

Target Russia?

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Russia perceives new US anti-missile deployments in Europe as, in part, aimed at its own forces. The authors examine the technological basis of these concerns. George N. Lewis has a Ph.D. in experimental physics and is associate director of the Peace Studies Programme at Cornell University. Theodore A. Postol is professor of science, technology and national security at the Massachusetts Institute of Technology and a former scientific adviser to the Chief of Naval Operations.

The Bush administration is proposing to deploy a missile defence that it claims would protect most of Europe and the continental United States against potential long-range ballistic missile attacks from Iran. The proposed system would have its major components at three sites. One unidentified site would host a radar in a forward position close to Iran to provide early-warning and cueing information.

That information would then be transferred to a large X-band radar, known as the European Midcourse Radar (EMR), designed to allow US defences to discriminate, track, and identify a target cluster. The European Midcourse Radar, planned for a site near Prague in the Czech Republic, would be built by upgrading and moving an existing X-band radar from the Pacific Missile Test Range at Kwajalein in the Marshall Islands. The other site, a farm of 10 missile interceptors, would be located in the north of Poland. According to statements made by the United States, this proposed deployment is not only 'optimal', thereby providing redundant protection of the continental United States and basic protection of European Nato allies against postulated future ballistic missile attacks from Iran, but also has absolutely no capabilities against Russian inter-continental ballistic missiles.

The Russian reaction to the proposed deployment has been sharply negative. President Vladimir Putin expressed alarm that 'the [nuclear] balance will be upset', and although the Russians have gone into little detail about how they arrived at their conclusions, US descriptions of talks with Russian officials indicate that the Kremlin perceives the US deployment to be at least in part aimed at Russia.

In order to understand Russian concerns, it is useful to examine how Russian military analysts might assess the capabilities of the proposed US system. They would assess both the initial technical capabilities of the US system and its potential capabilities as it matures. They would look twice at US decisions to site the system as

the Pentagon intends and rightly conclude that the system might be designed to counter Russia's deterrent in addition to a nuclear attack from Iran.

Current and potential capabilities

The clearest high-level statement with regard to US missile defence programmes is National Security Presidential Directive 23 (NSPD-23), signed by President George W. Bush on 6 December 2002. The directive stated that the United States would begin to deploy missile defences in 2004 'as a starting point for fielding improved and expanded missile defences later'. NSPD-23 was preceded in January 2002 by a memorandum from Secretary of Defence Donald Rumsfeld. The Rumsfeld memo directs the Missile Defence Agency to develop defence systems by using whatever technology is 'available', even if the capabilities produced are limited relative to what the defence must ultimately be able to do.

The Rumsfeld mandate and NSPD-23 would make it clear to Russian analysts that anything they see now will surely be upgraded to something far more capable as US missile defence activities advance.

Russian analysts would surely know that the US missile defense could be readily defeated by very simple countermeasures, such as decoys that would look much like basketball-sized balloons. The analysts and their political leaders also would rightly ask why the Americans are doing this.

What is the US intent? How will Russia have to modernize its inter-continental ballistic missiles and attack plans to keep up with the constantly changing character of the defence and the uncertainties created by it? What are the political motivations for the relentless US efforts to build defences obviously aimed at Russia? What is the relationship of the US missile defence efforts to the constant push to expand Nato and encircle Russia with US bases?

Russian analysts examining the system would also conclude that, at some unforeseen future time, under highly unpredictable and very specialized conditions, the European defence might be able to engage many hundreds of targets, thereby, in conjunction with other US systems, threatening Russia's nuclear deterrent. Such possibilities, however remote they would seem, would certainly conjure up apocalyptic threats to Russia's national survival.

The source of these concerns would be basic scientific facts that could be used by the Department of Defence in the relentless and unpredictable modernization effort foretold by National Security Presidential Directive-23. The location of the radar in the Czech Republic and the interceptors in Poland, both close to European Russia, would make it possible, at least in principle, for the radar to track Russian inter-continental ballistic missiles very early after a launch and to guide interceptors against them. Although the radar currently proposed for deployment will not have the capability to track hundreds of targets at long ranges simultaneously and the number of interceptors in the initial deployment would be small, Russian analysts would expect that the capabilities of the radar and interceptors could be substantially improved at a later time.

In particular, the limits of the radar's abilities to track large numbers of targets

simultaneously are determined by the antenna's effective size and average radiated power. The Pentagon could enhance both of these variables, boosting the system's capabilities.

Currently, the effective size and power of US X-band radar antennas are limited by the number of transmit/receive modules that are mounted in their faces. Initial plans call for the European Midcourse Radar antenna to have roughly 20,000 such transmit/receive modules thinly distributed over its 100- to 120-square-metre antenna face, each capable of radiating 2 to 3 watts of average power.

Yet, the maximum number of transmit/receive modules that could be placed on an antenna face of 120 square metres is well more than 300,000. Such a modernization would require the complete replacement and reconstruction of the antenna, but it would result in a vast increase in the number of targets that could simultaneously be engaged by the radar because the 'effective area' of the antenna is proportional to the number of transmit/receive modules. If the number of transmit/receive modules were to be increased by a factor of 16 to 17, then both the effective area of the antenna and the radiated power would increase by the same factor. The two factors combine to provide a nearly 300-fold ($17 \times 17 = 289$) increase in capability.

Currently, the ability to build X-band radars is limited by the rate at which transmit/receive modules are being manufactured. The modules are also expensive, currently about \$1,000 each. The current limits on manufacturing, however, can be expected to change over time as techniques improve. In addition, as the missile defence programme moves forward, the manufacturing base for these modules might grow. Thus, Russia fears that the X-band radar could target 300 times more missiles when a mature capability becomes available.

Russian analysts would also be concerned that the United States might expand the number of interceptors in Poland to take advantage of such a European Midcourse Radar's prodigious abilities to guide numerous interceptors simultaneously. Indeed, unless one believes Iran will stop building long-range missiles once they get to ten, such an expansion must be expected. Once interceptor manufacturing facilities are operating, additional interceptors could be obtained by extending manufacturing runs, by expanding manufacturing facilities, or both. The primary obstacle to an expansion would be political: increasing the number of interceptors would require modifications to an existing agreement with Poland. If Poland is already hosting US interceptors, the biggest political obstacle would already have been overcome.

Threat to Russia's deterrent

The location of the radar in the Czech Republic and missile defence interceptors in Poland, close to European-based Russian inter-continental ballistic missile installations, would raise questions among Russian analysts about the potential threat to Russian ICBMs based in European Russia.

The ground-based interceptors in some ways resemble inter-continental ballistic missiles themselves. They are extremely large, two-stage ballistic missiles, weighing roughly 21,500 kilograms each, with the two stages derived from the Minuteman series of ICBMs. They boast the same diameter as the

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Minuteman III's two upper stages and even use the same shroud. Indeed, if an interceptor were armed with a typical 1,100-kilogram Minuteman III payload of a missile bus and three nuclear warheads, it could carry that payload more than 6,000 kilometres. The interceptor would only have to carry a kill vehicle weighing 70 kilograms, allowing it to achieve a speed 40 per cent faster than an inter-continental ballistic missile on a trajectory from Russia to the United States and permitting the interceptor to catch a nuclear-armed Russian ICBM from behind.

Despite claims to the contrary, US interceptors launched from a Polish site could intercept the 18 to 25 Russian SS-25 inter-continental ballistic missiles based in Vypolzovo, roughly 340 kilometres north-west of Moscow. Furthermore, missiles launched from all of the other European-based Russian inter-continental ballistic missile fields would be much easier to engage. The 40 per cent faster speed of the defence interceptors relative to the ICBMs and the early-tracking information provided by the European Midcourse Radar in the Czech Republic would allow the defence system to engage essentially all Russian ICBMs launched against the continental United States from Russian sites west of the Urals. It is difficult to see why any well-informed Russian analyst would not find such a potential situation alarming.

It would also be clear to Russian analysts that the placement of the European Midcourse Radar and interceptor sites is not optimal for the defence of Europe. Under the current plan, part of Europe is not covered and must instead be covered by additional shorter-range defenses such as Theatre High Altitude Area Defence (THAAD) and Aegis. A European system covering more of Europe could provide greater redundancy by using these shorter-range ground- and sea-based systems as a second layer. Ground-based interceptors positioned in Turkey, Bulgaria, Romania, or Albania; Aegis sea-based interceptors; and a radar closer to Iran would be better positioned to defend Europe from an Iranian attack and would be too far from Russia to pose a threat to Russian inter-continental ballistic missiles. To a Russian analyst, the only obvious technical reason for choosing the Czech Republic for the European Midcourse Radar and Poland for interceptors would be to provide interceptors close to Russia that can be guided by the nearby EMR, making it possible for the European-based radar and interceptors to be added as a layer against Russia to the already developing US continental defence.

Concern about possible future US missile defence capabilities would be amplified by knowledge among Russian analysts that US Trident submarine-launched ballistic missiles (SLBMs), as well as US Minuteman III inter-continental ballistic missiles, are each capable of destroying Russian silo-based ICBMs. Internal documents produced by high-level technical experts in the Soviet Union during the late 1980s¹ unambiguously show that Russian technical analysts had concluded that Russian silo-based missiles could be wiped out by then-existing US forces. Today's US submarine-launched ballistic missile and inter-continental ballistic missile forces are yet more capable and pose an even more overwhelming threat to Russian ICBMs. Russia has been reducing its arsenal of inter-continental ballistic missiles and converting those that remain to single warhead missiles, but an increasingly capable US defence will create strong incentives for the Russians to reverse this

process. The concern of Russian military analysts would be that a future crisis between Russia and the United States might lead to US strikes on Russian inter-continental ballistic missiles followed by the use of a mature missile defence to reduce or eliminate the consequences of Russian efforts to retaliate.

Putin's alternative

Putin certainly would have been briefed by Russian analysts about their concerns. Plus, he could not have missed the remarks of Secretary of State Condoleezza Rice, who, while in Oslo in April 2007, described as 'ludicrous' Russian statements of concern about the potential threat to Russia from the US missile defence system. In late May 2007, during the Group of Eight conference in Europe, Putin surprised Bush by proposing that Russia would be willing to make the data from an early-warning radar in Azerbaijan available to the United States. One month later in a meeting at Kennebunkport, Maine, Putin significantly widened the scope of his proposal.

Putin offered to make available data from a second, much more modern Russian early-warning radar at Armavir, Russia. He also stated that Russia would not object to US missile defence interceptors being stationed in Iraq or Turkey or other appropriate southern European locations, nor to the United States using Aegis ship-based interceptors as part of a missile defence for Europe. He suggested that Russia would be willing to jointly man early-warning centres in Moscow and in Brussels. He also made it clear that Russia was willing to discuss further possible ways to address the impasse with the United States over the location of the X-band radar and interceptors.

His initial proposal mostly focused on Russia and the United States cooperatively monitoring and assessing the Iranian missile threat. His later additions and modifications make it unclear how far Putin might be willing to go with regard to a European missile defence in the future.

Placing missile defence radars and interceptors south and west of Russian inter-continental ballistic missiles would eliminate any potential future missile defence threat to Russian ICBMs from US interceptors based in Europe. Missile defence radars would not be able to observe and track Russian inter-continental ballistic missiles early after launch, and interceptors would be too far from Russian ICBMs to catch them after a launch.

Moreover, early-warning radars in Armavir and Azerbaijan would be a great benefit to a US missile defence and would achieve US goals of having such radars close to Iran. At such close ranges, the radar signals from targets would be very strong and the line-of-sight to targets would not be significantly obstructed by the curvature of the earth. They would be an ideal complement to a Forward Based X-band (FBX) radar in Turkey or Azerbaijan and interceptors placed in Turkey or other southern European locations.

The early-warning and X-band radars serve very different functions. Early-warning radars such as those in Azerbaijan and Armavir use an operating frequency (150 MHz) chosen to maximize the percentage of radar signal reflected by cone-shaped warheads. Such radars are not able to resolve details of a target much

smaller than perhaps 10 to 15 metres. As such, while these radars could track warheads with sufficient accuracy to support homing of defence interceptors towards the general target cluster, they could not differentiate between numerous objects that are likely to be deployed by a long-range missile along with a warhead.

These limits could be addressed by placing an existing FBX radar at a site in Turkey or Azerbaijan. The United States has said that it will forward-deploy an FBX but has not stated where.

The operating frequency of X-band radars is about 70 times higher than that of the Russian early-warning radars. Because of this much higher operating frequency, X-band radars can resolve details of targets to within 0.2 to 0.3 metres. If an adversary takes no steps to disguise the warhead, this resolution is sufficient to identify warheads relative to other objects of comparable size. Because these radars would be relatively close to Iranian missile launch sites, they would detect targets early and receive relatively strong return signals, which is advantageous both for discrimination and tracking. Unlike the European Midcourse Radar, these radars have relatively small antennas that are nearly fully covered with modules and thus cannot readily be upgraded by orders of magnitude like the EMR.

Thus, one or two such forward-based X-band radars could play two important roles in defending Europe: first, to simply 'inspect' objects launched by ballistic missiles and initially identified by the early-warning radars in order to determine whether they are likely to be warheads, debris, or decoys and further determine their trajectory; and second, to provide early and highly accurate tracking information to the numerous other elements of the defence system.

The high-quality radar data could be coupled with US interceptors placed in Turkey or other southern European locations or at sea, which would be better positioned to intercept missiles launched towards southern and northern European targets, relative to interceptors sited in northern Poland. The availability of such early and high-quality radar tracking data from radars close to Iran would enhance the effectiveness of shorter-range missile defence interceptors in Turkey and on Aegis ships in the Mediterranean or Black Seas. Such a combination of longer- and shorter-range missile defence interceptors and timely warning and guidance information from nearby radars would make possible a more robust defence of all of Europe, including the southern regions not covered by the current proposal for the European midcourse system.

Clearly, Putin's proposals open the door to potentially fruitful discussions that would lead to a missile defence configuration that would be far more robust than the configuration currently proposed for Europe by the United States. More of Europe could be defended and the system would have more reliability and redundancy. The reconfigured defence would pose no plausible threat of contributing to a US continental defence aimed at Russian strategic inter-continental ballistic missiles.

Thus, from a purely technical point of view, Putin's proposal to Bush addresses both Russia's stated concerns about future threats to its security and US stated objectives to deploy missile defences that protect its European allies while posing no threat to Russia. Nevertheless, policymakers must be aware of the costs and benefits of these two narrow policy choices. A serious discussion is under way

about whether and how we could move toward a world free of nuclear weapons.² Because missile defences and deterrent forces raise questions of national survival, activities in these areas create powerful inconsistencies in state behaviour.

The Russians are deeply upset and suspicious of what appears to be a lack of candour, understanding and realism with regard to US plans for missile defences. US political leaders relentlessly deny basic technical facts that show that the current US missile defence might well affect Russia. The result of this standoff is clear and predictable: a world with expanded nuclear forces on high alert aimed at compensating for defences, and defences that will be so fragile to simple or inadvertent countermeasures that they will, at very best, have little or no chance of working in combat.

Any consideration of the potential costs and benefits of future missile defence systems either for Europe or the continental United States that ignores these technical realities in favour of political ideology is simply an invitation to disaster.

Notes

1 Undated internal and untitled memo on mobile missiles from the archive of Vitalii Leonidovich Katayev at the Hoover Institution Archive, Stanford University. The memo states that 80 to 160 US targets could be attacked with remaining Russian ICBM warheads after a US strike on Russian land-based ICBMs.

2 See George P. Shultz et al., 'A World Free of Nuclear Weapons', *The Wall Street Journal*, 4 January 2007.

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