



# SEA-BASED MISSILE DEFENSE

EXPANDING THE OPTIONS

A JOINT STUDY BY  
THE CENTER FOR AMERICAN PROGRESS  
AND THE LEXINGTON INSTITUTE

## EXECUTIVE SUMMARY

Sea-based missile defense options are expanding. The fleet is rapidly evolving from a limited, experimental system to an operational, battle-ready missile defense capability. Since 2002, there have been numerous successful tests of realistic engagement scenarios. Sea-based missile defense works – and it's ready to do more.

The United States Navy plans to deploy a fleet of 18 cruisers and destroyers equipped to engage missiles from the sea before the end of the decade. Multiple theater commanders want and need the assets.

Several allies are also major players in sea-based defenses. The United States has partnered with Japan in expanding Aegis capabilities, and cooperative activity with several other allies is ongoing. Sea-based missile defense Aegis has the potential to serve the security interests of the United States and its allies around the globe.

This promising track record of performance is the result of focused, sustained investment. Sea-based missile defenses are now a full-fledged option for demonstrating commitment, preventing rogue states from holding allies at risk in the battlespace, and intercepting launches in critical areas.

This investment should continue. Near-term modifications to the Aegis system will expand the range of what can be done with sea-based assets. Improvements to radar tracking components and development of new missiles will lay the groundwork for future flexibility. Looking ahead, future intercepts may require a missile with more speed and punch to better protect the United States and its allies from emerging ballistic missile capabilities in rogue states such as Iran and North Korea.

Rebecca Grant, Lexington Institute

Andrew J. Grotto, Center for American Progress

*On the cover, a modified SM-2 Block IV interceptor is seen at the moment of launch from the deck of the USS *Lake Erie* on June 5, 2008. This missile successfully intercepted its target 12 miles above the Pacific Ocean during a Missile Defense Agency test. The USS *Lake Erie* was also the ship that conducted the successful intercept to destroy a failed US satellite on February 20, 2008.*

## THE PROBLEM

Ballistic missile proliferation among regional powers and rogue states has been a simmering source of concern for over 20 years, even as the nature of the threat has evolved. Exports from China, North Korea and the former Soviet Union, along with indigenous development and modification programs, have enabled many states to acquire short- and/or medium-range ballistic missile systems. Nearly all of these countries have friendly relations with the United States, so the threat is confined primarily to a handful of countries.

Syria is one of them. It boasts a short-range ballistic missile capability that could hold at risk U.S. military installations and allies in the region. The main drivers of concern, however, are Iran and North Korea. Both countries, which Director of the Missile Defense Agency Lieutenant General Henry "Trey" Obering has highlighted as the main actors driving U.S. missile defense planning, have both short- and medium-range capabilities that expand on their ability to threaten neighbors and U.S. forces in the region. North Korea is also actively developing an intermediate-range capability – the Taepodong II – that could in theory hold targets in Alaska, Hawaii, and possibly the West

Coast at risk, though North Korea has yet to conduct a successful test of this missile.

Iran and North Korea's missiles may not be highly accurate or heavily armed, but their effects would be dangerous nonetheless, terrorizing civilian and military populations and/or potentially disrupting U.S. military operations. The threat will only grow if Iran and North Korea's nuclear programs continue to progress.

## CONCEPTS OF OPERATIONS

Geography protects the continental United States against nearly all these ballistic missile threats. There are partial exceptions, of course – North Korea's Taepodong II is one possibility, as noted above. And China and Russia both have nuclear-armed intercontinental ballistic missiles (ICBMs) capable of devastating the U.S. homeland, though the United States no longer considers either country a mortal enemy as was the case during the Cold War.

Instead, the main problem concerns American forces and allies abroad. Iranian missiles have the reach to strike southern Europe – not to mention nations closer to Tehran, such as Israel. North Korean missiles have Japan and other nations well within range. Both





USS *Shiloh*, a *Ticonderoga*-class cruiser, has been an active participant in sea-based ballistic missile defense testing. In June 2006, USS *Shiloh* intercepted a multi-stage test missile launched from Hawaii. The ship is currently the US Navy Seventh Fleet's only forward-deployed Ballistic Missile Defense Cruiser.

countries' arsenals could also threaten American forces based or operating within their respective regions. The presence of regional missile threats affects deployed forces as well as the regional balance of power. Not surprisingly, theater missile defense has been a priority for regional commanders since the Gulf War of 1991.

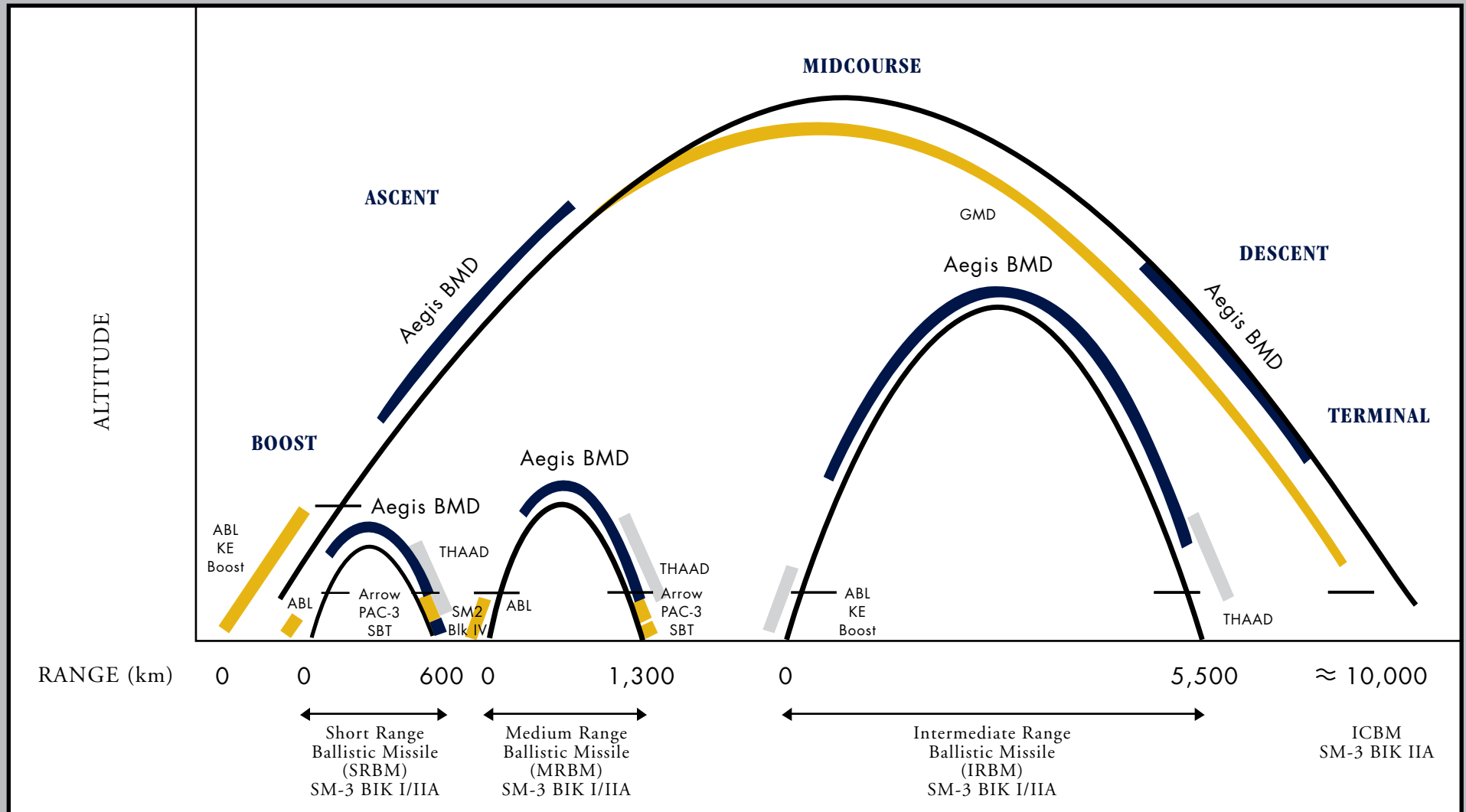
It is useful to break the missile defense problem down into components that layer attack and defense options. Preemptive or preventive attacks against missile sites prior to launch are an obvious option for military commanders. Such operations are difficult to conduct in practice, however, because they require unusually robust intelligence, along with precision targeting and forces (most likely fighters or bombers) in place to attack at the right time. If an adversary has multiple launch sites the challenge is even greater. For example, at the beginning of Operation Iraqi Freedom in 2003, a special effort was made to control regions of Western Iraq and prevent Scud launches, but Iraq still managed to launch nine short-range ballistic missiles against Coalition sites in Kuwait and Qatar.

Accordingly, attack operations must be supplemented with credible missile defense systems capable of destroying launched missiles. A missile can be

intercepted during the boost phase as its engines propel it skyward, during the mid-course phase when the missile is no longer powered by engines, or during the terminal phase when the missile begins descending towards its target. Defenses can be airborne, ground-based, or sea-based. Intercepting a missile during the boost phase is very challenging because that portion of its flight lasts for just a few minutes, so a missile defense system must rapidly characterize the threat and cue the interceptor, which generally must be positioned in space or airborne near the site to have a shot at taking the missile out.

The most mature missile defense systems are terminal and mid-course phase systems. Patriot PAC-III is the best-known terminal missile defense, used as a point defense for airfields, cities and other key sites. Theater High Altitude Area Defense (THAAD) aims at higher-altitude terminal interception, and has been successfully tested. (After a major overhaul, THAAD has made intercepts in four out of five test attempts since December 2005.) Relying just on the "catcher's mitt" of terminal defense is inherently risky, however, while technical and practical constraints limit the feasibility of this option in many cases. For example, terminal defenses must be in position and that

# ENGAGEMENT OPTIONS BY 2015



SOURCE: "Aegis Ballistic Missile Defense: Status, Integration and Interoperability," Missile Defense Agency, May 6, 2008.  
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generally means committing assets to defend relatively constrained areas.

Mid-course defenses are the most promising. During mid-course, missiles fly a predictable ballistic trajectory; it is also the longest phase of flight, which gives defenses more time to identify and neutralize the threat. Next to time of flight, perhaps the biggest advantage of mid-course interception is that tracking and engagement systems can be effectively deployed at sea as well as on land.

To be sure, mid-course defense is not easy. The missile and warhead may have a smaller heat signature, even if advances in tracking have made it easier to distinguish them. Moreover, a rational adversary can be expected to develop countermeasures.

Ideally, the United States would field a layered missile defense capability to maximize the probability of a

successful intercept, but preemptive or preventive attacks against unlaunched missiles, boost phase intercept and terminal defenses have a number of political and technological limitations, some of them quite formidable. The most flexible and technologically-capable component at this juncture is mid-course, and sea-based systems bring many advantages.

## THE SEA SHIELD

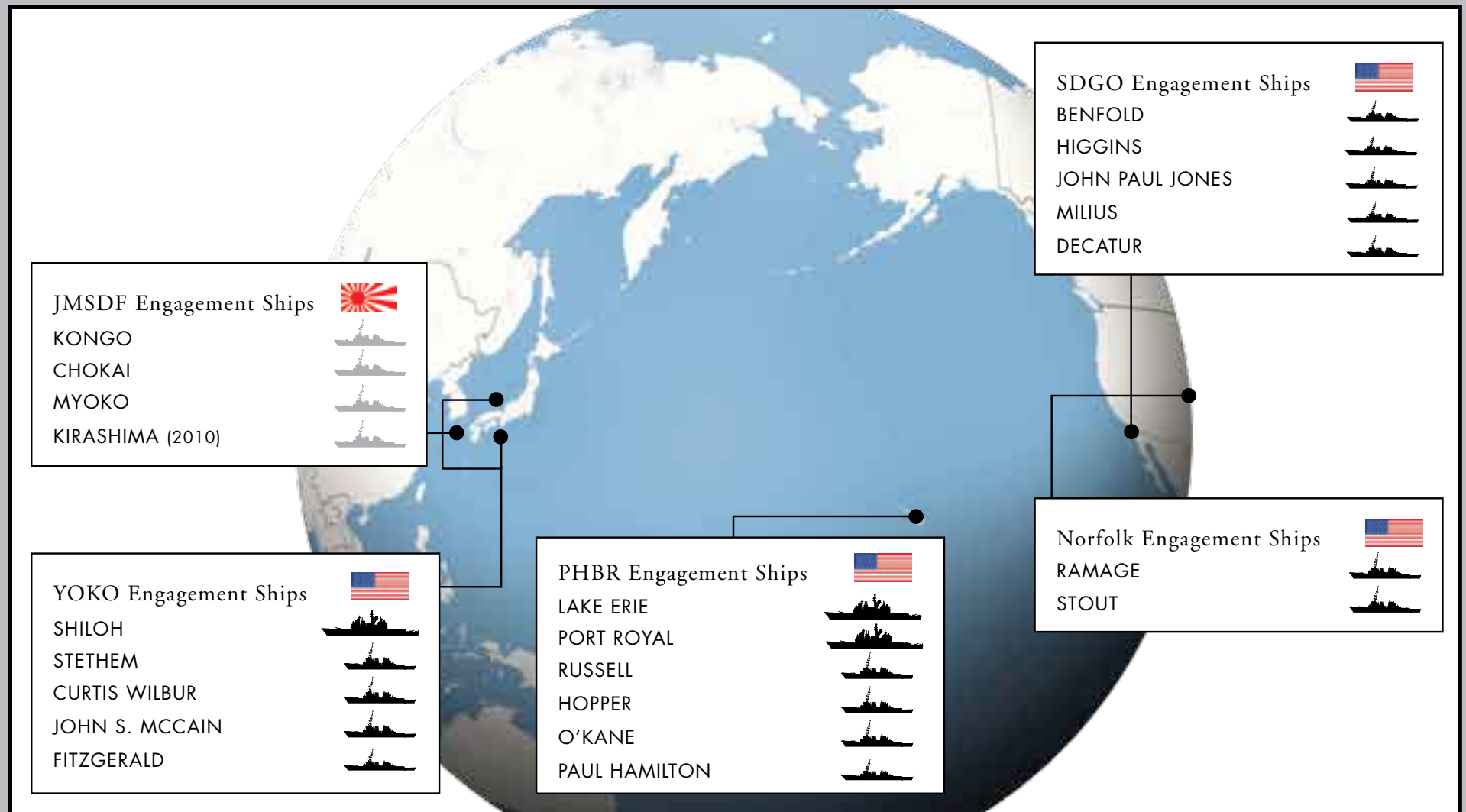
The Aegis system is at the heart of an expanding ability to track and engage missile threats. For the United States and many of its allies, any incoming missile will transit over large ocean areas during each phase of its flight. With ballistic missile defense (BMD)-capable Aegis, Navy ships can independently track and engage certain classes of ballistic missiles. The Aegis long-range tracking capability also functions as

Missile engagement is controlled from integrated displays in the ship's Combat Information Center, similar to the scopes pictured here.





# THE AEGIS BMD FLEET - END OF CY 2009



SOURCE: "Aegis Ballistic Missile Defense: Status, Integration and Interoperability," Missile Defense Agency, May 6, 2008.

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part of a team, handing off tracks or engagement to other sea-based or ground-based interceptors.

Aegis began as an initial, experimental capability but it has rapidly matured into a deployed system. In the early 2000s, only one ship, the USS *Lake Erie*, was configured for missile engagement with full systems and crew training. Currently the U.S. Navy has 12 engagement ships, with plans for a fleet of 18 by 2009. Aegis assets are routinely kept on station in the Western Pacific to deter against threats. Beyond this, the Navy now has enough BMD-capable cruisers and destroyers to commit assets to other theaters, such as the Middle East. As a result, sea-based missile defenses are maturing into a mainstay of U.S. capabilities for deterring and defeating regional missile threats against the United States and its allies.

The Aegis BMD system is designed to intercept some short-range and most medium-range missiles in the mid-course phase. Under some circumstances, the system may also be able to intercept missiles during the ascent phase and initial descent. The highest altitudes of intercontinental range missiles, however, are not currently within the Aegis/Standard Missile intercept zone.

Aegis has a strong track record of successful tests. Since 1999, the Aegis BMD system has made 11 intercepts out of 13 attempts. This confirms both the current operational credibility of the system and its potential for future improvements. Since 2005, there have been successful tests of sea-based intercepts; tracking of multiple targets; intercept of targets where the warhead was separating from the booster; engagement with ballistic missile and cruise missile targets; and hand-offs between sea- and ground-based assets.

This promising track record of performance is the result of focused, sustained investment. Sea-based missile defenses are now a full-fledged option for demonstrating commitment, preventing rogue states from holding allies at risk in the battlespace, and intercepting launches in critical areas.

This investment should continue. Near-term modifications to the Aegis system will expand the range of what can be done with sea-based assets. For example, improvements to radar tracking components and development of new missiles will lay the groundwork for future flexibility. Looking ahead, future intercepts may require a missile with more speed



Japan's Maritime Self-Defense Force destroyer JS *Kongo* tracked and intercepted a target missile with an Aegis-guided SM-3 missile on December 17, 2007. Japan became the second nation with a working sea-based missile defense capability. A sea-based deterrent to North Korea's rogue missiles is a top priority for Japan. "We will continue to strive to increase the system's credibility," Japanese Defence Minister Shigeru Ishiba said after the successful test.

and punch to better protect the United States and its allies from emerging ballistic missile capabilities in rogue states such as Iran and North Korea.

## REGIONAL DEFENSES

With an expanding fleet, today's sea-based missile defenses can supplement missile protection for Europe. Under one concept, six Aegis-BMD ships deployed in the Mediterranean, the Black Sea, the English Channel and the Baltic could cover a substantial portion of Europe. With today's systems the coverage could not extend to Scandinavia or Spain and Portugal. What sea-based missile defenses could do best is augment ground sites with additional sensor and track data for ground interceptors.

Future development of the SM-3 Block IIA missile around 2015 could change that operational picture. Instead of six ships forward with coverage gaps, two ships – positioned in the Red Sea and Black Sea, for example – could cover Europe and the Mediterranean and even parts of North Africa with a gap only in the northernmost reaches of Scandinavia. The SM-3 Block IIA would also expand the types of missiles that could be hit to include short, medium, intermediate and even

some ICBMs. Development costs for the SM-3 Block IIA may be around \$2 billion.

In the next decade the major issues will come from coordinating new and improved layers of terminal systems such as Patriot and THAAD with expanded sea-based systems. Upgraded sea-based missiles may even include some terminal engagement capability. Future decisions on the best missile defense configurations will have to take into account the geometry and requirements of different theaters and how best to allocate investment and operational assets.

Several allies are also major players in sea-based defenses. The United States has partnered with Japan in expanding Aegis capabilities and upgrading interceptors. The *Kongo*, a ship of the Japan Maritime Self-Defense Force, has been an active participant in recent missile tests. Close cooperation on Aegis constitutes an important cornerstone in the realignment of the bilateral security relationship between the two countries. It accommodates Japan's concern about North Korea and thereby helps to legitimize the contended military presence of the United States in Japan. In other words, Aegis has the potential to serve overall U.S. security interests in East Asia.



A single modified tactical Standard Missile-3 (SM-3), launched from the U.S. Navy AEGIS cruiser USS *Lake Erie* (CG 70), successfully impacted a non-functioning National Reconnaissance Office satellite approximately 247 kilometers (133 nautical miles) over the Pacific Ocean, as it traveled in space at more than 17,000 mph.



Similar to its relationship with Japan, Aegis contributes to better security cooperation with European partners. The Netherlands is a prominent example. While concerned about the impact of BMD installations in former Soviet satellite states, it has been very active in sea-based missile defense and has participated in Aegis flight testing. Other nations such as Spain and Australia are also in the picture. Fifth Fleet exercises in the U.S. Central Command region have drawn in allied participation as well. Cooperative sea-based missile defense options and layered sea-based and ground-based systems provide many options for allies considering how to keep their nations from being put “at risk.”

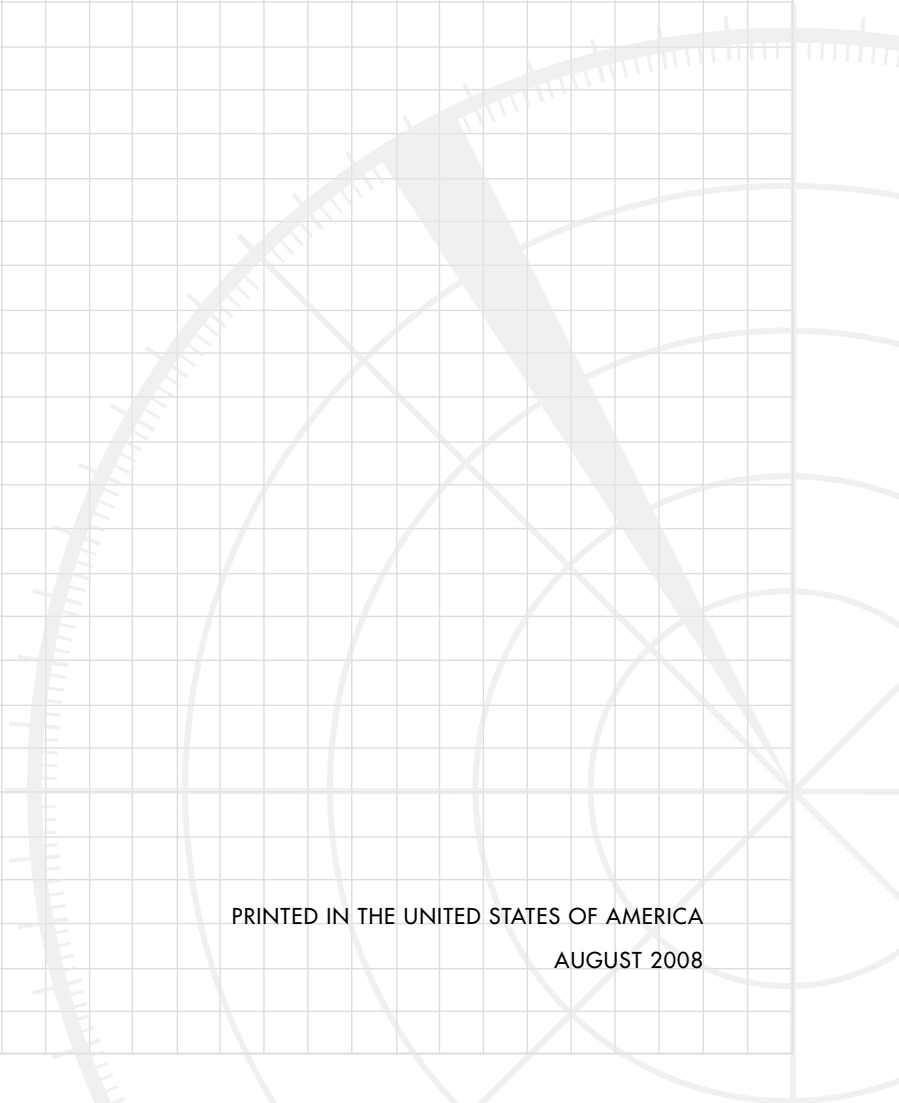
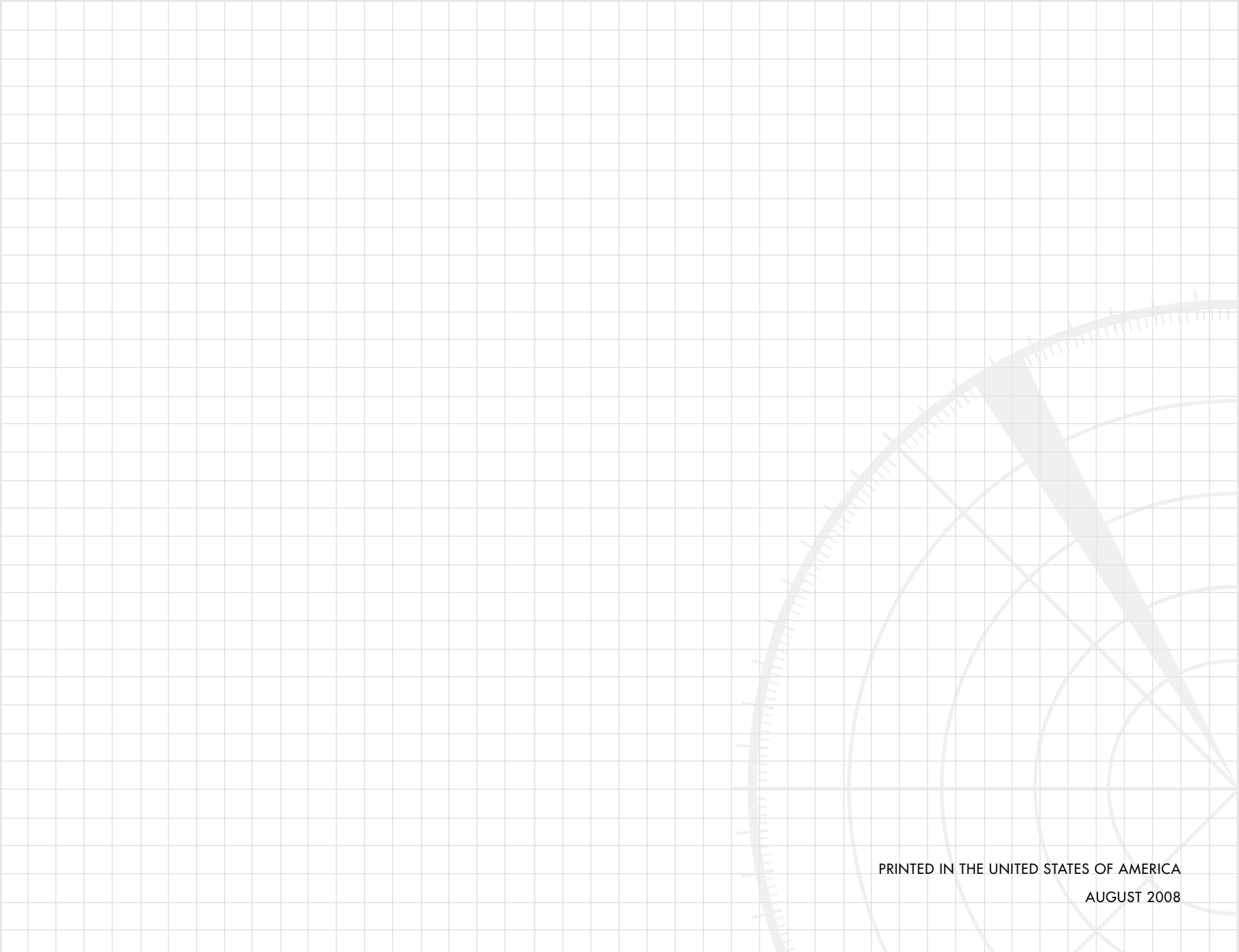
For the United States, major questions involve the level of investment and how to maintain and upgrade existing capability. The fleet is rapidly evolving from a limited, experimental system to an operational battle-ready missile defense capability. Multiple theater commanders want and need the assets and requirements are unlikely to abate. Sea-based missile defenses have received good support from Capitol Hill but the trick will be how to keep a solid investment line in track with other Navy and national priorities. As sea-based missile defenses mature, the mission may

become an even more prominent and distinct part of the Navy mission in maritime security.

Neither allies nor deployed U.S. forces should be held at risk by rogue states with burgeoning missile programs. It is a form of asymmetry based on political posturing with indiscriminate weapons of terror. Sea-based missile defenses can help raise the technical bar for proliferating nations and add to the layers of defenses necessary to counter the threat. There is deterrent value, too, in the ability of forward, sea-based missile defenses to characterize missile tracks right away and increase the chances for an intercept. When all is said and done, both the U.S. and its allies will rely on sea-based missile defenses to negate such challenges in the decades to come.



Sea-based missile defense is becoming an increasingly important mission for the United States Navy. As part of the Sea Shield concept, the Navy is building up to a fleet of 18 missile engagement vessels by 2010. This is another shot of USS *Lake Erie's* successful June 2008 test.



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1600 Wilson Boulevard • Suite 900 • Arlington, Virginia 22209

tel 703.522.5828 • fax 703.522.5837

[www.lexingtoninstitute.org](http://www.lexingtoninstitute.org) • [mail@lexingtoninstitute.org](mailto:mail@lexingtoninstitute.org)

Center for American Progress



1333 H Street NW • 10th Floor • Washington, D.C. 20005

tel 202.682.1611 • fax 202.682.1867

[www.americanprogress.org](http://www.americanprogress.org) • [progress@americanprogress.org](mailto:progress@americanprogress.org)