The Deep Crisis of Nuclear Arms Control and Disarmament: The State of Play and the Challenges

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ABSTRACT
After the golden age of arms control, Russia and the United States are no longer engaged in arms control negotiations. The landmark Intermediate-Range Nuclear Forces (INF) Treaty was officially terminated on 2 August 2019, and the New Strategic Arms Reduction Treaty (New START) expires in February 2021. The continued political alienation between Russia and the West, combined with new military-technological developments, will undermine strategic stability. A new arms race is looming with severe implications for global nuclear disarmament, nonproliferation, and regional stability. Neither superpower seems to have a strategy for developing arms control and disarmament. On the contrary, both sides are pursuing costly programs to replace and modernize their Cold War strategic arsenals. A more ambitious approach is necessary for further reductions in nuclear arsenals and the extension of long-standing arms control commitments. The collapse of the INF Treaty could have been prevented by reciprocal inspections to verify treaty compliance. The United States and Russia can agree to extend New START to 2026 and to undertake a wider and structured discussion about what they could do to enhance strategic stability. Such a model must take into account third-country actors, missile defense, precision-guided conventional strike systems, and future actions in outer space and cyberspace. NATO and Russia need to launch a substantive dialogue on how to reduce the risk of hazardous military activities and to prevent military escalation caused by accidents and miscalculations. Other nuclear-armed states and their different types of delivery systems must be part of the disarmament process.

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Introduction
Almost 30 years after the end of the Cold War, nuclear arms control has fallen out of the public’s consciousness. Central disarmament successes in recent decades are reflected in the decline in global stockpiles of nuclear weapons. However, this has also led to a marginalization of the manifold and catastrophic consequences of a nuclear explosion as well as the related safety and security risks of this military technology. Since 1991, some 40,000 warheads have been deactivated, mainly by the two nuclear superpowers, the United States and Russia. This process is in decline. Agreed disarmament obligations
are no longer being upheld. A new arms competition is evolving, and the remaining arms control framework is in a deep crisis. If it remains unresolved, the crisis could even lead to the total collapse of the arms control architecture, blocking disarmament efforts for decades. The end of the landmark 1987 Intermediate-Range Nuclear Forces (INF) Treaty is heralding the end of an era and might be the starting point of a new arms race. Even preventive nonproliferation agreements, such as the Iran deal of 2015, are being called into question. Conflicts surrounding the establishment of a rule-based world order are also affecting central elements of arms control and disarmament.

By 2017, the Stockholm International Peace Research Institute (SIPRI) estimated that around 14,465 nuclear weapons are possessed by nine nuclear-weapon-armed states; around 3,750 of these are deployed and 1,800 are immediately operational (Table 1). According to the SIPRI Yearbook 2018, the United States and Russia still have about 13,800 nuclear weapons at their disposal, together constituting 95 percent of all existing nuclear weapons. Both nuclear superpowers are modernizing their nuclear forces on land, sea, and air (termed the “nuclear triad”) and their nuclear infrastructure with a 21st century perspective, while nuclear-weapon owners such as China, India, Pakistan, and also North Korea are expanding their nuclear forces. In view of the catastrophic destructive power of a single nuclear weapon, however, these numbers alone are of little significance. More important are the destructiveness of these forces, the capabilities for their deployment, and nations’ readiness to use them. Countries’ nuclear-deployment doctrines, delivery-system capabilities, and perceptions of their rivals determine global nuclear policy and thus also the deployment of forces.

Following the encouraging speech given by US President Obama in Prague in 2009, in which the goal of a nuclear-weapon-free world was articulated, this momentum has further faded away. There continues to be massive and increased investment in nuclear armament and deterrence in all its various forms, while treaty-based limiting factors are left to erode (see Section 3). For the first time in more than 50 years, there are no current strategic arms control negotiations between the United States and Russia. At their summit on 16 July 2018, Presidents Trump and Putin expressed their desire to resume talks on strategic stability. This is precisely what is called for in the central Article VI of the Non-Proliferation Treaty (NPT), whose next review conference is scheduled for 2020. Article VI requires inter alia that the state parties “undertake to pursue negotiations in good faith on effective measures relating to cessation of the nuclear arms race at an early

| Country    | Deployed Nuclear Warheads | Other Nuclear Warheads | Total 2018 |
|------------|---------------------------|------------------------|------------|
| USA        | 1,750                     | 4,700                  | 6,450      |
| Russia     | 1,600                     | 5,250                  | 6,850      |
| UK         | 120                       | 95                     | 215        |
| France     | 280                       | 20                     | 300        |
| China      | 280                       | 280                    | 280        |
| India      | 130–140                   | 130–140                | 130–140    |
| Pakistan   | 140–150                   | 140–150                | 140–150    |
| Israel     | 80                        | 80                     | 80         |
| North Korea|                          |                        | (10–20)    |
| Total      | **3,750**                 | **10,715**             | **14,465** |

*Deployed warheads are warheads on missiles or bases with operational delivery systems.

*Other warheads are stored or in reserve or in the dismantlement process.

Source: SIPRI (2018).
date and to nuclear disarmament.” Additionally to the disarmament impasse, new evolving military technologies can undermine strategic stability, particularly the preservation of a nuclear second-strike potential (see Section 4). A new arms race is looming. In times of resurgent superpower rivalries and the rise of Chinese military potential, the arsenals of other nuclear-weapon possessor states will not remain unaffected by the political and technological developments of the two superpowers.

Moreover, the alienation between the NWSs and their allies from the majority of non-nuclear-weapon states (NNWSs) is intensifying: the adoption of a new Treaty on the Prohibition of Nuclear Weapons (TPNW) by 122 UN members in 2017 is a clear vote for further deep nuclear reductions. The NPT, signed in 1968, is under greater pressure than ever, especially in view of the new TPNW. Finally, the other central multilateral arms control treaties such as the Comprehensive Nuclear-Test-Ban Treaty (CTBT) from 1996 has established a global norm against nuclear testing but has never come into force yet. A Fissile Material (Cutoff) Treaty (FMCT) has still not been negotiated in the Geneva Conference on Disarmament (CD). At present, a valid and long-lasting ban on nuclear testing, the CTBT, is not yet safeguarded by international law. The verifiable monitoring by a future FMCT is not envisaged to bring any additional, limiting or lasting effect on the control of weapons-related fissile material due to a lack of serious negotiations. This article first describes the changes in strategic arms control since 2008 (Section 2) and their status in relation to the current New START and INF Treaty (Section 3). It then identifies challenges to strategic stability in the 21st century (Section 4), and discusses possible solutions (Section 5).

A Short History of Nuclear Arms Control

For more than 50 years, nuclear arms control was a central element of the relationship between the United States and the Soviet Union and later Russia. It has always been an indicator of relations between these two superpowers and a symbol of their willingness to disarm (Müller and Schörnig 2006). In nuclear arms control, the United States and Russia have often met on the basis of very different positions, but negotiations have helped to reconcile different interests and understandings (Arbatov 2016, 2017). The Cuban Missile Crisis of 1962 was the wake-up signal that prompted the Soviet Union and the United States to begin arms control negotiations regarding their strategic nuclear forces. These superpowers brought two essential motives to the negotiating table: first, concern about an accidental nuclear war, and second, a desire to reduce the enormous costs and dangers of a continued arms race. A global nuclear war would have meant the end of the civilization as we know it; the increasing nuclear danger made agreements and arrangements necessary so that the development of weapons would not get out of control. The multiple effects of nuclear-weapon explosions (heat/fire, pressure wave, and radioactivity) not only would have produced immediate destruction on an enormous scale, but also would have had catastrophic long-term consequences for our planetary infrastructure (OTA 1979). Risk reduction, cuts in the expanding arsenals of nuclear weapons, and verifiable compliance should directly contribute to confidence building, crisis stability and conflict prevention. In 1972, the treaty resulting from the Strategic Arms Limitation Talks introduced a numerical balance of carriers and warheads for the first time and formed the basis for withdrawing from the arms spiral. The INF Treaty was
signed in 1987 by Mikhail Gorbachev and Ronald Reagan. It was regarded as a decisive breakthrough at the end of the Cold War and is of central importance for European security. The treaty prohibits the development, testing, and production of land-based medium-range delivery systems with a range of 500 to 5,500 kilometers, whether carrying nuclear or conventional warheads. Under mutual verification, 2,692 INF systems including launch facilities were destroyed, dramatically reducing the nuclear threat in Europe. In addition, the verification system developed, which alone introduced five different types of inspection, set new standards for disarmament verification (Meier 2018). The end of the Cold War and the subsequent two decades opened the door to central bilateral nuclear arms control with a significant disarmament element. Conventional and nuclear disarmament in Europe paved the way for the change in Europe ending an arms race in several fields (Holik 2017). The INF Treaty (1987), START I (1991), START II (1993), the Strategic Offensive Reductions Treaty, or SORT (2002), and New START (2010) led to a massive reduction in strategic warheads from about 63,000 in 1986 to 8,300 today. Compliance with the treaties was also made possible by comprehensive verification mechanisms, which not only build trust but also provide a direct and reliable view into the arsenals of the other side through a verified data exchange. Only START I and New START achieved a significant reduction in the number of deployed strategic warheads, while tactical nuclear weapons did not become an integral part of existing arms control treaties. The conclusion of these treaties, however, was rather the exception and required mutual cooperative behavior in order to be negotiated and implemented.

The George W. Bush administration (2001–2009) pursued a greatly thinned out approach to nuclear arms control. The erosion of agreed treaties’ substance began in 2002 with the termination of the 1972 Anti-Ballistic Missile Treaty by the United States. With that decision, the geographical and numerical limitations on strategic missile defense were lifted and new deployments of missile defense became globally possible (Neuneck 2017). In 2002, Russia then withdrew from START II, which it had previously ratified in 2000. SORT limited the number of nuclear weapons that could be used to 1,700–2,200 per side, but contained neither clear definitions and counting rules nor comprehensive verification obligations. Delivery systems and nondeployed warheads were not limited at all. The focus of the Bush administration was the “war on terror” and greater flexibility for US armed forces, not arms control. Russia suspended the Conventional Armed Forces in Europe (CFE) Treaty in 2007, and the first voices suggesting the termination of the INF Treaty were heard in 2004. In 2007 Russian Defense Minister Sergey Ivanov publicly questioned the INF treaty (Kühn and Péczeli 2017, 70) and President Putin raised doubts in his speech at the Munich Security Conference about the INF Treaty as a barrier for restricting the United States and Russia versus INF deployments by North Korea, Pakistan, and Iran (Putin 2007).

In a first for a sitting US president, Obama articulated the vision of a nuclear-weapon-free world in Prague in April 2009, thereby reviving discussion of nuclear arms control (Obama 2009). In his speech, Obama also emphasized that “the United States will maintain a safe, secure and effective arsenal to deter any adversary.” In April 2010, New START was signed by the United States and Russia. It came into force on 5 February 2011 with a term of 10 years, meaning that it will expire in February 2021 if not extended. The agreed verification measures include important data exchanges, inspections, and mutual verification of strategic armed forces. The treaty limits the
number of deployed strategic nuclear warheads to 1,550 per side and the number of launchers (that is, bombers and missiles with intercontinental range) to 800. The planned “reset” between Russia and the Obama administration in 2009–2017 failed after Putin returned to the presidency in 2012. Obama had proposed a further reduction of the strategic nuclear arsenals by one-third in Berlin in 2013, but Putin rejected this notion. The Kremlin complained that the nuclear forces of the United Kingdom, France, and China were not involved in negotiations on questions of strategic stability and that a further expansion of ballistic missile defenses (BMD) would destroy the strategic balance (Rumer 2018, 5). At that time, Russia no longer showed any interest in treaty-based arms control arrangements with the Obama administration, instead relying on the drastic modernization of its military. Putin also suspended cooperation with the United States on the Plutonium Management and Disposition Agreement in 2016, as well as disarmament aid under the Nunn-Lugar program (known as Cooperative Threat Reduction). The Russian violation of the Budapest Memorandum of 1994, in which Russia, as well as the United States and the United Kingdom, pledged to respect Ukraine’s sovereignty and existing borders in return for Ukraine’s renunciation of nuclear weapons, shows that national interests have gained the upper hand over international agreements.

The number of nuclear warheads and the operational flexibility of the arsenals of both superpowers remain high. While the US modernization program of strategic armed forces has taken place continuously over the past decades, Russia began its planned 10-year modernization of its strategic armed forces about five years earlier. Russia also did not take part in the 2016 nuclear security summit, the last of the four nuclear security summits (2010, 2012, 2014, 2016) initiated by the Obama administration to prevent and respond to nuclear terrorism inter alia by securing, returning and destroying dangerous nuclear material usable in bombs worldwide (Kutchesfahani, Davenport, and Connolly 2018). On the other hand, Russia played an important role in the drafting of the Iran deal and has adhered to its commitments under New START. So far, it is clear that bilateral arms control was established to stabilize nuclear deterrence, but the dangers of accidents, miscalculations, further proliferation, and terrorism remain active under the changing world order (Holloway 2019).

The Current Situation

A variety of events such as the annexation of Crimea in 2014 and the ongoing Ukrainian crisis, the Syria conflict, and accusations of Russian manipulation of US elections have increased the deep alienation between these superpowers and accelerated the resumption of the great-power rivalries. The arms control realm is thus increasingly becoming the hostage of the general political climate despite its necessity independent of these rivalries. Two major treaties of the end of the Cold War, the INF Treaty and New START, are in acute danger of not being continued. The 2010 New START is the only remaining limitation treaty with an intact verification system between the two nuclear superpowers (Pifer et al. 2018). Both sides reduced their strategic nuclear forces to the limits specified by the treaty on 5 February 2018 and have so far complied with the requirements. However, what happens after 2019 is completely open. New START could be extended beyond February 2021 for five years without a new ratification process (Article XIV);
however, no negotiations are currently underway. The Trump administration has started an internal review process without a clear result at the end of 2019. In June 2018, Trump’s treaty-averse national security adviser, John Bolton, said about the extension of New START extension, “There is no decision, but I think it’s unlikely.” After Bolton’s abrupt departure on 10 September 2019, it is unclear how the new national security adviser Robert O’Brien will handle the complex challenges. President Trump showed no interest in New START during a telephone conversation with President Putin in February 2017. In an interview in March 2018, Putin declared that Russia was prepared to extend New START and further reduce the number of delivery vehicles and warheads allowed by the treaty. In view of the current tensions and the additional domestic problems in Washington, however, a structured and deep dialogue seems extremely difficult to imagine. Nonetheless, at the summit meeting in Helsinki in July 2018, both presidents declared that they would resume the dialogue on strategic stability. Also, in 2019, the United States articulated concerns about Russia not adhering to its CTBT obligations (US Department of State 2019, 39), although the United States has not ratified the treaty. Additionally, as this article was being finalized, the Trump administration was on the verge of preparing the withdrawal from the 1992 Open Skies Treaty. This multilateral treaty, which permits each state-party to conduct observation flights to collect data on ground-based military forces and activities, is important for European security (Reif and Bugos 2019).

There are voices in the US Congress who oppose the extension of New START, arguing that Russian violation of the INF Treaty weakens confidence in the value of New START.

Since 2014, the US government has accused Russia of having tested a new cruise missile – 9M729, or SSC-8 in the NATO designation – in violation of the INF Treaty (Woolf 2017). Russia rejects this accusation as unfounded and has been articulating its own accusations for some time (Moore 2014). Russia claims that the Mk-41 launch canisters of NATO missile defense sites in Poland and Romania are also suitable for testing and stationing offensive US cruise missiles. Additionally, Russia claims that the target missiles used by the United States for its missile defense tests were a kind of missile banned by the INF Treaty. Thirdly, Russia accuses the United States is pursuing the production of unmanned “heavy attack drones,” which also do not conform to the treaty. The mutual accusations have thus far not been resolved. A review could have been done within the framework of the Special Verification Commission of the INF Treaty through cooperative regulations such as open skies overflights, on-site inspections or a verifiable data exchange (Thielmann, Meier, and Mizin 2018). At present, however, the political climate hardly permits cooperative solutions. In several statements and hearings high-ranking generals declared that a breach of the treaty commitments by Russia undermined the foundations of the INF Treaty, but that the deployment of the new missile did not provide any significant military advantage for Russia. Ground-based cruise missiles are militarily attractive, as the launchers are easy to hide and are hardly affected by missile defense. Russia and the United States in particular have sea- and airborne cruise missiles. Nuclear cruise missiles are increasingly regarded as destabilizing by arms control experts (Doyle 2017a). The 2018 US Nuclear Posture Review (NPR) sees the Russian development of nuclear equipped delivery systems as an instrument for escalation control in the event of a nuclear crisis (Office of the Secretary of Defense 2018, 9), while other experts
suspect and propose new deployments in Asia (CSBA 2019, i). There is an increased need for regulation of INF systems in this particular region (Sayers 2018) due to the introduction of new medium-range delivery systems by China.

After the INF Treaty’s nearly 31 years of existence, the Trump administration formally withdrew from it on 2 August 2019. President Putin followed one day later, announcing that Russia would only deploy land-based INF missiles such as the Kalibr cruise missile (which has a range of 1,500–2,000 km) as a reaction to any US deployment in Europe. Some voices are being heard that Russian SS-26 Iskander missiles will also be deployed in Kaliningrad (Kristensen 2018b). These missiles, which have a range of 500 km, are capable of carrying nuclear warheads but are compliant with the INF Treaty. Neither side has developed a substitute accord or a strategy to preserve the treaty’s fundamental elements, thus risking a new unconstrained military competition (Countryman 2019). NATO Secretary General Jens Stoltenberg has embraced the US narrative: “[W]e have no intention to deploy new land-based nuclear missiles in Europe. We will not reflect the behavior of Russia. Because we do not want a new arms race and we remain committed to effective arms control, disarmament and non-proliferation” (Stoltenberg 2019). Avoiding a new Euromissile arms race with the deployment of new ballistic or cruise missiles enhances the need for new missile defense options and can trigger new nuclear and conventional force deployments. This cannot be prevented only by words and declarations. Instead, “the United States and NATO should more aggressively pursue arms control options to mitigate the risks of the collapse of the treaty” (Countryman and Reif 2019).

The Trump administration already has set a course leading to the development of new ground-launched missiles that are prohibited by the INF Treaty. Sixteen days after the formal end of the INF Treaty, the Defense Department conducted a test launch of a Tomahawk cruise missile from a ground-based Mark-41 canister traveling a distance of “more than 500 kilometers” (DoD 2019). Interestingly, the Mk-41 is the same launcher used in the Aegis Ashore BMD system in Romania and Poland, which has drawn objections from Russia. Deployment can follow in 18 months after the announcement. There is also an INF-range ballistic missile scheduled for a test launch in November 2019. This long-term project might take five years before deployment by the US Army. The Pentagon has included nearly $50 million in its fiscal year 2019 budget request to begin work on the two missile systems. US Secretary of Defense Mark Esper says that the Defense Department will “fully pursue the development of these ground-based conventional missiles as a prudent response to Russia’s actions and as a part of the joint force’s broader portfolio of conventional strike options” (Mehta 2019). In a UN Security Council meeting on August 22, Russia and the United States accused each other of fostering a new dangerous arms race (UNSC 2019).

These developments open the door for new steps for deploying destabilizing INF missiles. In Europe conventional and potential new nuclear warheads can threaten cities, leaders, command posts, and high-value targets. These warheads can be mounted on ballistic missiles of very short flight times or cruise missiles with sneak-attack patterns. There is still time to remove these dangerous systems west of the Ural mountains, and there are options for doing so. Another idea is that NATO countries can declare that no alliance members will host any INF Treaty-prohibited missiles as long as Russia does not field treaty-prohibited missiles which can hit NATO territory (Countryman and Reif
Possible and more comprehensive solutions here are a ban on all nuclear-armed ground-based cruise missiles or drones/unmanned aerial vehicles of any range, which will raise new questions of effective verification procedures. A plan to include China and the Asia Pacific region is not on the table, although the Trump administration argues in favor of “a new Era of Arms Control” in which Russia and China are both on a negotiation table (Bugos 2019).

The Chinese government has rejected any participation in future arms control regulations. It is estimated that the Chinese stockpile is approximately 290 warheads – 120–130 land-based ballistic missiles, 48 sea-based ballistic missiles, and bombers equipped with an air-launched ballistic missile and gravity bombs (Kristensen and Norris 2018c). It is also believed that the nontransparent Chinese nuclear stockpile is growing and that China is testing cruise missiles and hypervelocity vehicles. The introduction of multiple independently targetable reentry vehicles, or MIRVs (DF-5B/41), is to ensure that China can overcome US missile defenses. Only China’s 50 to 75 intercontinental ballistic missile (ICBM) launchers (DF-4/5/26/31), with about 90 warheads can reach the continental United States. Most of China’s strategic missile forces have also have medium and intermediate range. China’s regional missile force consists of two-stage, solid-fuel, road-mobile intermediate-range ballistic missiles (DF-15, DF21A, and DF26) with about 100 nuclear warheads. These missiles (for example, the new dual-use-capable DF-26 with a range of more than 4,000 km) can target the US base in Guam or aircraft carriers. China is expanding its fleet of nuclear submarines and is developing a new nuclear-capable bomber (Kristensen and Norris 2018c).

Already in July 2017, in its National Defense Authorization Act (NDAA) for FY 2018, the US Congress included several provisions in response to Russian inflexibility. These measures would destroy the INF Treaty and prevent a continuation of the New START process (Reif 2017). The House of Representatives made funds available for research and development (R&D) of a new ground-based, road-mobile cruise missile (with a range between 500 and 5,500 km) in order to close the “gap” with Russia. An arms race in Europe and a potential expansion of BMD plans would be likely if these missiles were deployed. The echoes of the NATO dual-track decision of 1979 are obvious although NATO states might favor the deployment of new conventionally equipped dual-use missiles that can be easily converted to a nuclear role. Since the deployment areas would also be in Europe, the European NATO members would call upon the Trump administration to clarify their positions and not to leave the decisions to the US Congress. Massive protests in European states could be another consequence of new deployments. Additionally, it is more than doubtful whether all governments in Europe would allow new nuclear-weapon deployments there. Additionally, in the Pentagon’s 2018 NPR, two new strategic nuclear weapons were proposed as a response to the INF Treaty violation. In the longer term, a sea-based cruise missile is to be developed (which does not require the approval of a host country) alongside a sea-based warhead with a low explosive yield (about 15 kilotons, the yield of the Hiroshima bomb) as a response to “gaps in regional deterrence.” Dual-use bombers such as the nuclear-weapon-capable F-35 are also to be introduced, and development of the tactical B61-12 nuclear weapon will continue. The Pentagon requested nearly $100 million in its FY 2020 budget for developing three ground-based missiles that are not compliant with the INF Treaty, including two new ground-based ballistic missiles. The House version of the FY 2020
NDAA would prohibit the Pentagon from spending money to develop these missiles until certain conditions are met. The administration would have to specify the military need of these new systems, conclude agreements with potential host countries, and obtain the support of NATO. Additionally, a detailed arms control proposal for an INF Treaty substitute is required (Reif 2018). It is unclear if the efforts of the Democratic Party to prevent a de facto breakdown of the INF framework will be successful, but legislatures tend to negotiate compromises. According to proposals by US Republicans, the funding for an extension of New START will be blocked as long as Russia is in violation of the INF Treaty. Should the INF Treaty regime fully collapse as a result of new, concrete decisions on deployment, a continuation of the provisions of New START would be highly endangered. If this happened, there would no longer be any legally binding limitations on the world’s two largest nuclear arsenals (Countryman and Zagorski 2018).

**Key Challenges Ahead**

The task of preserving and enhancing the nuclear arms control and disarmament framework is confronted by several central challenges: the lack of political will based on current great-power rivalries and domestic political sentiments, the disagreements regarding conflicts such as Ukraine and Syria, the unsolved arms control problems, and the ongoing military technical developments. Assuming that the problems surrounding New START can be solved by mutual agreement, structured talks and negotiations on the question of what “strategic stability” means for both superpowers in the 21st century are essential if both sides want to prevent a new nuclear competition. Otherwise, the end of the classic arms control regime will be at hand. The last of these talks about strategic stability took place in February 2018 with another short meeting in Geneva in spring 2019. Presidents Trump and Putin agreed to continue the talks at their summit in Helsinki in July 2018 where Putin had submitted concrete proposals on arms control and technical cooperation (Bender 2018), but concrete talks have not been started yet.

Both superpowers have already decided on long-term modernization programs that cost hundreds of billions of dollars for the next decades and are intended to increase the quality and scope of their operational nuclear capabilities. A new arms race is already manifesting itself in the budget planning and development steps of the nuclear forces of Russia and the United States. On several occasions, President Trump has called for the US nuclear arsenal to be “strengthened and expanded.” He claims without substantiation that the US nuclear capabilities have “fallen behind those of Russia.” The United States today has an active arsenal of about 4,000 nuclear weapons and over 800 ballistic missiles (Kristensen and Norris 2018a, 120). The Congressional Budget Office (CBO) estimated in 2019 that the United States would spend about $490 billion on new modernized nuclear forces over the next 10 years (CBO 2019). The United States is planning to develop and put into service a successor model for its current air-launched strategic cruise missile (ALCM), a new long-range standoff (LRSO) cruise missile. Out of the planned total of 1,000 LRSO missiles, 550 might be equipped with nuclear warheads. Arms control regulations are not yet in place for airborne and seaborne cruise missiles. Although the Pentagon has declared that it has not yet definitively determined the need for new weapon systems, the FY 2019 NDAA contains further increases in the armaments sector.
for that fiscal year: the modernization program for nuclear warheads has been increased, as have expenditures on nuclear infrastructure such as command and control (see Table 2). For FY 2019, the US Congress approved, under Republican dominance, $10.3 billion for the Missile Defense Agency (MDA), an increase of $1.4 billion above the budget request of $9.9 billion (ACA 2019). For the FY 2020, the Senate appropriators added $1.2 billion for the MDA above Trump Administration request of $9.38 billion. There is hope that with a Democratic majority in the House of Representatives, some projects such as low-yield nuclear missile warheads or new ground-based INF systems will be cut.

The US plans for a new strategic bomber (B-21), a new ICBM (the so-called Ground Based Strategic Deterrent), the LRSO cruise missile, and a new nuclear submarine extend well into the middle of the century. Further developments in the sector of hypersonic glide vehicles or missiles for the Prompt Global Strike program or improved space surveillance capabilities reinforce the concerns of Russia and China over US superiority in the strategic sector. Supersonic glide vehicles launched from ICBMs or sea-launched ballistic missiles (SLBMs) no longer fly on a ballistic trajectory; that helps them to overcome missile defenses. Strategic hypersonic missiles that fly faster than Mach 5 are in the development and testing phase and need to be incorporated into the New START counting rules. The 2018 NPR emphasizes the increased role of nuclear weapons in deterring “non-nuclear strategic attacks” including “cyber threats” (Office of the Secretary of Defense 2018, 21, 38) and speaks of new “tailor-made” nuclear options (Office of the Secretary of Defense 2018, XII). This refers to new modified warheads with lower yields (for example, the W76 for the Trident II SLBM). The new version of the B61-12 gravity bomb has adjustable yield and higher accuracy. It is designed for bombers of the types B-2, B-21, F-15E, F-16, and F-35A and thus for strategic and tactical use. Deployment in Europe could take place in the early 2020s (Kristensen and Norris 2018a, 129).

Achieving a strategic balance like that of the 1980s and 1990s has become far more complex in view of new military developments such as missile defense, conventional precision vehicles, successful space reconnaissance, and submarine combat against enemy nuclear forces (Holmes 2016). In military terms, the destruction of enemy nuclear weapons by a first strike of targeted nuclear weapons is now technically within reach again (Lieber and Press 2013; Kristensen, McKinzie, and Postol 2017).

This is particularly true in view of the current US capabilities in this field with regard to China’s nuclear forces, which are much smaller in numerical terms. But Russia is also concerned about maintaining strategic stability, and the US missile defense developments are far from complete. The danger of incidents leading to an accidental nuclear war is increasing (Borrie at al. 2017). If the extension of New START were not successful, the last treaty-based restrictions on nuclear arms control would be lifted and mutual verification of nuclear forces would no longer be possible.

Russia and China are also modernizing their nuclear forces in response to US developments, particularly with regard to BMD and to conventional precision-attack options. Russia is in the midst of an intensive modernization of its strategic and nonstrategic nuclear weapons (Kristensen and Norris 2018b). The orientation of the Russian nuclear forces is based on the nuclear heritage of the Soviet Union. Even though the ideological competition between the West and the Soviet Union has ended, the mutual threat based on nuclear deterrence has persisted to this day. Russia is developing and introducing new sea-
Table 2. US nuclear modernization programs.

| System                              | Status/ Costs                                      | Planned Deployment Period | Description                                                                                           |
|-------------------------------------|----------------------------------------------------|---------------------------|-------------------------------------------------------------------------------------------------------|
| Minuteman III ICBM                   | Modernization and replacement $7 billion           | Through 2030              | Modernizes propellant, guidance, propulsion system, targeting system, and reentry vehicles and continues work on the rocket motor |
| New ICBM Ground Based Strategic Deterrent | Replaces the Minuteman III missile and associated launch control and C2 facilities $85-140 billion (DoD estimate FY2017-2046) | 2020s through 2080s       | Air Force plans to purchase over 600                                                                 |
| B-2 Bomber                           | Modernization program $9.5 billion (FY 2000–2014)  | Until 2050s               | Improves radar and high-frequency satellite communications capabilities for nuclear command and control |
| B-52 H Bomber                        | Ongoing modifications                              | Until 2040s               | Incorporates GPS, updates computers, and modernizes heavy stores adapter beams, and a full array of advance weapons |
| B-21 “Raider” Strike Bomber          | R&D phase; replacement for B-1 and B-2 bombers $38.5 billion (FY 2017–2026) | Until 2080s               | The exact specifications are classified                                                                 |
| Long-Range Standoff Cruise Missile (LRSO) | Replacement for ALCM $20 billion (estimated); includes cost of W80-4 warhead refurbishment | Until 2060s               | The US Air Force plans to procure approx. 1,000 LRSOs for B-2, B-52, and B-21; production to start in 2021 |
| Trident II D5 (SLBM)                 | Modernization and life extension $6 billion (FY 2019–2023) | Until 2042                | The US Navy plans to purchase 12 new submarines to replace the existing 14 Ohio-class submarines          |
| “Columbia” Class Submarine SSBN(X)   | New ballistic missile $128 billion (estimate)       | Until 2031                |                                                                                                       |

Source: Arms Control Association (2018).
and land-based launchers (Yars, Rubezh, Bulava, Sarmat) and submarines (Boreis class) and bombers (Tu-160, Tu-Pak-Da) to replace the obsolete launchers from the 1980s such as the SS-18/19 and Topol (Kristensen and Norris 2018b; Oliker 2018). Russia is also working on reserve warheads in order to increase its upload capability, so that the Russia can increase the number of deployed nuclear warheads on each type of its delivery vehicles if contingencies warrant. Russia has fewer carrier systems than the United States does, so that its upload potential is weaker than that of the United States. Apart from the heavy economic burdens for Russia, the number of warheads could remain below the New START ceiling even when new launchers are introduced (Oliker 2018). The Russian military doctrine of 2010 and 2014 threatens the use of nuclear weapons “if the existence of the state itself is threatened” (Loukianova Fink 2017). Details of the nuclear doctrine are unpublished, leaving much room for speculation regarding the alleged doctrine (“escalate to deescalate”). It is generally assumed by the West that the threshold to nuclear deployment is lowered in order “to deescalate” a conflict on terms favorable to Russia (Office of the Secretary of Defense 2018, 8). The United States and NATO accuse Russia of withholding a large number of tactical nuclear weapons in storages and modernizing their delivery systems (NPR 2018, I, XI, 9). This includes the 9M729 cruise missiles, which are potentially noncompliant with the INF Treaty, as well as new low-yield nuclear warheads. In addition, Russian military and diplomatic officials have threatened the regional use of nuclear weapons (Schneider 2017). According to NATO, Russia simulated the use of nuclear weapons against NATO allies and partners during maneuvers. In the view of NATO’s military, Russia is placing greater emphasis on the use of nuclear weapons in the event of a conventional war or against BMD positions. (Kühn 2017).

In his speech on 1 March 2018, President Putin presented new futuristic nuclear delivery vehicles (see Table 3), such as the heavy ICBM RS-28 (“Sarmat”), which allegedly can fly over the South Pole; an autonomous torpedo with a nuclear warhead (“Status-6”); and a nuclear-powered supersonic missile with long range (“Avangard”) (Putin 2018), but Russia showed the new maneuverable warhead to U.S. inspectors under the auspices of New START. The central message of these announcements is that Russia has sufficient high-tech capabilities to overcome the currently limited US BMD system and thus has a comprehensive second-strike potential. While referring to the new capabilities of the Russian armaments complex with regard to high-tech weapons, Putin also offered to start negotiations surrounding them. In view of the developments and announcements on these futuristic plans however, it seems doubtful that there is sufficient time for a new reduction treaty, especially since both sides have not begun negotiations and the domestic political rhetoric is geared toward strong-arm tactics. Additionally, there is a danger that other NWSs will react to this and accelerate their own modernization programs. On the other hand, these new developments of delivery systems could also become part of a future arms control treaty if serious negotiations were conducted.

China is also modernizing and expanding its nuclear forces, which are far smaller than those of Russia and the United States, and has been doing so continuously since the 1980s. According to the US view, China’s goal is to challenge the superiority of the United States in the Asia-Pacific region (Office of the Secretary of Defense 2018, I). It is estimated that China has 280 nuclear warheads on land- and sea-based ballistic missiles and bombers (Kristensen and Norris 2018b). The Chinese nuclear doctrine is based on a no-first-use declaration. Older liquid-fueled missiles will be replaced by several more-modern mobile
| Program                        | Description                                                                 | Mission                                                                 | Comments                                                                 |
|-------------------------------|-----------------------------------------------------------------------------|--------------------------------------------------------------------------|---------------------------------------------------------------------------|
| Sarmat ICBM                   | Heavy ICBM with liquid propulsion; 200 metric tons with 10-ton payload      | Can fly over North or South Pole; replaces the SS-18 ICBM; has range of 11,000 km | 46 ICBMs are planned after 2020                                           |
| Nuclear-propelled Cruise Missile | Stealth capability; low-flying with „unlimited range”                        | Equipped with a nuclear warhead; can bypass air and missile defense      | Makeyev Design Bureau                                                    |
| “Status 6” High-speed-Underwater Torpedo | Nuclear propulsion; operates with high speed in deep ocean. | Can be equipped with a conventional or nuclear warhead (1 Megaton); aimed against aircraft carriers, sea-fortresses and harbors | Test cycle should end soon                                                |
| “Kinzhal” Air-launched Hypersonic Missile | Mach 10; maneuvers in all phases of flight; has range of more than 2,000 km | Vulnerable against air and missile defenses due to high speed; aimed against sea and land targets | Testing successfully completed; deployed since Dec.2017                   |
| “Avangard” Strategic Hypervelocity Glide Vehicle | Lateral and vertical maneuverability with high precision | Overcomes the global US BMD system                                      | Deployment phase                                                          |

Source: Putin (2018).
systems with faster launch capabilities, longer range, and solid-fuel propulsion (DF-21, DF-26, DF-31 AG). China is responding to concerns about a potential successful first strike by the dominant nuclear powers with minimal transparency of its arsenal. The introduction of MIRVs primarily serves to supersaturate missile defenses. The US NPR assumes that both Russia and China will develop and test maneuverable supersonic vehicles and cruise missiles that can also carry nuclear warheads (Saalman 2017). China is also pushing ahead with the development of its own BMD systems.

The enormous size and range of uses of the US and Russian nuclear arsenals are related to each other and cannot be explained by the much smaller arsenals of the other NWSs. Knowledge of their structure and purpose is based on the verifiable obligations of New START. The exact number of warheads (reserve warheads earmarked for dismantlement and spare parts, as well as deployed warheads) is not known precisely, particularly not for the other NWSs. This is especially applicable to tactical, or substrategic warheads, which are not part of arms control treaties or negotiations. New conventionally equipped launch vehicles such as accurate cruise missiles, hypersonic guided missiles, and strategic missile defense systems may pose a serious threat to NWSs and strategic stability in the future and must be taken into account in future arms control agreements alongside strategic cruise missiles. Appropriate definitions for the distinction of warheads and delivery systems, increased transparency of the arsenals, and appropriate and credible verification mechanisms are essential.

Some Possible Solutions

Despite the continuing stagnation of and current setbacks for the global arms control framework, there are various proposals on how nuclear arms control can be further developed globally and regionally to strengthen crisis stability, nonproliferation, and the potential for disarmament. The proponents of the reciprocal step-by-step approach face the supporters of a comprehensive disarmament initiative, epitomized by “global zero” and the TPNW. The tragedy is that neither concept functions properly any longer, but the two of them are dependent on each other because only significant and coordinated steps in the direction of disarmament would move the world closer to being free of nuclear weapons. There have always been setbacks and stagnation in the history of arms control. There have always been different interpretations of the concept of “arms control” and its purpose and usefulness. In view of the horrendously large nuclear arsenals, the changing security environment, and the increasing danger of a nuclear war, whether “accidental” or “deliberate,” the central leitmotif must remain making a nuclear war as unlikely as possible. The changing political environment and the developments in military technology also must be taken into account. It also should not be underestimated that there is a small group of armament experts who believe that new nuclear weapons would bring an increase in security (Waltz 1981). In view of the neglect of arms control and disarmament in recent years, several possibilities at different levels must be considered:

Short-Term Progress in Bilateral Arms Control

There are currently no structured arms control talks between the United States and Russia. In order to prevent a new arms race both in Europe and worldwide and to revive
the arms control process, the mutual accusations regarding the INF Treaty must be resolved. This is possible through mutual inspections, data exchanges, and demonstrations of the controversial INF systems (Thielmann, Meier, and Mizin 2018). Russia can publish the purpose, numbers, and deployment pattern of its new delivery systems. NATO and Russia can declare that they will not field any INF Treaty-prohibited missile or equivalent new nuclear capabilities in Europe. A new Trump-Putin summit gives both presidents the opportunity to initiate cooperative measures to end this dispute (Deep Cuts Commission 2018). This would be particularly in the interest of European allies. An extension of New START by five years – until February 2026 – can take place without further consideration by the US Congress or the State Duma and would revive strategic nuclear arms control with the prospect of further disarmament (Pifer 2018). This will buy time, strengthen the 2020 NPT Review Conference, and allow new talks on strategic stability in the 21st century. This can further lower the current ceilings and bolster each side’s confidence that the other is reducing its arsenal by verification, giving time for discussions on strategic stability and further reductions. In this way, the relations between the two superpowers could also be improved and progress could be made toward fulfilling the Article VI obligations of the NPT. President Putin has repeatedly stressed, most recently in his speech on 1 March 2018 and then again on 20 February 2019, that Russia is ready for arms control talks. At the Trump–Putin summit, the issue of nuclear disarmament was given high priority, but nothing followed from this. As the current U.S.-Russia numbers have come down, both nuclear superpowers have become concerned about the lack of transparency in the Chinese arsenal. While the PRC vehemently opposes joining the U.S.-Russia arms control talks, it should be encouraged to state, at a minimum least, that it does not intend to build up its nuclear forces to challenge the US or Russian forces. This can greatly help the United States and Russia to extend the New START. Russia, while expressing a willingness to extend the New START, demands that the United States meet many conditions such as limiting strategic missile defenses. This obstacle also has to be overcome to create more practicability for planners and budgets.

A NWS Dialogue on Future Issues of Strategic Stability and Other Confidence-Building Measures

A structured NWS dialogue on future issues and elements of strategic stability in the 21st century is of central importance, both between the United States and Russia, and among the five NWSs. These five countries could agree not to further increase the number of deployed and nondeployed nuclear warheads in their nuclear arsenals and to conclude agreements on their transparency and control as well as on their delivery systems. To date, the exact numbers of warheads in various categories (strategic or tactical, active or retired) are not known. Information on the number, type, delivery system, and operational status of all nuclear weapons in each country’s arsenal is overdue. In the medium term, honest and structured discussions on strategic stability among all NWSs are necessary to achieve multilateral disarmament. A return to the discussion of central principles of nuclear stability between the United States and Russia also is overdue (Dunn 2017). Arms control should be at the center of discussion; today, those discussions focus on mutual accusations from other policy fields. Key elements for a debate on strategic
stability are (a) the inclusion of tactical nuclear weapons; (b) the future treatment of missile defense; (c) the inclusion of cruise missiles and hypersonic missiles; and (d) the inclusion of military-related outer space developments. Another even more challenging issue is how to deal with the impacts of software-based threats such as offensive cyber technologies or artificial intelligence. On all these issues, proposals for future nuclear deterrence have been developed in the past. Unfortunately, there is no common understanding between the United States and Russia on what exactly strategic stability means due to the tendency to add current political conflicts, controversies, and challenges. Even debates within the Russian security community do not show a clear picture (Karaganov 2019).

To get beyond the current regime, which is based on the concept of mutual assured destruction, a “mutually assured stability” model would have to be based on mutual trust that preemption and military advantages will not prevail, but that sufficient time will be available in crises for negotiation and compromise (Wallander 2013). Furthermore, all other NWSs can contribute to confidence building through transparency of their nuclear arsenals. Transparency, particularly with regard to the payloads the missiles carry, whether nuclear or conventional, is important as a confidence-building measure and a commitment to avoid unintended escalation to a catastrophic nuclear conflict. The agenda should not be overloaded and must be well structured. A follow-on treaty to New START would be difficult to achieve at the moment, but a reduction from the current 4,500 warheads to 2,000 with a limit of 1,000 warheads and 500 delivery systems per side would represent a 50 percent reduction that would nevertheless keep the nuclear balance stable (Pifer 2018). The numerical inclusion of strategic hypersonic vehicles and their delivery systems in the arms control regime as well as a ban on strategic cruise missiles equipped with nuclear weapons would be an important step forward. A global ban on nuclear-armed strategic cruise missiles has been proposed (Weber 2018), but it raises new questions on verifiability.

There is also the possibility that the two nuclear superpowers can make important contributions to deep disarmament through unilateral restructuring of their nuclear arsenals, thus contributing to confidence building and significant security as well as financial relief. Options for the abandonment of individual elements of the nuclear triad have been considered in detail, such as the abandonment of land-based nuclear delivery systems, which are vulnerable to a first strike and often are stationed near population centers (Doyle 2017b; Snyder 2018). The adoption of a no-first-use policy by all NWSs would also have a stabilizing and disarmament-initiating effect. This would reduce the fear of nuclear first strikes, as they would no longer be considered a “dubious” response to a conventional attack (Fetter and Wolfsthal 2018). In view of the current nuclear rhetoric of the US and Russian presidents and the resentment in their legislatures toward the other country, such unilateral measures on the part of the two superpowers appear unlikely. Nevertheless, the first steps toward a declaration for self-restriction of new launchers and BMD would also have a high confidence-building effect.

Finally, the inclusion of all nuclear-armed states in the dialogue on strategic stability, beginning with an initiative by the five NWSs, is overdue in the medium term if Article VI of the NPT is to be taken seriously. The smaller NWSs could declare that they will not increase their nuclear arsenals as long as the two nuclear superpowers do not deploy new nuclear warheads and as they engage in the nuclear reduction process. More
transparency in terms of doctrine, categories, and numbers of weapons is also essential. An “accidental nuclear war” cannot be ruled out, given the complexity of nuclear arsenals and the possibility of misjudgments or mistakes, as well as increasing cyber dangers. The early-warning and command-and-control structure of the NWSs requires (a) effective protection against cyberattacks; (b) cooperation between the United States and Russia to reduce the danger of a “prompt launch posture” (de-alerting etc.); and (c) the leaders of both countries declaring, on the basis of the 1987 declaration by Reagan and Gorbachev, that “a nuclear war cannot be won and must never be fought” (Moniz and Nunn 2018).

**Strengthening the Nonproliferation Regime: NPT, CTBT, and FMCT**

Although not in force, the CTBT has created a strong taboo on new testing of nuclear weapons as it has almost universal support from states. This established global norm means a high barrier against the testing of entirely new nuclear-weapon designs and thus discourages vertical proliferation. Eight states, including the United States and China, are preventing the treaty from coming into force. A resolution of the North Korean nuclear problem should entail its accession to the CTBT. For Iran, completing the planned nuclear test monitoring stations can help augment confidence in its peaceful intention. It is of great importance for the CTBT states to strictly observe the terms of the treaty and support it even if the treaty is not in force. The signatories hesitating to ratify the CTBT should be strongly urged to do so as soon as possible. Any attempt to “unsign” the treaty would be seriously damaging to the nuclear order. Any disputes about compliance should be resolved through mutual transparency measures and the treaty’s dispute settlement mechanism (Civil Society Statement 2019).

An FMCT has been on the table at the Geneva Conference on Disarmament since 1994 without a negotiable treaty document having been drafted. Points of contention include the inclusion of the existing, very asymmetrical stockpiles of nuclear-weapon states, the usual questions of definition, and the verification of a ban (Schaper 2018). If a reliable disarmament regime is intended with the goal of a nuclear-weapon-free world, then not only the halt of the production of nuclear weapons material (which would mainly affect the NPT NWSs) would be central, but also the monitoring and control of the nuclear weapons material of all NWSs. The growing dangers of nuclear terrorism alone should oblige states to test, introduce, and gradually implement technical and procedural measures for the irreversible reduction of global quantities of nuclear-weapon-grade fissile material and the reliable verification of these reductions. A future FMCT should be designed as a disarmament treaty and include far-reaching transparency measures such as continuous declarations on the production, transfer, storage, and use of nuclear material (Dunn 2017, 9). One conceivable approach is to adopt a two-stage “Fissile Material Treaty” that would start with a verified “cutoff” phase – that is, the prohibition of the production of military-relevant fissile material – and follow that with the verified elimination of the fissile material.

The NPT process is faltering primarily because of the refusal of the NWSs to fulfill their Article VI obligations. The NPT has been successful over the past 50 years, but adaptation to the conditions of the 21st century is essential. The 2020 review conference is threatened by a further polarization between the NWSs and the NNWSs. It is particularly in the interest of the United States and Russia that the NPT remains as the foundation of a reliable and robust nonproliferation regime for the next 50 years. In order to develop appropriate
proposals, the creation of an official Russian-US commission of former politicians and military officials was proposed, to be appointed by the White House and the Kremlin (Dunn 2017). A combination of self-restraining measures, cooperative projects, and the extension of New START and the INF Treaty would certainly improve the situation.

Conclusions

Short-term progress in bilateral arms control to maintain the basic elements of the INF Treaty and to extend New START is an indispensable basis for the further development and adaptation of nuclear arms control to the circumstances of the 21st century.

A structured and deep dialogue of the NWSs on future issues and elements of strategic stability in the 21st century is of great importance both between the United States and Russia and among the five nuclear-weapon states.

The strengthening of the NPT regime, a continuation of the CTBT process, and the beginning of a regime to end the production of and control of nuclear weapon usable fissile material would be central elements of a global nuclear arms control and disarmament regime, which would require a robust verification component. For a rapprochement between NPT and TPNW proponents, a positive development with regard to achieving a nuclear-weapon-free world would be beneficial, especially in the verification sector.

Strengthening of European security can hardly succeed without further development of preventive arms control – that is, the INF Treaty and the CFE Treaty. The further development of both regimes is in Europe’s vital interest. New military technologies such as autonomous or hypersonic weapon systems and R&D in the fields of artificial intelligence, cyberweapons, and missile defense make preventive arms control in the European context necessary. NATO and Russia can declare that they have agreed not to deploy in Europe any delivery systems prohibited by the INF Treaty and to start working on banning nuclear-equipped cruise missiles or establishing zones free of such missiles.

If the logic of the INF Treaty is abolished and an uninhibited arms race is restarted, there is a high probability of increasing regional armament competition in the Asia-Pacific region and in Europe. A continuation of the New START regime would then be very unlikely. In order to prevent an arms race in different regions and military technologies, new procedures would have to be established in order to carry out effective crisis management and risk reduction.

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Notes on Contributor

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