long- and short-range hypersonic weapons, it has thus far not deployed either type.[67] The USA also still does not seem to have an effective capability to destroy deep underground targets by conventional means—which can be seen to be provide one rationale for its development of new low-yield nuclear warheads.[68]

Opportunities for nuclear–conventional substitution by Russia

The Russian perspective on precision-strike was initially shaped by its sense of vulnerability related to the USA's technological advantage with such weapons. In addition to Russian threat perceptions related to its conventional inferiority vis-à-vis US and NATO forces in Europe, some in Russia worried that US conventional weapons—such as its air- and sea-launched cruise missiles—could be able to destroy hardened targets, such as Russian intercontinental ballistic missiles (ICBM) silos.[69] Such counterforce concerns were subsequently increased by the CPGS programme.[70]

The post-cold war tilt in the conventional balance of power in favour of the USA increased Russia's reliance on nuclear weapons. Reminiscent of NATO's cold war strategy against the Warsaw Pact, in 1993 Russia renounced the Soviet-era NFU policy and subsequently began to emphasize non-strategic nuclear options in an apparent

[60] See e.g. Roberts, B., 'Debating first use, again', *Survival*, vol. 61, no. 3 (2019).

[61] Woolf (note 56).

[62] While high-yield nuclear warheads do not need to be accurate to cause extensive destruction, the effectiveness of low-yield nuclear weapons is based on their accuracy. See e.g. Kristensen, H. M. and Korda, M., 'Tactical nuclear weapons, 2019', *Bulletin of the Atomic Scientists*, vol. 75, no. 5 (2019).

[63] US DOD, Office of the Secretary of Defense, *Nuclear posture review* (DOD: Arlington, VA, 2018).

[64] While the NPR did not explicitly link this mission to low-yield nuclear weapons, it stated that the USA continues 'to field a range of conventional and nuclear capabilities to hold at risk North Korea's underground facilities'. See US DOD (note 63).

[65] US DOD, 'Statement on the fielding of the W76-2 Low-Yield Submarine Launched Ballistic Missile warhead', Press release, 4 Feb. 2020.

[66] Kristensen, H. M., 'B61 LEP: Increasing NATO nuclear capability and precision low-yield strikes', Federation of American Scientists, 15 June 2011.

[67] Sayler (note 55).

[68] US National Research Council, *Effects of nuclear Earth-penetrator and other weapons* (The National Academies Press: Washington, DC, 2005); and Bender, J. 'The 30 000-pound bomb that could be used against Iran's nuclear facilities "boggles the mind"', Business Insider, 25 June 2015.

[69] Acton, J. (ed.), *Entanglement: Russian and Chinese perspectives on nuclear weapons and nuclear risks* (Carnegie Endowment for International Peace: Washington, DC, Feb. 2017).

[70] Acton, J., 'Conventional prompt global strike and Russia's nuclear forces', Carnegie Endowment for International Peace, 4 Oct. 2013.

effort to compensate for the shortcomings in its conventional forces.[71] At the same time, Russia sought to catch up to the USA's conventional weapons capabilities. By the mid-2010s it had developed several precision-strike capabilities of its own, including the Iskander-M missile system and several new types of cruise missiles.[72]

Although there are indications that the resulting confidence in its conventional power lessened Russia's reliance on nuclear weapons for regional deterrence, its precision-strike systems are dual capable and as such no substitute for nuclear weapons.[73] Yet, Russia's stated policy of not deploying nuclear warheads in its non-strategic delivery vehicles, as well as some of its recent proposals regarding the non-deployment of land-based intermediate-range missiles in Europe, suggest that Russia might be ready to reduce the role of its non-strategic nuclear weapons.[74]

In contrast, Russia's long-range hypersonic weapons—such as the Avangard hypersonic glide vehicle—are specifically designed for nuclear weapon delivery.[75] Indeed, unlike the CPGS programme, the main rationale behind Russia's long-range hypersonic weapon development is to ensure the ability to deliver a retaliatory nuclear strike. As explained below, this reflects Russia's strategic threat perceptions regarding the combination of US long-range precision-strike and missile defence capabilities.

Summary: Precision-strike weapons and nuclear disarmament

Precision-strike weapons seem to have contradictory effects on nuclear arms control and disarmament. On the one hand, asymmetry in such capabilities increased Russia's reliance on nuclear weapons for regional deterrence in the 1990s. Although this can be seen to have changed with the subsequent improvements in Russia's conventional capabilities, the USA's plans to develop long-range precision-strike weapons—together with its missile defences—have fuelled Russian efforts to modernize its strategic nuclear forces.

On the other hand, precision-strike weapons have the potential to substitute nuclear weapons as a more credible and less risky source of deterrence against conventional aggression. Although this has not yet been translated into significant changes in either Russian or US nuclear doctrines, it can be argued that both countries could reduce the role of nuclear weapons in regional settings without jeopardizing their core security interests. On the contrary, removing nuclear weapons from regional conflict dynamics would improve security by reducing escalation risks and potential misperceptions related to dual-use delivery systems. This would allow significant nuclear cuts—including the elimination of Russian and US non-strategic nuclear weapons—and pave the way towards both countries adopting a minimal deterrence policy.

[71] ven Bruusgaard (note 34).

[72] The advanced Russian cruise missiles include Kalibr sea-launched cruise missiles, Kh-101 air-launched cruise missiles and the contentious 9M729 land-based cruise missile that contributed to the collapse of the INF Treaty. See ven Bruusgaard (note 34); and Erästö, T. and Topychkanov, P., 'Russian and US policies on the INF Treaty endanger arms control', SIPRI Topical Backgrounder, 15 June 2018.

[73] In addition to the concept non-nuclear deterrence in the 2014 military doctrine, in recent years non-strategic nuclear weapons have played a less visible role in Russian military exercises. See ven Bruusgaard (note 34).

[74] Podvig, P. and Serrat, J., *Lock them up: Zero-deployed non-strategic nuclear weapons in Europe*, UN Institute for Disarmament Research (UNIDIR) report (UNIDIR: Geneva, 2017).

[75] President of Russia, 'Presidential address to the Federal Assembly', 1 Mar. 2018.

II. Missile defences: Obstacle to further cuts in strategic nuclear arsenals?

The following discussion describes recent advances in missile defence development, outlining the USA's technological edge in this area. It also describes Russian responses to US missile defences and discusses the prospects for further Russian–US nuclear cuts taking into consideration the countries' unresolved disagreements over missile defence. The discussion points to a historical continuity regarding the link between nuclear arms control and missile defence (see box 3.1).

United States missile defence capabilities

Like the development of CPGS weapons, the USA has justified missile defence in terms of both counterproliferation and disarmament. Prior to the US withdrawal from the 1972 Anti-Ballistic Missile Treaty (ABM) in 2002, President George W. Bush argued that defensive capabilities, alongside offensive conventional and nuclear weapons, were needed to protect against a 'small number of missiles in the hands of . . . states . . . [who] seek weapons of mass destruction'.[76] He also suggested that abolishing the ABM Treaty could 'encourage still further cuts in nuclear weapons'.[77] The 2010 Ballistic Missile Defense Review, in turn, argued that 'the role of US nuclear weapons in . . . regional deterrence architectures can be reduced by increasing the role of missile defenses and other capabilities'.[78]

Since the early 2000s, the USA has deployed altogether 44 strategic ground-based interceptors (GBIs) in California and Alaska. These GBIs are to defend US mainland against limited ICBM threats from the Democratic People's Republic of Korea (DPRK, or North Korea) and, hypothetically, from Iran which, according to the USA, might still develop ICBMs.[79] While the rest of its missile defence systems are mainly designed to intercept shorter-range missiles, in some cases the line between strategic and theatre systems is blurred. For example, the SM-3 Block IIA interceptor missile, which is part of the Aegis system deployed both on US Navy vessels and on land in Europe, has been tested against ICBMs.[80] The total number of deployed Block IIA interceptors is set to reach several hundred in the coming decades.[81]

The USA has also used the SM-3 interceptor to destroy a satellite, thus demonstrating the ASAT capability inherent in this and practically any mid-course ABM systems. All US long-range missile defences rely on mid-course interception—that is, they seek to shoot down missiles in the middle of their trajectory when they are flying through space.[82]

According to the 2019 Missile Defense Review (MDR), the USA seeks to augment its missile defences through the pursuit of space-based sensors, partly to address the

[76] The Acronym Institute, 'Bush Speech on missile defence, nuclear reductions', *Disarmament Diplomacy*, no. 56, April 2001; and Treaty between The United States of America and The Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems (ABM Treaty), opened for signature 26 May 1972, entered into force 3 Oct. 1972, not in force from 13 June 2002.

[77] The Acronym Institute (note 76).

[78] The Acronym Institute (note 76); and US DOD, Office of the Secretary of Defense, *Ballistic Missile Defense Review Report* (DOD: Arlington, VA, Feb. 2010).

[79] By 2023, this number is set to increase to 64. See US DOD, Office of the Secretary of Defense, *2019 Missile Defense Review* (DOD: Arlington, VA, Jan. 2019).

[80] Arms Control Association, 'US conducts successful ICBM intercept test', Dec. 2020.

[81] A 2016 estimate predicted the number of deployed Block IIA interceptors would reach over 500–600, by the mid-to late 2030s. See Lewis, G. N., 'Strategic Capabilities of SM-3 Block IIA Interceptors', Mostly Missile Defense, 30 June 2016. This projection seems to be in line with current procurement plans, see O'Rourke, R., 'Navy Aegis ballistic missile defense (BMD) program: Background and issues for Congress', CRS Report for Congress RL33745 (US Congress, CRS: Washington, DC, 25 Feb. 2021.

[82] See e.g. Arms Control Association, 'Missile defense systems at a glance', Fact sheet, Aug. 2019.

Box 3.1. The link between missile defence and nuclear arms control

Efforts to counter ballistic missiles began soon after they were first used during World War II. However, it was the invention of nuclear-armed intercontinental ballistic missiles (ICBMs) that made missile defence a high strategic priority for the Soviet Union and the United States during the cold war. After having pursued their respective strategic defences in the 1960s, the Soviet Union and the USA eventually agreed to limit such systems with the 1972 Anti-Ballistic Missile Treaty (ABM Treaty).[a] The treaty described limits on missile defence systems as 'a substantial factor in curbing the race in strategic offensive arms'.[b] It reflected the shared conclusion that large-scale missile defences could not realistically defend against a massive nuclear attack, but their pursuit nevertheless questioned the survivability of second-strike nuclear forces, thus driving the expansion of the latter. This was because the simplest way to overcome ABM interceptor missiles was to outnumber them with offensive warheads.[c] Signed simultaneously with the 1972 Interim Agreement following the Strategic Arms Limitations Talks (SALT I), the ABM Treaty became a key pillar of the US–Soviet nuclear arms control process.[d]

The cold war consensus on the ABM Treaty and in particular its provision against the deployment of space-based interceptors began to crumble in early 1980s with President Ronald Reagan's Strategic Defense Initiative (SDI). The intention behind the SDI was to make the USA invulnerable to nuclear attacks by intercepting ICBMs in space.[e] While the USA wanted to conduct related testing also outside the laboratory, the Soviet Union regarded this as a violation of the ABM Treaty. The dispute stood in the way of a historic agreement on complete nuclear disarmament in 1986.[f] Instead, the two countries agreed on a more limited 1987 Intermediate Range Nuclear Forces Treaty (INF Treaty), followed later by the 1991 Treaty on the Reduction and Limitation of Strategic Offensive Arms (START I).[g]

Having ultimately abandoned the SDI as infeasible, in the 1990s the USA shifted its focus to shorter-range or 'theatre' ABM systems that could be used for regional defence. However, its renewed interests in strategic defences eventually led the USA to withdraw from the ABM Treaty in 2002. As a result, START II, whose ratification by Russia was conditional of compliance with the ABM Treaty, never entered into force.[h]

Although New START was eventually ratified in 2011, despite disagreements over US missile defence deployments in Europe, the treaty's preamble states that the importance of 'the interrelationship between strategic offensive arms and strategic defensive arms' will increase as nuclear weapons are reduced.[i] Upon signing New START, Russian President Dmitry Medvedev also argued that it 'can operate and be viable only if the USA refrains from developing its missile defense capabilities quantitatively or qualitatively.'[j]

[a] Treaty between the United States and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems (ABM Treaty), opened for signature 26 May 1972, entered into force 3 Oct. 1972, not in force from 13 June 2002.

[b] Each side could deploy strategic defenses at two sites (reduced to one in 1974) to protect their capitals or to safeguard ICBMs. The treaty also prohibited sea, air and space-based ABM systems.

[c] See e.g. Arms Control Association, 'Missile defense systems at a glance', Aug. 2019.

[d] Interim Agreement Between the United States of America and the Union of Soviet Socialist Republics on Certain Measures with Respect to the Limitation of Strategic Offensive Arms (Interim Agreement or SALT I), signed 26 May 1972.

[e] Atomic Heritage Foundation, 'Strategic Defense Initiative (SDI)', 2018.

[f] National Security Archive, 'Transcript of Gorbachov–Reagan Talks: Part 4', FBIS-USR-93-121, *International Affairs*, 20 Sep. 1993.

[g] Treaty on the Reduction and Limitation of Strategic Offensive Arms (START I), opened for signature 31 July 1991, entered into force on 5 Dec. 1994, expired on 5 Dec. 2009.

[h] Wines, M., 'After US scraps ABM Treaty, Russia rejects curbs of START II', *New York Times*, 15 June 2002.

[i] Treaty on Measures for the Further Reduction and Limitation of Strategic Offensive Arms (New START, Prague Treaty), signed 8 April 2010, entered into force on 5 February 2011.

[j] Hildreth, S. A. and Woolf, A., 'Ballistic missile defense and offensive arms reductions: A review of the historical record', Congressional Research Service (CRS) Report for Congress R41251 (US Congress, CRS: Washington, DC, 25 May 2010).

threat from Chinese and Russian hypersonic missiles. The 2019 MDR also discusses the development of a boost-phase interception capability based on high-energy lasers and the deployment of space-based interceptors.[83] Although boost-phase interceptors—which are to shoot down missiles right after launch, before they leave the atmosphere—have long been regarded as having strategic advantages, technological and operational challenges have thus far prevented their deployment.[84] In addition, the 2019 MDR referred to 'strike capabilities necessary to degrade North

[83] US DOD (note 79).

[84] Gleason, J., 'Boost phase missile defense', Missile Defense Advocacy Alliance, June 2017.

Box 3.2. Non-kinetic weapons

In addition to the advanced conventional capabilities which rely on kinetic or explosive force, both Russia and the United States and several other countries are developing non-kinetic weapons to destroy or disable the adversary's military systems through other means. From the point of view of strategic stability, one of the most significant examples of non-kinetic warfare has to do with the US 'left-of-launch' mission, which involves cyber capabilities to preventively eliminate missile threats.[a] Iran's and North Korea's missile and satellite programmes have recently experienced technical difficulties which have been explained by US cyber operations related to this mission.[b] Some of the Russian anti-satellite capabilities likewise rely on non-kinetic means of attack, such as laser technology to dazzle satellite sensors, as well as electronic systems to jam satellite signals. Russian cyber capabilities are also viewed as a potential threat to western military satellites.[c]

[a] Panda, A. 'US "left of launch" cyber efforts might increase Korean peninsula nuclear dangers', *The Diplomat*, 22 Oct. 2018.

[b] Lockie, A., 'North Korea's embarrassing missile failure may have been due to US cyber sabotage', *Business Insider*, 17 Apr. 2017; Sanger, D.E. and Broad, W. J., 'US revives secret program to sabotage Iranian missiles and Rockets', *New York Times*, 13 Feb. 2019; and BBC News, 'US "launched cyber-attack on Iran weapons systems"', 23 June 2019.

[c] Piotrowski, M. A., 'Russia's approach to anti-satellite weapons and systems', Polish Institute for International Affairs, *PISM Bulletin*, no 159 (14 Nov. 2019).

Korean missile capabilities prior to launch.'[85] In addition to kinetic attacks and use of explosives, such 'left-of-launch' capabilities also involve non-kinetic means of attack, notable cyber capabilities (see box 3.1).

The USA has sought to assure China and Russia that neither its strategic missile defences nor its long-range conventional forces are directed against them but rather against 'emerging regional missile threats'.[86] Yet, insofar as missile defences are effective against ICBMs or SLBMs, they can be used against any adversary possessing such missiles. Apparently aggravating Chinese and Russian concerns, the 2019 MDR states that 'in the event of conflict', US missile defences 'would defend, to the extent feasible, against a ballistic missile attack upon the US homeland from any source.'[87]

Russia's response to the perceived weakening of nuclear deterrence

In case of a nuclear war between Russia and the USA, Russian ICBMs and SLBMs would overwhelm current US missile defence systems given the formers' large numbers and the various Russian missile defence countermeasures.[88] However, Russian concerns about the survivability of its second-strike nuclear forces mainly focus on the absence of treaty-based limits on missile defence, which could over time lead to an increase both in the number and effectiveness of strategic interceptor missiles. Alternatively, the ratio between offensive and defensive missiles could be tilted in favour of the latter if Russia and the USA significantly reduce their strategic nuclear arsenals—a prospect that would likely prevent Russia from going forward with such reductions.

Russian concerns about missile defence are tied to the CPGS concept, as precision-strike weapons and other counterforce capabilities could in theory be used together with missile defence to launch a disarming strike against Russia. In 2017, Russian President Vladimir Putin described such a scenario, saying that 'some high-precision weapons are used to carry out a pre-emptive strike, while others serve as a shield against a retaliatory strike, and still others carry out nuclear strikes'.[89] The US 'left-of-launch' concept has further added to this concern (see box 3.2).[90]

[85] US DOD (note 79).
[86] US DOD (note 78).
[87] US DOD (note 79)
[88] Lilly, B., 'How Putin uses missile defence in Europe to distract Russian voters', NATO Review, 29 Jan. 2015.
[89] See e.g. President of Russia, 'Meeting with heads of international news agencies', 17 June 2016.
[90] Acton (note 70).

While Russia has invested in shorter-range defensive systems, such as the S-400 air and missile defences, it has chosen not to compete with the USA in the area of strategic missile defence. Russia's strategic defences are still limited to what was an ABM Treaty-compliant system deployed around Moscow since the 1970s, although that system is being upgraded.[91] Instead, Russia has responded by modernizing its strategic nuclear forces. As noted above, this modernization effort includes the development of hypersonic weapons, which Putin has described as 'the most modern means of evading missile defence'.[92]

Russia has reportedly also accelerated ASAT testing in recent years. Reflecting the dual-use nature of strategic missile defence as a weapon against both incoming missiles and orbiting satellites, Russian ASAT testing is partly connected with its plans to upgrade the missile defence system around Moscow.[93] Russia's interest in ASAT capabilities can also be viewed in the light of the perceived threats from US missile defence and precision-strike weapons, since both depend on satellites. According to one observer, Russia's ASAT development is part of its 'asymmetric response' to the USA's missile defence, hypersonic weapons and other advanced conventional capabilities.[94]

Summary: Missile defence and nuclear disarmament

Even if the effectiveness of US offensive and defensive weapons would further increase over time, any attempt to eliminate the vast Russian nuclear arsenal—which includes hard-to-track SLBMs and mobile ICBMs—would be foolhardy. Indeed, the failure to intercept even one incoming nuclear-armed missile could create unacceptable damage to the attacker. Russian concerns about US missile defence are therefore hardly based on an imminent threat of a disarming strike. Yet, such concerns are in line with the basic logic of nuclear deterrence, which depends on survivable second-strike capabilities. From this perspective, unrestrained US missile defence development—in combination with improvements in its counterforce capabilities—poses a huge dilemma for arms control and disarmament by perpetuating the existing nuclear status quo. In this context, Russia is unlikely to cut its strategic nuclear arsenal beyond a point where the ratio between its offensive warheads and US defensive missiles would favour the latter. Without confidence-building and limits to US missile defences, this problem is likely to hinder cooperative efforts at minimal nuclear deterrence, in the case Russia and the USA would muster the political will to move towards such an objective.

[91] Kristensen, H. M., McKinzie, M. G. and Norris, R., 'The protection paradox', *The Bulletin of Atomic Scientists*, vol. 60, no. 2 (2004); and Defence World, 'Russian military tests anti-missile, anti-satellite defence system', 28 Oct. 2020.

[92] See. e.g. President of Russia (note 75).

[93] See e.g. Defence World (note 91).

[94] Piotrowski, M. A., 'Russia's approach to anti-satellite weapons and systems', Polish Institute for International Affairs, *PISM Bulletin*, no 159 (14 Nov. 2019).

4. The path to global zero

This chapter broadens the discussion on the impact new technologies on the strategic conditions for disarmament to the multilateral setting. It argues that the same challenges that impact the Russian–US strategic relationship—notably the increasing vulnerability of second-strike nuclear forces to preventive strikes—also affect the prospects for arms control and disarmament in other nuclear-armed states. Recognizing the paramount importance of norms, institutions and political will in the path towards global zero, this chapter also identifies some technologies that could potentially facilitate progress towards universal nuclear disarmament or contribute to the task of maintaining a nuclear weapon-free world.

I. Strategic challenges to multilateral nuclear disarmament

As noted above, China officially relies on minimal deterrence and subscribes to a NFU policy. Historically, China's nuclear restraint also been reflected in the low state of readiness of its nuclear forces—notably based on de-mating nuclear warheads from missiles. However, this traditional posture seems to be changing with the ongoing modernization of China's nuclear forces.[95] As part of this modernization, Chinese nuclear weapon stockpile increased from 260 warheads in 2015 to 320 warheads in 2020.[96] At the same time, China's efforts to enhance its sea-based nuclear deterrent have been seen to increase the operational readiness of its nuclear weapons. This is because submarines must carry operationally deployed nuclear weapons to pose a credible threat, which suggests there may be an exception to China's official practice of de-mating.[97]

These upgrades in China's nuclear arsenal have been viewed with concern by the USA and its allies. However, rather than a desire to match Russia and the USA, China's nuclear upgrades seem to be driven by the perceived need to ensure the survivability of its second-strike capability.[98] Indeed, the justifications behind China's nuclear modernization are based on strategic stability concerns that are very similar to Russian ones; China explains the need to reinforce its nuclear deterrent based on the perceived threat from US missile defences and precision-strike weapons.[99] From the Chinese perspective, the vulnerability problem with its second-strike nuclear forces appears even more acute given that its previous ICBM arsenal would have been outnumbered by US strategic interceptor missiles in the near future.[100] Like Russia, China has also developed its own hypersonic weapons in an effort to bypass US missile defences. Although the short range of Chinese hypersonic weapons suggests a focus on regional defence against US power projection capabilities, long-range applications of hypersonic technology might eventually be developed to penetrate strategic US defences.[101] In addition, China has invested in its own ASAT capabilities, presumably based on similar considerations that drive Russian efforts in this area.[102]

[95] US DOD, *Military and Security Developments Involving the People's Republic of China 2019*, Annual Report to Congress 2019 (US DOD: Washington, DC, 2 May 2019), p. 36.

[96] Kile and Kristensen (note 14).

[97] Zhao, T., *Tides of Change: China's Nuclear Ballistic Missile Submarines and Strategic Stability* (Carnegie Endowment for International Peace: Washington, DC, 24 Oct. 2018).

[98] Talmadge, C., 'China and nuclear weapons', Brookings Institution, *Global China*, Sep. 2019.

[99] Zhao, T., *Narrowing the US–China Gap on Missile Defense: How to Help Forestall a Nuclear Arms Race*, Carnegie-Tsinghua Center for Global Policy (Carnegie Endowment for International Peace: Washington, DC, 28 June 2020).

[100] Lewis (note 81).

[101] Zhao (note 99); and Bernstein, B. and Hancock, D., 'China's hypersonic weapons', Georgetown Journal of International Affairs, 27 Jan. 2021.

[102] US DOD, *Military and security developments involving the People's Republic of China*, Annual report to Congress 2020 (DOD: Arlington, VA, 2020).

These strategic dynamics also have an impact on the prospects for disarmament in nuclear-armed states that are outside of the NPT.[103] For example, Chinese armament shapes India's threat perceptions and thus influences nuclear dynamics in South Asia.[104] At the same time, South Asia is undergoing its own offense–defence arms race, whereby India's missile defence systems have prompted Pakistan to build up its nuclear stockpile.[105] Any arms control or disarmament process in South Asia would therefore require addressing strategic stability issues at both the global and regional levels.

As suggested above, nuclear disarmament is likely to be most difficult in countries which rely on nuclear deterrence to compensate for their conventional inferiority vis-à-vis their adversaries. Paradoxically, one such country, North Korea, has long been the primary focus of international efforts at nuclear disarmament. It is unlikely that North Korea can be coerced into giving up its nuclear deterrent as long as it believes this might render it vulnerable to conventional aggression or domination. The only way to change its threat perceptions would be a sustained diplomatic process involving confidence-building with the USA, against which the country's nuclear deterrent is directed.[106] In the absence of such efforts and following the logic of maintaining survivable second-strike forces, North Korea might well be driven to expand its small nuclear arsenal to hedge against the threat of disarming strikes by the USA. An alternative scenario is that the USA would employ its counterforce weapons and missile defences in a high-risk military operation to eliminate North Korea's nuclear capability.[107] Even if this would succeed in disarming the country, preventive war is hardly compatible with the goal of a nuclear weapon-free world. Indeed, the threat of aggression seems to have pushed North Korea to cross the nuclear threshold in the first place.[108] Were preventive war ever waged against a nuclear-armed North Korea, this would also reinforce the perceived need for China and Russia and potentially other countries to maintain robust nuclear arsenals to avoid a similar fate.

As for the US allies—France, Israel and the UK—they seem somewhat removed from the current strategic dynamics described above. To be sure, France and the UK are part of NATO and, particularly since 2014, a nuclear-armed Russia has once again been high on their threat perceptions. The UK also highlights first strike concerns and new technologies in connection with its nuclear policy in a 2021 security policy document.[109] Yet, neither France nor the UK face any imminent military threats from Russia, and in general their arguments to justify nuclear deterrence are vague.[110]

Israel, whose threat perceptions focus on the Middle East, presents an even greater anomaly. Given its conventional military strength and the absence of other nuclear-armed states in the region, Israel's nuclear weapon status seems to lack a military rationale apart from the hypothetical threat of further regional proliferation.[111] The determination of these three states to maintain their nuclear arsenals therefore serves

[103] Four non-state parties to the NPT—India, Israel, North Korea and Pakistan—possess nuclear weapons.

[104] See e.g. Saalman, L., 'India's no-first-use dilemma: Strategic consistency or ambiguity towards China and Pakistan', SIPRI WritePeace Blog, 2 Dec. 2020.

[105] Jaspal, Z. N., 'Countering Indian ballistic missile defense & strategic stability in South Asia', Margalla Papers 2018; and Peck, M., 'Is India's missile defense making war with pakistan more likely?', *The National Interest*, 6 Mar. 2020.

[106] Hilpert, H. G. and Meier, O. (eds.), 'Facets of the North Korea conflict: Actors, problems and Europe's interests', SWP Research Paper 12, German Institute for International and Security Affairs, Dec. 2018.

[107] Sanger, D. E., 'Talk of "preventive war" rises in White House over North Korea', *New York Times*, 20 Aug. 2017; and Saertren, Wilson, G. and Erästö, T., 'Breaking down the North Korea crisis', War is Boring, 18 Aug. 2017.

[108] Hilpert and Meier (note 106).

[109] British Government (note 15).

[110] See e.g. British Government (note 15); and French Ministry for the Armed Forces (note 15).

[111] Erästö, T., 'Lack of disarmament in the Middle East: Thorn in the side of the NPT', SIPRI Insights on Peace and Security no. 2019/1, Jan. 2020.

as a reminder that not all obstacles to disarmament are security-related, but identity and affective factors also play a role.

II. The role of technology in maintaining a nuclear weapon-free world

This report has mainly highlighted the challenges to nuclear disarmament posed by recent advancements in military technologies. Yet, in principle, some of these technologies could be harnessed to serve the goal of universal disarmament. If operated as part of an international cooperative effort, missile defence could function as a hedge against cheating within, or when approaching, a nuclear weapon-free world.[112] Indeed after the cold war, Russia and the USA briefly considered turning national missile defences into a Global Protection System against limited ballistic missile attack, and a more limited Russia–NATO missile defence cooperation was explored in 2010.[113] While sharing relevant technology—and, in particular, command and control and launch authority—would require a degree of mutual trust that is clearly absent in today's world, in theory, global missile defence could provide additional reassurance against proliferation and restored nuclear arsenals in a nuclear weapon-free world.[114]

Similarly, the counterforce potential of precision-strike weapons could theoretically be harnessed to deter and respond to new nuclear proliferation by providing a capability to eliminate nuclear threats before they materialize. Although the capability for preventive use of force can be highly destabilizing, it might be amenable to regulation through new or reformed international institutions and strengthened norms against aggression.

Finally, the giant task of verifying and monitoring a nuclear weapon-free world would be eased if more countries deployed civilian nuclear technologies that minimize the use of proliferation-sensitive materials—highly enriched uranium and plutonium—and especially if they substituted nuclear power with renewable energy sources.[115] Some evolving technologies, such as artificial intelligence and machine learning, could also enhance the effectiveness of global monitoring, particularly when it comes to analysing huge amounts of satellite imagery to detect any illicit nuclear activities in a nuclear weapon-free world.[116]

[112] Sauer, T., *Eliminating nuclear weapons: The role of missile defence* (Hurst & Company: London, 2011).

[113] White House, Office of the Press Secretary, 'Joint S.S.-Russian statement on a Global Protection System', 17 June 1992; The White House, 'US policy on ballistic missile defenses and the future of the ABM Treaty', Presidential Review Directive NSC-31, 26 Apr. 1993; and Pifer, S., 'NATO–Russia missile defense: Compromise is possible', Brookings Institution, 28 Dec. 2018.

[114] Senn, M., 'Spoiler and enabler: The role of ballistic-missile defense in nuclear abolition', *International Journal,* vol. 67, no. 3 (2012).

[115] Erästö, Komžaite and Topychkanov (note 42).

[116] Erästö, Komžaite and Topychkanov (note 42).

5. Policy recommendations

As highlighted in this report, the impact of recent military-technological trends on nuclear disarmament seem overwhelmingly negative. While the USA's precision-strike weapons and missile defences hardly pose an imminent threat to its nuclear peers, they create uncertainty about the survivability of their second-strike nuclear capabilities, making small arsenals seem increasingly insufficient as a basis for deterrence. While highlighting the urgent need to address this obstacle to nuclear disarmament at a strategic level, the following recommendations also build on the potential of precision-strike weapons to substitute for nuclear deterrence at a non-strategic level. The recommendations also highlight the role of diplomacy in paving the way towards disarmament through confidence-building, arms control and stronger international norms against both nuclear and conventional aggression.

1. Include missile defence and long-range precision-strike weapons in Russian–US nuclear arms control negotiations

Due to the problems outlined above, it is difficult to imagine major reductions in Russian and US nuclear arsenals unless missile defence and conventional long-range precision-strike weapons are included in relevant arms control negotiations. While it might be difficult to limit conventional offensive weapons, imposing treaty-based numerical limits to the number of strategic interceptor missiles is possible—indeed, it has been done before in the ABM Treaty.[117] While current US law prevents legal limits to missile defences, ultimately this is a matter of political decision making, which should be guided by an understanding of the defence–offense arms race dynamic with both China and Russia. Given that previous confidence-building efforts on missile defence have been unsuccessful, legal limits might be the only effective measure to address Chinese and Russian concerns about the survivability of their retaliatory nuclear capabilities.[118] Given that China and Russia will likely avoid a situation where the ratio between strategic offensive and defensive missiles favours the latter, such limits should be adjusted to the desired level of future cuts in nuclear weapon stockpiles.

2. Set minimal nuclear deterrence based on no first use policy as an interim disarmament goal for all nuclear-armed states

As the two countries with the largest nuclear arsenals, Russia and the USA have a special responsibility to take the next steps towards disarmament. As argued in this report, the intermediate goal of bilateral reductions should be minimal deterrence, which could be based on an arsenal consisting of a few hundred nuclear weapons—with the caveat that they would not be outnumbered by defensive interceptor missiles. The most straightforward path towards this goal would be through a NFU policy.

Were the current or future US administrations to strive towards minimal deterrence, a logical area for nuclear–conventional substitution would be US security guarantees to allies. While such guarantees could still deter nuclear attacks, the existing conventional capabilities already provide a credible deterrent against conventional

[117] ABM Treaty (note 76).

[118] Erastö, T., 'Between the shield and the sword: NATO's overlooked missile defense dilemma' (Ploughshares Fund: San Francisco, CA, June 2017); Thielmann, G., 'Incorporating missile defense in strategic arms control', *Deep Cuts Issue Brief*, no. 12 (Oct. 2020); and Pifer, S., 'Should US missile defenses be a part of arms control negotiations with Russia?', *National Interest*, 26 Jan. 2021.

aggression.[119] To be sure, Asian and European allies' resistance to giving up nuclear weapons as additional reassurance against conventional attacks has previously been an obstacle to the US adopting a NFU policy.[120] This resistance is arguably based on insufficient consideration of the enormous risks of introducing nuclear weapons to regional conflicts. Hence the countries that are currently under the US nuclear umbrella should invest more resources in examining the risks of nuclear escalation, taking into account the relative strength of their conventional forces as well as their respective commitments under the NPT. Together with potential Russian–US efforts to ban non-strategic nuclear weapons (see recommendation 3), this might ultimately change allies' views on NFU.

Other nuclear-armed states that have not yet done so should also adopt a NFU policy.[121] As suggested above, if all nuclear-armed states subscribed to a NFU policy and maintained the minimum level of nuclear arsenals required for retaliation in kind, this would in principle eliminate the need for nuclear deterrence.

3. Ban the deployment of non-strategic nuclear weapons in Europe

As argued in this report, conventional military capabilities form a more credible and less risky basis for regional deterrence than nuclear weapons. Yet both Russia and the USA have kept nuclear weapons as part of their regional deterrence forces by maintaining dual-capable non-strategic delivery systems in and around Europe. In line with the concept of limited nuclear war, they also claim the right to the first use of nuclear weapons.

However, there is scope for confidence-building and arms control measures that could reduce the role and ultimately remove nuclear weapons from regional armament dynamics. While the USA removed its non-strategic nuclear weapons from Asia already in the 1990s, its non-strategic warheads in Europe have lost much of their previous military value and they mainly serve a symbolic function.[122] Russia's stated policy of not deploying nuclear warheads in its non-strategic delivery vehicles can likewise be viewed as an indication of their limited military value—even though it would probably seek to link any arms control measures in this area to missile defence limits.[123]

As the first step towards removing nuclear threats from Europe, the USA, NATO and Russia could refrain from deploying nuclear warheads to non-strategic delivery systems in Europe and to agree on relevant verification measures.[124] If Russia and the USA were also to adopt a NFU policy they could ultimately ban non-strategic nuclear weapons as unnecessary for the purpose of retaliation against nuclear strike.[125] Such a ban should also consider the possibility of restraining the tactical use of long-range low-yield weapons in limited nuclear strikes. While these steps would require strong support from NATO allies, they could also help create such support by addressing European threat perceptions about Russian non-strategic nuclear weapons.

[119] Holdren, J. P., 'The overwhelming case for no first use', *Bulletin of the Atomic Scientists*, vol. 76, no.1 (2020).
[120] Roberts (note 60).
[121] Currently only China and India have adopted a NFU policy.
[122] Kristensen, H. M. and Norris, R.S., 'A history of US nuclear weapons in South Korea', *Nuclear Notebook*, vol. 73, no. 6 (2017); Credi (note 46); and Kristensen, H. M. and Korda, M., 'United States nuclear weapons, 2021', *Nuclear Notebook*, 28 Jan. 2021.
[123] Podvig and Serrat (note 74); and Pifer (note 113).
[124] Podvig and Serrat (note 74).
[125] Wolfsthal (note 36).

4. Strengthen norms against preventive war and other forms of aggression

Given the increasing counterforce potential of modern conventional weapons, NFU policies and relevant changes in nuclear postures are not sufficient to alleviate concerns about disarming strikes—which could also be conducted with such conventional weapons. This points to the need to strengthen existing UN Charter-based norms against conventional aggression.

Reinforcing such basic norms would help to facilitate arms control and disarmament among nuclear-armed states, as their perceived need for large nuclear arsenals and opposition towards NFU policies are closely tied with concerns about conventional aggression. It could also help to pave the way for managing conflict dynamics in a nuclear weapon-free world given the potentially lower threshold for the use of force in such a world.

In particular, there is a need to strengthen the norm against preventive war. Although preventive war is already unlawful unless authorized by the UN Security Council, this norm has been weakened by state practice.[126] In addition to the unilateral 2003–2011 Iraq war, the USA and some other nuclear-armed states have continued to entertain the prospect of preventive attack against North Korea and Iran.[127] As suggested in this report, however, breaching the norm against preventive war is counterproductive, as that norm is essential both for non-proliferation and progress towards a nuclear weapon-free world.

Civil society groups, non-nuclear weapon states and those nuclear-armed states that agree should therefore firmly reject military action as a method to achieve either non-proliferation or disarmament—with the potential exception of a multilateral use of force in the future to maintain a nuclear weapon-free world. Even though there has been little public debate on using low-yield nuclear weapons as a counterproliferation tool after the early 2000s, relevant capabilities have subsequently been developed, calling for the need for strong pushback against this idea in case it re-emerges in the future.

5. Strengthen the norm against nuclear weapons

While this report has mainly focused on security-related obstacles to disarmament, nuclear weapons are also viewed as a source of prestige and, for many established nuclear-armed states, this perceived special status has become a seemingly inseparable part of their national identity. There is also considerable inertia both within nuclear-armed states and among their allies when it comes to adjusting nuclear weapon policies to changing circumstances—even when the previous security rationales behind those policies would have disappeared over time. As for the more recent proliferators—India, North Korea and Pakistan—the value of nuclear weapons has been increased by the degree of sacrifice and investment that developing them required.

By establishing a clear and universal stigma against nuclear weapons and thus denying any prestige previously associated with them, the TPNW can be an effective tool in addressing such non-security-related obstacles to disarmament. At the same time, the TPNW and the humanitarian process that preceded it have raised awareness of the catastrophic consequences of nuclear weapon use. Although the countries that rely on nuclear deterrence remain critical of the TPNW, that awareness—together

[126] Kaufman, W., 'What's wrong with preventive war? The moral and legal basis for the preventive use of force', *Ethics & International Affairs*, vol. 19, no. 3 (2005).

[127] In addition to the example of a potential US attack against North Korea discussed earlier in this paper, the UK and the USA maintained that 'all options' were on the table regarding their potential response to the Iran nuclear crisis prior to the negotiation of the 2015 Joint Comprehensive Plan of Action. Israel also continues to threaten Iran with preventive strikes.

with domestic pressure to subject existing nuclear policies to greater scrutiny—could still prompt them to engage in a much-needed reassessment of the security benefits versus the risks of nuclear deterrence in today's world.

6. Conclusions

This report has analysed the prospects for nuclear disarmament in light of new technologies, based on a transitional approach that acknowledges both security-related challenges and the need for tangible steps towards a nuclear weapon-free world. It has argued that the adoption of the policy of minimal nuclear deterrence by Russia and the USA would be a necessary intermediate goal towards multilateral disarmament. Although disarmament ultimately means giving up nuclear deterrence, this intermediate goal could be reached even without consensus on the end goal of the abolition of nuclear weapons. Instead, further cuts by the two countries with the largest nuclear arsenals might initially be motivated by their shared interest to reduce nuclear risks.

Russia and the USA could begin such cuts by removing nuclear weapons from regional conflict dynamics, owing to their robust conventional forces based on precision-strike weapons and other advanced conventional systems. In other words, they can afford to give up nuclear weapons as a deterrent against conventional aggression and should do so to for the sake of reducing the risk of nuclear weapon use. Together with the abandonment of cold war-era nuclear doctrines focused on the idea of winning a nuclear war, this would open the door for significant nuclear reductions.

However, such reductions would likely require limiting US missile defence systems and addressing perceived threats from long-range precision-strike weapons. These and other advanced military systems have raised the bar for credible nuclear deterrence by creating uncertainty about US adversaries' second-strike capabilities. Lowering that bar and eventually reducing the perceived need for nuclear deterrence will require creative arms control diplomacy as well as stronger norms against both nuclear and conventional aggression. Together with a strong stigma against nuclear weapons, such steps would also help prevent further proliferation and pave the way for multilateral nuclear disarmament.

While most of the responsibility for concrete disarmament steps lie with the nuclear-armed states, non-nuclear weapon states and civil society have a crucial role to play by tirelessly promoting progress towards the end goal of complete nuclear disarmament. In particular, non-nuclear weapon states that rely on extended nuclear deterrence should examine their role in maintaining such a policy and how it influences the prospects for reducing global nuclear stockpiles.

STOCKHOLM INTERNATIONAL PEACE RESEARCH INSTITUTE
Signalistgatan 9
SE-169 72 Solna, Sweden
Telephone: +46 8 655 97 00
Email: sipri@sipri.org
Internet: www.sipri.org

HIROSHIMA PREFECTURE