Countermeasures to the Proposed US National Missile Defense System

Recommended Citation

Lisbeth Gronlund, "Countermeasures to the Proposed US National Missile Defense System", nuke policy, March 30, 2000, https://nautilus.org/nuke-policy/countermeasures-to-the-propos-d-us-national-missile-defense-system-2/

Countermeasures to the Proposed US National Missile Defense System

by Lisbeth Gronlund
Senior Staff Scientist
Union of Concerned Scientists
President Clinton recently announced that he would not authorize deployment of the national missile defense (NMD) system under development by the United States. However, the issue of NMD will remain on the agenda for the next administration.If the next President does decide to proceed with deployment of an NMD system, that system may differ somewhat from the one currently under development. The United States could take a totally different approach by developing a boost-phase defense, designed to intercept attacking missiles during their boost phase. However, if the United States continues to develop an NMD system designed to intercept missiles in the mid-course of their trajectory, it will necessarily operate in the same basic way as the one the Clinton administration has been developing. Any mid-course system, regardless of whether the interceptors are ground-based or sea-based, would use infrared-homing, hit-to-kill interceptors guided by ground-based radars and space-based infrared sensors, as would the system currently under development. Thus, for specificity, I will focus on the mid-course NMD system currently under developmentOperational Effectiveness Will the NMD system that the United States is developing work against the threat it is intended to defend against? According to the US government, the system is designed to defend against attacks of up to tens of long-range ballistic missiles launched by emerging missile states that might acquire such missiles in the future.The effectiveness of the NMD system would depend in large part on the "countermeasures" that an attacker could take to counter the defense by confusing or overwhelming it. In his September 1 announcement that he would not authorize deployment of a national missile defense, President Clinton correctly stated that there remain "questions to be resolved about the ability of the system to deal with countermeasures."

It is the task of the US Defense Intelligence Agency to define the characteristics of the threat that a US weapons system under development must contend with, and this threat definition is usually based on intelligence data gathered by satellites, humans, and other sources. However, there may be no such intelligence information about the countermeasure programs of emerging missile states.

The July 1998 Report of the Rumsfeld Commission to Assess the Ballistic Missile Threat to the United States (more commonly known as the Rumsfeld Commission, after its chair Donald Rumsfeld) called attention to two important issues about threat analysis. First, the report noted that the absence of evidence is not evidence of absence— that is, the failure of the US intelligence community to detect direct evidence of weapons development does not necessarily mean that such development is not taking place. Second, given the possibility of non- observable development activities, a threat analysis must assess what weapons a country is capable of developing, given its technical sophistication.

A panel of eleven independent physicists and engineers, of which I was a member, applied this methodology to understanding what countermeasures would be available to a country able to develop a long-range ballistic missile to attack the United States. Our premise was that missile and countermeasure capabilities would be consistent with each other. The panel, which included scientists with considerable experience on ballistic missile defense and countermeasures issues, produced a detailed report—Countermeasures: A Technical Evaluation of the Operational Effectiveness of the Planned US National Missile Defense System.

The first publicly available document to discuss countermeasures that might be available to emerging missile states was the September 1999 National Intelligence Estimate on the Ballistic Missile Threat to the United States, which is a consensus document of the US intelligence agencies. This document noted that such states could use "readily available" technology to develop countermeasures and could do so "by the time they flight test their missiles."

Our study took the next step: we considered in detail the types of countermeasures that would be available and then assessed how effective the planned US NMD system would be against such countermeasures. Such a detailed analysis is possible because the United States is now so close to potential deployment that it has selected the specific interceptor and sensor technologies that the NMD system would use.

In our analysis we assume that the NMD system has all of the sensors and interceptors planned for the full system that would be deployed by 2010 or later. This is the system the Pentagon says will be effective against missile attacks using "complex" countermeasures. We made generous assumptions about the capability of the defense; we assume that the individual components work perfectly and their performance is limited only by the laws of physics. In particular, we assume that the system can "hit a bullet with a bullet."

We assume that the attacker can make a long-range missile and a nuclear or biological weapon to arm it with, and therefore possesses the technology and the scientific and engineering expertise required to do so. This is appropriate because that is the stated rationale for the US NMD system. Specifically, we assume a potential attacker can build: a multi-stage intercontinental-range missile with a payload of 1,000 kilograms; guidance accurate enough to target a large city; either a biological weapon containing anthrax or a nuclear warhead compact and light enough to be carried on the missile; and a reentry vehicle capable of shielding the warhead from reentry heating. An attacker with such capabilities is clearly capable of building a wide range of countermeasures.

The Countermeasures report surveys the types of countermeasures that would be available to an emerging missile state, and then goes into considerable detail for three of those countermeasures: (1) biological weapons deployed on submunitions, (2) nuclear weapons deployed with anti-simulation balloon decoys, and (3) nuclear weapons covered with a liquid-nitrogen cooled shroud.

We found that each of these three countermeasures would defeat the fully deployed NMD system by either causing it to fail catastrophically or significantly degrading its effectiveness.

An attacker using biological weapons could divide the agent into 100 or more small warheads, or submunitions, that would be released early in flight after boost phase. Such submunitions would simply overwhelm the planned NMD system. Our study considered how the attacker could disperse the submunitions and shield them from heating during reentry, and found that doing so would be difficult for a country that could deliver a unitary biological weapon via long-range missile.

An attacker using nuclear weapons could use anti-simulation decoys. In this case the decoys are not made to look exactly like a specific warhead, but the warheads are disguised to make them look like decoys. Anti-simulation is a particularly powerful tool against exo- atmospheric hit-to-kill interceptors. Above the atmosphere, there is no air resistance and lightweight objects travel on the same trajectory as heavy objects.

In the case we consider, we assume the attacker puts its nuclear warhead inside a balloon made of aluminized mylar, and released it along with dozens of empty balloons. Each of the balloons could be made a slightly different shape from the others.

We then consider in great detail the various ways that the defense might be able to use its different sensors to tell which balloon contains the warhead -- by the radar reflections of the balloons, by observing their motions or shapes, or by measuring their temperature and thermal behavior. We find that an attacker could readily make balloons that had no unique distinguishing physical characteristics that could be observed by the planned sensors. Thus, regardless of how capable and accurate the system sensors are, they would not be able to discriminate the empty balloons from those containing warheads. The defense would need to shoot at all the balloons to prevent the warheads from getting through, and an attacker could deploy enough balloons that the defense simply couldn't shoot at them all.

The third countermeasure is a "cooled shroud," in which the attacker covers its nuclear warheads with a double-walled cone containing liquid nitrogen. The very cold liquid nitrogen would greatly reduce the infrared radiation emitted by the shrouded warhead. Discrimination is not the issue here; the X-band radars could see each shrouded warhead and guide the interceptor close to its intercept point. But the cooled shroud would prevent the kill vehicle from homing on the warhead: the kill vehicle's infrared sensors could not detect the warhead in enough time to maneuver to hit it. Our report also shows that an attack could be launched on nighttime trajectories to prevent the kill vehicle from using visible light sensors for homing.

None of the technical analysis in our report has been publicly disputed. Instead, our critics have made one of two general arguments: (1) that we have underestimated how difficult it would be for an emerging missile state to develop and deploy the countermeasures we describe, or (2) that the system will eventually be able to respond to such countermeasures with counter-countermeasures that could defeat them.

We believe that the first criticism is clearly incorrect. Any country capable of building both an intercontinental-range ballistic missile and a nuclear warhead compact and light enough to be delivered by such a missile would clearly be able to build the relatively simple countermeasures our report analyzed.

Some—including Lt. General Kadish, Director of the Ballistic Missile Defense Organization (BMDO)—argue that emerging missile states would be unable to test their countermeasures enough to have confidence in them, and that the resulting uncertainty can deter an attack. However, the countermeasures we considered are well suited for testing in ground facilities or from aircraft and would not require flight testing on a missile.

Moreover, as the Rumsfeld Commission noted in their July 1998 report, emerging missile states such as North Korea neither require nor seek high standards of reliability in their missile programs. In fact, US threat assessments are based on the premise that emerging missile states can present a credible threat without adhering to high standards of testing and reliability. Thus, the United States declared the North Korean Nodong missile operational after a single test flight. If the missile programs of emerging missile states had to meet the standards some want to impose on countermeasures, there would be no missile threat.

The second criticism raises a valid point, but not one that undermines the conclusions of our report. First, as noted above, we considered the full planned NMD system, with all of its sensors and interceptors. The Pentagon states that this system would work against even "complex" countermeasures, and our report showed that this claim was incorrect.

It may indeed be possible to modify the planned NMD system to respond to the some of the countermeasures we discuss (but not to submunitions, which only a boost-phase system could hope to counter). But the offense has important advantages over the defense in this regard. Even if the United States made hardware changes to the planned NMD system to counter some of the countermeasures we discuss, it would take years to develop, test and deploy the new hardware, giving the attacker both the information and time needed to take additional steps to defeat it.

Because the United States is a relatively open society, and any NMD system must go through a multi-year test program in advance of its deployment, the attacker will know a great deal about what sensors and components the NMD system will incorporate. The attacker will have this information well in advance of US deployment, and can tailor its countermeasures to the specific NMD system.

In contrast, the United States is likely to know very little about the countermeasures an emerging missile state is developing. A potential attacker will understand the importance of not divulging such information. As the Rumsfeld Commission emphasized, emerging missile states are increasingly able to conceal sensitive activities. The countermeasures we described could be deployed with considerable confidence without flight testing, after sufficient testing using ground facilities and, where appropriate, airplanes.

A Countermeasure Red Team In any event, there is a time-honored way to answer questions like this: do the experiment. As we recommend in the Countermeasures Report, the United States should establish an independent countermeasures "Red Team" to develop, build, and test countermeasures using information and technology available to emerging missile states.

There is a partial precedent for such an effort: BMDO oversees a program that develops, builds, and tests countermeasure prototypes to theater missile defenses—the Countermeasures Hands-On Program (CHOP). The program involves young scientists, engineers, and military officers not specifically trained in missile defense or countermeasures, who are only given access to the open literature and commercial off-the-shelf technology. But the CHOP program is oriented toward theater missile defenses and not to developing countermeasures to the NMD system. Moreover, the program staff serve for relatively short periods—a year or less—and therefore do not reflect the kind of in-house expertise an emerging missile state is likely to have. And because its funding, staff, and direction are under the control of BMDO, the program is not independent.

The planned NMD system should then be tested against the countermeasures the Red Team determines would be available to potential attackers. As the American Physical Society, the professional association of 42,000 physicists, noted in its April 2000 statement on NMD Technical Feasibility and Deployment: "The United States should not make a deployment decision unless that system is shown -- through analysis and through intercept tests -- to be effective against the types of offensive countermeasures that an attacker could reasonably be expected to deploy with its long-range missiles." Unfortunately, the United States may begin deployment before such tests are performed.

Confidence The issue of "effectiveness" (i.e., how well would the system work?) is different from, but related to, the issue of "confidence" (i.e., with what certainty would US military planners and politicians know how effective the system would be?)

An easy way to understand the difference between these two concepts is to consider a coin that was weighted so the odds of heads and tails was not necessarily 50%. What are the odds of getting heads? The odds are not known a priori. The only way to determine the odds is through testing—in this case, through repeated coin flips. The degree of confidence the coin flipper has in the odds will increase with the number of flips they do. For example, if the person flipped the coin once and it landed on "tails," the person could not conclude with any confidence that the odds of getting heads was zero. It is only by flipping the coin many times that the person can have any confidence in what the odds are of getting heads.

The same thing is true for the NMD system—the probability of intercepting an incoming warhead (or the effectiveness of the system) can only be determined through testing. And in order to have high confidence in what the effectiveness is, many tests are needed. Unlike the coin example, the outcome of an intercept attempt depends on may factors, so even more testing would be needed in this case to assess the defense effectiveness under a range of conditions. The fact that the attacker controls some of these conditions—such as the time of day of the attack and the countermeasures used—complicates the testing even more. Because testing is both expensive and time- consuming, the United States will not conduct enough tests to be able to really assess the system effectiveness. The bottom line is that the United States is unlikely to know—with any significant degree of confidence—how effective its NMD system would be if it needed to respond to a real attack.

Not knowing how effective its NMD system was might not be a problem for the United States if it planned to use the system only as a "last measure" if deterrence failed and an emerging missile state attacked using long-range missiles. However, many NMD supporters, including Secretary of Defense William Cohen, argue that the principle reason the United States needs a NMD system is to "preserve US freedom of action" in the world—to permit the United States to intervene with its conventional forces without fear of reprisal on US cities.

Secretary Cohen and others argue, for example, that North Korea might threaten to attack a US city with long-range missiles to deter the United States from intervening on behalf of South Korea in a potential future conflict. They further argue that if the United States had deployed its NMD system, that such a threat could be ignored because the NMD system would be able to shoot the North Korean missiles down. But in reality, even if the NMD system were highly effective, US policy makers would not know, with high confidence, how effective the system would be before it was used.

So if US policymakers would be deterring from intervening without an NMD system, they should be deterred with an NMD system of unknown effectiveness. The Pentagon apparently understands that it will need to have high confidence in the system effectiveness: the classified requirements for the system are reportedly that the United States be 95% confident that the system would be 95% effective. But achieving this level of confidence and effectiveness with what will necessarily be a limited test program is impossible. Not only will countermeasures available to any country that could deploy a long- range missile very likely render the planned NMD system ineffective, they will also undercut the confidence the United States would be able to gain from its test program.

View this online at: https://nautilus.org/nuke-policy/countermeasures-to-the-proposed-us-na-ional-missile-defense-system-2/

Nautilus Institute
608 San Miguel Ave., Berkeley, CA 94707-1535 | Phone: (510) 423-0372 | Email: nautilus@nautilus.org