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LETTER FROM THE EDITORS

Welcome to the June 2019 edition of the American Foreign Policy Council's (AFPC's) *Defense Dossier* e-journal. This issue breaks the mold of its predecessors, in terms of look and feel, as we have modernized our publication to match AFPC's newly launched website. We hope you enjoy the new layout!

In this edition, we tackle the reorientation of the U.S. national security toward planning for great power conflict by revisiting arms control, strategic weapons and defenses.

The topic is a pressing one. In the nearly two decades since the events of 9/11, the U.S. military has focused primarily on countering insurgent threats and defending against rogue nation states. But Russia's 2014 annexation of Crimea and its repeated violations of the INF Treaty, Chinese aggression in the South and East China Seas, and the massive military modernization now being undertaken by both countries increasingly necessitate a new look at America's defense posture.

The articles in this issue take a look at just one aspect of this renewed competition: strategic weapons. We explore the nuclear weapon modernization efforts of America's adversaries, and outline why the U.S. must address its depreciating arsenal. We also discuss the development and deployment of hypersonic weapons, and the need for the U.S. to properly defend against them. These and other pressing topics are explored in the pages that follow in what is sure to be an informative and timely read. We hope that you enjoy it.

Sincerely,

Ilan Berman
Chief Editor

Richard M. Harrison
Managing Editor

The Case For Keeping The INF Treaty

Margot van Loon

The guiding purpose of arms control is stability, but as a landmark arms control treaty appears headed for the dustbin of history, this ambition is in greater jeopardy than ever before. President Trump's February decision to withdraw the United States from the Intermediate-Range Nuclear Forces (INF) Treaty has unleashed fierce domestic and international responses, ranging from praise for standing up to Russia to ominous warnings about the advent of a new arms race. However, underlying it all is a profound sense of uncertainty. With the clock ticking toward the August deadline when the U.S. withdrawal will become final, Washington has yet to present a clear vision for a post-INF world. Coupled with the development of new weapons and technologies unconstrained by traditional arms control frameworks, the treaty's demise is likely to increase nuclear dangers, undermine the value of American arms control commitments, and impel the world blindly and at great cost into an unstable new paradigm.

A BEDROCK OF ARMS CONTROL

The INF Treaty's significance stems from its role as the longest-standing building block of the U.S.-Russian bilateral arms control architecture. By the early 1980s, the Soviet Union's development and extensive deployment of intermediate-range SS-20 missiles capable of targeting European capitals caused the U.S. and NATO to adopt a "dual track" strategy of deploying similarly ranged missiles across the European continent – both to deter Moscow and to create negotiating leverage that might deescalate the situation. The strategy worked, and the final text of the INF Treaty signed by Presidents Ronald Reagan and Mikhail Gorbachev in 1987 committed both countries to the destruction of all ground-based nuclear-armed missiles with ranges between 500km and 5500km – 2,700 missiles in total, along with their associated launchers and equipment. The INF Treaty also prohibited the future deployment of weapons with these ranges and committed both parties to rigorous inspection and verification protocols.

These limitations heralded a new era of strategic stability in Europe. Since its entry into force, the INF Treaty has prevented another massive build-up of intermediate-range missiles and paved the way for subsequent bilateral agreements, including START I, SORT, and New START, creating a framework for mutual deterrence and commitment to reductions that has long steadied the relationship between Washington and Moscow.

Yet signs of decay in this framework have been visible for some time. As early as 2013, the Obama administration began privately raising concerns that Moscow was violating the treaty with its development of the 9M729 land-based cruise missile system (NATO callsign SSC-8), whose range violates the treaty's terms.[1] The Trump administration took these concerns public in 2017 by reporting that Moscow was deploying the prohibited system in southern Russia.[2] The Kremlin, for its part, continued to deny Russian noncompliance and cast aspersions of its own that some U.S. systems, including Aegis Ashore, also constituted an INF violation (a controversial accusation that has been rejected by most members of the arms control community).

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Faced with continued Russian denials and seeing no viable path forward, the Trump administration chose to escalate the pressure. On October 20, 2018, Trump announced that he intended to withdraw the U.S. unilaterally from the INF Treaty; less than two months later, Secretary of State Mike Pompeo formally confirmed this intention.[3] U.S. withdrawal proceedings began on February 1, 2019; Russian President Vladimir Putin promised a "symmetrical" response and signed an executive order on March 4, 2019 suspending Russia's implementation of its treaty obligations "until the United States of America rectifies its violations of the said Treaty or it expires."[4] Under Article XV of the Treaty, the final withdrawal will take place on August 2, 2019 unless Washington reverses its decision. However, the Trump administration has made the destruction of the SSC-8 systems a precondition for reversing course, and Moscow flatly refuses to concede on this point. As the broader bilateral relationship continues to deteriorate, prospects for future negotiations to save the INF Treaty appear dim.

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NO CLEAR PATH FORWARD

In some sense, the decision is arguably liberating. It sends an unequivocal message to Moscow that the U.S. government will not tolerate its cheating or accept the military disadvantage inherent in one-sided compliance with a bilateral treaty. If Russia is bent on developing intermediate-range systems, withdrawal from the INF Treaty would allow the United States to develop necessary counter-systems. Indeed, proponents of this view contend that a non-verifiable treaty in which only one side complies is a greater liability than an asset.[5] "If the INF Treaty dies," U.S. Ambassador to NATO Kay Bailey Hutchison has argued, "blame Russia… A treaty cannot exist when one side complies and the other does not."[6] Under Secretary of State for Arms Control and International Security Affairs Andrea Thompson expressed a similar view, noting that "we have remained in compliance with the INF Treaty and all of our other arms control treaties, where Russia has violated [them]. So, when folks point to an arms race, my counterpoint is that Russia started an arms race. And it started eight years ago, when it violated the INF."[7]

However, the unilateral U.S. withdrawal has undoubtedly given the Kremlin the upper hand in controlling the narrative. Now freed from any significant pressure to return to compliance, Russia has successfully shifted the blame for the treaty's imminent demise away from its own violations and fully onto the United States, claiming that it was prepared to remain in the Treaty and negotiate but for Washington's decision.[8]

Meanwhile, the Trump administration's position that withdrawing from the agreement will allow Washington to negotiate a new treaty with Russia that also includes China and other nuclear states not party to the INF Treaty – something that Administration officials have repeatedly asserted[9] – ignores key differences between the security environment that surrounded the original negotiations and the one prevailing today. The chances of China joining a multilateral version of the INF Treaty are slim to none, given the dominant role that intermediate-range weapons play in Beijing's arsenal. Moreover, the successful "dual track" strategy that led to the original INF Treaty hinged on an agreement by NATO members to host intermediate-range missiles on their territories; there is no sign that America's partners, either in Europe or in the Indo-Pacific, would be willing to make the same decision at present.[10] Indeed, NATO Secretary General Jens Stoltenberg told Congress in April 2019

that the Alliance had "no intention of deploying land-based nuclear missiles in Europe."[11] Japan has been similarly averse to the prospect of a similar deployment vis-à-vis Beijing.[12]

Additionally, those who envision anew the deployment of intermediate-range systems in Europe conveniently neglect the historical lessons about why these systems presented such a threat in the first place. The U.S. interest in limiting the number of deployed Russian missiles has not changed since the 1980s; the presence of these systems would still threaten our NATO allies, offset traditional U.S. aerial and naval advantages, and make it more difficult for the U.S. to defend them and uphold its Article V commitments in the case of any future conflict. [13] The mobility and short flight time of the intermediate-range class compounds a key problem in crisis decisionmaking[14] – namely, that it is impossible for one party to tell if its adversaries' missiles are equipped with conventional or nuclear warheads. A greater number of these missiles kept on high alert could thus provoke more rapid escalation during a crisis scenario.[15]

Moreover, since the Trump administration does not appear to have a clear plan to replace the Treaty, the prospect for a new nuclear arms race suddenly seems closer than ever. At the 2019 Munich Security Conference, German Chancellor Angela Merkel lamented that "a treaty that was essentially designed for Europe, an arms reduction treaty that directly affects our security, has been cancelled by the United States of America and Russia… and we are left sitting there… the answer cannot be a blind arms race." [16] Former Secretary of Energy Ernie Moniz and former Senator Sam Nunn write that a post-INF world "will open the door to unfettered deployment of Russian INF-range systems."[17] Former Secretary of State George Schultz and former Soviet leader Mikhail Gorbachev – two of the central figures in the codification of the original INF treaty – have similarly warned that abandoning the agreement will mark the start of a new arms race.[18]

In fact, the entire treaty architecture governing arms control between the United States and Russia is in danger. If INF fails and New START is subsequently allowed to expire in 2021, we will be living through the end of legally binding and verifiable constraints on nuclear arsenals.[19] At a time when relations between the world's two largest nuclear powers are dangerously bad, all limits to nuclear build-up will be lifted[20] while a vital area of cooperation evaporates. Richard Burt, former U.S. chief negotiator of the Strategic Arms Reduction Treaty under George H.W. Bush, has warned that "the INF failure and the failure to get into discussions about extending New START is a sign of the U.S. sleepwalking into a new nuclear arms race."[21]

Since the Trump administration does not appear to have a clear plan to replace the Treaty, the prospect for a new nuclear arms race suddenly seems closer than ever.

TANGIBLE COSTS TO PARTNERSHIPS, BUDGETS

The problems presented by the end of the INF Treaty run deeper than these strategic implications, however. An American resumption of deployment of intermediate-range missiles would carry significant political, financial, and normative costs as well.

Politically, the manner in which the Trump administration conducted the withdrawal has aggravated the existing polarization between the Executive Branch and Congress. Congressional leaders were reportedly not consulted on the Administration's decision,[22] and the resulting backlash – particularly on the Democratic side – has been harsh. Since the start of 2019, the 116th Congress has introduced four separate pieces of legislation to block development of new non-INF compliant systems and constrain the Executive Branch's actions, hoping to preserve the Treaty as long as possible.[23] Amid this infighting, a replacement arms control solution (even if the Administration had proposed one) would likely be far out of reach.

The reaction from U.S. allies and partners is just as heated. NATO members were also reportedly not consulted regarding the Trump administration's decision, and many European states continue to see the treaty as vital to their security.[24] Many of these countries perceive the U.S. departure from the INF Treaty as exposing them to an increased threat from Russia, and "needlessly antagonizing"[25] Europeans at a moment when President Trump has repeatedly questioned the value of the NATO Alliance itself. While European leaders unanimously supported the U.S. in condemning Russia's violations of the treaty, they continue to believe that saving the treaty is preferable to scrapping it. [26] The chasm between Washington and Brussels on this issue endangers both the prospect of any future arms control negotiations (as Western unity was a key factor in previous successes)[27] as well as the changes in posture that will become necessary if deployments of intermediate-range missiles are required.

While European leaders unanimously supported the U.S. in condemning Russia's violations of the treaty, they continue to believe that saving the treaty is preferable to scrapping it.

Washington also cannot ignore the financial costs associated with redeveloping and redeploying these systems. Pentagon spokesperson Lt. Col Michelle Baldanza has confirmed that the United States has already started work on developmental testing for conventional ground-launched missiles that would have been banned under the terms of the treaty.[28] Funding these programs will inevitably divert resources from other programs deemed crucial to the Department of Defense's ability to carry out its mission – an expenditure that could have been avoided had the INF Treaty endured.

Finally, the end of the INF would erode the norms of disarmament and nonproliferation that the international community has worked so hard to establish. It is a common refrain that, as the world's two largest nuclear powers, the U.S. and Russia bear a special responsibility to uphold strategic stability through commitment to such binding agreements. [29] Abrogating this responsibility reduces international trust and disincentivizes the negotiation of future treaties. Non-nuclear weapons states may also accuse the U.S. and Russia of failing to live up to their commitments to disarmament under the Nuclear Non-Proliferation Treaty – an ominous message to send as the 50th Anniversary review of the NPT approaches next year. It also erodes the international normative restraints that have helped dissuade most other states from seeking nuclear weapons. In a post-INF world, other countries may feel more encouraged to aggressively pursue their own offensive nuclear and missile capabilities – a trend that objectively would be detrimental to U.S. interests.

A NEW PARADIGM OF STRATEGIC STABILITY?

The strategic landscape has shifted significantly since the original ratification of the INF Treaty, but that does not mean that arms control is obsolete. Rather, the emergence of a multitude of new technologies, including hypersonic delivery systems which blur the lines between conventional and nuclear capabilities,[30] along with other new warheads, precision guidance systems, cyber, and space-based platforms[31] – that are not currently subject to any arms control mechanisms renders this kind of architecture increasingly vital. The rise of China (and potentially India) as another nuclear armed great power on the global stage means that the United States must strive harder than ever to commit to arms control instead of throwing in the towel.

Whether or not Washington and Moscow can agree to save the INF Treaty before the August 2nd deadline, it is high time to reverse the decline of U.S.-Russian arms control. Doing so, however, will require going back to basics and understanding each side's incentives and interests, rethinking the concessions that each is willing

to make, and rebuilding the requisite political will for arms control.

To start with, the United States should push for more working-level discussions and bilateral strategic stability dialogues with Russia as a way of signaling to Moscow that Washington still perceives shared strategic interests in meaningful arms control measures. While neither INF nor New START encompasses hypersonic systems, both treaties provide "a platform of stability" and hard-won verification provisions that could serve as a basis for discussions on these new systems without starting from scratch.[32] Washington also must rebuild political will at home and with its allies for such negotiations if it is to carve out a new strategic stability paradigm.

None of these are easy tasks, but if we could push through landmark treaties during the height of the Cold War, we can – and must – do so today. Anything short of this will constitute a damning failure to prevent nuclear confrontation at all costs.

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Planning for Arms Control Failure

Paula A. DeSutter

The contemporary threats confronting the United States have evolved to such a degree that they have eclipsed arms control as a practical tool in America's toolbox. These threats are rooted in the pursuit by current and future treaty partners of weapons designed to evade or violate existing and possible future agreements. Russia, China and other states are developing and deploying weapons specifically designed to exploit U.S. vulnerabilities and perhaps to evade negotiated limitations. Among these are hypersonic weapons, which are designed to evade not only strategic arms control limits but also missile defenses, novel deployment modes (such as the reported Chinese use of cargo containers for launching ballistic missiles), capabilities to cause electromagnetic bursts over the U.S. and or forces abroad, multiple types of anti-satellite weapons, cyber threats, and the creation of new forms of chemical weapons, such as binary weapons like the *Novichok* agent used by Russia in the UK earlier this year.

THE TWO "ARMED" CAMPS

In light of the above, prudence dictates that we acknowledge and plan for arms control failure. For arms control advocates, the best response to arms control failure is to pursue new agreements. For arms control skeptics, the best response is to pursue non-arms control responses. Consideration of options other than arms control in the face of arms control failure, however, reignites a half-century-old but still heated debate between these advocates and skeptics.

Arms control skeptics, like myself, judge it folly to continue to believe that effectively verifiable agreements to address the new threats can be attained under current circumstances. Skeptics believe that agreements which seek to preclude the threat can only be viable if they are effectively verifiable – meaning that verification is built into the fabric of the agreement, that noncompliance can be quickly detected and verified, and that the U.S. has the will and ability to bring the other party back into compliance, deny the violator the benefits of their non-compliance, and take measures to reinforce deterrence of further or future violations.

This is especially true of agreements that limit U.S. freedom of action to address the threat by other means. Agreements that are not effectively verifiable constrain the U.S. and may preclude active and aggressive pursuit of defensive and offensive means to counter threats. In such cases, far from diminishing the threats facing America, arms control has a soporific effect on our willingness and ability to enforce agreements and our pursuit of the means necessary to counter them. In these cases, skeptics believe that further U.S. adherence to such agreements should be abandoned and the pursuit of unverifiable agreements avoided.

Arms control advocates, by contrast, view talk of abandoning arms control and existing arms control agreements in favor of unilateral solutions to threats as something akin to heresy. U.S. defensive and offensive programs to counter threats are viewed as provocative, dangerous, and destabilizing. In the face of breaches or evasions of existing agreements, they can be expected to advocate new arms control agreements as the sole viable solution. If effective verification, which is built into the fabric of agreements and intended to detect noncompliance, is not possible, they will advocate negotiating "transparency and confidence building measures" that can only confirm areas of compliance rather than providing for timely detection of noncompliance.

Non-experts are left to try to navigate between the two camps. The passion and vehemence of the arguments are sometimes baffling, while the history, motivations and rationales behind the positions are generally implied but not always categorized, making navigating them even more challenging.

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THE ARMS CONTROL CENTURY: LOTS OF ARMS CONTROL, LOTS OF VIOLATIONS[1]

The 20th century might be considered the century of arms control. There have been many legal limitations and prohibitions on the types, quantities or use of armaments – and restrictions and prohibitions on armament location. With few exceptions, all have been breached.

The 20th century arms control experiment began inauspiciously after World War I with the limitation of German rearmament in the Versailles Treaty and the Washington Naval Treaty of 1922 (followed by two London Naval Treaties). Germany began violating and subsequently renounced both treaties, while Japan renounced the Naval treaties.

Beginning in the 1960s, agreements like the 1961 Antarctic Treaty, the 1967 Outer Space Treaty, and the 1971 Seabed Treaty were reached. These precluded parties from doing things no nation could be envisioned doing. Not surprisingly, no nation has been found to be in violation of them. But there were other 1960s agreements that were more useful, like the 1963 Limited Test Ban Treaty (LTBT), which banned atmospheric nuclear tests and required parties to undertake measures to preclude the release of radioactive material across national borders. The Soviet Union continually failed to prevent release of radioactive debris beyond its borders despite the absence of military gain to be had, and despite U.S. offers to assist it in undertaking preventative measures.

The 1970s was the zenith of multilateral agreements, and the beginning of strategic bilateral agreements between the U.S. and Soviet Union. Multilateral agreements concluded during that decade include the 1970 Nuclear Nonproliferation Treaty (NPT) and the 1972 Biological and Toxin Weapons Convention (BWC). The NPT stands out as one of the few arms control agreements the Soviet Union did not violate. It was, however, violated by both Iran and North Korea. The BWC has been violated by China, Iran, Iraq, Libya, and North Korea – and Syria, a signatory, has maintained an offensive program that would violate the BWC if it were a Party. Bilateral agreements between the U.S. and Soviet Union include the 1972 SALT I Interim Offensive Agreement; the 1972 Anti-Ballistic Missile (ABM) Treaty; the 1974 Threshold Test Ban Treaty,[2] and the never ratified 1979 SALT II agreement. The Soviet Union violated its commitments under these agreements, although it was found that its violation of the TTBT was only "likely."

The 1980s was the first time the U.S. undertook a concerted effort to assess and enforce arms control agreements.[3] President Reagan demanded that Soviet noncompliance be reported and factored into negotiations over theater and strategic arms limitations – something that ultimately motivated his call for strategic missile defenses. While the Soviet Union had not responded eagerly to President Reagan's call for strategic and theater arms control, the military buildup he directed, especially the deployment of NATO INF systems and the Strategic Defense Initiative, eventually lead Russia to change its policy. This resulted in the 1987 Intermediate Range Nuclear Forces (INF) Treaty, and the 1991 Strategic Arms Limitation Agreement (START), both of which were designed from the outset to be effectively verifiable. Importantly, this design was not just a matter of on-site inspections, but embedded in such things as the definitions of permitted and prohibited items and actions.

In 1991, the Soviet Union collapsed, leading to a new optimism in the U.S. that the pattern of Soviet violations of its obligations would come to an end. The Nunn-Lugar program was established in 1991 to cooperatively assist the states of the former Soviet Union to secure and eliminate the Soviet programs for weapons of mass destruction.

From the beginning, there were relatively minor compliance and implementation problems with the INF

Treaty, but until after Vladimir Putin ascended to the Russian presidency for the second time in 2013, these issues were identified, reported to Congress on a timely basis, raised with Russia and resolved. Russia violated some provisions of the START Treaty as well. For the most part, however, the Kremlin complied with the Treaty.

The Conventional Forces in Europe Treaty was signed in 1990, followed by the 1992 Concluding Act of the Negotiation on Personnel Strength, and in 1999 the Agreement on Adaptation of the CFE Treaty. Russia and other states of the former Soviet Union regularly violated the CFE Treaty, and in December 2007 Russia "suspended" implementation of its obligations under the agreement and ceased permitting inspections. Suspension is neither permitted under the CFE Treaty nor international law, and Russia has thus been violating the Treaty since December 2007.

In 1993, the Chemical Weapons Convention was signed, requiring declaration and elimination of stockpiles of chemical weapons. Since then, however, the U.S. has discovered that the CWC has been violated by China, Iran, Russia, and most recently Syria.

President George W. Bush's 2002 *National Security Strategy* declared that the world's division "by a great struggle over ideas: destructive totalitarian visions versus freedom and equality" was over. The new struggle was with terrorists and proliferators, and "We must defeat these threats to our Nation, allies, and friends."[4] Accordingly, the Administration withdrew from the 1972 Anti-Ballistic Missile (ABM) Treaty, which precluded effective American defenses against the ballistic missile programs of Iran and North Korea. It advocated enforcement of existing treaties, such as the Nuclear Nonproliferation Treaty, and pursued negotiations with North Korea to seek an end to its nuclear weapons programs. The Bush administration also sought to add new tools to the U.S. toolbox, including UN Security Council Resolution 1540, the Proliferation Security Initiative and the G-8 Global Partnership Against the Spread of Weapons and Materials of Mass Destruction.[5]

The Obama administration produced two arms control agreements between 2009 and 2017. The first was the 2010 "New START" agreement. The second was the 2015 nuclear deal with Iran, formally known as the Joint Comprehensive Program of Action (JCPOA). Arms control advocates would argue that both are verifiable, and neither has been violated. Skeptics would argue that neither was effectively verifiable – despite elaborate mechanisms giving them the appearance of strong verification. Thus, the absence of verified violations does not mean the absence of actions the agreements were advertised as precluding. Moreover, both agreements fail to clearly prohibit actions that enable rapid and massive breakout, so it is not even necessary to violate them, gain strategic advantage, and defeat the object and purpose of the agreements.

RATIONALES AND MOTIVATIONS FOR ARMS CONTROL

Arms control skeptics view the above history of arms control as evidence that arms control is unlikely to provide a solution to threats facing the U.S., especially unless they are effectively verifiable and rigorously enforced. Advocates, however, disagree. Yet while the overarching reason for arms control is to attain a negotiated solution to an existing or potential military threat and thereby avoid conflict, other rationales are also present.

In 1993, the Chemical Weapons Convention was signed... Since then, however, the U.S. has discovered that the CWC has been violated by China, Iran, Russia, and most recently Syria.

Financial Rationales: Producing and deploying armaments is expensive. Attracting, training, and retaining the personnel to produce, deploy and employ them is also expensive. The economic appeal of achieving a negotiated agreement or framework that permits a

country to forego these expenditures is therefore obvious.

However, what is seldom discussed in this regard is that financial savings are only achieved if the negotiated reduction or elimination of the threat actually happen. Threat may remain or expand if one or more of the other parties fails to comply, and refuse to come back into compliance. In that case, eventually, as Fred Ikle' described in his seminal 1961 *Foreign Affairs* essay,[6] responses must be undertaken. As Ikle' describes, the pursuit of such responses is likely to be difficult – particularly if, as he noted, the violating party successfully avoids detection for some time but also plans to avoid penalties of being detected. The usual means of avoiding penalties is to deny the activity happened, offer some other interpretation of the obligation, or threaten to withdraw from the agreement if enforcement is taken.

Depending on the timeliness of the detection and verification of violations, responses in the form of increased military expenditures are likely to be needed on an urgent basis.

Enforcement requires compensatory measures to restore the situation that existed prior to the agreement. But in order to deter further or future violations, enforcement must also be punitive. Depending on the timeliness of the detection and verification of violations, responses in the form of increased military expenditures are likely to be needed on an urgent basis. Any financial benefits believed to accompany the agreement are not only likely to be lost, but the requirement to respond on an urgent basis may cost more than the military options considered to counter the threat in the first place.

One example of this problem is the German rearmament following World War I, which was pursued in violation of the 1919 Versailles Treaty. The Treaty sought to ensure that Germany could no longer pose a military threat to the Allied powers. Some hoped this would also lead to arms reductions by the other WWI states. Allied commissions were established to oversee reductions with inspections. While the U.S. did not ratify the Versailles Treaty, as a result of it and successive naval limitation treaties the U.S., Britain and France believed they could safely slash defense expenditures and reap the peace benefits. Yet Germany almost immediately began to circumvent and violate the arms limitations. Conducted clandestinely at first, then uncovered but ignored by the Allied powers during the 1920s, German rearmament was greatly expanded under the Nazis, who denounced the Treaty in 1933 and made clear two years later that they would pursue rearmament thought to have been precluded by Versailles. Later still, the western powers, including the United States, were forced to undertake crash programs to rearm and train in order to counter and eventually defeat the Nazi war machine. The costs of ignoring German violations of the Versailles Treaty were thus enormously costly in terms of both loss of life and expenditures on military forces.

Moral Rationales: Moral rationales in favor of arms control include arguments that some weapons are morally repugnant, that all weapons are morally repugnant, or that war is repugnant – and that therefore the only solution is to negotiate arms control agreements. Advocates assert that any arms control agreement that offers the slightest possibility of reducing hostilities is *ipso facto* the best solution. Rigorous assessment of the ability of an agreement to achieve these ends can be sidetracked by moral sentiment. Debate in which one side argues that a particular agreement is unlikely to or has failed to achieve these goals is frequently countered by assertions that those taking that position do not support the goals of peace.

In this fashion, negotiators and other advocates of arms control in the Executive and Legislative branches of government, as well as in assorted advocacy groups, can style themselves as "peacemakers," and brand their opponents as "warmongers." Politicians and advocacy groups may use this self-declared status to raise money

or endear themselves with parts of the electorate. The labeling of critics as warmongers can have the same effect, and the added benefit of damaging political foes.

Perhaps the best recent example was President Obama's August 5, 2015 speech on the JCPOA. In remarks that were aired on Iranian television and repeated in the "echo chamber" the White House created to support the deal,[7] Obama argued that the Joint Comprehensive Program of Action (JCPOA) was the only path to peace: "So let's not mince words. The choice we face is ultimately between diplomacy or some form of war – maybe not tomorrow, maybe not three months from now, but soon." He stated: "Congressional rejection of this deal leaves any U.S. administration that is absolutely committed to preventing Iran from getting a nuclear weapon with one option – another war in the Middle East."[8] In case that wasn't clear enough, the President said opposition to the JCPOA was by "arm chair nuclear scientists" and by the same warmongers that sup0orted the U.S. war in Iraq.

Diplomatic Rationales: Responding to critiques of an agreement, including that it fails to provide for significant and verifiable elimination of threats, advocates generally argue that the agreement will "begin a dialogue," is "the first (or subsequent) step in a process," or will serve as a tool of influence over the other party or parties. Under this logic, the standard against which the agreement is measured may be limited to whether there is an agreement at all, whether talks continue, or whether there are subsequent agreements. The fruits of this rationale are far more likely to be "confidence-building" or "transparency" measures that end up producing neither.

Political, Personal, and Internal Bureaucratic Rationales: Political, personal, and bureaucratic motivations for supporting arms control are seldom, if ever, discussed. Perhaps this is because such discussion might be viewed as unseemly. However, they play a not-insignificant element in the debates surrounding arms control.

Political motivations include those discussed under moral rationales, but another is related to the financial rationale. Advocates often believe that arms control, by enabling reduced financial expenditures on military programs, will enable the politician to increase expenditures on projects popular among their electorate. Similarly, bureaucratic motivations include the prospect that restrictions on one military branch's programs will enable growth in other branches.

Finally, in addition to being able to consider themselves peacemakers, negotiators gain other benefits not clearly visible to most Americans. Travel on diplomatic passports, stays in luxurious hotels or apartments, daily payment for rooms, meals and incidentals, flight awards and perhaps even personal drivers, all at taxpayer expense, can be intoxicating, and serve as supplements to the ego boost of representing the U.S. on important and often publicly visible matters. It is worth noting that arms control negotiations are never convened at hardship posts. Once an agreement is signed, those involved in its negotiation are almost always given prestigious awards and financial bonuses, which help them advance not only in their U.S. government careers, but also in their post-government careers.

The 20th century might be considered the century of arms control... With few exceptions, all have been breached.

CONCLUSION

Beyond the problem of unverifiable agreements that can be violated with impunity, development and deployment of technologies that evade limitation, and effectively verifiable agreements that are not enforced, there are other problems as well. Non-state actors are only constrained by arms control to the degree that the States in which they operate can and will preclude them from pursuit of banned or limited activities. Additionally, states cannot be forced to become parties to agreements,

and some, like China, are not interested in negotiated limitations on its ballistic missile and other programs.

The most significant arms control failures, however, are states that adhere to agreements to create the soporific arms control effect while never intending to comply. Syria, for example, refused to adhere to the Chemical Weapons Convention (CWC) until coming under threat of attack in 2013. The Assad regime then evaded inspections, falsified declarations, and continued to carry out multiple chemical weapons attacks. Syria clearly never intended to comply, but undertook means of avoiding the penalties of cheating.

Which brings us to the crux of the problem. A toolbox with only one tool is insufficient to address the global threats facing the United States. Arms control agreements are often inadequate to do the job for which they are intended, and can lead to a false sense of security that the threat has been eliminated.

A failure to prepare for and acknowledge the failure of arms control puts lives at risk. The arms control century is over. Now it is time to rely on programs that make our position unassailable.

ENDNOTES

1 The discussion herein can be verified by review of the October 5, 1984 *Report by the General Advisor Committee to the President, Presidential Reports to Congress on Soviet Noncompliance and Reports on Adherence to and Compliance with Agreements.*

2 The TTBT entered into force in 1990, after agreement was reached between the U.S. and Soviet Union on a TTBT verification protocol to provide for the use of the hydrodynamic yield measurement method with respect to all tests having a planned yield exceeding 50 kilotons, as well as seismic monitoring and – with respect to all tests having a planned yield exceeding 35 kilotons – on-site inspection.

3 President Reagan's Interim Restraint Policy, articulated in NSDD 236 and made public in the U.S. Department of State Special Report No. 147: *U.S. Interim Restraint Policy: Responding to Soviet Arms Control Violations*, May 27, 1986, provide what is probably the best articulation of the need to respond to violations ever produced.

4 White House, *National Security Strategy of the United States of America*, September 2002, Section 1, https://georgewbush-whitehouse.archives.gov/nsc/nss/2002.

5 The G-8 included Russia until 2014, when it was excluded from the arrangement following its annexation of Crimea.

6 Fred Charles Ikle', "After Detection – What?" *Foreign Affairs*, January 1961.

7 Paul Farhi, "Obama official says he pushed a 'narrative' to media to sell the Iran nuclear deal," *Washington Post*, May 6, 2016, https://www.washingtonpost.com/lifestyle/style/obama-official-says-he-pushed-a-narrative-to-media-to-sell-the-iran-nuclear-deal/2016/05/06/5b90d984-13a1-11e6-8967-7ac733c56f12_story.html.

8 White House, Office of the Press Secretary, "Remarks by the President on the Iran Nuclear Deal," August 5, 2015, https://obamawhitehouse.archives.gov/the-press-office/2015/08/05/remarks-president-iran-nuclear-deal.

U.S. Nuclear Weapons Modernization: What and Why

Mark Bucknam

The United States is just now gearing up to modernize its nuclear arsenal. After more than a quarter-century of reducing both the size of its nuclear arsenal and the role of nuclear weapons in U.S. national security, Washington has changed course and begun to recapitalize America's aging nuclear weapons delivery systems, nuclear weapons and their associated infrastructure, and nuclear command, control and communications (NC3).

This U.S. modernization effort is necessary, modest in scope, eminently affordable, and comes not a moment too soon. The following pages briefly explain what is being done to update the U.S. nuclear arsenal, and why.[1]

FROM PRAGUE AGENDA TO PROGRAM OF RECORD

From the Cold War's ending to the middle of President Barack Obama's second term, four successive administrations—two Republican and two Democratic—made significant strides in reducing both the size of America's nuclear arsenal and the role nuclear weapons played in U.S. national security. The less threatening security environment permitted the safe elimination of more than 85 percent of all U.S. nuclear weapons. And the relatively benign state of the world, notwithstanding the terrorist threat that manifest itself on September 11, 2001, facilitated President Obama's ambitious Prague agenda with its goal of further progress toward a world without nuclear weapons.

Thus, the priority objectives of the Obama administration's *2010 Nuclear Posture Review* (NPR) were to prevent nuclear proliferation and nuclear terrorism. Talk of using U.S. nuclear weapons to deter Russia or China seemed unnecessarily provocative and counterproductive. America sought to lead the world by example in demonstrating the inutility of nuclear weapons. In such an environment, America's nuclear spending holiday seemed appropriate and prudent to many observers, including most of those who controlled the U.S. government's purse strings.

Less than two years into President Obama's second term, however, new realities emerged. Russian and Chinese actions augured a new age of great power competition, and the United States found itself without followers in its effort to lead the world in reducing the role and numbers of nuclear weapons. Both Russia and China were embarked on programs to comprehensively modernize and expand their nuclear arsenals—especially Russia. Even as the United States reduced its arsenal to meet the limits of the New START Treaty, Russia built up to those limits. America's advantage over Russia in nuclear striking power eroded, disappeared, and now Russia's offensive nuclear capabilities are on the verge of surpassing those of the United States. Most of Russia's nuclear weapons systems are brand new, while America's date from the Cold War. And Russian President Vladimir Putin seems intent on posturing Russia to field a first-strike capability against the United States. China's nuclear buildup has been more measured, but its fielding of new nuclear capabilities has been steadfast and impressive.

Russia and China's nuclear weapons advances are even more troubling given their intent to overturn the U.S.-led, rules-based international order that the United States helped establish after World War II and which has served America well for 70 years. Russia's intervention in eastern Ukraine and annexation of Crimea, and China's militarization of reefs and islands

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in disputed waters of the South China Sea, were among the behaviors that helped convince the Obama administration to modernize all three legs of the U.S. strategic nuclear triad.

In February 2018, the administration of President Donald Trump published its NPR, which, *inter alia*, called for a continuation of the program of record for modernizing U.S. nuclear forces that was established under the Obama administration. Those programs and their rationales are described below.

SEA-BASED LEG OF THE U.S. STRATEGIC NUCLEAR TRIAD: COLUMBIA-CLASS SSBNS

Ballistic missile submarines (SSBNs) and their submarine-launched ballistic missiles (SLBMs) are widely recognized as the most survivable leg of the U.S. strategic nuclear triad, and the existing U.S. fleet of SSBNs is in urgent need of replacement. The current *Ohio*-class nuclear-powered SSBNs were fielded as part of the Reagan-era defense buildup in the waning stages of the Cold War and designed for a 30-year service life. Fourteen of the original 18 *Ohio*-class SSBNs built remain as SSBNs, and the first of those would already be decommissioned but for a service-life extension that stretched the boats' operating life to 42 years. The *Ohio*-class subs will begin to retire in 2027 and the last will cease deterrent patrols in 2040. Unless the *Ohio*-class's replacement, the *Columbia*-class SSBN, is fielded without any delays, there are likely to be gaps in SSBN deterrent patrols in the late 2020s, a state of affairs which would significantly undermine America's secure second-strike capability and hence its overall deterrence.

The program of record established during President Obama's administration called for deployment of up to 12 *Columbia*-class SSBNs starting in 2027, and the 2018 NPR modified that, potentially, by stating that the United States intends to build *a* minimum of 12 *Columbia*-class subs. The new SSBNs will use the same *Trident*-II D5 SLBMs as are currently used on the *Ohio*-class boats. The 2018 NPR also called for a new low-yield version of a warhead deployed on the *Trident*-II as a near-term capability to plug a gap that defense analysts believe Russia perceives in America's ability to respond to Russian first-use of low-yield nuclear weapons.

Russia's intervention in eastern Ukraine and annexation of Crimea, and China's militarization of reefs and islands in disputed waters of the South China Sea, were among the behaviors that helped convince the Obama administration to modernize all three legs of the U.S. strategic nuclear triad.

Russian nuclear doctrine, deployments, and exercises have all demonstrated that its leaders believe they could make limited use of low-yield nuclear weapons to terminate a conflict with NATO or the United States without provoking a U.S. nuclear response. Rather than lowering the threshold for U.S. use of nuclear weapons, the new low-yield *Trident* SLBM in fact raises the threshold for Russia's first use of nuclear weapons. The 2018 NPR's longer-term fix for plugging the gap is to field a new low-yield sea-launched cruise missile (SLCM), essentially reconstituting a capability the United States surrendered when it retired the nuclear version of the *Tomahawk Land Attack Missile* (TLAM-N) in the early part of this decade.

LAND-BASED LEG OF THE TRIAD: GROUND BASED STRATEGIC DETERRENT (GBSD)

Whereas the United States once fielded over 1,000 intercontinental ballistic missiles (ICBMs), each equipped with multiple independently targetable reentry vehicles (MIRVs), it has drawn down to just 400 *Minuteman*-III missiles, each with a single warhead, deployed among 450 hardened underground silos distributed among three bases and spread across five states: Colorado, Montana, Nebraska, North Dakota,

and Wyoming. The *Minuteman*-III program began in 1966 as an improvement to earlier versions of the *Minuteman* missile—a program that originally dated back to the 1950s. *Minuteman*-III was the first ICBM capable of carrying MIRVs, and can carry three of them – although, as just noted, today the United States chooses to arm each with a single warhead. Over the decades, the *Minuteman*-III has undergone several life extension modifications to ensure the reliability of its reentry vehicle and its guidance and propulsion systems. The most recent life extension program was completed in 2015 to keep the aging missile viable until 2030—60 years after its initial deployment and far beyond its designed service life.

ICBMs are the most responsive leg of the U.S. strategic nuclear triad. Without them, an adversary's nuclear planning and targeting problems would be vastly simplified. Any adversary contemplating a disarming first strike against the United States must commit two or more warheads from its fastest, most accurate means of delivery against each *Minuteman* silo in order to have a reasonable chance of knocking them out. Absent such a widely dispersed and hardened U.S. ICBM system, an adversary could destroy the vast majority of America's offensive nuclear striking power by eliminating just six targets—three bomber bases, two SSBN bases, and U.S. Strategic Command Headquarters. With ICBMs, an adversary would have to employ nearly a thousand of its best nuclear weapons. And because of the high state of readiness of U.S. ICBMs, that adversary would be confronted with the near certainty that its weapons would be striking empty U.S. silos and that U.S. ICBMs would already be *en route* to their targets. Simply put, ICBMs are the best insurance against an adversary ever attempting a nuclear first-strike against the United States – which is, after all, *the* top priority mission of the U.S. defense establishment.

As early as 2010, the Obama administration committed to retaining the strategic nuclear triad, including finding a replacement for the *Minuteman*-III ICBM. The new U.S. ICBM system, dubbed the *Ground-Based Strategic Deterrent* (GBSD), is under development and a new missile should begin to enter service in 2029. Four hundred GBSD missiles will be deployed among the 450 existing *Minuteman*-III silos, and those silos will have refurbished launch control facilities.

Absent such a widely dispersed and hardened U.S. ICBM system, an adversary could destroy the vast majority of America's offensive nuclear striking power by eliminating just six targets...

AIRBORNE LEG OF THE U.S. STRATEGIC NUCLEAR TRIAD AND DUAL-CAPABLE AIRCRAFT

The airborne leg of the triad—comprised of long-range heavy bombers—constitutes the most visible and the most flexible leg. American presidents can and do signal U.S. resolve and capability by deploying B-52 and B-2 bombers during times of increased tension to reassure U.S. allies and to deter U.S. adversaries. Day-to-day, American bombers do not sit on nuclear alert, but the president can order them placed on alert and can disperse them within the United States or overseas. Unlike ballistic missiles, bombers carry nuclear weapons that can be set to produce one of a variety of explosive yields ranging over three orders of magnitude, from a fraction of a kiloton equivalent of TNT to several hundred kilotons in the case of the B61 nuclear bomb, or from low-kiloton to a megaton yield in the case of the B83. The warhead on the *Air-Launched Cruise Missile* (ALCM) can reportedly be set to one of several yields between 5 and 150 kilotons. Moreover, bombers, unlike ballistic missiles, can be recalled after launch. And bombers and cruise missiles can be and have been used in conventional—that is, non-nuclear—roles.

America needs a new long-range heavy bomber, and work is underway to produce at least 100 B-21 *Raider* aircraft to augment and eventually replace existing

bombers, starting in the late 2020s. The B-52 bomber remains the backbone of the strategic nuclear bomber force, even though the newest one was delivered to the U.S. Air Force in 1962. Unable to penetrate Soviet air defenses by the 1980s, the B-52 was outfitted with the ALCM to give it standoff capability and make it more survivable.

The venerable B-52 is expected to remain in the inventory for decades to come, and will need a new, more survivable cruise missile. The ALCM is now more than 25 years beyond its designed service life and is growing increasingly vulnerable to modern sophisticated air defenses. To replace the ALCM, the Department of Defense intends to field 1,000 new *Long-Range Standoff* (LRSO) cruise missiles to be carried by the B-52, B-21, and the B-2, which is incapable of carrying the ALCM and presently can deliver gravity bombs only. The United States has just 20 B-2s, and all B-1 bombers were rendered incapable of delivering nuclear weapons in the 1990s and further deprived of nuclear capabilities in 2011 as a consequence of the New Strategic Arms Reduction Treaty (New START). The U.S. Air Force had a requirement for a new long-range heavy bomber, regardless of whether it had a nuclear mission, and the B-1s will be the first of the existing bombers to be retired as B-21 *Raiders* become operational.

In addition to strategic nuclear weapons, the United States has long fielded non-strategic or tactical nuclear weapons, which are characterized by having shorter ranges and lower yields and being designed for use on or close to the battlefield. Deployment of such weapons has helped to assure U.S. allies and deter adversaries in situations where U.S. use of strategic nuclear weapons would violate the principle of proportionality, and hence the deterrent threat to use them could well lack credibility. Whereas the United States once had thousands of such non-strategic nuclear weapons of various types deployed in Europe and East Asia, it has eliminated all but a few hundred B61 gravity bombs. All tactical nuclear weapons were withdrawn from Asia in the early 1990s, and fewer than 200 B61s remain in Europe for use with dual-capable aircraft (DCA) – that is, with fighter aircraft specially certified for delivery of nuclear weapons in addition to their conventional weapons capabilities. Today's dual-capable aircraft—certain U.S. F-15Es, F-16s, and European-built Panavia *Tornado* aircraft—are increasingly vulnerable to modern air defenses and are in need of replacement. The F-35 *Lightening II*—an all-weather, day-or-night, multirole stealth fighter—is expected to take up the DCA mission beginning in 2024. The F-35 will be capable of delivering a new variant of the B61 gravity bomb, the B61-12, which will have greater accuracy and lower yields than existing versions of the B61. In addition to the United States, Belgium, Italy, and the Netherlands will or are likely to replace their existing DCA aircraft with the F-35. It remains to be seen whether Germany will also opt for the F-35.

NUCLEAR COMMAND, CONTROL AND COMMUNICATIONS (NC3)

Powerful nuclear weapons and modern means of delivering them will be of little use to the United States unless there is a robust and reliable way to communicate to the President warnings of attacks and attack assessments, to effect deliberations and decision-making conferences with the President's top advisors, and to relay presidential orders to U.S. nuclear forces. Unfortunately, the last major upgrade to the nuclear command, control and communications (NC3) system took place in the 1980s during the Reagan administration.

Vintage NC3 systems have become difficult to operate and maintain and cannot be expected to operate with modern computer and communications systems associated with the latest satellites, radar, command posts, and weapons delivery systems. There are more than 100 Defense Acquisition Category 1, 2, and 3 programs associated with today's NC3 systems. Dissatisfied with the decentralized management of acquisition for this vital mission area, former Defense Secretary James Mattis in October 2018 appointed U.S. Strategic Command Commander, General John Hyten, "to be the single operational commander for NC3, with increased responsibilities for operations, requirements and systems engineering and integration."[2]

The future NC3 architecture must unfailingly knit together terrestrial radar and space-based warning satellites with nuclear planning, decision-making, and conferencing capabilities, receive and transmit presidential orders, and otherwise enable the

management and direction of nuclear forces under the most trying circumstances, including attacks in space and cyberspace and adversary attacks with nuclear weapons. Getting the next generation of NC3 right will require conquering technical challenges, systems architecture and engineering design challenges, and not least bureaucratic management and leadership challenges.

RECOMMENDATIONS FROM THE 2018 NPR AND BEYOND

The 2018 NPR evinced strong continuity with America's nuclear policies and posture since the end of the Cold War. The changes in the 2018 NPR from the 2010 NPR and earlier nuclear posture reviews were more evolutionary than revolutionary, and those changes reflected appropriate and measured responses to changes in the international security environment. The current administration is right to sustain its predecessor's program of record for nuclear modernization, including retaining and recapitalizing all three legs of the U.S. strategic nuclear triad, NC3, and DCA. Two new capabilities called for in the 2018 NPR—a low-yield option for a small number of *Trident*-II SLBMs and a low-yield, nuclear SLCM—are needed to close a perceived gap in U.S. deterrent capabilities that Russia seems bent on attempting to exploit. Fielding those low-yield options is necessary to deter dangerous Russian miscalculation.

The peak for spending on the nuclear deterrence mission—for new systems and for operating and maintaining existing systems—will occur in the late 2020s, and is currently estimated at 6.4 percent of the Defense budget, or less than one percent of the entire Federal budget. That price tag is eminently affordable for the Defense Department's highest priority mission—deterring a nuclear attack against the United States and its allies. America's nuclear capabilities also deter major conventional wars with great powers and the coercion of the United States and its allies and partners, thereby enhancing stability and strengthening the rules-based international order. An America that is demonstrably capable and willing to deter aggression by other nuclear powers also allows U.S. allies who could field their own nuclear weapons to continue foregoing that option and rely instead on America's extended deterrence guarantees, thus reducing nuclear proliferation and avoiding destabilizing regional arms races.

America's nuclear modernization comes none too soon, and deserves continued widespread bipartisan support.

ENDNOTES

1 For a more detailed description, see "Nuclear Weapons Modernization: Current Capabilities and Emerging Threats," American Foreign Policy Council *Strategic Primer* 5 (Winter 2019), available at https://www.afpc.org/uploads/documents/Nuclear_Weapons_Modernization_Primer_-_March_2019_(web).pdf

2 U.S. Strategic Command Public Affairs Office, "USSTRATCOM announces initial operational capability of NC3 Enterprise Center," April 4, 2019, https://www.af.mil/News/Article-Display/Article/1805503/usstratcom-announces-initial-operational-capability-of-nc3-enterprise-center/

The Advent of Hypersonic Weapons: Implications and Challenges for Congress, the Defense Department, and Industry

Howard Thompson

It has now been more than two generations since the American people, Congress, and the country's defense establishment experienced the stark reality of being left behind technologically. Not since the Soviet launch of Sputnik in October of 1957 has the United States found itself lagging so far behind in a crucial national security arena to a strategic adversary as it is today in the realm of hypersonics. Yet today, after years of focusing on counterterrorism and nation-building in the Middle East, U.S. officials and military leaders are sounding the alarm that Russia and China's testing, development, and fielding of hypersonic weapons constitute a clear and present danger to our military forces around the globe, as well as to the U.S. homeland itself.

This past December, then-Deputy Secretary of Defense Pat Shanahan and Undersecretary of Defense for Research and Engineering Mike Griffin took the unusual step of sitting down with executives from across the entire defense industrial landscape to essentially throw down a gauntlet. Shanahan and Griffin challenged the assembled businessmen to re-tool their thinking and processes in order to rapidly begin to field "thousands" of hypersonic weapons, and concurrently, design, develop, and deploy a defense against the Russian and Chinese hypersonic threat.[1] Griffin, in this meeting and others since, has repeatedly stated that hypersonics are his absolute top priority. Back then, he told the assembled defense executives that "we are going to have to create a new industrial base for these systems. Industry will get a very clear message from the department as to the paths we are pursuing in hypersonic offensive and defensive systems development, and we're confident you guys will respond."[2]

Further exacerbating the contemporary challenge posed by hypersonics is the fact that the U.S. must deal with offense and defense simultaneously. It is as if we had decided to design, build, and field our intercontinental ballistic missile (ICBM) force at the same time we fielded our ballistic missile defense capability (BMD). But in this case, we simply cannot prioritize one over the other. The United States has pursued a prompt global strike capability for many years and for sound national security reasons; hypersonic weapons hold out the promise of finally providing us with such a capability. At the same time, however, it would be irresponsible to leave American forces and facilities abroad, as well as the U.S. homeland, defenseless against the emerging hypersonic threat.

To better understand how we got here, and how we should proceed, it is useful to understand the evolution of hypersonic technology, the current state of weapon development in the U.S., China, and Russia, and what a capable defense against those threats might entail.

THE HISTORY OF U.S. HYPERSONICS

America's efforts to develop and produce hypersonic vehicles goes back at least to the late 1940s, and can only be described as a very mixed bag of false starts, cancellations, and some successes. The Lockheed X-7 began development in 1946 and first flew in 1951. It was designed to be a testbed aircraft to investigate the use of ramjet technology and to have a top speed of at least Mach 3. Lockheed followed up soon afterwards with the Mach 14.5-capable X-17, which used a three-stage solid

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fuel rocket engine to power it to an altitude of 17 miles before pitching back down toward Earth. These were both unmanned aircraft, but provided valuable lessons for the eventual development of a manned hypersonic vehicle.

The X-15, built by North American Aviation and flown by the National Aeronautics and Space Administration (NASA) and the U.S. Air Force, was the nation's first manned hypersonic aircraft. It first flew in 1958, and over the next 10 years completed a total of 13 missions, during which it generated a significant amount of extremely valuable information that directly affected the design of subsequent aircraft and spacecraft. The X-15 still holds the official world speed record for a manned aircraft.

In the early 1980s, a new entity came to the fore in the research and development of hypersonics. In 1982, DARPA, the Defense Advanced Research Projects Agency, began development of a series of hypersonic projects, beginning with the Copper Canyon single-stage-to-orbit (SSTO) program. This directly translated to the development of the X-30 National Aerospace plane, a scramjet powered SSTO which eventually was cancelled without ever being flown. However, DARPA later partnered with NASA and the Air Force on the X-37B Orbital Test Vehicle program, a highly successful, and highly secretive, program that continues to this day.

NASA and DARPA continued to collaborate on a number of experimental hypersonic test vehicles, including the X-43 Hyper-X, the Hypersonic Flight Demonstration, and the X-51 Waverider – all of which are designed to help researchers overcome the challenges involved in achieving hypersonic velocities and maintaining vehicle control throughout flight.

All of these programs, whether successful in flight or not, contributed immensely to the bulk of knowledge and experience that has put the U.S. defense industry on the cusp of achieving what Shanahan and Griffin challenged them to do – rapidly begin to field thousands of hypersonic weapons for the U.S. military.

THE CURRENT STATE OF U.S. HYPERSONIC WEAPONS DEVELOPMENT

To some, the case for pursuing hypersonic weapons may not seem evident. Yet one need look no further than the Mitchell Institute for Aerospace Studies' recent paper, Hypersonic Weapons and U.S. National Security: A 21st Century Breakthrough, to encounter a compelling case for why the U.S. should aggressively pursue hypersonic weapons. The study's authors conclude that such a capability would afford the U.S. "unprecedented rapid reach," "global target access," and a "fourth dimension effect" by effectively shrinking "a foe's decision-making window," and by rendering existing air defenses completely obsolete.[3]

While there are a number of hypersonic testbed vehicles being funded to support the technology in general, five unclassified weapons programs have garnered significant funding, both this year and in 2020.

- The first is DARPA's Hypersonic Air-breathing Weapon Concept (HAWC), a scramjet powered strike missile system currently being developed by multiple defense companies, which should enter flight testing very soon.
- DARPA has also awarded contracts to at least two contractors to develop their respective versions of a Tactical Boost Glide (TBG) hypersonic weapon for use in the approximately 500 nautical mile range.
- Additionally, two systems, the Hypersonic Conventional Strike Weapon (HCSW) and the AGM-183A Advanced Rapid-Response Weapon (ARRW) are both designed to be carried and launched by an aircraft, but descend from different design lineage. Air Force Assistant Secretary for Acquisition, Technology, and Logistics Will Roper has predicted that HCSW should be operational in late 2020, and the ARRW approximately six months later. This is an extremely optimistic schedule that, frankly, does not account for inevitable failures during flight testing.
- Finally, the U.S. Army is seeking to develop a Long Range Hypersonic Weapon (LRHW) that could see flight testing as early as 2023. According to the Army, LRHW will provide them "a prototype strategic attack weapon system to defeat anti access/area denial (A2/AD) capabilities, suppress adversary long range fires, and engage other high payoff/time sensitive targets."[4]

But while each of these programs will undoubtedly face challenges ahead before finally fielding an operational capability, our strategic adversaries face far fewer – if any – hurdles in bringing hypersonic weapons to bear against us and our allies.

THE EVOLVING THREAT

Russia and China's research, testing, and development of hypersonic weapons have by far outpaced that of the U.S. This is especially true of the Chinese; Undersecretary Griffin has said that the PRC has conducted "more tests in the past year than the United States has conducted over the past decade."[5] In fact, Griffin concludes, the Chinese have in fact already achieved an initial operating capability with hypersonic weapons.[6]

"While each of these [U.S. hypersonic weapon] programs will undoubtedly face challenges ahead before finally fielding an operational capability, our strategic adversaries face far fewer – if any – hurdles in bringing hypersonic weapons to bear against us and our allies.

The most recent system tested by the Chinese is called Starry Sky-2, and is a hypersonic glide vehicle (HGV) that is boosted aloft by a ballistic missile and then glides at the edge of the atmosphere at hyper-velocity to its target. According to the Chinese government, the HGV achieved a speed of between Mach 5.5 and Mach 6 at an altitude of 100,000 feet.[7]

The Chinese DF-ZF weapon system is also an HGV that has undergone extensive recent flight test, demonstrating speeds between Mach 5 and Mach 10, and will purportedly be fully operational next year.[8] It has been dubbed a "carrier killer," because it could pose a serious threat to U.S. carriers and their associated Strike Groups operating in the South China Sea, as well as in the vicinity of Taiwan.

At the same time, Russia has either deployed or is currently deploying two hypersonic weapon systems: one strategic and the other more tactical. The former is the Avangard HGV, which is designed to be launched initially by an ICBM. The Avangard completed a final operational test last December, during which it is said to have achieved a velocity of Mach 27 en route to a direct hit on its target.[9] According to Russian media reports, the missile has entered full-rate production and is currently being deployed.[10] The latter is an air-launched ballistic missile, known as the Kinzhal, which is carried and launched from either a bomber or fighter aircraft, has a reported speed of Mach 10-12, and is intended for use against high priority targets, such as U.S. or NATO ships in the maritime approaches, or allied air defense systems in eastern Europe.

The depth and breadth of the technological and engineering challenges in dealing with these threats are indeed significant, but need not be daunting. Nevertheless, a fully capable defense against hypersonic weapons will require the U.S. Defense Department and American industry to approach the problem in a new and entirely different way.

DEFENDING AGAINST HYPERSONIC WEAPONS

Current air and missile defense doctrine within the U.S. military organizes defensive systems geographically, first around the Combatant Commander's Area of Responsibility (AOR), then focuses on various regions within that AOR, and finally utilizes point defense systems to protect forces in the field and main operating bases. As for defense of the homeland, the Missile Defense Agency's (MDA) array of satellite sensors, sea-borne and terrestrial radars, and ground-based interceptors are designed against a singular threat – an incoming ballistic missile launched from North Korea, or perhaps, from Iran.

Hypersonic weapons, and especially HGVs, are specifically designed to exploit gaps and seams within our missile defense structure. While a ballistic missile flight path is relatively predictable, an HGV flies a completely unpredictable path, with the energy to aggressively maneuver throughout its flight profile. Hypersonic

weapons all fly at such high velocities that, when combined with their lower flight altitude, they compress the radar detection range and reaction times to the point that none of our current systems have a realistic chance of successful intercept. General John Hyten, the commander of U.S. Strategic Command, admitted as much to Congress during recent testimony, saying: "We don't have any defense that could deny the employment of such a weapon against us."[11]

Unlike our current air and missile defense force structure, an effective defense against hypersonic weapons must, from the outset, be capable across the entire globe. This is because potential hypersonic targets for our adversaries include not just decapitation opportunities within the U.S., but also our Carrier Strike Groups at sea and remote operating locations around the world, such as Guam or Kadena Air Base on Okinawa. Finally, our adversaries are not bound to launch hypersonic weapons from known, fixed locations, but instead are free to do so from aircraft or ships anywhere in the world.

Hypersonic weapons all fly at such high velocities that, when combined with their lower flight altitude... none of our current systems have a realistic chance of successful intercept.

Countering this will require the U.S. to invest in an extensive defensive architecture that provides diversified, redundant, globally persistent space layers in order to detect a hypersonic weapon's initial launch, track it through its transition to hypersonic flight and throughout its profile, until cueing capable non-kinetic or kinetic kill systems to defeat it. This all speaks to a highly robust "family of systems" that nonetheless must be envisioned, designed, developed and deployed in a completely holistic manner. It must provide a continuum of capabilities across the entire problem set that allow for no single points of failure. Furthermore, every part and parcel of this framework must be developed with open mission system architecture design, providing for configuration control and interoperability.

The foundation of this defense is what Undersecretary Griffin and others have called the "space sensor layer," as well as robust, secure, very high speed and very high quality data-transfer capabilities that immediately share with all nodes and components everything that is known and learned about the weapon, from detection to destruction. On at least this last point, the Pentagon may have a serendipitous partner – the commercial telecommunications industry, which is planning to launch thousands of satellites in the next few years to create a "web in space" based on laser communications technology. Leasing capability from these providers would go a long way toward providing the robust, very secure, high speed and quality data transfer the architecture requires at a fraction of the cost of developing a whole new constellation.

Once detected and tracked, the key to destroying a hypersonic weapon may well lie with a non-kinetic capability like directed energy, specifically high energy lasers (HEL) and high power microwave (HPM) systems, especially during the weapon's launch and cruise phases. A space-based HEL, orbiting at an altitude that affords the best tradeoff with satellite survivability against adversary anti-satellite systems with the effective range of the laser, could be used to great effect against the weapon.

Unlike a kinetic interceptor, which is akin to "hitting a bullet with a bullet," an air delivery vehicle employing an HPM device could scramble the weapon's guidance systems and electronics by simply passing within a requisite proximity. Ground-based HEL and HPM could also be arrayed in a point-defense role, especially around what our adversaries would call a "high value target." Finally, while having little or no current utility, a kinetic interceptor, with sufficient advance warning and targeting quality data cued from the space sensor layer, may prove to be effective, especially in the weapon's terminal phase.

CONGRESSIONAL ACTION NEEDED

Despite the bold challenge issued by Shanahan and Griffin to industry, and industry's initially energized response, our ability to simultaneously produce thousands of hypersonic weapons ourselves and build and deploy a capable defense against similar weapons is by no means guaranteed. Slower than anticipated maturation of necessary technologies, unforeseen setbacks during testing and development, failure to enforce complete interoperability (on the defensive side), and even future technological leaps by Russia and China all threaten our success.

However, the greatest threat to success is domestic. Will the Administration and Congress build and sustain the political will to see the threat for what it is, and then budget accordingly? The early results from the President's 2020 budget are not terribly encouraging, and suggest that the onus may be on Congress to prioritize a holistic defensive system against hypersonic weapons.

While the President's 2020 budget request identifies some $2.6 billion for development of U.S. offensive hypersonic weapon capabilities, the Space Sensing Layer – readily identified by Griffin and others as the top priority in America's defensive architecture – received just a paltry $73 million. But prioritizing offense over defense is short sighted. With Russia and China having already fielded hypersonic weapons, a demonstrated capability to defend against them, even if only rudimentary, may afford the U.S. a "strategic pause" during which our adversaries will question their ability to successfully use their weapons, and consequently give us more time to develop and field our own hypersonic capability.

The urgency of this threat requires Congress to make hypersonic weapons defense a national priority, even if the President's budget fails to do so. Time will tell whether it will.

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Back to the Future of Missile Defense

Michaela Dodge

Thirty-six years ago, the United States embarked on a serious effort to render the threat of nuclear-armed ballistic missiles "impotent and obsolete." Despite some progress, however, we are not significantly closer to that goal today than we were in 1983. What does the future hold for the development and advancement of the U.S. missile defense program?

HOW THE PAST HAS SHAPED THE PRESENT

President Ronald Reagan made protecting the U.S. against Soviet nuclear-armed ballistic missiles one of the U.S. defense establishment's organizing principles. He launched a family of missile defense programs under the umbrella of the Strategic Defense Initiative (SDI). These programs built upon existing U.S. missile defense efforts, which had been constrained by the limitations in the 1972 Anti-Ballistic Missile Treaty with the Soviet Union. We continue to reap the fruits of those intellectual (if not technical) efforts today. Moreover, missile defense will likely continue to be a prominent aspect of U.S. defense policy.

Regrettably, the threat of ballistic missile attacks on the United States, our forces, allies, and partners will not diminish anytime soon. These missiles have attributes that make them prized strategic possessions for many states and even non-state actors. Ballistic missiles are prized as tools of power projection and coercion because they can attack quickly, are relatively cheap as compared to the damage they can cause, and are difficult to intercept. Continued increases in the sophistication of ballistic missiles, as well as their decreased costs, will undoubtedly help to shape future security environments.

Thanks to our adversaries, however, we no longer have the luxury of being able to worry only about ballistic missiles. The threat today includes missiles that do not fly on ballistic trajectories, including hypersonic weapons and cruise missiles. Missiles can be armed with multiple independently targetable reentry vehicles, possess stealthy characteristics, maneuverable reentry vehicles, decoys, and jammers – all of which complicate U.S. efforts to intercept them. In recognition of these developments and expanding threats, the Trump administration's congressionally mandated review of U.S. missile defense policy was titled the "Missile Defense Review (MDR)" rather than the Obama-era "Ballistic Missile Defense Review."

However, disagreements over the technical feasibility of missile defenses that plagued the SDI effort are largely gone today. U.S. missile defense interceptors now have a proven track record. Admittedly, it is not perfect, but such is always the case with extremely complicated and technologically challenging systems. And U.S. missile defenses are getting better every day.

After all, the goal of our efforts is to hit an incoming missile travelling thousands of miles an hour with a relatively small kinetic kill vehicle. Decades ago, the technology to accomplish this feat did not exist, and the United States had to rely on nuclear-tipped interceptors. At that time, some thought that non-nuclear, hit-to-kill intercepts would never be possible. Today, the debate about U.S. missile defense programs centers largely on whether they are feasible in the context of strategic relations with other nuclear-armed states, particularly Russia and China, and whether the price of these systems is worth it in an era of decreasing defense budgets. Discussions about costs associated with the system will continue to be prominent, particularly as we face potential sequestration this Fall under the Budget Control Act.

U.S. policy has required missile defense systems to be "cost-effective at the margin." Generally, that means that the cost of the interceptor should be comparable to the cost of the incoming missile. But over time, we

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have come to realize and appreciate the deficiencies of this component of the so-called "Nitze criteria." Missile defense interceptors are much more expensive than ballistic missiles, but we do not question why policemen wear bulletproof vests even though a bullet is much cheaper than the vest.

We have seen a real-life demonstration of the benefits that missile defenses bring to policymakers and to populations terrorized by missile and rocket attacks. The Israeli experience with the Iron Dome system illustrates that what matters is the value of what is being protected, not just how much an interceptor costs relative to an incoming missile. Missile defenses give a government additional time to consider the least escalatory steps in a crisis in which an adversary uses ballistic missiles in an effort to escalate a conflict, potentially averting a hot war with many more casualties. Missile defense may never be able to catch up with missiles in terms of costs, but future advanced technologies and miniaturization certainly have the potential to put missile defense in a more favorable position on the cost curve.

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AN IMMINENT RECKONING

Yet U.S. policymakers will soon face a missile defense reckoning. Today, we agree on a bipartisan basis that we need to defend the U.S. homeland from Iranian or North Korean missiles. As the missile capabilities and technologies of those two regimes become more advanced, our missile defense systems will have to evolve to address them if we do not want to open ourselves up to blackmail. In addition, this inexorable evolution might eventually give our missile defense systems capabilities against Russian and Chinese missiles. The Trump administration's MDR explicitly rejects accepting limits on U.S. homeland missile defense systems to counter North Korean and Iranian ballistic missiles, even if those defense systems might have some capability against other states' ballistic missiles.

President Trump was even more forward-leaning in his remarks announcing the MDR at the Pentagon in January 2019, when he said, "My upcoming budget will invest in a space-based missile defense layer. It's new technology. It's ultimately going to be a very, very big part of our defense and, obviously, of our offense. The system will be monitored, and we will terminate any missile launches from hostile powers, or even from powers that make a mistake. It won't happen. Regardless of the missile type or the geographic origins of the attack, we will ensure that enemy missiles find no sanctuary on Earth or in the skies above."[1] But any such lofty plan must be backed by resources; otherwise, it remains just a statement.

The President's declaration also highlights an important contradiction in today's U.S. missile defense policy. If we are truly in an era of great-power competition with China and Russia, as the Trump administration's *National Security Strategy* declares[2], our missile defense policy should reflect that. It must translate into investment in capabilities that can address large, sophisticated Russian and Chinese ballistic missiles. As President Reagan asked on another occasion, "Wouldn't it be better to save lives than to avenge them?"

Yet having a sound missile defense policy is just a starting point – necessary but not sufficient by itself. We need to back this policy with investments. The MDR came out too late to have a significant influence on the President's fiscal year (FY) 2020 budget request for the Department of Defense, and that could explain deficiencies in terms of building missile defense systems for the future as far as this budget cycle is concerned. The MDR was supposed to be released in the Fall of

2017, but it was delayed for more than a year, not coming out until January 2019 and largely missing an opportunity to impact the FY 2019 and FY 2020 budget cycles.

Shooting down Russian and Chinese missiles, ballistic or not, means increasing investments in advanced technologies, including directed energy missile defense concepts, defenses against hypersonic weapons, and space-based interceptors. The United States must invest in boost-phase missile defense because that is where missiles are the slowest and have not yet deployed decoys and countermeasures. Regrettably, the boost phase of flight is also the shortest and consequently most technologically challenging phase in which to conduct an intercept.

MISSILE DEFENSE POLICY FOR THE NEAR FUTURE

Even before we get to technologically advanced programs and concepts, however, there are steps the United States can and should take to improve the existing missile defense architecture. The United States should make existing missile defense capabilities more effective. We can accomplish that by improving the quality of the data fed into our existing sea-based and ground-based missile defense architecture. The best way to get this done is to develop a space-based sensor layer. Not only do space-based sensors "see" more than ground-based sensors do, but they are also, relatively speaking, less vulnerable to adversary attacks.

The President's FY 2020 budget request, however, allocates only $15 million for "a prototype proliferated Low Earth Orbit communications and data transport layer." That is simply not enough to make any meaningful advancement on this important issue. The lack of funding is even more surprising when one considers that successive directors of the Missile Defense Agency (MDA), the agency responsible for missile defense research and development, have all strongly emphasized the need to improve U.S. cueing and tracking data.

Additionally, the United States can explore options to increase the capability of the existing family of interceptors. For FY 2020, the MDA is requesting a mere $14 million for the Multi-Object Kill Vehicle program, which is designed to allow a single interceptor to destroy more than one incoming object. That is not a significant amount of funding for a program that is simply common sense and that should have been pursued consistently since President George W. Bush's abrogation of the 1972 Anti-Ballistic Missile Treaty in 2002.

If the United States truly is serious about great-power competition with Russia and China, and about defending against their long-range ballistic missile arsenals, it will have to increase both its investment in and the capabilities of more than just large ground-based interceptors. This is not to say that the United States should cease all investments in its Ground-Based Midcourse Defense (GMD) system, but GMD interceptors today are simply too expensive and too vulnerable to a potential Russian or the Chinese attack.

If we are serious, we will increase investments in space-based capabilities and future missile defense technologies, including directed energy weapons. Finally, we will make it an explicit U.S. policy to defend against any ballistic missile attacks, just as President Trump, speaking at the Pentagon, said he would. Unless we take these steps today, our missile defense future will be bleak.

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