PLRC Pacific Life Research Center

631 Kiely Boulevard * Santa Clara, CA 95051 * Phone 408/248-1815 * Fax 408/985-9716 * E-mail bob@plrc.org

PLRC-010821A This paper is current only to 29 July 2002

BALLISTIC MISSILE DEFENSE 1:[1]
BMD STRUCTURE, BATTLE MANAGEMENT, AND SENSORS

Compiled by Bob Aldridge

The concept of defending against missiles was conceived in the 1940s and became more publicly known and refined during the 1960s, shortly after ballistic missiles were introduced as carriers for nuclear warheads. It was at first called ballistic missile defense (BMD) and the interceptor used to counter ballistic missiles was called an anti-ballistic missile (ABM). Decades later and tens of billions of dollars poorer, the US is still trying to develop a workable ABM system.[2]

On 23 March 1983 President Ronald Reagan kicked off the Strategic Defense Initiative (SDI, or Star Wars) with a whopping increase of budget. From 1985 through 2001 there has been $58 billion spent on SDI/BMD and that is probably a conservative figure. Billions more probably have been spent by services and organizations other than the Ballistic Missile Defense Organization (BMDO -- now renamed the Missile Defense Agency, or MDA). SDI activities pertained to intercepting the long-range strategic missiles and were restricted by the ABM Treaty. Tactical, or theater, missile defense programs were compartmentalized by themselves because they are not subject to ABM Treaty guidelines.[3] Under the Reagan Star Wars program there was envisioned a layered defense where various weapons would intercept and destroy hostile missiles in the boost-, midcourse-, and terminal-phases. At this time the phases of engagement only pertained to intercepting long-range strategic nuclear missiles.

In May 1993 President Bill Clinton terminated SDI in name only, reverting to the original name of Ballistic Missile Defense, or BMD. Active SDI programs were transferred to what was then known as the multi-service Ballistic Missile Defense Organization (BMDO). Since the word "strategic" no longer appeared in the title, tactical missile defense was also included. Now activities under the BMDO are blurred because some have to be ABM Treaty-compliant and some do not.

---

[1]This is the first in a set of four papers. The set includes:

- PLRC-010821 -- Ballistic Missile Defense 1: BMD Structure, Battle Management, and Sensors.
- PLRC-010822 -- Ballistic Missile Defense 2: Boost-Phase Intercepts.
- PLRC-010823 -- Ballistic Missile Defense 3: Midcourse-Phase Intercepts.
- PLRC-010824 -- Ballistic Missile Defense 4: Terminal-Phase Intercepts.

[2]For a more complete historical review of ABM activities, and a description of the ABM Treaty, see Aldridge, *First Strike*, pp. 193-196.

[3]See Aldridge, *Nuclear Empire*, pp. 92-105, for a summary of BMD activities during the Reagan and Bush (Sr.) administrations.

What is the difference between "strategic" and "tactical"? A missile's velocity is relative to its range. Intercontinental ballistic missiles (ICBMs) and submarine-launched ballistic missiles (SLBMs) have the longest ranges and need the biggest boost from rocket motors. Therefore, these long-range "strategic" weapons approach their target at a much greater speed than the shorter-range "tactical" ballistic missiles. An interceptor could more easily maneuver to engage a short-range ballistic missile (SRBM). Medium-range ballistic missiles (MRBMs) and intermediate-range ballistic missiles (IRBMs) are incrementally faster and would require a more agile interceptor. To destroy ICBMs and SLBMs traveling at great speed would require the most energetic interceptor. On the other hand, the shorter the missile's range, the shorter the flight time. This leaves less time to destroy slower, shorter-range missiles after they have been detected and tracked. The ranges of various missile classifications are as follows:

Missile	Max. Range (kilometers/ miles)
ICBM/SLBM	10,000/ 6,000
IRBM	3,500/ 2,175
MRBM	1,300/ 800
SRBM	600/ 375

Under the Clinton administration, strategic missile defense was called national missile defense (NMD), and tactical missile defense was called theater missile defense (TMD).

Research and development on BMD systems has been going on for 55 years and it looks like the spending curve will rise even steeper. Congress appropriated $5.29 billion to spend on BMD during fiscal year 2001. The fiscal year 2002 budget is $8.3 billion. For fiscal year 2003 a sum of $8.615 billion has been requested -- $7.8 billion for research, development, testing, and procurement and $815 million for space-based sensors.

BMD UNDER THE GEORGE W. BUSH ADMINISTRATION

Reagan's 1983 "Star Wars" speech touched off open-ended spending for BMD. That gradually slowed as people became more conscious of how money was being wasted. Now, in 2001, it appears that the Bush administration is attempting to open the purse strings again for BMD research, all to the benefit of the large corporations involved.

Under the George W. Bush administration there have been several very significant changes which, if they don't change actual activities, do attempt to change the public and international perspective of what the BMD program are doing. It also perpetuates the huge expenditure on taxpayer dollars, to the benefit of weapons manufacturers.

1. BMD Name Change.

One of the first things the current administration did was a cosmetic clean up. It eliminated the titles of National Missile Defense (NMD) and Theater Missile Defense (TMD). That has stymied some of the objections to ABM Treaty-prohibited activities of defending the entire US. Everything -- both NMD and TMD -- has now been lumped into what the administration calls a "Layered Missile Defense." This further muddies the distinction between strategic and tactical, long-range and short-range, ABM Treaty controlled and not ABM Treaty controlled. The only difference from the earlier Star Wars program is that intercepting shorter-range hostile missiles are now jumbled into the BMD pie, hoping that the different sophistication of technologies needed to engage the missiles of various ranges (and speeds) will not be publicly debated.

Changing the name did not change the behavior. The name change just made it more awkward to single out NMD activities for criticism. Let us remember an old axiom in politics: "The more things seem to change, the less they actually do."

The three intercept layers for which BMD weapons are being studied are 1) Boost-Phase Intercepts while the hostile missiles' rocket motors are still burning, 2) Midcourse-Phase intercepts while the missiles' final stage and the warheads are coasting through space, and 3) Terminal-Phase intercepts while the warheads are reentering the earth's atmosphere and bearing down on their targets. These three layers of intercepts will be addressed in three companion papers to this one. (See footnote 1)

In another name change early in January 2002, the BMDO was given a bureaucratic upgrade from an "organization" to an "agency." Henceforth it will be known as the Missile Defense Agency (MDA).

2. Emphasis Now On Testing.

Apparently realizing that the compressed deployment schedule so avidly championed during his campaign did not allow time to salve the overwhelming objections of US allies and to negotiate ABM Treaty differences with Russia, President Bush changed direction to an aggressive research, development, testing, and evaluation (RDT&E) program. This has opened a gamut of technologies -- expensive technologies -- to investigate. Along with the name change, the spectrum of BMD weapons now being addressed closely emulates the Star Wars of the 1980s. It introduces open ended spending that will cause BMD spending to soar, possible over $100 billion.

3. Perpetuating The Enemy Image.

Having a threat publicly-perceived as credible is necessary to continue any military program. Shortly after taking office, President Bush halted negotiations with North Korea and has promoted the concept of rogue nations. Had those negotiations been sincere in the first place they would have eliminated what is possibly the biggest threat used to pursue BMD programs.[4]

4. Scrapping the ABM Treaty.

The Bush administration has now declared the ABM Treaty to be a cold war relic. It states that the world must move beyond that treaty and has engaged Russia in discussions aimed toward that end. On 13 December 2001, President Bush gave the other parties to the ABM Treaty the required six-month notice that the US planned to abrogate. On 13 June 2002 the ABM Treaty faded into the halls of history with only token Congressional opposition to the Executive Branch of government unilaterally abrogating a treaty ratified by the Senate.

BATTLE MANAGEMENT, COMMAND, CONTROL AND COMMUNICATION (BM/C3).

BM/C3 is described as the brain and nervous system of BMD. BM/C3 is being designed to plan, coordinate, direct and control NMD weapons and sensors. It has been identified as possibly the most difficult aspect of the NMD program. Rather than being mostly a hardware development program, it is chiefly software oriented. Besides being certain there are no bugs in the millions of lines of programming, it cannot be realistically tested except under the actual hostile conditions.

[4]For some understanding of the history of negotiations with North Korea see PLRC-940814B. It is on my inactive list and is not up to date. However, current events are similar. For a current assessment of the situation with North Korea, see *Bulletin of the Atomic Scientists*, May/June 2000, pp. 33 - 39.

Consequently, it may not only be the most difficult aspect, but the most uncertain aspect as far as knowing if it will actually work.

1. Battle Management System.

There are varying degrees of BM/C3. Overall command and control is in the North American Aerospace Defense Command (NORAD) and the US Space Command, which are located in an underground command post in Colorado's Cheyenne Mountain, near Colorado Springs. Each interceptor base has its own battle management center, whether that be on land or at sea. More than one of these local command locations may be involved in a specific attack.

2. Single Integrated Air Picture (SIAP).

In the field and at sea, the SIAP will receive data from many sensors to be instantaneously processed to form a detailed picture of the nature of the attack. Then the commander can direct the necessary weapons to intercept the attack. The SIAP is intended to provide a common battlefield picture for aircraft, cruise missile, and ballistic missile defense. This would integrate all the myriads of sensors and intelligence information from all three services and have it instantaneously available to all commanders. Such a capability is not now possible and effective integration will require hundreds of solutions.

The Navy's Cooperative Engagement Capability (CEC), which has been in development during the 1990s, is the backbone for a SIAP. CEC uses computers to combine all the fleet's radar, sensor and targeting systems into a single picture displayed on computer screens in ships and aircraft. It determines which ship or aircraft should track the targets and which should engage them. Even though a ship may not have radar contact with the hostile vehicle, it can participate in the engagement through this special communications design. CEC is currently being developed by Raytheon as prime contractor and Lockheed Martin as backup. CEC is now on several ships as well as E-2C Hawkeye warning planes and P-3 anti-submarine aircraft. Raytheon now has a contract to build 33 CEC units for $265.5 million.

In 2004 the Navy plans to hold competition to build 200 more advanced CEC units designated Block-2. This would move into full production in 2005. Lockheed Martin teamed with Solipsys Corp. (Laurel, Maryland) will likely be competing against Raytheon. By 2007 the Navy plans to have CEC equipment on all cruisers and destroyers with Aegis radars. The fiscal year 2001 budget request for CEC was $135.2 million.

It is this capability that SIAP will extend to the Army and Air Force. Raytheon expects a contract to integrate CEC into the Air Force's Airborne Warning & Control System (AWACS) aircraft. By 2002 the Army hopes to buy about 60 CEC systems for its Patriot PAC-3 batteries. Efforts are also in work to integrate CEC into the THAAD system and SBIRS-Low. SBIRS-Low will be discussed in further detail below. PAC-3 and THAAD will be discussed in the companion paper on BMD Terminal Defense.

Two systems that will figure prominently in SIAP are the Army's Theater Missile Defense-Ground Based Radar and the Navy's Aegis Weapons System with its SPY-1 radar.

a) Theater Missile Defense-Ground Based Radar (TMD-GBR).

TMD-GBR is the Army's small, ground-based, air-transportable phased-array radar to provide search, track and discrimination capabilities for theater missile defense. It operates in the X-band frequency. Raytheon is the prime contractor for the radar. It is part of the BM/C3 system of the BMD Terminal Defense Segment which will receive and instantaneously process data from all sensors to form a detailed picture of the nature of the attack. First production of the TMD-GBR is scheduled for fiscal year 2002. Estimated cost for the TMD-GBR is $5.4 billion.

b) Aegis Weapons System/SPY-1 Radar.

The Navy's counterpart of the TMD-GBR is improvements to the Aegis weapons system and its SPY-1 radar already installed on DDG-51 Arleigh Burke-class destroyers and CG-47 Ticonderoga-class cruisers. The Navy contends that the cost of a sea-based lower-tier is cheap because it builds on the $42 billion already invested in the ships and Aegis. Lockheed Martin Government Electronics Systems (Moorestown, NJ) is modifying the Aegis software. Raytheon Co. (Lexington, Massachusetts) is producing the SPY-1D (V) transmitters and the Mark-99 fire control system. The Navy is also looking into adding the X-band capability to the existing S-band on Aegis cruisers and destroyers. S-band frequencies handle long-range, all-weather search and detection along with initial discrimination. X-band frequencies are more suited to horizon search and track as well as precise ballistic missile discrimination.

MAJOR BMD SENSORS

The sensors presently planned for BMD use are Ground-Based Radars and Space-Based Sensors.

1. Ground-Based Radars (GBR).

Radars which will make up the GBR system are upgraded early-warning radars and new X-band radars.

a. Updated Early Warning Radars (UEWR). The US will be updating the ultra-high frequency (UHF) Ballistic Missile Early Warning System (BMEWS) radars located in Alaska, Greenland and England. The BMEWS radars at Clear, Alaska and Thule, Greenland are two-faced phased-array radar which monitor 240 degrees of azimuth (each face of US phased-array radars monitor 120 degrees of azimuth from horizon to zenith). The BMEWS radar at RAF Fylingdales in Yorkshire, England is a three-faced phased-array radar, and thus operates over a full 360-degree circle. These phased-array radars are made by Raytheon Co. (Lexington, Massachusetts), and this company will also do the updating for NMD.

The other two early warning radars to be upgraded are UHF PAVE PAWS phased-array radars located in the continental United States to provide early warning of SLBM attack. The locations are Cape Cod Air Force Station, Massachusetts; and Beale Air Force Base, California. These are two-faced, phased-array radars are also manufactured by Raytheon Co.

Those are the five early warning radars to be upgraded (also by Raytheon). They are all UHF phased array radars. Exactly what the upgrade is has not been revealed but my speculation is that it will add an X-band capability.

There has been no formal request to Britain and Denmark (Denmark has jurisdiction over Greenland) to upgrade the BMEWS radars in England and Greenland, but those two countries have sent out warnings that they will not approve any installation that does not comply with existing treaties -- including the ABM Treaty -- and that the US should not assume unqualified cooperation for deploying what was at the time known as a national missile defense.

b) X-band Radars.

Plans under the Clinton administration were to build the first new X-band radar on Shemya Island in the Alaskan Aleutian Chain -- the same island that now has a 2-faced phased-array radar called Cobra Dane. The George W. Bush administration now seems to be leaning toward upgrading the existing Cobra Dane radar on Shemya Island to add an X-band capability. This would take about one year to accomplish, as opposed to three years for a new X-band radar at that location. X-band frequencies are better for low-altitude and close-to-the-horizon tracking and discrimination. Work is planned to start during the summer of 2002 to upgrade Cobra Dane and install the X-band capabilities.

Nine X-band radars are scheduled to be built between 2010 and 2015. It is not clear if these will be upgrades to existing early warning radars or new X-band radars at places like Menwith Hill in England. They might be X-band radars on container ships and barges, along with the Aegis ships. One BMDO document released under the Clinton administration indicated some of the locations would be Barrow in Alaska, Hawaii, Shemya Island in Alaska, Beale in California, and Otis in Massachusetts -- again, the last three could be upgrades to existing large phased-array radars.[5] *Space Daily* reports that an X-band radar will be built in South Korea.[6]

X-band radars do not work well in rain and sleet. Radar experts at the US National Weather Service, who are familiar with X-band radars warn that there will be a lot of loss of effectiveness in bad weather. Phillip Coyle, former chief of Pentagon testing, said: "My former office has recommended that tests be done in bad weather, late at night, and when the sun is at different angles in relation to the targets. . . . Those tests are a long way off but the [Pentagon] has agreed in principal to do them eventually, but my guess is they won't get to them for some years."[7]

2. Space-Based Sensors.

The current space-based early warning system, called Defense Support Program (DSP) Satellites, have been continuously upgraded since there initial deployment. Three satellites are currently deployed in geosynchronous orbit[8] over the equator -- one each over the Indian, Pacific and Atlantic Oceans. (There may be more as the actual number in orbit is secret.) Three replacement satellites are awaiting launch. The last is scheduled for launch in 2003. These spacecraft use infrared sensors to watch for ICBM and SLBM launches around the world. During the Persian Gulf war the DSP system was used to detect SCUD missile launches from Iraq. Since DSP was first deployed three decades ago, 21 satellites have been put into orbit. One more is scheduled for launch in the next few years before the replacement Space-Based Infrared System (SBIRS) starts taking over.

Two layers of SBIRS satellites are in work for future missile defense activities which will support both NMD and TMD. They are known as SBIRS-High and SBIRS-Low.. Besides detecting hostile missile launches, the fully integrated system (SBIRS-High and SBIRS-Low) will also track

---

[5]Figure 3-2.

[6]*Space Daily*, 16 November 2001.

[7]Cited in *Defense News*, 20 August 2001, p. 1.

[8]Geosynchronous, or Earth-Synchronous, satellites are in equatorial orbit (always over the equator) and at an altitude of approximately 22,300 miles where one orbit of the satellite is synchronized with one revolution of the earth, thus causing the satellite hovers over one spot on the equator -- they appear stationary in the sky.

them and provide targeting information for defensive missiles, as well as provide technical intelligence and analyze battle situations, to say nothing about anti-satellite operations. SBIRS will be able to track missiles and warheads after the rocket motors burn out, something the present early warning satellites cannot do.

Another function of SBIRS could be to locate mobile targets. They may carry the Ground Moving Target Indicator and Synthetic Aperture Radar to provide near-continuous global coverage and precision mapping to detect mobile launch points before they launch missiles. One ground station that has been approved is Menwith Hill, Yorkshire, in England.

a) High Orbit Space-Based Infrared System (SBIRS-High). In November 1994 the Pentagon approved the High Orbit Space-Based Infrared System. SBIRS-High is envisioned as a multi-layered constellation composed of four spacecraft in geosynchronous orbits around the equator and infrared sensors aboard two classified US National Reconnaissance Office satellites in highly-elliptical polar orbits to cover the more-northern regions more effectively. SBIRS-High will watch for the hot exhaust plume of missile launches and is slated to start replacing DSP as its satellites are launched. The global coverage and technical improvements of SBIRS-High over DSP will allow better determination of a missile's launch point, trajectory, and intended impact point.

A team led by Lockheed Martin Space Systems Company (Sunnyvale, CA) has a $2 billion Air Force contract to build six geosynchronous-orbit satellites and provide sensors to ride piggy back on other satellites for better coverage in the polar regions. The first was to be launched in 2004 or early 2005 with the next three following at one-year intervals.

That was the original plan. As usual, there are technical problems with schedule and cost overruns. The first satellite is not scheduled to be launched until 2006. Realistic testing, originally scheduled for 2007, will not occur this decade. The estimated cost has jumped to at least $4.5 billion. That may only be for five satellites.

Lockheed Martin is the prime contractor responsible for the spacecraft along with systems engineering & integration and the ground segment. Aerojet (Azusa, CA) and Northrop Grumman (Bethpage, NY) will provide the primary infrared sensor; Lockheed Martin Federal Systems (Gaithersburg, MD) and Aerojet will provide ground systems for mission data processing and message dissemination, mobile ground elements, satellite telemetry, and satellite tracking and control; and Honeywell Space Systems (Clearwater, FL) will provide on-board data processing and data handling for both the spacecraft and payload. Northrop Grumman is to manufacture the Guidance Reference Assembly.

The requested SBIRS-High budget for fiscal year 1997 was $173.3 million, and the fiscal year 1998 request is $338 million. $538 million was appropriated for fiscal year 1999, $542 million in fiscal year 2000, and $553 million in fiscal year 2001.

2. Low Orbit Space Based Infrared System (SBIRS-Low).

SBIRS-Low satellites will compliment SBIRS-High by tracking hostile missiles and warheads through their long coast through space (the midcourse phase) after their booster motors burn out, and discriminating between the actual warheads and decoys. This will provide better targeting and engagement of interceptors. SBIRS-Low will be a network of 24 to 32 small satellites cross-linked[9]

---

[9]Up-link is communication from the earth's surface to a satellite. Down-link is communication from the satellite to a surface station. Cross-link is communication between satellites.

in low orbit -- about 400 kilometers (250 miles) high. This is the low-orbit portion of the full Space-Based Infrared System. It is also a resurrection of "Brilliant Eyes" program which was so prominent in the Reagan administration's Star Wars fiasco of the 1980s.

Some SBIRS-Low sensors will use synthetic aperture radar to view through clouds and darkness. Others will use electronic cameras. Data will be relayed from one SBIRS-Low satellite to another by laser beam, to reach the relevant command center at the speed of light. The data would be handed over to the ground-based radar (GBR) which would in turn send trajectory information to the interceptors.

On 16 August 1999 the US Air Force awarded teams led by TRW Space and Electronics Group (Redondo Beach, California) and Spectrum Astro (Gilbert, Arizona) each a $275-million competitive contract to define the SBIRS-low system concept. This contract expires in October 2001. But in August 2001, the Pentagon awarded each of these teams a $230 million contract to extend the study phase an additional 9 months. The deployment schedule is expected to hold -- to start launching in 2006 and have all the satellites in orbit by 2011.

Spectrum Astro has Northrop Grumman Corp. (Los Angeles, California) as its main team partner. Spectrum Astro leads overall design effort and is responsible for the spacecraft and overall systems architecture. Northrop Grumman Corporation's Electronic Sensors And Systems Sector is responsible for the sensor design and related ground systems data processing, and the ground segment integration. Analex Corporation, and the Space Dynamics Laboratory of Utah State University are also on the Mission Integrated Product Team. In March 2001 it was announced that Lockheed Martin Space Systems was added to the Spectrum Astro team to develop algorithms and key aspects of the ground segment. At the same time Boeing's Missile Defense And Space Control Division (California) was also brought aboard to develop sensors and associated algorithms.

A production contract could range up to $5 billion. The Air Force intends to spend $11.8 billion on SBIRS-Low over its lifetime through fiscal year 2022. In October 2001, SBIRS-Low was shifted from the Air Force to the BMDO, now MDA.. The fiscal year 2002 budget authorization is $420 million. The 2003 budget document proposes transferring procurement funds for SBIRS-Low back to the Air Force.

A February 2001 General Accounting Office (GAO) report warns: "The Air Force's current SBIRS-low acquisition Schedule is at high risk of not delivering the system on time or at cost or with expected performance."[10] The GAO has identified three main problem areas:

a) **The current acquisition schedule does not provide for flight test results of crucial satellite functions and capabilities until 5 years after production has started.** The GAO report called attention to a previous report which stated that "the incorporation of advanced technologies before they are mature has been a major source of cost increases, schedule delays, and performance problems on weapons systems..."[11]

b) **Five of the six critical technologies have been judged immature for the current stage of the program.**[12] A critical technology is defined as one so necessary that

[10] GAO-01-6, p. 3.

[11] GAO-01-6, p. 14, referring to GAO/NSIAD-99-162.

[12] The five critical technologies not up to the required maturity are 1) the scanning infrared sensor used to acquire ballistic missiles early in their flight, 2) the tracking infrared sensor used to track missiles, warheads, and

without its function the SBIRS-low system would not be able to perform its mission. In this case, 5 out of 6 are lacking the scheduled degree of maturity.

c) **Alternative terrestrial systems to the SBIRS-low have not been investigated.** Such investigations are required by Pentagon acquisition policies and procedures but the Air Force claims that no alternatives exist. However, other studies for the BMDO (now MDA) identify sea-based and land-based radar alternatives.[13] Compliance with the requirement to study alternatives seem particularly pertinent given the immaturity of critical technologies in the SBIRS-low program. After this GAO report was issued, the Pentagon announced that a study of alternatives to SBIRS-low has been delayed from 1 March 2001 until early spring in order to construct simulations of its review.

In October 2001 the Pentagon was planning to extend the design competition by nine months, thus about doubling each of the $275 million contracts. This has run into resistance from the Senate Armed Services Committee which has called the extension premature, saying such action should wait until the outcome of an ongoing Pentagon study on alternatives to SBIRS-Low. The study, which was expected to have been completed in the spring of 2001, is still plodding along. The Senate has given the Pentagon until the end of March 2002 to complete it. Launch of the first satellite is not expected until at least 2008 and realistic operational testing will probably not begin this decade. That would place deployment of the entire constellation at about the middle of the next decade.

By November 2001 the House Appropriations Committee was recommending that the entire $385 million in the fiscal year 2002 budget be canceled because of SBIRS-Low is over budget and behind schedule.

NUCLEAR WARHEADS ON ABM INTERCEPTORS

The earlier Sentinel and Safeguard ABM systems were based on using nuclear interceptors. A system was actually deployed for a short time until it was discovered that the electromagnetic pulse (EMP) from a high altitude nuclear explosion would fry the electronic systems of America. The site was dismantled and US ABM efforts started looking at other types of interceptor warheads.

Now there are stories being floated that the US may revisit the prospect of nuclear-armed interceptors. There are even reports that Russia is interested in helping with the project. Proponents claim that a nuclear interceptor would overcome the problem of identifying the actual enemy warhead amid its array of protective decoys and chaff. Proponents also suggest that with modern technology the nuclear explosion could be kept small enough to minimize any EMP effect.

---

other objects during the middle and later stages of flight, 3) the fore optics cryocooler, 4) the tracking infrared sensor cryocooler, and 5) the satellite communications crosslinks which allows the satellites to talk to each other. The only technology up to the required degree of maturity is the on-board computer processors.

[13]For instance, BMDO's June 1999 study entitled *Summary of report To Congress On Utility Of Sea-Based Assets To National Missile Defense* stated that properly deployed sea-based radars can provide forward-based radar warning and tracking functions against many threats while remaining difficult to find, and that they would add robustness against enemy attacks particularly before SBIRS-low is available. Also, a 1999 Rand issue paper entitled *Planning A Ballistic Missile Defense System Of Systems: An Adaptive Strategy* suggest that ground-based radars have the potential to identify and track interceptors during the midcourse phase of their flight. That report concludes that the NMD schedule is inadequate and that alternative solutions to tracking BMD threats should be considered.

A nuclear warhead sounds like a massive shotgun approach to solving many of the obstacles being encountered in developing a BMD system. But one must realize that most of a hostile missile's trajectory is out in space. One rule of physics is that there is no blast in space. There is no atmosphere to carry the devastating shock wave (blast) from a nuclear explosion. The only way a nuclear bomb can destroy an enemy warhead in space is by radiation -- mainly gamma radiation and neutron radiation. Since an opponent's warhead can be "hardened" to a certain extent against radiation, the nuclear interceptor would have to have a significant yield -- a yield that would create the electromagnetic pulse which proponents of nuclear interceptors think can be eliminated.

As far as using a nuclear interceptor within the atmosphere, the short time allowed during the endoatmospheric portion of the boost phase (a minute or two) would make reaction time impossible after the hostile missile is launched. The only way to stop it within the atmosphere would be with a first strike before that hostile missile is launched. Regarding the endoatmospheric portion of the terminal phase, no one would want to set of a nuclear blast that close to home. Both the blast and EMP would be destructive to homeland or friendly troops.

SYSTEMS WHICH SUPPORT BALLISTIC MISSILE DEFENSE

Two sensor aircraft support BMD activities. They are the Airborne Warning And Control System (AWACS) and Joint Surveillance and Target Attack Radar System (J-Stars) aircraft.

1. Airborne Warning and Control System (AWACS).

Also known as the E-3, this fleet of aircraft are Boeing 707 derivatives with a large flying-saucer-type radar dish on top. The radar, built by Northrop Grumman, has now been upgraded to track cruise missiles. The US Air Force operates 34 AWACS aircraft.

Britain also operates a fleet of seven AWACS which are called the Boeing Sentry AEW Mk.1. They were purchased pursuant to a late-1986 decision. France has ordered four AWACS aircraft from the US. A NATO consortium of 12 nations share 18 AWACS aircraft. Saudi Arabia operates AWACS aircraft. South Korea, Turkey and Italy have indicated an interest in buying AWACS aircraft.

Newer AWACS are modified Boeing 767 aircraft -- usually referred to as E-767 AWACS. They offer 50 percent more floor space, almost double the cabin volume, an estimated 10 percent more time on station, and an additional 25,000 pounds payload capacity. Japan ordered four of these new AWACS.

In May 1995 the US Air Force and BMDO made public that it plans to contract with Boeing Defense and Space Group (Seattle, Washington) for a three year demonstration program called the "AWACS Extended Airborne Global Launch Evaluator" (AWACS EAGLE). Goal of this program is to track missiles with AWACS and provide targeting information -- with production starting in 2001 or 2002. The AWACS EAGLE demonstration program cost is about $60 million. The infrared tracking system which is to be integrated into existing aircraft will run between $8 million and $15 million each.

2. Joint Surveillance and Target Attack Radar System (J-STARS).

This Boeing 707-type aircraft, dubbed J-STARS and sometimes Joint Stars but officially designated E-8, is a long-range, air-to-ground surveillance aircraft designed to detect, track, classify, and support the attack of moving and stationary targets at a distance of 120 miles. It was developed primarily to locate and identify mobile ground targets as part of the US/NATO deep interdiction program. J-STARS is a joint Army and Air Force program to pinpoint mobile missile batteries and, if those batteries are not destroyed before launching their missiles, provide early detection on where those missiles are coming from.

Low-Rate Initial Production began in 1993 to provide the Air Force with two J-STARS aircraft (refurbished Boeing 707 aircraft). Northrop Grumman is the systems integrator and also builds the radar. In July 1994 Northrop Grumman Corp. (Los Angeles, CA) was awarded a $376.4-million contract to modify two more Boeing-707s for delivery in 1996. Funding for two was requested for fiscal year 1997 and one for fiscal year 1998. By early 1996 the cost of each aircraft had risen to $426 million. The ninth aircraft was delivered by January 2001. In early 2002 Northrop Grumman was awarded a contract for advanced procurement for the 17th aircraft

However, before committing to Full Rate Production US law requires that test and evaluation be performed to adequately certify the system suitable for combat. Exercises over Bosnia in 1995 and 1996 were used for this purpose. A 20 September 1996 report said that J-STARS had only tested satisfactorily for 25 percent of the criteria to certify Full Rate Production, that the aircraft was unsuitable as tested, and that it is only effective for operations other than war. Nevertheless, five days later the cognizant undersecretary of defense approved Full Rate Production of this $11 billion program. The US General Accounting Office blasted this decision as premature and raising the program's level of risk.[14]

CONCLUSION

Most of BMD -- especially the Ground-Based Midcourse Segment, formerly known as National Missile Defense -- is a system designed to protect against a hypothetical type of terrorism that is not likely to occur. If a terrorist country wished to deliver a weapon of mass destruction, it could be much easier and more economically done by smuggling. Regarding the threat of weapons of mass destruction, then Defense Secretary William S. Cohen stated openly: “I think the act of terrorism taking place is more likely than intercontinental ballistic missile.”[15]

And regarding the overall impact on national security, the Ground-Based Midcourse Segment will ignite a new arms race as Russia scraps all arms reduction treaties enacted so far and China boosts its strategic missile force from about 20 to 200 in order to be able to overcome a US missile defense. If China does that, India will respond and that will bring Pakistan into the picture.[16]

Even if a terrorist country did deliver a weapon of mass destruction by missile, the weapon would more likely be biological than nuclear. Then the warhead would be numerous canisters or bomblets, something the midcourse and terminal segments of BMD would be useless against. This country is wasting grossly abnormal sums in money and talent to combat a form of terrorism that is not likely to happen.

According to the US Commission on National Security/21st Century, “for many years to come Americans will become increasingly less secure, and *much less secure than they now believe*

[14]GAO/NSIAD-97-68, pp. 1 through 4.

[15]DOD News Briefing 7/2000.

[16]This new arms race is depicted in an August 2000 National Intelligence Estimate report entitled “Foreign Responses To US National Missile Defense Deployment,” and cited in “Report: Missile Defense May Spur China,” *Mercury News*, 10 August 2000, p. 7A.

themselves to be.[17] (Emphasis in original) Those are somber words to ponder and all the more scary coming from a government-mandated study. The commission continues:

> "...the most serious threat to our security may consist of unannounced attacks on American cities by sub-national groups using genetically engineered pathogens. Another may be a well-planned cyber-attack on the air traffic control system on the east coast of the United States, as some 200 commercial aircraft are trying to land safely in a morning's rain and fog. Other threats may inhere in assaults against an increasingly integrated and complex, but highly vulnerable, international economic infrastructure whose operation lies beyond the control of any single body. Threats may also loom from the unraveling of the fabric of national identity itself, and the consequent failure or collapse of several major countries.
>
> Taken together, the evidence suggests that threats to American security will be more diffuse, harder to anticipate, and more difficult to neutralize than ever before. Deterrence will not work as it once did; in many cases it will not work at all.[18]

That commission doesn't mention missiles. And it doesn't mention NMD. Yet there is a big push to get NMD started while the real threats are being neglected.

The public is also being deceived regarding flight testing. From the target warhead the test range officers are receiving NAVSTAR GPS positions and radar beacons -- ostensibly benign as far as testing is concerned, *unless something goes wrong*. And we are told by BMDO (now MDA) directors about little animated warheads that talk to themselves about seeing balloons and how those balloons help them find their targets. No terrorist country is going to be so accommodating.

If the so-called hoax is true, why do we have such a far ranging BMD program? BMD continues because some people are making a lot of money, and the rest of us are too bewildered to object. It has become so profitable that our corporate-dominated government is considering trading off more nuclear warheads in START-3 in exchange for an ABM Treaty revision allowing a National Missile Defense, by whatever euphemism it is now called. BMD has already cost American citizens way over $35 billion in direct budget items, and more in hidden programs. Projections indicate many tens of billions of dollars will be spent in the next five years alone. That is big business.

So let us not be deceived by this hoax. Many informed critics and professional organizations have pinpointed the ultimate goal -- that is, stop financing a system designed to prevent an unlikely form of terrorism. BMD will only enrich the weapons merchants, alienate America from friendly countries, wipe out hard-earned advances in arms reductions, initiate another arms race, and squander huge sums of money and talent that are vitally needed to satisfy critical human needs. By voice or by silence, by design or by default, the final decision will rest with the taxpaying public.

* * * * *

REFERENCES

Alcorn, Gay; Washington correspondent, *Sydney Morning Herald* (Australia), 27 July 2000 and 28 July 2000.

Aldridge, Robert C.; *First Strike: The Pentagon's Strategy for Nuclear War* (Boston; South End Press, 1983).

Aldridge, Robert C.; *Nuclear Empire* (Vancouver, Canada; New Star Books, 1989)

BMDO Fact Sheet PO-99-01, April 1999.

---

[17] *New World Coming*, p. 8.

[18] *New World Coming*, p. 8.

BMDO study: *Summary of report To Congress On Utility Of Sea-Based Assets To National Missile Defense*, June 1999

Bulletin of the Atomic Scientists, The, various issues.

Coyle, Phillip (Director of Operational Test and Evaluation for the Pentagon during the Clinton administration); "Rhetoric or Reality: Missile Defense Under Bush," *Arms Control Today*, May 2002.

Defense Link, http://www.defenselink.news , various articles.

Defense News, (6883 Commercial Drive, Springfield, VA 22159-0500), various issues.

DOD News Briefing 7/2000 -- Presented by Secretary of Defense William S. Cohen, 5 July 2000.

DOD News Briefing 27March2001 -- Presented by Rear Adm. Craig R. Quigley, 27 March 2001.

Figure 3-2, National Missile Defense, Chapter 3, page 3-3, undated, available at http://www.acq.osd.mil/bmdo/bmdolink/pdf/ch3-5.pdf

GAO/NSIAD-97-68 -- *Tactical Intelligence: Joint STARS Full-Rate Production Decision Was Premature and Risky*, US General Accounting Office Report, April 1997.

GAO/NSIAD-98-37 – *Theater Missile Defense: Significant Technical Challenges Face the Airborne Laser Program*, US General Accounting Office report, October 1997.

GAO/NSIAD-99-50 – *Defense Acquisitions: DOD Efforts to Build Laser Weapons for Theater Defense*, US General Accounting Office report, March 1999.

GAO/NSIAD-99-162 -- *Best Practices: Better Management Of Technology Development Can Improve Weapons Systems Outcomes*, US General Accounting Office report, 30 June 1999.

GAO-01-6 -- *Defense Acquisitions: Space-Based Infrared System-Low At Risk Of Missing Initial Deployment Date*, US General Accounting Office report, February 2001.

Honolulu Star-Bulletin, (Honolulu, Hawaii), various issues.

International Herald Tribune, various issues.

Ivanov-8/2001 -- DOD News Transcript, "Secretary Rumsfeld with Minister Ivanov at Start of Plenary" (Remarks with Russian Defense Minister Sergei Ivanov at start of the plenary session between US and Russian delegations), 13 August 2001.

Kadish-7/2001 -- Department of Defense news briefing by Lt. Gen. Ronald T. Kadish, USAF, Director of the Ballistic Missile Defense Organization, 13 July 2001.

Lockheed Martin, Boeing Join SBIRS-Low Team, http://defence-data.com/current/page10260.htm

Lyles, Lt. Gen. Lester L.; DOD News Briefing, 20 January 1999.

Mercury News, (San Jose, California), various issues.

New Horizons, Lockheed Martin Space Systems, various issues.

New World Coming: American Security in the 21st Century, the Phase-1 Report on the Emerging Global Environment for the First Quarter of the 21st Century by the United States Commission on National Security/21st Century, 15 September 1999.

PLRC-940814B, *Korea and nuclear Weapons: A Background Paper on Easing Tensions on the Korean Peninsula*, Revised 27 March 1995.

Post-Intelligencer (Seattle, Washington), various issues.

Putin-8/2001 -- DOD News Transcript, "Secretary Rumsfeld with President Putin at Kremlin," (Remarks with Russian President Vladimir Putin at the Kremlin), 13 August 2001.

Rand issue paper: *Planning A Ballistic Missile Defense System Of Systems: An Adaptive Strategy*, 1999

Rumsfeld-3/2001 -- Joint Media Availability At The Pentagon With NATO secretary General Lord George Robertson, 8 March 2001.

Space Daily, http://www.spacedaily.com/news, various issues.

Star, The, (Lockheed Martin Space Systems Company, Sunnyvale, California), various issues.

Sun, The, (Bremerton, Washington), various issues.

Washington Post (Washington, D.C.), various issues.

Yahoo News, http://dailynews.yahoo.com , various articles.

GLOSSARY

707	A US commercial jetliner built by Boeing.
767	A US commercial jetliner built by Boeing.
ABM	Anti-Ballistic Missile. An interceptor of ballistic missiles.
AWACS	Airborne Warning and control System. Originally a Boeing 707 type aircraft designated E-3. In the early 1990s a Boeing 767 AWACS became available.
AWACS EAGLE	AWACS Extended Airborne Global Launch Evaluator.
BM/C3	Battle Management/Command, Control and Communication.
BMD	Ballistic Missile Defense.
BMDO	Ballistic Missile Defense Organization.
BMEWS	Ballistic Missile Early Warning System.
CBO	Congressional Budget Office.
CEC	Cooperative Engagement Capability.
DOD	Department of Defense (US).
DOE	Department of Energy (US).
DSP	Defense Support Program for early-warning satellites.
E-3	The AWACS aircraft, followed by an update letter.
E-767	The new AWACS with the Boeing 767 airframe.
E-8	The J-STARS aircraft, followed by an update letter.
EMP	Electromagnetic Pulse.
Endoatmospheric	Within the atmosphere.
Exoatmospheric	Outside the atmosphere.
GAO	General Accounting Office (US Congress).
GBR	Ground-Based Radar for BMD
ICBM	Inter-Continental Ballistic Missile.
IRBM	Intermediate-Range Ballistic Missile.
J-STARS	Joint Surveillance and Target Attack Radar System -- a 707-type aircraft equipped with special battle management radars. Also designated E-8
MDA	Missile Defense Agency.
MIRV	Multiple Independently-targeted Reentry Vehicles.
MRBM	Medium-Range Ballistic Missile

NMD	National Missile Defense.
NORAD	North American Aerospace Defense Command.
PAVE PAWS	Perimeter Acquisition of Vehicle Entry Phased-Array Warning System.
RDT&E	Research, Development, Testing & Evaluation.
SBIRS	Space-Based infrared System, a proposed constellation of early-warning and tracking satellites.
SDI	Strategic Defense Initiative, also dubbed "Star Wars."
SIAP	Single Integrated Air Picture.
SLBM	Submarine-Launched Ballistic Missile.
STARS	Strategic Target System.
Strategic	Pertaining to nuclear weapons: ICBMs, SLBMs and intercontinental bombers designed for a thermonuclear war between the superpowers.
SRBM	Short-Range Ballistic Missile.
Tactical	Pertaining to nuclear weapons: those designed to be used in battlefield or theater operations.
TMD	Theater Missile Defense.
TMD-GBR	Theater Missile Defense-Ground Based Radar.
UEWR	Updated Early Warning Radars.
US	United States.