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From the Sea
National Missile Defense Is Neither Cheap Nor Easy

by Charles V. Peña

Executive Summary

Sea-based missile defense is being advocated as an alternative to the Clinton administration's limited land-based national missile defense (NMD), which is in the early stages of testing. Proponents of sea-based NMD (which is only a concept, not a program) argue that such a system can be deployed more quickly and will be less expensive than the Clinton administration's land-based system. Some argue that the Navy Theater Wide (NTW) system—which is being designed to provide midcourse intercept capability against slower, shorter-range theater ballistic missiles—can be upgraded to attack long-range intercontinental ballistic missiles (ICBMs) in their boost phase (when under powered flight at the beginning of their trajectories). Interestingly enough, advocates of sea-based NMD include not only traditional supporters of missile defense but also people who were previously opposed to missile defense.

The claims made about sea-based NMD and boost-phase intercept capability should be viewed skeptically. The current NTW system does not have boost-phase capability against ICBMs. The NTW interceptor cannot be easily and cheaply modified to provide such capability. In fact, a new interceptor would have to be designed and built, and a faster, larger interceptor with boost-phase capability might not be compatible with the vertical launchers on Aegis ships. Moreover, the technological problems associated with sea-based NMD are compounded by operational issues.

Finally, sea-based NMD is really not a "national" missile defense system; it is the first step to a much larger and more expensive global missile defense system. Thus, the claims that sea-based NMD is inexpensive do not ring true. Even if initial costs of sea-based NMD are relatively low (which is a doubtful proposition), the follow-on costs to deploy space-based defenses will be significantly greater—in all likelihood by an order of magnitude or more—and certainly much greater than the cost of a limited land-based system.

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Introduction

Much debate surrounds the United States' deployment of a national missile defense (NMD) system. Supporters of NMD are generally conservatives, who have been in favor of a defense against ballistic missiles since President Reagan's famous "Star Wars" speech in March 1983.[1] Opponents of NMD, generally left-of-center politically, favor arms control and believe that the Anti–Ballistic Missile (ABM) Treaty is the cornerstone of strategic deterrence and stability.[2] Interestingly, some previous opponents of ballistic missile defense now favor the Clinton administration's proposed land-based system[3] or a sea-based system.[4] In many ways, those opposing sides have not changed their arguments in the 17 years that have passed since President Reagan started the Strategic Defense Initiative.

However, despite the recent NMD test failures, the debate is increasingly shifting to what type of system should be deployed. The Clinton administration is currently considering whether to go forward with a limited land-based system. Such a system would consist of space-based sensors, one or more new ground-based radars (and upgrades to older ones), and anywhere from 20 to as many as 250 ground-based interceptors located at one or two sites. That system is designed to defend against a limited attack (that is, tens of warheads) using hit-to-kill technology (that is, the interceptor destroys the warhead by colliding with it) to intercept warheads during their midcourse phase of flight (when they are "coasting" outside the atmosphere along predictable trajectories). The most recent Congressional Budget Office estimate for an NMD deployment consisting of 100 interceptors based in Alaska, a new X-band radar, and upgraded existing early warning radars is $30 billion ($4 billion more than the Pentagon's estimate of $26 billion),[5] which includes design, procurement, construction, and operations costs from fiscal year 1999 to FY15 (assuming an FY05 deployment).

Ardent NMD supporters who oppose the limited land-based system being considered by the Clinton administration have advocated a sea-based approach to NMD. Proponents argue that a sea-based system can be deployed more quickly and will be less expensive than the Clinton administration's limited land-based system.[6] Some argue that the Navy Theater Wide (NTW) system (which is currently being designed to provide midcourse intercept capability against slower, shorter-range theater ballistic missiles) can be upgraded to destroy long-range intercontinental ballistic missiles (ICBMs) in their boost phase (when under powered flight at the beginning of their trajectories).[7]

Interestingly enough, those supporters have now found unlikely allies among policymakers and analysts who previously opposed NMD.[8] Former Democratic defense officials John Deutch (former U.S. deputy secretary of defense and former director of central intelligence), Harold Brown (former U.S. secretary of defense), and John P. White (former U.S. deputy secretary of defense) believe "deployment of the present NMD system should be deferred" and instead favor an upgraded NTW to provide boost-phase intercept capability.[9] Richard L. Garwin of the Council on Foreign Relations, a long-time critic of ballistic missile defense, also favors a sea-based boost-phase system.[10]

Sea-Based NMD Is Problematic

Advocates of a sea-based NMD capability argue that it will be significantly less expensive than the Clinton administration's proposed limited land-based system. For example, the Heritage Foundation states that "an affordable and effective missile defense system could become operational within four years and cost less than $8 billion."[11] The claimed cost is so low because proponents would deploy sea-based NMD on existing Aegis ships (a sunk cost) and thereby avoid the construction costs (for both interceptors and radars) associated with land-based

NMD. However, it is not clear whether the cost figures cited are acquisition costs or total life-cycle costs.

On the surface, a less expensive sea-based NMD that could be deployed almost immediately sounds appealing. But the concept deserves closer scrutiny. [12]

The NTW System Cannot Perform Boost-Phase Intercepts

As previously noted, the NTW interceptor currently under development is a theater missile defense system designed to intercept slower, shorter-range missiles during the midcourse phase. The interceptor is not capable—in its current configuration—of intercepting long-range ICBMs during their boost phase. According to Garwin, for a ballistic missile to reach intercontinental range, it must achieve a velocity of approximately 7 kilometers per second (km/s).[13] The NTW interceptor travels at approximately 3 km/s.[14] One need not be a rocket scientist to conclude that a significantly slower interceptor is not going to be able to catch a faster missile in boost phase if the interceptor has to catch the missile on its way up.[15]

The problem of building a fast enough boost-phase interceptor for existing Aegis ships is compounded by interceptor size. The current NTW interceptor is being designed to fit inside the vertical launch system (VLS) on Aegis ships. A significantly faster interceptor (for example, probably one achieving speeds of at least 5.5 to 6.5 km/s)[16] would be much larger. As proof, the currently proposed land-based NMD interceptor is designed to achieve the kinds of velocities that might enable it to achieve boost-phase intercept capability, but that interceptor is much larger than the NTW interceptor and would probably not fit inside the Aegis VLS.[17] Therefore, even if a fast enough interceptor could be built, deploying it aboard existing Aegis ships would be problematic. According to Owen Cote, a national security specialist at the Massachusetts Institute of Technology, "You cannot build a big enough boost-phase interceptor . . . and put it on surface ships."[18]

If a forward-deployed sea-based NMD system (that is, one positioned near potential launch areas to achieve maximum boost-phase capability) missed a boost-phase intercept attempt, it would probably not be able to take a second shot at the warhead during its midcourse phase. Problems exist with a trailing or chasing shot—that is, the difficulty of trying to "catch a bullet with a bullet" when the target has a significant head start. That problem is further compounded by the differences between the sensor on the kill vehicle required for boost-phase intercept (which distinguishes the booster body from the rocket plume) and the sensor required for a midcourse intercept (which distinguishes a colder reentry vehicle, which contains the warhead, in space). According to David R. Tanks of the Institute for Foreign Policy Analysis, "An IR [infrared] sensor that could handle the special requirements for a boost-phase intercept would have to be developed. . . . A different type of IR sensor must be developed that can withstand intense IR energy, one that differs from those being used in the midcourse kill vehicles [that is, the sensors in the current NTW interceptors]." [19]

Currently, no program exists to develop and build a sea-based boost-phase interceptor that could be deployed aboard Aegis ships (whether as a modified NTW interceptor or a new interceptor).[20] And the bottom line is that the proposed NTW interceptor would have to be significantly upgraded just to prove the technical feasibility of a sea-based NMD capability. According to the Ballistic Missile Defense Organization (BMDO), "The interceptor would require significantly higher burnout velocity [and] better seeker performance and kill vehicle divert capability."[21]

At best, sea-based NMD is a concept on paper. BMDO believes that "deployment of a partial sea-based NMD capability while feasible, has technical risks and engineering challenges that have not yet been proven or demonstrated."[22] In contrast, the land-based NMD interceptor is currently in its initial stages of flight testing.[23] Therefore, it is high-

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ly unlikely that a sea-based boost-phase capability, which has not yet been designed, developed, and tested and for which there is no current funding, could be deployed sooner than a land-based system that is more mature, is beginning its flight test program, and is being funded. (Even the Block I NTW program—currently in development—is not scheduled to be fully deployed until 2010.)[24] According to Tanks:

> It is clear that a significant number of obstacles must be overcome before an Aegis-based NMD system could be made operational. The issues . . . also beg the question as to how a sea-based NMD system could be developed by 2004 and at a much lower cost than a land-based system, especially considering the fact that so much of the land-based sensor, communication, and kill-vehicle systems are also needed for a sea-based option.[25]

Sea-Based NMD Operational and Deployment Issues

Even if achieving a boost-phase intercept capability from Aegis ships were technologically possible in a short time, the system would have operational and deployment drawbacks. A sea-based NMD would require that an Aegis ship be positioned relatively near the potential enemy's missile launch areas. The total number of ships required would be a function of the number of potential threat nations. According to *U.S. News & World Report* journalist Richard J. Newman, "At a minimum, the Navy thinks a sea-based national missile defense network would require four to seven ships—more if round-the-clock coverage were necessary."[26]

If those Aegis ships need to be dedicated exclusively to the NMD mission (a high probability because of the inability to predict when a potential aggressor might choose to launch a missile), then at least one Aegis ship (and probably more) would need to be constantly deployed and ready to respond to a potential missile launch. According to one senior Navy official, "If you grow me missions, I need more ships."[27] Tanks notes: "If an NMD mission requiring dedicated ships is given to the navy, the navy will certainly ask for more assets to fulfill its new obligations. Thus, the assertion that the dedicated NMD mission can be carried out with existing Aegis assets appears optimistic."[28]

Because ship crews must be trained and have rest, a small fleet of dedicated Aegis ships would be needed in order to rotate ships to and from the deployment areas. According to Tanks: "At least two and perhaps three defensive areas would have to be occupied at all times. Since these ships need to be refueled and replenished, and the crews and ships occasionally need to return to home port for rest and maintenance, this requirement would create a considerable operations and maintenance burden."[29]

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Aegis ships dedicated to the NMD mission will not be available for other missions (for example, theater missile defense). Therefore, the proponents' claimed cost savings to be realized by using existing fleet resources would not be achieved. If new Aegis ships need to be built (at approximately $1 billion each for acquiring the vessels[30] plus approximately $20 million per year to operate them),[31] the cost figures cited by the Heritage Foundation are too low. The Heritage Foundation's estimate of less than $3 billion (of a total estimated price tag of less than $8 billion) for ship-related costs was based on using existing Aegis ships. Also uncertain is whether the Navy can obtain, train, and retain the requisite manpower for the added ships during a time of recruiting and retention difficulties.

Conversely, if NMD-capable Aegis ships would be used for multiple missions, then the potential exists for ships to be out of position to conduct NMD when they are tasked to perform a mission that would take them outside the patrol area for boost-phase intercept capability (assuming such capability could be achieved). For example, Aegis ships are generally tasked to provide air and cruise-missile defense, as well as offensive strike missions using the Tomahawk cruise missile. Therefore, they are usually deployed relatively close to the enemy's coastline (for example, approximately 100–200 kilometers offshore). However, according to Tanks, "To perform an NMD mission, the Aegis would have to be positioned well back from the launch site"[32]—for boost-phase intercept, perhaps 600 or more kilometers off the coast. BMDO acknowledges that "ship locations and load outs for NMD tend to conflict with those for theater missions."[33]

Another operational problem with sea-based NMD is that the system would probably need to shoot at every missile launched from a potential threat state. Given the relatively short timelines for boost-phase intercept, a theater commander would not have a significant amount of time in which to assess the potential threat and attempt an intercept. In all likelihood, the commander would need to commit to an intercept almost immediately. Yet, during the very early stage of a missile's flight, it will be difficult to ascertain the ultimate destination of that missile. The missile might not be a threat to the United States because the launch was a test or was conducted for scientific or commercial purposes. Thus, the commander might be faced with the choice of launching a provocative intercept of a potentially nonthreatening missile or losing the opportunity to intercept a missile that was poised for a catastrophic attack on U.S. soil. In contrast, the commander of an NMD system based on U.S. soil to intercept missiles in the midcourse phase would be more certain that the missiles launched were headed for the United States.

Also, NMD-capable Aegis ships deployed forward near the threatening nation could become lucrative targets to be attacked from the sea and air. Because the ships would need to be deployed forward for boost-phase intercept, they would be well within range of systems that potential enemies already possess (for example, aircraft, cruise missiles). If NMD-capable Aegis ships could not provide adequate self-defense, additional resources would have to be expended to defend them. If NMD-capable Aegis ships needed their own escorts[34] for defense, the cost of sea-based NMD would increase significantly.

Certain Trajectories Are More Difficult for Sea-Based NMD

Certain missile trajectories pose difficulties for a sea-based boost-phase intercept. Whereas a sea-based system might have some capability against North Korean missiles launched at the United States across the Pacific Ocean, forward-based ships (for example, in the Sea of Japan) would have little or no capability against a shot from North Korea to the United States along a polar trajectory.[35] Yet North Korean missiles are the most often cited threat to be countered by NMD.[36] According to Tanks, to achieve capability against polar trajectories, "at least two Aegis ships would have to be maintained on station year round, one close to Canada's east coast and the other just south of Alaska."[37] Similarly, certain trajectories from the Middle East would pose problems for ships based in the Persian Gulf and Mediterranean Sea.[38] But, after North Korea, the Middle Eastern nations (specifically, Iran and Iraq) are generally cited as the most likely emerging ballistic missile threats to the United States.[39] According to Garwin, threatening missiles that could not be intercepted from ships based in the Persian Gulf and Mediterranean Sea would require interceptors to be based on land in Turkey.[40] Thus, a sea-based system will be inadequate to deal with the very threats that are driving the requirements for national missile defense.

Because a sea-based NMD would not be able to cope with all potential threat trajectories, the system would need to be augmented with either a land-based system or space-based weapons.[41] Unlike a land-based missile defense in the United States, sea-based NMD cannot be considered a "stand-alone" system for national missile defense—which means that claims that its capability is superior to and its cost lower than those of the Clinton administration's proposed land-based system are questionable.

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Boost, Midcourse, and Terminal Intercepts

Understanding sea-based NMD is further complicated because advocates of a sea-based system are not always talking about the same thing. As previously noted, Deutch, Brown, and White are in favor of an upgraded NTW system to provide boost-phase intercept capability. Garwin also favors boost-phase intercept but proposes using an interceptor, similar to the one used in the land-based NMD system, aboard military cargo ships, as well as land-based systems in Turkey and Russia.[42] The Heritage Foundation now seems to be advocating a sea-based system for boost, midcourse, and terminal defense:

> Stationed near the coasts of potentially threatening states, these ships could intercept and destroy enemy missiles in the ascent phase—and in some cases, even in the boost phase—of their trajectory. In open seas, they could target enemy missiles in their mid-course phase. Deployed close to home or near the coastlines of America's allies, they could hit incoming missiles or warheads at the terminal phase of trajectory.[43]

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As noted previously, boost-phase and midcourse intercept will require different seekers on the kill vehicles because the targets are different. Moreover, boost-phase intercept will require forward-based forces whereas midcourse intercept will require more deployment areas further to the rear (for example, near Alaska, where the proposed land-based NMD system would be deployed). Second, intercepting missiles from the sea in all three phases would require a more extensive and expensive sea-based deployment than a handful of forward-deployed Aegis ships (especially if the ships have to be dedicated to the NMD mission). Third, the NTW hit-to-kill interceptor is currently not designed for terminal-phase intercept. A terminal-phase interceptor would likely have different technical requirements than does either a boost-phase or a midcourse interceptor. The NTW interceptor is an exo-atmospheric (outside the atmosphere) interceptor, and a terminal-phase engagement requires an endo-atmospheric (inside the atmosphere) interceptor. Finally, coastline deployment of Aegis ships will provide only minimal protection for the United States. According to Tanks:

> Aegis platforms located near the North American coasts may not be as effective as a land-based system with faster interceptors (situation dependent). Although it has been proposed that a barge loaded with interceptors be anchored in the Great Lakes to defend the central part of the nation, it is puzzling how this would be an improvement over a land-based deployment.[44]

Even though Aegis ships positioned near the coastline to defend against ICBMs would not be very effective against shorter-range missiles launched from ships against the United States, such deployment of the ships is sometimes used as a veiled rationale for sea-based NMD.[45] Those shorter-range missiles are really theater ballistic missiles and would need to be countered by a theater ballistic missile defense system. Both the NTW and the Navy Area Defense (NAD) systems to be deployed aboard Aegis ships will have such capability. However, NAD will defend an area with a radius of only 50–100 kilometers, whereas the NTW will defend an area with a radius of several hundred kilometers.[46] Therefore, in contrast with a potential NMD deployment of only one or two ships, many more Aegis ships would be needed—positioned several hundred kilometers apart along the entire coastline—to provide adequate defensive coverage.

Sea-Based NMD Is Only a First Step

Even if a sea-based boost-phase capability were technologically feasible (and that has not yet been demonstrated), such a capability is insufficient by itself; it is only a first step toward a global missile defense system, which the most ardent advocates of sea-based NMD want. According to the Heritage Foundation, "The fastest and least expensive way to build a global missile defense system would be to *begin by building sea-based defenses and then to follow them as soon as possible with space-based defenses.*"[47]

Sea-based NMD is really not a "national" missile defense system. Some proponents of the system would like to defend friends and allies around the world, not just the United States as a geographic entity. Thus, the claims that sea-based NMD is inexpensive are suspect. BMDO cost estimates also reflect the assessment that land- and sea-based NMD costs are likely to be comparable: "The cost for the land-based NMD Capability 2 architecture with 80 to 100 interceptors based in Alaska is about $13B to $14B. . . . The cost for the stand-alone sea-based architecture to protect all 50 states is estimated to be $16B to $19B."[48] But the follow-on costs to deploy space-based defenses will be significantly greater.[49] Many of the ardent advocates of sea-based NMD do not mention those additional costs for a global missile defense system[50]—giving the uninitiated reader the misleading impression that an initial and limited sea-based missile defense by itself is sufficient and can be achieved at low cost.

Also driving the need to move beyond a sea-based-only defense to a more extensive and expensive global missile defense is the fact that many advocates of NMD want a missile defense against more than just so-called rogue state threats. The Heritage Foundation states:

> Improvements in the Aegis system would be necessary to defend against more advanced ICBMs. These improvements should include a larger interceptor that has improved sensor and countermeasure capabilities *to create an effective ship-based defense against some of Russia's current-generation ICBMs.*[51]

Thus, at least some advocates of NMD cannot shake Cold War thinking and feel compelled to extend the capabilities of an NMD system beyond the emerging limited threats posed by rogue states. As stated in a previous Cato Policy Analysis:

> Clearly, we do not need to build an NMD system to defend against a Russian preemptive first strike. And although an accidental or unauthorized launch from Russia is a possibility, it does not present a sufficient threat to warrant building an expensive layered defensive system. . . . But the threat from rogue states does represent a real danger that could justify a limited NMD deployment.[52]

Conclusion

Sea-based NMD is a poor choice for a truly national missile defense system. The current NTW system cannot destroy ICBMs in the boost phase. The NTW interceptor cannot be easily and cheaply modified to provide such a capability. And a new larger and faster interceptor with boost-phase intercept capability would probably not fit in the VLS tubes on Aegis ships. Therefore, the notion that a sea-based NMD capability could be deployed quickly, easily, and cheaply is suspect. Moreover, the technological problems associated with sea-based NMD are compounded by operational drawbacks.

Although the limited land-based NMD being considered by the Clinton administration is not without technical problems (for example, the ability to discriminate between warheads and decoys), the administration's system is further along in its development and is undergoing actual testing. The technical risks can be minimized with thorough and realistic operational testing. In contrast, sea-based NMD is only a concept.

Scrapping the administration's land-based system to start over on a more technologically challenging sea-based boost-phase concept—which would have operational

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drawbacks and leave gaps in coverage—is ill-advised. The Clinton administration's limited land-based system is the best choice to give the United States a truly national missile defense at the earliest possible date and at a reasonable cost. Only that program should be continued by the next president.

Notes

1. See, for example, Sen. Jon Kyl (R-Ariz.), in "Prepared Remarks of Senators Jon Kyl, Carl Levin, and Joseph Biden at the Symposium on National Missile Defense Sponsored by the Jean and Samuel Zacher Foundation," Washington, June 27, 2000, http://www.clw.org/ef/catospeeches.html.

2. See, for example, Sen. Joseph Biden (D-Del.), in ibid.

3. See, for example, Sen. Carl Levin (D-Mich.), in ibid.

4. John Deutch, Harold Brown, and John White, "National Missile Defense: Is There Another Way?" *Foreign Policy* (Summer 2000): 91–99.

5. Geoffrey Forden and Raymond Hall, "Budgetary and Technical Implications of the Administration's Plan for National Missile Defense," Congressional Budget Office, April 2000, http://www.cbo.gov/showdoc.cfm?index=1984&sequence=0&from=7. See also Eric Planin and Roberto Suro, "Cost of Missile Shield Is Double Pentagon Estimate, CBO Says," *Washington Post,* April 26, 2000, p. A10. The estimated cost of an initial NMD deployment has steadily increased. In 1996 the Department of Defense estimate for 100 interceptors at an unspecified location was $10 billion, and the CBO estimate for 100 interceptors at Grand Forks, North Dakota, was $14 billion. Ray Hall and David Mosher, "Budgetary Implications of H.R. 3144, the Defend America Act of 1996," Congressional Budget Office, 1996. In 1998 DoD estimated $11 billion for a 20-interceptor deployment in Alaska ($9 billion in Grand Forks, North Dakota), which was subsequently increased to $13 billion. John Donnelly, "NMD Cost Estimate Up 30 Percent since Last Week," *Defense Week*, January 19, 1999. The current CBO estimate also shows that adding 150 interceptors in the continental United States would increase the system's cost to $49 billion. An additional $10.6 billion would be needed to construct and operate 24 low-orbit infrared satellites for detection and discrimination. Thus, the total cost (development, acquisition, and operation) could be as high as $60 billion for a land-based NMD system.

6. See, for example, Heritage Foundation, Commission on Missile Defense, *Defending America: A Plan to Meet the Urgent Missile Threat* (Washington: Heritage Foundation, 1999). The commission argues that "the NTW system, which would deploy interceptors from Aegis cruisers, could be built much sooner than ground-based sites and for about one-tenth the cost of building the first ground-based site for the Clinton Administration's NMD program" (p. 47).

7. Jack Spencer and Joe Dougherty, "The Quickest Way to Global Missile Defense: First from the Sea," Heritage Foundation Backgrounder no. 1384, July 13, 2000, pp. 3–7.

8. For a more detailed discussion of the various camps' reasons for supporting sea-based NMD, see Ivan Eland, "Let's Make National Missile Defense Truly 'National,' " Cato Institute Foreign Policy Briefing no. 58, June 27, 2000.

9. According to Deutch, Brown, and White, "As soon as possible, forward-deploy current systems that are configured to provide *some capability* against North Korean ballistic missiles. Deployment of an Aegis cruiser equipped with an existing missile and aerodynamic kill vehicle off the coast of North Korea can provide *modest capability for a boost-phase intercept* of a Taepo-Dong missile. This capability would be available well before the initial operational capability of the [land-based] NMD system in 2005." Deutch, Brown, and White, p. 98. Emphasis added.

10. Richard L. Garwin, "A Defense That Will Not Defend," *Washington Quarterly* (Summer 2000): 109–23.

11. Heritage Foundation, Commission on Missile Defense, p. 1. The commission estimated that less than $3 billion would be needed for Block I of an effective NTW system and less than $5 billion would be needed for a space-based sensor system. Ibid., p. 3. In contrast, the CBO estimates that the space-based sensor would cost $10.6 billion. Forden and Hall, p. 10.

12. For a more detailed discussion of sea-based NMD, see Charles V. Peña and Barbara Conry, "National Missile Defense: Examining the Options," Cato Institute Policy Analysis no. 337, March 16, 1999, pp. 16–18.

13. Garwin, "A Defense That Will Not Defend," p. 113.

14. Heritage Foundation, Commission on Missile Defense, p. 50.

15. The minimum required interceptor velocity

for a successful boost-phase engagement will be a function of several different factors, including the distance between booster launch location and interceptor launch location, booster burn time, booster burnout altitude, how far down range the booster has flown at burnout, whether the interceptor launch point is along the flight path of the booster, and the slant angle between the interceptor launch point and the booster flight path. The acceleration of the booster further compounds the problem because the location of the target booster along its flight path cannot be predicted accurately since acceleration is not a constant. Therefore, the difference between the predicted and the actual location of the booster is potentially large. Thus, boost-phase intercept using hit-to-kill technology deployed at sea is not a simple problem; it is as complicated and stressing—if not more so—as midcourse intercept using land-based interceptors. In fact, the most effective way to achieve a boost-phase intercept is to use weapons in space that can destroy a missile from above rather than try to catch it from below.

16. Tanks, p. 5.8.

17. For current testing purposes, the "surrogate" for the NMD interceptor booster is a modified Minuteman II ICBM (second and third stages), which is much larger than the Standard missile that is the basis for the NTW interceptor. Ballistic Missile Defense Organization, "Fact Sheet: Ground Based Interceptor," BMDO Fact Sheet JN-99-09, March 1999. Federation of American Scientists, "Military Analysis Network: MK41 Vertical Launching System (VLS)," http:/www.fas.org/man/dod-101/sys/ship/weaps/mk-41-vls.htm, shows that a Navy Standard Missile-2 Block IV/IVA occupies the entire space of a VLS strike canister. United Defense, "Vertical Launching System (VLS) Mk41—Strike Length Module," http:/www/udlp.com/markets/defense/weapons/delivery/mk41/strike.htm, shows that the maximum length for the VLS as 247 inches (just over 20 feet) and the maximum diameter as 23 inches (just under 2 feet).

18. Quoted in Richard J. Newman, "Shooting from the Ship," *U.S. News & World Report*, July 3, 2000, p. 20. Even if a larger booster could be accommodated in the VLS, problems would remain. According to Tanks, "If a faster [that is, boost-phase capable] interceptor were needed in the future, it might be required that the ships be reconfigured/rebuilt to strengthen their hulls and modify the VLS firing cells" (p. 5.5), and "it is questionable that a missile defense system that would require massive modification to or replacement of the current VLS configuration would be very cost effective" (p. 5.10).

19. Ibid., p. 5.3.

20. According to Tanks: "Since the Navy does not have an NMD mission, no serious engineering effort has been undertaken to determine if a 6.5-kps interceptor could be launched from the Aegis platform (as currently structured)." Ibid., p. 5.8.

21. Ballistic Missile Defense Organization, "Summary of Report to Congress on Utility of Sea-Based Assets to National Missile Defense," June 1, 1999, p. 4.

22. Ibid.

23. So far, 3 of 19 scheduled flight tests have taken place. The first test (October 1999) was a successful intercept, but the subsequent tests have failed, the second (January 2000) because of a cooling pipe problem and the third (July 2000) because of a payload separation problem. Roberto Suro, "Failure of Booster Foiled Missile Test," *Washington Post*, July 9, 2000, pp. A1, A14.

24. Newman, p. 10. According to the BMDO, "Deployment of a Block II NTW-based system would be well beyond the current timeline for the land-based NMD Capability I architecture." Ballistic Missile Defense Organization, "Summary of Report to Congress," p. 9. Moreover, the U.S. General Accounting Office recommended that the Navy revise the precursor NTW Block I program "to ensure that the Navy can undertake initial operational testing before producing most of its missiles." U.S. General Accounting Office, *Missile Defense: Schedule for Navy Theater Wide Program Should Be Revised to Reduce Risk* (Washington: GAO, May 2000), pp. 5–6. Currently, the Navy is rushing the Block I program by doing initial operational testing in 2010—the year by which 100 percent of the Block I missiles will be produced and delivered. Unbelievably, all of the missiles are being purchased before any are tested operationally to see if they work. Although GAO did not specifically recommend slowing the NTW Block I program, the implication is clear. Proponents of a sea-based NMD are proposing accelerating the NTW program at the same time that the GAO is urging actions that would seem to necessitate a slowing of the program.

25. Tanks, p. 5.10.

26. Newman. The Navy had previously estimated that between 7 (2 overseas) and 15 ships (5 overseas) would be needed for sea-based NMD. U.S. Navy, "Naval Missile Defense: Forward . . . From the Sea," Briefing, 1996. BMDO assumed that 3–6 dedicated Aegis ships would be needed. Ballistic Missile Defense Organization, "Summary of Report to Congress," p. 21.

27. Quoted in Newman, p. 20.

28. Tanks, p. 5.13.

29. Ibid., p. 5.10.

30. Christopher Hellman, "Fiscal Year 2001 Request for Selected Weapons," Center for Defense Information, February 7, 2000, http://www.cdi.org/issues/usmi/fy01/weapons.html.

31. U.S. Navy Visibility and Management of Operating and Support Costs (VAMOSC) Report, cited by Federation of American Scientists, http://www.fas.org/man/dod-101/sys/ship/vamosc.htm.

32. Tanks, p. 5.11.

33. Ballistic Missile Defense Organization, "Summary of Report to Congress," p. 2.

34. For example, a small surface action group consisting of an additional cruiser, destroyer, and auxiliary ship.

35. Newman.

36. See, for example, Rumsfeld Commission, *Executive Summary of the Report of the Commission to Assess the Ballistic Missile Threat to the United States* (Washington: Government Printing Office, 1998), pp. 6–7; and Heritage Foundation, Commission on Missile Defense, pp. 11–12.

37. Tanks, pp. 5.9–5.10.

38. Newman.

39. Heritage Foundation, Commission on Missile Defense, pp. 9–12.

40. Richard L. Garwin, "Cooperative Ballistic Missile Defense," November 17, 1999, http://sun00781.dn.net/rlg/991117.htm.

41. BMDO states, "The most practical and effective role for sea-based systems would be to supplement land-based systems." Ballistic Missile Defense Organization, p. 4. The Herritage Foundation also acknowledges that sea-based NMD will need to be augmented: "To be most effective, this first-phase global missile defense system—based on the NTW system—should be supplemented with space-based interceptors and lasers as those technologies mature." Heritage Foundation, Commission on Missile Defense, p. 4.

42. Garwin, "Cooperative Ballistic Missile Defense."

43. Spencer and Dougherty, p. 6.

44. Tanks, p. 5.13.

45. The Heritage Foundation states: "Several rogue states and terrorist groups could launch shorter-range missiles from ships lying close to U.S. coasts." Spencer and Dougherty, p. 10.

46. Charles V. Peña, "Theater Missile Defense: A Limited Capability Is Needed," Cato Policy Analysis no. 309, June 22, 1998, pp. 19, 21.

47. Heritage Foundation, Commission on Missile Defense, p. 43. Emphasis added.

48. Ballistic Missile Defense Organization, "Summary of Report to Congress," p. 20.

49. No current cost estimates exist for a layered space-based NMD system because such a system is not currently being considered. But the CBO estimated previously that a "high-end" layered defense system consisting of 300 ground-based interceptors, 500 space-based interceptors, 20 space-based lasers, and space and missile tracking system infrared satellites would have a 20-year life-cycle cost of $140 billion. Congressional Budget Office, "Answers to Questions Posed by Senators Exon and Dorgan," 1996, p. 1.

50. The Heritage Foundation states: "For a total of $2 billion to $3 billion, and with streamlined Navy management, the first generation of an NTW missile defense system could begin operations in just three to four years." Spencer and Dougherty, p. 7. But that cost figure is the only one given—even though the authors explicitly acknowledge that "sea-based, space-based, and ground-based interceptors are all needed," that their proposed plan to meet the urgent missile threat is to "build a space-based sensor system as a companion to the Navy's missile defense system," and that they would "expedite sea-based and space-based programs with streamlined management modeled after the successful Polaris program." Spencer and Dougherty, pp. 3, 8, 9.

51. Ibid., p. 7. Emphasis added.

52. Peña and Conry, pp. 19–20.

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