Seabased Ballistic Missile Defense

By ALAN B. HICKS

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U.S. Navy (James E. Foehl)

USS *Lake Erie* commanding officer CAPT Randall Hendrickson explains ship's vertical launching system to media

As the 21st century dawns, the world presents a precarious mixture of growing challenges. The events of September 11, 2001, clearly revealed that Americans are at risk from terrorist attacks throughout the world, even within the borders of their own country. Earlier terrorist attacks targeted U.S. Government and military personnel and sites, such as the bombings of U.S. Embassies in East Africa and the USS *Cole* while in port in Yemen. Now, everyday American civilians are at risk. Considering the strategic environment, we face growing threats from weapons of mass destruction (WMD) in the hands of states or nonstate actors.

These threats range from terrorism to ballistic missiles tipped with WMD, intended to intimidate the United States by holding it, its friends, and its allies hostage. Presently, more than 25 nations have developed chemical and biological WMD. More than 30 nations have ballistic missiles in their arsenals. Not only are forward deployed forces at risk from ballistic missiles, but also the U.S. homeland is within range of these threats, which continue to grow in number, range, and complexity. One factor that makes ballistic missiles desirable as a delivery vehicle for WMD is that the United States and its allies have lacked an effective defense against this threat.

U.S. Air Force (John Lafferty)

Terminal High Altitude Area Defense missile tip undergoes testing at hypervelocity wind tunnel

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Within 30 minutes, an intercontinental ballistic missile could be launched from any location in the world and strike somewhere in the United States. Today, over 200,000 forward deployed American Soldiers, Sailors, Airmen, and Marines are at risk from short- to intermediate-range ballistic missiles located in North Korea and Iran.[1] On July 4 and 5, 2006, North Korea launched seven ballistic missiles, including a long-range Taepo Dong–2.[2] In October of that year, North Korea detonated a nuclear device.[3] During the Great Prophet exercise conducted in November, Iranian state television reported that dozens of ballistic missiles were fired, some capable of striking Israel, Turkey, and American bases in that region. These events demonstrate that ballistic missiles are not a future threat, so there is an urgent need to rapidly deploy a ballistic missile defense capability.

Deterrence

The emerging missile threat from hostile states is fundamentally different from that of the Cold War and requires both a different approach to deterrence and new tools for defense. Today's rogue leaders view WMD as weapons of *choice*, not of last resort. These weapons are their means to compensate for U.S. conventional strength, allowing them to pursue their objectives through coercion and intimidation.

To deter such threats, the United States must devalue ballistic missiles as tools of extortion and aggression by fielding defenses. Although missile defenses are not a replacement for an offensive response capability, such defenses are a critical dimension of deterrence. Missile defenses will also help to assure U.S. allies and friends and to dissuade countries from pursuing ballistic missiles by undermining their military value.[4]

Fighting and winning wars are the main missions of the U.S. Armed Forces; however, deterring wars, one of our strategic priorities, is always preferable. To ensure credible deterrence across the range of threats in the current strategic environment, the Chairman of the Joint Chiefs of Staff has expressed the need for a "New Triad" consisting of improved global strike capability, further developed global missile defense systems, and modernized strategic weapons systems and infrastructure. Also, increased emphasis is needed not only on development of American capabilities but also on building the capacity of partners to counter threats and to promote regional stability.[5]

Missile Defense Agency

The Missile Defense Agency (MDA) was established to integrate all missile defense programs and technologies into one Ballistic Missile Defense System (BMDS), which will provide integrated, multilayered defense to intercept ballistic missiles of all ranges and in all phases of flight.

To develop and field the BMDS, the MDA has instituted an evolutionary, capability-based acquisition approach called *spiral development*. BMDS fielding opportunities are structured to occur in "blocks." Each block consists of planned fielded capabilities against specified threats. Block 1, for instance, is defense of the United States from North Korean long-range threats. Block 2 is defense of allies and deployed forces from short- to medium-range threats (in one theater/region, and so on). Blocks 1, 3, and 4 deliver capabilities for long-range defenses, while Blocks 2 and 5 deliver capabilities to address the shorter range threats. These blocks deliver element capabilities that are ready for continued rigorous testing and full BMDS integration. Each block enhances BMDS capabilities that were previously fielded. This approach allows missile defense capabilities to be put in play as soon as technically feasible, but only after a disciplined, robust, technological process and demonstrated success.

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Over time, this spiral development approach will integrate all of the segment elements into a layered missile defense system that is capable of defeating ballistic missiles of all ranges and in all phases of flight.

Guided missile cruiser USS *Lake Erie* launches Standard Missile–3 to destroy nonfunctioning National Reconnaissance Office satellite, February 2008

U.S. Navy

Initial BMDS

With the initial fielding in 2004 of Ground-based Midcourse Defense (GMD), seabased Aegis Ballistic Missile Defense (BMD), and Command, Control, Battle Management, and Communications (C^2BMC) elements, the MDA established a Limited Defensive Capability for the United States against a North Korean long-range missile threat. This is the first priority of the BMDS implementation strategy. Included in this priority is the fielding of protection for deployed forces from shorter range threats with Patriot Advanced Capability–3 (PAC–3) batteries and Aegis BMD engagement ships.

To complete the initial BMDS configuration, the Seabased X-band radar (SBX)

completed sea trials and commenced integration testing. The SBX radar is a unique combination of advanced X-band radar with a mobile, ocean-going, semisubmersible platform. The X-band radar tracks and discriminates ballistic missiles and cues other BMDS sensors and weapons systems. The mobility of the platform allows the radar to be repositioned as needed to provide coverage of possible threat ballistic missile launches. The SBX radar is based at Adak, Alaska.

Also, the first Forward Deployable Radar (AN/TPY–2) was stationed in Japan. This transportable, forward-based X-band radar provides early warning, detection, and tracking of ballistic missiles. TPY–2 information is transmitted to other BMDS sensors and weapons systems, via the BMDS command and control system, to facilitate engagement of threats to the U.S. homeland, deployed forces, allies, and friends. It is designed to be transportable by ground, air, roll-on/roll-off ship, and rail. The radar consists of a solid-state, phased array antenna supported by electronics and cooling units.

This Block 1 BMDS configuration (for example, GMD, Aegis BMD, C²BMC, SBX, and TPY–2) was put to a real-world test during the North Korean missile firings. As the situation escalated, the BMDS was turned over to warfighters. Aegis BMD long-range surveillance and track (LRS&T) destroyers patrolled the Sea of Japan to provide early warning to the BMDS of a Taepo Dong–2 launch. The positioning of the TPY–2 radar was accelerated to provide more coverage of a possible launch. The SBX radar was stationed off Hawaii for similar purposes. North Korea launched seven ballistic missiles, including a long-range Taepo Dong–2, which spurred a limited operational activation of the BMDS that, according to the commander of U.S. Strategic Command, "demonstrated a credible operational missile defense capability for homeland defense."[6] For the first time in U.S. history, we had the capability to defend ourselves from a long-range ballistic missile attack.[7]

Since the North Korean missile firings, the MDA has increased the breadth and depth of missile defenses by adding more forward deployed network sensors. In addition to the Cobra Dane radar in Alaska, the testing and integration of fixed radars in California and the United Kingdom were completed. In 2007, MDA began negotiations with Poland and the Czech Republic to deploy long-range defenses in Europe. An integrated, layered BMDS will complicate any attack, reducing the military use of ballistic missiles, discouraging the proliferation of such technology, and bolstering deterrence.

Aegis BMD

To fulfill the seabased portion of the initial missile defense capabilities, the MDA, working closely with the Naval Sea Systems Command and other Navy organizations, has brought the Aegis BMD 3.6 Weapon System into service. The Aegis BMD element of the BMDS consists of the Aegis BMD Weapon System armed with the Standard Missile–3 (SM–3) Block IA missiles.

Aegis BMD 3.6 contributes two major warfighting capabilities to the BMDS. The first warfighting capability provides the engagement of short- to intermediate-range, unitary, and separating ballistic missiles in the midcourse phase of flight with the SM–3 Block IA missiles. This capability is integrated into a weapons system configuration that includes LRS&T. Aegis ships, manned with naval Sailors and officers, have recently completed a series of firing missions to validate the operational capabilities of Aegis BMD against a progressively more complex set of targets and scenarios, compiling a record of 12 successful intercepts in 14 attempts.

The flexibility of this capability was demonstrated by the recent intercept of an errant U.S. satellite. The satellite was higher, faster, and larger than any previous target. Modifications were made to the Aegis BMD Weapon System and the SM–3 missile to accommodate these new target challenges. The USS *Lake Erie* detected the satellite in its orbit with the AN/SPY–1 radar. A fire control solution was calculated and a SM–3 missile was fired. The missile collided with the target, destroying it with lethal force and therefore rupturing the hydrazine tank. The intercept speed was calculated at approximately 22,000 miles per hour.

Seabased X-band radar docked at Pearl Harbor Naval Station for maintenance and upgrade

U.S. Navy (John W. Ciccarelli, Jr.)

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The second capability is provided by LRS&T installations that can search, detect, and track ballistic missiles of all ranges, including intercontinental ballistic missiles, and transmit the track data to the BMDS via C²BMC. This tracking data cues other BMDS sensors, as well as assisting in the fire control solution of the GMD system.

At Sea, on Patrol

The USS *Curtis Wilbur*, equipped with the LRS&T capability, made history when it began the Nation's first BMD patrol, arriving on station September 30, 2004.[8] Forward deployed ships tracking ballistic missiles and transmitting track data to the BMDS extend the battlespace. Earlier detections enable earlier GMD fire control solutions, winning back critical reaction time. Earlier fire control solutions enable engagements at longer ranges and the opportunity to reengage. Due to their mobility, Aegis ships can quickly maneuver to different locations for surveillance operations. Undoubtedly, the Aegis BMD LRS&T capability significantly complements the initial BMDS and therefore devalues the military value of a long-range ballistic missile system.

The Aegis BMD engagement capability supports forcible entry and protects forward deployed forces, population areas, debarkation ports, amphibious objective areas, expeditionary forces, and coastal airfields from the ballistic missile threat. Stationed close to a launch site, these Aegis ships increase the engagement battlespace with the ascent phase intercept capability. For homeland defense, the engagement capability would protect U.S. coastal cities against an off-shore ballistic missile launch. The MDA, Aegis BMD, and Navy are aggressively moving out to deploy this engagement capability against short- to intermediate-range, unitary, and separating ballistic missiles on more Aegis ships to add to the combatant commanders' arsenal in times of crisis.

Deployment

The Missile Defense Agency and the Navy are modifying 18 Aegis combatants to conduct ballistic missile defense operations. At the end of 2007, 10 warships could track and destroy ballistic missiles while conducting other tasks simultaneously; another 7 warships were also available to track ballistic missiles in support of BMDS operations. All 18 ships will have the ability to destroy ballistic missiles by the end of 2008. Sixteen of these ships are assigned to the Pacific Fleet. The remaining two ships are assigned to the Atlantic Fleet with the first Aegis destroyer receiving the BMD upgrade in December 2007.

New Maritime Strategy

Maritime BMD is a new capability for preventing wars. Since the end of the Cold War, the United States has shifted emphasis from preparation for a global war to more frequent use of expeditionary forces to contain regional conflicts. The rapid proliferation of ballistic missiles among potential regional adversaries requires a dramatically increased U.S. capability for BMD. National objectives include protection of forward deployed and expeditionary elements of our Armed Forces and the ability to support the defense of friendly forces and allies, including important seaports, airfields, and population centers. The goal is not only actual defense against ballistic missiles but also the strengthening of U.S. security relationships and reassurance for allies.

BMD supports broader political goals because it can help discourage the proliferation of ballistic missile technology and WMD by reducing incentives to develop, acquire, or use these weapons. Furthermore, the ability to extend reliable protection to allies and friends can have a significant mitigating effect on their desire to produce or acquire their own offensive systems as a deterrent against other nations in a region. At the same time, it can encourage the willingness of potential allies to act in concert with the United States during a conflict.

Deploying long-range BMD at sea provides a dramatic deterrent and war-winning capability. Because we can position ships

maritime BMD is a new capability for preventing wars

closer to anticipated ballistic missile launch points, our Aegis cruisers and destroyers can provide hundreds of thousands of square kilometers of defended area, encompassing entire geographic regions. The world's oceans permit this forward positioning at sea, enabling the Navy to achieve ascent phase intercept in just the areas we are most likely to need it (for example, the Sea of Japan, Arabian Gulf, and the Mediterranean Sea).

Forward deployed BMD ships also provide substantial political and military leverage. Naval forces are mobile. They can arrive on the scene early and sustain themselves for days. In fact, naval forces are normally the first on scene when a crisis is imminent. They provide great operational flexibility. Naval ships project a positive and engaged U.S. image to reassure friends and to encourage regional stability. They are relatively independent of host nation support and can influence political events immediately on arrival. BMD-equipped ships buy time for negotiation and promote the cohesion essential for allied coalitions.

If not already on station, naval ships provide the means to bring initial BMD capability into a theater in a few days with substantial additional forces within 10 days. This greatly eases the demand on airlift and sealift to bring in BMD defenses early to protect the very ports and airfields from which these forces must debark. Aegis BMD ships enable the combatant commander to concentrate available lift on antiarmor, tactical aviation support, tanks, troops, ammunition, and other reinforcements needed to deter or stop the enemy advance in a crisis.

Near-term Capabilities

The deployment of Aegis BMD is only the start of this new Navy core mission; we must be prepared for a variety of ballistic missile threats. Depending on the range of the hostile missile, we may have to engage in the terminal phase instead of the midcourse phase. Longer-range ballistic missiles may be more sophisticated and deploy decoys, and we need to be able to combat these threats to devalue their military use.

Missile Defense Agency

First ground-based interceptor lowered into silo at Fort Greely, Alaska, 2004

Terminal Capability. In 2006, the Navy and MDA successfully intercepted a short-range ballistic missile in the terminal phase with a modified SM–2 Block IV missile. The success of this demonstration, called Pacific Phoenix, resulted in a joint Navy-MDA venture to deploy a near-term seabased terminal (SBT) capability. The Navy is funding the modification of existing SM–2 Block IV missiles, and MDA is funding the development, integration, and test of the SBT capability into the Aegis BMD Weapon System. The SBT capability is scheduled to deploy in fiscal year 2009. With the addition of the SBT capability, Aegis BMD has increased its role in the BMDS to include not only midcourse engagement of short- to intermediate-range ballistic missiles but also terminal engagement of short- to medium-range ballistic missiles, a significant contribution to the BMDS and deterrence.

THAAD Interface Testing. Aegis BMD has been conducting advanced engineering on exchanging track data with the developmental Terminal High Altitude Area Defense (THAAD) system, which is a land-based element capable of intercepting ballistic missiles both inside and just outside the atmosphere. It consists of four major components: truck-mounted launchers, interceptors, X-band radar, and fire control/communications. During the 2008–2010 timeframe, engineering and testing efforts will continue to develop and demonstrate THAAD and Aegis BMD engagement coordination.

Over time, more missile defense elements and capability upgrades will be developed and integrated into the BMDS; therefore, the number of engagement opportunities will also increase, enabling layered defense. In the near future, midcourse (Aegis BMD) and terminal missile defense systems (Patriot, THAAD, TPY–2, and Aegis BMD) will coordinate engagements of short- and medium-range ballistic missiles. Integrated, layered defense will be realized as tracking information is shared among these systems, enabling a midcourse engagement opportunity followed by terminal engagements.

Longer-range Threat Set. Longer-range, multistaged ballistic missiles eject a reentry vehicle (RV) or warhead during their midcourse phase of trajectory. The size of the RV is much smaller than the missile or missile stages and challenges the performance capability of the tracking sensor. Tracking the small-sized RV is further complicated by other target-like objects in the same vicinity. The initial radar returns of all these objects result in a display of a cluster of radar video. Objects are difficult to differentiate. These objects, such as other missile sections, separation debris, and hot fuel chuffing (burning chunks of solid fuel), must be tracked and identified in the radio frequency (radar) and infrared (missile) spectrums. Each object must be eliminated from target consideration in order to correctly identify the RV.

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RADM Alan Hicks briefs media after cooperative Aegis ballistic missile defense intercept flight test

U.S. Navy (Johnny I. Michael)

Tracking Improvements. Aegis BMD's improved sensor discrimination involves the SPY–1 radar's signal processor and the SM–3 kinetic warhead's infrared seeker. The Aegis BMD Signal Processor provides real-time discrimination capability, which enables tracking of individual objects and identification through the use of advanced algorithms. Two-color sensor technology in the SM–3 seeker provides the capability to sense infrared information in two distinct wavebands, improving the identification of multiple, closely spaced objects. The two-color seeker improves sensitivity for longer-range targets, high-speed processing for multiple tracks, and robust performance against complex threats. Both of these discrimination capabilities have been tested in earlier flight test missions and will be deployed in the 2010–2011 timeframe.

Missile Improvements. The SM–3 Block IB is the next seabased missile spiral upgrade. The seeker, signal processor, and propulsion system of the SM–3 Block IB missile kinetic warhead (KW) are improved over those of the SM–3 Block IA. These improvements result in sustained high effectiveness against increasingly longer-range and sophisticated ballistic missiles.

Since flight test mission (FTM) 04–1, the design and development of the SM–3 two-color seeker has progressed. Early design telescopes have been built and tested with the results used to iterate preliminary design. The Advanced Signal Processor provides increased capability to support new discrimination algorithms. The SM–3 Block IB Sensor preliminary design review was successfully conducted in February 2007. Proof-of-design telescopes are in fabrication, and the design was finalized at the critical design review in late 2007.

The new propulsion system for the KW is the Throttleable Divert and Attitude Control System (TDACS), which is a proportionally controlled propulsion system with multiple thrusters to maneuver the KW to an intercept. This throttling capability provides robust flexibility. TDACS enables the KW to vary its thrust and operational maneuvering time. The propulsion system is also easier to produce, thus reducing the per unit missile cost. A prototype TDACS successfully completed a ground test simulating space flight in July 2006. A preliminary design review was conducted in April 2007, and a series of component experiments and tests was conducted throughout the summer.

The SM–3 Block IB development effort is scheduled to support a flight test in mid-2010. Delivery of fleet deployment rounds is expected to begin in 2011. This missile upgrade, in combination with the BMD signal processor, provides not only the Aegis BMD but also the BMDS with

significant capability to identify closely spaced objects and improve the probability of kill against advanced threats.

Future Capability

As MDA proceeds with the spiral development of the BMDS into the next decade, the emphasis will be on a missile defense force structure that features a persistent, real-time global detection, tracking, and fire control capability, as well as upgraded seabased interceptors with increased range and velocity to defeat the long-range ballistic missile threat. In response to the MDA's long-term strategy, Aegis BMD's future capabilities are focused on increasing the seabased missile defense force structure and developing a faster, longer-range, and more agile missile.

Open Architecture. Historically, cruisers and destroyers are decommissioned earlier than their designed service life unless their combat systems are modernized. If ships' combat systems cannot evolve to match projected threats, they are relegated to lesser duties until scrapped. The Aegis cruisers and destroyers are at their designed midservice life. Modernization of these combat systems will maintain their warfighting relevance, continue supportability with new technology, and establish the computing infrastructure and computer program architecture from which additional warfighting capabilities will be implemented with the lowest possible cost and schedule impact.

The Navy and MDA are engaged in a joint effort to integrate the Aegis BMD capability with the Aegis Modernization Program's Open Architecture (OA) environment. The endstate of this joint program is a more robust, multimission capability fielded in modernized Aegis ships. The Navy gains a modernized fleet of Aegis cruisers and destroyers and increased operational flexibility enabled by the option to host the BMD capability on any ship within the modernized fleet. The Navy also benefits from streamlined in-service support as a result of the consolidation and reduction in the number of combat system configurations. The Aegis OA program is key to expanding the Aegis BMD capability to the entire fleet of Aegis ships, with a proposed total of 84 ships. The modernization program also provides the foundation for implementing Aegis BMD in 80 allied navy ships.

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Higher Velocity, Longer-range Missile. The longer-range missile, SM–3 Block IIA, is being codeveloped with Japan. The upgrade increases the range and velocity of the missile, providing reach, firepower, operational flexibility, and performance—all of which are key warfighting objectives sought in the missile defense mission. With the addition of enhanced sensor performance, more hostile ballistic missiles can be engaged, with a greater probability of kill, which produces an increase in the defended "footprint." The large missile magazine capacity of Aegis ships allows for multiple engagement opportunities per ballistic missile, again enhancing probability of kill. For a given defended region,

Guided missile cruiser USS *San Jacinto* (foreground) and Russian navy destroyer in Mediterranean

U.S. Navy (Justin Phillips)

fewer ships are needed to be employed in the BMD role due to the increased reach and firepower of the Aegis BMD SM–3 Block IIA when combined with the BMDS. The SM–3 Block IIA's performance provides the necessary flyout acceleration to engage intermediate-range ballistic missiles and some intercontinental ballistic missiles.

International Efforts

The United States and Japan are working together to build a multilayered regional BMD system. The elements are already in place and operational, awaiting the Block 2 Engagement Sequence Groups, which integrate Aegis BMD, TPY–2 radar, and PAC–3.

In 2006, MDA, in conjunction with U.S. Pacific Command, completed deployment activities for the TPY–2 radar in Japan. Information from the TPY–2 radar will be shared between U.S. and Japanese forces. In 2007, the first PAC–3 battery was deployed.

In June 2006, USS *Shiloh* participated in FTM–10 and successfully intercepted a medium-range, separating ballistic missile target using the operational Aegis BMD weapon system. Shortly after FTM–10, the *Shiloh* deployed with the Aegis BMD–certified engagement capability and shifted homeports to Yokosaka, Japan. Meanwhile, the engagement upgrade commenced for Aegis BMD LRS&T destroyers. All Aegis BMD LRS&T destroyers homeported in Yokosaka have been upgraded to the engagement capability.

The *Shiloh* and these Aegis BMD engagement destroyers comprise a most capable BMD Surface Action Group. With the TPY–2 radar and PAC–3 batteries stationed in Japan, these BMD assets form a sound foundation for a regional BMDS. Upon fielding the Block 2 Engagement Sequence Groups, the Northwestern Pacific theater will have a robust, multilayered BMDS to provide increased protection to our deployed forces, friends, and allies against short- to intermediate-range ballistic missiles.

International Participation in Flight Tests. Using its time wisely while waiting for its first BMD ship to be modified and SM–3 missiles produced, Japan is participating in Aegis BMD flight tests *now*. In June 2006, the Maritime Self-Defense Force ship JS *Kirishima* became the first allied ship to participate in a maritime domain awareness flight mission, FTM–10. With a minor modification to its Aegis Weapon System, JS *Kirishima* successfully tracked the separating ballistic missile target.

Such international participation continued in the follow-on flight test, FTM–11. In this flight mission, the Royal Netherlands Navy ship HNLMS *Tromp* tested modifications to its Signal Multi-beam Acquisition Radar for Tracking–L (SMART–L) system. The ship's radar searched for, detected, and tracked the ballistic missile. Tracking data were also exchanged with an Aegis BMD destroyer. The Spanish navy Aegis-equipped Frigate *Méndez Núñez* participated in FTM–12, using the flight test as a training and preparedness activity to assess the future BMD capabilities of their F–100 class. Again, with a minor modification to its Aegis Weapon System, *Méndez Núñez* successfully detected and tracked the medium-range, separating ballistic missile target.

As the success of Aegis BMD continues, more allied navies are actively participating in U.S. flight tests as preliminary training, proof of concept, or predecisional test and training feasibility events to assess the potential of a seabased missile defense capability.

Potential Global Seabased BMD Force. The Aegis Weapon System—with such major components as the SPY radar, standard missile, and vertical launching system—is the foundation for the Aegis BMD system. In addition to Japan, the Aegis Weapon System has been sold to Australia, Norway, South Korea, and Spain. By their procurement of the basic weapon system, these allied countries are investing in the prerequisites to a possible BMD capability upgrade.

Countries that do not have the Aegis Weapon System are also interested in BMD. The United Kingdom is actively conducting a BMD capability study with the United States, concurrent with a joint research effort of S-band radar technologies. Other countries are investigating the potential of using SM–3 and the vertical launching system with their air search radars. The Netherlands participated in a recent Aegis BMD flight test to determine the BMD potential of its F–124 frigates. More and more nations are expressing interest in cooperative studies to support a seabased BMD capability as a critical mission for their navies.

The ballistic missile is a global weapon. MDA has made substantial progress toward increasing not only missile defense coverage for friends and allies, but also allied participation in developing and deploying missile defense systems. Multilayered defense for the Northwestern Pacific theater will be realized in the near future when Aegis BMD (midcourse and terminal), TPY–2 radar, and PAC–3 are fielded. Allied navies are actively participating in U.S. missile defense flight tests. Joint studies have led to research and now joint development. BMD foreign military sales cases have been established. The potential exists for a global land- and seabased BMD force through a coalition of international cooperation.

Aegis Ballistic Missile Defense enhances global and regional deterrence, providing an umbrella of protection to forward deployed forces and friends and allies, while performing a strategic role in homeland defense. The Missile Defense Agency, with significant contributions from Aegis BMD, and our allied coalition members are forming the initial foundation of international cooperation to deter and defeat a critical transnational challenge, the proliferation of ballistic missiles. **JFQ**

NOTES

[1] General Peter Pace, Chairman of the Joint Chiefs of Staff, Posture Statement, Testimony before 110th Congress, Senate Committee on Armed Services, February 6, 2007.

[2] U.S. Northern Command, press release, July 4, 2006.

[3] BBC News, "North Korea Claims Nuclear Test," October 9, 2006.

[4] National Policy on Ballistic Missile Defense, fact sheet, May 20, 2003.

[5] Admiral Michael G. Mullen, Chairman of the Joint Chiefs of Staff, Posture Statement, Testimony before 110th Congress, House Armed Services Committee, February 6, 2008.

[6] General James E. Cartwright, USMC, Commander, U.S. Strategic Command, Testimony before Strategic Forces Subcommittee, House Armed Services Committee, March 8, 2007.

[7] Lieutenant General Henry A. Obering III, USAF, Director of Missile Defense Agency, Testimony before Strategic Forces Subcommittee, House Armed Services Committee, March 27, 2007.

[8] Admiral Vernon Clark, USN, Chief of Naval Operations, Testimony before Senate Committee on Armed Services, February 10, 2005.