Conventional Prompt Global Strike and Russia's Nuclear Forces

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On June 19, 2013—just hours before President Barack Obama called for further nuclear reductions in Berlin—President Vladimir Putin issued a preemptive rebuttal, stating that

> we see that work is active around the world on developing high-precision conventional weapons systems that in their strike capabilities come close to strategic nuclear weapons. Countries that have such weapons substantially increase their offensive capability.

There is little doubt that the United States is foremost in Putin's mind. The Russian strategic community has repeatedly expressed concern that U.S. high-precision conventional weapons could be used to hold Russian nuclear forces at risk. As such, "strategic conventional weapons" appear set to become a major issue during any future arms control negotiations. Moreover, if the United States and Russia ever find themselves in a crisis deep enough for the use of nuclear weapons to be conceivable, fears of "conventional counterforce" could precipitate the first use of nuclear weapons.

One U.S. conventional weapon program highlighted by Russian officials and experts is Conventional Prompt Global Strike (CPGS)—an initiative to develop long-range non-nuclear weapons that could hit distant targets in a short period of time. Notably, in 2007, Anatoly Antonov, who was then director of the Security and Disarmament Department at the Russian Ministry of Foreign Affairs and is now a deputy defense minister, stated that prompt global strike (as CPGS was then known), "when combined with global missile defense, becomes a means of seeking to dominate the world politically and strategically."

For its part, the Obama administration has stated that CPGS would "not negatively [affect] the stability of our nuclear relationships with Russia and China." Indeed, although both the George W. Bush and Obama administrations have raised the possibility of acquiring CPGS weapons to attack an adversary's nuclear force, the only potential targets they have identified have been North Korea or a nuclear-armed

Iran, or if such specificity was inappropriate, “rogue states” or “regional adversaries.” (Russia, by contrast, is referred to as a “near-peer competitor” in U.S. military jargon.) Moreover, the idea of “substituting” large numbers of nuclear weapons with conventional weapons, which never enjoyed much support within the U.S. government, has now completely fallen out of favor. (To be clear, the United States does have a long-standing interest in developing conventional options for scenarios where even small-scale nuclear strikes might lack credibility; however, *large-scale* substitution is a different matter.)

That said, it is clear that Moscow has yet to be convinced that CPGS would not undermine its nuclear deterrent. This observation raises the questions of whether, from a technical perspective, CPGS could pose a threat to Russia’s nuclear forces and how, from a policy perspective, Russia and the United States could cooperate to enhance mutual security.

What is Conventional Prompt Global Strike?

The goal of the CPGS program is often described as the development of long-range high-precision conventional weapons capable of reaching a target anywhere in the world within one hour. The program’s focus has, however, now shifted to the development of non-global systems. Almost all funding is currently focused on the Advanced Hypersonic Weapon—a gliding reentry vehicle that would travel in the upper atmosphere after being propelled by a rocket to hypersonic speeds (at least five times the speed of sound). If procured, the Advanced Hypersonic Weapon could be based on land or at sea and would have a range of about 8,000 km. In the most recent U.S. defense budget, a better known global-range “boost-glide” system, the Hypersonic Technology Vehicle-2, was stripped of almost all funding and downgraded to a “risk mitigation program” following failures in two flight tests.

The CPGS program is currently in the research and development phase. No decision to acquire a weapon system has yet been taken. However, the Obama administration has indicated that it intends to make an acquisition decision within the next few years.

If and when the acquisition process commences, the Advanced Hypersonic Weapon is unlikely to be the only weapon concept considered. There are indications that the Obama administration is exploring the possibility of a new Intermediate-Range Sea-Launched Ballistic Missile, which could be equipped with a steerable but non-gliding reentry vehicle. Hypersonic cruise missiles, which are being developed in a bureaucratically separately effort from CPGS, may also be considered. In addition, because the Obama administration has committed to a competitive acquisition process, industry may also submit additional ideas.

Given the current climate of fiscal austerity in the United States, it is possible that the program may be cancelled by either the administration or by the U.S. Congress. While Congress has been generally supportive of the concept of CPGS, it has strongly opposed a number of specific projects (including the conversion of Trident-D5 ballistic missiles to carry conventional warheads). There is no guarantee that it would fund any acquisition request. If acquisition does go ahead, deployment is unlikely before the mid-2020s.

Do CPGS weapons pose a threat to Russian silos?

Discussions within the United States about using CPGS weapons to attack hard and deeply buried targets inevitably raise concerns in Russia about the survivability of silo-based intercontinental ballistic missiles (ICBMs).

Penetrators delivered by CPGS weapons would have one major advantage and one major disadvantage compared to air-dropped bombs, such as the GBU-57, more commonly known as the "Massive Ordnance Penetrator," which is reportedly able to penetrate to a depth of 20 m in concrete and is the most effective non-nuclear "bunker buster" that the United States currently possesses. The advantage of CPGS-delivered weapons would be their much greater speed. My calculations suggest that they could plausibly penetrate to a depth of 30 m or 40 m in concrete. Their disadvantage would be the relatively small amount of conventional explosive they could carry—perhaps 10 times less than the GBU-57—giving them a significantly smaller destructive ability.

A penetrator could destroy a silo-based missile by piercing through the silo door to reach the silo tube and its contents. The doors to Russian SS-18 silos are reported to be about 1 m thick and made largely from reinforced concrete. It seems highly unlikely, therefore, that one could stop a penetrator (whether CPGS delivered or air dropped). It can therefore be assumed that a direct hit on a silo tube would destroy the missile inside.

A more complex issue is by how much a penetrator could miss a silo tube and still destroy its contents. After all, a silo is a small target and would be hard to hit directly (the radius of the SS-18 silo tube, for example, is reportedly just 2.95 m in radius).

If a penetrator missed a silo tube it could still cause serious damage by penetrating into the surrounding concrete and rock, and detonating its conventional explosive. If this explosive was detonated at the optimum depth, the resulting craters could be relatively large. Experiments suggest that, if detonated in hard rock, the GBU-57 might produce a crater of up to about 8 m in radius, whereas a CPGS-delivered penetrator might produce a crater less than half that size. This difference implies that, if the weapons had equal accuracy, the GBU-57 would probably be *more* effective at attacking silos than a CPGS-delivered weapon (a graph of kill probability as a function of accuracy for both weapons is shown in figure 1).

In terms of the absolute degree of threat that CPGS weapons would pose to silos, these approximate calculations suggest that for a CPGS-delivered penetrator to have a 90% probability of destroying a silo-based ICBM, it would need an accuracy of around 3 m. This kind of accuracy might be achievable with Global Positioning System (GPS) navigation under ideal conditions. However, in a crisis or in wartime, Russia would presumably try to jam the GPS signal. In this case, much would depend on the effectiveness of U.S. counter-jamming efforts and the feasibility of equipping CPGS weapons with backup guidance systems, both which are technically challenging.

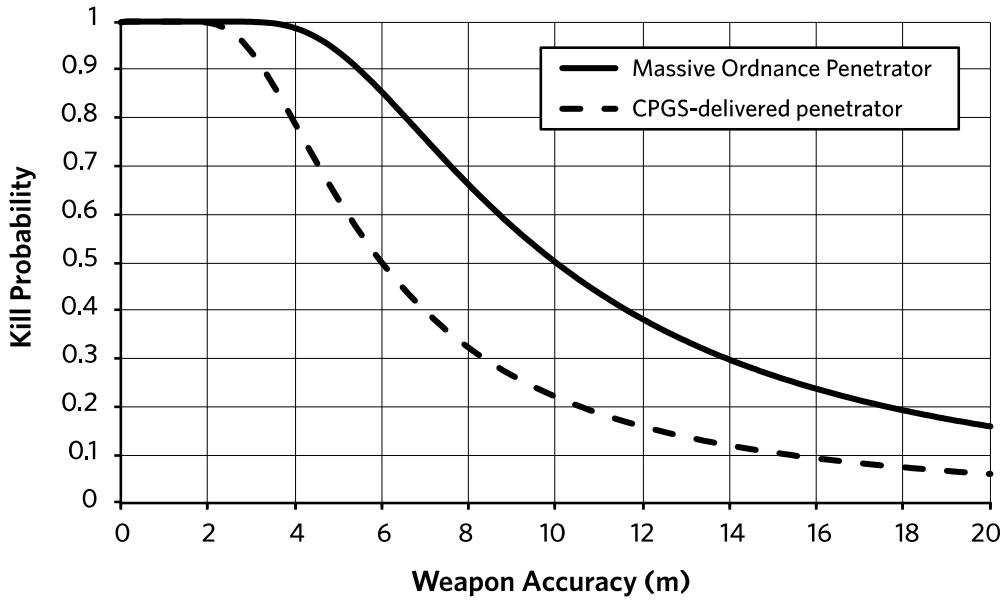

FIGURE 1: Graph of the Kill Probability of the GBU-57 (Massive Ordnance Penetrator) and a CPGS-Delivered Penetrator Used Against an SS-18 Silo as a Function of Weapon Accuracy. Technically, weapon accuracy is given by the circular error probable. For details of the calculation see James M. Acton, "Hypersonic Boost-Glide Weapons," (forthcoming).

An additional challenge facing any attempt to use CPGS weapons to destroy silos would be air and missile defenses. CPGS weapons would rely on their speed to enhance their survivability. However, if penetrators are delivered too fast (typically more than about 1,000 m/s) they can deform significantly and even fracture on contact with the ground, significantly reducing their military effectiveness. For this reason, CPGS weapons armed with penetrating warheads would have to slow down significantly from their cruising speeds, increasing their vulnerability to interception.

There are good reasons, therefore, to question whether CPGS weapons would pose a significant threat to Russian silos. Of course, even if they do not, other conventional weapons may conceivably pose a threat. As Russian analyst Evgeny Miasnikov observes, a range of warheads types, including shaped charges delivered by cruise missiles, could theoretically be used to attack silos and each system must be analyzed separately. However, given the political significance of the CPGS program, a finding that CPGS weapons could not reliably hold silos at risk would not be an unimportant one.

Do CPGS weapons pose a threat to Russian mobile missiles?

About 20% of Russia's 1,050 or so land-based strategic nuclear warheads are deployed on mobile launchers. The challenges of attacking mobile missiles were famously highlighted by the "great Scud hunt" during the 1991 Gulf War against Iraq when the United States failed to achieve a single confirmed kill of a missile-related target despite 1,460 sorties directed against them. U.S. capabilities to attack mobile targets have improved significantly since then. However, there are still good reasons to question

whether American intelligence, surveillance and reconnaissance systems able to operate from outside the theater are capable of locating and tracking moving missiles with enough reliability to enable successful attacks (although, admittedly, because these systems are so highly classified, any discussion of their capabilities is necessarily subject to significant uncertainties.)

Satellite-based radar offers the most promising means of tracking mobile missiles from afar. Although the United States does not currently possess enough such satellites for this purpose, the number that would be required is not so large as to be entirely unfeasible. Indeed, over the last fifteen years, the United States has initiated various plans to develop a constellation of satellite-based radars capable of providing near continuous coverage of most of the globe. In an important 2008 report on CPGS requested by Congress, the National Research Council of the U.S. National Academies singled out the most recent of these programs, the Space Radar, as enhancing the U.S. capability to find mobile targets from "episodic" to "relatively reliable." However, this program was cancelled in 2008—apparently between the completion of the Council's report and its publication. There does not appear to be any successor program in place and, given current financial realities, neither is there likely to be.

For the foreseeable future, airborne assets—including both manned and unmanned aircraft—provide the only plausible means for detecting and tracking mobile missiles. However, it seems unlikely that this approach would prove successful against Russia—a vast state with sophisticated air defenses (especially after plans to replace the aging E-8 Joint Surveillance Targeting and Attack Radar System (JSTARS) aircraft were recently been shelved). In short, unless the United States developed a reliable surveillance system to locate and track mobile targets, it seems unlikely that CPGS—or any other high-precision weapon system—could pose a significant threat to Russia's mobile nuclear forces after they have been dispersed.

Policy options

These technical arguments notwithstanding, there is unquestionably a gulf in perceptions between U.S. and Russian planners about whether CPGS and other high-precision conventional weapon systems could pose a threat to Russia's nuclear forces. Part of this gap almost certainly derives from the different assumptions made by each side. Russian planners presumably worry about a bolt-from-the-blue conventional first strike in peacetime when GPS jammers are not operating, air defenses are not on alert, and mobile missiles are not dispersed. By contrast, if U.S. planners were to think about preparing for such a strike at all, they would have to assume that Russia would be in a state of high alert. Practical measures to enhance confidence that CPGS weapons would not pose a threat to Russia's nuclear forces are needed.

In the final analysis, the most effective means at Moscow's disposal to ensure the survivability of its nuclear forces as U.S. conventional capabilities evolve is self-help. Specifically, the analysis above suggests that dispersed mobile ICBMs are probably more survivable than those based in silos. Moreover, if silos can reliably be held at risk with any kind of conventional weapon, placing multiple warheads on each silo-based missile compounds this problem. For these reasons, Russia should consider whether the development of a new multiple-warhead silo-based "heavy" ICBM is in its best interests or whether it

would be better served by continuing to invest in new mobile weapons. Russia could also consider keeping a fraction of its mobile ICBMs on alert in peacetime.

A range of cooperative options exist for building confidence that U.S. CPGS deployments would not adversely impact the survivability of Russia's nuclear forces. One powerful confidence-building option would be to make all CPGS weapons accountable in a future U.S.-Russian arms control treaty. However, with the current controversy around ballistic missile defense still unresolved, the prospects for a new treaty are poor; it therefore seems likely that, for the time being at least, a treaty-based route for dealing with CPGS will not be available.

Fortunately, other cooperative measures are still possible. A first-order task is a dialogue between Washington and Moscow on CPGS. Because the CPGS program is still in the research and development phase, there is political space for Russia to explain its concerns to United States and for the United States to shape the program in ways that are less threatening to Russia. This is not to suggest that the United States will—or should—give Russia a veto over *whether* CPGS weapons are acquired. But, it is to imply that the Obama administration might show flexibility in *how* the program is developed.

A dialogue could also develop stand-alone confidence-building measures, such as data exchanges, declarations, and joint studies. Other measures, such as launch notifications and inspections, could address other potential risks associated with CPGS, such as the possibility that Russia could misidentify a CPGS weapon as nuclear-armed.

Confidence-building measures could be legally binding or politically binding and could be negotiated relatively quickly. Another advantage of this approach is that some measures could be applied to non-prompt conventional capabilities, long-range cruise missiles in particular. While the United States would not agree to subject these weapons to binding limits, it is interested in greater transparency given Russian investments in this area. As a result certain confidence-building measures, such as data exchanges, basing restrictions, and movement notifications, could be reciprocal and hence clearly mutually beneficial.

Data exchanges about precision-guided weapons, including cruise missiles and CPGS systems, could cover acquisition and deployment. On the former, the parties could agree to exchange information about plans, over the next five years say, for the procurement of agreed types of high-precision conventional weapons. They could also agree to give, perhaps, one year's notice of changes in such plans. Meanwhile, three Russian analysts, Alexei Arbatov, Vladimir Dvorkin, and Sergei Oznobishchev have called for data exchanges on "the practice of deploying high precision weapons on ships, submarines and aircraft." This could be accomplished by, for example, exchanging data about the number of agreed types of high-precision conventional weapons deployed in certain theaters.

Cooperative measures could also help resolve any genuine technical disagreement between Russia and the United States about the threat posed to silos by high-precision conventional weapons such as cruise missiles and CPGS. To try to resolve these concerns, the U.S. and Russian national academies of science

could conduct a joint study. If they are not able to resolve the disagreement, they might be able to design joint experiments that could, such as actually detonating a weapon, say, next to a model silo door.

Confidence-building measures would be useful whether or not the United States and Russia succeed in negotiating a new arms control treaty. In fact, by kick-starting cooperation and starting to resolve contentious issues, they would make a future treaty more likely.

Conclusions

There is a real danger that the long-standing U.S.-Russian controversy over ballistic missile defense will be repeated with CPGS and perhaps other high-precision conventional weapons. The similarities are clear. Both ballistic missile defense and strategic conventional weapons have caused deep-seated disquiet within the Russian strategic community about the survivability of Russia's nuclear forces. In both cases, the spillover affects the broader bilateral relationship.

In fact, if U.S. ballistic missile defenses continue to be developed more slowly than expected—as the recent cancellation of phase 4 of the European Phased Adaptive Approach typifies—high-precision conventional weapons could take the place of ballistic missile defense as *the* major irritant in the U.S.-Russian strategic relationship. Both Moscow and Washington have a clear interest in avoiding this outcome.

Fortunately, there is one critical difference between CPGS and ballistic missile defense in terms of finding solutions: the former is still a research and development program. No decision to acquire any CPGS weapons has yet been taken and deployment, if it ever occurs, is at least a decade away. As a result, cooperation is more likely to be successful than in the case of ballistic missile defense, which has already been deployed. This window of opportunity will not last forever, however. Russia and the United States should try to take advantage of it as soon as possible.