

1994

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Recommended Citation

Soofer, Robert M. (1994) "Ballistic Missile Defense from the Sea," *Naval War College Review*: Vol. 47 : No. 2 , Article 7.
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Ballistic Missile Defense from the Sea

Robert M. Soofer

ON 28 SEPTEMBER 1992, the U.S. Navy and Marine Corps adopted a new strategy that fundamentally shifts the focus of their war planning from global threats to regional challenges and contingencies. This new strategic direction, promulgated in a Navy white paper entitled “. . . From the Sea,” represents a move away from open-ocean warfighting *on* the sea toward joint operations conducted *from* the sea.¹ It is a strategy derived directly from the new U.S. National Security Strategy, which also emphasizes regional contingencies over global or superpower conflict.²

In terms of force planning, the new strategy means that the U.S. Navy will concentrate more on capabilities required in the operating environment of the littoral, or coastlines, of the earth, with emphasis on joint strike operations designed to project power ashore. The purpose of this article is to examine whether those capabilities should include protection against ballistic missile threats, and if so, what some of the options available are.

The emerging ballistic missile threat poses a problem for the implementation of both the U.S. naval and U.S. national security strategies. Providing theater ballistic missile protection from the sea—for naval and power-projection forces offshore as well as ground forces and other military or civilian assets ashore—would be an efficient way to support both the naval mission and the overarching national defense strategy.³ In fact, there are certain advantages inherent to sea-based Theater Missile Defense (TMD) that are essential in some scenarios and which otherwise complement ground-based systems. Moreover, given the shift away from a “blue-water” strategy to one that focuses on operations in the geographically constrained littorals, the ability to protect expeditionary forces against ballistic missile attacks becomes increasingly important. The analysis

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The views expressed in this article are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

concludes with the observation that for a relatively small investment, existing Aegis-equipped warships can be modified to provide this important sea-based TMD capability.

The Navy's Role in the New National Security Strategy

Even before the outbreak of the Gulf War, the United States had begun crafting a post-Cold War defense strategy that shifted defense planning from a focus on the global threat posed by the Soviet Union to a focus on regional threats and challenges. Ironically, President George Bush announced the fundamental themes of his new defense strategy on the same day, 2 August 1990, that Iraq invaded Kuwait.

This shift to a regional emphasis continues under the Clinton administration, which at the time of this writing is engaged in a major defense and foreign policy review. Secretary of Defense Les Aspin has testified before Congress that "with the demise of the Soviet Union, threats to stability in key regions throughout the world have become America's principal military concern and a major determinant of our defense budget priorities."⁴ The administration has proposed to Congress a fiscal year 1994 defense budget that "provides for military capabilities sufficient to address a full range of regional contingencies, placing special emphasis on strategic mobility and military power projection."⁵

Secretary Aspin's testimony and other statements indicate that there will be considerable continuity between the regional defense strategy promulgated by the Bush administration and the Clinton administration's new defense policy. However, certainty awaits completion of the defense policy review. For the sake of analysis in the interim, therefore, this article will examine the role of the Navy in the context of the strategy of the previous administration, making the supportable assumption that its elements will endure for the period of time in question.

Former Secretary of Defense Dick Cheney's regional defense strategy contained four critical elements useful for guiding defense planning and the development of U.S. military forces: strategic deterrence and defense, forward presence, crisis response, and reconstitution.⁶ While the Navy has a role in supporting each of these elements, its forces and capabilities are particularly well suited for the forward presence and crisis response missions.

Forward presence provides a tangible demonstration of U.S. commitment in regional and global affairs and is critical to deterring threats to American interests in key regions of the world.⁷ Forward presence can take many forms, such as stationing forces at forward bases, rotational or periodic deployments, military exercises, port visits, and military assistance. Stationing forces overseas or

62 Naval War College Review

deploying naval vessels is perhaps the most visible demonstration of U.S. regional commitments. As the number of forces and bases maintained permanently overseas declines, the U.S. will increasingly rely on its naval and Marine forces to fulfill a number of regional roles, including forward presence.

The *crisis response* element of the strategy requires the U.S. to maintain highly ready and rapidly deployable power projection forces “capable of handling regional and local contingencies that vary across the spectrum in size and intensity.”⁸ Naval forces provide a wide range of crisis response options, including the ability to contain crises through forward operations and through rapid response with flexible and sustainable sea-based forces. Naval forces also provide political flexibility in that they can be withdrawn without engagement should diplomatic activities resolve a crisis.⁹

In addition to its new focus on regional warfare, the Navy will continue to make a contribution to *strategic nuclear deterrence* through its nuclear ballistic missile submarines and, with its reserves, will contribute to a *reconstitution* capability should that be needed to cope with new threats. Finally, the potential exists for naval forces to contribute to the strategic defense mission that is essential for shielding our allies and U.S. expeditionary forces from ballistic missile attack* in a given theater and for implementing the new National Security Strategy.

In summary, the Navy and Marine Corps will play key roles in implementing the new defense strategy. During a regional conflict, the central task of the Navy will be “to control the ocean adjacent to the littoral battlefield, the ground from the shore to our objectives, and the skies above both.”¹⁰ The Navy will therefore find itself operating in areas close to land that are characterized by confined and congested water and air space, facing threats that were not normally associated with open-ocean operations. Some of these dangers are familiar in one form or another—mines, fast combatant craft, and advanced, land-based, sea-skimming cruise missiles. A newer threat, however, is the theater, or tactical, ballistic missile (TBM), a weapon that poses a serious challenge to maritime missions near to, or involving, the land.¹¹

An Emerging Threat: Theater Ballistic Missiles

According to Secretary of Defense Les Aspin, “The global proliferation of ballistic missile technology and weapons of mass destruction has become one of the most immediate and dangerous threats to U.S. national security in the post Cold War era.”¹² Today, more than fifteen Third World nations have ballistic missiles. By the year 2000, perhaps twenty such nations may have them, and

* All references to ballistic missile attack are in the theater and tactical, not “strategic,” context.

some of those missiles may be armed with chemical, biological, and even nuclear warheads.¹³

These theater (i.e., tactical) ballistic missiles vary in range from 80 to 3,000 kilometers, with the most common today being the 300, 600 and 900-kilometer-range "Scud" variants. Though the exact size of the Third World ballistic missile inventory is difficult to determine, it is estimated to be in the thousands and growing. Accuracies of these TBMs are also expected to improve substantially as the Global Positioning System (GPS) becomes readily available during this decade.¹⁴

The possession or use of ballistic missiles by potential regional adversaries can have tactical, operational, and strategic implications.¹⁵ The weapons can be used to gain a local operational advantage during a conflict; to carry out deep strike and interdiction missions as adjuncts to, or surrogates for, aircraft; as terror weapons to demoralize an adversary; or as a deterrent against intervention by countries outside the region.

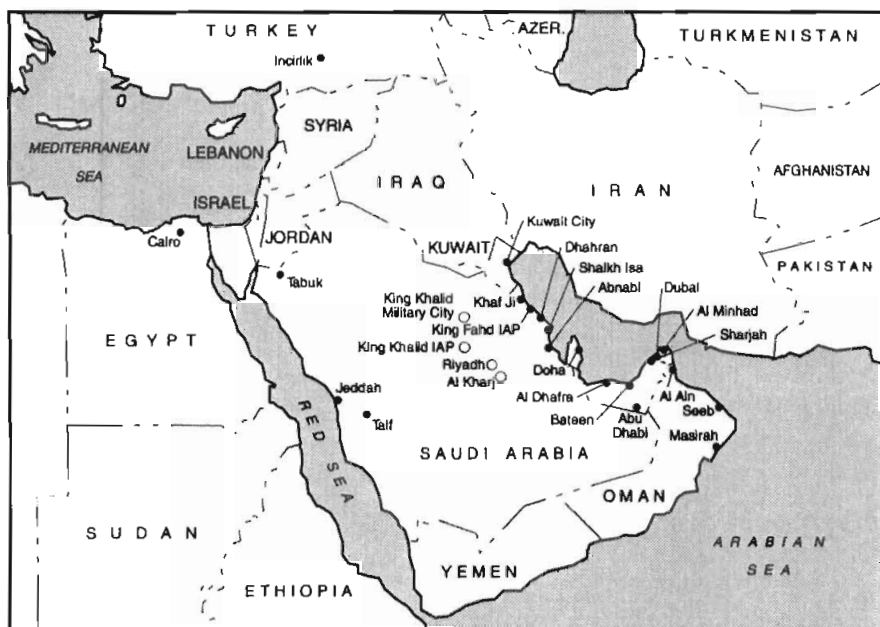
The impact of Iraq's use of Scud missiles on the Gulf War has been addressed elsewhere.¹⁶ By way of summary, ballistic missiles were used strategically by Saddam Hussein to provoke Israeli retaliation, with the hope of thereby disrupting the coalition.¹⁷ In an operational sense, fighters and other air assets assigned to search for and destroy Scuds represented a diversion of resources that could have been used to prosecute directly the war against Iraq.¹⁸ Finally, Saddam Hussein's theater ballistic missiles also posed a continuous tactical threat, as illustrated by the loss of twenty-eight U.S. service personnel when a Scud hit a barracks in Dhahran, Saudi Arabia, and when a single Scud, landing near a pier at a Saudi port, narrowly missed doing substantial damage to nearby ships or the ammunition stacked on the pier.¹⁹

A Role for the Navy in Theater Ballistic Missile Defense?

Former Secretary Cheney noted that "one of the lessons of the Gulf War with major implications for future regional contingencies is the political and military importance of possessing a capability to protect against the threatened or actual use of ballistic missiles and weapons of mass destruction."²⁰ Deploying ballistic missile defenses (either land-based or sea-based) to protect against this threat thus becomes an important element in the new defense strategy. Add to this the increasing likelihood that in support of the new defense strategy naval forces will operate within range of hostile TBMs, or that expeditionary forces maneuvering ashore will come under fire by TBMs, and one has a solid strategic rationale for sea-based TMD. What follows, then, is an examination of the role for defenses in terms of our forward presence and crisis response requirements.

64 Naval War College Review

In support of our forward presence on the ground, theater ballistic missile defense systems, operating in concert with early warning systems, can provide limited-area and wide-area defense against tactical ballistic missiles for forward-based and expeditionary forces. Defenses could provide protection, on short notice, for U.S. and host-nation forces, military bases, ports and airfields used by arriving forces, and population centers. Such a capability will become increasingly important as Third World countries acquire ballistic missiles with the intent of deterring the formation of defensive coalitions or of compounding their tactical problems.



- Airfields Defendable by Aegis with SPY Modifications and SM-2 Block IVA.
- Airfields Not Easily Defendable.

Coastal Airfields Defendable by Aegis SPY Mods / SM-2 Block IVA

This defensive capability in support of forward deployed forces can be provided by ground-based or sea-based TMD forces, or both. Without prejudice to ground-based systems²¹—which constitute the bulk of the Defense Department's current TMD capability—sea-based systems offer certain advantages:

- Sea-based TMD can be deployed offshore near potential flash points in regions where U.S. land-based TMD forces are not already in place.
- No foreign entry permission or approval is required for sea-based TMD, whereas it may be for ground-based systems.

- Deployment is highly flexible, and ships can remain on the scene indefinitely.

- Offshore deployments that are non-obtrusive would not exacerbate a potential crisis, as might the deployment of more visible ground-based systems.

- Sea-based TMD is less likely than fixed, ground-based sites to invite preemptive attack, since the warships upon which it is embarked are, being highly mobile, more difficult (though not impossible) targets.

Sea-based TMD can also support our crisis response requirements. In the pre-crisis stage, a TMD capability located offshore but having sufficient inland coverage could serve to dampen or defuse regional crises by deterring the employment of ballistic missiles. Land-based TMD could serve the same purpose, but it may not be as readily available as naval systems, or even be, in some scenarios, feasible.

Should attempts at crisis mitigation or deterrence fail, sea-based missile defenses would then be reliably nearby to:

- Support the insertion of U.S. and allied forces (including ground-based TMD units) into the region either through friendly ports or coastal airfields or by amphibious operations;

- Minimize the requirement to use scarce airlift to insert ground-based TMD systems during the early days of a crisis;²²

- Defend sea and air lines of communication, command and control nodes, vital political and military assets, and supporting infrastructure; and,

- Increase the likelihood that potential adversaries could not use their ballistic missiles to gain an advantage.²³

In the aggregate, sea-based TMD can provide local commanders as well as the National Command Authority with a highly flexible deterrent and response to the threat of enemy ballistic missile attack. This capability is important not only for protecting forward deployed U.S. forces and their host nations but also for giving U.S. unified commanders in chief an immediate crisis-response option where land-based TMD is unavailable or not suitable. Perhaps most importantly, TMD provides the president with the flexibility to employ military power when necessary to support U.S. national security objectives without fear of ballistic missile attack.

There are strong arguments, then, for the potential contribution of sea-based TMD to U.S. forward presence and crisis response, specifically for the protection of forces and facilities on the ground. It is less clear, however, whether maritime forces themselves, in view of the mobility and small size of their constituent units, also require the protection of TMD. In the open-ocean operating environment formerly envisioned, one characterized by widely dispersed and highly mobile naval forces and inaccurate TBMs, there was little rationale for fleet protection against ballistic missiles. If the Navy intends, however, to operate

66 Naval War College Review

closer to shore, perhaps for extended periods, in support of land-sea operations, then the threat to the fleet posed by increasingly accurate TBMs becomes an important factor to consider. According to Rear Admiral Edward Shaefer, Jr., Director of Naval Intelligence, "For the rest of this decade, tactical ballistic missiles [attacking] ships moving on the high seas are not going to be a problem. No one has for sale a ballistic missile that's going to steer its way into a moving ship. But when you approach the littoral area and you've got ships anchored, it's something you've got to be very much concerned about."²⁴ As Acting Secretary of the Navy, Admiral Frank Kelso noted this in an 8 February 1993 memorandum to the Secretary of Defense: "In a littoral operating environment, such a capability could be a determining factor in our ability to prevail. Continued research and development into TMD is essential for successful power projection in an uncertain world."²⁵

The Navy TMD Program

The strategic rationale for sea-based ballistic missile defense forces just outlined is the context of a brief overview of the TMD options now under consideration.²⁶ As envisioned, the sea-based TMD program is an integral part of the ongoing Theater Missile Defense Initiative (TMDI)—directed by the Ballistic Missile Defense Organization (BMDO)²⁷—encompassing also Patriot and Hawk improvements, the Theater High Altitude Area Defense (THAAD) system (which includes the THAAD missile and the TMD ground-based radar), Corps Sam (a highly mobile point defense system to support troops on the move), and advanced space-based "cueing" (fairly precise alerting to targets.)²⁸

Sea-based TMD enjoys broad political and military support. A joint Navy-BMDO program was established by the Director, BMDO (then SDIO), in 1992. It has since received the support of the Secretary of the Navy, the Assistant Secretary of the Navy for Research, Development and Acquisition, the Chief of Naval Operations (CNO), and the recently created Deputy CNO for Resources, Warfare Requirements and Assessment (N8).²⁹ Additionally, Secretary Aspin's "Bottom-Up Review" of defense programs (briefed to Congress in September 1993) endorsed both upper and lower-tier Navy TMD programs and directed that they should be a part of the core TMD program.

In congressional deliberations over fiscal year (FY) 1993 defense funding, all four defense committees (the Senate and House Armed Services and Defense Appropriations committees) endorsed an increased role for the Navy in TMD and formally approved initiation of Navy TMD as a new budget item at not less than \$90 million in FY 1993. U.S. industry has welcomed this new initiative, and allied navies in Europe and the western Pacific have expressed interest in becoming involved.³⁰

The planned Navy TMD program is structured to take advantage of existing Navy resources, including nearly fifty Aegis cruisers and destroyers (of which one-third are presently deployed). These ships are already equipped with the fixed-antenna, phased-array SPY-1 series radar, the Vertical Launching System, and command, control, and communications elements useful for TMD operations, and they are supported by a network of logistical and support facilities and personnel. The plan consists of two elements.

In the near term, the objective is to provide the Navy with a "lower-tier" (i.e., intercepts inside the atmosphere), limited-area TBM defense that would be similar to the upgraded Patriot (PAC-3) now being planned for the Army but would provide greater defensive coverage. Though coverage depends on circumstances and the location of the ship offshore, it could be extended up to a hundred kilometers inland.³¹ Such a system could provide to a theater commander in chief faced with a TBM threat an initial response, one providing protection for sea and ground forces, ports, amphibious objective areas, and coastal airfields. This effort includes modifications to radar and weapon control system software to allow Aegis to detect, track, and engage TBMs, and also development of warhead changes, fuze modifications, and an improved seeker for the Standard Missile (SM-2) Block IV.³² Modifications are also necessary to the existing battle management and command, control, and communications "architecture" to include early warning from space-based sensors. The goal is a deployable "operational assessment prototype," or "User Operational Evaluation System," by the late 1990s and a full "Initial Operational Capability" at the turn of the century.³³

A second objective is to achieve an "upper-tier" (exo-atmospheric), long-range intercept capability to provide a broader defense of joint forces, cities, vital assets, and inland regions within an entire theater of operations. The upper-tier concepts currently under consideration for development and deployment as early as the end of the decade are:

- A "hit-to-kill" kinetic-kill vehicle based upon BMDO's Lightweight Exo-Atmospheric Projectile technology, integrated with the first two stages of the SM-2 Block IV missile.³⁴

- A sea-based version of the Army's developmental (THAAD) missile.³⁵

- A combination of an SM-2 boost stage with a THAAD variant.

To maximize their capabilities, sea-based theater missile defense systems will also require early warning sensor support, such as from existing DSP (Defense Support Program) satellites, to provide cueing for the Aegis radar. Additionally, "Brilliant Eyes" infrared satellites (space-based sensors being designed to support national ballistic missile defenses) will be capable of tracking ballistic missile bodies during the post-boost phase and could support providing sensor inputs

68 Naval War College Review

directly to an already launched upper-tier theater-defense missile, thereby greatly expanding its defensive coverage.

In summary, the plan is to build on Aegis potential by first upgrading the SM-2 Block IV to provide a lower-tier, limited-area defense of ports, coastal airfields, amphibious objective areas, and expeditionary forces on the ground. This capability would then be augmented by an upper-tier, wide-area defense of joint forces, cities, and entire theaters of operation, if desired.³⁶

The feasibility of sea-based theater missile defense continues to undergo serious examination. The Naval Research Advisory Committee and the Lincoln Laboratory at the Massachusetts Institute of Technology, under the direction of the Assistant Secretary of the Navy for Research, Development and Acquisition, conducted separate studies during 1991 evaluating possible naval roles and capabilities in this area. Additionally, the Defense Science Board completed an in-depth look at TMD during its 1991 Summer Study. All of the studies concluded that the Navy had a substantial role to play in TMD.³⁷

According to figures supplied by the Navy in late 1992, it is estimated that less than \$5 billion is needed over the next six years for both the lower-tier and upper-tier theater-wide upgrades to the Aegis system. The Navy TMD program represents approximately ten percent of the existing investment of \$43 billion on Aegis cruisers and destroyers and the nearly \$2 billion programmed by the Navy for development of contributing advanced concepts (such as "Cooperative Engagement" and SM-2 Block IV missile).³⁸ The FY 1994 budget request for Navy TMD programs is approximately \$240 million out of a total Theater Missile Defense Initiative request of \$1.8 billion, and it increases significantly each year of the Future Years Defense Plan.

The shift to a regional and littoral environment requires new doctrinal and force-structure thinking. In light of the threat posed by ballistic missiles, the Navy and BMDO are carefully examining the requirements for sea-based TMD, the naval capabilities that could contribute to such defenses, and the impact this would have on other naval mission areas.³⁹ The foregoing discussion demonstrates that ballistic missile protection from the sea is an important capability that would not only contribute to the naval mission but would be an essential component of our new national security strategy.

By way of summary, sea-based TMD is needed to protect naval forces conducting operations in the littoral; to protect forward deployed forces, friends, and allies; to provide cover for joint strike and power-projection forces maneuvering ashore during a conflict; to provide political flexibility during a potential

crisis involving adversaries having ballistic missiles; and finally, to provide the reassurance necessary to maintain coalition solidarity in the face of ballistic missile threats.

In addition to its compelling strategic rationale, sea-based TMD also makes sense from a budgetary perspective. Using the extensive Aegis "infrastructure" already in place, a sea-based TMD capability can be had in the near term at relatively low cost. The Navy TMD program enjoys broad political support on Capitol Hill and within the Department of the Navy and is being considered by U.S. allies. For all the reasons stated above, Theater Missile Defense is likely to become a serious naval mission, with the Navy becoming a serious contender for limited TMD funds.

Notes

1. U.S. Department of the Navy, ". . . From the Sea: Preparing the Naval Service For the 21st Century" (Washington: September 1992).

2. See The White House, *National Security Strategy of the United States* (Washington: August 1991); and U.S. Department of Defense, *Defense Strategy for the 1990's: The Regional Defense Strategy* (Washington: January 1993).

3. Ballistic missiles are usually divided into two categories: strategic ballistic missiles are those that have intercontinental range, sometimes defined as 5,500 kilometers or greater; theater, or tactical, ballistic missiles have ranges from 80 to 3,000 kilometers and have slower reentry speeds than strategic missiles. Both categories can be armed with conventional, chemical, biological, or nuclear warheads.

4. Prepared statement of Secretary of Defense Les Aspin to the House Armed Services Committee, 30 March 1993.

5. *Ibid.*

6. For details see U.S. Department of Defense, *Report of the Secretary of Defense to the President and the Congress* (Washington: January 1993), pp. 3-6 (hereafter 1993 SecDef Report); and *Defense Strategy for the 1990's*, pp. 5-18.

7. 1993 SecDef Report, pp. 4-5.

8. *Ibid.*, p. 5.

9. ". . . From the Sea," p. 3.

10. *Ibid.*

11. The threat of tactical ballistic missiles was recognized in ". . . From the Sea," p. 4. See also Admiral Frank Kelso, "From the Sea, Into the Future," *Seapower*, April 1993, p. 18, where he writes: "In the littoral area, our adversaries can concentrate and layer defenses. Here, we may face . . . the use of mines, sea-skimming cruise missiles, and possibly even tactical ballistic missiles."

12. From Les Aspin's written responses to advance questions submitted by the Senate Armed Services Committee before his confirmation hearing of 7 January 1993.

13. 1993 SecDef Report, pp. 71-2.

14. The *Mission Need Statement for Theater Missile Defense* (an unclassified Pentagon document of 18 July 1991) states that "a trend toward longer-range missiles with increased accuracy and more lethal warheads is already apparent." See also U.S. Department of Defense, *1993 SDIO Annual Report to Congress* (Washington: January 1993), chap. 1; System Planning Corp., *Ballistic Missile Proliferation: An Emerging Threat* (Washington: 1992); and Arthur Knoth, "GPS Technology and Third World Missiles," *International Defense Review*, May 1992, pp. 413-16.

15. See Andrew Hull, "The Role of Ballistic Missiles in Third World Defense Strategies," *Jane's Intelligence Review*, October 1991, p. 464; and W. Seth Carus, *Ballistic Missiles in Modern Conflict* (New York: Praeger, 1991).

16. See Keith B. Payne, *Missile Defense In The 21st Century: Protection Against Limited Threats Including Lessons from the Gulf War* (Boulder, Colo.: Westview, 1991); and U.S. House Armed Services Committee Report, "Defense for a New Era: Lessons of the Persian Gulf War," April 1991.

70 Naval War College Review

17. The importance of Patriot to Israeli restraint is noted by Israeli officials in Marcus Eliason, *The Associated Press*, 19 January 1991.

18. Air Force Chief of Staff General Merrill McPeak has observed in this regard, "We thought from the beginning that we would have to attack Scuds. What surprised us was we put three times the effort that we thought we would on this job. . . . We had some obstacles to overcome. . . . We worked around the diversion of a significant portion of our combat power on the Scud problem." Quoted from U.S. Department of Defense, Office of the Assistant Secretary of Defense (Public Affairs), *News Briefing*, 15 March 1991, pp. 5, 15.

19. See James T. Hackett, "Navy ships almost defenseless against incoming missiles," *San Diego Union-Tribune*, 6 September 1992, p. C-4.

20. 1993 SecDef Report, p. 72.

21. For a discussion of ground-based TMD systems, see U.S. Department of Defense, *1992 Report to Congress on the Strategic Defense Initiative* (Washington: July 1992), chap. 2; and U.S. Department of Defense, *1993 Report to Congress on the Theater Missile Defense Initiative* (Washington: June 1993).

22. The airlift necessary to transport ground-based TMD during the early stages of a crisis has been recognized as a potential liability. According to the "High Altitude Theater Missile Defense" Operational Requirements Document, 22 January 1992, p. 4, para. 3.d: "Strategic and tactical deployability characteristics of current Army air defense weapon systems are unsatisfactory. Large numbers of oversized end items place excessive demands on strategic air transport means and limit intra-theater flexibility."

For example, it requires 301 C-141 sorties or 153 C-17 sorties to deploy a Patriot battalion of six fire-units with a missile capacity of 192. By way of comparison, a naval battle group consisting of two guided missile cruisers, one guided missile destroyer, and one destroyer could bring to bear 390 missiles in support of the sea-based TMD mission. Figures from an unclassified briefing by Commander John Carey, USN, "Introduction to Sea-based Theater Missile Defense," SDIO, March 1992.

23. See the *1993 SDIO Report To Congress*, p. 1-3.

24. As quoted in an interview with *Defense Week*, 24 May 1993, p. 13. The commanding officer of the nuclear aircraft carrier *Theodore Roosevelt*, Captain Stanley W. Bryant, put it this way: "In a littoral conflict, you're putting yourself in missile envelopes the old world order didn't put you into." (Quoted in Barton Gellman, "Mud soldiers take to the sea," *The Washington Post*, 4 April 1993, p. 23.)

25. Quoted in Joseph Lovece, "Ambitious Navy Missile Defense Efforts Run Smack into Budget Wall," *Defense Week*, 22 March 1993, p. 7.

26. For a very good technical description of the Navy TMD program, see Rodney Rempt, "Killing Scuds from the Sea," and John E. Carey, "Fielding a Theater Ballistic Missile Defense," U.S. Naval Institute *Proceedings*, June 1993. Information is also drawn from a 10 December 1992 SDIO white paper entitled "Sea-Based Theater Missile Defense."

27. On 13 May 1993 SDIO was renamed the Ballistic Missile Defense Organization (BMDO).

28. See *1993 Report to Congress on the Theater Missile Defense Initiative*.

29. In a 4 June 1992 memorandum, the Secretary of the Navy directed acceleration of Navy project management and planning efforts, to include the immediate submission of a program plan, acceleration of Initial Operational Capability dates, and the approval of documentation of requirements necessary to formalize the acquisition process. Also, in an 8 February 1993 memorandum to the Secretary of Defense, Admiral Frank Kelso stated that "the Department is cooperating fully in developing a TMD capability for our Aegis cruisers."

30. See Theresa Hitchens, "U.S. Urges Sea-Based Missile Defense for NATO," *Defense News*, 25 January 1993, p. 3; and Nicholas Doughty, "NATO Discusses Secret Plans for Sea-Based Missile Defenses," *Reuters Library Report*, 25 February 1993.

31. The protective coverage of a defensive missile system can vary, depending on the range of its interceptors, its location relative to both the target and the area to be protected, the speed of the incoming target, and the availability of external cueing and early warning.

32. For a description of the SM-2, see E.R. Hooton, ed., *Jane's Naval Weapon Systems* (Surrey, U.K.: 1992).

33. See the *1993 Report to Congress on the Theater Missile Defense Initiative*.

34. For details see Rempt, and the *1992 Report To Congress on the Strategic Defense Initiative*.

35. The THAAD missile is designed to engage tactical ballistic missiles in the high endo- and exoatmospheric region, nominally above thirty kilometers. By way of comparison, THAAD's defensive coverage represents roughly a ten-fold increase over the Patriot (PAC-2) used in the Gulf War and a four-fold increase over the soon-to-appear improved Patriot (PAC-3).

36. An effective defense against theater ballistic missiles requires two "tiers" of interceptors. An upper tier engages missiles at long range and high altitude and provides protection for a very large area. The lower tier intercepts missiles that "leak" through the upper tier and also those short-range, low-altitude ballistic missiles that can fly under the upper tier.

37. More recently, in January 1993 the Johns Hopkins Applied Physics Laboratory conducted a critical analysis of the Navy's plans for a lower-tier ballistic missile defense utilizing the Aegis/SM-2 Block IVA modifications. The study demonstrated that the system is effective, showed the value of having two tiers of protection against tactical ballistic missiles, highlighted the value of sea-based mobility, and generally justified continued investment in the Navy lower tier.

38. Strategic Defense Initiative Organization, "Sea-Based Theater Missile Defense," white paper dated 10 December 1992. For a discussion of cooperative engagement, see Carey.

39. According to Vice Admiral William Owens, head of Navy resources, requirements, and budget, a low-cost capability for regional defense against theater ballistic missiles is another mission area the Navy is pursuing. See John Morrocco, "New Navy Maritime Strategy Focuses on Coastal Warfare," *Aviation Week and Space Technology*, 19 October 1992, p. 25. It is also specifically referred to in ". . . From the Sea."

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1919–1993

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