

The Proposed U.S. "National Missile Defense" System Architecture and Its Compatibility With the ABM Treaty

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In late summer 2000, US-President Clinton intends to decide whether the United States will begin deployment of a nationwide National Missile Defense (NMD) system to protect the territory from attacks by a limited number of long-range missiles equipped with weapons of mass destruction. In January 1999, the administration announced that the deployment decision will be based on four criteria: the ballistic missile threat, the costs, the readiness of interception technology, and arms control implications. Deployment should take place between 2003 and 2005 if construction work starts in 2001. After an initial veto against the Republican demand, President Clinton eventually signed the "National Missile Defense Act" of 1999, which states that it was U.S. policy to deploy an NMD system "as soon as technologically feasible." Meanwhile, the US has started talks with Russia to modify the ABM Treaty which has been limiting the use of interception technology since 1972. The following paper argues that the decision will be based on just three intercept tests with an incomplete system. The planned NMD system and its proposed architecture is largely incompatible with the ABM Treaty and would most certainly undermine this cornerstone of strategic stability in the longer run.

After several postponements, the US held a first intercept test of the National Missile Defense (NMD) system on October 2, 1999. According to the Ballistic Missile Defense Organization (BMDO), a so-called Exoatmospheric Kill Vehicle (EKV) successfully intercepted a modified Minuteman Intercontinental Ballistic Missile (ICBM) over the Pacific Ocean. Even though considerable technological problems are yet to be mastered before any such system could be deployed, this test was another clear indication that the political will exists to build a national missile defense system. In January 2000, the second of three NMD tests which are scheduled before the deployment decision this year was held and failed. In addition, according to a report in the New York Times of January 14, 2000, "in recent interviews, the Pentagon officials conceded that the interceptor [of the first test] had hit its target only after a series of technical mistakes caused it to drift off course and that it had initially picked up on a decoy balloon rather than the warhead."

Over the past decade, the United States has spent approximately US\$ 100 billion to create an effective protection shield against incoming ballistic missiles. Since 1983, 17 tests have been conducted, of which only three were reported to be successful¹. And even after this

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¹ See: George N. Lewis, Theodore A. Postol, John Pike: *Why National Missile Defense Won't Work*, in: Scientific American, August 1999, p.36-41

latest test there is good reason for considerable doubt whether the result is worth the effort: technologically, it is not feasible to achieve 100% protection against the nuclear threat, which is not necessarily a ballistic missile threat. Only one more tests is scheduled before the deployment decision² – too few, no doubt, to come to a sound decision on the maturity of the technology-of-choice for future conflict situations. Rather, there is a real danger of Russia pulling back from the Anti-Ballistic Missile Treaty (ABM Treaty). Thus, the disarmament debate will be once more complicated and can come to a stillstand blocking all other arms control fora.

1.1 A Look Back: From Reagan's Utopia Back to Earth

When President Clinton announced in January 1999 that he intends to add almost US\$ 7 billions to the funds for a homeland missile defense system, public attention was once more drawn to US plans to build a comprehensive missile defense. With this announcement, the President gave way to many requests of the Republican-controlled Congress. Consequently, in the months to come, Congress even increased the pressure. In March 1999, for example, both the Senate and the House of Representatives passed the National Missile Defense Act. So far, Bill Clinton's administration has repeatedly pointed out – and continues to do so at least in public – that the system should only be deployed if an analysis of the ballistic missile threat for the US proves the demand. Congress, however, simply demands deployment "as soon as technologically feasible."

Well over 17 years ago, the US had already made it clear that they would probably comply with the ABM Treaty just until it is technologically feasible to build a reliable missile defense system. In his so-called "Star Wars" speech of 1983, then-President Ronald Reagan promoted the Strategic Defense Initiative (SDI) which projected a continental space defense in order to render weapons "impotent" and "obsolete." If successfully implemented, this would have meant a radical change from the regime of 'mutual vulnerability' to a regime of 'single-sided vulnerability' and consequently the end of deterrence. Up to this date, however, no convincing model has been presented which makes the move from a world determined by the offensive nuclear threat to an effective defense. Technologically, SDI favored in particular space-based laser and directed energy weapons. But serious technical analyses showed that an effective defense was not feasible at a reasonable cost considering the technology recommended at that time.³ Quite the contrary: it would have led to first strike pressure, an increasing arms race, and tremendous costs.

By introducing the so called '3+3' program in 1996, the Clinton administration has made national missile defense a main issue of their policy and set the course for NMD deployment using more down-to-earth technologies. Three years of development time should provide for the technology which would permit deployment of these systems within another three years if a threat is identified. Meanwhile, this has been modified to a '3+5' program.⁴ The final decision about the deployment of the planned NMD systems is due in June 2000. Therefore, the systems could be operational by 2005. The construction work - which is, by the way, prohibited by the ABM Treaty - could begin in spring 2001. However, there is strong evidence that the decision has already been taken – at the latest when the first test was successfully conducted in October 1999. There are voices saying this is due to the presidential campaign. If Clinton would decide against an deployment this would be an outstanding campaign topic for the Republican candidate.

² [Editors' comment:] This article was written in December 1999 and updated in March 2000.

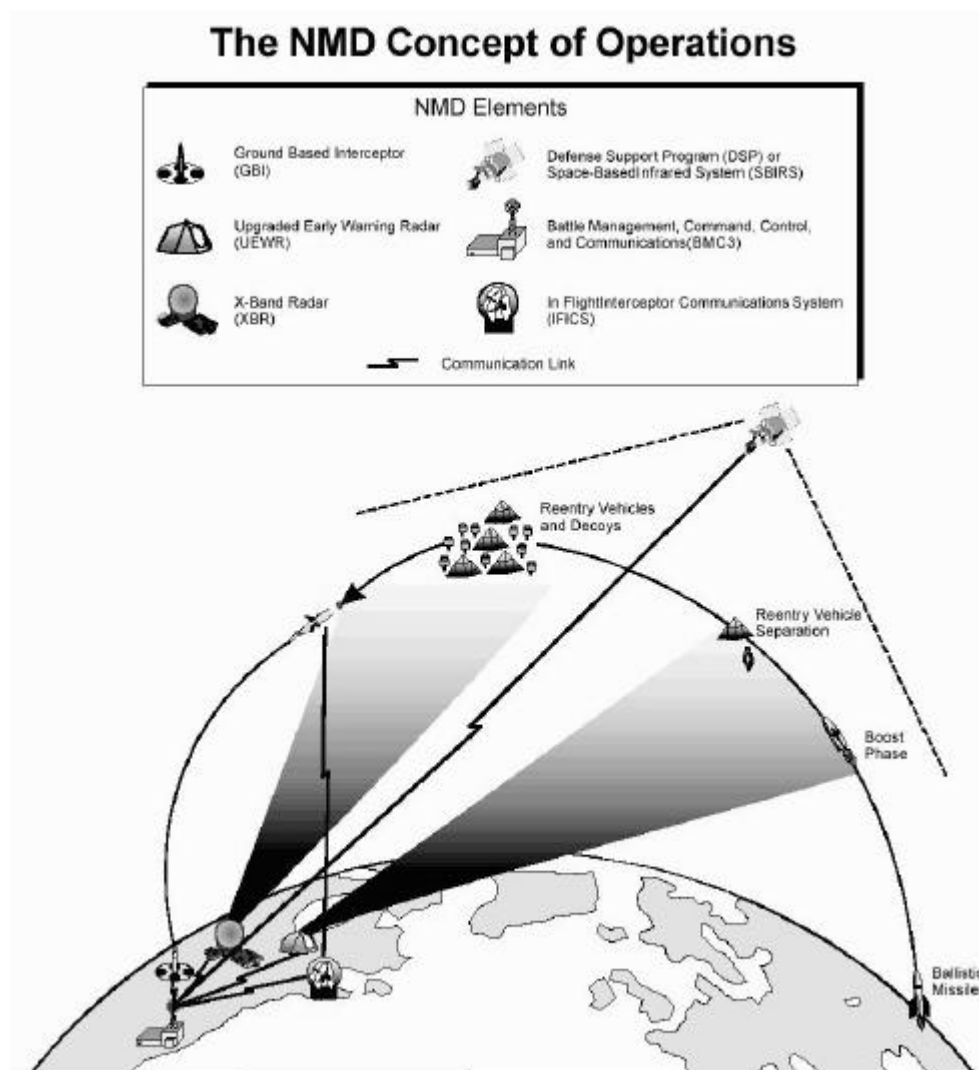
³ See e.g.: American Physical Society, *Report to the APS of the Study Group on Science and Technology of Directed Energy Weapons* in: *Review of Modern Physics, Vol. 59(3) Part IIK*, 1987, pages 1-201

⁴ George Lewis: *The U.S. "3+3" NMD Program and the ABM Treaty*, in: *INESAP Information Bulletin*, No.16 November 1998, p. 26-29

1.2 Purpose And Architecture of National Missile Defense

It is intended that the territorial NMD system would defend all 50 US States, i.e. including Hawaii and Alaska, against a limited ICBM strike.⁵ The system would comprise the identification of incoming missiles, discrimination, battle management, and interceptor navigation. This complex process would require the integration of a large variety of sensors, communication facilities, and the actual weapon systems. In addition it is planned to integrate the mobile missile defense systems THAAD (the Army's Theater High Altitude Area Defense system) and Navy Wide Area and to link all sensors and interceptors in a network.

The planned NMD system's architecture would consist of ground-based and space-based components.



Source: Ballistic Missile Defense Organisation

⁵ FY 1998 Annual Report of the Director, Operation Test & Evaluation, submitted to Congress, February 1999

1.2.1 Ground-Based Components

The system focuses on the interception of incoming warheads well above the earth's atmosphere. In order to intercept successfully, it is of vital importance to detect the target early, to track its path with high precision, and to guide the interceptor missile which would be ground-based for the time being.

Table 1: Ground-Based Components

Ground-Based Interceptors (GBI)	Ground-Based interceptor missiles which would be deployed in silos and guide an "Exoatmospheric Kill Vehicle" to the warhead by means of infrared sensors.
Upgraded Early Warning Radars (UEWR)	The existing radars at five sites (California, Massachusetts, Alaska, Greenland, and UK) would be upgraded as the existing radars are not precise enough to guide the interceptors to the incoming target. An additional radar system is planned to be located in South Korea.
X-Band Radars (XBR)	Phased-array radars would track the missile's path and discriminate targets above the earth's atmosphere. This could mean deployment of up to eight new radars.
In-Flight Interceptor Communications Systems (IFICS)	Communication between the Battle Management Center and the interceptor locations.
Battle Management Center	Interceptor Center in the Cheyenne Mountains (Colorado) for interception planning and guidance and situational awareness.

On April 30, 1998, the Ballistic Missile Defense Organization (BMDO) announced that Boeing has been chosen as the main contractor and leading 'system integrator'. Boeing's responsibility covers the integration of all NMD components as well as organizing the demonstration tests and preparing for system deployment. By mid-1998, the rocket booster for the Ground-Based Interceptor was selected. It is based on commercially available rocket stages and consists of three identical solid propellant rocket engines. The booster would accelerate the Exoatmospheric Kill Vehicle (EKV) towards targets which travel with 7-8 km/h. According to official sources, both tests of the sensor configuration - for the two EKV designs by Boeing (June 1997) and Raytheon (January 1998) - were successful. As has been mentioned above, the first real intercept test took place above the Pacific Ocean on October 2, 1999. Since then, US-Russian relations on the field of arms control have reached a low. Vladimir Yakovlev, commander of the Russian strategic missile forces is quoted by saying: "If the United States throws out the 1972 ABM treaty, they will effectively become the culprit for a disruption of the process of limiting nuclear weapons," the commander of Russia's Strategic Missile Forces, Col. Gen. Vladimir Yakovlev was quoted as saying. "All agreements that have been signed or are being prepared, will come under threat - namely, START-I, START-II and consultations on START-III."⁶

Within the next six years, approx. 20 more intercept tests are planned, but only one, however, before the deployment decision in May 2000 or later. Thus, the decision to deploy NMD is to be based on a mere three tests, although there is considerable doubt whether the system could actually comply with the requirements. First, the configuration of these tests varies from the desired configuration of the final systems. The test of October 2, 1999, was limited to the actual interceptor homing head, the EKV, i.e. it did not cover the complete system. Second, the conditions under which the tests were carried out differ significantly from realistic situations, under which the system will have to operate after deployment. Possible countermeasures (multiple warheads on each missile, decoys, shrouded warheads which are cooled and therefore invisible to the infrared sensors, etc.) have not been

⁶ *Russia Warns U.S. of Arms Race.* AP, Oct 05, 1999

included. Furthermore, the reliability of the system as a whole has so far not been analysed. By the way: even if the system met the required 95% reliability against 20 incoming warheads, this would still mean that one nuclear bomb would hit. And ballistic missiles are just one part of the nuclear threat potential. Other carriers like ships or airplanes would not be detected by the NMD system.

The Pentagon declared that it assumes deployment as soon as one of the three tests planned before June 2000 has been successful. As this criterion has already been fulfilled by the first test, the decision in June 2000 will obviously not be based on technological but on political criteria.

1.2.2 Space-Based Components

Tracking of warheads beyond the horizon requires numerous low earth orbit satellites. The system would therefore be integrated into a Space and Missile Tracking System (SMTS) which would consist of existing and projected early warning satellites. Since 1970, Defense Support Program (DSP) satellites have been deployed to detect missile launches from a geostationary earth orbit. As part of the Space-Based Infrared System (SBIRS), up to 30 satellites are needed for this task. Four SBIRS-High (high earth orbit) are to replace the existing DSP satellites. Approx. 16 SBIRS-Low (low earth orbit) are to identify missiles from lower earth orbits. Thus, the system would allow tracking the complete path of a ballistic missile. It is planned to deploy the SBIRS-Low satellites in 2004. Moreover, the SMTS system would not only support the homeland defense of the US but also mobile missile defenses in the individual theaters (Theater Missile Defense, TMD.) Development of the SMTS infrared satellite concept and its deployment is estimated to cost the US\$ 5 billion. *Table 2* gives an overview of the sensor systems which are planned to be deployed in space.

Table 2: Existing And Planned Space-Based Sensors⁷

System Name	Main Contractor	Type of Infrared Sensors	Earth Orbit	Number	Planned Deployment
Defense Support Program (DSP)	TRW Inc.	Short-wave	Geostationary	4-5	Early 70s
Space-Based Infrared System (SBIRS-High)	Lockheed Martin Missiles and Space Co.	Short- and medium-wave near-visible	Geostationary	4	2002
			High earth orbit	2	
Space and Missile Tracking System (SBIRS-Low, formerly called Brilliant Eyes)	TRW/Hughes vs. Boeing/ Lockheed	Short-, medium-, and long-waves	Low earth orbit	16-24	2004

⁷ David Mosher: *The Grand Plans*, in: The Institute of Electrical and Electronics Engineers: Spectrum, Special Report, September 1997, p. 35.

Development of the NMD architecture is planned in three steps:

Table 3: Three step deployment patterns of the NMD architecture

Pattern Name(IOC)	Purpose	Possible Deployment	Space Component
Capability 1 (2003)	Defense against 'rogue states' with a small number of targets (five warheads) without or with ineffective countermeasures	20 interceptors in Alaska and one X-band radar in Shemya (Western part of Alaska's Aleutian Islands)	DSP SBIRS-High
Capability 2 (2005)	Defense against 'rogue states' and small accidental or unauthorized launches with a small number of targets (five warheads) and effective countermeasures (20 decoys)	100 interceptors in Alaska and three additional X-band radars in Alaska, Greenland, and UK including SBIRS satellites	DSP SBIRS-High SBIRS-Low
Capability 3 (2010-2015)	Defense against 'rogue states' and small accidental or unauthorized launches with many targets and effective countermeasures	125 interceptors or more in Alaska and North Dakota, resp., and five additional X-band radars in South Korea, California, Massachusetts, Hawaii, and South Korea	SBIRS-High SBIRS-Low

The first 100 NMD interceptors are intended for deployment in Alaska. As the whole US territory is to be protected, deployment in Grand Forks (North Dakota) and other locations would be required and is being considered in long-term planning. Grand Forks is also the designated building site for the main radar system (Ground-Based Radar, GBR.) A prototype based on the THAAD system technology (see *Theater Missile Defense*) has been built on the Kwajalein Atoll in the Marshall Islands (Pacific Ocean.) To allow tracking of the complete path of an incoming missile, the existing early warning radars of the US are currently being updated and improved. The same applies to the systems in Thule (Greenland) and Fylingdales (UK) as well as Clear Air Station (Alaska.) Possibly, more Forward-Based Radars (FBRs) will be deployed in Alaska or at the US east or west coast.

1.3 Theater Missile Defense

Currently, US missile defense research still concentrates on Theater Missile Defense (TMD) intended to safeguard against tactical missiles. These systems, however, are planned to become effective enough to also intercept strategic weapons. This is one point where the ABM Treaty is affected.

Five TMD systems are being developed concurrently. The radar-guided defense system for low altitudes which is designed for point defense on the battlefield – originally intended for air defense (PATRIOT, MEADS) – is being upgraded. In addition, the Theater High Altitude Area Defense (THAAD) system is being developed for area defense. THAAD is projected exclusively to defend against ballistic missiles and is also required to intercept medium-range missiles: It enables the U.S. to initiate interception inside and outside the atmosphere by firing several interceptor devices. Furthermore, the navy is working on a shorter-range TMD system (Navy Area Defense) which would be deployed on US Aegis cruisers as well as on a comprehensive longer-range defense system (Navy Theater Wide Defense.) Sea-mobile missile defense implies a high measure of world-wide mobility and would for the first time assign missile defense tasks to the Navy.

On top of that, the US Air Force plans to develop and deploy the Space-Based Laser (SBL) which is designed to destroy missile warheads from a maximum distance of several hundred km. Work on the SBL is funded with approx. US\$ 30 million each year. Deployment of a system like this is clearly prohibited by the ABM Treaty. First SBL tests are planned for 2005-2008.

Within the framework of its Boost Phase Intercept program, the US Air Force conducts studies and experiments to defend against incoming tactical missiles: the Airborne Laser (ABL) is designed to intercept missiles in the boost phase (10-20 km above ground.). This chemical lasers would be installed on seven Boeing 747-400 airplanes. An 'in-flight kill test' is planned for 2002. The decision on ABL production is expected for 2003. So far, research and development amount to US\$ 1.1 billion. Costs for deployment in 2006 are estimated to amount to US\$ 10 billion. Each ABL plane would cost about US\$ 1 billion.

1.4 The Essence of the ABM Treaty and Compatibility With the Planned Systems

In the past the Clinton' administration pointed out that the ABM Treaty permits deployment of up to 100 interceptor missiles. Article I(2) unequivocally imposes on the parties to the treaty (i.e. Russia and the US) "not to deploy ABM systems for a defense of the territory of its country and not to provide a base for such a defense.". Although the treaty permits each side to deploy a maximum of 100 interceptor missiles "within one ABM system deployment area", it refers only to defense of an 'individual site'. The NMD system, on the contrary, has the purpose of defending the whole US territory including Hawaii and Alaska. Considering the design of the complete NMD system and the NMD budget for the next five years, an amendment to the ABM Treaty has become inevitable.

Article III demands that a party to the treaty should deploy all 100 ABM systems including the radars "within one ABM system deployment area having a radius of one hundred and fifty kilometers", i.e. it permits deployment at a 'single site'. On closer inspection, all NMD systems currently under discussion are 'multiple site' systems: in order to detect and track an incoming missile early in the boost phase, they depend on forward-deployed radars and on the space-based SMTS system. The treaty prohibits 'upgrading' of the early warning radars to bring them up to ABM requirements just as it prohibits the deployment of ABM radars outside the own national territory and the use of space-based components for missile defense. Compatibility with the ABM Treaty (Article III) would restrict deployment to a maximum of 100 interceptor systems in Grand Forks (North Dakota). Deployment of additional systems in Alaska would be in contrary to the provisions of the ABM Treaty. In addition, the treaty limits the number and type of radars.

Article V prohibits the parties "to develop, test, or deploy ABM systems or components which are sea-based, air-based, space-based, or mobile land-based." Article VI limits deployment of radars to "locations along the periphery of its national territory and oriented outward." However, all projected X-band radars are 'forward-deployed' and would therefore not conform with the treaty. Modernization of the early warning radar would be compatible with the treaty (Article VIb), not however installation of a new radar in South Korea. Implementation of a global space-based network of early warning and tracking satellites (SBIRS-Low) would not be in agreement with the ABM treaty as it is designed to replace existing systems by a space-based ABM radar - which is prohibited according to Article Vb. Of the deployment patterns C1-C3 (see *Table 3*), only a modified C3 variant would be ABM compatible, where 100 interceptors and an early warning radar could be deployed in North Dakota. All additional ground-based interceptors and X-band radars would have to be renounced.

It is not even convincing to argue that the plans compromise just a "thin defense" which would give effective protection against so-called 'rogue states' (North Korea, Iraq, etc.) and accidental or unauthorized missiles but not against a massive use of the Russian strategic arsenals. First, current NMD plans would create a basis which could be extended at any time. Second, by overlapping NMD and TMD, a "tighter" defense could be implemented within a very short time, even more so as the various TMD systems are particularly designed for integration into a network. Even if deterrence were still assured for the time being, military planners in Russia or China would have to take into account that their deterrence arsenals might become obsolete.

It is true that 100% defense is just as impossible now as it has been at times of the initial SDI program. However, uncertainty would force a potential adversary to assume a high effectiveness of the NMD system. This would result in a renewed arms race or in the maintenance and strengthening of existing delivery systems in Russia, China, and India.

Indeed, nuclear disarmament as undertaken in the START framework is inconceivable without ABM restrictions. Strategic weapons could only be reduced when all parties involved are certain that even a small number of nuclear warheads would suffice to effectively counteract a massive attack. As soon as one party might protect itself against the retaliatory strike by means of a missile defense system, this stability is threatened.

1.5 Conclusion

- The Clinton administration will not specify the final NMD system architecture until deployment has been decided on.
- The deployment decision is planned for October 2000. It depends on a) the threat development, b) the impact on arms control, c) the costs and d) the technological feasibility 'in principle', not, however, on the 'operational system features'. The decisive factor will be political arguments, not technological and functional system maturity.
- The threat by 'rogue states' cannot be completely eliminated by implementation of a missile defense. On the other hand, sufficient preventive diplomatic measures are in place and warning time is adequate to decrease the assumed threat.
- The planned NMD system architecture is not compatible with the provisions of the ABM Treaty. It might be possible to amend the ABM Treaty, but any such agreement would likely be rather dictated by the dynamics of the US deployment decision than by cooperative measures, disarmament, and regional arms control.
- Fundamental nuclear arms control would be seriously complicated and might even break down. From a point of deterrence theory the most effective countermeasure against defensive systems is to modernize and increase offensive nuclear arsenals.
- Preventive measures like further nuclear disarmament, regional arms control, and containment of missile proliferation provide a higher level of security than implementation of an NMD system. It is easier to strengthen offensive components (at the price of further disarmament) than to strengthen a global missile defense which covers only part of the potential threat scenarios.

Translated by Regina Hagen.

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