Shielded from Oversight

The Disastrous US Approach to Strategic Missile Defense

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Appendix 1: The Development of the GMD System

Union of Concerned Scientists

The origins of most of the technologies and systems used in the current Ground-based Midcourse Defense (GMD) missile defense system can be traced back decades, in some cases to the Strategic Defense Initiative or even earlier. However, the current GMD system resembles in many respects the National Missile Defense (NMD) architecture proposed by the Clinton administration in 1996. That similarity is not surprising given the continuity of the technology and the interest of the George H. W. Bush Administration in deploying a system rapidly.

The Clinton NMD System's Origins

Throughout his terms in office, President Clinton was skeptical about the technical feasibility of an NMD system and of the imminence of the threat; he was also concerned about the effects of deploying an NMD system on US–Russian relations and the prospects for efforts to further reduce nuclear weapons. In late 1995, he vetoed the fiscal year (FY) 1996 Defense Authorization bill primarily because it required deployment of an NMD system by 2003. However, under continuing pressure from the Republican-controlled Congress, in 1996 the Clinton administration announced its "3+3" program.

Under the 3+3 plan, the United States would spend the first "3" years developing the components of an NMD system. If at the end of this period, in 2000, a decision was made to deploy, then an operational system would be ready in a further three years—by 2003. If no decision to deploy was made in 2000, then development would continue such that the system would remain deployable within three years of a decision to do so.

On September 1, 2000, President Clinton announced that he had decided not to deploy, in effect passing the decision on to the next president. Clinton argued, "I simply cannot conclude with the information that I have today that we have enough confidence in the technology, and the operational effectiveness of the entire NMD system, to move forward to deployment." He singled out the problem of countermeasures, stating, "There are also questions to be resolved about the ability of the system to deal with countermeasures." [1]

The Clinton NMD System's Architecture

Had President Clinton decided to begin deployment, the NMD system would have been fielded in three increasingly capable phases. As is standard practice for new military systems, specific requirements had been set for each phase of this system, although these were classified. The first phase, known as the Capability 1 (C-1) system, was primarily oriented toward North Korea.[2] The C-1 system was intended to counter a relatively simple threat (the C-1 threat), the details of which were, and still are, classified.

The C-1 system would have deployed at first 20, and eventually 100, Ground-Based Interceptors (GBIs) at Fort Greely in central Alaska. Each GBI would have been armed with a hit-to-kill Exo-atmospheric Kill Vehicle (EKV), which would have used an infrared sensor to home in on the target during the relatively long midcourse portion of the target's trajectory, during which it is in outer space above the atmosphere. The EKV would then use its divert thrusters to maneuver into a direct high-speed collision with the target.

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[1] Clinton, W. 2000. Remarks by President Bill Clinton on national missile defense. ***Arms Control Today***, September 1. Online at ***www.armscontrol.org/act/2000_09/clintonnmd***. Note: All URLs in footnotes to this appendix were accessed June 5, 2016.

[2] For a description of the three phases of the Clinton NMD system, see: Sessler, A.M., J.M. Cornwall, B. Dietz, S. Fetter, S. Frankel, R.L. Garwin, K. Gottfried, L. Gronlund, G.N. Lewis, T.A. Postol, D.C. Wright. 2000. ***Countermeasures: A technical evaluation of the operational effectiveness of the planned US National Missile Defense system.*** Cambridge, MA: Union of Concerned Scientists and MIT Security Studies Program. April. Online at ***http://www.ucsusa.org/sites/default/files/legacy/assets/documents/nwgs/cm_all.pdf***.

The core sensor infrastructure of the C-1 system would have been provided by upgrading five existing early warning radars in Alaska, California, Massachusetts, Greenland, and England. These relatively low-frequency radars (440 megahertz), now referred to as Upgraded Early Warning Radars (UEWRs), would be able to track targets accurately enough to guide GBIs to potential intercepts. However, they would have essentially no capability to distinguish warheads from decoys or other objects, that is, to perform the essential task of discriminating among targets, nor could they be upgraded to be able to do so. Existing Defense Support Program (DSP) early warning satellites and their future replacements would have been relied upon for the initial detection of missile attacks and cueing of the early warning radars.

The key discrimination sensors of the system were to have been large X-band Ground Based Radars (GBRs) specifically designed and built for the NMD mission. The GBRs, operating at about 10 gigahertz, would have emphasized precision tracking and discrimination capabilities. The C-1 system, with its primary orientation against North Korea, would have deployed a single GBR at Shemya Island, Alaska, at the western end of the Aleutian Islands chain.

The fully realized Clinton NMD system (Capability 3, or C-3), would have added a second interceptor site, most likely at the former Safeguard site in North Dakota. It would also have brought the total number of interceptors up to 250. But the C-3 system differed from the C-1 most notably in its sensor system. It would have deployed as many as eight additional X-band GBR discrimination radars at sites spanning much of the northern hemisphere. It would also have deployed a space-based missile tracking system of infrared sensors (known as SBIRS-Low) consisting of some 24 satellites in low earth orbit. SBIRS-Low would have been able to provide track data that were accurate enough to guide interceptors to the vicinity of their targets without assistance from other sensors. SBIRS-Low was also intended to assist with target discrimination by providing information, such as temperature and infrared signal strength and variation, about the objects in a missile threat cloud.

At the time of Clinton's announcement in 2000 deferring a deployment decision, the NMD deployment schedule had already slipped, with the earliest operational date for the C-1 system being 2005 or later, and with the completion of the C-1 deployment delayed until at least 2007.

The Bush Administration's Vision for National Missile Defense

As a presidential candidate, George W. Bush argued that the Clinton administration's approach to NMD was "flawed—a system initially based on a single site, when experts say more is needed."[3] He further stated that the Clinton administration was "driving towards a hasty decision, on a political timetable." Instead, he argued that "America must build effective missile defenses, based on the best available options, at the earliest possible date. Our missile defense must be designed to protect all 50 states—and our friends and allies and deployed forces overseas—from missile attacks by rogue nations or accidental launches."[4] Thus, he entered office with a firm commitment to missile defense deployments, and to NMD deployment in particular.

The Bush administration's missile defense program envisioned an ultimate objective of a single integrated ballistic missile defense system against missiles of all ranges, covering not only US territory but also US forces abroad and the territories of allies. It formally abolished the distinction between theater and national missile defenses, although in practice most missile defense systems could still be readily identified as either theater or national systems. For example, the Ground-based Midcourse (GMD) system was clearly a national missile defense system and Patriot was a theater system.

Fundamental Changes to Oversight and Acquisition

Unlike the Clinton NMD system, the Bush administration's missile defense system did not start out with a well-defined architecture and threat, but instead employed an incremental approach in which the architecture of the system was to evolve as the system was developed. A key aspect of that approach was to be the use of "spiral development," which the Bush

[3] Bush, G.W. 2000. Missile defense now. ***The Washington Times***, May 25. Online at ***www.washingtontimes.com/news/2000/may/25/20000525-011405-4469r/***.

[4] Bush, 2000.

Administration argued would allow it to deploy needed missile defense systems to the field more rapidly.

Under spiral development, rather than developing the missile defense system to meet a specific set of final requirements, an initial version would be developed and deployed. The system would subsequently be further developed in an incremental manner as technology development and testing proceeded and as the requirements for the defense system changed. Thus the final configuration of and capabilities of a system might not be known until well after its development and deployment had begun. The Missile Defense Agency (MDA) explicitly emphasized the possibility of deploying prototype systems for operational use in an emergency.[5]

To employ this evolutionary spiral approach, in early 2002, the Pentagon exempted the MDA from existing rules requiring that military systems be built to meet detailed specific requirements.[6] The MDA was also exempted from standard reporting requirements about programs' progress and cost. The Pentagon's Director of Operational Test & Evaluation would have decreased oversight of the MDA's programs. The Pentagon further announced that information about targets and decoys used in testing the GMD system would be classified.[7]

Deployment of the GMD System

Once in office, the Bush administration moved forward quickly. In December 2001, it gave the legally-required six months advance notice of its intent to withdraw from the 1972 Anti-Ballistic Missile (ABM) Treaty, which forbade both the United States and the former Soviet Union from constructing a missile defense system that protected their entire national territories. The United States then formally withdrew from the Treaty on June 13, 2002. Two days later, construction of interceptor silos at Fort Greely, Alaska began. On December 17, 2002, President Bush announced that he had directed the secretary of defense to begin fielding a ground-based national missile defense against long-range ballistic missiles, to achieve initial operational capabilities in 2004.[8] This national missile defense system became known as the Ground-based Midcourse Defense (GMD) System.

The establishment of this ambitious two-year deadline for achieving a GMD operational capability had several important consequences. First, it meant that the system would have to be structured out of components already under development and the resulting system would thus closely resemble the proposed Clinton C-1 system. Second, as discussed above, the standard Department of Defense regulations on developing, testing, and acquisition of military systems would have to be significantly relaxed if not entirely bypassed.

Deployment of Ground-Based Interceptors began on July 22, 2004 when the first GBI was deployed in a silo at Fort Greely Alaska. On September 30, when five interceptors were in place, the administration declared that the GMD system had achieved a limited deployment option (LDO) capability, meaning the system was now capable of being turned on and used if necessary. Northern Command, the operator of the GMD system, formally accepted this capability on December 31, 2004, when the system had eight GBIs deployed: six at Fort Greely and two at Vandenberg Air Force Base in California.

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[5] According to then Ballistic Missile Defense Organization (BMDO) Director Lt. General Ronald T. Kadish, the program is designed so that "in an emergency and, if directed, we might quickly deploy test assets to defend against a rapidly emerging threat." Kadish, R. 2001. Statement before the House Armed Services Committee. July 19. Online at ***www.mda.mil/global/documents/pdf/ps_kadish19jul01.pdf***.

[6] Graham, B. 2002. Rumsfeld pares oversight of Missile Defense Agency. ***The Washington Post***, February 16, A2. Online at ***https://www.washingtonpost.com/archive/politics/2002/02/16/rumsfeld-pares-oversight-of-missile-defense-agency/ae1ac912-b01c-4a27-8821-8cc4c68c81d7/***. According to General Kadish, the missile defense system would not be hindered by "rigid military requirements" (Kadish 2001).

[7] Graham, B. 2002. Secrecy on missile defense grows. ***The Washington Post***, June 12, A10. Online at ***www.washingtonpost.com/archive/politics/2002/06/12/secrecy-on-missile-defense-grows/f09acd4e-10ac-4fcd-8142-102efa7866d9/***.

[8] White House, The. 2002. President announces progress in missile defense capabilities. Statement by the President. December 17. Online at ***http://georgewbush-whitehouse.archives.gov/news/releases/2002/12/20021217.html***. National policy on ballistic missile defense, National Security Presidential Directive 23 (December 16, 2002) states that "The United States plans to begin deployment of a set of missile defense capabilities in 2004. These capabilities will serve as a starting point for fielding improved and expanded capabilities later." Online at ***http://fas.org/irp/offdocs/nspd/nspd-23.pdf***.

In addition to command, control and communication facilities and existing DSP early warning satellites, these eight interceptors were supported by the Upgraded Early Warning Radar at Beale Air Force Base in California and the Cobra Dane radar on Shemya Island in the Aleutians. In addition, several US Navy Aegis destroyers with Long-Range Surveillance and Tracking (LRS&T) upgrades could be forward deployed to provide early tracking data of North Korean ballistic missile launches.

The architecture and robustness of the Bush GMD system was affected by the decision to initially set it up as missile defense test bed that could be used operationally if necessary.[9] For example, for range safety reasons, test launches of interceptors cannot be conducted out of the interceptor deployment site at Fort Greely Alaska. Thus, five test launch silos were built at Vandenberg Air Force Base in California, four of which were ultimately used for deploying operational GBI interceptors.

More significantly, the Bush Administration argued that, rather than building the large X-band GBR radar at Shemya as in Clinton's initial NMD system, for testing purposes it would be more useful to build a smaller version of this radar on a sea-going platform. Such a mobile radar, it was argued, could support a much wider range of testing scenarios than a fixed radar at Shemya could and would also cost less. Thus the proposed GBR at Shemya was never built and instead the Sea Based X-band (SBX) radar was built on a modified ocean-going oil drilling platform. The SBX radar reached Hawaii in early 2006 and first participated in a GMD flight test in September 2006. Although it originally was to be home ported at Adak Island in the mid-Aleutians, the SBX radar now is based primarily in Hawaii, from which it deploys for GMD tests or other purposes (see Appendix 2: The Sea-Based X-Band (SBX) Radar).

Unlike the Clinton NMD plan, the GMD system explicitly incorporated two types of smaller forward-based radars: the TPY-2 X-band radar and the S-band Aegis radar on US Navy cruisers and destroyers. The TPY-2 is an air-transportable, ground-based radar. It is used both as a forward-based radar and as the fire control radar for the Terminal High Altitude Area Defense (THAAD) system. In the forward-based mode, a TPY-2 was deployed to northern Japan (about 1,000 km from the North Korean test launch site) in September 2006.

The SPY-1 S-band (2-4 GHz) radar on US Navy Aegis destroyers and cruisers that have received a Ballistic Missile Defense (BMD) upgrade can also operate as forward-based radars with the GMD system. When the GMD system achieved its initial operating capability in late 2004, the only ships that could fulfill this role were several that had received a LRS&T upgrade. These LRS&T ships were able to track long-range ballistic missiles early in their flights, but had no capability to engage ballistic missiles. Today, all ships that have received the Aegis BMD upgrade are capable of both the LRS&T and the engage missions. However, for missile defense purposes, both the range and the discrimination capability of an Aegis radar are significantly less than that of a TPY-2 radar

During the Bush Administration, the MDA continued the development of a space-based missile tracking system, now renamed the Space Tracking and Surveillance System (STSS). Although deployment of this system was not expected for many years, two STSS demonstration satellites were built. These satellites were eventually launched in 2009.

The GMD System at the End of the Bush Administration

At the end of 2008, the GMD system had deployed 26 GBIs out of a planned total of 44 (see Table 1). Two of the GBIs were equipped with the new and not yet flight-tested CE-II version of the EKV. Three large phased array radars (the Cobra Dane on Shemya, and the early warning radars at Beale Air Force Base in California and Fylingdales, Britain) had been upgraded and incorporated into the system. The system also included the SBX radar operating in the northern Pacific and a forward-based TPY-2 X-band radar in northern Japan. Eighteen US Navy Aegis ships had been upgraded to be capable of both the LRS&T and engage missions.[10]

[9] For a more detailed description of the test bed, see: Gronlund, L., and D. Wright. 2001. The Alaska test bed fallacy: Missile defense deployment goes stealth. ***Arms Control Today***. September. Online at ***www.armscontrol.org/act/2001_09/gronlundwrightsept01*** .

[10] O'Reilly, P. 2009. Statement before the Strategic Forces Subcommittee of the House Armed Services Committee. May 21. Online at ***http://www.mda.mil/global/documents/pdf/ps_hasc052109.pdf***.

The GMD System and European Deployments

In August 2006, the Bush Administration announced its intention to deploy a system to Europe to enhance the capabilities of the GMD system against missiles launched from Iran.[11] Under this plan, 10 two-stage versions of the GBI would be deployed in silos in Poland by the end of 2011 (a date that eventually slipped to 2018). Removing a stage from the GBI reduces its boost time by about one-third, allowing a faster response by the interceptor at the price of a somewhat reduced burnout speed. Although the existing GMD system, with three-stage GBIs located in the United States, would in principle be able to intercept ICBMs launched from Iran towards the United States, European interceptors would have allowed additional interception opportunities earlier in the Iranian ICBM's flight.

In this plan, discrimination and additional guidance for the interceptors would have been provided by a large X-band radar to be deployed in the Czech Republic, supported by a smaller forward-based TPY-2 X-band radar (its precise location was not specified) and the already existing early warning radar at Fylingdales in the United Kingdom. At the time of the announcement, the X-band radar slated to be stationed in the Czech Republic was the one known as the Ground-Based Radar – Prototype (GBR-P), a radar located at the US ballistic missile test range at Kwajalein Atoll in the Pacific Ocean, where it was used in early flight tests of the GMD system. The GBR-P was similar to, although significantly smaller than, the SBX and the never-built Clinton Administration's GBR radars.[12] The GBR-P, no longer needed for testing at Kwajalein, was to have been dismantled, refurbished, and moved, and then renamed the European Midcourse Radar.[13]

This European deployment proposal was highly controversial.[14] Critics pointed out that the 10 planned interceptors could be easily overwhelmed by Iran, and thus that the system might ultimately need to be significantly enlarged. Russia strongly objected to the plan, arguing that the system was not needed and that it would present a potential threat to some of its own strategic forces (a claim the US denied) and because it represented a further eastward expansion of US and NATO military capabilities.

Less than a year after taking office, in September 2009, President Obama cancelled the proposed European missile defense plan, replacing it with what became known as the European Phased Adaptive Approach (EPAA).[15] The EPAA involved deploying defenses to Europe in four phases. The first three phases, scheduled for 2011, 2015 and 2018 respectively, focused on regional threats and would defend Europe from possible future missile attacks from the Middle East using systems originally intended for use as theater missile defenses, such as several increasingly capable versions of the Navy's Aegis Standard Missile 3 (SM-3) interceptor (SM-3 IA, IB, and IIA) and TPY-2 forward-based X-band radars. The plan to deploy the large European Midcourse Radar in the Czech Republic was cancelled. Instead, a forward-based TPY-2 X-band radar was deployed in eastern Turkey as part of the EPAA in 2011.[16]

The fourth phase of the EPAA, initially scheduled for about 2020, would have been essentially a substitute for the Bush European Missile Defense System. In this phase, the United States would deploy a to-be-designed high-speed version of the SM-3, the Block IIB. The SM-3 IIB interceptors would be capable of intercepting Iranian ICBMs launched towards the United States and would

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[11] Reuters. 2006. US plans to propose missile defense site in Europe. ***The Washington Post***, August 16, A2. Online at ***www.washingtonpost.com/wp-dyn/content/article/2006/08/15/AR2006081501013.html***.

[12] The SBX radar has a nominal range of about 4,800 km (Dees, B. 2015. Sea-based x-band radar. Presentation to MDA small business symposium, August. Online at ***http://www.mda.mil/global/documents/pdf/osbp_15conf_SBX_Dees10.pdf***. Given its smaller size and lower power transmit-receive modules, the GBR-P's nominal range would have been about 44 percent of that of the SBX radar, or about 2,100 km.

[13] In intercept tests through 2005, targets were fired towards Kwajalein, from which the interceptors were launched, so that the intercept attempts could be observed by the GBR-P. Starting in 2006, the interceptors were launched from Vandenberg Air Force Base at targets launched from Alaska or Kwajalein, and the intercept attempts were primarily conducted using radars in the continental United States or at sea.

[14] The October 2007 issue of ***Arms Control Today*** contains several articles describing and assessing the proposed European Missile Defense System from different perspectives. Online at ***www.armscontrol.org/aca/336***.

[15] Baker, P. 2009. White House scraps Bush's approach to missile shield. ***The New York Times***, September 17. Online at ***www.nytimes.com/2009/09/18/world/europe/18shield.html***.

[16] A TPY-2 radar has a much smaller tracking range than the European Midcourse Radar (EMR)—smaller by a factor of about 0.42, based on the power-aperture-gain products of the two radars. However, the TPY-2 radar site in Turkey is about 2,000 km closer to Iran the proposed site for the EMR in the Czech Republic.

have been deployed at Aegis Ashore sites in Poland and Romania as well as on US Navy ships. Russia also raised strong objections to the EPAA, particularly about phase four.

In March 2013, citing delays in the program, the Department of Defense announced the cancellation of the Block IIB interceptor program, effectively cancelling phase four of the EPAA as well.[17] Thus, at present there are no plans to deploy interceptors in Europe capable of intercepting missiles launched from the Mideast towards the United States.

The GMD System Today

The Obama administration continued deploying the GMD system as it was planned at the end of the Bush Administration, although at a somewhat slower pace. In April 2009, citing revised intelligence assessments, the MDA announced that the planned number of GBIs was being reduced from 44 to 30. The 30th GBI was deployed in September 2010. However, in March 2013, nominally in response to a North Korean satellite launch, the Obama administration announced that the number of deployed GBIs would be increased, back to the original number of 44, by deploying 14 additional GBIs at Fort Greely by the end of 2017.[18] The last 10 of the 14 GBIs would be equipped with the new CE-II Block 1 version of the EKV (see Appendix 6: The Ground Based Interceptor and Kill Vehicle).

In 2011, the Upgraded Early Warning Radar at Thule, Greenland, was incorporated into the GMD system. Current plans call for the early warning radars in central Alaska and at Cape Cod, Massachusetts, to be upgraded and incorporated into the GMD system by 2017 and 2018 respectively.[19] These upgrades will complete the planned network of six UEWRs (including the Cobra Dane radar).

At the beginning of FY 2013, the SBX radar was placed in a "limited test operations status" in order to save on its operating costs.[20] In this status it is available for testing—it participated in FTG-07 in 2013 and FTG-06b in 2014—and can be returned to operational status if necessary. Although at one time more than one SBX radar was planned, only a single SBX radar was ever built, and it is the only large X-band radar in the current GMD system.[21]

In December 2014, a second forward-based TPY-2 radar was deployed to Japan, at Kyogamisaki in central Japan, and was subsequently incorporated into the GMD system. Four other TPY-2 radars are deployed outside the continental United States: in Turkey as part of the EPAA, in Israel and Qatar (both as forward-deployed radars), and in Guam (as part of a THAAD battery). However, there no public indication that any of these four radars have so far been incorporated into the GMD system.

As of 2015, 33 ships were Aegis BMD capable, with this total slowly increasing to 49 by 2021.[22]

In 2010–2011, the STSS space-based missile tracking system was scaled back, both in terms of number of satellites and their capabilities, and renamed the Precision Tracking Space System (PTSS). However, in April 2013, the MDA cancelled PTSS, citing doubts about its long-term fiscal sustainability. The MDA continues to operate the two STSS prototype satellites launched in 2009.

The GMD System Beyond 2017

In order to improve the GMD system's discrimination capabilities, the MDA plans to deploy a new Long Range

[17] Hagel, C. 2013. Missile defense announcement. As delivered by Secretary of Defense Chuck Hagel. The Pentagon. March 15. Online at ***http://archive.defense.gov/Speeches/Speech.aspx?SpeechID=1759***.

[18] Hagel, 2013.

[19] Syring, J. 2016. Statement before the Strategic Forces Subcommittee of the House Armed Services Committee. April 14. Online at ***http://www.mda.mil/global/documents/pdf/FY17_Written_Statement_HASC_SF_Admiral_Syring_14042016.pdf***.

[20] "In FY 2013, we will also place the SBX in a limited test operations status for affordability reasons, but we will be prepared to activate the SBX if indications and warnings of an advanced threat from Northeast Asia become evident." O'Reilly, P. 2012. Statement before the Strategic Forces Subcommittee of the House Armed Services Committee. March 6. Online at ***http://www.mda.mil/global/documents/pdf/ps_oreilly_030612_HASC.pdf***.

[21] In 2004 Congressional testimony, MDA Director Lt. Gen. Ronald T. Kadish stated that a second SBX radar was planned. Kadish, R. 2004. Testimony before the Defense Subcommittee of the Senate Committee on Appropriations. April 21. Online at ***https://www.gpo.gov/fdsys/pkg/CHRG-108shrg3910492/pdf/CHRG-108shrg3910492.pdf***.

[22] O'Rourke, R. 2016. ***Navy Aegis ballistic missile defense (BMD) program: Background and issues for Congress.*** Congressional Research Service Report RL33745. Washington, DC. May 26. Table 1. Online at ***www.fas.org/sgp/crs/weapons/RL33745.pdf***.

Discrimination Radar (LRDR) in 2020. The S-band (2-4 GHz) LRDR will be deployed at Clear Air Force Station in central Alaska (see Appendix 3: The Long Range Discrimination Radar (LRDR)). Once the LRDR is deployed, the SBX radar may be relocated to the East Coast or permanently based in Hawaii.

Rather than continuing to incrementally improve the design of the EKV, the MDA has decided to design and deploy an entirely new kill vehicle, the Redesigned Kill Vehicle (RKV). MDA hopes that the RKV, with a modular design and a more rigorous design process, will be able to provide a much higher level of reliability than it seems possible to achieve with the EKV. Under current plans, the RKV will have a (non-intercept) flight test in 2018, an intercept test in 2019, and be available for deployment starting in 2020. MDA also plans to introduce an improved version of the GBI rocket booster, including an option for a two-stage version, in about 2020.

MDA has also initiated a development program for a Multiple Object Kill Vehicle (MOKV) that could lead to deployments in the 2025–2030 timeframe. The MOKV program aims at easing the burden of discrimination by developing interceptors armed with multiple small homing kill vehicles that can attack all (or at least several) of the potentially threatening objects released by a ballistic missile. (For more details on the RKV and the MOKV, see Appendix 6: The Ground Based Interceptor and Kill Vehicle.)

Although the MDA has stated that the current GMD system already covers all 50 states and that a third interceptor site in the eastern United States is not needed for that purpose, the fiscal year 2013 National Defense Authorization Act required the MDA to conduct a study of potential interceptor basing sites in the eastern United States. In September 2013, the MDA announced that it had identified five candidate sites in the eastern United States for further study as potential interceptor deployment sites, and that one or more of these sites would subsequently be selected for Environmental Impact Studies (EIS) in order to shorten the time that would be needed to build a third interceptor site.[23] Four sites were eventually selected for EIS studies: Camp Ravenna Joint Military Training Center, Ohio; Fort Custer Training Center, Michigan; Fort Drum, New York; and the Naval Air Station Portsmouth Survival, Evasion, Resistance and Escape (SERE) School near Rangeley, Maine.[24] However, in January 2016, the Missile Defense Agency announced that the site in Maine was no longer being considered.[25] The EIS studies for the three remaining sites are to be completed in 2016. However, the MDA continues to emphasize that no decision to build an additional interceptor site has been made. (See Appendix 5: East Coast Missile Defense Site.)

[23] American Forces Press Service. 2013. Defense Department announces missile defense siting study. News release. September 12. Online at ***http://archive.defense.gov/news/newsarticle.aspx?id=120764***.

[24] Liang, J. 2014. MDA whittles down potential east coast GMD deployment sites to four. ***Inside Missile Defense***, February 5.

[25] Missile Defense Agency (MDA). 2016. SERE East designated as alternative considered but not carried forward. Press release, January 15. Online at ***www.mda.mil/news/16news0001.html***.

TABLE 1. Development of the Ground-based Midcourse Defense (GMD) System from the National Missile Defense (NMD) System (summarized from the discussion in this appendix).

	Clinton NMD C-1 System (Planned for 2005-2007) ***Clinton NMD C-3 System (Planned for post-2007)***	GMD System (As built, end 2008) ***Future plans (as of 2008)***	GMD System (As built, 2015) ***Future plans (as of 2015)***
Ground Based Interceptors (GBIs)	100 ***250***	26 ***44***	30 ***44***
Europe-based Interceptors	No	No ***10 Two-Stage GBIs in Poland***	No ***No. GBIs cancelled in 2009. SM-3 Block IIBs in Poland and Romania cancelled 2013***
Upgraded Early Warning Radars (UEWRs)	California Fylingdales, UK Thule, Greenland Cape Cod, MA Central Alaska	California Shemya, AK (Cobra Dane) Fylingdales, UK ***Thule, Greenland*** ***Cape Cod, MA*** ***Central Alaska***	California Shemya, AK (Cobra Dane) Fylingdales, UK Thule, Greenland ***Cape Cod (2018)*** ***Central Alaska (2017)***
Large X-band Radars	Shemya, AK ***7–8 additional locations***	Sea-based X-band (SBX), Pacific Ocean ***European Midcourse Radar (EMR), Czech Republic***	SBX, Pacific Ocean ***EMR cancelled 2009*** ***Long Range Discrimination Radar (LRDR) in Alaska (2020)***
Forward-based TPY-2 X-Band Radars	No	Northern Japan ***Others likely***	Two in Japan ***Others likely (Turkey)***
Aegis Ballistic Missile Defense (BMD) (Long Range Surveillance and Track (LRS&T)	No	Yes, 18 ships	Yes, 33 ships
Space-based Early Warning	Yes	Yes	Yes
Space-based Tracking	No ***SBIRS-Low***	No ***Space Tracking and Surveillance System***	No ***No. Precision Tracking Space System cancelled in 2013.***