EXECUTIVE SUMMARY

This study provides a comprehensive overview of national missile defense (NMD) issues now under discussion. Threats, arms control issues, missile defense technologies, the current NMD program, and NMD alternative options are all discussed. Chapter 6 contains the findings and recommendations that point out the strengths and weaknesses of the programs and policies now being pursued and set forth new concepts for NMD as part of broader national security policy.

Chapter One: Introduction

The post-Cold War international security environment has solidified into a unipolar structure, a condition many states would like to change. A key factor in the current proliferation movement is the overwhelming military superiority of the United States. The unintended consequence of successful U.S. military actions from the Gulf War through the Kosovo air campaign has been to convince other states that conventional weapons alone cannot check U.S. power. This observation is leading a number of states to focus their military procurement efforts on the acquisition of asymmetrical military capabilities. As a result of this shift in focus, the major security challenges that the United States itself is most likely to face during the next decade or two include:

- A terrorist-style threat using WMD
- Long-range cruise missile threats
- Information warfare attacks (to include threats to space assets)
- Ballistic missile attack or threat of attack with WMD payloads

In addition, as new states join the missile club, neighboring states are becoming concerned; some are acting to develop their own retaliatory capabilities. Consequently, proliferation rates are increasing with some of the activity being conducted by U.S. allies. As more states join the missile club, the number of potential suppliers of missile technology also grows.

If the United States is to enjoy some measure of security in the years ahead, each of these potential threats must be countered. Of the potential threats listed, ICBMs are the only lethal capability that can be used to threaten (directly or indirectly) another sovereign state on a global scale without deployment to a forward location--a movement that would signal escalation, perhaps leading to war. Ballistic missiles are also the only potential threat for which there are no countermeasures now available other than retaliation or preemptive strike (see figure 1, p. vi).

Missile and WMD technology transfers are an increasingly important factor in the post-Cold War security calculus. Both Russia and China have lost central control over many of the industrial activities on their soil; both states also have a declared policy to work together to bring about a multipo-

lar international structure. *The clear implication of such a policy is that the United States must be weakened and additional centers of power must be established if a multipolar structure is to emerge. Russian and Chinese actions of both omission and commission reflect such a strategic goal.*

During the years ahead, it is likely that Russia will continue to lose military capability as it struggles to revive its economy. Although Russia's large nuclear arsenal will ensure that it remains the largest potential threat to U.S. security for many years to come, the threat of a Russian missile strike against the United States has greatly diminished. With little to gain and much to lose from a nuclear strike against the United States, the principal threat of such an attack from Russia would be as a result of a false alarm of incoming U.S. missiles or an accidental launch of one or more Russian missiles.

In the case of China, Beijing's missile development activities point toward the future emergence of a strategic strike force larger than the two-dozen ICBMs it is reported to have deployed as of the end of 1999. The new ICBMs and SLBMs are expected to be equipped with multiple reentry vehicles that China is now developing. These activities point toward the possible deployment of several hundred strategic warheads by 2010-2015. What is more disturbing is an evolving Chinese viewpoint that sees nuclear weapons as usable warfighting systems. This view is tied to some Chinese postulations that future nuclear exchanges could involve limited nuclear strikes and proportional counterstrikes (e.g., a Los Angeles for Taipei scenario). Under these conditions, the side with the greatest resolve would win.

As detailed in Chapter 1, missile technology is spreading around the rimlands of Eurasia. It is clear that the United States and many of its allies are or will be threatened by these systems in the future. Unless some event occurs to change the current trend, Russia, China, and North Korea will continue to proliferate missile technology and related hardware to other states during the coming decade. If North Korea successfully develops a three-stage ICBM, it should be expected that the missile would not only threaten the U.S. from North Korea, but likely would be exported to other rogue states. Clearly, the ability of additional countries to threaten the U.S. with ballistic missiles would make it increasingly difficult for the world's remaining superpower to defend its national interests, including: maintaining global

The New Strategic Setting

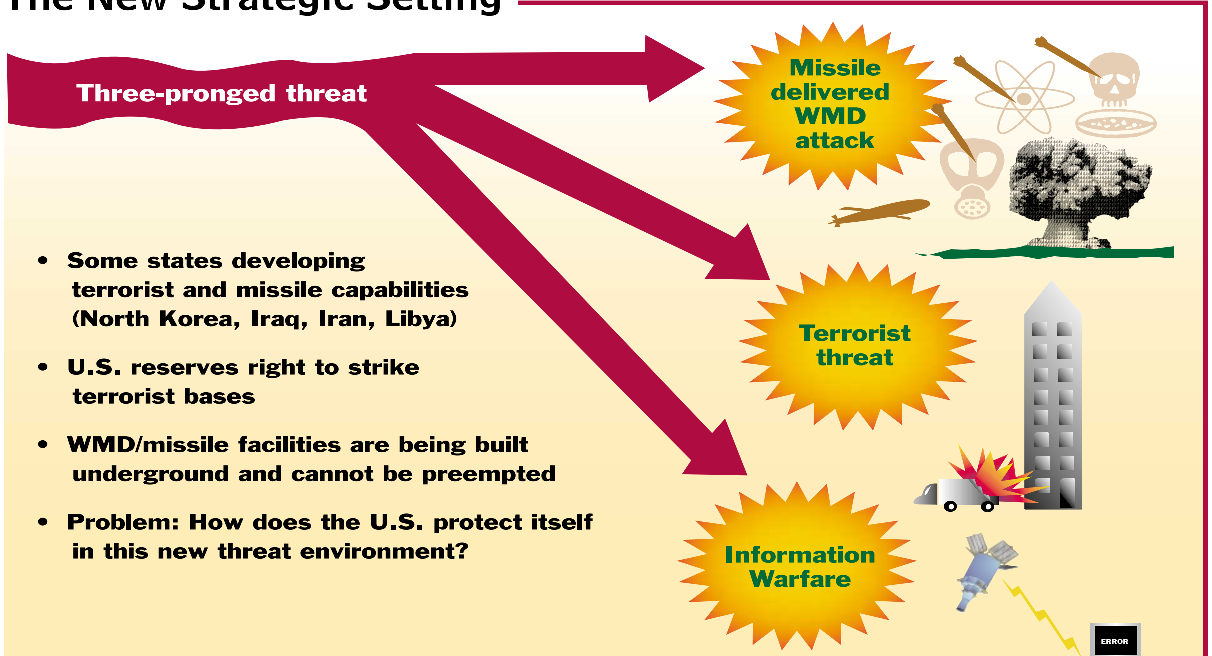

Figure 1

stability, slowing the rate of WMD and missile proliferation, protecting access to oil, deterring terrorism, and providing believable security guarantees to allies.

Chapter Two: U.S. Policy: The Arms Control and NMD Dichotomy

For better or worse, many of the legacy arms control agreements of the Cold War era are crumbling, and U.S. policy makers are divided on how to respond. U.S. security policy is caught between shoring up weakened arms control regimes and establishing a national missile defense, the type and extent of which is subject to disagreement. The compromise language used in the National Missile Defense Act of 1999 supporting both NMD and continued negotiated reductions in Russian nuclear forces reflects this dichotomy. There is a possibility that the lack of policy consensus on how to proceed in the future could produce the worst of both worlds: a fig-leaf NMD system coupled to an obsolete arms control structure, with neither being capable of dealing effectively with evolving proliferation challenges.

The ABM and START treaties are intertwined with the NMD deployment decision. Russia has tied its continued participation in the START treaties to U.S. adherence to the ABM treaty. Russia also promises to negate the effectiveness of any U.S. NMD system deployed by improving its own offensive capabilities. Russia's position is clearly part of a diplomatic offensive designed to persuade the U.S. not to deploy an NMD system.

The Russian *Duma* had long resisted START II ratification, primarily because of that treaty's prohibition on multiple reentry vehicles on ICBMs. To field the START II force structure would require that Russia build about 1500 new missiles to replace those systems becoming obsolete and to carry the single-warhead payloads specified by the treaty (see page 2.6). Currently, the production rate for Russia's new SS-27 ICBM is about 10 missiles per year. To maintain strategic parity with the United States, Russia hopes to drive the START III warhead limits to much lower levels than the U.S. has indicated it is willing to accept. Russia also wants START III to allow three or so multiple warheads to be mounted on the new SS-27 ICBMs. However, the United States had refused to begin START III negotiations until the START II treaty was ratified by Russia.

The *Duma's* ratification of the START II treaty on 15 April 2000 contains some "poison pill" provisions that will likely prevent that treaty from entering into force, while still ensuring that START II will create more obstacles for the U.S. NMD deployment decision process. Russia's START II ratification stipulates that the treaty not enter into force until the United States ratifies the 1997 ABM Treaty demarcation agreements and the START II extension protocol. The U.S. Senate has previously signaled that it would not ratify the demarcation agreements if the administration submitted them to the Senate for a vote. In addition, the *Duma's* START II ratification also contains a declaration making U.S. failure to abide by the provisions of the ABM treaty a provocation that would cause Russia to withdraw from the START II treaty.

China also poses a potential problem in that it could react to the deployment of an NMD system by building up its strategic missile forces and increasing its rate of missile technology transfers to other states. Since the U.S. engagement policy is designed to lead China toward a peaceful transition to a democratic system, the United States clearly would like to avoid pushing China toward proliferation activities certain to raise Sino-American tensions.

In trying to resolve the U.S.-Russian dispute over START and the ABM treaty, at least four potential U.S. courses of action have been suggested (specified on pages 2.7 to 2.11):

1) Terminate the ABM treaty (two methods)

2) Negotiate the minimum treaty changes needed for an initial NMD deployment

3) Subsume the ABM issues into the new START III negotiation

4) Unilaterally reinterpret portions of the ABM treaty

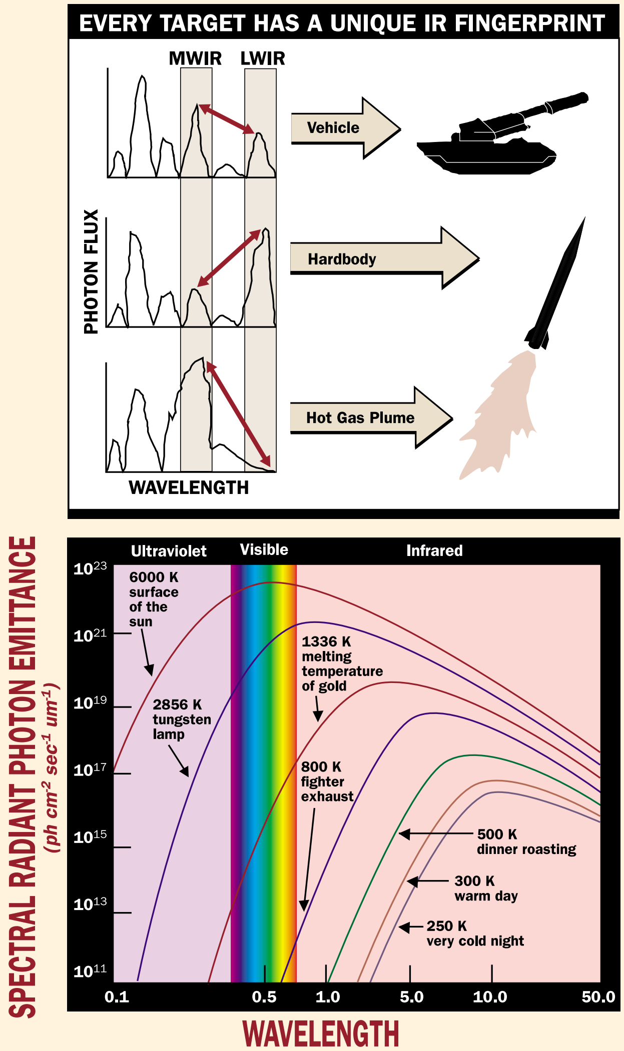

Figure 2

The Clinton administration has followed option two, but it also finds option three attractive. The main problem with option two is that it sets up the NMD issue to be a continual source of friction in U.S.-Russian relations for years to come. Each time the ABM treaty must be modified to respond to a changing threat situation, the treaty will have to be renegotiated.

A potential pitfall in the above situation is that Russia clearly wants to maneuver the United States into a START III negotiation that would reduce strategic nuclear warhead levels to 1000 reentry vehicles (the U.S. does not want to go below 2000 RVs). Convincing the United States to reduce its START III warhead ceiling to a level below 1500 warheads would weaken the United States' strategic capabilities to a point that might be challenged by China (it has the fissile materials needed to match such a level). Since a bilateral agreement would only apply to Russia and the United States, it would do nothing to slow proliferation activities around the globe, and it could contribute to the emergence of additional centers of power capable of asymmetrically challenging the United States' military capabilities.

Russia's apparent preferred outcome to the ABM and START issues outlined above would bind the United States in a bilateral agreement at a time when the world is changing dramatically. If the United States entered such an agreement without any accompanying restrictions on Russian, Chinese, and North Korean global proliferation activities, or on the strategic development programs of states such as China, the United States could find itself in an increasingly precarious security situation. At the heart of the issue is the pressing question, what is the underlying U.S. policy for dealing with both proliferation and excessive U.S.-Russian nuclear capabilities? Much of the current debate focuses on one or the other side of this issue, but both fail to address the entire problem: how should arms control and NMD fit together to maximize U.S. security?

Chapter 3: Understanding NMD Technology

The policy deliberations over how to handle the issues cited above have incited a disagreement over the technological readiness of the NMD program. As a result, the policy community has become engaged in a debate that encompasses technological questions outside the boundaries that normally delineate strategic policy deliberations. Consequently, this chapter reviews penetration aid (penaid) options, explains how infrared and radar technologies work, and describes the capabilities and functioning of each of the NMD components. It is recommended that policy makers take some time at least to skim this chapter since the material is not easily summarized.

There are three points discussed in this chapter that warrant special attention:

- The critical NMD technologies are the sensors and processing systems that link them together. The sensors being developed for NMD use infrared (IR) and radar (microwave and laser) technologies. *The highest degree of target-array discrimination occurs when the data from both IR and broadband, high-frequency radar are fused together into a composite picture of a target array. It is much easier for offensive-missile engineers to develop countermeasures against a single type of sensor than it is to defeat two different sensor types that are working together.* For example, an effort to decrease an IR signature can result in making the object more visible to radar. *Under current plans, this dual radar-IR discrimination capability will not be deployed and made operational until the initial NMD system is upgraded around 2010* (some of the technology needed for the upgrade is still being developed).

- If an IR sensor only measures the signature of a target array using a single IR color (one wavelength), it could easily be spoofed because the sensor would tend to identify the brightest object in the target array as the reentry vehicle (the object with the most intense signal--it might be a flare). *To discriminate a complex target array requires a multicolored IR sensor.* All objects in the universe emit a distinct IR signature--see figure 2. To plot the signatures requires IR measurements in multiple colors. In addition, the sensitivity of the IR sensor and its optical system determine how far away cold body objects can be detected. This is a critical issue in terms of determining the effectiveness of the proposed interceptor system--see figure 3. In assessing alternative NMD systems, the internal capabilities of various kill vehicles must be understood (e.g., the relative capabilities of a LEAP kill vehicle versus the EKV).

- A number of technologies must be developed if the NMD system is to have the robust capabilities needed for the future. This is especially true of technologies capable of defeating early-release submunitions, for example. Unfortunately, only about one-third of the technology development projects critical to future NMD capabilities are now being funded. This issue is discussed on pages 3.29 to 3.31.

Divert Envelopes Figure 3

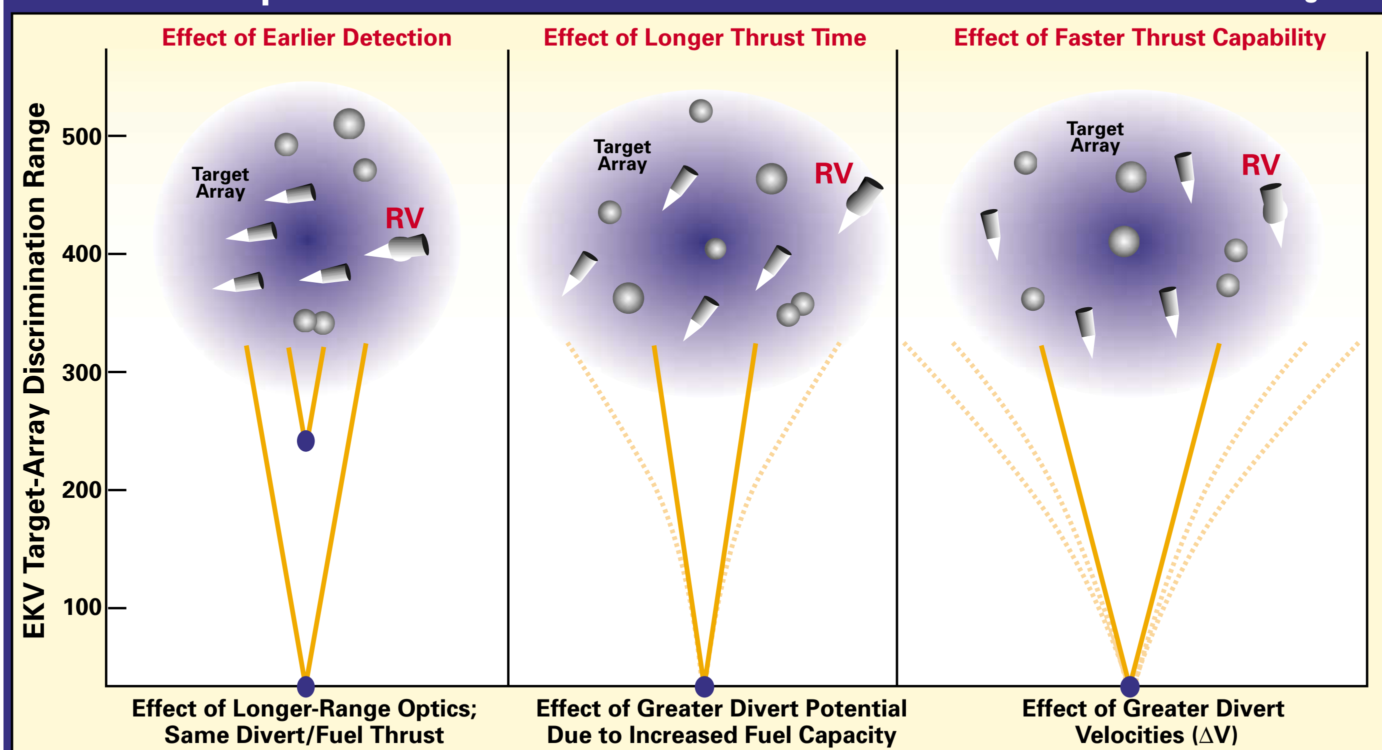

Figure 4

Chapter 4: The NMD Program

The current program would establish an initial 20-interceptor capability in Alaska by 2005, expand it to 100 interceptors by 2007, then upgrade the capability with additional X-band radar systems and by establishing a second site with another 100 or so interceptors (probably at Grand Forks, ND) around 2010-2012. The sites being considered for the radar and the communication systems are shown in figure 4. As noted earlier, the initial NMD system will not be fully capable of handling advanced target arrays. It is designed to defeat the capabilities of emerging missile powers and to field a system that can be upgraded to destroy more complex target arrays in the future as some needed technology is further developed.

If an accidental launch of a complex missile should occur prior to system upgrade, it would require the expenditure of many or perhaps nearly

all of the interceptors deployed in Alaska to try to defeat that level of threat. The rule is that all objects (RVs or decoys) that cannot be determined to be a decoy must be treated as a target for destruction. A complex target array would likely have some decoys that could not be resolved. However, once the NMD system is upgraded around 2010, it should be capable of defeating complex target arrays using fewer interceptors. Meanwhile, the effort and resources expended to field the initial NMD capability would not be wasted since it would be a step along the path leading to the advanced NMD capability.

NMD testing. Although most policy makers are focused on the record of hits or misses being produced by the NMD flight-test program, it is the integration of the components and the capability of the system to discriminate the target array that are the more critical challenges needing resolution early in the development effort. In the first two flight tests, the sensors were exposed to target arrays of medium complexity to assess their capabilities to determine the differences between the elements of the array.

The first flight test that attempted an intercept was successful against a simple target array composed of three objects: the booster, a balloon, and the RV. The array incorporated a key discrimination test in that the signatures of the items in the target array had been altered so that the RV was the smallest object in the array and, contrary to the normal signature situation, it was also the coolest object in the sensor's view (rather than the warmest). Although there is some dispute over the success of the mission, the EKV hit the correct target even though a human error in loading the star map put the EKV off course when it reached the predicted intercept area.

In test four (the second intercept attempt), moisture contaminated one of the cryogenic gasses (krypton) used to pre-cool the IR focal plane. Ice formed, plugging a small opening in a routing pipe preventing the focal plane from being cooled sufficiently for its IR sensor to function. Gradually, the lessons taught by these types of problems will result in product and procedural improvements needed to ensure consistent hit-to-kill success. The more challenging issue is whether or not the EKV can discriminate among the objects in a

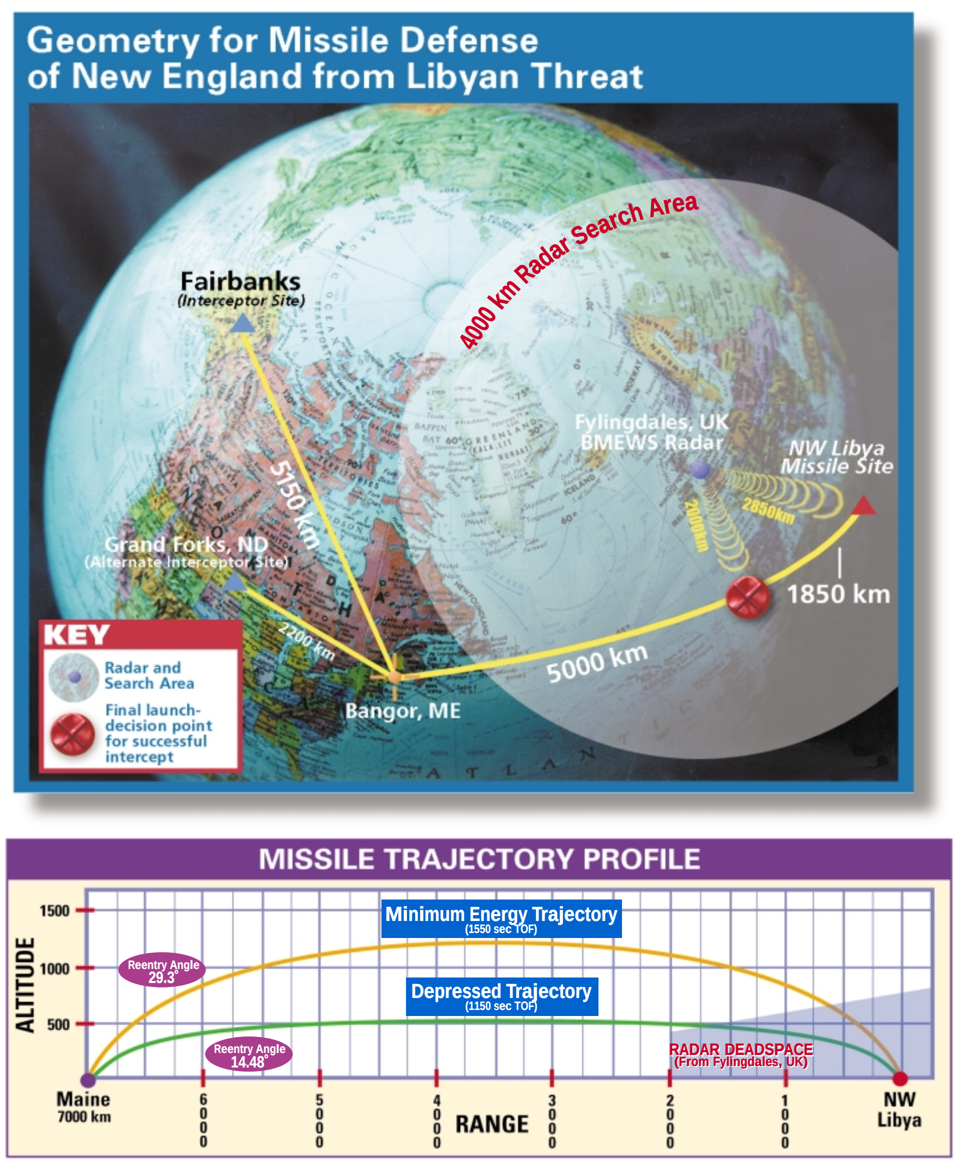

Figure 5

target array consistently. Other challenges associated with the testing program are discussed on pages 4.14 and 4.15.

NMD system capabilities. The initial single-site defense will rely entirely on the EKV for target-array discrimination. Due to the flight distances that will be involved in many of the potential intercept attempts, the battle manager will be forced to use salvo-launched tactics in many of the scenarios examined. For example, a Libyan missile launched toward Bangor, Maine would follow a trajectory 6850 kilometers long. It is 5150 kilometers from Fairbanks to Bangor. Obviously, if the first interceptor missed the Libyan missile, there would not be enough time for a second shot. Thus, four or more interceptors would have to be dispatched in a rippled salvo soon after the missile's launch was detected. If the first interceptor connected, the follow-on systems would be wasted. A similar situation would exist if a second interceptor site is established at Grand Forks, North Dakota (see figures 5, p. xi, and 6).

Two Ways To Achieve An Intercept

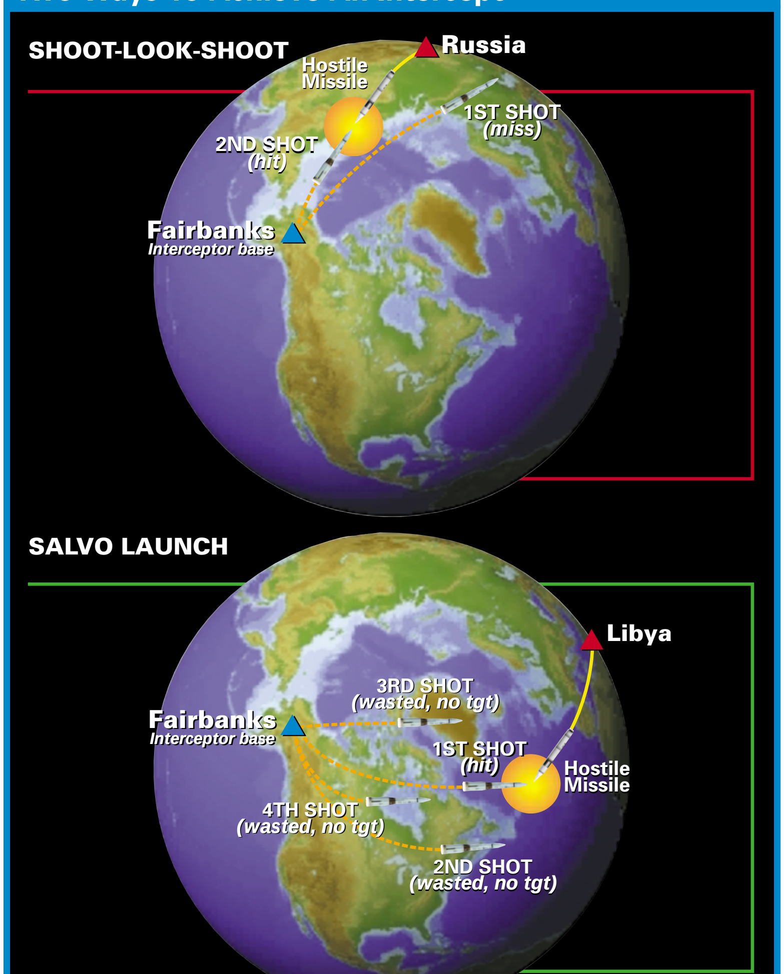

Figure 6

If the United States wanted to increase its NMD capabilities, it would need to increase the number of potential engagements that would use shoot-look-shoot tactics. Such tactics would allow the fielded missile force to defeat a greater number of offensive systems than would be the case where salvo-launch tactics are common.

Chapter 5: Alternative NMD Proposals

Three alternative NMD proposals are discussed:

- Boost-phased interceptor for land-basing
- Navy NTW system for use against ICBMs
- Space-based laser (SBL)

Boost-phase intercept. A boost-phase intercept system would attempt to hit the missile while it is still boosting. Current midcourse kill-vehicles cannot target a missile while in boost-phase (the intense IR energy blinds the sensor). It has been proposed that a 8 to 8.5 kilometers per second (kps) missile with a boost-phase-capable seeker be developed for land-based deployment. The proposed system would be able to defend a footprint of 800 to 1000 kilometers (figure 7), thus requiring basing rights in a host country (e.g., Russia, Turkey, or Ukraine).

The potential drawback of such a system is that when the boosting missile is struck, its payload may not be destroyed. In some cases, its payload could fall to earth, possibly detonating in the country hosting the interceptor base. Consequently, it is questionable whether or not many countries would be willing to have such a base on their territory. Although its engagement footprint would be smaller than that of the land-based option discussed in the foregoing (due to the slower flyout velocity of its missile), the possibility of basing such a capability at sea on *Aegis* ships needs to be

explored -- discussed in Chapter 6.

Powered Flight Profiles of North Korean 250 Second Burn-Time ICBM and Russian-US 100 Second Burn-Time Ground-Based Interceptor

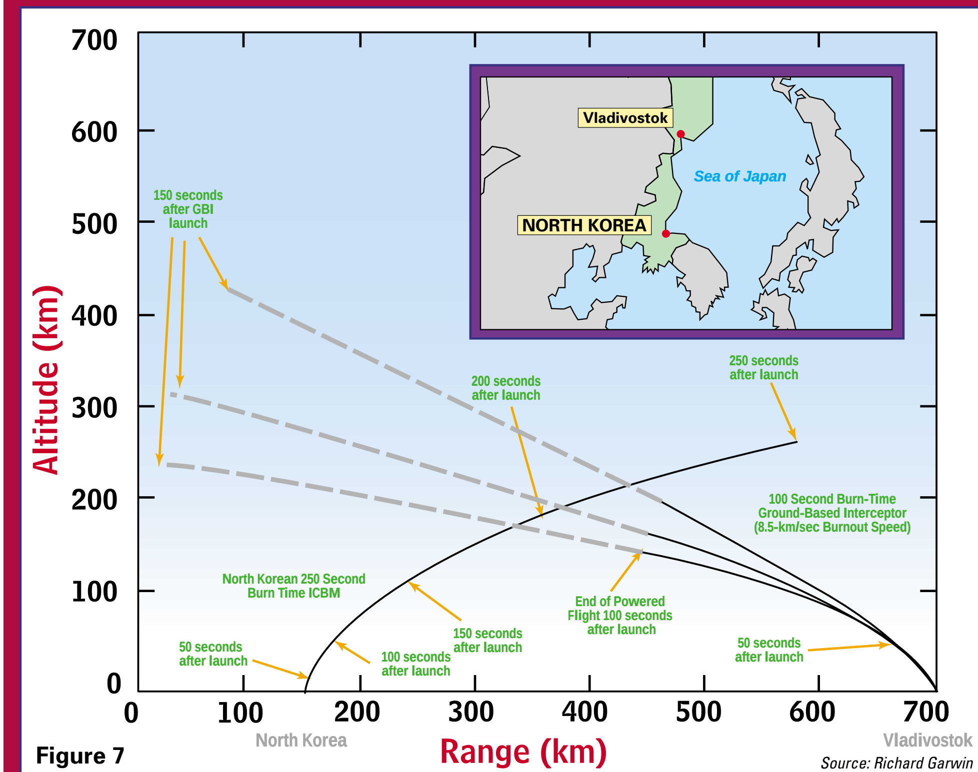

Figure 7

Sea-based NMD system. Another alternative proposal is that the Navy Theater Wide (NTW) missile defense program be accelerated and substituted for the land-based NMD system. The argument has been used that since a missile-launch system already exists in the navy's *Aegis* ships, the U.S. should capitalize on that sunk investment--a proposal that minimizes the fact that the launch facility is far less important to than is the global network of the sensors, processors, and communication assets. In addition, there is still much work that needs to be done before the navy can deploy its NTW Block II capability. Even after its 4.5 kps interceptor is developed, the single-colored LEAP kill vehicle (operating at a velocity that is slower than that of ICBM-class missiles) would produce an NMD capability inferior to that being developed for the land-based system. Clearly, the NTW system has great potential for use as an NMD augmentation asset, but inherent limitations prevent its use as a replacement system for the current program without sacrificing missile defense capability (see pages 5.4 to 5.13).

As the navy's Block II NTW system is developed, it should be optimized to perform midcourse ascent-phase intercepts within the limitations of the system. Such a capability could act to thin a missile attack; it would also add an additional capability to discriminate the target array. However, it is clear that such a capability would be location dependent.

SBL. The SBL will provide a global boost-phase intercept capability that should be able to destroy about 80 percent of ballistic-missile threats. Unfortunately, the system is unlikely to be ready for deployment before 2018 because a number of the complexity development challenges that must be solved depend upon making some technological breakthroughs, a requirement that makes the program a high-risk project. Although there may be some potential for accelerating this program, the acceleration would probably be measured in terms of a few years rather than a dramatic shortening of the development timeline. The SBL capability clearly should be pursued, but not as a potential option for near-term deployment. Its deployment will also require that policy makers first confront the issue of stationing weapon systems permanently in space.

A layered missile defense. The ultimate U.S. objective should be to establish a layered missile defense. The ability to attack a missile at several points along its flight path creates a synergy among the systems that significantly improves the overall effectiveness of the defense. The Airborne Laser and a boost-phase interceptor system--and in the more distance future a space-based laser--could be employed to destroy a missile during

boost-phase before it deploys its payload. Utilizing *Aegis* cruisers with their inherent advantage of mobility as platforms, the Block II NTW capability can be used to attack ICBMs during their ascent phase of the midcourse. The now programmed land-based NMD system should be deployed to handle payloads that are in the descending phase of the midcourse trajectory.

If or when deployed, the space-based laser would provide a highly effective defense against boost-phase missiles, but even with the deployment of that system, the terrestrial missile defense systems will still be required to destroy warhead packages that leak through the SBL's defensive shield. Consequently, the effort expended on terrestrial defenses will not wasted since they still will be required for decades to come. Although the first priority should be to establish the initial land-based NMD system, the alternative options hold promise for strengthening that defense and further decreasing the vulnerability of the United States to future missile threats. Therefore, they should be viewed not as competing systems but as reinforcing elements of the missile defense that will be needed by the United State in the decades ahead.

Chapter 6: Findings and Recommendations

- Russia and China believe that it is in their interest to undermine U.S. power and raise additional centers of power to help counter U.S. dominance.
- Present trends indicate that Russia will have a net loss in strategic missile capability in the future although it will field an increasing number of new SS-27 ICBMs.
- It is not in the interest of the United States to have Russia or China build new strategic capabilities or increase their rate of missile technology transfers to other states.
- Missile proliferation is spreading around the rimlands of Eurasia. The U.S. and its allies are or will be threatened by this movement unless it is slowed immediately.
- Although bilateral U.S.-Russian arms control agreements provide for the reduction of nuclear arms, they fail to address the problem of third-state proliferation. The ABM treaty, in particular, encourages asymmetrical proliferation activities by making it impossible for the United States to build the kind of missile defense needed to counter new missile threats.
- The land-based NMD program can provide an effective defense sooner than could any of the proposed alternatives. The issue is not the launch platform; the issue is sensors, interceptor velocities, and the global communications and processing network needed for an effective defense.
- The initial NMD system will provide an interim capability against rogue-state missile threats. Just as important, however, is the fact that the initial system provides a structure that can be upgraded as technology becomes available. It is the C2 NMD architecture that would provide the full capability to counter advanced missile threats. (Note: if a deployed NMD system will be as ineffective as its critics claim, why are Russia and China fighting its deployment so vigorously?)

The recommendations are specified on pages 6.10 to 6.14. They contain new ideas for developing a possible consensus on future U.S. security policy and the NMD question. Since these recommendations may be controversial to some, please turn to page 6.10 to read this short section with the accompanying rationale for the five recommendations cited.