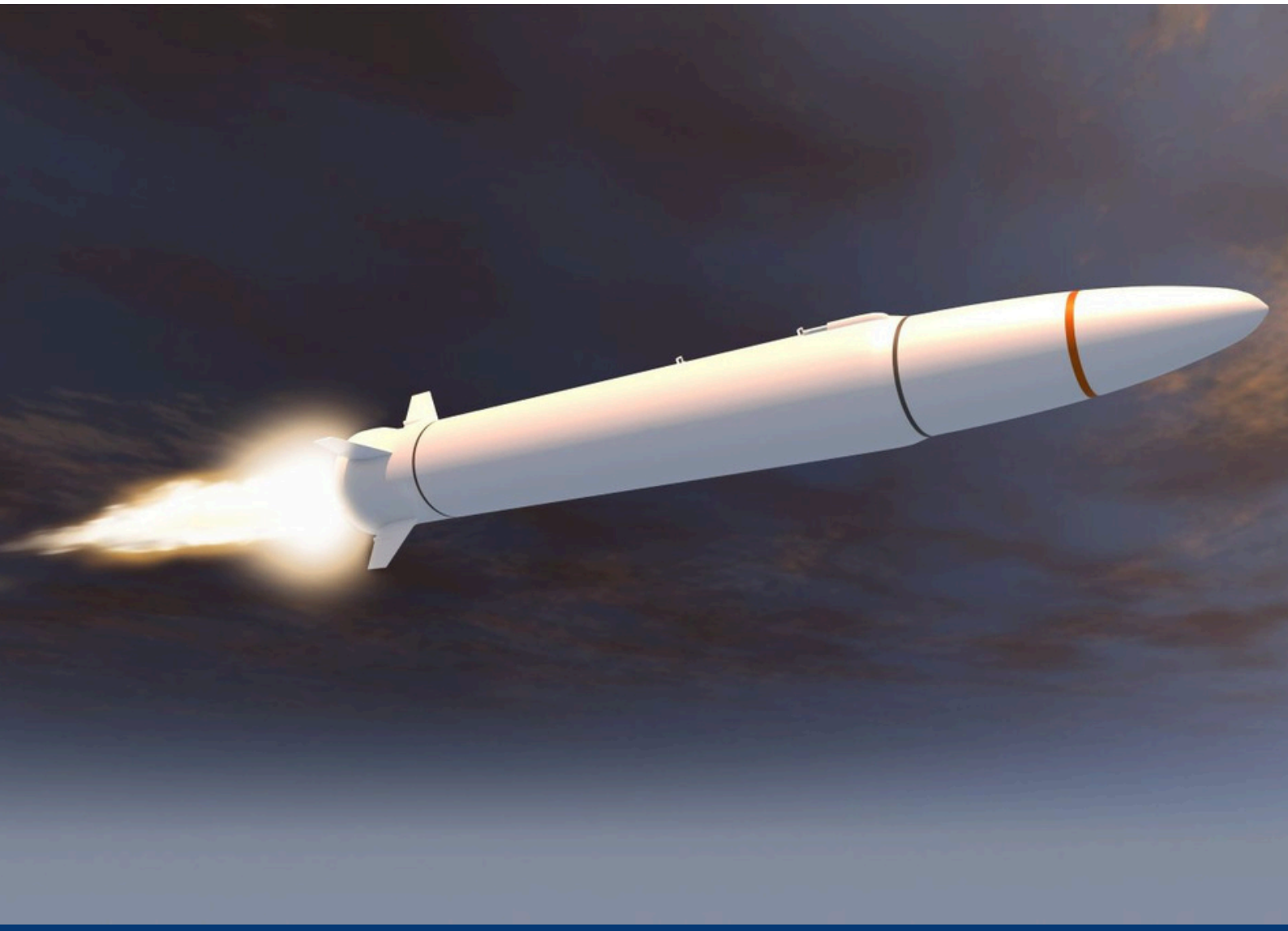
Toda Peace Institute

REPORT

16 DEC 2024
REPORT
NO. 204



THE POTENTIALLY REVOLUTIONARY IMPACT OF EMERGING AND DISRUPTIVE TECHNOLOGIES AND STRATEGIC CONVENTIONAL WEAPONS ON NUCLEAR DETERRENCE

Tom Sauer

About the Author

TOM SAUER

Tom Sauer (Belgian) is a Professor in International Politics and spokesperson of the Research Group International Politics at the Department of Politics at the Universiteit Antwerpen, Belgium. He has been an International Security Fellow at the Kennedy School of Government at Harvard University (US). Tom Sauer is a member of the Advisory Board of the International Institute for Peace in Vienna (Austria) and an active member of the Pugwash Conferences on Science and World Affairs. He also received the Rotary International Alumni Global Service Award.

Toda Peace Institute
Samon Eleven Bldg. 5F,
3-1 Samon-cho, Shinjuku-ku
Tokyo 160-0017, Japan

Tel. +81-3-3356-5481
Fax. +81-3-3356-5482
Email: contact@toda.org

Summary

This paper posits that the combination of emerging and disruptive technologies and strategic conventional weapons may have a revolutionary impact on the future of nuclear weapons. While emerging and disruptive technologies may yield additional arguments to keep relying on nuclear weapons to defend against them, they are often regarded as destabilizing for the global nuclear order, which makes it more likely that nuclear deterrence will fail and nuclear weapons will be used. At the same time, strategic conventional weapon systems (including hypersonic missiles) have deterrence characteristics comparable to nuclear weapons. Because they could be used in a way that at least seeks to comply with jus in bello principles, by minimizing civilian harm (in comparison with nuclear weapons), they are also more credible as a deterrent. This may in turn increase political willingness to seriously consider fully delegitimizing nuclear weapons, and eventually replacing them with the default option: modern conventional weapons.

Introduction

Article 6 of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) obliges the nuclear weapon states—China, France, Russia, the United Kingdom and the United States, who are the five states officially recognized as possessing nuclear weapons by the NPT—to disarm their nuclear weapons over time. While no deadline has been set, it is abundantly clear that most non-nuclear weapon states expect action from the nuclear weapon states. The longer it takes, the more polarized the two groups of states become, with potentially negative repercussions for the NPT.[1] Advocates of nuclear deterrence argue that it yields security advantages, meaning that even if a world without nuclear weapons is desirable in principle and legally required under the NPT, politically it is not feasible in the current circumstances.

There are, however, three new elements in the debate that may help convince the sceptics of a nuclear weapon-free world. First, new non-nuclear technology and weapons are in the making that are likely to further destabilize the current nuclear order. Second, there is a newcomer to the scene—the Treaty on the Prohibition of Nuclear Weapons (TPNW)—which is the result of the non-nuclear weapon states' frustration at the lack of nuclear disarmament. The TPNW should be regarded as a signal of this frustration.[2] Its goal is to ban nuclear weapons, and stigmatize them and their possessors, including by invoking international humanitarian law. Nuclear weapons are weapons of mass destruction whose use in all likelihood will be contrary to international humanitarian law (jus in bello). Third, the war in Ukraine has made the debate about nuclear weapons much more concrete.[3] It shows that even established nuclear weapon states and founding fathers of the NPT, such as Russia, are willing to attack (relatively large) non-nuclear weapon states and threaten to use nuclear weapons. While advocates and opponents of nuclear deterrence will tease out different lessons from this war, it is hard to escape the conclusion that it has brought the world closer to nuclear war, and that it is still not over.

This paper focuses on new non-nuclear technology and weapons. It posits that emerging and disruptive technologies (EDTs), such as hypersonic weapons, cyber capabilities and artificial intelligence (AI), as well as strategic conventional weapons (advanced conventional weapon systems designed and deployed to accomplish strategic functions)[4], may have a revolutionary impact on the future of nuclear weapons—in two main ways. First, while EDTs may yield additional arguments to keep relying on nuclear weapons as a deterrent against these new systems, they are also regarded as destabilizing and disruptive for the global nuclear order, which makes it more likely that nuclear deterrence will fail and nuclear weapons may be used. Second, strategic conventional weapons (sometimes in combination with EDTs) arguably have similar or more credible deterrence characteristics than nuclear weapons and may gradually replace them as weapons of deterrence. These non-nuclear weapons could form the bedrock of deterrence policies in a world without nuclear weapons. Although it is not the intention of this paper to sketch out the road towards nuclear

elimination, the new insights it provides may help the current proponents of nuclear deterrence to become less sceptical of the idea of eliminating nuclear weapons. As a result, these insights may strengthen the level of acceptability of the idea of a world without nuclear weapons, which in turn may stimulate new research on how to disarm nuclear weapons in a multilateral way.

The paper is structured as follows. First, it argues for the growing vulnerability of nuclear weapons due to EDTs. It also argues that strategic conventional weapons in combination with some of the emerging technologies and weapon systems could be a viable alternative for nuclear deterrence. Lastly, the paper provides an overarching conclusion.

The growing vulnerability of nuclear weapons as a result of EDTs and strategic conventional weapons

Central to this paper is the question of how EDTs will impact nuclear deterrence and, at least according to the proponents of nuclear deterrence, stability. Crisis stability (including first-strike stability) means that nuclear forces and doctrines are geared in such a way that the chances of nuclear weapons being used in a crisis are minimized and they are not likely to be used out of fear that the other side will strike first, destroying one's own second-strike capability.

There are numerous ways in which EDTs can have a negative effect on crisis stability, by neutralizing or at least minimizing the so-called stabilizing effect of nuclear weapons.[5] Back in 2017, observers warned that 'changes in technology . . . are eroding the foundation of nuclear deterrence'.[6] Today, the main danger is that EDTs make nuclear weapons more vulnerable, as they can make it easier and more credible to attack the enemy's nuclear forces and key nuclear infrastructure (e.g. command-and-control and early-warning systems).[7] Indeed, experts note that: 'States investing in strategic non-nuclear weaponry today could potentially give themselves the option to consider preemptive strikes that knock out an adversary's nuclear capabilities, thereby completely altering the military dynamics of a conflict in the future'.[8] The result—crucially—is that the enemy will be aware of this vulnerability and may be under pressure to use their (sometimes small number of) nuclear weapons in a preemptive, destabilizing 'use them or lose them' way.[9]

EDTs are particularly useful for attacking three types of strategic targets related to nuclear weapons: (a) early-warning systems; (b) the nuclear forces themselves; and (c) command-and-control systems. First, early-warning systems in the form of radars and (sometimes) satellites are crucial for nuclear-armed states. Depending on the state, early-warning systems could potentially be neutralized by EDTs, either in a non-kinetic way through jamming (generating noise to interfere with satellite signals) and spoofing (broadcasting a false signal) via electromagnetic interference (by radio waves), cyberattacks (targeting data) or accurate modern conventional missiles against radars.[10]

Second, both cyber and hypersonic weapons can be used to attack and neutralize the nuclear forces of the enemy. The latter action—to neutralize—is the main declared goal of deterrence by denial postures. ICBMs, in particular, are cyber-sensitive, but even submarines (regarded as almost invulnerable nowadays) may be vulnerable to hacking.[11] Moreover, as a result of big data and AI, the exact location of mobile ICBMs or submarines may become available in the future, which would be nothing less than revolutionary.[12] Submarines are regarded as having substantially contributed to strategic stability and are generally seen as the most secure component of a second-strike capability. 'Invulnerable' submarines, however, may become vulnerable due to sensors on underwater drones or swarm robotics that operate in an autonomous way.[13] This could be destabilizing, as it may put more pressure on nuclear-armed states to use their vulnerable nuclear weapons sooner rather than later.

Third, cyberattacks and/or kinetic attacks can be used to disrupt the nuclear command-and-control systems of the enemy.[14]

Nuclear-armed states are, of course, aware of the vulnerabilities caused by these EDTs. The main danger is that they will be under immense pressure to safeguard their own nuclear forces and systems in crisis, and as a result use them, possibly even in a preemptive way.[15] In the ongoing war in Ukraine, for example, this would apply to a possible cyberthreat by the USA against Russia, which 'could in practice make [nuclear] use [by Russia] more likely'.[16]

There are numerous clear and direct ways in which EDTs can have a negative impact on crisis stability. As the old nuclear world order disappears, it seems that the new one may be (even) more unstable. In fact, due to the ongoing deployment of EDTs, the use of nuclear weapons may be more likely in future crises.

A more credible conventional deterrent than nuclear brinkmanship

As argued by US physicist Stephen Lukasik, there are 'a number of technologies that can be combined to protect a nation's security that were not on the horizon when the decision to develop nuclear weapons was made'.[17] Indeed, some EDTs could be responsible for both sounding the death knell for nuclear weapons and easing the passage to a world without nuclear weapons—a world in which one could rely on strategic conventional weapons as the only deterrent, in the form of ballistic, cruise and/or hypersonic missiles, as well as drones and aircraft.[18]

FROM V-2s TO PROMPT GLOBAL STRIKE SYSTEMS

Due to improvements in technology in the 1970s, especially with respect to accuracy (linked to satellites and GPS), a new generation of much more accurate missiles was developed and deployed in the 1980s, including cruise missiles. The USA used these weapon systems, particularly GPS-steered (Tomahawk) cruise missiles and precision-guided munitions, in the 1990–91 Gulf War. These weapons were part of a whole new category of weapons and technology that resulted from the so-called Revolution in Military Affairs (RMA).

Not only did the accuracy increase, so too did the destructive capacity of conventional weapons. A US Air Force analyst at the time explained the development as follows: 'Today we've got conventional weapons that approach the effectiveness of the old nuclear stuff. We can dig out those Iraqi bunkers more effectively with guided 2000 pound bombs than with tactical nuclear weapons—and without the moral downside'.[19] The evolution in the destructive capacity of conventional weapons is also clearly demonstrated by the comparison that 4500 B-17s in World War II or 95 F-105s in the Vietnam War would each have to drop two bombs to obtain the same destructive capacity as one F-117 dropping one bomb of a similar weight (900 kg) in the 1980s and 1990s.[20] In short, the combination of more accurate missiles and bombs and the increased destructive capacity of conventional weapons changed warfighting substantially.

The arrival of accurate conventional missiles, and in particular so-called prompt global strike (PGS) weapons, should also be situated in the context of the debate about the remaining relevance of nuclear weapons after the Cold War. In contrast to what could have been expected, the 1994 Nuclear Posture Review under the administration of US President Bill Clinton did not lead to major changes in US nuclear weapons policy.[21] That said, the idea of 'mini-nukes'—very low-yield nuclear weapons—resurfaced in order to combat proliferation. Low-yield nuclear weapons would cause less damage and be ideal to preventatively take out a nascent nuclear weapon programme in 'rogue states'.[22] The latter was regarded as one of the 'new' threats at that time.[23] Sceptics argued that lowering the nuclear threshold would be dangerous, and that accurate

conventional missiles with penetrator warheads would be better and more legitimate instruments to take out hard targets (see below).[24] In this context, the George W. Bush administration then came up with the notion of Prompt Global Strike (PGS) weapons.[25] The idea was to acquire accurate (hypersonic) ballistic missiles—either ICBMs or submarine-launched ballistic missiles (SLBMs)—with conventional warheads that would be able to take out any target in the world within one hour. However, because of the risk of entanglement of conventional and nuclear weapons, and under pressure from Congress, the idea was put on hold. Later on, President Barack Obama, who wanted to diminish the role of nuclear weapons, would reintroduce the idea of conventional PGS. His administration proposed the development of new and separate missiles for conventional tasks in order to minimize the entanglement risk.

Unsurprisingly, these new weapon systems and their impact on the change of thinking in the USA also affected military thinking in Russia and China.[26] As a result of the end of the Cold War and encouraged by US military operations in the 1990–91 Gulf War, Russia and China tried to find complements for nuclear weapons too. Russia was particularly concerned about the combination of US missile defence (since US President Ronald Reagan's Strategic Defense Initiative in the 1980s) and modern conventional missiles, both PGS systems and cruise missiles.[27] Given the poor state of nuclear readiness in Russia in the 1990s, the USA could have launched a first strike (or that was at least the fear).[28] That situation also helps to explain Russia's anger when the Bush administration announced the USA's unilateral withdrawal from the Treaty on the Limitation of Anti-Ballistic Missile Systems (ABM Treaty) in 2001. The withdrawal triggered a major reinvestment programme in (conventional and nuclear) hypersonic missiles (e.g. Avangard) in Russia that could be either used for warfighting or strategic stability (read deterrence) purposes. The latter started in the 1980s, but was accelerated in the 2000s, as it became more affordable due to the increasing gas and oil revenues.[29] China became more recently concerned about the increasing number of US medium-range and intermediate-range offensive and defensive missiles in the region, which accelerated its hypersonic development program.

Today, conventional missiles have strong strategic (including deterrence) potential, especially because they have improved in terms of speed, pinpoint accuracy (due to improved guidance), and to a lesser extent manoeuvrability.

NOT ONLY FOR WARFIGHTING, BUT ALSO FOR DETERRENCE

Due to the fact that conventional weapons could be used without endangering the entire globe, it can be argued that conventional deterrence is more credible than nuclear deterrence. Already in the early 1980s, US political scientist Samuel Huntington wrote: 'Effective retaliation means credible retaliation, and in today's world, credible retaliation means *conventional* retaliation'.[30] Just a few years later and for the same reasons, in 1988 a team led by Fred Iklé and Albert Wohlstetter advised the US government to rely more on conventional weapons for deterrence purposes.[31] In case of an (unlikely) deterrence failure, strategic conventional weapons—meaning advanced conventional weapon systems designed and deployed to accomplish strategic functions—could be used in a proportionate manner, which is not the case for nuclear weapons.[32]

Linked to issues of credibility and the end of the Cold War, in the 1990s many experts recommended a conventional instead of a nuclear deterrent, or at least complimenting nuclear with conventional deterrence.[33] In 1991, William J. Perry, who would later serve as US secretary of defense, wrote: 'This new conventional military capability adds a powerful dimension to the ability of the United States to deter war'.[34] Former US ambassador and nuclear 'hawk' Paul Nitze also concluded: 'Smart conventional weapons are safer, cause less collateral damage, and cause less threat of causing escalation—therefore offering greater flexibility for use in situations where nuclear weapons use would be politically or militarily impractical'.[35] Similarly but less radically, in 1997 the bipartisan US National Defense Panel's report—looking ahead to the year 2010—concluded that conventionally armed ICBMs could provide 'a supplement *or alternative* to nuclear arsenals of the Cold War'.[36] Moreover, in 2005 Barry Watts, former director of program analysis and evaluation at the US Department of Defense, noted the 'growing ability of accurate, non-nuclear . . . munitions to achieve military effects comparable to nuclear weapons, without the collateral damage of nuclear employment'.[37]

Today, conventional missiles have strong strategic (including deterrence) potential, especially because they have improved in terms of speed, pinpoint accuracy (due to improved guidance), and to a lesser extent manoeuvrability. In addition, warhead technology and therefore hard-target-kill capability have been improved. In all likelihood, AI will further boost these capabilities.[38] Nikolai Sokov from the Vienna Center for Disarmament and Non-Proliferation argues:

> Like nuclear weapons and unlike traditional conventional weapons, [the] use [of long-range precision-guided conventional weapons] can have strategic outcomes severely degrading the fighting capacity of the adversary—not just its military capability, but also its industrial capacity, transportation networks and its command, control and communication systems.[39]

A 2022 International Institute for Strategic Studies (IISS) report entitled 'Non-Nuclear Weapons with Strategic Effect: New Tools of Warfare' similarly argued that 'the significant capabilities of conventional long-range strike capabilities, including for strategic purposes, are well-known and understood, *thus contributing to their deterrent value*'. The report concludes that 'non-nuclear strategic weapons are not only much more usable politically, they also do not necessarily invite nuclear retaliation'.[40] The latter is by definition impossible in a world without nuclear weapons; so too is the problem of conventional–nuclear entanglement. One other advantage of hypersonic missiles is that a country does not need many because they are hard to defend against.[41]

...in the US government there have been sporadic but clear moves in the direction of delegitimizing nuclear weapons, with nuclear weapons being replaced by conventional weapons, although to a limited extent and without much fanfare.

An increasing number of experts can envision a scenario where strategic non-nuclear weaponry would replace nuclear deterrence and see it as a real option. SIPRI analyst Tytti Erästö is optimistic: 'Precision-strike weapons have the potential to *substitute* nuclear weapons as a more credible and less risky source of deterrence against conventional aggression'.[42] A 2020 Chatham House report states that 'many of the new capabilities are non-nuclear and could augment *or even replace* nuclear weapons for certain deterrence functions'.[43] Similarly, a 2023 Wilton Park conference report concludes that:

> ... many of these [nuclear] measures could be politically difficult. Non-nuclear measures could include improving or developing: cyber capabilities and resilience, multilateral cooperation in space resilience, and coordinated deterrence campaign planning, missile defence capabilities, deep precision strike capabilities.[44]

Today, for instance, South Korean conventional precision-strike weapons are used as the main deterrent against North Korea (apart from US extended nuclear deterrence), particularly in the form of a potential decapacitation strike.[45] Thus, some observers conclude: 'That a nonnuclear power is attempting to deter a nuclear-armed rival and incorporate both counterforce and countervalue targeting vividly illustrates how advanced remote sensing and precision guidance have sparked a revolution in military affairs'.[46]

Other experts are willing to consider conventional deterrence as a new option, although they do not (yet) regard it as the most likely scenario.[47] Although Lieber and Press are not ready to abandon nuclear deterrence, they too conclude: 'Nuclear deterrence can be robust, but nothing about it is automatic and everlasting'.[48] Cimbala and Korb recommend to denuclearize the US ICBMs and turn them into a strategic conventional prompt global strike system. They conclude: 'By mid-century, nuclear weapons could remain deployed in the arsenals of major powers but without their status as mainstays of deterrence, passing that baton to advanced non-nuclear weapons offering deterrence by denial preferentially to deterrence by threat of regional or global annihilation'.[49]

Furthermore, also in the US government there have been sporadic but clear moves in the direction of delegitimizing nuclear weapons, with nuclear weapons being replaced by conventional weapons, although to a limited extent and without much fanfare. Financing the research and development of conventional Prompt Global Strike missiles started in 2003 under the Bush administration. Limited doctrinal changes were then introduced by the Obama administration in the 2010 Nuclear Posture Review, the 2010 Quadrennial Defense Review and the 2013 Nuclear Employment Guidance.[50] In contrast to the existing policy at the time, the Nuclear Posture Review stated that 'our conventional weapons capability is an effective deterrent in all but the most extreme circumstances'.[51] The Nuclear Employment Guidance later directed the US Department of Defense 'to strengthen non-nuclear capabilities and reduce the role of nuclear weapons in deterring non-nuclear attacks' and 'to conduct deliberate planning for non-nuclear strike options to assess what objectives and effects could be achieved through non-nuclear strike options, and to propose possible means to make these objectives achievable'; …'Planning for non-nuclear strike options is a central part of reducing the role of nuclear weapons'.[52] And contrary to expectations, the Nuclear Posture Reviews under both Donald J. Trump and Joe Biden continued the line of integrating conventional and nuclear deterrence.

Biden's 2022 Nuclear Posture Review 'underscores the linkage between the conventional and nuclear elements of collective deterrence and defense', which is now called 'integrated deterrence'. It further states: 'Non-nuclear capabilities may be able to complement nuclear forces in strategic deterrence plans and operations in ways that are suited to their attributes and consistent with policy on how they are employed'.[53] The October 2023 Final Report of the (bipartisan) Congressional Commission on the Strategic Posture of the USA was a mixed bag; it did not recommend a diminished role for nuclear weapons, but at the same time it pushed to 'prioritize funding and accelerate long-range *non-nuclear* precision-strike programs . . . in greater quantities than currently planned'. It also argued that 'the objectives of US strategy must include effective *deterrence* and defeat of simultaneous Russian and Chinese aggression in Europe and Asia *using conventional forces*'.[54] When the report was presented, Rose Gottemoeller—one of the meeting participants—emphasized the need to build up conventional capabilities so that the USA would not have to rely on nuclear weapons.[55] As well as non-nuclear precision-strike programmes (hypersonics), the report recommended increased funding for cyber defences, emerging technologies such as AI, quantum computing, big data analytics, and directed energy.[56] In the same month, a State Department report went even further:

> Over the long term, one way to reduce the demand for nuclear weapons would be to broaden the defense and deterrence portfolio, including by developing more advanced conventional means, such as advances in precision, in order to provide the President with more decision-making space and effective strategic options in the event of an existential threat or nuclear coercion against the United States or one of our allies.[57]

Interestingly, in October 2022 President Biden made it implicitly clear that the USA would respond with conventional weapons if Russia used a tactical nuclear weapon in Ukraine.[58]

The Chinese expert Tong Zhao also recommends that 'by managing the risk of nuclear escalation, Washington and its allies could more effectively collaborate on strengthening their conventional deterrence, a factor that holds greater sway than nuclear weaponry in shaping the outcome of future conflicts'.[59] China deployed the medium-range DF-17 hypersonic missile (with a glide vehicle) that according to China has a purely conventional deterrent mission.[60]

There are also Russian voices that emphasize conventional instead of nuclear deterrence, although they date back to before the start of the war in Ukraine.[61] Russian experts such as Valeriy Akimenko have recommended replacing tactical nuclear weapons with conventional weapons, and using conventional weapons instead of nuclear weapons for de-escalation in a crisis.[62] Akimenko believes even the Russian government understands the stakes, arguing: 'An analysis of Russian military theory and practice suggests that Russia's views have undergone an evolution, moving from reliance on nuclear deterrence towards a greater emphasis on non-nuclear deterrence'.[63] He refers to the 2014 Russian military doctrine, and also quotes Sergei Shoigu, then-Russian minister of defence, who stated in 2017: 'In the future, a gradual transfer of the deterrent factor from the nuclear to the non-nuclear plane is possible'.[64] This language was later confirmed in the June 2020 Russian statement on nuclear deterrence.[65] It remains to be seen what lessons Russia will draw from the war in Ukraine.

CRITICISMS

Of course, there remain many sceptics to the idea of strategic conventional weapons as the only deterrent, partly because the idea of nuclear weapons being around forever is so dominant.[66] One group of critics is concerned that because conventional weapons are less destructive and therefore more usable, the world will witness more conventional wars.[67] Conventional deterrence may also fail, just like nuclear deterrence, which would result in instability. In fact, former British defence strategist Michael Quinlan once said: 'Better a world with nuclear weapons but no major war than one with major war but no nuclear weapons'.[68] This paper, however, sees that argument as a false dichotomy. In a world with nuclear weapons, major wars can happen as well. The ongoing war in Ukraine is just the latest example. That said, the major advantage of non-nuclear deterrence is that the destruction will remain limited, at least in comparison with nuclear weapons, and that the risk of the destruction of the whole civilization is negligible compared to the current situation. As Henry D. Sokolski, executive director of the Nonproliferation Policy Education Center, argues: 'If there is some way to accomplish military missions without resorting to nuclear arms, most military planners favor it. A key reason why is the inability to know, after the nuclear shooting begins, when and where it might stop'.[69] In addition, traditional arms control could and should help to limit the number of conventional weapons, just as with nuclear weapons during the Cold War.

Other critics argue that the current geostrategic situation is not conducive for the changes proposed in this paper. They claim that they will not be feasible and may not even be desirable. Most Russian experts and politicians, just like their US colleagues, do not (yet) want to go as far as replacing nuclear with conventional deterrence.[70] In France, too, most experts are not (yet) convinced.[71] The same applies to the other nuclear-armed states. However, it is important to note that the argument of this paper is not that nuclear-armed states may—let alone will—switch to conventional deterrence in the very short term. The argument is that nuclear-armed states first have to be convinced of the desirability and therefore feasibility of that (r)evolution, and that the analysis of this paper may contribute to the kind of thinking that could re-open the debate. That said, one could make the argument that the current geostrategic environment points to the need to de-emphasize the role of nuclear weapons more than ever before. The war in Ukraine has shown that nuclear weapons are not theoretical objects, but weapons that possibly may be used.[72]

The threat of violent conflicts among states will always remain, and conventional weapons will not disappear either. Consequently, as long as there is no global security community—which is a community of states that do not fear each other—states will feel the need to have a deterrent.

Other critics agree that a world without nuclear weapons may offer more benefits than costs, but wonder whether the interim period towards a nuclear weapon-free world would not be too destabilizing. To sketch out a concrete path towards nuclear elimination, including conventional arms control and confidence-building measures, goes beyond the scope of this paper. Rather, the main goal is to show that a world with nuclear weapons is a dangerous world and that EDTs enhance the risk of nuclear weapon use. At the same time, it argues that the existence of some EDTs, particularly conventional hypersonic weapons, may help convince sceptics that disarming nuclear weapons is possible because there exists a valid alternative, namely modern conventional weapons. Yet only when sufficient experts and political leaders are convinced by the idea, can they start working towards this goal. This should be done in a multilateral and gradual way, involving all nuclear-armed states as well as (representatives of the) non-nuclear weapon states. This paper believes that the necessary conditions for eliminating nuclear weapons are universality (i.e. all nuclear-armed states should be on board); an intrusive verification and sanctions regime; a change in the UN Security Council constellation (e.g. including India as a permanent member); and improving the existing collective security arrangements, at both global and regional level (including setting arms control limits for conventional weapons). The end of the war in Ukraine may be a catalyst in this regard.[73]

Nevertheless, the threat of violent conflicts among states will always remain, and conventional weapons will not disappear either. Consequently, as long as there is no global security community—which is a community of states that do not fear each other—states will feel the need to have a deterrent.[74] That deterrent, however, has to be credible. One could make the argument that the pre-World War I and II conventional weapons did not have the characteristics of a credible deterrent, which partly explains the existence of many wars at that time.[75] Nuclear weapons, in contrast, are simply too destructive to be used. Their use would by definition violate international humanitarian law (except in very specific circumstances like attacking an aircraft carrier) and large-scale nuclear use could mean the end of civilization; as a result, a nuclear deterrent is not very credible either.[76] Like in the story of Goldilocks and the three bears, something is needed that is just right, not too much and not too little. Thus, the best deterrent would be something in between classic conventional and nuclear: speedy but highly accurate conventional missiles that can reach any target very quickly, be it hypersonic or not.

Conclusion

It is unclear whether the world has survived thanks to or despite nuclear weapons. That said, the goal—even for the nuclear-armed states—is to gradually diminish the number of nuclear weapons and to ultimately eliminate them. The latter has been agreed by all states, including by the five formal nuclear weapon states, when they signed and ratified the NPT.

The movement towards nuclear elimination, however, has come to a standstill. Nuclear arms control, not to mention nuclear disarmament, has been stalled since New START in 2010 and arguably stalled already in the mid 1990s. All of the nuclear-armed states are modernizing their arsenals; some of them, like China, are even building them up. One of the main reasons for this nuclear inertia or nuclear revival—apart from parochial industrial and bureaucratic interests—is the belief that nuclear deterrence ‘works’ and the resulting idea that there is no need to give up nuclear weapons and certainly not in a context of increased tensions between major powers. Critics have not been able to convince the advocates of nuclear deterrence that these beliefs are wrong (and vice versa). The war in Ukraine will probably not change the minds of opponents or proponents either.

Technology (in combination with political will), however, may do so. This paper argues that EDTs—referring to hypersonic missiles, cyber capabilities and AI—and strategic conventional weapons could more easily attack the early-warning and command-and-control systems of nuclear forces, or the forces themselves, which would be highly destabilizing. In addition, they may substantially undermine the invulnerability of nuclear submarines. The combination of both threats may be the final nail in the coffin of nuclear weapons and could speed up the process of nuclear elimination.

Yet eliminating nuclear weapons requires coming up with a valid alternative. Not by chance, the other main argument of this paper is that some of the same EDTs could provide such an alternative. They could not only supplement, but in time replace nuclear weapons as a deterrent. Strategic conventional weapons that are fast and accurate, including hypersonic missiles, come into this picture. Because they could be used in a way that at least seeks to comply with jus in bello principles, by minimizing civilian harm (in comparison with nuclear weapons), they are also more credible as a deterrent. This may in turn increase political willingness to seriously consider fully delegitimizing nuclear weapons, and eventually replacing them with the default option: modern conventional weapons.

A world without nuclear weapons will not mean a world without violent conflicts. The costs and benefits of a world with and without nuclear weapons have to be further assessed very carefully. If, however, the conclusion is that a nuclear weapon-free world is indeed desirable, as prescribed by the NPT and the TPNW, and given the increased awareness of the nuclear escalation risks in the war in Ukraine, the arrival of EDTs such as hypersonic missiles may make this scenario more politically feasible.

A longer version of this report was first published by EU NPDC in December 2024.

NOTES

[1] Joelien Pretorius and Tom Sauer, 'When Is It Legitimate to Withdraw From the NPT? Withdrawal as a Political Tool to Move Nuclear Disarmament Forward', *Contemporary Security Policy,* Vol.43, No.1, 2022, pp.161-185, https://www.tandfonline.com/doi/abs/10.1080/13523260.2021.2009695.

[2] Paul Meyer and Tom Sauer, 'The Nuclear Ban Treaty: A Sign of Global Impatience', *Survival*, Vol.60, No.2, 2018, pp.61-72, https://www.tandfonline.com/doi/full/10.1080/00396338.2018.1448574.

[3] Tom Sauer, 'How Useful Are Nuclear Weapons in Practice? Case-study: The War in Ukraine', *Journal for Peace and Nuclear Disarmament,* Vol.7 (1), 2024, pp.194-210, https://www.tandfonline.com/doi/full/10.1080/25751654.2024.2359818.

[4] Fabian Hoffmann, 'Strategic Non-Nuclear Weapons and Strategic Stability – Promoting Trust Through Technical Understanding', *FRS paper*, November 2021, p.2, https://www.frstrategie.org/en/programs/npt-and-the-p5-process/strategic-non-nuclear-weapons-and-strategic-stability-promoting-trust-through-technical-understanding-2021.

[5] James Acton, 'Escalation Through Entanglement: How the Vulnerability of Command-and-Control Systems Raises the Risk of an Inadvertent Nuclear War', *International Security*, Vol.43, No.1, 2018, pp.56-99, https://doi.org/10.1162/isec_a_00320; Sergei Karaganov and Dmitry Suslov, 'The New Understanding and Ways to Strengthen Multilateral Strategic Stability', *Moscow Higher School of Economics report*, 2019, p.12, https://eng.globalaffairs.ru/articles/strategic-stability/; Jurgen Altmann, 'Technology, Arms Control and World Order', *Toda Peace Institute Policy Brief no.89*, September 2020, https://toda.org/assets/files/resources/policy-briefs/t-pb-89_jurgen-altmann.pdf; Christopher Chyba, 'New Technologies and Strategic Stability', *Daedalus*, Vol.149, No.2, Spring 2020, https://doi.org/10.1162/daed_a_01795; Johnson, James, 'Artificial Intelligence in Nuclear Warfare', *The Washington Quarterly*, vol.43, no.2 (2020); James Johnson, 'Inadvertent Escalation in the Age of Intelligence Machines', European *Journal of International Security*, Vol.7, No.3, 2022, https://www.cambridge.org/core/journals/european-journal-of-international-security/article/inadvertent-escalation-in-the-age-of-intelligence-machines-a-new-model-for-nuclear-risk-in-the-digital-age/D1F1FC47D12FA4DCB12D1648412B696B; Johnson, James, 'Deterrence in the Age of Artificial Intelligence and autonomy', *Defense and Security Analysis*, vol.36, no.4 (2020); Johnson, James, '"Catalytic Nuclear War" in the Age of Artificial Intelligence and Autonomy', *Journal of Strategic Studies*, 2021; Favaro, M., *Weapons of Mass Distortion* (London: Kings' College London), May 2021; Tytti Erastö, *New Technology and Nuclear Disarmament* (Stockholm: SIPRI, 2021), p.11, https://www.sipri.org/publications/2021/policy-reports/new-technologies-and-nuclear-disarmament-outlining-way-forward; Futter, Andrew, 'Explaining the nuclear challenges posted by emerging and disruptive technology', *EU NPDC Non-Proliferation and Disarmament Paper* no.73, March 2021'; Andrew Futter and Benjamin Zala, 'Strategic Non-Nuclear Weapons and the Onset of a Third Nuclear Age', *European Journal of International Security*, Vol.6, No.3, 2021, pp.257-277; Lissner, Rebecca, 'The Future of Strategic Arms Control', *CFR Discussion Paper Series on Managing Global Disorder,* no.4, April 2021; Fabian Hoffman and William Alberque, 'Non-Nuclear Weapons with Strategic Effect: New Tools of Warfare ?', *IISS Roundtable Report*, March 2022, https://www.iiss.org/globalassets/media-library---content--migration/files/research-papers/2022/03/non-nuclear-weapons-with-strategic-effect-new-tools-of-warfare.pdf.

[6] Keir Lieber and Daryl Press, 'The New Era of Counterforce', *International Security*, Vol.41, No.4, Spring 2017, p.9, https://doi.org/10.1162/ISEC_a_00273.

[7] Alternatively, early-warning systems can also be regarded as being part of command and control systems.

[8] Futter and Zala, 'Strategic Non-Nuclear Weapons', p.268.

[9] For a critical view on preemptive wars, see Dan Reiter, 'Exploding the Powder Keg Myth: Preemptive Wars Almost Never Happen', *International Security*, Vol.20, No.2, Fall 1995, pp.5-34, https://doi.org/10.2307/2539227.

[10] Acton, 'Escalation Through Entanglement', p.82-92; Favaro, 'Weapons of Mass Distortion', p.13.

[11] Johnson, 'Catalytic Nuclear War', p.7. Others – like Jürgen Altmann - are less convinced about the possibility of denial of service attacks (personal communication to author).

[12] James Holmes, 'Sea Changes: The Future of Nuclear Deterrence', *The Bulletin of the Atomic Scientists*, Vol.72, No.4, July 2016, pp.228-233, https://www.tandfonline.com/doi/full/10.1080/00963402.2016.1194060; Laurel Baker, 'Interview: Rose Gottemoeller on the Precarious Future of Arms Control', *The Bulletin of the Atomic Scientists,* 29 July 2024, https://thebulletin.org/2024/07/interview-rose-gottemoeller-on-the-precarious-future-of-arms-control/. For a more skeptical view, see Ryan Snyder and Benoît Pélopidas, 'Correspondence: New Era or New Error? Technology and the Future of Deterrence', Vol.43, No.3, Winter 2018/2019, pp.190-193, https://doi.org/10.1162/isec_c_00338; Owen Coté, 'Invisible Nuclear Armed Submarines or Transparent Oceans ?', *The Bulletin of the Atomic Scientists,* Vol.75, No.1, 2019, pp.30-35, https://www.tandfonline.com/doi/abs/10.1080/00963402.2019.1555998, and see Steve Fetter (personal communication to author).

[13] Lieber and Press, 'The New Era', pp.32-46; Jack O'Doherty, 'Is America Buying Nuclear Weapons to Win a War or to Prevent One?', *The Bulletin of the Atomic Scientists*, 20 August 2024, https://thebulletin.org/2024/08/is-america-buying-nuclear-weapons-to-win-a-war-or-to-prevent-one/.

[14] Acton, 'Escalation'; Wilfred Wan, Andraz Kastelic and Eleanor Krabill, 'The Cyber-Nuclear Nexus: Interactions and Risks', *UNIDIR Nuclear Risk Reduction: Friction Points Series*, no.2, 2021, https://unidir.org/publication/the-cyber-nuclear-nexus-interactions-and-risks/.

[15] Johnson, 'Deterrence', p.429.

[16] Erica Lonergan and Keren Yarhi-Milo, 'Cyber Signaling and Nuclear Deterrence: Implications for the Ukrainian Crisis', *War on the Rocks*, 20 April 2022, https://warontherocks.com/2022/04/cyber-signaling-and-nuclear-deterrence-implications-for-the-ukraine-crisis/.

[17] Stephen Lukasik, 'To What Extent Can Precision Conventional Technologies Substitute for Nuclear Weapons ?', in Henry Sokolski (ed), *The Next Arms Race* (US Army War College, 2012), p.394.

[18] Erastö, 'New Technology'.

[19] Quoted by Richard Price and Nina Tannenwald, 'Norms and Deterrence', in Peter Katzenstein, ed., *The Culture of National Security* (New York: Columbia University Press, 1996), p.140.

[20] Paul White, Robert Pendley and Patrick Garrity, 'Thinking about No Nuclear Forces', in Regina Cowen Karp, ed., *Security Without Nuclear Weapons* (Oxford: Oxford University Press, 1992), p.113. That said, using these weapons against Iraq is easier than against Russia or China.

[21] Janne Nolan, *An Elusive Consensus* (Washington DC: Brookings Institute Press, 1999); Tom Sauer, *Nuclear Inertia. US Nuclear Weapons Policy after the Cold War* (London: I.B.Tauris, 2005).

[22] Thomas Dowler and Joseph Howard, 'Stability in a Proliferated World', *Strategic Review,* Spring 1995, pp.26-37.

[23] For a critical view, see Michael Klare, *Rogue States and Nuclear Outlaws* (New York: Hill and Wang, 1995).

[24] Paul Nitze, 'A Conventional Approach', *Proceedings*, May 1994, https://www.usni.org/magazines/proceedings/1994/may/conventional-approach; Tytti Erastö, New Technology, p.11.

[25] Dennis Gormley, 'US Advanced Conventional Systems and Conventional Prompt Global Strike Ambitions', *The Nonproliferation Review*, Vol.22, No.2, 2015, pp.123-139, http://dx.doi.org/10.1080/10736700.2015.1117735.

[26] Roger McDermott and Tor Bukkvoll, 'Tools of Future Wars – Russia is Entering the Precision-Strike Regime', *Journal of Slavic Military Studies*, Vol.31, No.2, 2018, https://www.tandfonline.com/doi/abs/10.1080/13518046.2018.1451097; Kristin Ven Bruusgaard, 'Russian Nuclear Strategy and Conventional Inferiority', *Journal of Strategic Studies*, Vol.44, No.1, 2021, p.12, https://www.tandfonline.com/doi/full/10.1080/01402390.2020.1818070.

[27] Alexei Arbatov, 'A New Era of Arms Control', Carnegie Moscow Center, 24 October 2019, https://carnegieendowment.org/posts/2019/10/a-new-era-of-arms-control-myths-realities-and-options?lang=en; Kristin Ven Bruusgaard, 'Russian Nuclear Strategy', p.17-18.

[28] Keir Lieber and Daryll Press, 'The end of MAD? The Nuclear Dimension of Nuclear Primacy', *International Security*, Vol.30, No.4, 2006, pp.7-44, http://www.jstor.org/stable/4137528.

[29] Ven Bruusgaard, 'Russian Nuclear Strategy', p.18.

[30] Samuel Huntington, 'Conventional Deterrence and Conventional Retaliation in Europe', *International Security*, Vol.8, No.3, 1983/1984, p.56, https://doi.org/10.2307/2538699. My emphasis.

[31] Fred Iklé and Albert Wohlstetter, Discriminate Deterrence. *Report from the Commission on Integrated Long-Term Strategy,* January 1988, https://www.airandspaceforces.com/PDF/DocumentFile/Documents/2008/DiscriminateDeterrence_010188.pdf.

[32] Fabian Hoffmann, 'Strategic Non-Nuclear Weapons', p.2.

[33] William Perry, 'Desert Storm and Deterrence', *Foreign Affairs*, Vol.70, No.4, Fall 1991, https://www.foreignaffairs.com/articles/iraq/1991-09-01/desert-storm-and-deterrence; Seth Cropsey, 'The Only Credible Deterrent', *Foreign Affairs,* March/April 1994, https://www.foreignaffairs.com/articles/1994-03-01/only-credible-deterrent; Paul Warnke, 'Strategic Nuclear Policy and Non-Proliferation', *Arms Control Today*, May 1994; Michael MccGwire, 'The Anatomy of the Argument', in Joseph Rotblat, ed., *Nuclear Weapons: The Road to Zero* (Boulder: Westview Press, 1997); Mathias Dembinski, Alexander Kelle and Harald Müller, 'NATO and Non-Proliferation: A Critical Appraisal', *PRIF Report,* no.33, April 1994.

[34] William Perry, 'Desert Storm', p.66.

[35] Nitze, 'A Conventional Approach', p.46.

[36] US National Defense Panel, Transforming Defense (Washington DC, December 1997), https://documents.theblackvault.com/documents/dod/readingroom/1/902.pdf, my emphasis.

[37] Quoted in Gormley, 'US Advanced Conventional Systems', p.125.

[38] Hoffmann, ibid.

[39] “How to Deal with Long-Range Precision-Guided Conventional Weapons, an Interview with Nikolai Sokov”, *EU Non-Proliferation and Disarmament Consortium Newsletter*, No 38, May 2022, p.1, https://www.nonproliferation.eu/wp-content/uploads/2022/05/eunpd_e-newsletter_38.pdf.

[40] Hoffman and Alberque, ‘Non-Nuclear Weapons’, p.6. My emphasis.

[41] Carrie A.Lee, ‘Technology Acquisition and Arms Control: Thinking Through the Hypersonic Weapons Debate’, *Texas National Security Review*, Vol.5; No.4, Fall 2022, p.45, https://tnsr.org/2022/09/technology-acquisition-and-arms-control-thinking-through-the-hypersonic-weapons-debate/.. That applies to nuclear weapons as well; in practice, however, the US and the Soviet Union built tens of thousands of nuclear weapons.

[42] Erastö, ‘New Technology’, p.13, my emphasis; see also Stephen Lukasik, Ibid.

[43] Quoted by Andrew Futter, ‘The Risks Posed by Emerging Technologies to Nuclear Deterrence’, in Beyza Unal and others, *Perspectives on Nuclear Deterrence in the 21st Century* (Chatham House Research Paper, 2020), pp.27-30, https://www.chathamhouse.org/2020/04/perspectives-nuclear-deterrence-21st-century-0/risks-posed-emerging-technologies-nuclear. My emphasis.

[44] Jacklyn Majnemer and Eva-Nour Repussard, ‘NATO’s New ‘Deterrence Baseline’ and the Future of Extended Nuclear Deterrence’, *Wilton Park Report*, September 2023, https://www.wiltonpark.org.uk/app/uploads/2023/10/WP3131-NATOS-New-Deterrence-Baseline-and-the-Future-of-Extended-Nuclear-Deterrence.pdf.

[45] Ian Bowers and Henrik Stalhane Hiim, ‘Conventional Counterforce Dilemmas. South Korea’s Deterrence Strategy and Stability on the Korean Peninsula’, *International Security*, Vol.45, No.3, Winter 2020/2021, pp.7-39, https://doi.org/10.1162/isec_a_00399; Joshua Pollack, Cristina Varriale and Tom Plant, ‘The Changing Role of Allied Conventional Precision-Strike Capabilities in Nuclear Decision-Making’, *The Nonproliferation Review,* Vol.27, No.1-3, 2020, pp.21-37, https://www.tandfonline.com/doi/full/10.1080/10736700.2020.2003561; Tom Sauer, ‘US Extended Nuclear Deterrence in Europe and East Asia: A Comparative Analysis’, *Asian Affairs*, Vol.53, No.3, 2022, https://www.tandfonline.com/doi/full/10.1080/03068374.2022.2074731.

[46] Bowers and Hiim, ibid., p.36.

[47] Futter and Zala, ‘Strategic Non-Nuclear Weapons’, p.273-274.

[48] Lieber and Press, ‘The New Era’, p.49. In a more recent article, in contrast to previous publications, Lieber and Press criticize a pure counterforce strategy and opt for a so-called “hybrid approach”, in between deterrence by denial and deterrence by punishment. Keir Lieber and Daryl Press, ‘US Strategy and Force Posture for an Era of Nuclear Tripolarity’, *Atlantic Council Issue Brief*, April 2023, https://www.atlanticcouncil.org/in-depth-research-reports/issue-brief/us-strategy-and-force-posture-for-an-era-of-nuclear-tripolarity/.; John Harvey and Robert Soofer, ‘Nuclear Priorities for the Biden Administration’, *Atlantic Council Issue Brief*, December 2021, p.2, 11-12, https://www.atlanticcouncil.org/in-depth-research-reports/issue-brief/nuclear-*priorities-for-the-biden-administration/; see also Michael Gerson, ‘Conventional Deterrence in the Second Nuclear Age’, Parameters,* Vol.39, No.3, Autumn 2009, pp.32-48, https://press.armywarcollege.edu/cgi/viewcontent.cgi?article=2486&context=parameters.

[49] Stephen Cimbala and Lawrence Korb, ‘Rethinking the US Strategic Triad’, *The Bulletin of the Atomic Scientists*, 20 December 2023, https://thebulletin.org/2023/12/rethinking-the-us-strategic-triad-when-it-comes-to-nuclear-platforms-how-many-are-enough/.

[50] Hans Kristensen, ‘Forget LRSO. JASSM-ER Can Do the Job’, *Federation of American Scientists report* (2015), https://fas.org/publication/lrso-jassm/.

[51] Quoted by Erastö, ‘New Technology’, p.11.

[52] Quoted by Kristensen, ‘Forget LRSO’.

[53] Quoted by Hans Kristensen and Matt Korda, ‘The 2022 Nuclear Posture Review: Arms Control Subdued By Military Rivalry’, *Federation of American Scientists*, 27 October 2023, https://fas.org/publication/2022-nuclear-posture-review/.

[54] Executive Summary, *America’s Strategic Posture. The Final Report of the Congressional Commission on the Strategic Posture of the US* (Washington DC, October 2003), https://armedservices.house.gov/sites/republicans.armedservices.house.gov/files/Strategic-Posture-Committee-Report-Final.pdf. My emphasis.

[55] Al Mauroni, ‘The Strategic Posture Commission’s Amazing Trip Back to the Future’, *War on the Rocks*, 13 December 2023, https://warontherocks.com/2023/12/the-strategic-posture-commissions-amazing-trip-back-to-the-future/.

[56] Al Mauroni, Ibid.

[57] ISAB, *Report on Deterrence in a World of Nuclear Multipolarity*, US State Department, Washington DC, October 2023, p.15, https://www.state.gov/wp-content/uploads/2023/11/ISAB-Report-on-Deterrence-in-a-World-of-Nuclear-Multipolarity_Final-Accessible.pdf.

[58] David Sanger, ‘Biden Says Russian Use of Nuclear Weapon Would Be a “Serious Mistake”’, *New York Times*, 25 October 2022.

[59] Tong Zhao, 'It's Time to Talk About No First Use', *Foreign Policy*, 6 November 2023, https://foreignpolicy.com/2023/11/06/united-states-china-nuclear-meeting-no-first-use-arms-control/.

[60] Henrik Stalhane Hiim, Taylor Fravel, and Magnus Langset Troan, 'The Dynamics of an Entangled Security Dilemma', p.183.

[61] Andrei Kokoshin, *On the System of Non-Nuclear Deterrence in Russia's Defense Policy* (Moscow: Moscow University Press, 2012); Pavel Podvig, 'Blurring the Line Between Nuclear and Nonnuclear Weapons', *The Bulletin of the Atomic Scientists*, Vol.72, No.3, 2016, p.148, https://www.tandfonline.com/doi/abs/10.1080/00963402.2016.1170363; Valeriy Akimenko, 'Russia and Strategic Non-Nuclear Deterrence', *Chatham House Briefing Paper,* July 2021, 18 p, https://www.chathamhouse.org/2021/07/russia-and-strategic-non-nuclear-deterrence.

[62] See Erastö, 'New Technology', p.13; and Akimenko, 'Russia and Strategic Non-Nuclear Deterrence'.

[63] Akimenko, Ibid., p.2.

[64] Ibid., p.15.

[65] President of the Russian Federation, 'Executive Order on Basic Principles of State Policy of the Russian Federation in het Sphere of Nuclear Deterrence', Russian Ministry of Foreign Affairs, June 2, 2020, https://www.mid.ru/en/foreign_policy/international_safety/1434131/. See also: Janice Gross Stein, 'Escalation Management in Ukraine', *Texas National Security Review*, Vol.6, No.3, Summer 2023, pp.29-50, http://dx.doi.org/10.26153/tsw/47414.

[66] Benoît Pélopidas, 'The Birth of Nuclear Eternity', in: Sandra Kemp and Jenny Anderson (eds), *Futures* (Oxford: Oxford Uniiversity Press), 2021.

[67] Christine Leah, 'Deterrence and Arms Control in a Second Conventional Age', *Comparative Strategy*, Vol.34, No.5, 2015, pp.401-421, https://www.tandfonline.com/doi/full/10.1080/01495933.2015.1089122.

[68] Michael Quinlan, 'The Future of Nuclear Weapons in World Affairs', *The Atlantic Council of the US Bulletin*, 20 November 1996, 2, quoted by General Eugene Habiger, 'Strategic Forces for Deterrence', *Joint Forces Quarterly*, Winter 1996/1997, 66.

[69] Henri Sokolski, 'A Peek into Our Nuclear Future', *The American Interest,* 5 August 2020, https://www.the-american-interest.com/2020/08/05/a-peek-into-our-nuclear-future/.

[70] Edward Rhodes, 'Conventional Deterrence', *Comparative Strategy*, Vol.19, No.3, 2000, pp.221-253, https://www.tandfonline.com/doi/abs/10.1080/01495930008403210; John Stone, 'Conventional Deterrence and the Challenge of Deterrence', *Contemporary Security Policy*, Vol.33, No.1, 2012, pp.108-123, https://www.tandfonline.com/doi/abs/10.1080/13523260.2012.659591.

[71] For instance Corentin Brustlein, 'Conventionalizing Deterrence ? US Prompt Strike Programs and their Limits', *IFRI Proliferation Paper*, no.52, January 2015, https://www.ifri.org/en/publications/etudes-de-lifri/proliferation-papers/conventionalizing-deterrence-us-prompt-strike.

[72] Sauer, 'How Useful Are Nuclear Weapons'.

[73] Tom Sauer, 'The Origins of the Ukraine Crisis and the Need for Collective Security between Russia and the West', *Global Policy,* Vol.8, No.1, 2017, pp.82-91, https://doi.org/10.1111/1758-5899.12374; Tom Sauer, 'A Call for a Security Order in Europe Based on Collective Security instead of Balance of Power', *Scienza e Pace,* online on 27 June 2023, http://dx.doi.org/https://doi.org/10.13131/unipi/wzx4-zq06.

[74] On the concept of security community, see: Karl Deutsch (and others), *Political Community and the North Atlantic Area* (Princeton: Princeton University Press, 1957).

[75] John Mearsheimer, *Conventional Deterrence* (Ithaca: Cornell University Press, 1983); Rhodes, "Conventional Deterrence".

[76] Ward Wilson, 'The Myth of Nuclear Deterrence', *The Nonproliferation Review*, Vol.15; No.3, 2008, pp.421-439, https://www.tandfonline.com/doi/full/10.1080/10736700802407101.

THE TODA PEACE INSTITUTE

The Toda Peace Institute is an independent, nonpartisan institute committed to advancing a more just and peaceful world through policy-oriented peace research and practice. The Institute commissions evidence-based research, convenes multi-track and multi-disciplinary problem-solving workshops and seminars, and promotes dialogue across ethnic, cultural, religious and political divides. It catalyses practical, policy-oriented conversations between theoretical experts, practitioners, policymakers and civil society leaders in order to discern innovative and creative solutions to the major problems confronting the world in the twenty-first century (see www.toda.org for more information).

CONTACT US

Toda Peace Institute
Samon Eleven Bldg. 5 th Floor
3-1 Samon-cho, Shinjuku-ku, Tokyo 160-0017, Japan

Email
contact@toda.org

Sign up for the Toda Peace Institute mailing list
https://toda.org/policy-briefs-and-resources/email-newsletter.html

Connect with us on the following media.
YouTube: @todapeaceinstitute3917
X (Twitter): https://twitter.com/TodaInstitute
Facebook: https://www.facebook.com/TodaInstitute