The Security Implications of Missile Defense- A Policy Perspective

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Beijing, China
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An Important Observation About What Drives the US Missile Defense Program

Extremely Important

US Missile Defense Policy is shaped mostly by US DOMESTIC POLITICS
A Comment on the State of US Domestic Politics

Paul Krugman, Nobel Prize Winner in Economics and New York Times Columnist

Commenting on the US debate over economic priorities:

“what we have … is a political culture in which one side sneers at knowledge and exalts ignorance, while the other side hunkers down and pretends to halfway agree.”

Why Some Americans Believe Missile Defense is a Necessity

- Some US leaders genuinely believe that missile defense is needed.
- They believe it is needed because of the “moral superiority” of “American Values.”
- Since the US is “inherently good,” and is also wiser than other world cultures, missile defense allows the US to promote good around the world, without fear of retribution.
- They are not interested in the practical technical problems of whether a missile defense can be built.
- They simply assume that American ingenuity can solve any problem if enough money is committed to it.
• Other political leaders see missile defense as an opportunity to portray their DOMESTIC political opponents as not concerned with defending the US from dangerous foreign enemies.

• Opponents of missile defense believe that it cannot be made to work, and that it would also be destabilizing.

• The democratic party has been an opponent of missile defense, but it has adopted a political strategy of “pretending that it could work” while at the same time trying to limit the program.

• This approach has been a political disaster, because the real issue is that there is no existing science or technology that could ever produce reliable and robust missile defenses.

• The democratic strategy of pretending that missile defenses could work has created a group of senior government officials who would now have to admit they were wrong. This creates yet another domestic political barrier to reversing these ill-advised programs.
• Before Obama took office he expressed skepticism about whether existing science could produce workable missile defenses.

• Once he became President, he decided to “give his opponents what they want” by “pretending his administration had a better idea of how to build such defenses.” (The Phased Adaptive Approach)

• The Obama Administration now says that the better idea is the “Phased Adaptive Approach” to missile defense.

• In reality, the “Phased Adaptive Approach” has no technical merit. Later in this talk I will show why this is the case.

• The Obama announcement of the “Phased Adaptive Approach” was initially effective in creating a false understanding that progress in missile defense had been achieved. This political subterfuge is now beginning to unravel as analysis is made available to the public.

• As will be discussed later in this talk, US missile defense systems have serious and fundamental technical flaws. These technical flaws are ignored because of the dominance of domestic politics.
The Obama Missile Defense Plan

- The Obama Missile Defense Plan
- The “Phased Adaptive Approach”
- Initially Announced by President Obama on Thursday, September 17, 2009
- Elaborated on in the Ballistic Missile Defense Defense Review, signed out by Secretary of Defense, Robert Gates, on February 1, 2010
The Ballistic Missile Defense Defense Review

- *Ballistic Missile Defense Review* was directed by the President and mandated by Congress.
- It was conducted over ten months.
- Co-led by:
  - Under Secretary of Defense for Policy, Michelle Flournoy
  - Under Secretary of Defense for Acquisition, Technology and Logistics, Ashton B. Carter
  - The Vice Chairman of the Joint Chiefs of Staff, James E. Cartwright
- Signed out by Secretary of Defense, Robert Gates, on February 1, 2010.
- It appears to have been conducted without any independent or competent scientific input.
- According to the Department of Defense, which had oversight responsibility for the Review, it was conducted in coordination with many “other stakeholders.”
- This suggests that the report was more of an internal political negotiation, rather than a technical review of the issues.
- The other “stakeholders” was the Department of State, the Department of Homeland Security, the Intelligence Community, the White House National Security Staff, and the Office of Management and Budget.
The Underlying Assumptions that Form the Foundations of the 
Ballistic Missile Defense Defense Review

- There are no basic or fundamental scientific problems that need to be solved in order to make it possible to build reliable and robust exo-atmospheric defenses.

- The key technologies needed to deploy reliable and robust exo-atmospheric ballistic missile defenses have been proven.

- Obtaining reliable and robust ballistic missile defenses is simply a matter of deploying the right numbers of interceptors and sensor systems to support them.

- There are some improvements to existing missile defense technologies that would be helpful, and will be implemented, but essentially everything that is needed to build reliable and robust missile defenses is already in-hand.

- The “new” national policy and strategy generates a vast and ambitious acquisition, deployment and national security strategy that is based on the presumption that the US can build robust and reliable global and regional ballistic missile defenses.

- If the United States cannot build reliable and robust ballistic missile defenses, the arguments for and reality behind this national strategy falls apart. This would then, with near certainty, result in massive US national security failures in the next decade.
The Underlying Assumptions that Form the Foundations of the Ballistic Missile Defense Defense Review

- There are no basic or fundamental scientific problems that need to be solved in order to make it possible to build reliable and robust exo-atmospheric defenses. **UNTRUE**

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The Technical Achievements Presumed by the Ballistic Missile Defense Review are Codified in Numerous Statements

- The United States is currently protected against limited ICBM attacks. This is a result of investments made in the ground-based midcourse defense system (GMD) by the Bush and Clinton administrations over the past decade.

- This advantageous position of the US has made it possible to counter the projected ICBM threat from North Korea and Iran for the foreseeable future.

- However, given the uncertainties about the future ICBM threat, including the time-period in which it could mature, the United States will have to continue to invest heavily in the GMD system so as to maintain this advantageous position.

- In the area of regional ballistic missile defenses “recent successes” have demonstrated that the US can now rely on missile defense systems like the Navy’s Standard Missile 3 (SM-3) ballistic missile defense system and the Army’s Patriot and THAAD systems.

- The Navy’s SM-3 system has proven so reliable in its tests that the US will push hard for major upgrades and deployments.

- The SM-3 Block IA will be upgraded to the Block IB (in 2015), to the IIA (in 2018) and to the IIB (in 2020). These upgrades will enhance the already substantial US capability to defend the Continental US from ICBM attack.
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• **The Ballistic Missile Defense Review** is supposed to be a document that is based on a technical assessment within a political context.

• In reality, the *Ballistic Missile Defense Review* is a purely political document that has no basis in technical truths.
A National Defense Strategy Based on Provably False Assumptions

- Assumptions Used by the DoD for GMD Performance Cannot Possibly be Known Hence, Actual Performance of the GMD is Unknowable
- The Record of “Proven Reliability” of the Navy’s SM-3 Interceptor Actually Shows that the SM-3 Will Be Highly Unreliable in Actual Combat Conditions

Tony Auth Philadelphia Inquirer, Universal Uclick
• Assumption:
The US has an essentially limitless supply of money and no meaningful level of debt.

• Strategy that Builds on Assumption:
The US can address its current economic crisis without any concerns about financial or debt limitations.
• The United States could damage its relations with allies and friends by pushing on them false and unreliable solutions to real security problems.

• The United States will antagonize both Russia and China with massive defense deployments that have the appearance of being designed to be “flexibly” adaptable to deal with Russian and Chinese strategic forces.

• The negative effects of a costly and energetic US program that appears to be aimed at blunting Russia’s strategic retaliatory strike forces will sow distrust of the US within the Russian government and will create significant barriers to future arms reductions efforts.

• If arms reductions efforts with Russia come to a halt, this will have serious adverse effects on Russian and US efforts to maintain the viability of the Nonproliferation Treaty of 1968, which is already under considerable pressure due to the US-India Nuclear Deal and lack of past progress in arms reductions.

• By deploying systems that are easy to defeat, the United States could fail to deter, or actually stimulate, ballistic missile proliferation. With near certainty we can expect proliferators like North Korea and Iran to introduce highly effective countermeasures against the missile defense-systems (GMD, SM-3, THAAD, and possibly even Patriot) that the US has currently chosen to emphasize. These proliferators could, and likely would, sell these countermeasures to client states.
Potential Consequences of Current Ballistic Missile Defense Strategy

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Another Example of the Dominant Influence of Domestic Politics on US Ballistic Missile Defense Planning

- North Korea is only one successful flight test away from demonstrating a launch vehicle that could be used as an ICBM that would range the entire Continental United States. The United States could become vulnerable to such an ICBM threat, because it is building the wrong missile defense-systems to deal with it.

- There are alternative defense-systems that could defend the United States from ICBM attack from North Korea and Iran. The new missile defense strategy de-emphasizes these defense-systems in favor of unproven, unworkable, and far more expensive systems.
Basic Outline Obama Missile Defense Plan
(Announced on Thursday, September 17, 2009)

- Put Aside (NOT Scrap Flawed) Plan to Deploy 10 Interceptors in Poland and an X-Band Radar in the Czech Republic (Change one flawed plan for another).
- Immediately Use Aegis Ships Armed with SM-3 Block IA Interceptors to Provide Some Defense for Southeastern Europe
- Deploy SM-3 Block IB Interceptors on the Ground As Needed to Enhance Defense Coverage and Number of Interceptors
- Deploy Forward-Based X-Band Radars to Provide Tracking, Discrimination and Engagement Functions for the Defense
- Continue Modernizing the SM-3 Series of Interceptors Towards the Eventual Deployment of SM-3 Block IIA for Full Defense-Coverage of Europe by 2018
- Develop and Use a New SM-3 Block IIB Interceptor for Enhancing Interceptor Firepower Against ICBMs for Defense of the US
- No Mention of Boost-Phase Against Non-Mobile ICBMs Launched from Fixed Sites
Issues Addressed and Raised by the Obama Missile Defense Plan  
(Announced on Thursday, September 17, 2009)

- The Plan “Puts Aside” a Defense System that had No Chance of Working and that Addressed a Threat from Iran that Does Not Now, and May Never, Exist

- The Plan Focusses Attention on Iran’s Short-Range Conventionally-Armed Ballistic Missiles.

- It Uses Much Lighter, Less Expensive, and Therefore Potentially Many More Interceptors to Address Existing Iranian Capabilities to Launch Many Tens of Shorter Range Conventionally-Armed Ballistic Missiles that Could be Used to Attack Targets in Southeastern Europe (Turkey, Greece, etc.)

- The Choice to Go to Many Interceptors Implies an Emphasis on Defending Against Conventionally Armed Ballistic Missiles. At $10 million + per Interceptor, It Is Hard to Understand Why There is No Emphasis on Passive Defense.

- The Interceptors Could be Readily Deployed on Ships or on Land, Where They Can Be Located for Optimal Defense of Potential Targets.
Issues Addressed and Raised by the Obama Missile Defense Plan
(Announced on Thursday, September 17, 2009)

• The Interceptors, Which Home on the Infrared Signals from Attacking Missiles at High-Altitude Will Still Be Susceptible to Certain Infrared Countermeasures. However, As Long As the Attacking Ballistic Missiles are Not Nuclear-Armed, the Effects of Successful Countermeasures Will be Much Diminished Relative to Attacks that Utilize Nuclear-Armed Ballistic Missiles.
The Rise of the “Phased Adaptive Approach” as a Replacement for the European Missile Defense System
The Phased Adaptive Approach Simply Replaces a Small Number of Heavy Ground-Based Interceptors with Numerous Light Sea-Mobile
Orbital Sciences Ground-Based Interceptor and Raytheon Exoatmospheric Kill Vehicle

<table>
<thead>
<tr>
<th>Rocket Components</th>
<th>Length (ft)</th>
<th>Diameter (ft)</th>
<th>Component Weight (lbs)</th>
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<tr>
<td>Shroud</td>
<td>11.6</td>
<td>4.17</td>
<td>200</td>
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<tr>
<td>Payload (Kill Vehicle)</td>
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<td>-</td>
<td>155</td>
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<tr>
<td>Payload Adaptor</td>
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<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1st Stage (Orion 50XLG)</td>
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<td>2nd Stage (Orion 50XL)</td>
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<td>4.17</td>
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<tr>
<td>Total</td>
<td>51.4</td>
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**Estimated Performance Parameters of the National Missile Defense Launch Vehicle**

<table>
<thead>
<tr>
<th>Rocket Components</th>
<th>Burn Time (sec)</th>
<th>Vacuum Specific Impulse (sec)</th>
<th>Vacuum Thrust (lbs)</th>
<th>Component Weight (lbs)</th>
<th>Propellant Weight (lbs)</th>
<th>Empty Weight (lbs)</th>
<th>Empty/Full Mass Fraction</th>
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<tbody>
<tr>
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<td>-</td>
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<td>1st Stage (Orion 50XLG)</td>
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<td>37,900</td>
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<td>2nd Stage (Orion 50XL)</td>
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<tr>
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<td>140</td>
<td>-</td>
<td>-</td>
<td>47,665</td>
<td>-</td>
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Comparative Dimensions of the Exoatmospheric Ground-Based Kill Vehicle and Different Generation Navy Aegis Kill Vehicles

Ground-Based Kill Vehicle

≈ 8.5 in

≈ 8.5 in

55 in

Navy Large-Aperture High Divert-Speed SM-3 Block II Kill Vehicle

≈ 8.5 in
Basic Functional Architecture of a Baseline and Expanded National Missile Defense

Estimated Trajectory from Early Warning Radars

THAAD Ground-Based Radars

Communication Lines

Early Warning Radars

NMD or THAAD Interceptors
Navy Aegis Concept of Operation
Ship Radar Inadequate, Land Radar Marginal, and Interceptor Acceleration and Speed Low

1. Detection by Remote Sensor(s)
2. Surveillance and Track by Remote Sensors
3. Interceptor Launched Before Launch System Radar Detects Threat
4. Launch System Radar Acquires Threat Missile
5. Trajectory Refinement and Intercept by Launch System Radar
Radar Search, Acquisition and Tracking Capabilities in the Phased Adaptive Approach is Very Weak
Aegis Cruiser and Destroyer Radar System

**Radar Characteristics**
Average Power per Radar Face = 58 KW  
Face Area = 12 M²  
3.3 GHz Frequency (S-Band)  
Assumed System Losses = 10  
Known System Temperature = 500°K

**Estimated Performance per Dwell**
Range Against 1M² Target ≈ 900 – 1000 km  
(Single 0.1 Second Dwell)  
Coherent S/N = 56, Incoherent S/N ≈ 20 -25  
Range Against 0.01M² Target ≈ 250 – 300 km  
(Single 0.1 Second Dwell)  
Coherent S/N = 56, Incoherent S/N ≈ 15 -20  
Beam Width:  
1.5° × 1.5° ≈ 2 Square Degrees per Dwell
Comparison of the Relative Sizes and Average Power of the Fylingsdale UEWR, the GLOBUS II Radar at Vardo, Norway, and the Forward-Based X-Band (FBX) Radar

**UEWR**

- **PAVE PAWS**
  - 31 meter Diameter
  - ~ 755 m² Antenna Area
  - 150 KW
  - Average Power
    - \( PA = 113 \times 10^6 \text{ W} \cdot \text{m}^2 \)
    - \( PA \sigma = 65 \times 10^6 \text{ W} \cdot \text{m}^4 \)
    - \( \sigma = 0.5 \text{ m}^2 \)

- **Aegis Radar Antenna**
  - ~ 12 m² Antenna Area
  - 58 KW
  - Average Power
    - \( PA = 0.7 \times 10^6 \text{ W} \cdot \text{m}^2 \)
    - \( PA \sigma = 0.007 \times 10^6 \text{ W} \cdot \text{m}^4 \)
    - \( \sigma = 0.01 \text{ m}^2 \)

**GLOBUS II**

- **27 meter Diameter
  - ~ 570 m² Antenna Area
  - 150 KW
  - Average Power

**FBX**

- **9.2 m² Antenna Area
  - 30 – 70 KW
  - Average Power

**Aegis Radar**

- Average Power per Radar Face = 58 KW
- Face Area = 12 M²
- 3.3 GHz Frequency (S-Band)
The Forward-Based X-Band Radar (FMX) Has Limited Acquisition Abilities Against 0.01 m² Cone-Shaped Warheads at Ranges Greater Than 600 to 700 km and Against 0.001 m² Targets at Ranges Greater Than 300 to 400 km
FBX Range ≈1300 km Against Targets with RCS 0.1 m² to 0.2 m² Targets
FBX Range ≈1300 km Against Targets with RCS 0.1 m² to 0.2 m² Targets
Missile Defense Targets

Launch Gross Weight with 1000 kg Warhead is 21,500 kg

Irish Sejjil 2000km Range Ballistic Missile

First Stage Solid Propellant
Second Stage Solid Propellant

Navy Target Missiles for SM-3 Tests

Minuteman/Trident/MX Warhead
Missile Defense Targets and Interceptors

- **Exoatmospheric Kill Vehicle**
- **Orion 50XL Rocket Stage**
- **SM-3 Block IIA/B**
- **Orion 50XLG Rocket Stage**
- **GMD Interceptor**
- **SM-3 Block IA/B**
- **Iranian Sejjil 2000km Range Ballistic Missile**
- **Launch Gross Weight with 1000 kg Warhead is 21,500 kg**
- **Navy Target Missiles for SM-3 Tests**
- **Minuteman/Trident/MX Warhead**

Launch Gross Weight with 1000 kg Warhead is 21,500 kg.
Notional Intercept Trajectory of Standard Missile 3 Block IA/B (SM-3 Block IA/B) Against 2000 km Range Iranian Ballistic Missile

Obama Missile Defense Plan (Announced on Thursday, September 17, 2009)

Trajectories Show Missile Locations at One-Minute Intervals

SM-3 Block IIA

SM-3 Block IA/B Interceptor Launched from Mediterranean

2000 km Range Ballistic Missile Launched from Iran
Notional Intercept Trajectory of Standard Missile 3 Block IA/B (SM-3 Block IA/B) Against 2000 km Range Iranian Ballistic Missile

Trajectories Show Missile Locations at One-Minute Intervals

SM-3 Block IA/B Interceptor Launched from Mediterranean

Location of Ballistic Missile When SM-3 Interceptor is Launched

2000 km Range Ballistic Missile Launched from Iran

Related Locations:
- Iran
- Saudi Arabia
- Sudan
- Ethiopia
- Somalia
- Arabian Sea
- Afghanistan
- Pakistan
- Saudi Arabia
- Egypt
Notional Intercept Trajectory of Standard Missile 3 Block IA/B (SM-3 Block IA/B) Against 2000 km Range Iranian Ballistic Missile

Trajectories Show Missile Locations at One-Minute Intervals

2000 km Range Ballistic Missile Launched from Iran

Location of Ballistic Missile When SM-3 Interceptor is Launched

SM-3 Block IA/B Interceptor Launched from Mediterranean

Countries: Italy, Greece, Turkey, Sicily, Israel, Egypt, Libya, Mediterranean

Missile's path shows multiple locations at one-minute intervals.
All the Interceptors in the GMD and PAA Systems Home on Targets Using Infrared Telescopes
The Same Basic Physics Governs the Homing of All the Kill Vehicles

All the Kill Vehicles Use a Telescope and Infrared Sensors for Homing on Targets
What the US Defense Planner Expects the Kill Vehicle to See
What the Defense Planners Expect the Infrared Sensor on the Homing Interceptor to See
What the US Kill Vehicle Might Actually See
What the Infrared Sensor on the Homing Interceptor Might Actually See!
False Targets Cloud Created in Army Ballistic Missile Development Agency Test Using a Titan II ICBM on January 10, 1975, Signature of Fragmented Tanks (SOFT),

Booster Fragmentation
False Targets Cloud Created in Army Ballistic Missile Development Agency Test Using a Titan II ICBM on January 10, 1975, Signature of Fragmented Tanks (SOFT),

Figure 8.4. The Signature of Fragmented Tanks experiment cut the Stage II of Titan II ICBM B-27 (62-008) into the numerous pieces shown above. The resulting debris cloud was used to test the ability of the Safeguard Anti-Ballistic Missile radar system to discriminate between debris from the upper stage and the reentry vehicle. From David K. Stumpf, "Titan II, A History of a Cold War Missile Program," The University of Arkansas Press, Fayetteville, Copyright 2000, pages 200-201
How Objects Appear to the Kill Vehicle

Expected Appearance of the Target Warhead at About Ten Kilometers Range

100-120 meters

100-120 meters

12-15 meters
Focal Plane Array from the IFT-1A NMD Experiment
Resolution Limits Associated with Current Exoatmospheric Kill Vehicle Technology

1. **Image of Target Warhead**
   - Projected onto the Focal Plane Array by Optical Lenses or Mirrors

2. **Focal Plane Array**
   - Image of Warhead Reduced to Intensity Values in Two Individual Detectors

3. **Individual Infrared Detector**
   - Lens or Equivalent Mirror
Current Testing of Missile Defense Systems
Current Testing of Missile Defense Systems

Terrier orion
Current Testing of Missile Defense Systems

Time to Impact

Less than 0.1 seconds to Impact

Range ≤ 0.3 km

Roughly 0.5 seconds to Impact

Range ~ 1.8 km

Roughly 1.0 seconds to Impact

Range ~ 3.5 km

Full Video Frame

Magnified Image

Magnified Image

3.5 km
Conclusion from US Navy Videos of “Successful Intercepts

Simple countermeasures that disguise the location of the warhead from the infrared homing sensors are very easy to implement and will drastically reduce the chances of hitting a target. These could be used as decoys or to surround warheads disguising them as balloons.

Balloons that have been flown in space
The Kill Vehicle Must Determine Which of These Are Warheads and Which are Decoys from 500 Kilometers Range!
Why the SM-3 Missile Defense Could Appear to Be Threatening Even Though Its Capabilities are Obviously Limited
Locations of the Vertical Launch System Boxes on Two Different Variants of the DDG-51 Navy Destroyer
Basic Characteristics of the Vertical Launch System Components

SM-3 Block IIA
21” Diameter
4,000 lb
Interceptor
Aegis Block IA Interceptor and Vertical Launch Cannister
Basic Operational Characteristics of the Vertical Launch System Components
### Variants of the Aegis SM-3 Interceptor and Kill Vehicles

#### Burnout Speed
- **Block IA**: 3 km/sec
- **Block IB**: 4.5 km/sec
- **Block IIA**: 5.5 – 6 km/sec

<table>
<thead>
<tr>
<th>Block IA</th>
<th>Block IB</th>
<th>Block IIA</th>
<th>Block IIB</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Kill Warhead (KW)</strong>&lt;br&gt;• 1-Color Seeker&lt;br&gt;• Divert &amp; Attitude Control System (DACS)</td>
<td>KW&lt;br&gt;• 2-Color Seeker&lt;br&gt;• Improved Optics&lt;br&gt;• Advanced Signal Processor&lt;br&gt;• Improved DACS</td>
<td>21” Nosecone&lt;br&gt;Large Diameter KW&lt;br&gt;• Advanced Discrimination Seeker&lt;br&gt;• High Divert DACS</td>
<td>Improved KW&lt;br&gt;High Performance Upper Stage</td>
</tr>
<tr>
<td><strong>Stage 1</strong>:&lt;br&gt;• MK 72 Booster&lt;br&gt;• MK 41 Vertical Launch System (VLS) Compatible</td>
<td><strong>Stage 1</strong>:&lt;br&gt;• MK 72 Booster&lt;br&gt;• MK 41 VLS</td>
<td><strong>Stage 1</strong>:&lt;br&gt;• MK 72 Booster&lt;br&gt;• MK 41 VLS</td>
<td><strong>Stage 1</strong>: Existing MK 72 Booster</td>
</tr>
<tr>
<td><strong>Stage 2 &amp; 3</strong>:&lt;br&gt;• 13.5” Propulsion</td>
<td><strong>Stage 2 &amp; 3</strong>:&lt;br&gt;• 13.5” Propulsion</td>
<td><strong>Stage 2 &amp; 3</strong>:&lt;br&gt;• 21” Propulsion</td>
<td><strong>Stage 2</strong>:&lt;br&gt;• 21” Propulsion</td>
</tr>
</tbody>
</table>

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**AEGIS BMD SM-3 EVOLUTION.** The SM-3 is being fielded in “blocks” as technology advances, enabling improved defense through upgrades to the interceptor.
Aegis BMD SM-3 Evolution Plan

<table>
<thead>
<tr>
<th>Block IA</th>
<th>Block IB</th>
<th>Block II</th>
<th>Block IIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block 2004</td>
<td>Block 2008</td>
<td>High Velocity Variant</td>
<td>High Divert Variant</td>
</tr>
</tbody>
</table>
| - 2- Color Seeker  
  - Increased IR Acquisition  
  - Improved Discrimination  
- TDACS  
  - Increased Divert  
  - Lowers AUR Cost  
- All-Reflective Optics (ARO)  
- Advanced Signal Processor (ASP) | | | |
| Block IB Seeker | | Block IB Seeker | |
| - 21" Propulsion  
  - 2nd & 3rd Stage  
  - Increased Missile Vbo = xx | | 21" Nosecone | |
| - 21" Nosecone | | MK 41 VLS Compatible | |
| MK 41 VLS Compatible | | | |

Funded Since PB06 | Capability Change From Previous Block

Approved for Public Release  
06-MDA-1922 (13 SEP 06)

ms-108727 / 091406
# Variants of the Aegis SM-3 Interceptor and Kill Vehicles

<table>
<thead>
<tr>
<th>Model Interceptor Parameters</th>
<th>Kill Vehicle</th>
<th>Third Stage Motor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight≈1322 lbs</td>
<td>Weight≈600 lbs</td>
<td>I&lt;sub&gt;sp&lt;/sub&gt;≈289 sec</td>
</tr>
<tr>
<td>Fuel Load≈0.90</td>
<td>Weight≈2000 lbs</td>
<td>Weight≈2000 lbs</td>
</tr>
<tr>
<td>Fuel Load≈0.85</td>
<td>Fuel Load≈0.85</td>
<td>Fuel Load≈0.85</td>
</tr>
</tbody>
</table>

- **First Stage Motor**
  - I<sub>sp</sub>≈220 sec
  - Weight≈1200 lbs
  - Fuel Load≈0.75

- **Second Stage Motor**
  - I<sub>sp</sub>≈280 sec
  - Weight≈2000 lbs
  - Fuel Load≈0.85

- **Third Stage Motor**
  - I<sub>sp</sub>≈289 sec
  - Weight≈600 lbs
  - Fuel Load≈0.90

### SM-3 Block IA/B
- Diameter: 13.5"

### SM-3 Block IIA
- Diameter: 21"
- Second Stage Motor: 21" 2<sup>nd</sup> Stage
- Third Stage Motor: 21" 3<sup>rd</sup> Stage
Capabilities of the Future 4.5 km/sec and 5.5 km/sec Variants of the SM-3 Block IIA and Block IIB Interceptors to Engage ICBMs
Capabilities of the Future 4.5 km/sec and 5.5 km/sec Variants of the SM-3 Block IIA and Block IIB Interceptors to Engage ICBMs

Locations of All Missiles Shown at One Minute Intervals
Kinematic Capabilities of Future 4.0 km/sec and 4.5 km/sec Variants of the SM-3 Block II Interceptors to Engage ICBMs
Kinematic Capabilities of a 4.5 km/sec SM-3 Block IIA Interceptor

All ICBM Attack Corridors from Russia to the United States Could Be Covered by Suitably Placed SM-3 Aegis-Armed Destroyers

All ICBM and Interceptor trajectory locations marked at one minute intervals.
Kinematic Capabilities of a 4.5 km/sec SM-3 Block IIA Interceptor

All ICBM Attack Corridors from Russia to the United States Could Be Covered by Suitably Placed SM-3 Aegis-Armed Destroyers

All ICBM and Interceptor trajectory locations marked at one minute intervals.
Military planners have the responsibility of looking towards future threats.

- Increase in number and speed of the Interceptors
- Increase in the capabilities and numbers of radars
- Concerns about possible prior damage to nuclear forces from pre-emptive strikes.
- Interceptors with small nuclear weapons

Result, military planners may recognize that the current defense system has limited capabilities, but they will have to consider and plan for possible future expansions and upgrades of the system.

One way to deal with such circumstances would be for China to expand its nuclear forces and to also increase its emphasis on countermeasures.

Hence, the US preoccupation with missile defenses that have little capability gets the worst of two worlds, defenses that are not reliable, and adversaries who could react as if the defenses actually could work.

An example from history.
Vast expansion of US nuclear strike forces in response to the Russian Moscow missile defense