MIT
Science, Technology, and
Global Security Working Group

The Proposed US Missile Defense in Europe:
Technological Issues Relevant to Policy

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Major Questions that Need to Be Addressed

Major Issues

- What Are the Benefits Versus the Costs Associated with the Current Plan to Deploy a Missile Defense in Europe?
- Could This Deployment Cause an Avoidable Major Policy Confrontation with Russia at a Time When Russian-US Cooperation is Critical?
- Will the System Provide the Promised Performance Benefits?
- Are Their Alternative System Configurations that Could "Do the Job" that would Not Be Perceived as a Threat by the Russians?

Serious Questions About the Future of Security Relations Between Russia, Europe, and the United States and Their Other Allies

- It appears that the US Government is Attempting to Mislead the US Public, and the European Allies, About the "Theoretical" Capabilities of the US Proposed Missile Defense in Europe?
- Misleading Statements Are Being Made by High-Level Members of the US Department of State, and the US Department of Defense
- These misleading Statements Have Serious Security Implications for Both the Europeans and the US.
- False Statements Being Made to Russia by the US, As Well As US Portrayals to the Europeans of Russia as Disingenuous, Could Have Very Serious Long-Range Implications for the Future Relationship of Russia with the West
- Serious Damage to US National Security Could Result By Further Reducing the Credibility of the US With Its European Allies.
- Serious Damage to the Security of the European Allies Could occur From Decisions Based on Inaccurate Information.
- The US Policy of Lying in Negotiations and to Allies is a Serious Matter That Must Be Addressed to Avoid Long-Range Damage to the Security of Russia, Europe, the United States, and Its Other Allies.

Concerns Expressed by the Russians

Engagement With Russia

- March 17, 2006 (Washington): Bilateral Defense Commission Meeting. Under Secretary of Defense Edelman and General Mazurkevich, Chief of the Main Directorate for International Cooperation
- April 3, 2006 (Moscow): Briefing of Russian officials by U.S. Embassy (Moscow) on DOD decision to resume consultations with Poland regarding the site of U.S. missile defense assets
- November 3, 2006 (Moscow): Dr. Cambone, Lt Gen Obering, DASD Green, Russian Minister of Defense Ivanov, Chief of General Staff Gen-Col Baluevskiy, Gen-Col Mazurkevich
  - Russians did not acknowledge Iran emerging threat as a rationale for deployment of U.S. missile defense assets
  - Believe Russia is real target
  - Russians "portrayed" lack of understanding and confusion on technical aspects of a deployed missile program and proposed architecture. U.S. committed to following-up with technical discussions to Russian counterparts
- January 29, 2007 (Moscow): Strategic Dialogue Meeting. Under Secretaries Joseph and Deputy Foreign Minister Kislyak
  - Ambassador re-committed that U.S. will follow-up with technical briefings/explanations regarding U.S. missile deployment
- February 9, 2007 (Seville): Secretary Gates and Minister of Defense Ivanov during NATO-Russia Council Ministerial meeting

U.S. Has Offered Future Event Establishing Technical Experts Meeting (Spring 2007)

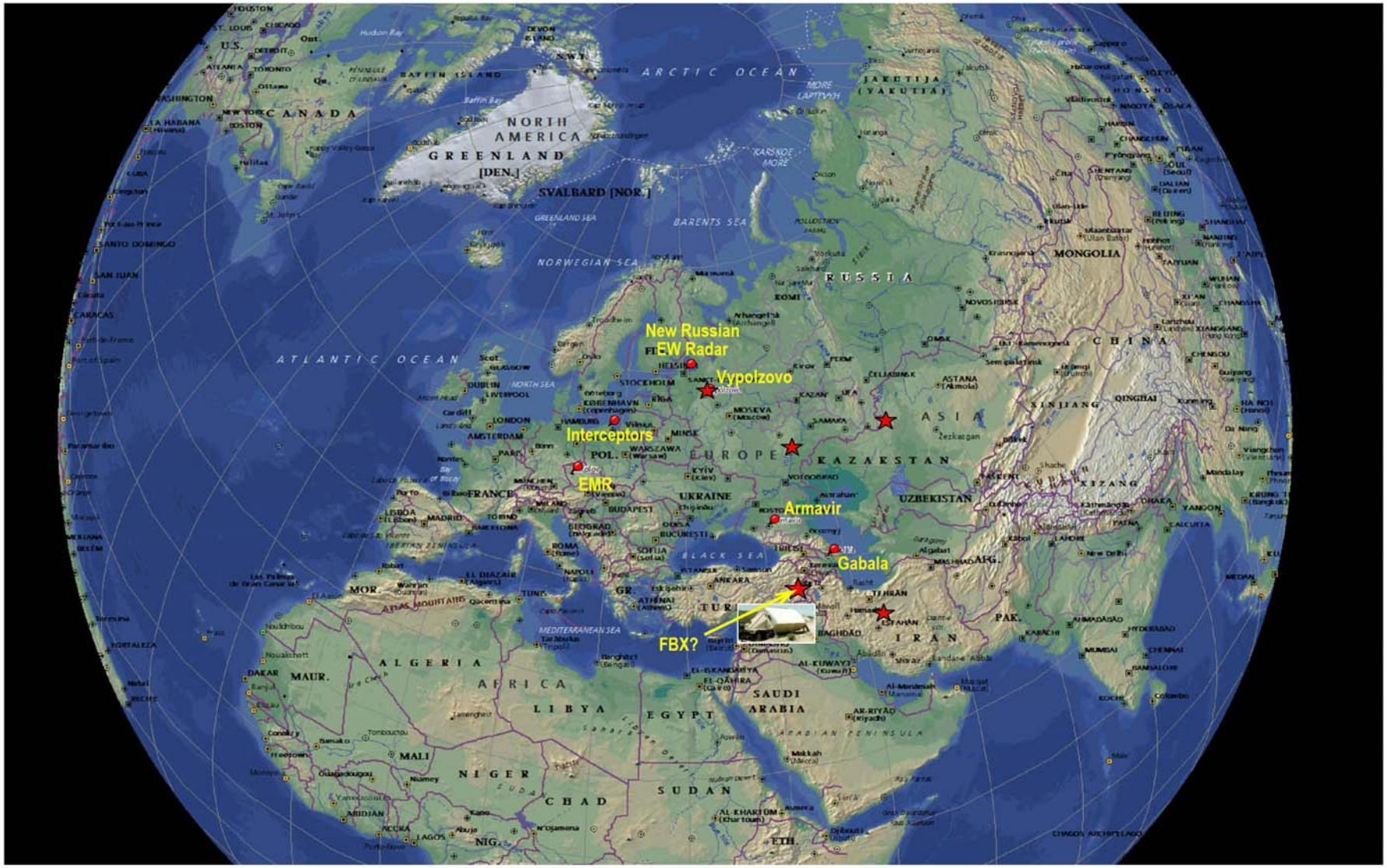
Proposed Elements Of A European Missile Defense

- Up to 10 silo-based long-range interceptors located in Eastern Europe (2011-2013)

- Re-location of a narrow-beam, midcourse tracking radar currently used in our Pacific test range to central Europe (2011)

- Field an acquisition radar focused on the Iranian threat from a forward position to provide detection, cueing, and tracking information (2010-2011)

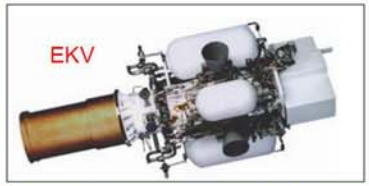
Locations of Physical Assets Relevant to an Assessment of the Policy Issues



Interceptors are Modified Ground-Based Interceptors

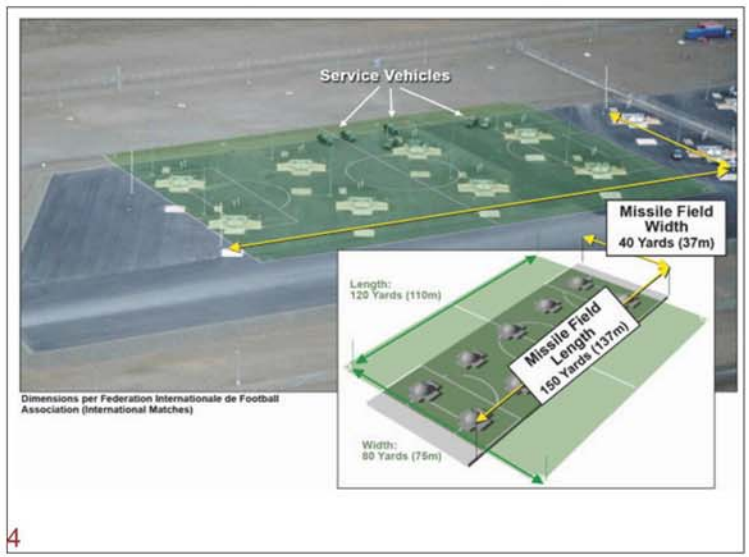
2 Stage Instead of 3 Stage
47,400 lbs versus 31,500 lbs
51 Feet Long versus

The interceptors planned for Poland are nearly identical to the three-stage interceptors based in the U.S. except that they are a two-stage variant that is quicker, lighter, and better suited for the engagement ranges and timelines for Europe. The silos that house the ground-based interceptors have substantially smaller dimensions (e.g., diameter and length) than those used for offensive missiles, such as the U.S. Minuteman III ICBM. Any modification would require extensive, lengthy, and costly changes that would be clearly visible to any observer.



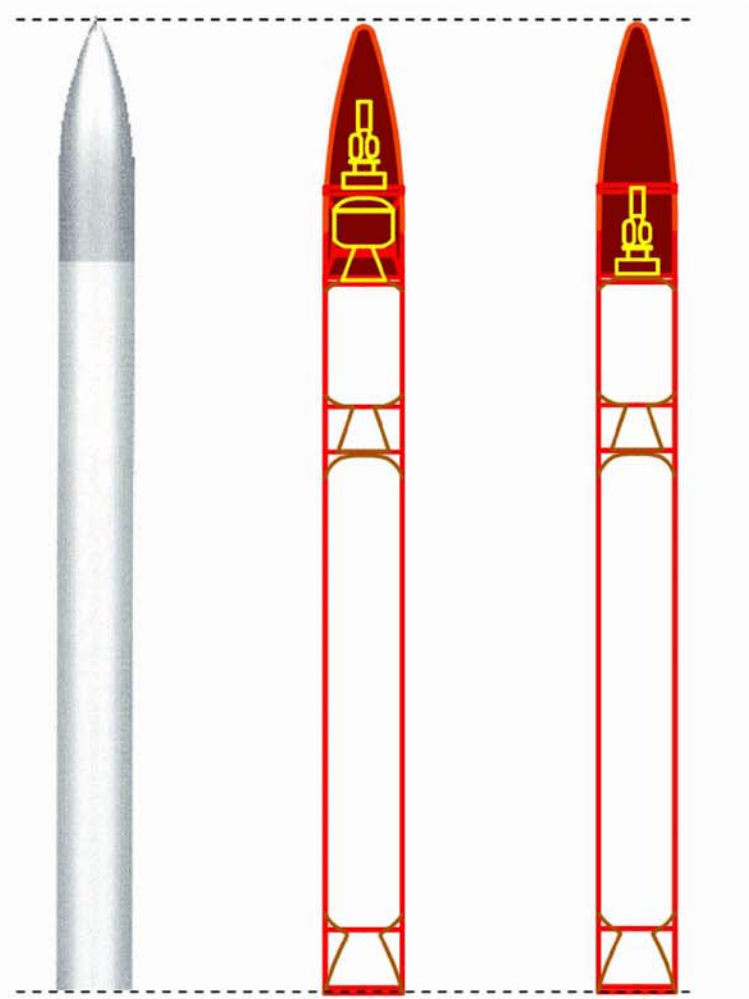
The ground-based interceptors are comprised of a booster vehicle and an exoatmospheric kill vehicle (EKV). Upon launch, the booster flies to a projected intercept point and releases the EKV which then uses on-board sensors (with assistance from ground-based assets) to acquire the target ballistic missile. The EKV performs final discrimination and steers itself to collide with the enemy warhead, destroying it by the sheer kinetic force of impact.

Future European Missile Site – Size Comparison

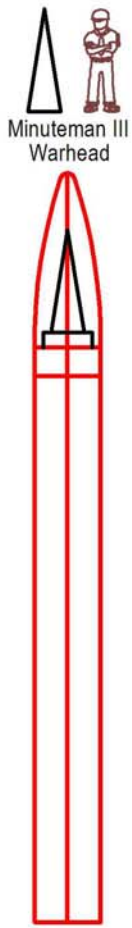


Pegasus/Taurus Derived Ground-Based Interceptor

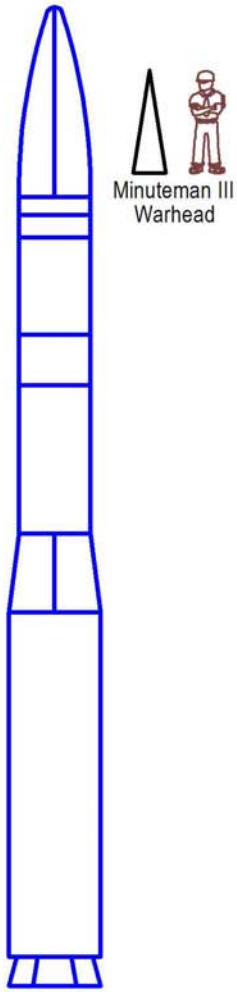
Two-Stage and Three-Stage Variants of the Ground-Based Interceptors to be Deployed Europe and Continental United States Respectively



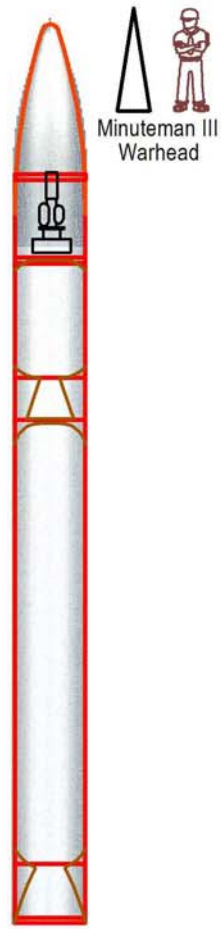
Throw Weights of Potential ICBM's to 10,000 Kilometers Range



Midgetman ICBM
Launch Weight ≈ 30,000 lbs
Throw Weight ≈ 1000 lbs



Minuteman III
Launch Weight ≈ 75,000 lbs
Throw Weight ≈ 2,500 lbs



European GBI
Launch Weight ≈ 49,500 lbs
Throw Weight ≈ 1,500 lbs

Sensitivity of the Burnout Velocity to Model Assumptions
Two-Stage Variant of the Ground-Based Interceptor

Missile Defense Agency Stated Launch Weight = 21,500 kg (47,400 lbs)
Model Launch Weight = 47,655 lbs

Baseline Model: 9.37 km/sec

Baseline with Specific Impulse of First Stage Increased to 295 sec-1:
Burnout Speed = 9.50 km/sec

Baseline with Shroud Carried to Burnout:
Burnout Speed = 8.95 km/sec

Baseline with Total Rocket Motor Burn Time Increased from 140 to 150 sec:
Burnout Speed = 8.93 km/sec

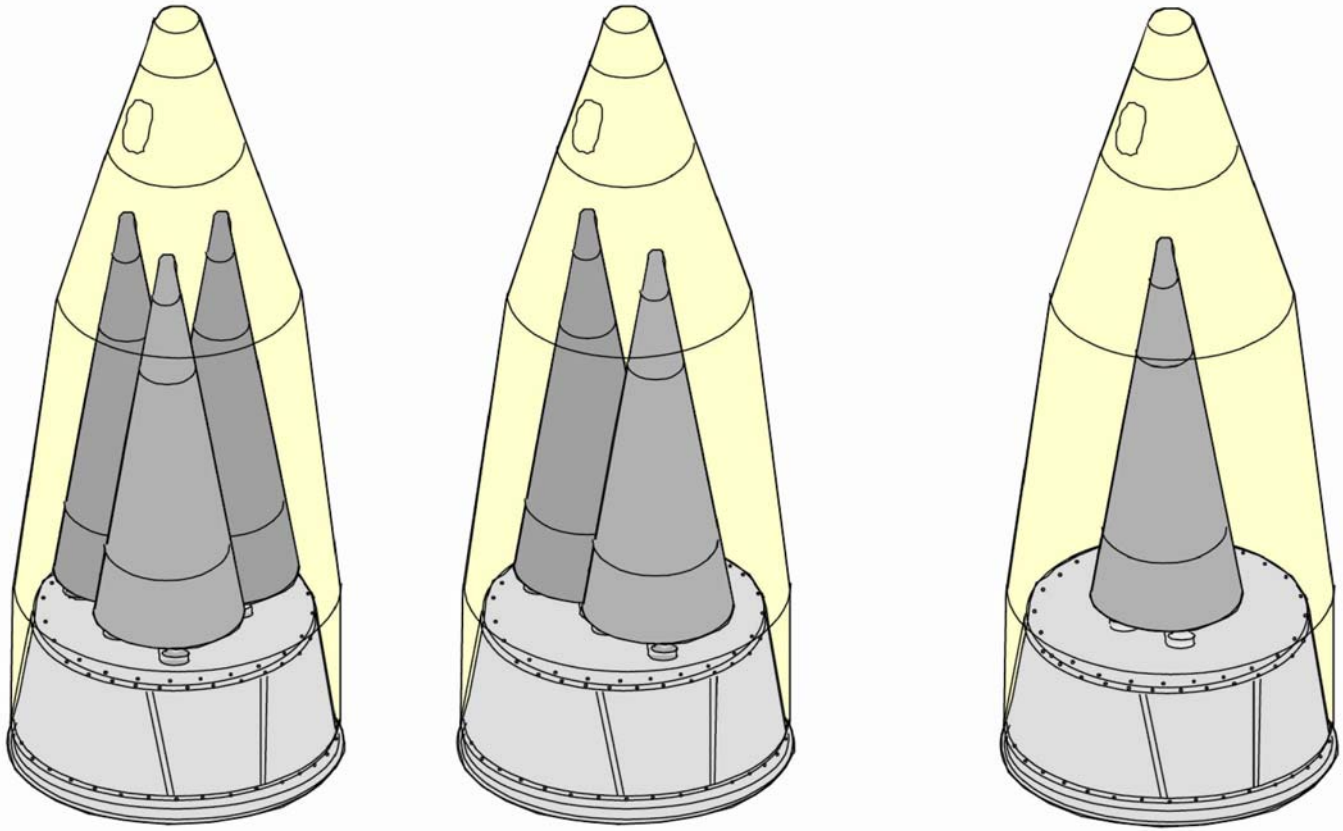
Baseline with All Three Variants Applied Together:
Burnout Speed = 8.93 km/sec

Baseline has all three excursions together, and carries the Kill Vehicle plus 2,075 lbs of ballast
Burnout Speed = 6.3 km/sec.

Ground-Based Interceptor
Achieves 6.3 km/sec Carrying a Payload of 1950 lbs

Ground-Based Interceptor
Achieves 8.5 to 8.7 km/sec Carrying a Payload of 220 to 155 lbs

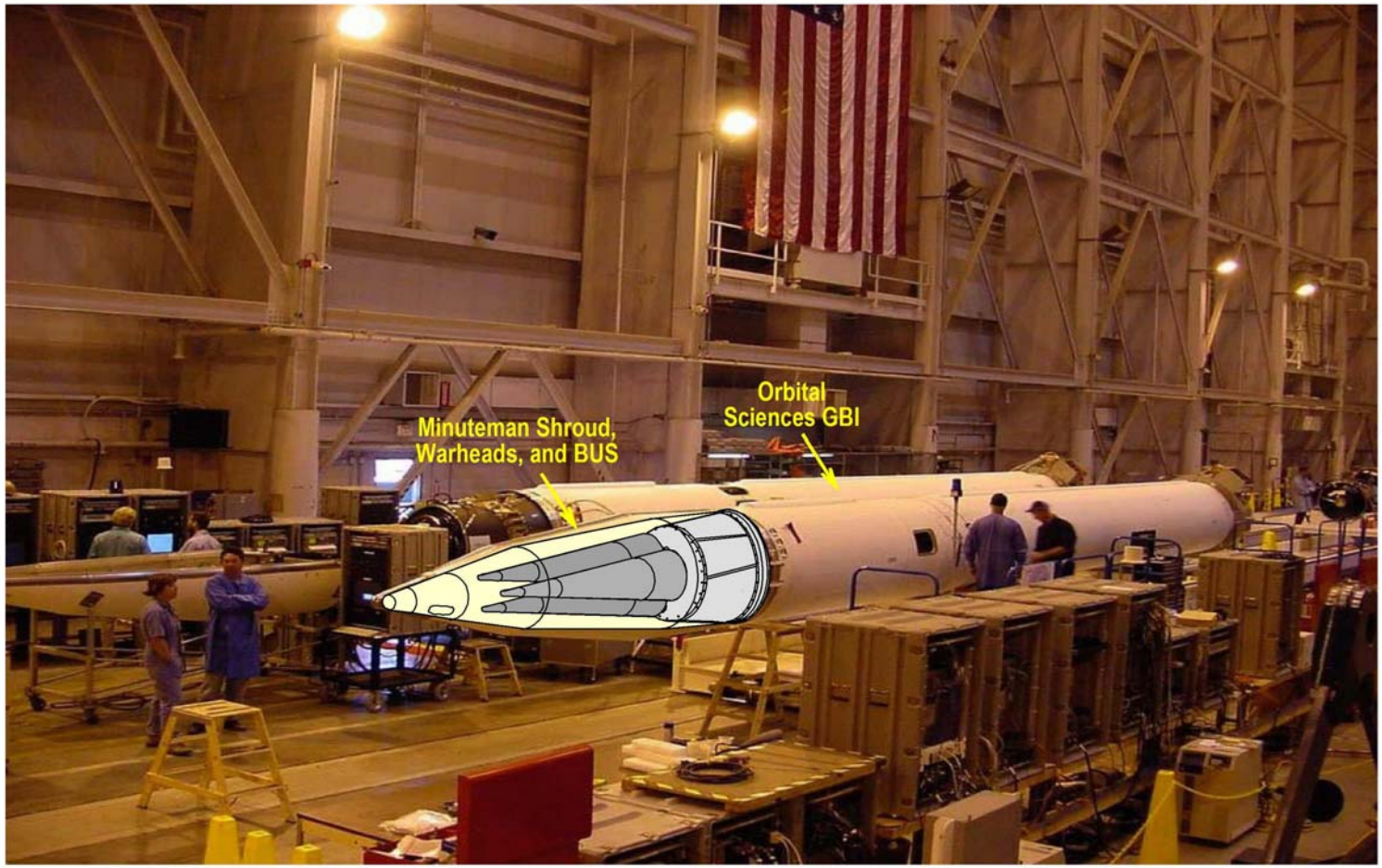
REENTRY SYSTEMS



2-3 RV
EXISTING

1 RV
MODIFIED

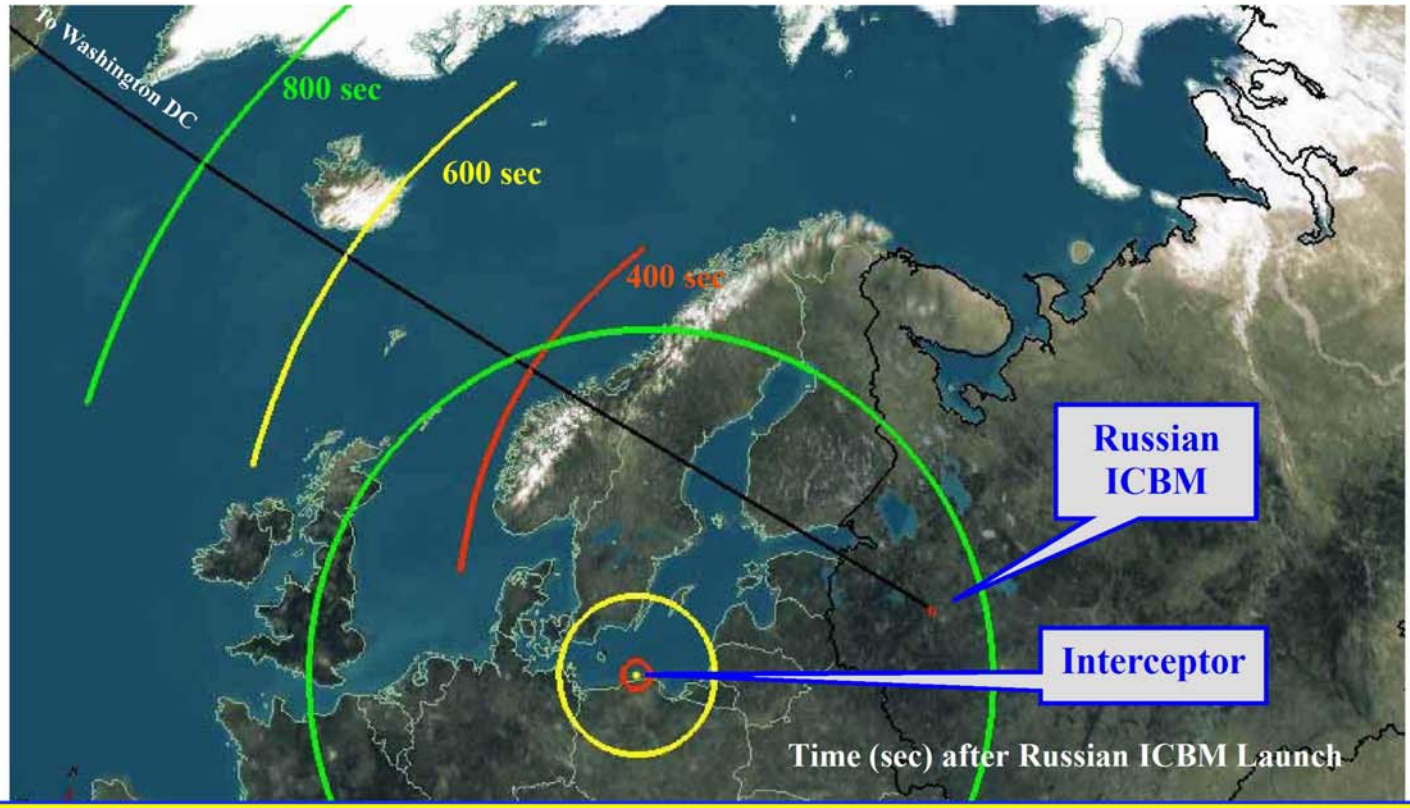
The Ground-Based Interceptor
Can Carry a Full Minuteman III BUS and Three Warheads to 6,000+ Kilometers



Can the Europe-Based Missile Defense Engage Russian ICBMs and if so Why Does that Matter?

General Obering's Original Slide

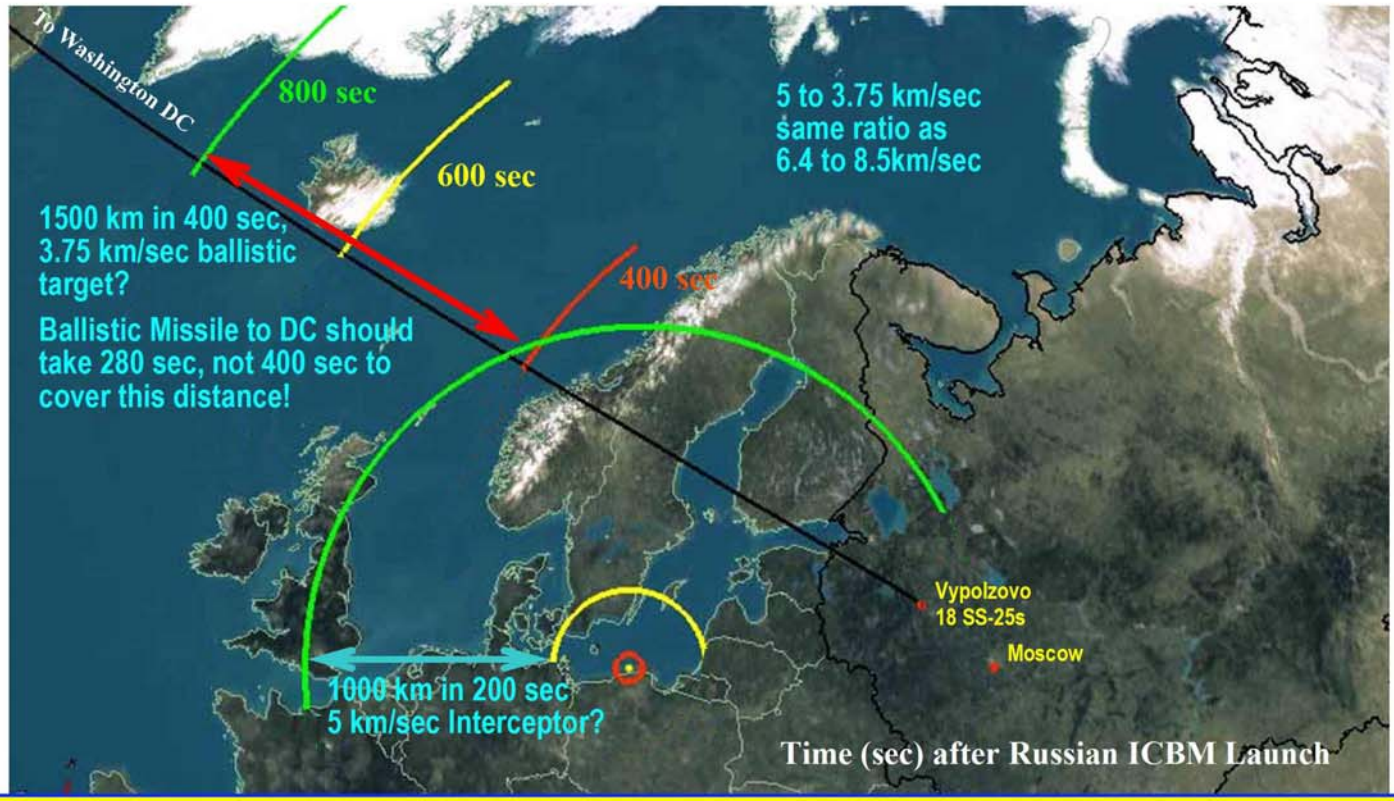
Interceptors Cannot Catch Russian Missiles



U.S. European Interceptor Site Cannot Affect Russian Strategic Capability

Obering's Slide – Distances and Speeds Wrong

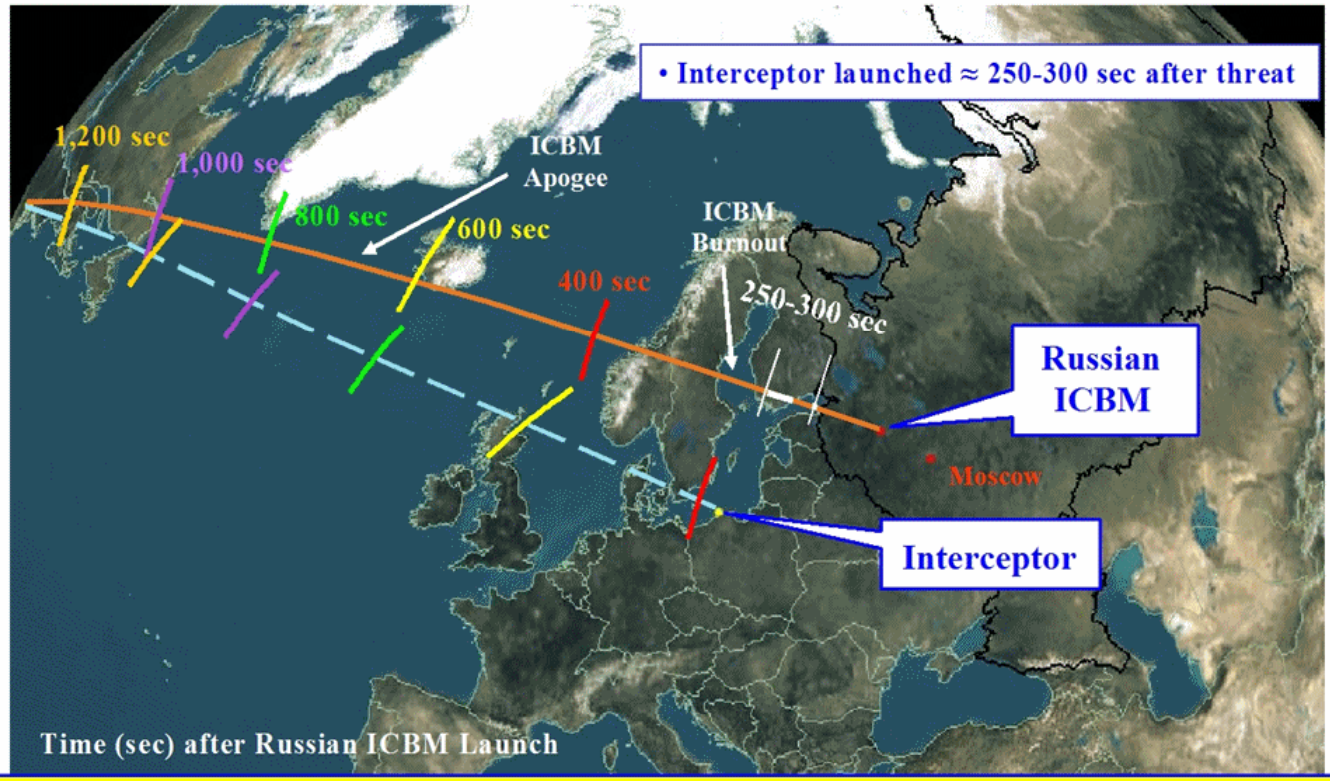
Interceptors Cannot Catch Russian Missiles



U.S. European Interceptor Site Cannot Affect Russian Strategic Capability

Misleading MDA Slide Indicating Interceptors Cannot Engage Russian ICBMs

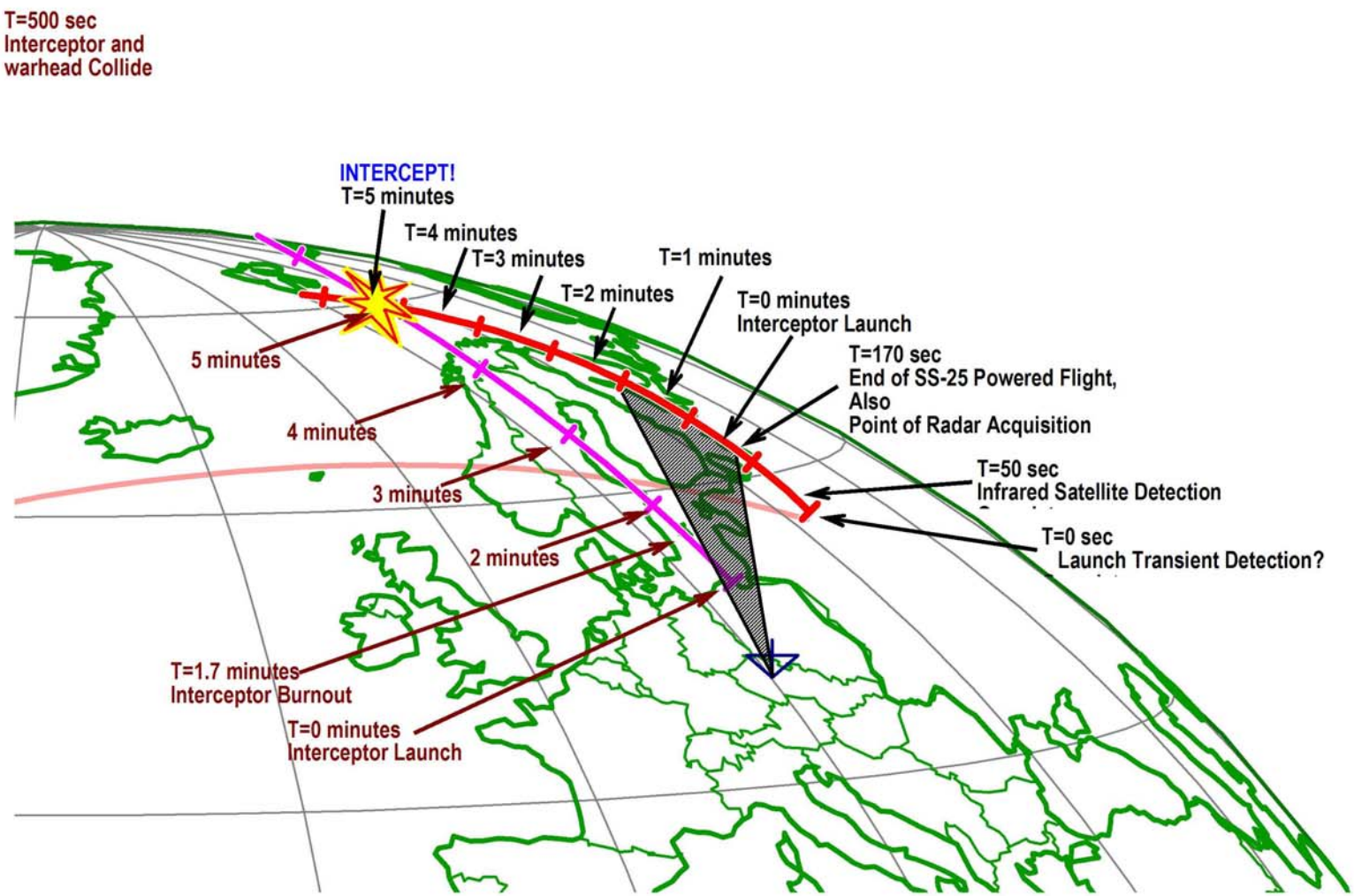
Interceptors Cannot Catch Russian Missiles



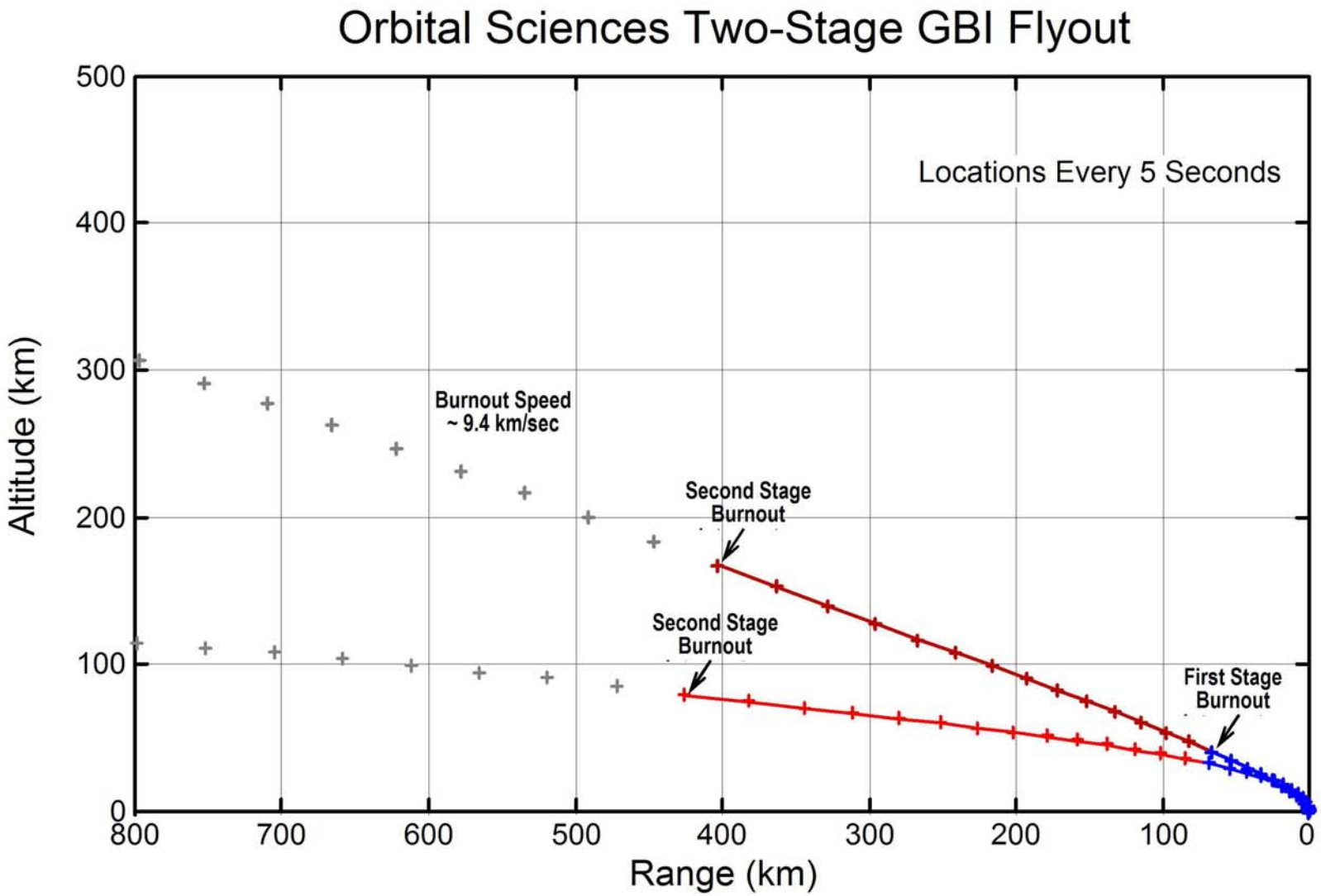
U.S. European Interceptor Site Cannot Affect Russian Strategic Capability

Misleading MDA Slide

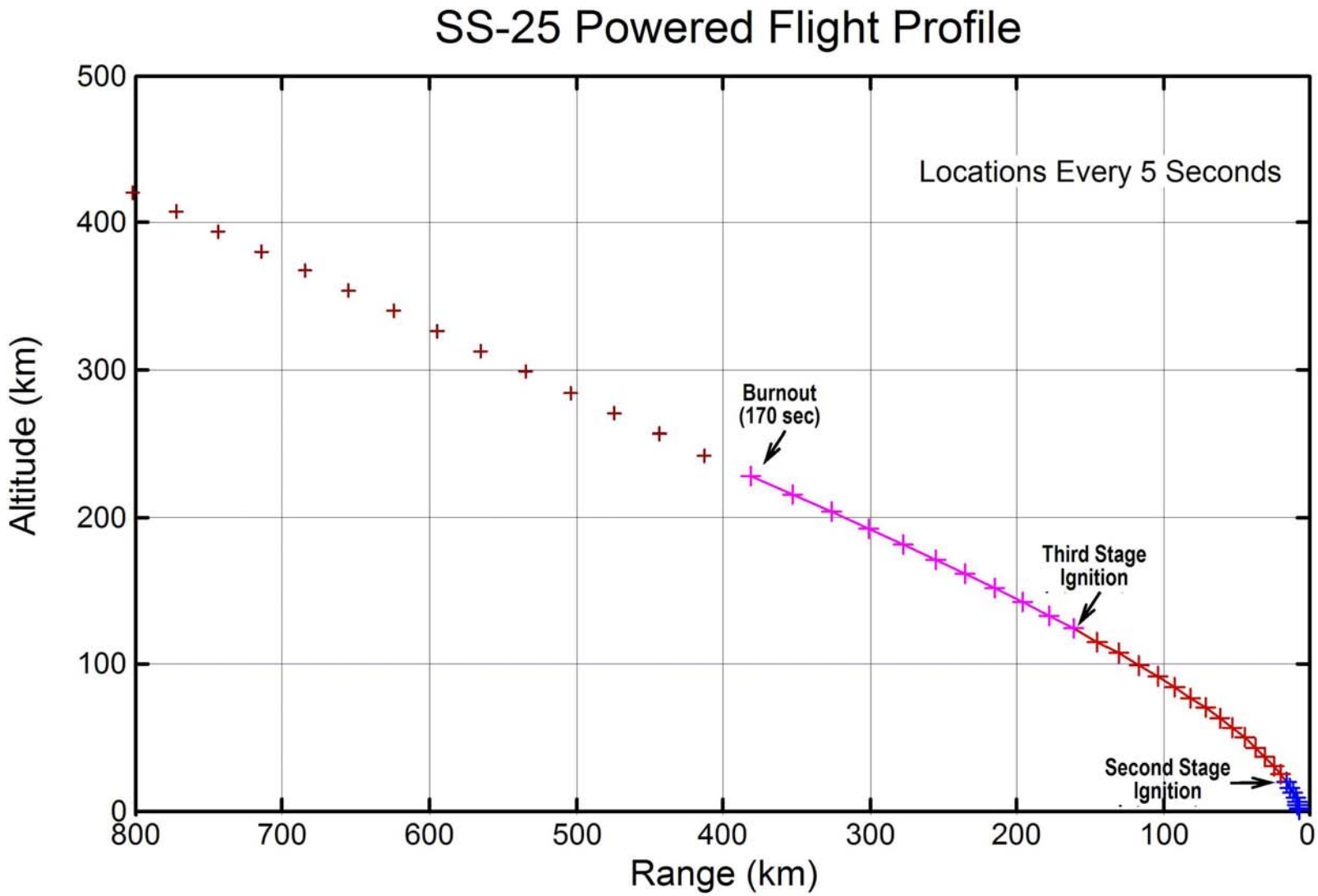
Engagement Event Timeline for Engagement of SS-25 from Vypolzovo with 2-Stage Missile Defense Interceptor



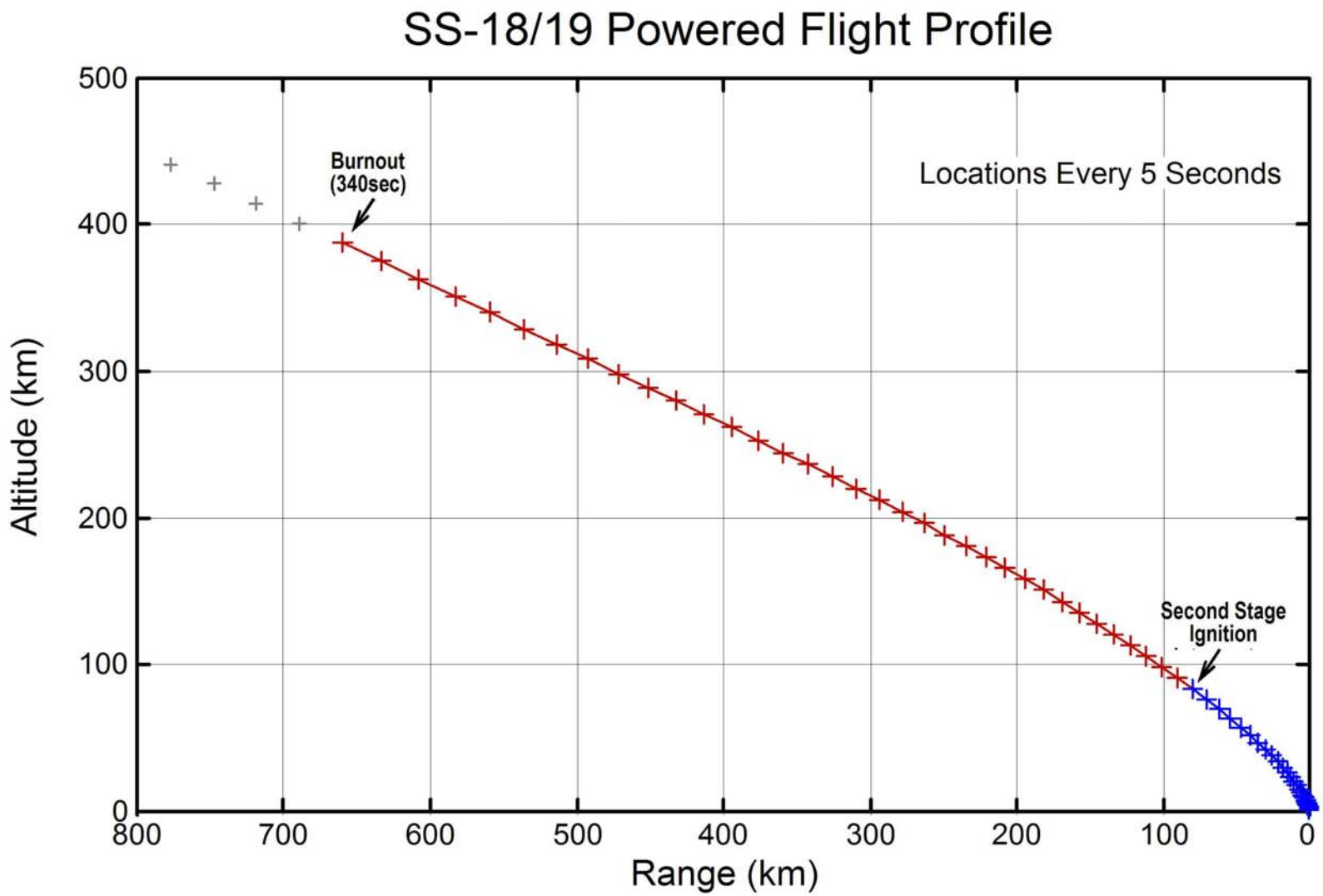
Location of Orbital Sciences Two-Stage GBI at 5 Second Intervals During Powered Flight



Location of SS-25 Russian ICBM at 5 Second Intervals During Powered Flight

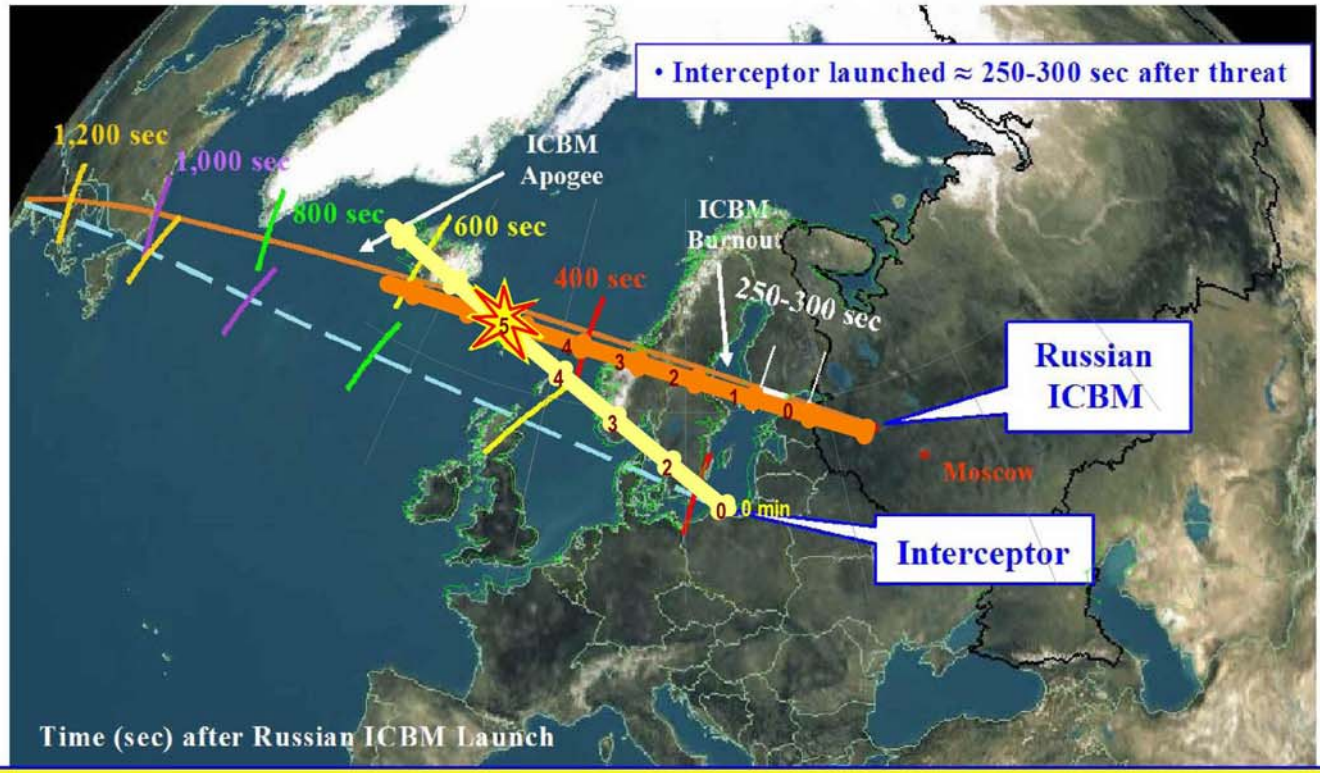


Location of SS-18/19 Russian ICBM at 5 Second Intervals During Powered Flight



Misleading MDA Slide Indicating Interceptors Cannot Engage Russian ICBMs

Interceptors Cannot Catch Russian Missiles



U.S. European Interceptor Site Cannot Affect Russian Strategic Capability

Misleading MDA Slide

Actual Timelines for an Engagement

Interceptors Cannot Catch Russian Missiles

U.S. European Interceptor Site Cannot Affect Russian Strategic Capability

This statement is wrong

Missile Defense Agency Slides Showing Additional Defense-Coverage of Hokkaido, Japan with Interceptors from the Polish Launch Site

Relevant Observations:

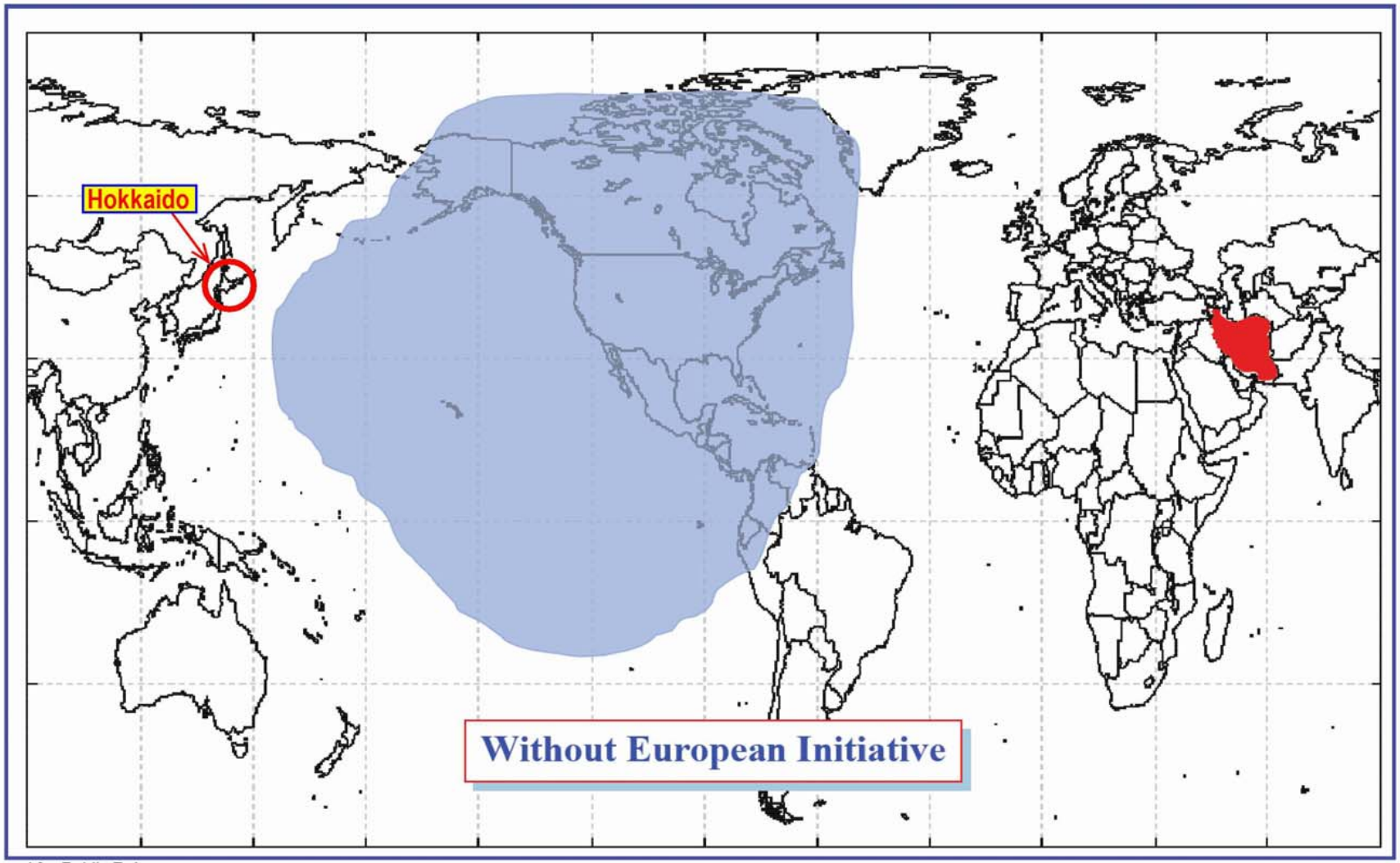
- Radar in Czech Republic Not Used
- Intercept Achieved with FBX or Adjunct Radar Tracking from Eastern Turkey
- Interceptor Speed 40% Faster Than 6.3 km/sec Speed Claimed by US administration
- HOWEVER, MDA CONTINUES TO REVISE AND CHANGE ITS STATEMENTS ABOUT THE CHARACTERISTICS OF THE POLISH-BASED INTERCEPTORS

Missile Defense Agency Statement About the Poland-Based Interceptor Characteristics Revised to Explain Original Claim of 6.3 km/sec Burnout Speed

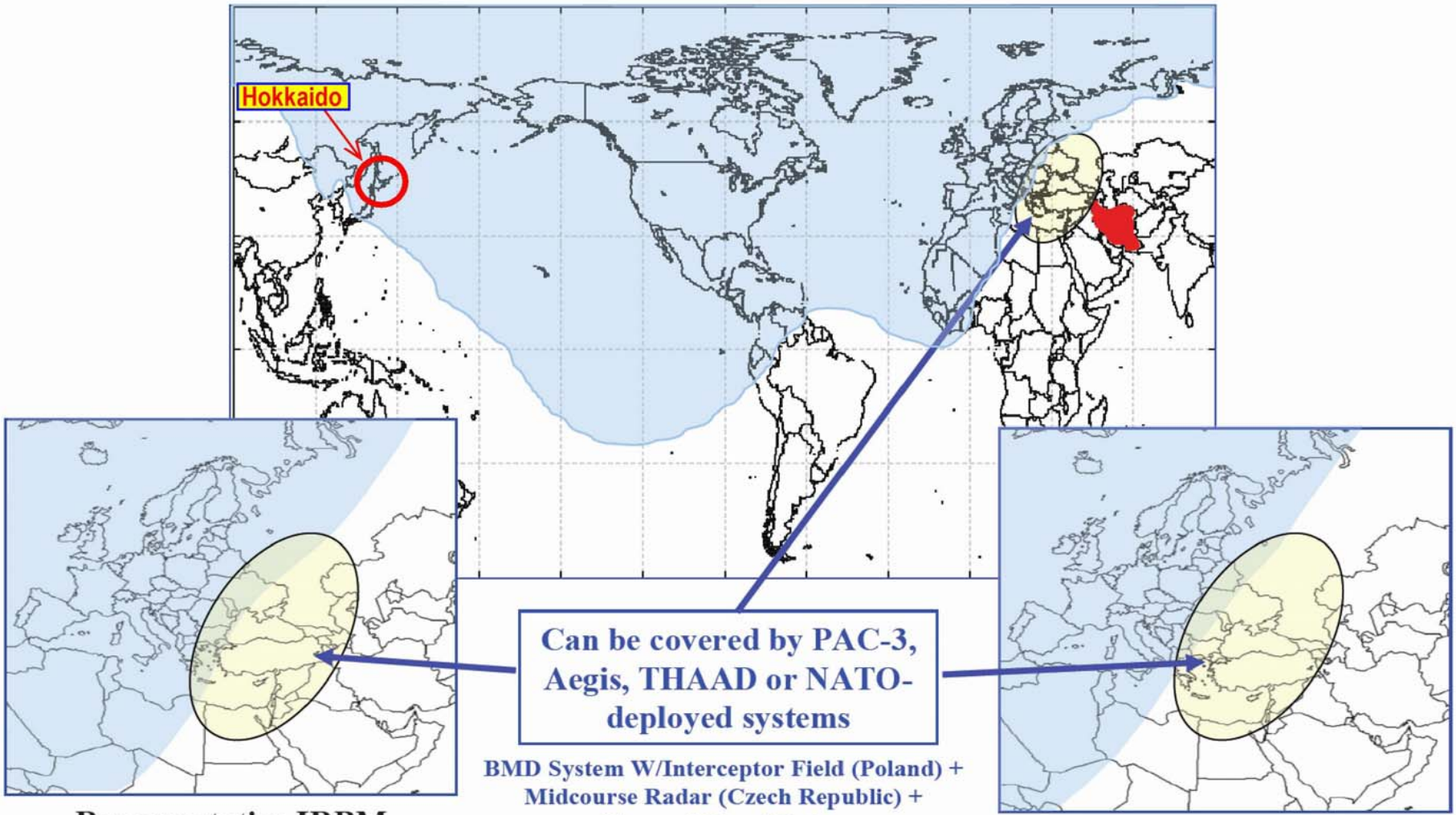
Relevant Observations:

- Predicted Interceptor Burnout Speed Drops from 9.4 km/sec to 7.5 km/sec
- Interceptor Can No Longer Achieve Defense-Coverage of Japan, As Claimed by Missile Defense Agency
- Interceptor Speed Still 20% Higher Than 6.3 km/sec Speed Originally Claimed by US administration
- Interceptor Still fast Enough to Achieve Intercepts Against Russian ICBMs, Although Only for Trajectories Towards the East Coast of the US
- Hence, Defense Coverage Claimed by Missile Defense Agency Must Be Wrong!

Ballistic Missile Coverage Against Long-Range Iranian Missiles

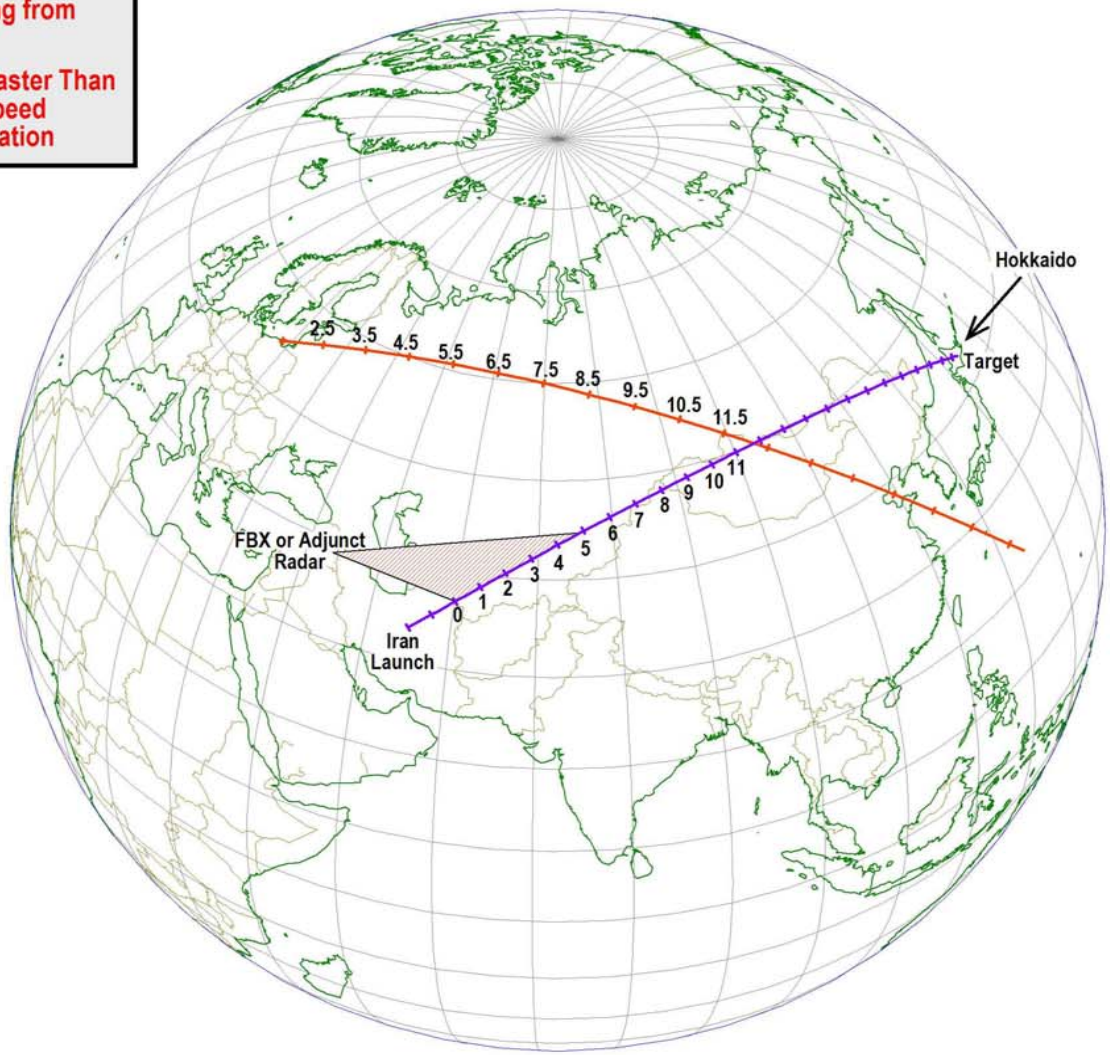


Capability Provided Versus Iranian Intermediate To Long-Range Ballistic Missiles



Notional Intercept Trajectory for 9.4 km/sec Interceptor Launched from Poland

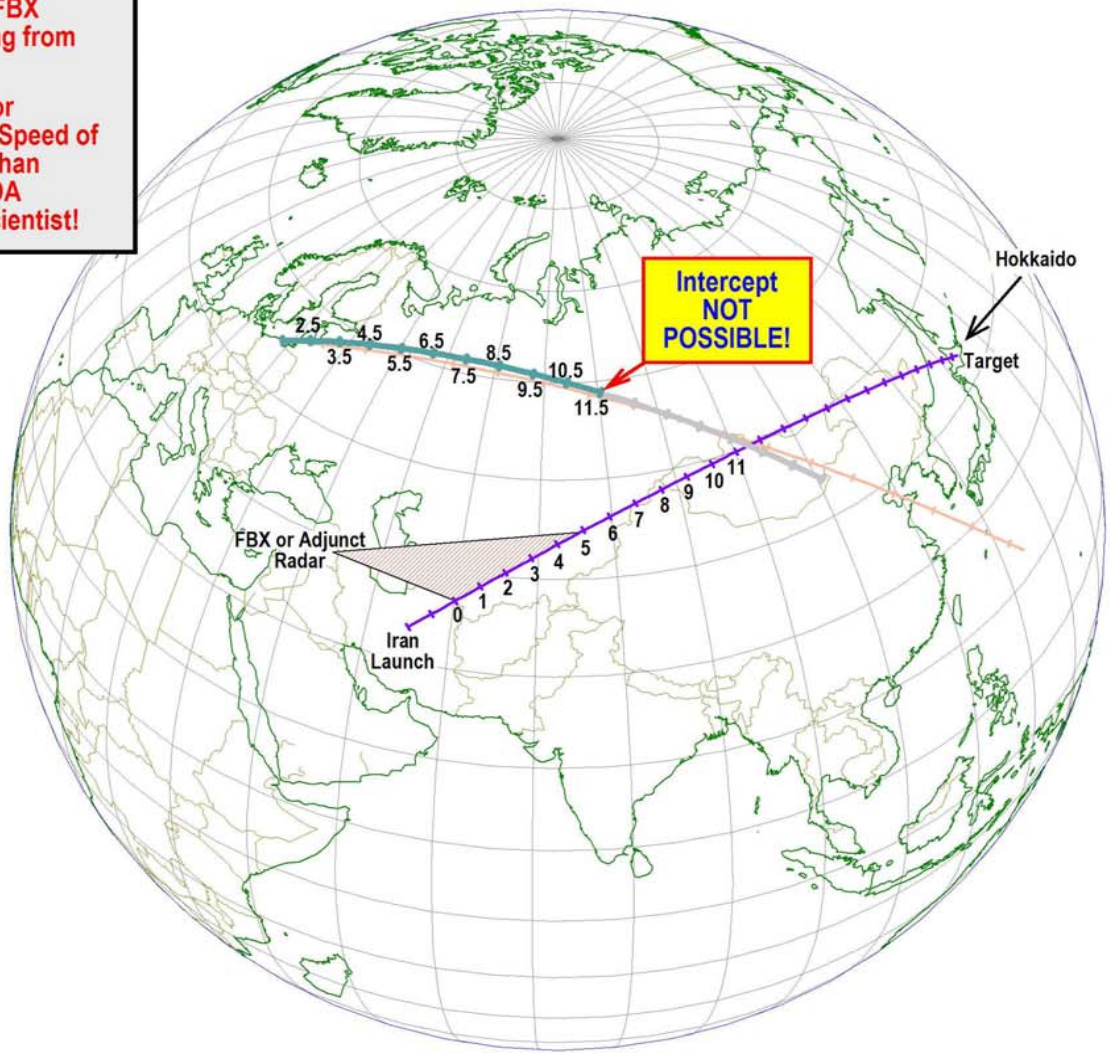
- Radar in Czech Republic Not Used
- Intercept Achieved with FBX or Adjunct Radar Tracking from Eastern Turkey
- Interceptor Speed 40% Faster Than 6.3 km/sec Interceptor Speed Claimed by US administration



Revised Interceptor Characteristics Indicates

Defense-Coverage Claimed by Missile Defense Agency Must Be Wrong!

- Radar in Czech Republic Not Used
- Intercept Achieved with FBX or Adjunct Radar Tracking from Eastern Turkey
- REVISED MDA Interceptor Parametrs Give Burnout Speed of 7.5 km/sec, 15% Faster Than Originally Claimed by MDA Spokesman and Chief Scientist!



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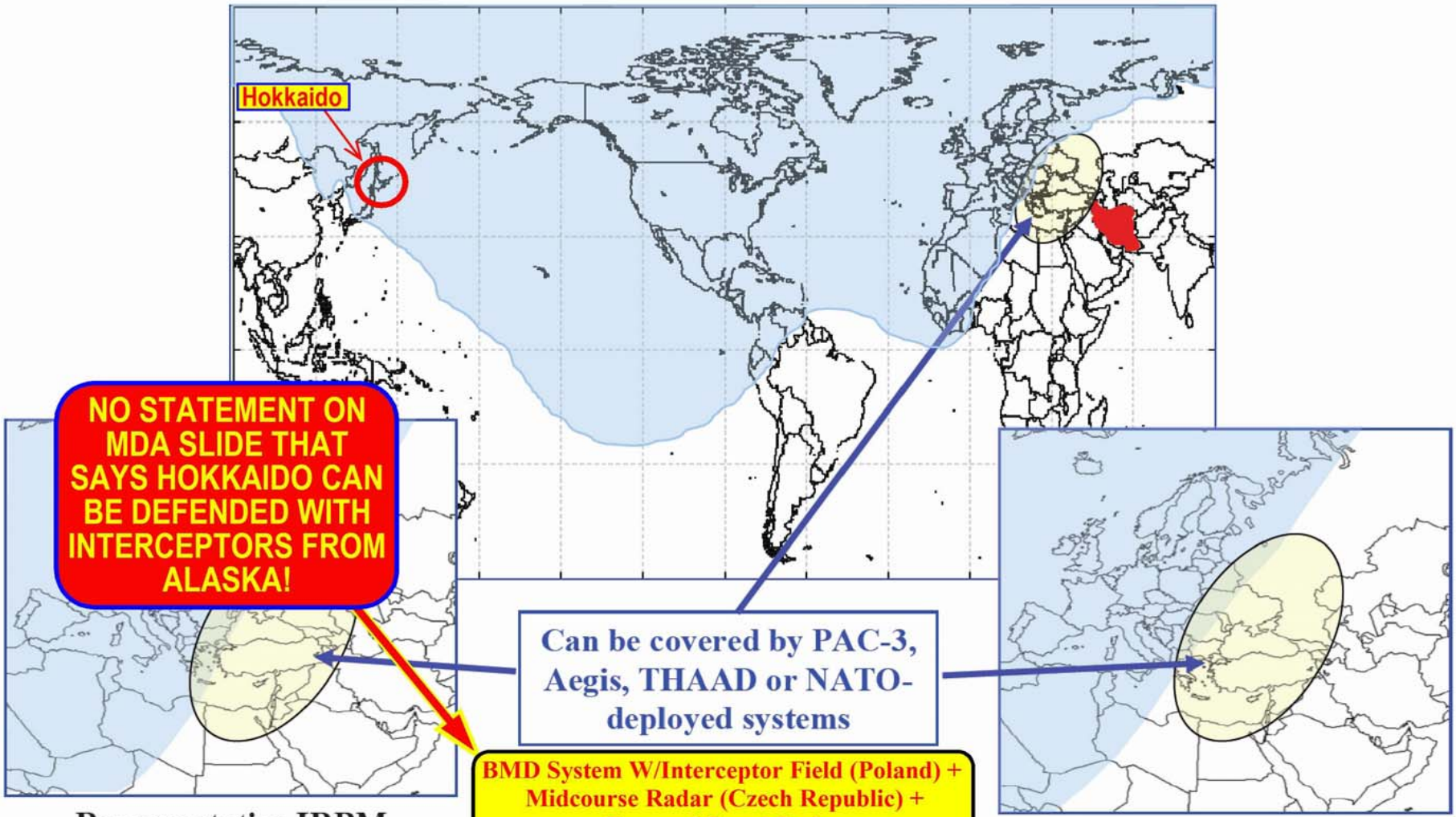
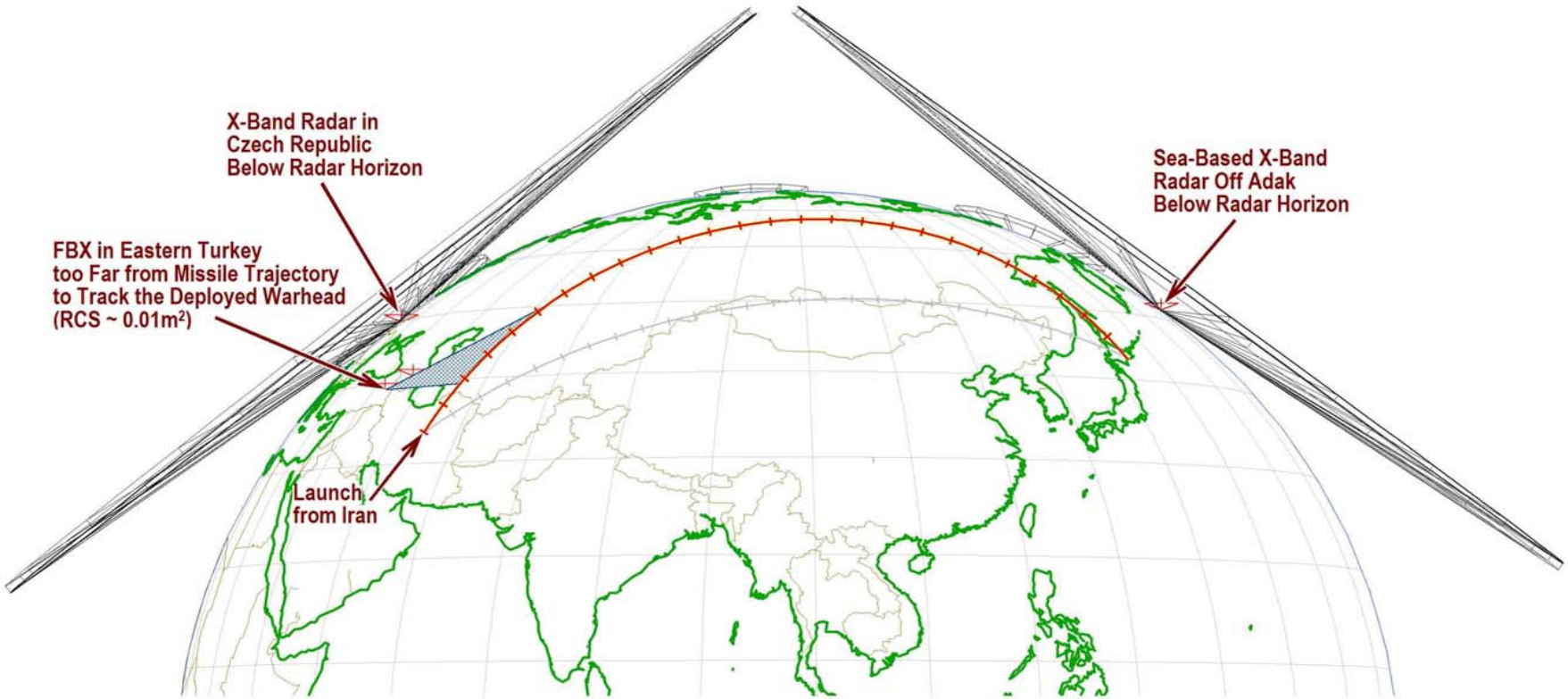


False Claims Made in Presentations to European (and Japanese?) Allies by Missile Defense Agency that US Proposed European Missile Defense Can Defend Northern Japan

NO PLAUSIBLE WAY FOR DEFENSE SYSTEM TO OBTAIN PRECISION TRACKING DATA NEEDED TO GUIDE INTERCEPTORS FROM ALASKA!



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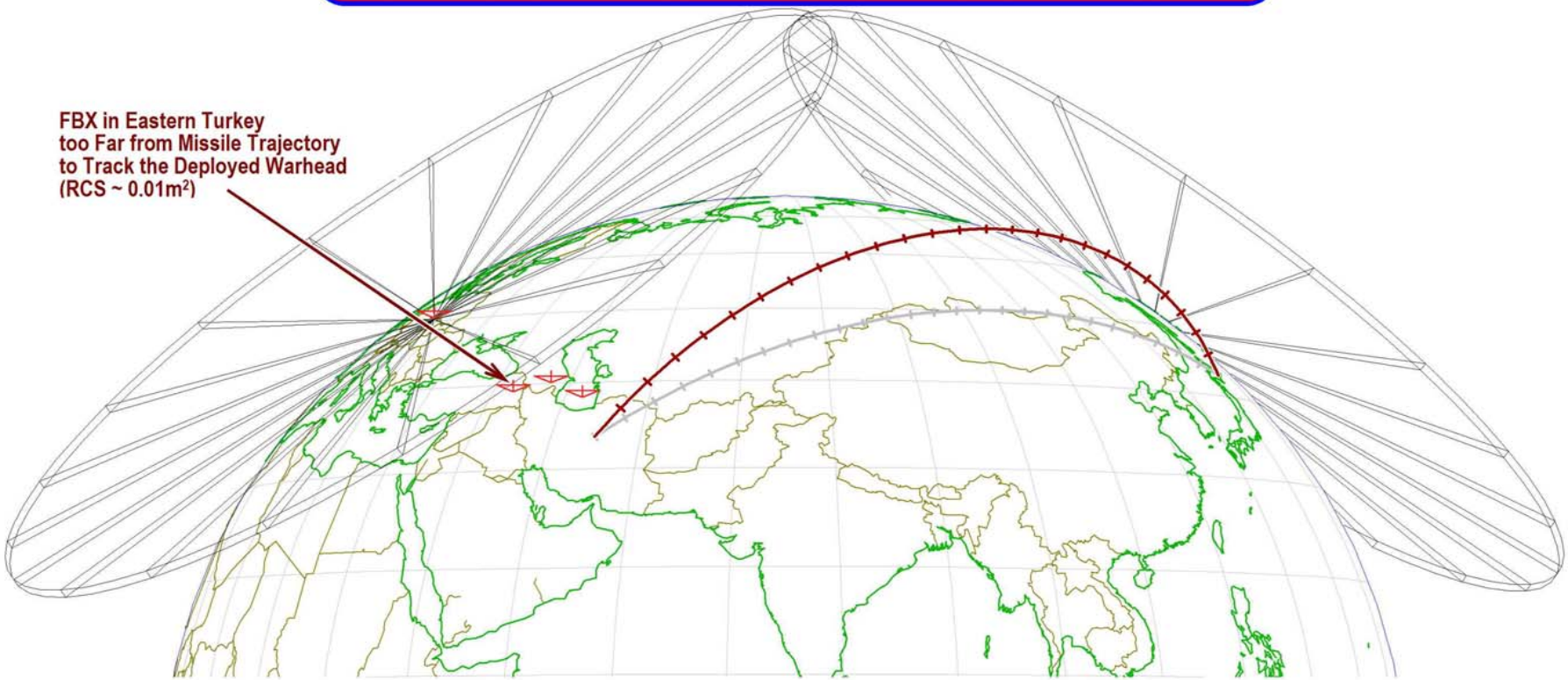
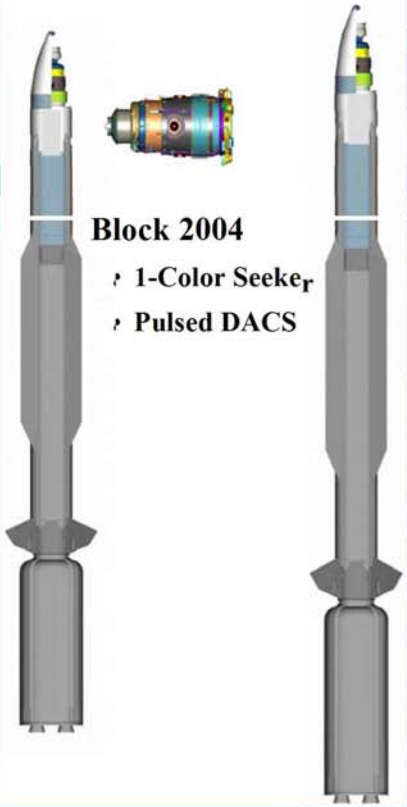
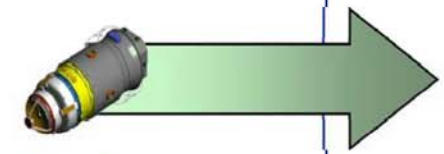


False Claims Made in Presentations to European (and Japanese?) Allies by Missile Defense Agency that US Proposed European Missile Defense Can Defend Northern Japan

Radar Fan Acquisition and Tracking Coverage in Support of Aegis Launch Platforms

Aegis BMD SM-3 Evolution Plan

Block IA	Block IB	Block II	Block IIA
 Block 2004 • 1-Color Seeker • Pulsed DACS	• 2- Color Seeker - Increased IR Acquisition - Improved Discrimination • TDACS - Increased Divert - Lowers AUR Cost • All-Reflective Optics (ARO) • Advanced Signal Processor (ASP)	High Velocity Variant • Block IB Seeker • 21" Propulsion - 2nd & 3rd Stage - Increased Missile Vbo = xx • 21" Nosecone • MK 41 VLS Compatible 	High Divert Variant • Large Diameter KW - Advanced Discrimination Seeker - High Divert DACS • 21" Propulsion - 2nd & 3rd Stage - Increased Missile Vbo = yy • 21" Nosecone • MK 41 VLS Compatible 
Block 2004	Block 2008	Block 2010 / 2012	Block 2012 / 2014



Funded Since PB06 | Capability Change From Previous Block

In Summary

- It appears that the US Government is Attempting to Mislead the US Public, and the European Allies, About the "Theoretical" Capabilities of the US Proposed Missile Defense in Europe?
- Misleading Statements Are Being Made by High-Level Members of the US Department of State, and the US Department of Defense
- These misleading Statements Have Serious Security Implications for Both the Europeans and the US.
- False Statements Are Being Made to Russia by the US, Which Could Have Very Serious Long-Range Implications for the Future Relationship of Russia with the West.
- Serious Damage to US National Security Could Result By Further Reducing the Credibility of the US With Its European Allies.
- Serious Damage to the Security of the European Allies Could occur From Decisions Based on Inaccurate Information.
- The US Policy of Lying in Negotiations and to Allies is a Serious Matter That Must Be Addressed to Avoid Long-Range Damage to the Security of Russia, Europe, the United States, and Its Other Allies.

Summary of the Technological Issues Relevant to Policy (1 of 2)

- Two-Stage Ground-Based Interceptors sited in Poland are kinematically able to provide intercept coverage for most, but not all, of Europe.
- The Two-Stage Ground-Based Interceptors are also capable of intercepting Russian ICBMs launched towards targets on the East Coast of the United States.
- Missile Defense Agency claims that such intercepts are not possible are inaccurate.
- Missile Defense Agency claims about the ability to defend Northern Japan by adding missile defense components in Europe are Inaccurate.
- The Missile Defense Agency Has Provided Journalists with Three Technically Contradictory Sets of Claims About the Ground-Based Interceptors to be Deployed in Poland.
- The missile Defense Agency Has Also Made Three Unambiguously False Claims About the Additional Areas That Could be Defended by Deploying Defense-Components in Europe.
- Aegis system interceptors are kinematically able to provide intercept coverage for a missile defense of Europe.

Summary of the Technological Issues Relevant to Policy (2 of 2)

- **The planned radar support for the European missile defense is woefully inadequate, even if the defense faces no countermeasures.**

  X-band radars are fundamentally not suited for the role of acquisition and surveillance. Lower frequency radars operating at VHF, UHF, or L-Band are all far more suitable for this mission.

- **The radar acquisition and surveillance problem could probably be solved by using multiple Forward-Based X-Band radars placed strategically between Iran and Europe. However, the defense would still be easily defeated by simple countermeasures.**

  These radars would probably only be able to acquire and track cone-shaped ballistic missile warheads at ranges less than 1000 km range. They would, however, be able to track the upper rocket stage that deploys the warhead at greater range. This may make it possible for the radar to cue on upper rocket stages as part of a process aimed at acquiring and tracking the warhead.

- **The radar acquisition and surveillance problem could also be solved, assuming no countermeasures, by using the Russian Voronezh Class VHF Early Warning Radar in Armavir, Russia.**
- **There is overwhelming evidence that exoatmospheric Missile Defenses are fundamentally vulnerable to exoatmospheric decoys. This near-certain vulnerability has far ranging implications for the viability of exoatmospheric missile defenses and the nation's security. Congress should consider investigating this serious and fundamental vulnerability.**

Presidential National Security Directive 23 (PNSD-23)

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Signed by President Bush on December 6, 2002.

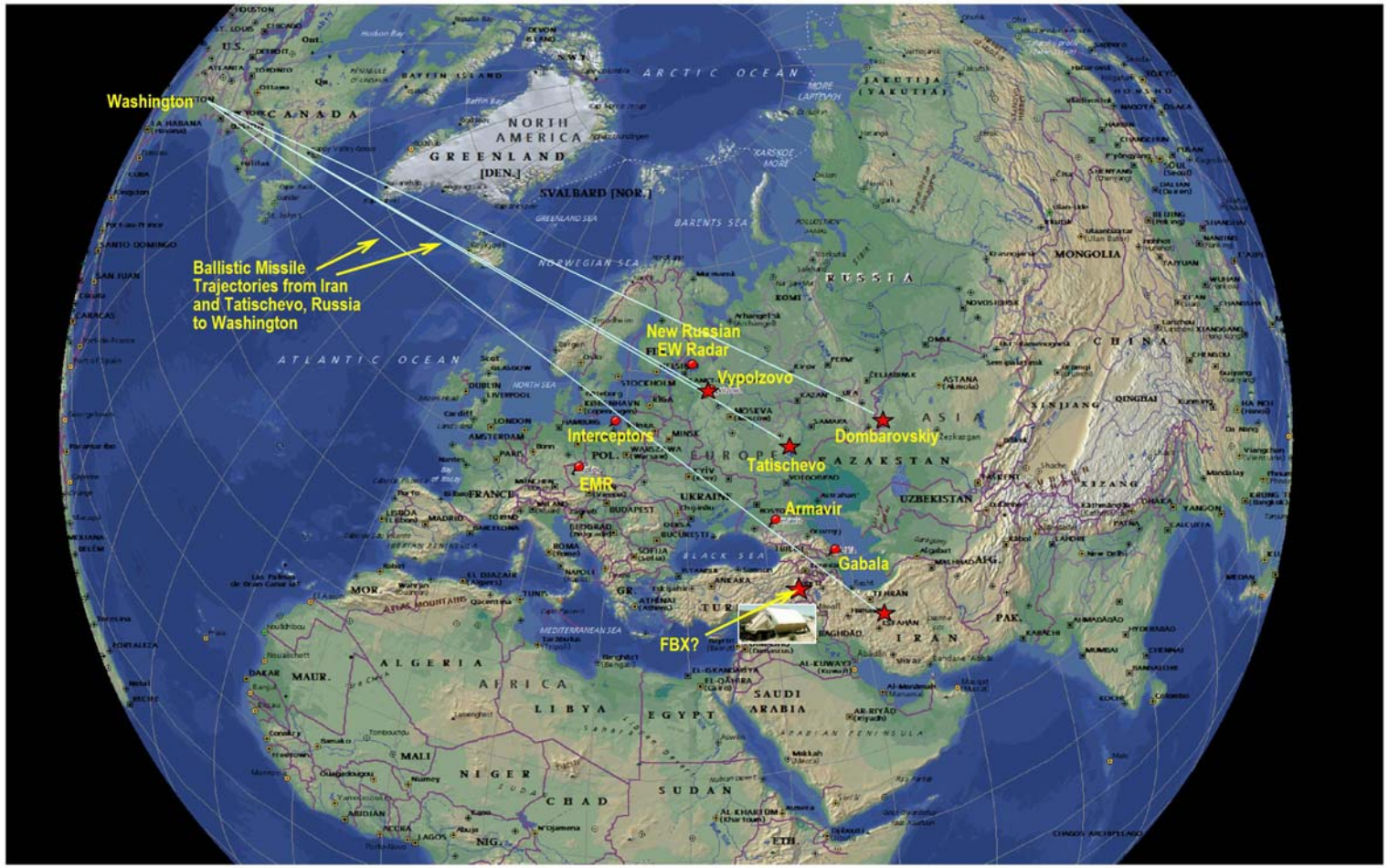
- PNSD-23 reaffirmed the policy of the Bush administration "to develop and deploy, at the earliest possible date, ballistic missile defenses drawing on the best technologies available."
- The Directive also states that the United States would begin to deploy missile defenses in 2004 "as a starting point for fielding *improved and expanded missile defenses later [emphasis added]*."
- And that the ultimate goal was missile defenses "not only capable of protecting the United States and our deployed forces, but also friends and allies."
- PNSD-23 was preceded in January 2002 by a memorandum from then Secretary of Defense Donald Rumsfeld. The Rumsfeld memo directs the Missile Defense Agency to develop defense systems by first using whatever technology is "available," even if the capabilities produced are limited relative to what the defense must ultimately be able to do.

Observation

PNSD-23 Appears to be a Mandate for *Continued* and *Unbounded* Expansion and Modernization of the Missile Defense System in Europe and Elsewhere.

If this is True, PNSD-23 Would Indicate to the Russians that the Current Defense Deployment in Europe is only the *Leading Edge* of a Much Larger and More Capable Future Deployment.

Ballistic Missile Trajectories from Iran and Tatischevo, Dombarovskiy, and Vypolzovo, Russia to Washington



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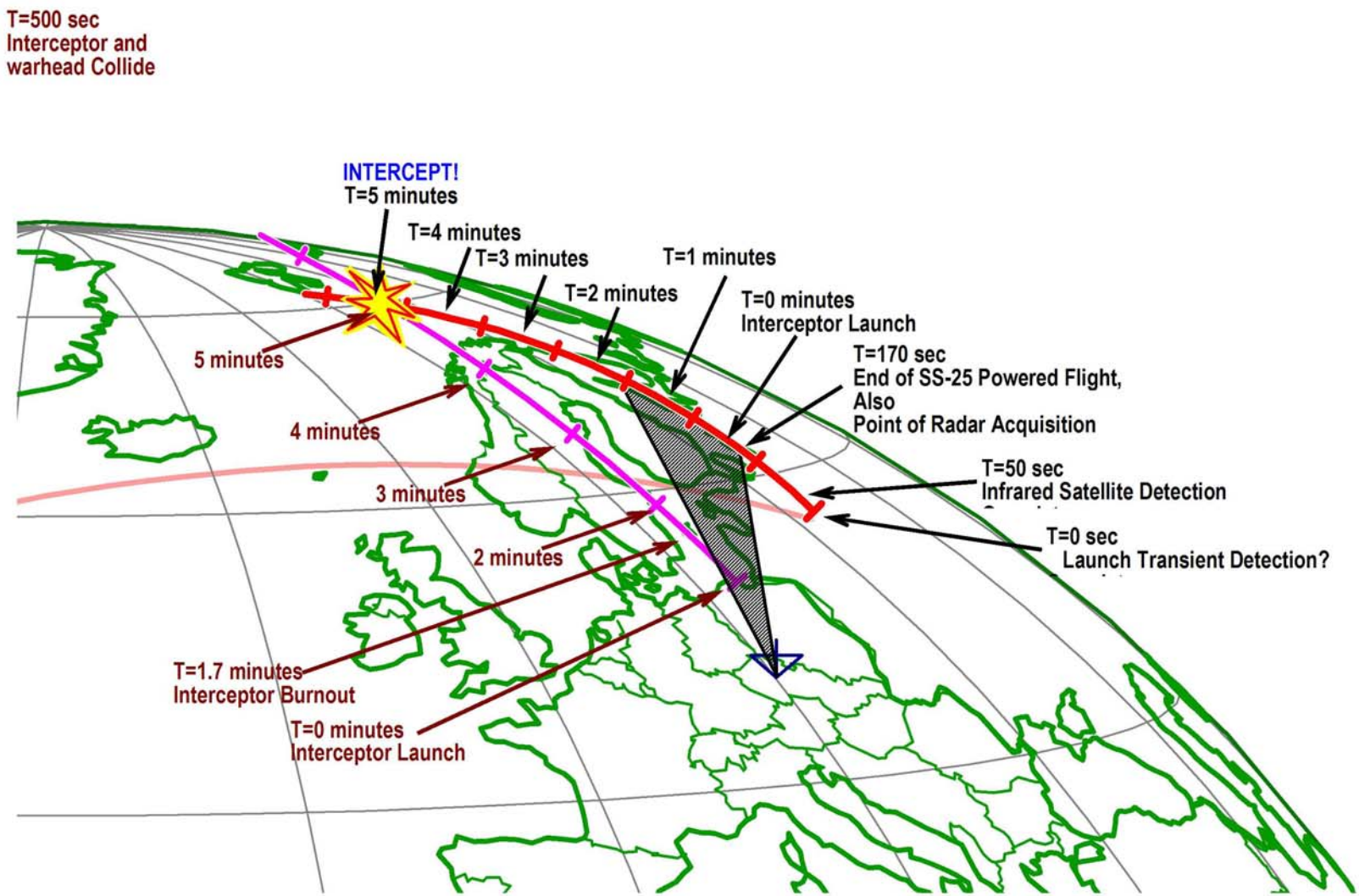
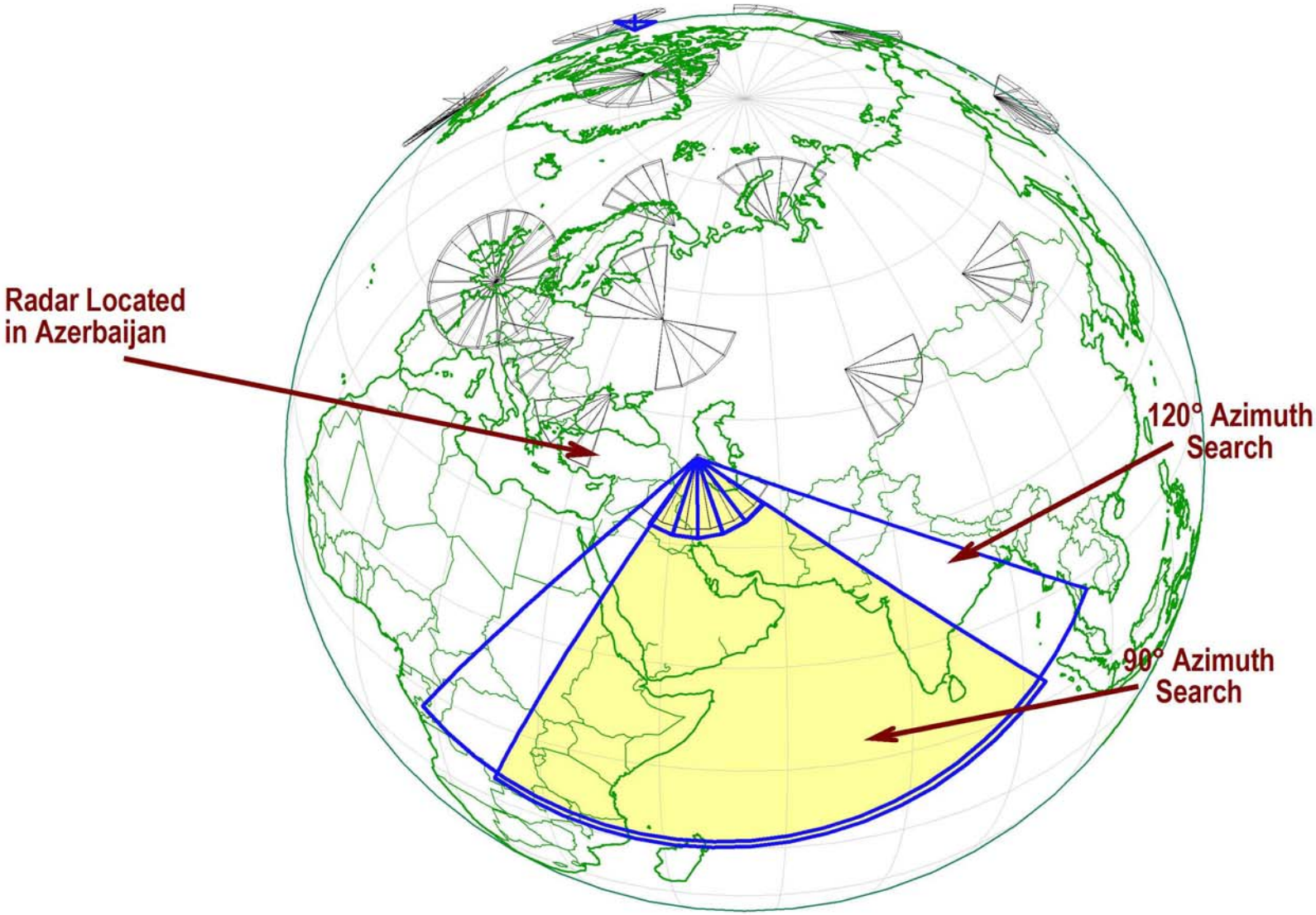
Engagement Event Timeline for Engagement of SS-25 from Vypolzovo with 2-Stage Missile Defense Interceptor



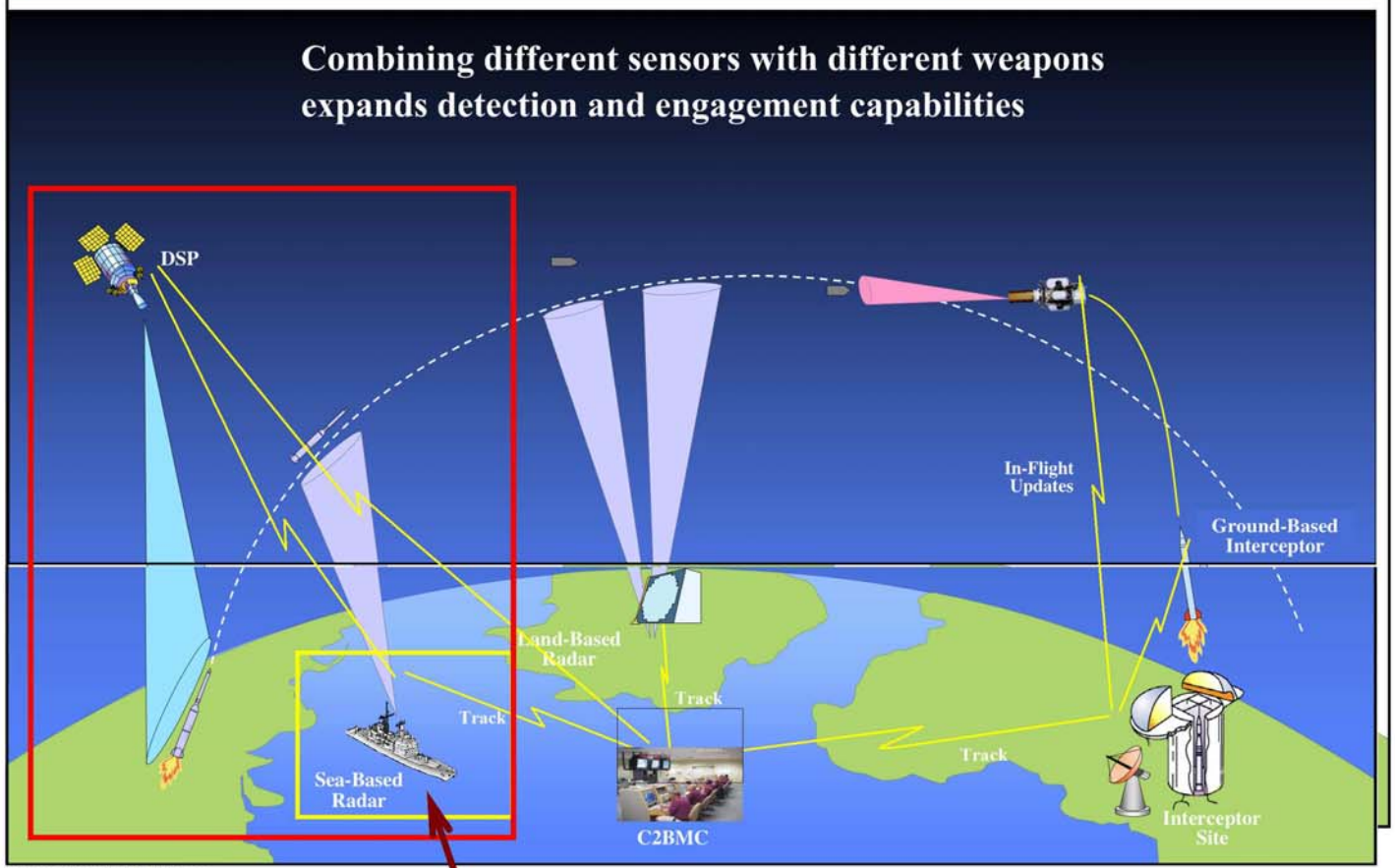
Search Coverage of the X-Band Radar Using Electronic Scanning



Search Coverage of the X-Band Radar Using Electronic Scanning

Precision Cueing Role Played by the EMR in the Czech Republic?

An Integrated Approach To Ballistic Missile Defense



Precision Cueing Role Played by the EMR in the Czech Republic?

Reported Demonstrations of How Simple Radar Cueing Information Can Substantially Improve a Missile Defense's Theoretical Capabilities

"With cuing from an Aegis ship and three ships with the Block 1A capability, we can in fact defend our ally Japan and the U.S. forces there. Additionally, if we station a ship off the Hawaiian Islands with a ship forward, we can in fact defend Hawaii. Likewise, we can defend Guam by moving the detection ship forward. We have run many of these scenarios."

Rear Admiral Brad A. Hicks
Program Director,
Aegis Ballistic Missile Defense
December 19, 2005 in a talk at the Marshall Institute

Full talk is available at:
http://www.marshall.org/article.php?id=363

Why Cueing from the European Midcourse Radar (EMR) Could be of Concern to Russian Military Analysts

Reported by several publications:

On August 19, 2004, Army Col. Charles Dreissnack, THAAD's program manager, said at a conference that recent tests of the THAAD's radar have shown that THAAD will have a "residual" capability against ICBMs.

He said: "We weren't planning to have the ICBM capability," but the radar is "outperforming what we thought it supposed to do."

He also said that although deployment won't begin until FY 2009, test assets could be ready to defend Hawaii years earlier.

From
Marc Selinger, "THAAD displaying 'residual' capability against ICBMs,"
Aerospace Daily & Defense Report, August 20, 2004.

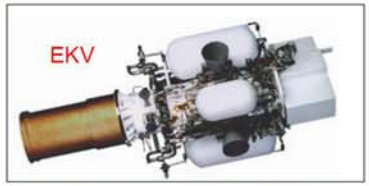
Note: This description implies that THAAD's NMD capabilities are limited by the radar, not the interceptor. See "Highly Capable Theater Missile Defenses and the ABM Treaty" in *Arms Control Today*, April 1994. Available on the Web at:

http://www.ucsusa.org/global_security/missile_defense/theater-missile-defense-the-abm-treaty.html

Interceptors are Modified Ground-Based Interceptors

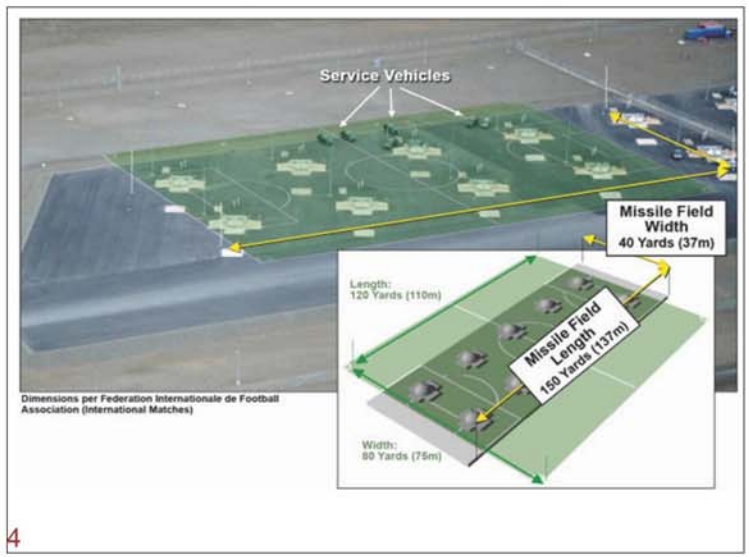
2 Stage Instead of 3 Stage
47,400 lbs versus 31,500 lbs
51 Feet Long versus

The interceptors planned for Poland are nearly identical to the three-stage interceptors based in the U.S. except that they are a two-stage variant that is quicker, lighter, and better suited for the engagement ranges and timelines for Europe. The silos that house the ground-based interceptors have substantially smaller dimensions (e.g., diameter and length) than those used for offensive missiles, such as the U.S. Minuteman III ICBM. Any modification would require extensive, lengthy, and costly changes that would be clearly visible to any observer.



The ground-based interceptors are comprised of a booster vehicle and an exoatmospheric kill vehicle (EKV). Upon launch, the booster flies to a projected intercept point and releases the EKV which then uses on-board sensors (with assistance from ground-based assets) to acquire the target ballistic missile. The EKV performs final discrimination and steers itself to collide with the enemy warhead, destroying it by the sheer kinetic force of impact.

Future European Missile Site – Size Comparison



Data from Press Statements by Spokesman and Chief Scientist for the Missile Defense Agency, Colonel Rick Lehner and Mr. Keith Englander Provided Stage Weights for the Orbital Sciences Two-Stage Ground-Based Interceptor

STATEMENTS MADE BY MDA TO THE PRESS:

Launch Weight = 47,400 lbs
First Stage Weight = 37,800 lbs
Second Stage Weight = 9,500 lbs
Kill Vehicle Weight = 155 lbs
Burnout Speed = 6.3 km/sec

ANALYTIC RESULTS:

- Assumptions:
  The shroud weighs 200 lbs, and the Pegasus-derived rocket motor fuel weights and specific impulses are exactly those from the *AIAA International Reference Guide to Space Launch Systems*.
- Expected Launch Weight of GBI = 37,800 + 9,500 + 155 + 200 = 47, 655 lbs.
- The vehicle weight stated by Lehner is 47,400 lbs)
- If one assumes a vehicle with a Launch Weight of 49,730 lbs, a payload of 2075 + 155 = 2230lbs, the burnout speed is 6.30 km/sec.
- The same vehicle carrying a 155 lb payload achieves a burnout speed of 9.37 km/sec.
- If the vehicle payload is 255 lbs, to accommodate a 100 lb vibration isolation and mounting adapter, (and/or endo/exo heatshield protection for EKV) the burnout speed is then 9.11 km/sec

CONCLUSION

US Interceptors will have sufficient speed to engage all Russian ICBMs launched from West of the Urals against all targets in the continental United States

Data on Ground-Based Interceptor Launch Gross Weight, Stage Weights and Burn Times Provided by MDA Spokesman, Rick Lehner, and MDA Chief Scientist, Keith Englander

Orion 50SXLG Rocket Motor

Source	Full Weight (lbs)	Propellant (lbs)	Empty Weight (lbs)	Burn Time (sec)	I_{sp} (sec^{-1})	Length (m)
Taurus	??	33,120	??	68.4	285	8.94
Pegasus	36,195	33,140	3055	68.3	293	10.27
MDA-1	37,800	35,480	2,320	70	??	??
MDA-2	37,800	34,398	3,402	70	270	??

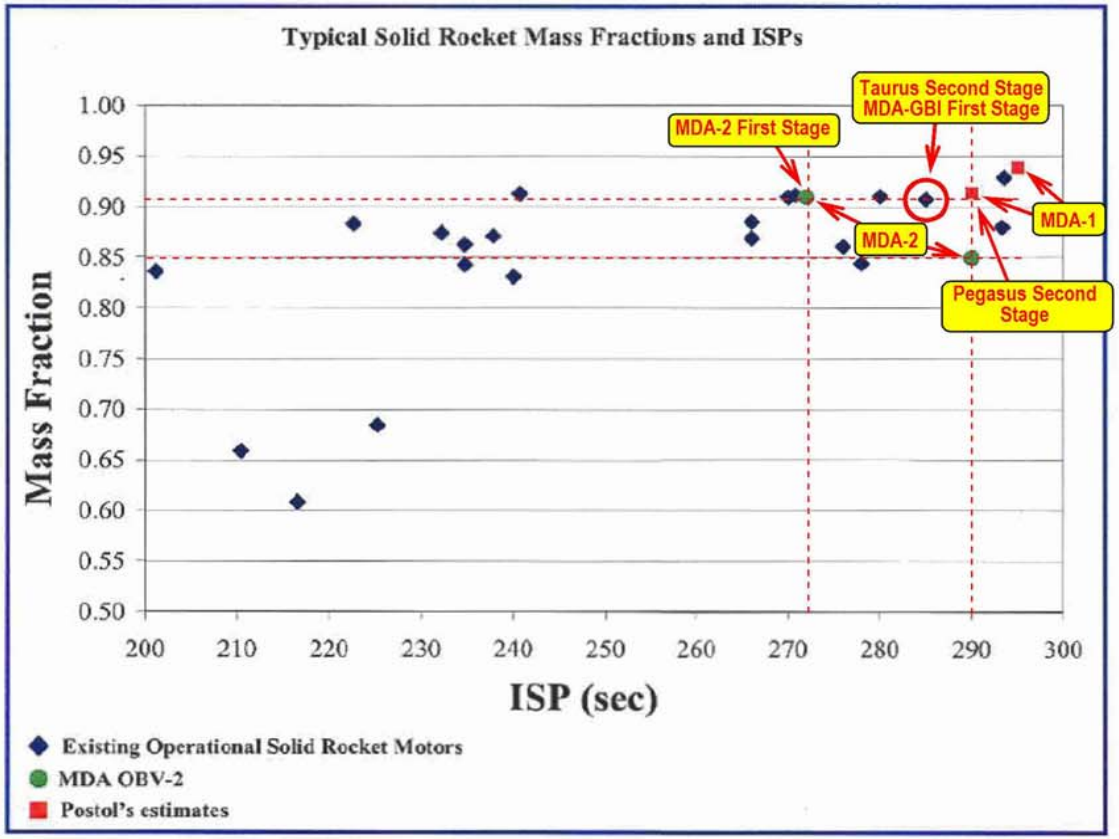
Orion 50XL Rocket Motor

Source	Full Weight (lbs)	Propellant (lbs)	Empty Weight (lbs)	Burn Time (sec)	I_{sp} (sec^{-1})	Length (m)
Taurus	??	8,655	??	69.4	289	3.11
Pegasus	9,566	8,649	917	69.8	290	3.11
MDA-1	9,500	8,680	820	70	??	??
MDA-2	9,500	8,075?	1,425?	70	289	

Two-Stage GBI Launch Weight = 21,400 kg (47,400 lbs)
GBI Carries No Ballast

Comparison Between Postol's Rocket Motor Stages And Existing Operational Motors

Existing Operational Solid Rocket Motors	
Sergeant	PeaceKeeper Stage 1
M88 (Mod M5E1)	GEM
Castor I	M57A1
Mk 11 Mod 2 Talos	Castor IIA
Mk12 Mod1 Terrier	GSTS TVE
M51 BOMARC	H-1500
Castor IV	SR-73-AJ-1
Lance MGM-52	U-75
Castor IVA	Orbus 1
Castor II	Orbus 21S
Castor II	Centaur G-Prime
Castor IVA	Centaur I
Malemute II	Centaur II
M55A1	Centaur IIA
Castor IVB	Mk 70 Mod 1
Castor V	Polaris A3 Stage 1
M56A1	Polaris A3 Stage 2

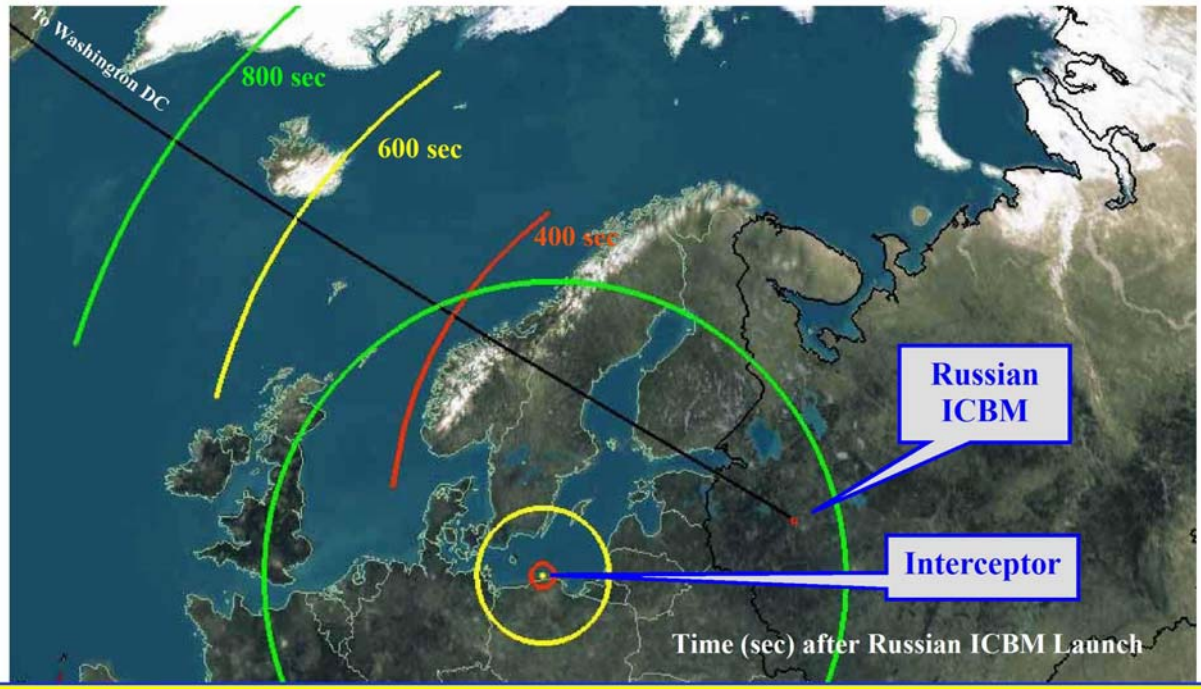


Postol's stage motor performance estimates are at the very high end compared to existing operational solid rocket motors

Can the Europe-Based Missile Defense Engage Russian ICBMs and if so Why Does that Matter?

General Obering's Original Slide

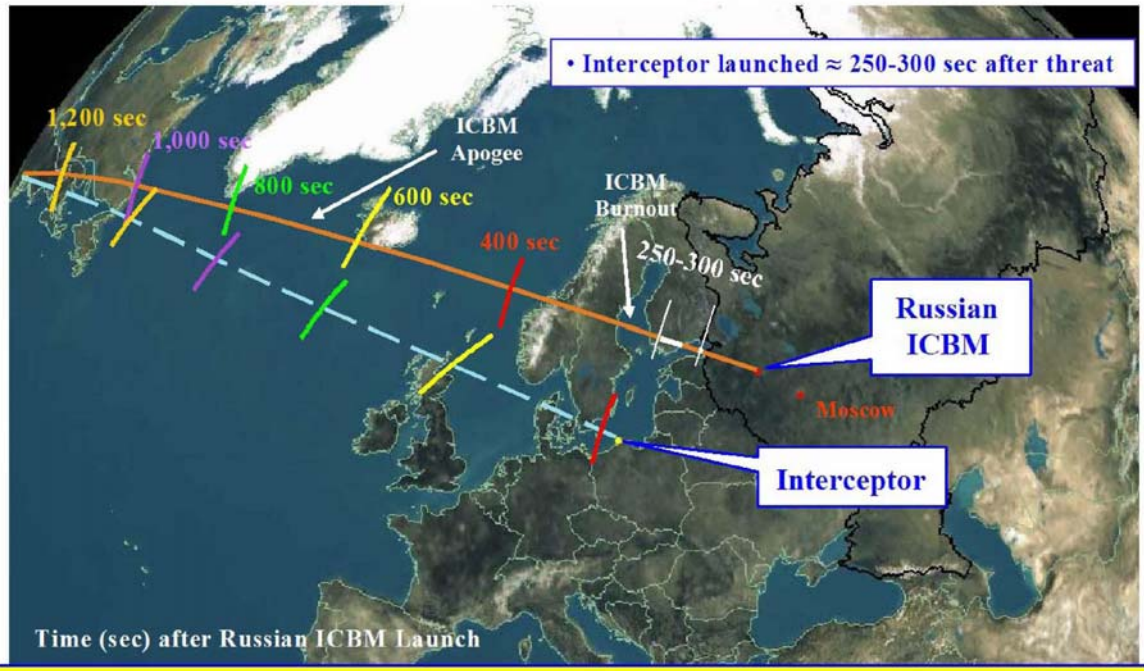
Interceptors Cannot Catch Russian Missiles



U.S. European Interceptor Site Cannot Affect Russian Strategic Capability

Misleading MDA Slide Indicating Interceptors Cannot Engage Russian ICBMs

Interceptors Cannot Catch Russian Missiles



U.S. European Interceptor Site Cannot Affect Russian Strategic Capability

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07-MDA-2623 (13 JUN 07)

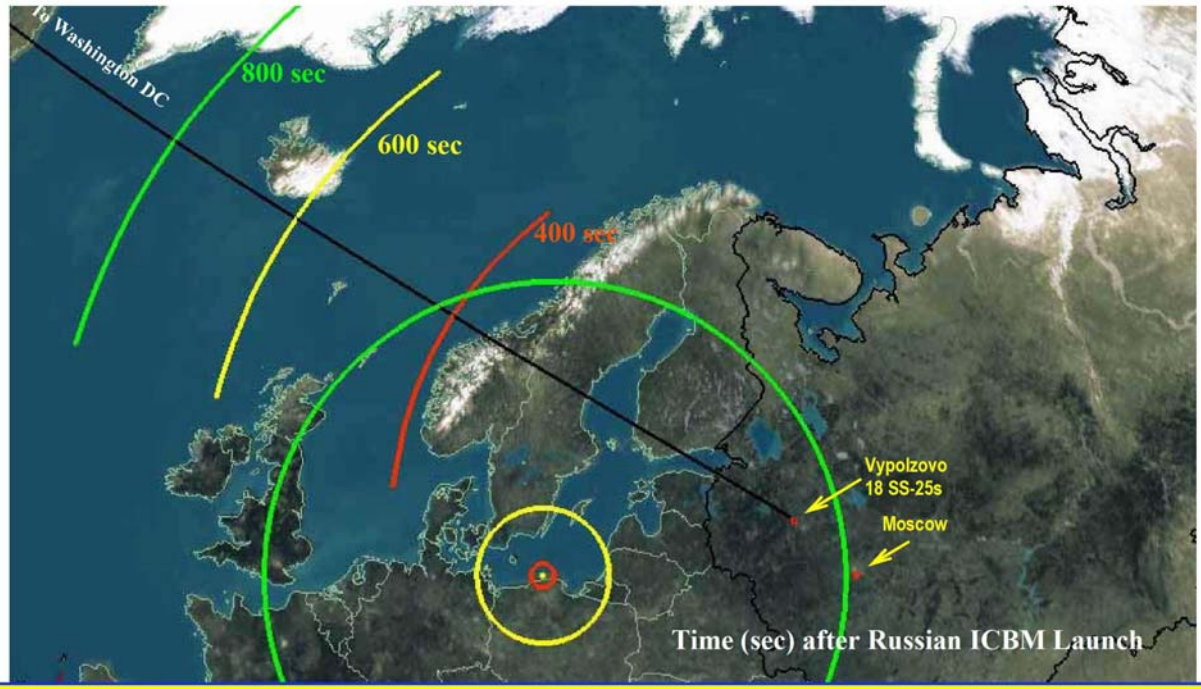
Misleading MDA Slide

ms-109673B / 061407 27

Slide 29

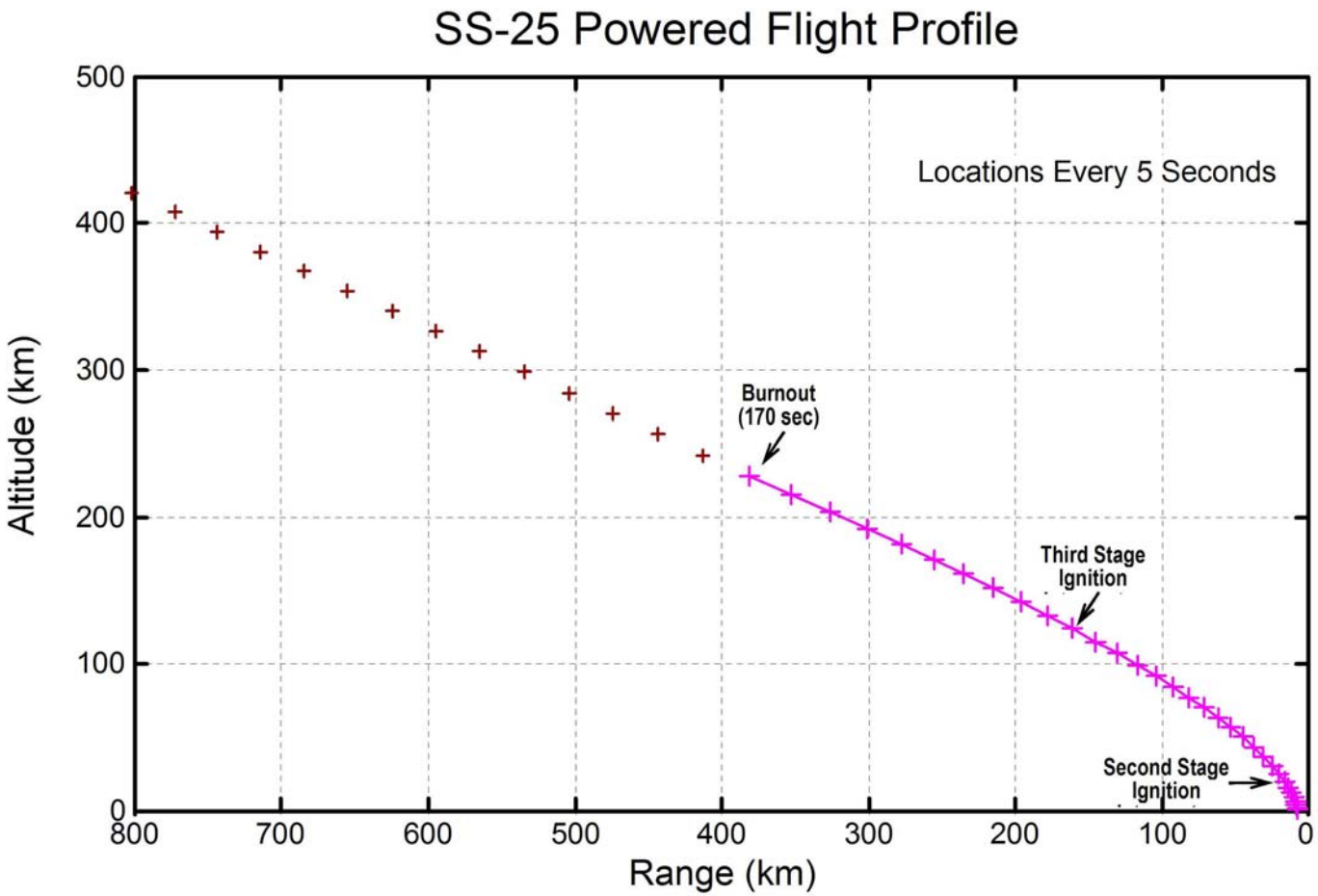
Obering's Slide With MDA Labels Removed

Interceptors Cannot Catch Russian Missiles



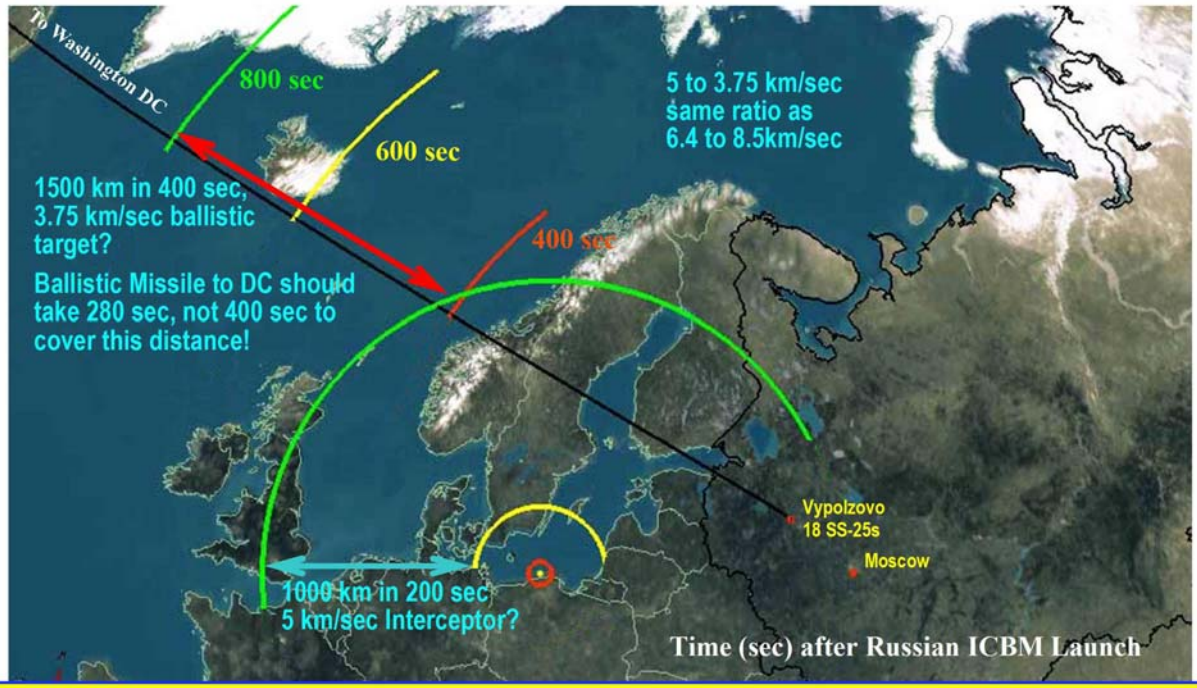
U.S. European Interceptor Site Cannot Affect Russian Strategic Capability

Location of SS-25 Russian ICBM at 5 Second Intervals During Powered Flight



Obering's Slide – Distances and Speeds Wrong

Interceptors Cannot Catch Russian Missiles



U.S. European Interceptor Site Cannot Affect Russian Strategic Capability

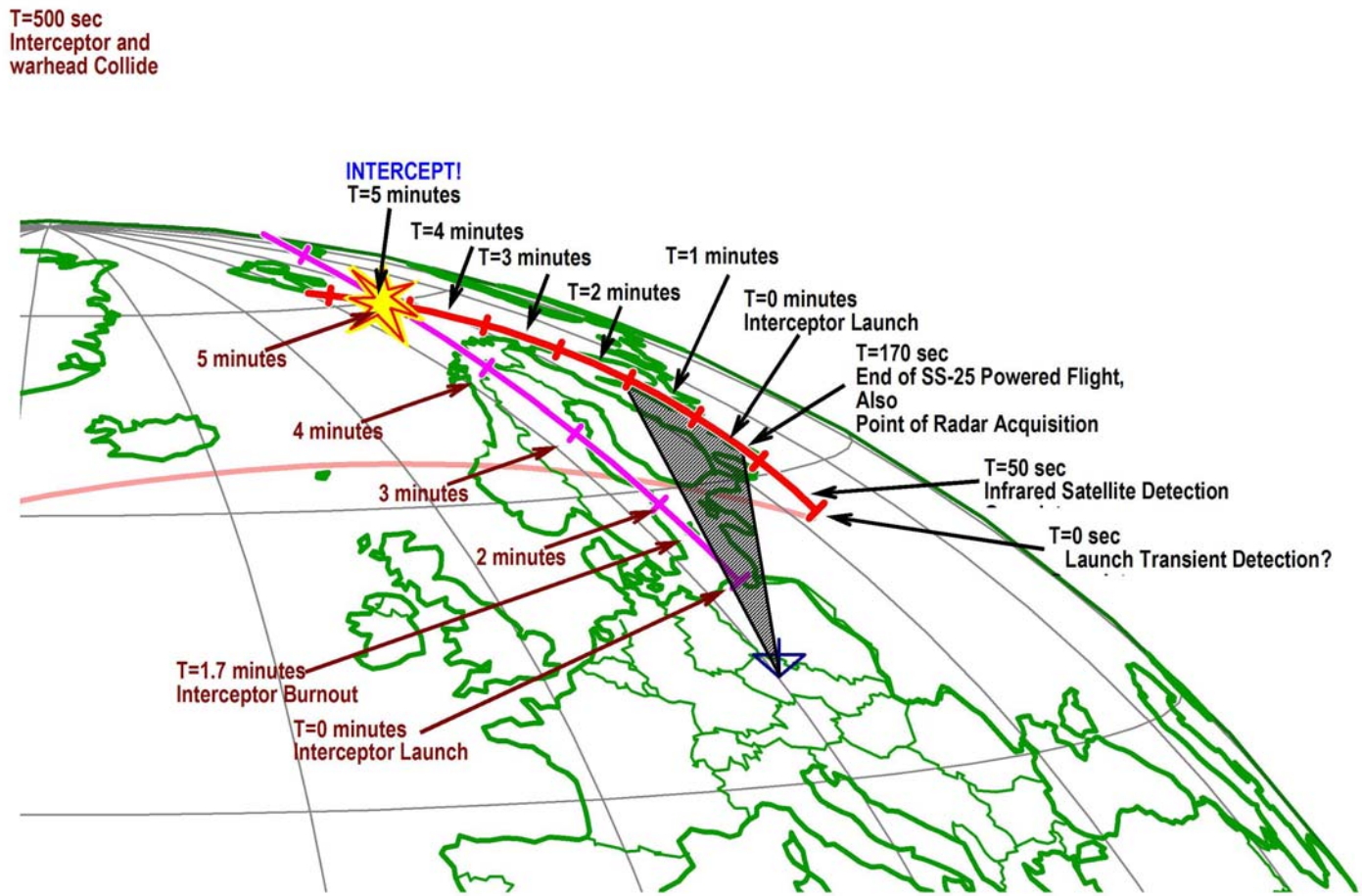
Actual Timelines for an Engagement

Interceptors Cannot Catch Russian Missiles

U.S. European Interceptor Site Cannot Affect Russian Strategic Capability

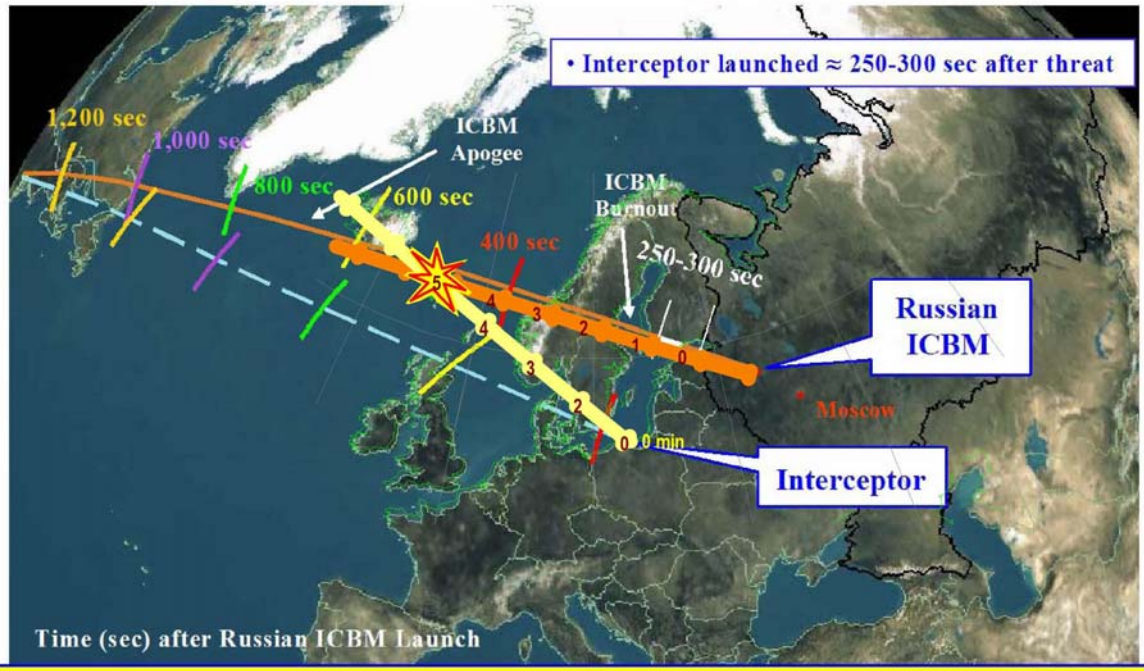
This statement is wrong

Engagement Event Timeline for Engagement of SS-25 from Vypolzovo with 2-Stage Missile Defense Interceptor



Misleading MDA Slide Indicating Interceptors Cannot Engage Russian ICBMs

Interceptors Cannot Catch Russian Missiles



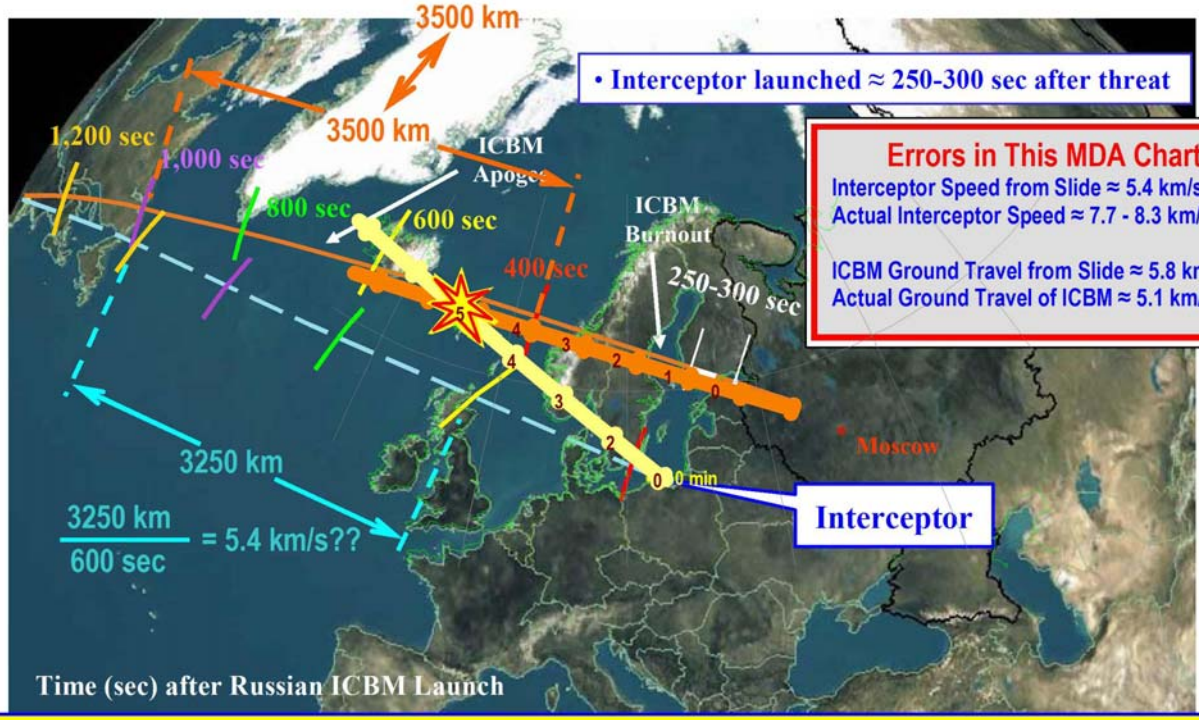
U.S. European Interceptor Site Cannot Affect Russian Strategic Capability

Misleading MDA Slide

Misleading MDA Slide that Indicates Interceptors Could Never Intercept Russian ICBMs

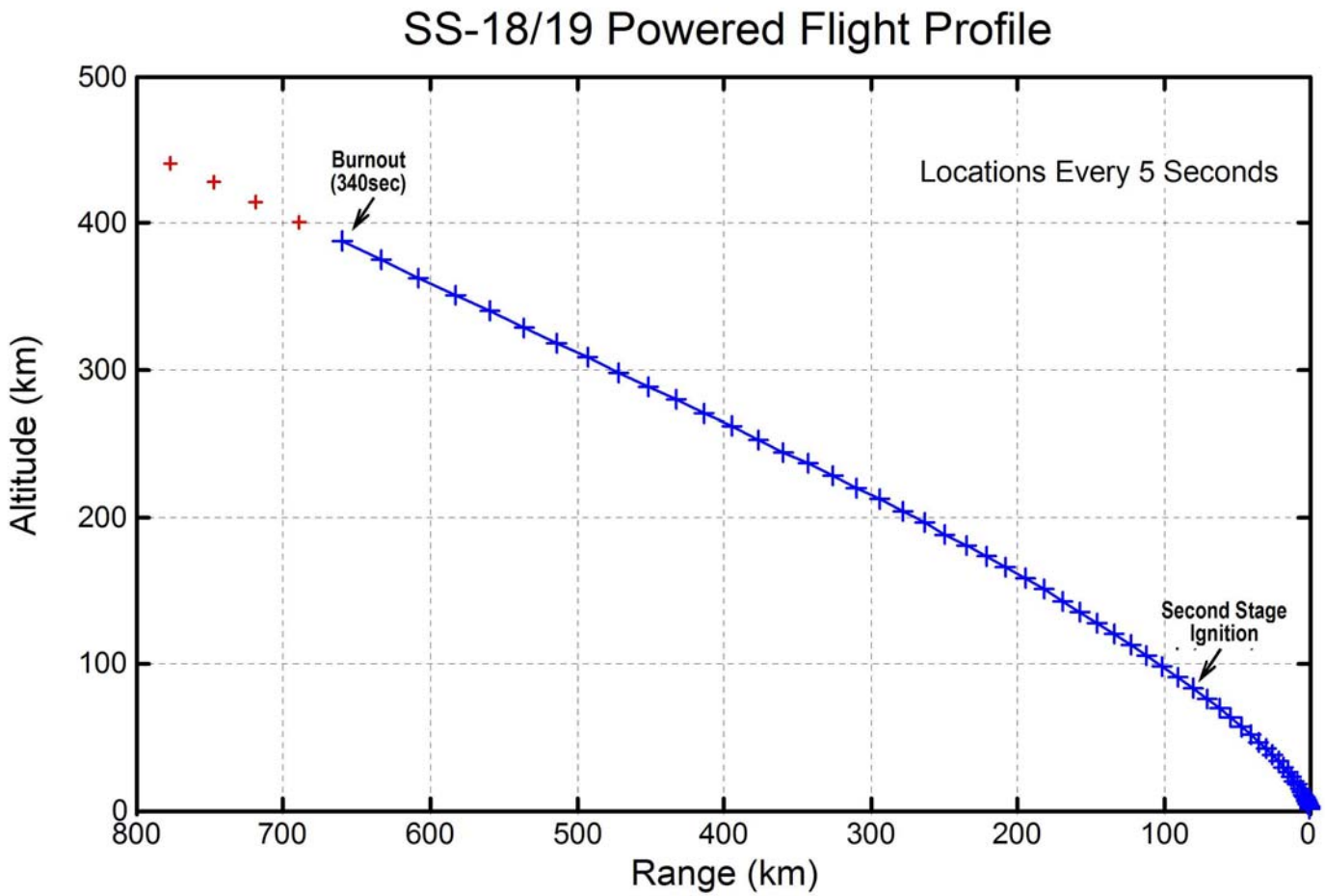
Slide Overstates the Speed of ICBMs by 15% and Understates the Speed of Interceptors by more than 30%

Interceptors Cannot Catch Russian Missiles

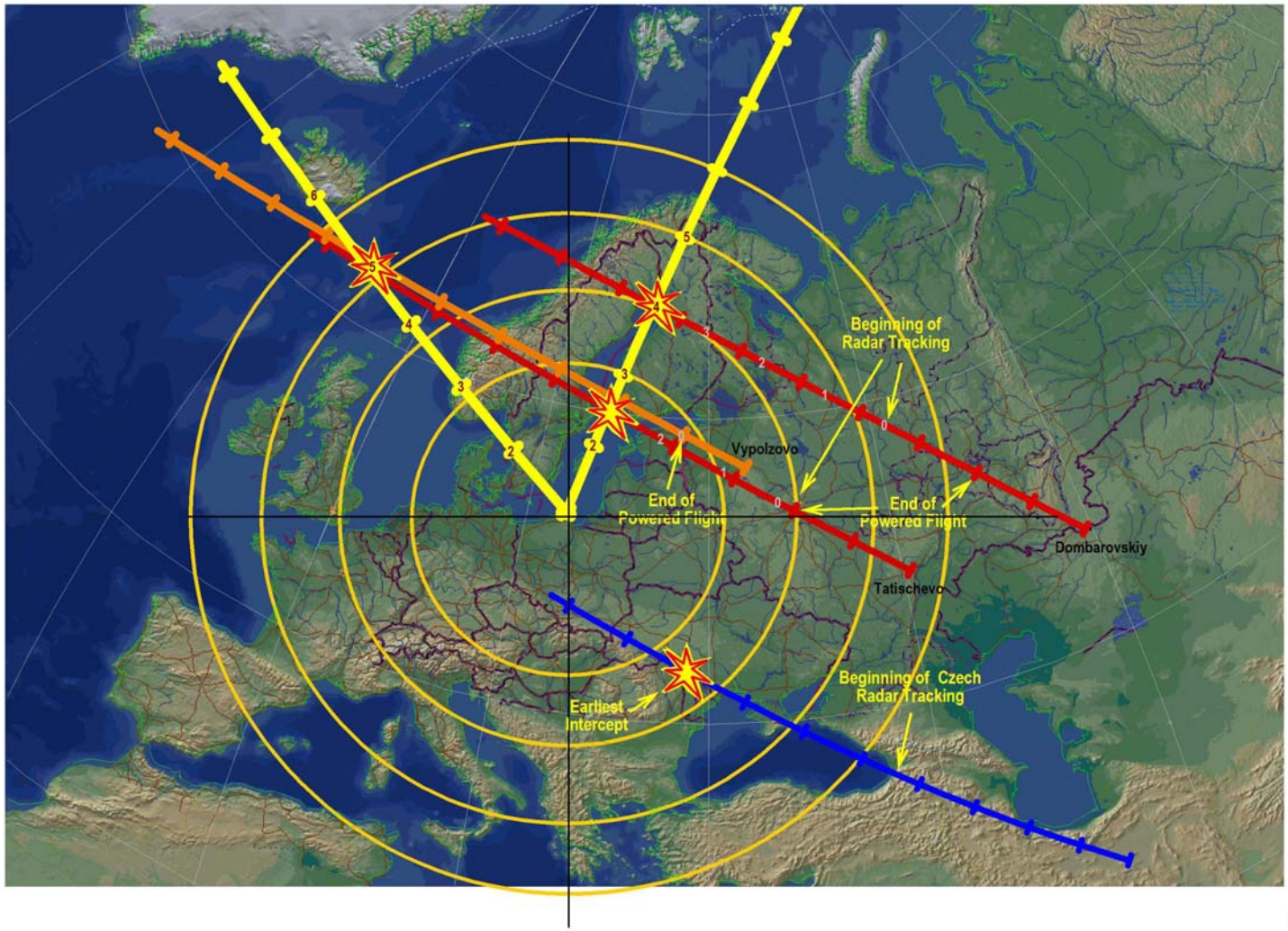


U.S. European Interceptor Site Cannot Affect Russian Strategic Capability

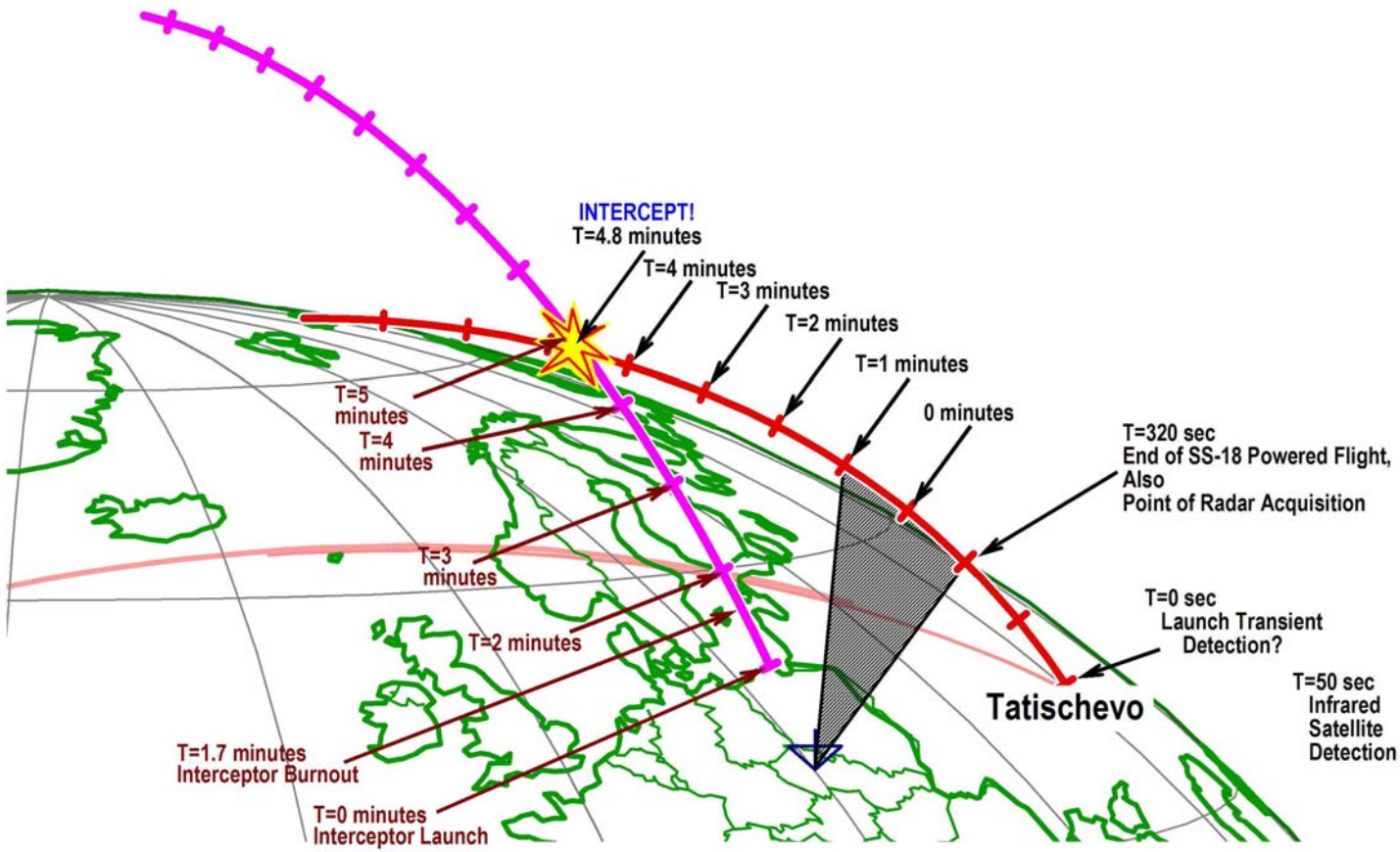
Location of SS-18/19 Russian ICBM at 5 Second Intervals During Powered Flight



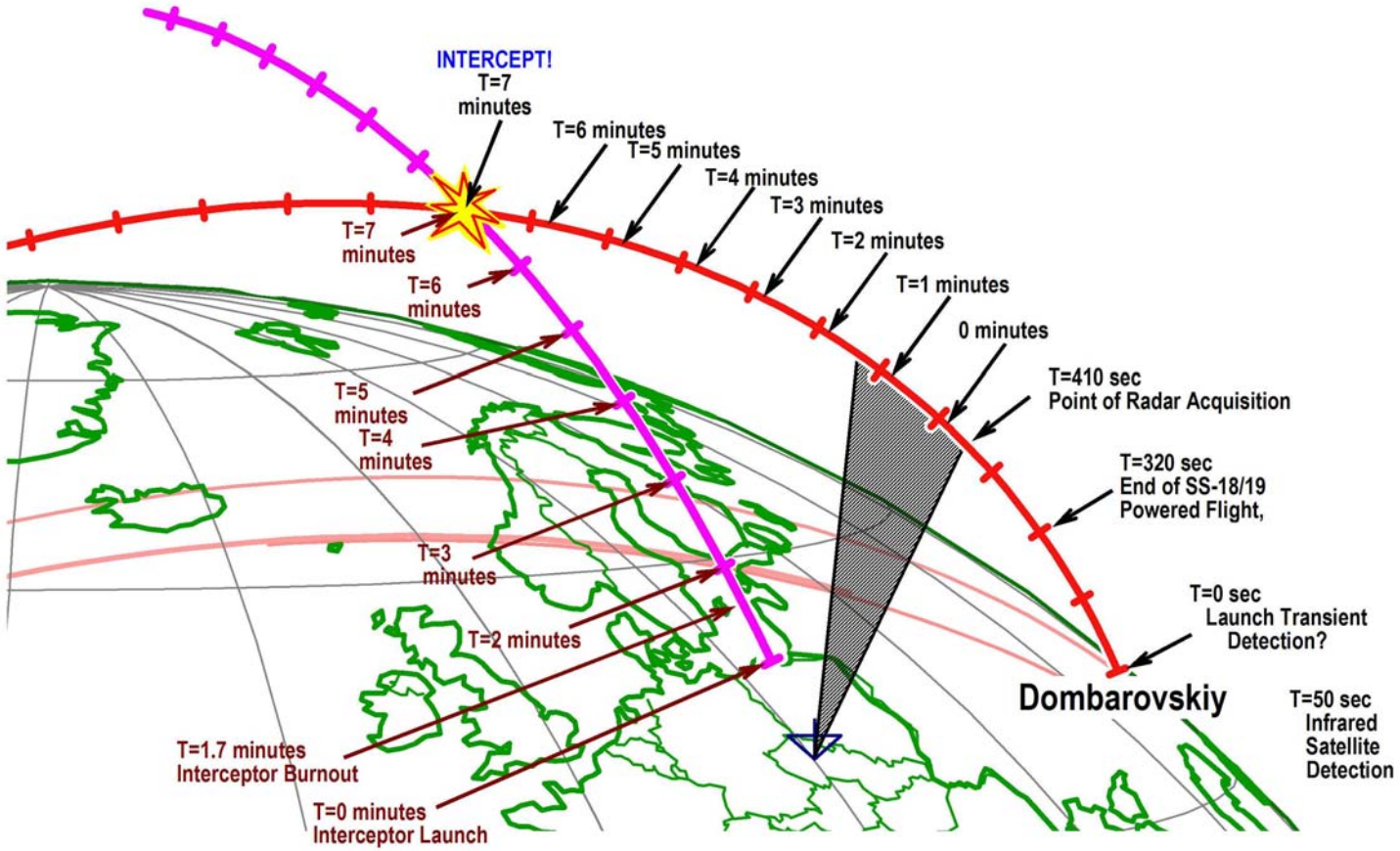
Timelines and Events for Intercepts with Two-Stage Variant of the GBI



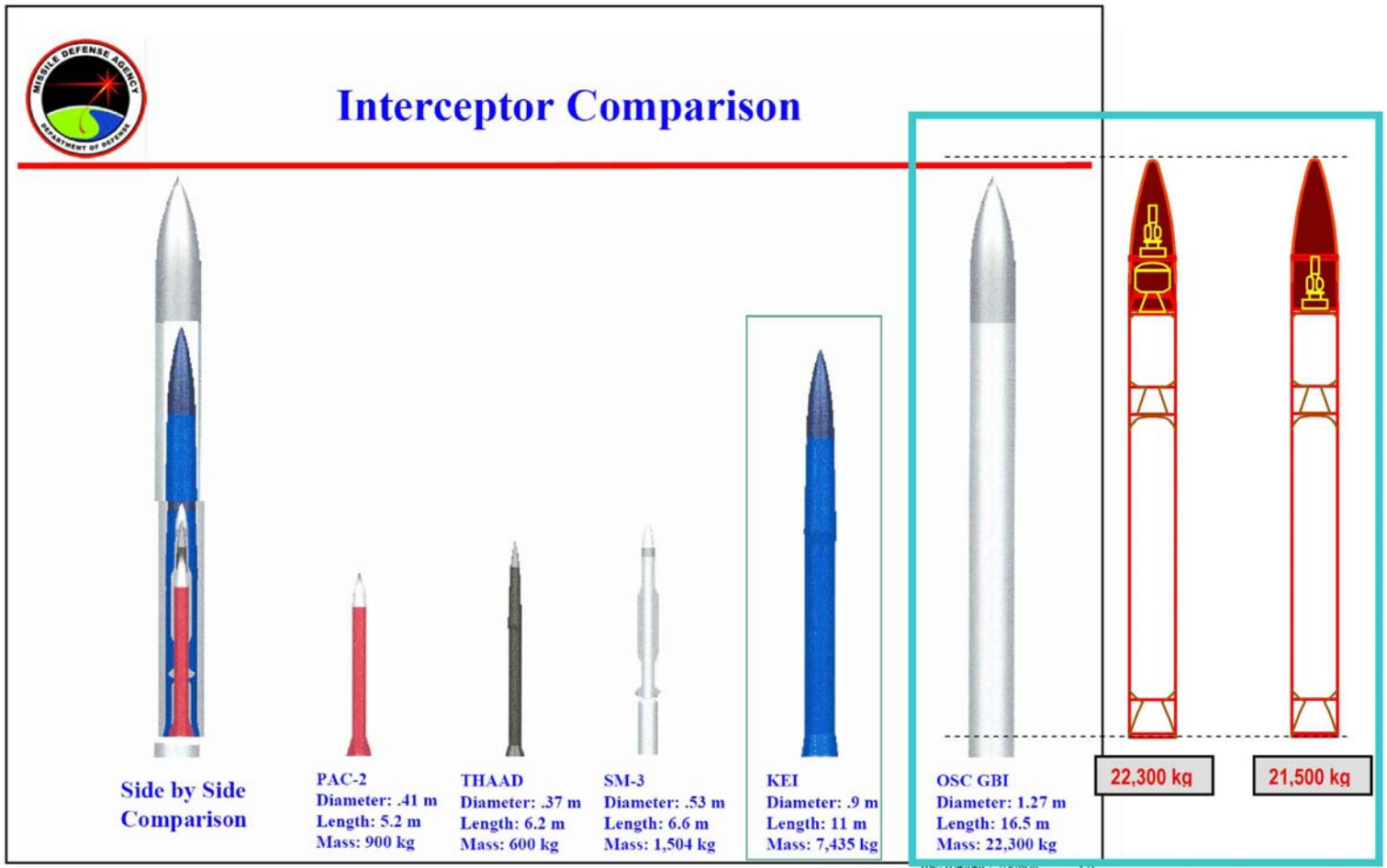
Engagement Event Timeline for Engagement of SS-18/19 from Tatischevo with 2-Stage Missile Defense Interceptor



Engagement Event Timeline for Engagement of SS-18/19 from Dombarovskiy with 2-Stage Missile Defense Interceptor

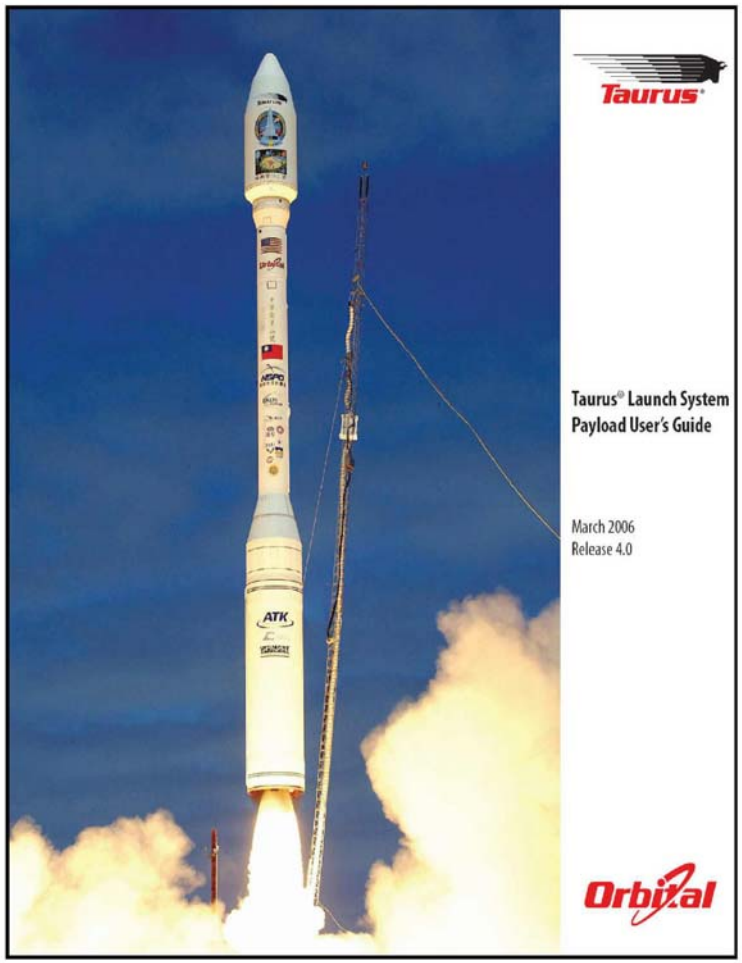


Two-Stage and Three-Stage Variants of the Ground-Based Interceptors to be Deployed Europe and Continental United States Respectively



Pegasus/Taurus Derived Ground-Based Interceptor

Additional Source Information on Rocket Stages and Related Components



Pegasus

June 2007

Pegasus® User's Guide

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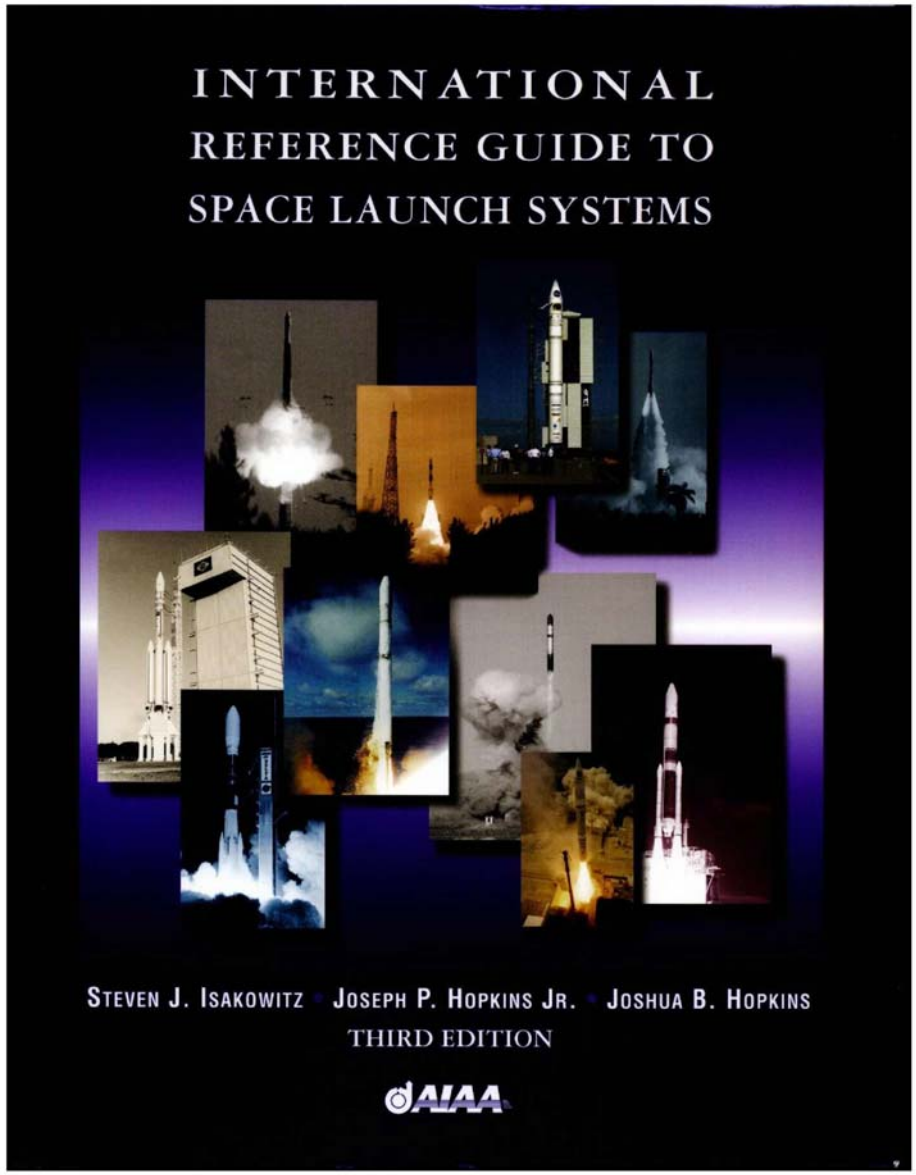
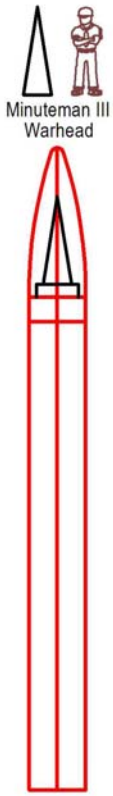
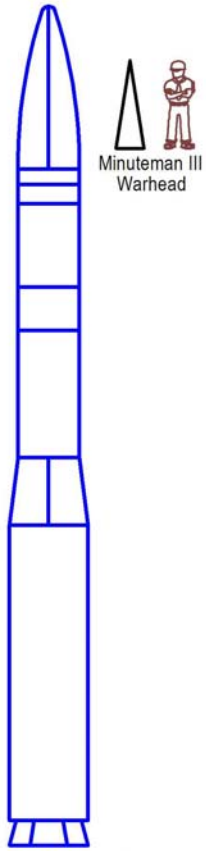
Source of Performance Data on the Ground-Based Interceptor



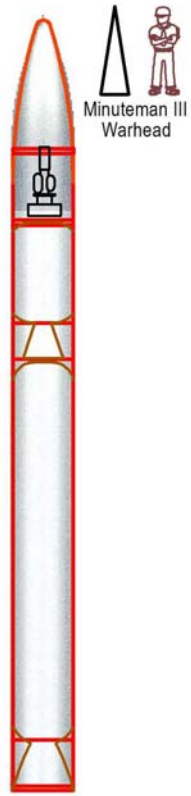
Throw Weights of Potential ICBM's to 10,000 Kilometers Range



Midgetman ICBM
Launch Weight ≈ 30,000 lbs
Throw Weight ≈ 1000 lbs

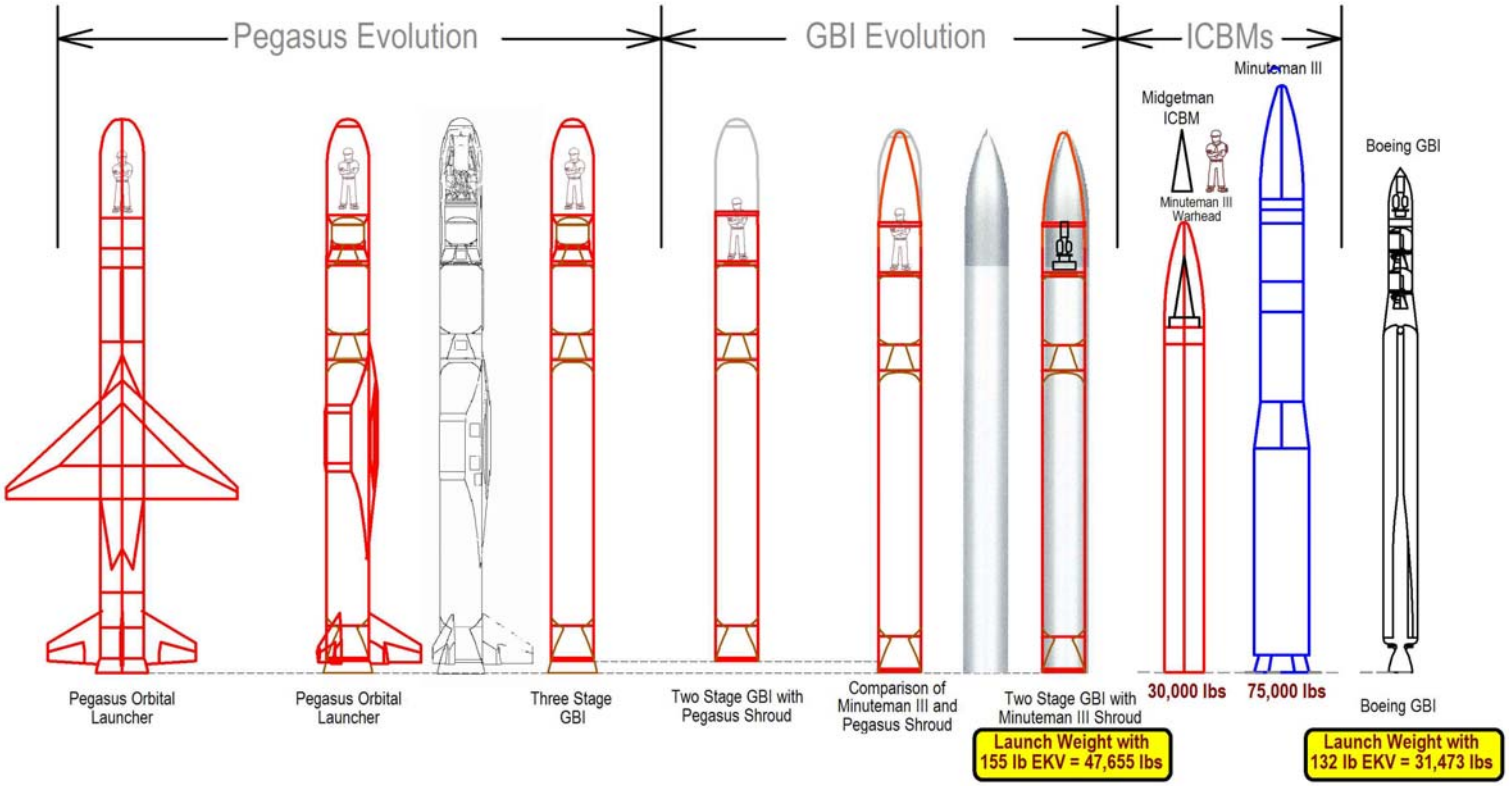


Minuteman III
Launch Weight ≈ 75,000 lbs
Throw Weight ≈ 2,500 lbs

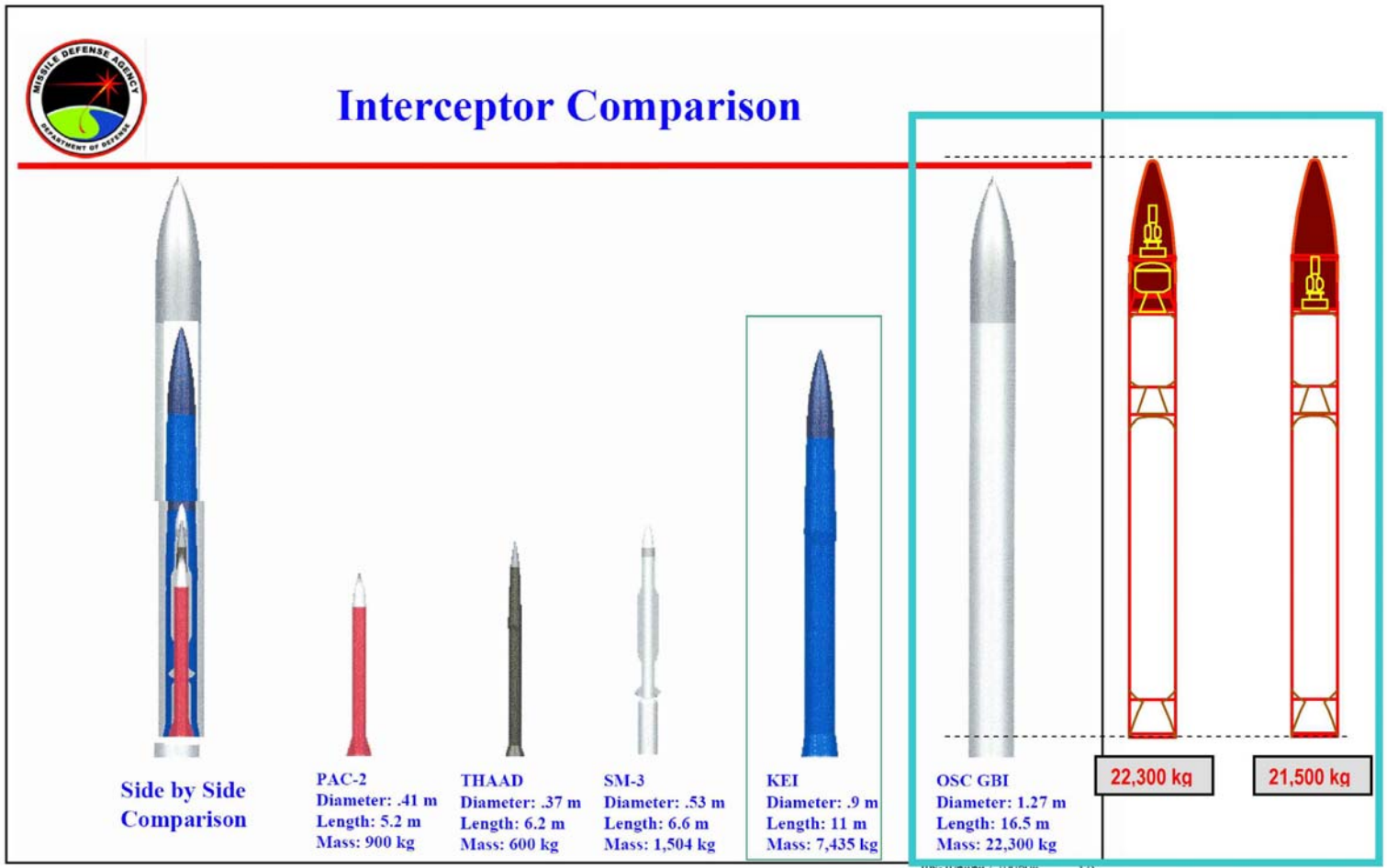


European GBI
Launch Weight ≈ 49,500 lbs
Throw Weight ≈ 1,500 lbs

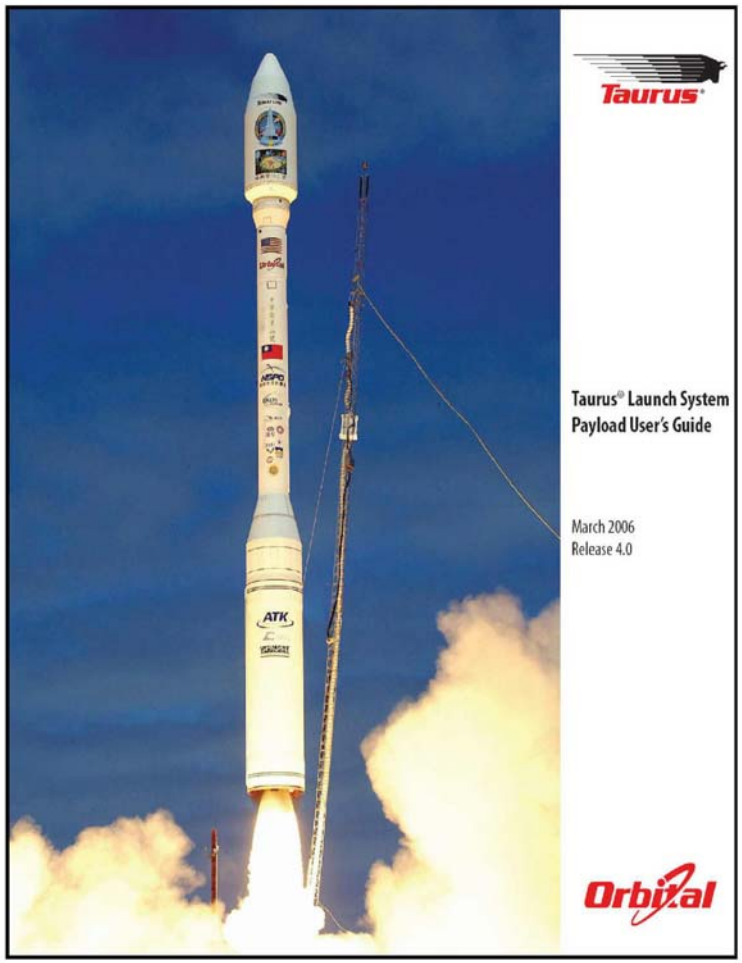
Evolution and Comparison of Launch Vehicles, ICBMs and the GBI Interceptor



Two-Stage and Three-Stage Variants of the Ground-Based Interceptors to be Deployed Europe and Continental United States Respectively



Additional Source Information on Rocket Stages and Related Components



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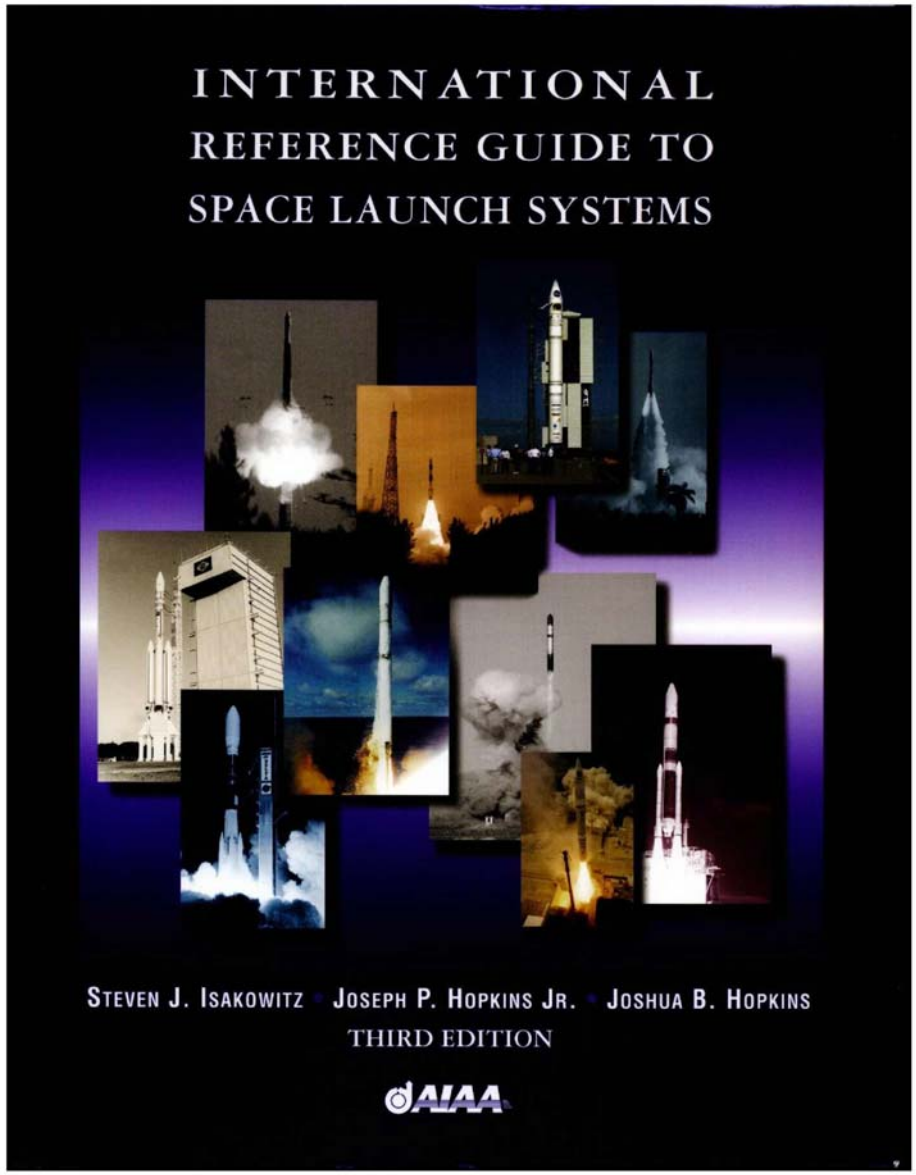
Source of Performance Data on the Ground-Based Interceptor



Sensitivity of the Burnout Velocity to Model Assumptions
Two-Stage Variant of the Ground-Based Interceptor

Missile Defense Agency Stated Launch Weight = 21,500 kg (47,400 lbs)
Model Launch Weight = 47,655 lbs

Baseline Model: 9.37 km/sec

Baseline with Specific Impulse of First Stage Increased to 295 sec-1:
Burnout Speed = 9.50 km/sec

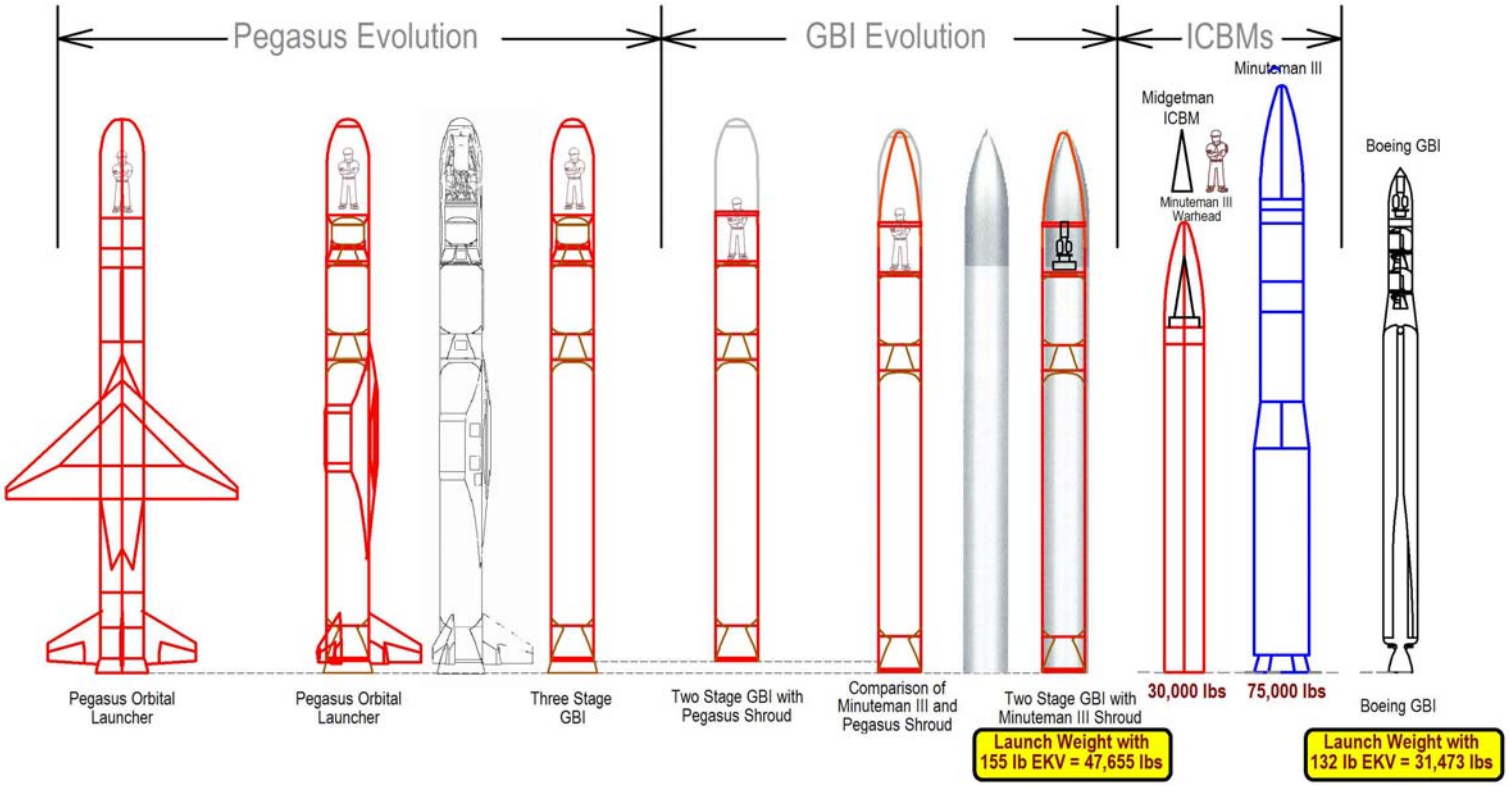
Baseline with Shroud Carried to Burnout:
Burnout Speed = 8.95 km/sec

Baseline with Total Rocket Motor Burn Time Increased from 140 to 150 sec:
Burnout Speed = 8.93 km/sec

Baseline with All Three Variants Applied Together:
Burnout Speed = 8.93 km/sec

Baseline has all three excursions together, and carries the Kill Vehicle plus 2,075 lbs of ballast
Burnout Speed = 6.3 km/sec.

Evolution and Comparison of Launch Vehicles, ICBMs and the GBI Interceptor



Ground-Based Interceptor
Achieves 6.3 km/sec Carrying a Payload of 1950 lbs

Ground-Based Interceptor
Achieves 8.5 to 8.7 km/sec Carrying a Payload of 220 to 155 lbs

The Ground-Based Interceptor
Can Carry a Full Minuteman III BUS and Three Warheads to 6,000+ Kilometers