MIT
Science, Technology, and
National Security Working Group

The Security Implications of Missile Defense- A Technical Perspective

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The Institute for Applied Physics and Computational Mathematics
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Why I Am Here Lecturing in China (1 of 4)

1. It is the Chinese decision how to deal with American missile defenses.

2. A wise decision requires accurate technical and political information.

3. My talk at Tsinghua University yesterday provided some political information and some technical information.

4. Today I will focus only on technical information.

5. An important point I made yesterday was that much of the American missile defense program is shaped by domestic political competition rather than by accurate assessments of military needs and technological realities.

Why I Am Here Lecturing in China (2 of 4)

6. It is essential that Chinese analysts of missile defense understand this political component.

7. It is the only way that Chinese analysts will then be able to explain the technically meaningless characteristics of American missile defense activities.

8. During my visit to China it has become clear to me that many Chinese technical analysts are deeply concerned that China may not be able to use decoys to defeat US infrared sensors.

9. Because of this, I would like to first describe the only serious proof-of-concept missile defense tests where the United States tried to use infrared sensors against decoys.

10. These tests failed, and the results were falsely represented to the Congress as complete successes.

Why I Am Here Lecturing in China (3 of 4)

11. Understanding how such lying to the Congress could be tolerated, even welcomed, requires a political analysis of what is happening in the United States.

12. What I will do here is simply explain what the results of these tests were.

13. Let me emphasize, that I have a lot more data to support my statements and would be pleased to share it with my Chinese colleagues in the future.

14. My purpose here is simple. I am concerned that US missile defense activities will provoke China to expand its nuclear arsenal as a hedge against US missile defenses.

15. I believe that this will hurt the security of both our countries.

Why I Am Here Lecturing in China (4 of 4)

16. However, I also understand that it will be extremely difficult for the Chinese to not react to the apparent threat from US missile defenses.

17. It is a Chinese decision whether or not and how to react to American missile defenses.

18. My hope is to provide my Chinese colleagues with enough information that they might choose to discourage the threat of missile defenses by simply showing the US that they can and will defeat them with extremely simple decoys.

19. Such an approach to this serious destabilizing problem would lead to the least damage to the security of both our countries.

Appendix

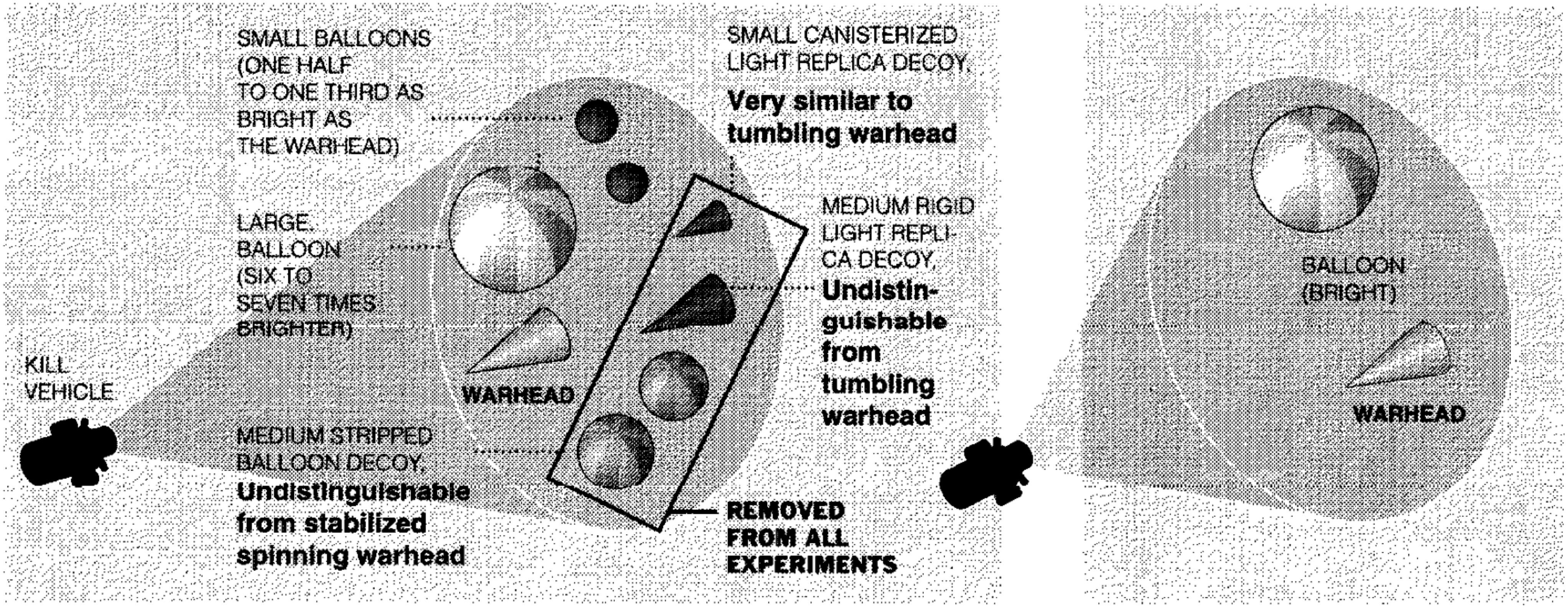
US Missile Defense
Lessons That Have Still Not Been Learned

Testing of Missile Defense Systems

Those Who Ignore the Errors of the Past Are Destined to Repeat Them

Fraudulent Testing of Missile Defense Systems

The Only Two Fundamental Proof-of-Concept Missile Defense Tests Experiments Yet Performed:
The IFT-1A in June 1997 and January 1998



Source: Theodore A. Postol, M.I.T.

New York Times Reports Major Fraud in Missile Testing in Front Page Story

The New York Times

Copyright © 2000 The New York Times NEW YORK, FRIDAY, JUNE 9, 2000 $1 beyond the greater New York metropolitan

Antimissile Testing Is Rigged To Hide a Flaw, Critics Say

By WILLIAM J. BROAD

Citing the Pentagon's own plan, critics of the proposed antimissile defense and even some military experts say all flight tests of the $60 billion weapon have been rigged to hide a fundamental flaw: The system cannot distinguish between enemy warheads and decoys.

In interviews, they said that after the system failed to achieve this crucial discrimination goal against mock targets in its first two flight tests, the Pentagon substituted simpler and fewer decoys that would be easier for the antimissile weapon to recognize.

The Pentagon's plan was obtained by Theodore A. Postol, an arms expert at the Massachusetts Institute of Technology who opposes the weapon. It covers the four tests that have taken place as well as future tests up to the system's projected deployment in 2005.

Other technical experts who have seen it, including both antimissile and decoy designers, concurred with his criticism, as did a senior government official who has examined the Pentagon's testing plan.

"It is clear to me," said the official, who spoke on condition of anonymity, "that none of the tests address the reasonable range of countermeasures," or decoys that an enemy would use to try to outwit an antimissile weapon.

While acknowledging the plan Dr. Postol obtained as authentic, Pentagon officials strongly defended the testing program. Lt. Gen. Ronald T. Kadish of the Air Force, director of the Pentagon's Ballistic Missile Defense Organization, denied that his program had engaged in any deception or dumbing down. General Kadish said that the testing program would be extremely useful and that the resulting weapon would defeat crude warheads launched by inexperienced nuclear powers that might emerge in the future, like Iran, Iraq or North Korea.

Though unclassified, the plan is considered sensitive. Dr. Postol said he obtained it from a Pentagon source he would not identify.

Dr. Postol, who is preparing a report for the White House on what he sees as the plan's flaws, made his argument on Monday at a meeting of the State Department's advisory board on arms control, along with another antimissile critic, Nira Schwartz. Dr. Schwartz, a former senior engineer at the military contractor TRW, lost her job after challenging the claims the company made about the weapon's ability to distinguish warheads from decoys.

Dr. Postol, who worked in the Reagan administration on such issues as antimissile defense, says that the Pentagon has ignored earlier criticism like Dr. Schwartz's and instead put flawed testing methods at the heart of all its plans to develop and build a weapon. The upshot, he says,

Continued on Page A22

Critics Maintain Pentagon Has Been Rigging Antimissile Tests to Hide a Crucial Flaw

Continued From Page A1

is that any real attacker — no matter how inexperienced — would be able to easily outwit the weapon.

Pentagon officials "are systematically lying about the performance of a weapon system that is supposed to defend the people of the United States from nuclear attack," Dr. Postol said in an interview.

General Kadish conceded that "this technology is difficult." As a result, he said, his organization's approach "is to walk before we run, with increasingly stressful decoys to match what we expect" by way of enemy threats. "When we get to that end point," he said, "we'll have the confidence to put this on alert."

But far from increasing the complexity of future tests, the Pentagon has made them easier, military experts who examined the testing plan agreed. Two rigorous experiments, in 1997 and 1998, to have the weapon simply observe the targets, they said, have been followed by interception tests designed to make discriminating between decoys and mock warheads as easy as possible.

"They did a good fox trot for the first couple of tests and then slowed down to a crawl," said Bob Dietz, a retired former designer of warhead decoys for American missiles. "You have to ask why they don't build better decoys. They've always said they'd get better with time."

Michael W. Munn, a retired scientist for the military contractor Lockheed and a pioneer in designing and testing antimissile weapons, said: "The only way to make it work is to dumb it down. There's no other way to do it. Discrimination has always been the No. 1 problem, and it will always remain that way."

He said manipulation of antimissile flight tests was nothing new. "It's always been a wicked game," Mr. Munn said.

The Pentagon itself is sharply divided on the testing issue. In February, Philip E. Coyle III, the Defense Department's director of testing and evaluation, faulted the antimissile tests as insufficiently realistic to make decisions about moving from research to building the weapon.

The 16 interception test flights called for in the development program would cost at least $1.6 billion, Pentagon experts say. So far, the two observation tests have been followed by two interception attempts, the first successful, the second a failure. Another test is scheduled in July.

The Clinton administration plans to make a decision later this year on whether to start building the antimissile system, which is to shield the United States from limited missile attacks by so-called rogue states.

Dr. Postol, a professor of science and national security studies at M.I.T. and the author of many private and federal weapon reports, was a top Navy science adviser in the Reagan administration and for decades has studied enemy counter measures to antimissile weapons.

After the 1991 Persian Gulf war, he challenged the Army's claims of success for its Patriot antimissile system, saying it had, in fact, destroyed no Iraqi missiles at all. Though the Pentagon at first denied his assertion, it later conceded that initial reports of the Patriot success had been exaggerated.

The current scientific fray centers on the interceptor's 120-pound homing device, known as a kill vehicle. Fired on a rocket, it is designed to use a telescopic sensor, a computer and jet thrusters to steer itself through space toward a warhead, destroying it by force of impact.

Dr. Postol's critique involves its hardest job, distinguishing between actual enemy warheads and the cloud of decoys considered sure to be launched to disguise them. If unable to tell decoys from warheads, a defender would be forced to fire interceptors at every threatening object, quickly exhausting a defensive force.

Dr. Postol began digging into the first antimissile flight test, in June 1997, after reviewing Pentagon data gathered by Dr. Schwartz.

The sensors at issue are cooled to more than 300 degrees below zero and work in the icy void of space to track faint heat emissions from warm targets, just as ordinary telescopes track light. They see warheads and decoys as twinkling points of light, like stars.

The June 1997 flight test, Dr. Postol asserted, showed that the infrared twinkles were random and insufficiently different from one another to let the interceptor distinguish among them, and that the Pentagon had conspired to hide this surprising discovery. The Pentagon, he said, has altered future tests to artificially heighten any differences that could be detected between warheads and decoys.

His accusation is based mainly on a detailed chart from the Pentagon's Ballistic Missile Defense Organization that gives an overview of its program for Integrated Flight Tests of the kill vehicle. Entitled "I.F.T. Targets Selections," the chart is dated May 5, 2000, and at the top is labeled "For Planning Purposes." The chart's bottom warns, "Configuration controlled by N.M.D. J.P.O.," or the National Missile Defense Joint Program Office. "Do not alter this document."

The chart starts with the June 1997 test, lists another sensor flight and then goes through the 16 intercept tests scheduled for the kill vehicle's entire development. The last flight is listed as June 2004, right before the antimissile weapon is to begin operating in 2005. In each case, the chart spells out the exact type and number of test decoys and warheads and depicts them in small pictures.

Dr. Postol said the chart shows how the initial suite of challenging decoys, the ones that twinkled a lot, making them hard to distinguish from a warhead, had been replaced by fewer and simpler decoys that twinkled as little as possible, accentuating their differences from warheads that fluctuate a lot in infrared intensity.

Long and conelike, pointy at one end, flat at the other, the warheads can wobble and shift in complex ways while moving through space, presenting differing heat emissions to a distant sensor. By contrast, the spherical decoy balloons have more uniform signatures.

The removed decoys, Dr. Postol said in his report, all had infrared signatures similar to the warheads. Abandoned were spherical balloons whose stripes made their infrared emissions fluctuate, rigid decoys that looked like warheads and balloons that inflated to conelike shapes.

"These decoys," he wrote, "have brightness and time-dependent oscillating signals that can be quite similar to the signals from either warheads that are spinning around their axis of symmetry, or tumbling end over end."

The only retained decoys, he said, were spherical, uniform in materials and substantially brighter or dimmer than warheads. Their signatures, he said, "will have very uniform and controlled intensities."

All the program's interception tests, Dr. Postol said in the draft report to the White House, "have been carefully orchestrated to avoid encountering the discrimination problems." In an interview, he said he hoped to get the report, a draft of which runs to 20 pages, to the White House next week.

General Kadish, while saying the planning chart was authentic, if tentative, strongly denied that the testing program had been structured to become increasingly easy. To the contrary, he said, the decoys were selected to make the evolving tests increasingly hard.

"Complexity is increasing," he said.

Asked how a smooth balloon could be more difficult to track than a rigid decoy shaped to look like a warhead, he replied, "That's a valid technical argument," but he added that just because a decoy seemed effective "doesn't mean its credible."

The test program, he said, was structured to make the weapon flexible and robust. Testing it against decoy shapes that were too specific might allow an enemy to fool the weapon by changing them "a little bit," General Kadish said. "What we're after is a basic physics approach."

Previously, Pentagon officials have said they reduced the complexity of some antimissile testing when the government cut the program's goal from trying to knock out advanced warheads from countries like Russia and China to more primitive ones from rogue states.

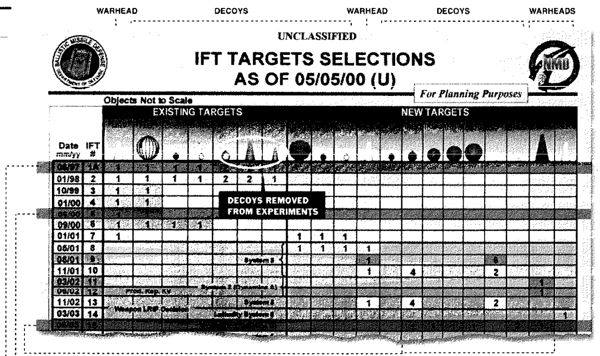
Lt. Col. Richard Lehner of the Air Force, an antimissile spokesman, said the current testing diagram depicts provisional goals rather than a hard and fast plan. The only decoy configuration set in concrete, he added, was the next test flight, which has been delayed repeatedly and is now scheduled for the first week of July.

Yesterday, Dr. Postol belittled the Pentagon's retorts, saying they were misrepresenting the program's logic. "They've been caught in one outright lie after another," he said.

KEEPING TRACK

Bar Reported Lowered For Missile Defense Tests

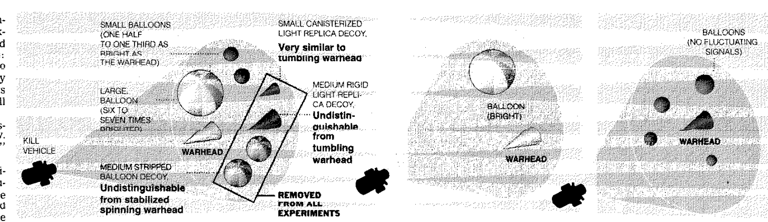
Theodore A. Postol and other critics of the proposed National Missile Defense system argue that future tests of the system are being manipulated to hide the fact that it cannot differentiate between realistic decoys and the warheads it is intended to intercept. The next test is set for July.



June 1997 and Jan. 98 Tests:
TWO TESTS WITH CREDIBLE DECOYS
The Exoatmospheric Kill Vehicle (EKV) sees the signals from distant objects as fluctuating points of light. The light from a rotating ballon covered with stripes fluctuales like that of a warhead changing its orientation as it rotates and/or tumbles in space. If the balloon is not clearly brighter or darker it becomes undistinguishable from the target.

July 2000 Test:
DECOYS REMOVED
After the second test, the only decoys retained were those that are spherical, and substantially brighter or dimmer than target warheads, and thus easily distinguishable.

June 2003 Test:
DECOYS REPLACED
All new decoys are modified to be featureless spheres so they have no time-varying signals like those of the non-spherical spinning and tumbling warheads.



Source: Theodore A. Postol, M.I.T.

The New York Times

Rick Friedman for The New York Times

Theodore A. Postol, the M.I.T. professor who obtained the Pentagon's antimissile testing plan.

Purpose of the Baseline Algorithm (BLA)

- Identify Known Objects By Matching ***Expected*** Appearance to ***Observed*** Appearance.

- Similar to Visually Identifying Suitcases at an Airport

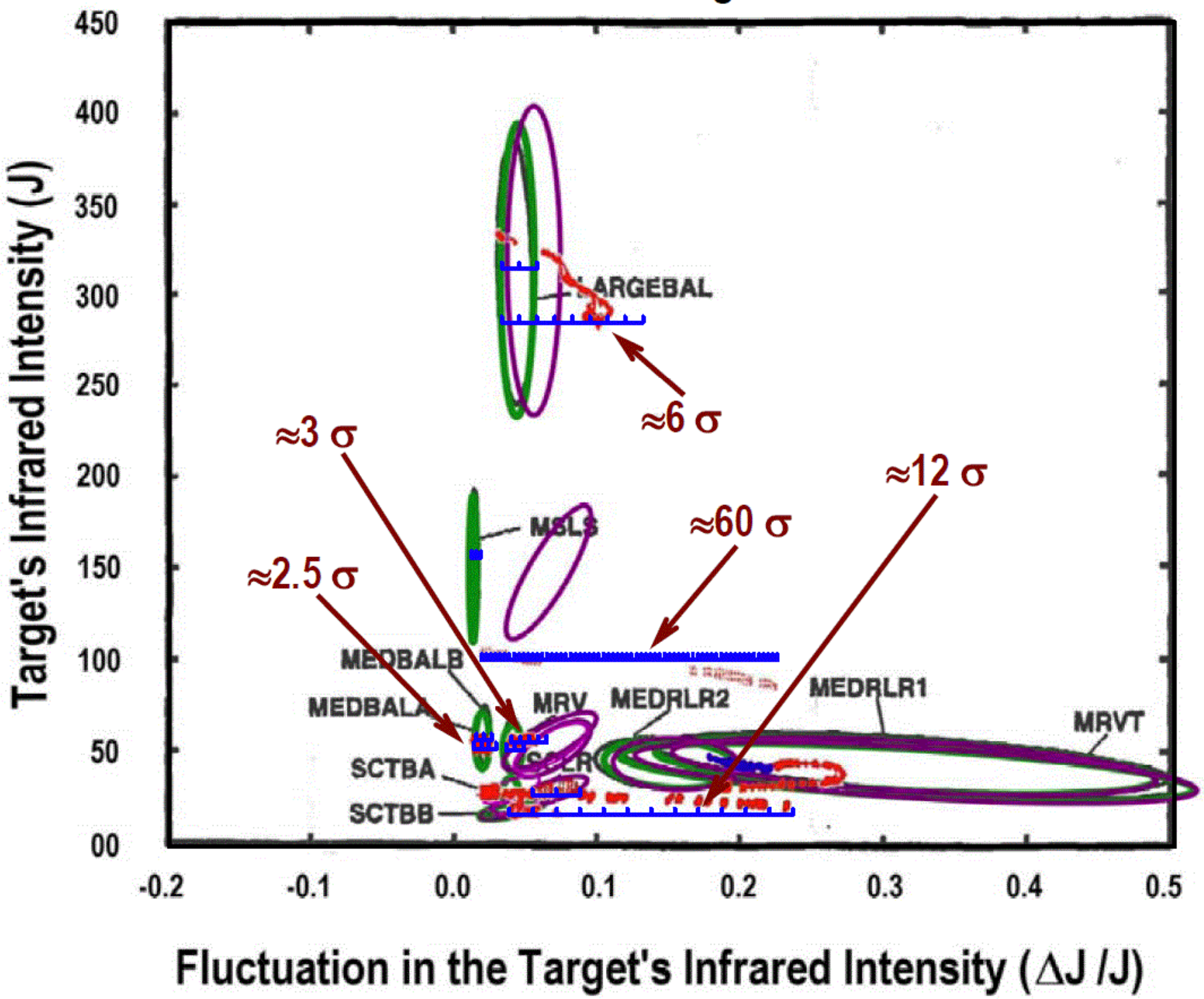
Objects Flown in the IFT-1A and IFT-2 NMD Tests

LARGEBAL	Large Balloon (2.2 Meter Diameter Balloon)
SCLR	Small Canisterized Light Replica (Balloon)
MEDBALA	Medium Balloon A (0.6 Meter Diameter Balloon)
MEDBALB	Medium Balloon B (0.6 Meter Diameter Balloon)
MEDRLR1	Medium Rigid Light Replica 1 (2 Meters Long & 0.6 Meter Base)
MEDRLR2	Medium Rigid Light Replica 2 (2 Meters Long & 0.6 Meter Base)

MSLS	Mission Service Launch System (Rocket Upper Stage)
SCTBA	Small Cannisterized Traffic Balloon A (Small Balloon)
SCTBB	Small Cannisterized Traffic Balloon B (Small Balloon)
MRV	Medium Reentry Vehicle (2 Meters Long & 0.6 Meter Base)

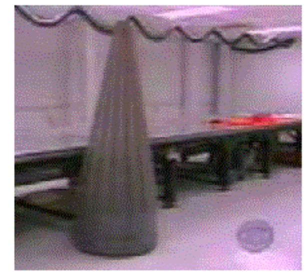
Non-Gaussian Behavior of the Data from the IFT-1A Experiment

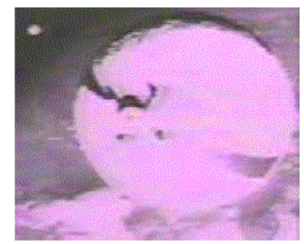
Expected Values (One-σ Ellipse) for the Composite Intensity and Fluctuation in Composite Intensity for IFT-1A Target Set



Example of Warhead

Example of Possible "Replica" Decoy





Example of Striped Balloon Decoy

Reference:

Transparent Overlay of Figures 4 and 5 from the POET Report 1998-5

Original Plans to Fly Ten or More Objects in IFT-3 and IFT-4 Experiments

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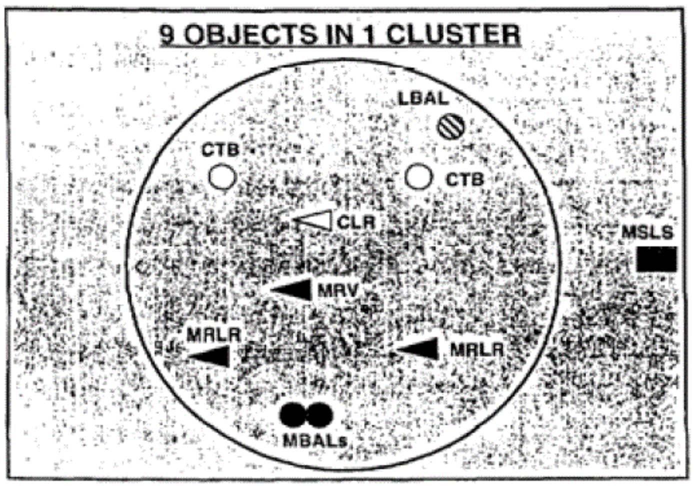
TSRD TARGET REQUIREMENTS SUMMARY (IFT-1 – 1FT-4) (U)

Nichols Research

NRC

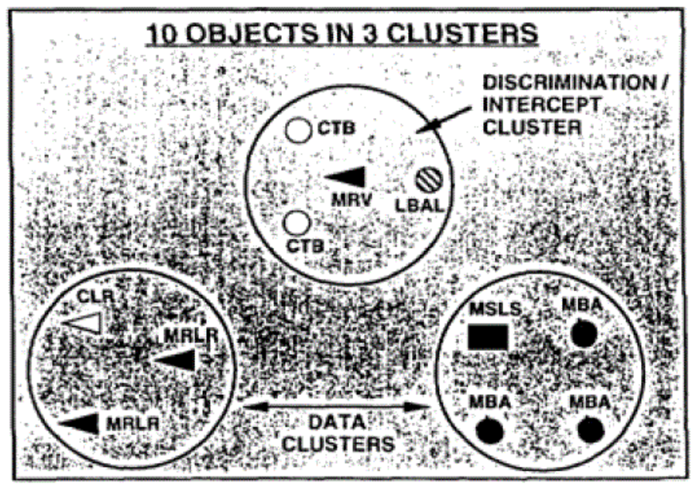
IFT 1&2
SENSOR FLIGHT TESTS
AUG 96 / NOV 96

- 1 MED RV (I)
- 2 MED RIGID LIGHT REPLICAS (MRLR) (I)
- 2 MED BALLOONS (MB) (U)
- 1 CANISTERIZED LIGHT REPLICA (CLR) (I)
- 2 CANISTERIZED TRAFFIC BALLOONS (CTB) (I)
- 1 LG BALLOON (LB) (U)



IFT 3&4
EKV FLIGHT TESTS
OCT 97 / JAN 98

- 1 MED RV (I)
- 2 MED RIGID LIGHT REPLICAS (MRLR) (I)
- 3 MED BALLOONS (MB) (U)
- 1 CANISTERIZED LIGHT REPLICA (CLR) (I)
- 2 CANISTERIZED TRAFFIC BALLOONS (CTB) (I)
- 1 LG BALLOON (LB) (U)



I - INSTRUMENTED
U - UNINSTRUMENTED

LARGE CL
MED. CLA
SMALL CL

After First Test Failed, All Subsequent Tests Rigged to Avoid the Further Failures

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IFT TARGETS SELECTIONS AS OF 05/05/00 (U)

For Planning Purposes

Objects Not to Scale

Date mm/yy	IFT #	MRV	LB	CSB-1	CSB-2	MB	MRLR	SCLR	LSB	SSB-A	SSB-B	MTRV	IRB-1	IRB-2	IRB-3	IRB-4	IRB-5	RB-1	RB-2	GROW	MLRV	Notes
		EXISTING TARGETS							NEW TARGETS													
06/97	1A	1	1	1	1	2	2	1														
01/98	2	1	1	1	1	2	2	1														
10/99	3	1	1																			
01/00	4	1	1																			
06/00	5	1	1																			
09/00	6	1	1	1	1																	
01/01	7	1							1	1	1											
05/01	8								1	1	1	1										System 5
08/01	9											1						6				System 5
11/01	10											1		4				2				System 5
03/02	11																			1		System 2 (Dynamics A)
06/02	12																			1		Prod. Rep. KV; System 2 (Dynamics A)
11/02	13											1		4				2				System 5; Weapon LRIP Decision
03/03	14																				1	Lethality System 5
06/03	15													1	1	1	1		2	1		System 2 (Dynamics B)
11/03	16																				1	Lethality System 5
02/04	17																				1	Lethality System 5
06/04	18													1	1	1	1		2	1		System 2 (Dynamics B, CSOs)
11/04	19																					OTA TESTS
03/05	20																					OTA TESTS
05/05	21																					OTA TESTS

Configuration controlled by NMD JPO – Do not alter this document.

▭ = Nighttime Engagement

NMD Forging America's Shield

5/5/00 NMD Flight Test Targets and Scenarios Task Update

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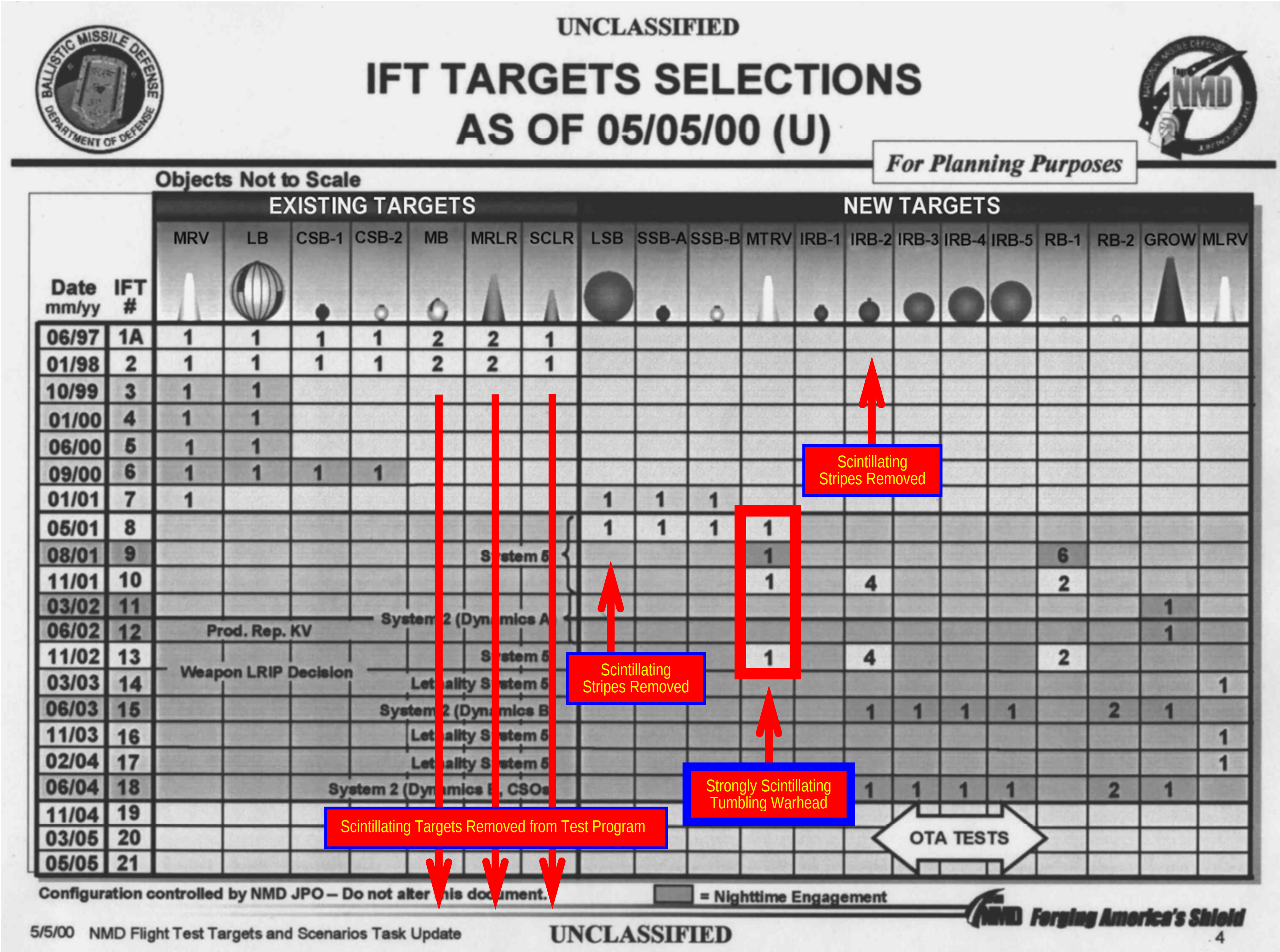
4

After First Test Failed, All Subsequent Tests Rigged to Avoid the Further Failures



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IFT TARGETS SELECTIONS AS OF 05/05/00 (U)

For Planning Purposes

Objects Not to Scale

Date mm/yy	IFT #	MRV	LB	CSB-1	CSB-2	MB	MRLR	SCLR	LSB	SSB-A	SSB-B	MTRV	IRB-1	IRB-2	IRB-3	IRB-4	IRB-5	RB-1	RB-2	GROW	MLRV
		EXISTING TARGETS							NEW TARGETS												
06/97	1A	1	1	1	1	2	2	1													
01/98	2	1	1	1	1	2	2	1													
10/99	3	1	1																		
01/00	4	1	1																		
06/00	5	1	1																		
09/00	6	1	1	1	1																
01/01	7	1							1	1	1										
05/01	8								1	1	1	1									
08/01	9							System 5				1						6			
11/01	10											1		4				2			
03/02	11																			1	
06/02	12		Prod. Rep. KV					System 2 (Dynamics A)												1	
11/02	13		Weapon LRIP Decision					System 5				1		4				2			
03/03	14							Lethality System 5													1
06/03	15							System 2 (Dynamics B)						1	1	1	1		2	1	
11/03	16							Lethality System 5													1
02/04	17							Lethality System 5													1
06/04	18							System 2 (Dynamics B, CSOs)						1	1	1	1		2	1	
11/04	19																				
03/05	20													OTA TESTS							
05/05	21																				

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NMD Forging America's Shield

5/5/00 NMD Flight Test Targets and Scenarios Task Update

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4

Claims of Success in the IFT-1A and IFT 2 Experiments Made to Congress

Opening Statement By *Lieutenant General Lester L. Lyles*, USAF
Director, Ballistic Missile Defense Organization
before the Subcommittee on Defense Committee on Appropriations *(April 22, 1998)*

"During the past year, Mr. Chairman, ***we conducted two very successful*** NMD exoatmospheric kill vehicle - or EKV - ***flight tests***. Two different industry teams supported those efforts and are competing against each other. ***We demonstrated*** in those initial tests ***that we can*** use an EKV sensor to ***identify and track*** objects in space - including ***threat representative targets and decoys*** - and allow us to discriminate and determine what is an actual target and what is not."

Statement of
***Lieutenant General Ronald T. Kadish*, USAF**
Director, Ballistic Missile Defense Organization
Before the
House Armed Services Committee
Subcommittee on Military Research & Development
Thursday, *June 22, 2000*

This significant countermeasures package [in the IFT-1A and IFT-2 experiments] contained more objects than the countermeasures packages we employed during IFT-3 and IFT-4 because ***we wanted to see how well the EKVs could discriminate within the target complex and identify the warhead***. ***We gathered an immense amount of data that increased our confidence in our ability to meet the discrimination challenge***. ***IFT-1A and 2 demonstrated a robustness in discrimination capability that went beyond the baseline threat*** for purposes of designing the Expanded C-1 system.

This phase began with IFT-3, a partially integrated intercept test, when we successfully demonstrated our ability to do on-board discrimination and target selection as well as hit-to-kill.

Claims of Success in the IFT-1A and IFT 2 Experiments Made to the Press

EKV prototypes discriminate 'spectacularly well,' boeing nmd chief says
Inside Missile Defense, September 30, 1998 -

"[The] particular target complex that these seekers were launched against was a quite sophisticated target complex, far more than we have to handle for an initial deployment," Peller noted. "Without going into details let me say that each seeker, using its own discrimination algorithms, positively nailed the reentry vehicle identified in the set of all those objects. . . . It picked it all up -- objects of all types," he said.

"We went from the case of not having any demonstrated optical discrimination to all of a sudden having an abundance of it."

BMDO BEGINS 'ORDERLY PHASEOUT' OF BOEING BACKUP NMD KILL VEHICLE
Inside Missile Defense, May 19, 2000 -

"We found that in both cases we were able to pick the reentry vehicle out of the target complex. There was just some minor adjustments done after that based on what they learned, but with the data that they had, they were able to pick it out in both cases."

Data from those tests will benefit the NMD program over the next 10 years, Englander noted.

Extremely Important

US Missile Defense Policy is shaped mostly by
<u>US DOMESTIC POLITICS</u>

Extremely Important

This is the Only Way to Explain the Technically Senseless US Missile Defense Program

Extremely Important

Although This Talk Will Focus Exclusively on the Technical Issues Associated with US Missile Defense Programs, it is Important to Understand that the Program Cannot Be Explained Without Understanding the Domestic Politics that Drives It.

- 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 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.**

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 Ballisitic 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

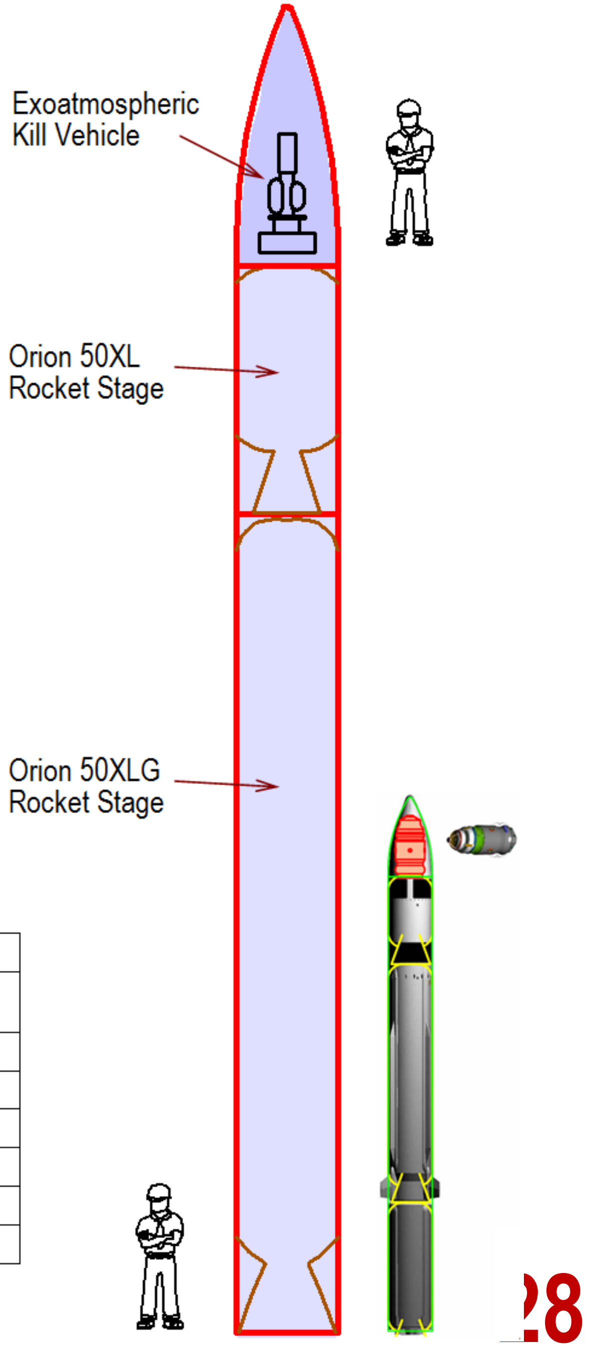
Orbital Sciences Ground-Based Interceptor and Raytheon Exoatmospheric Kill Vehicle

Estimated Dimensions and Weight of the National Missile Defense Launch Vehicle

Rocket Components	Length (ft)	Diameter (ft)	Component Weight (lbs)
Shroud	11.6	4.17	200
Payload (Kill Vehicle)	–	–	155
Payload Adaptor	–	–	–
1st Stage (Orion 50XLG)	33.8	4.17	37,800
2nd Stage (Orion 50XL)	11.7	4.17	9,500
Total	51.4	–	47,655

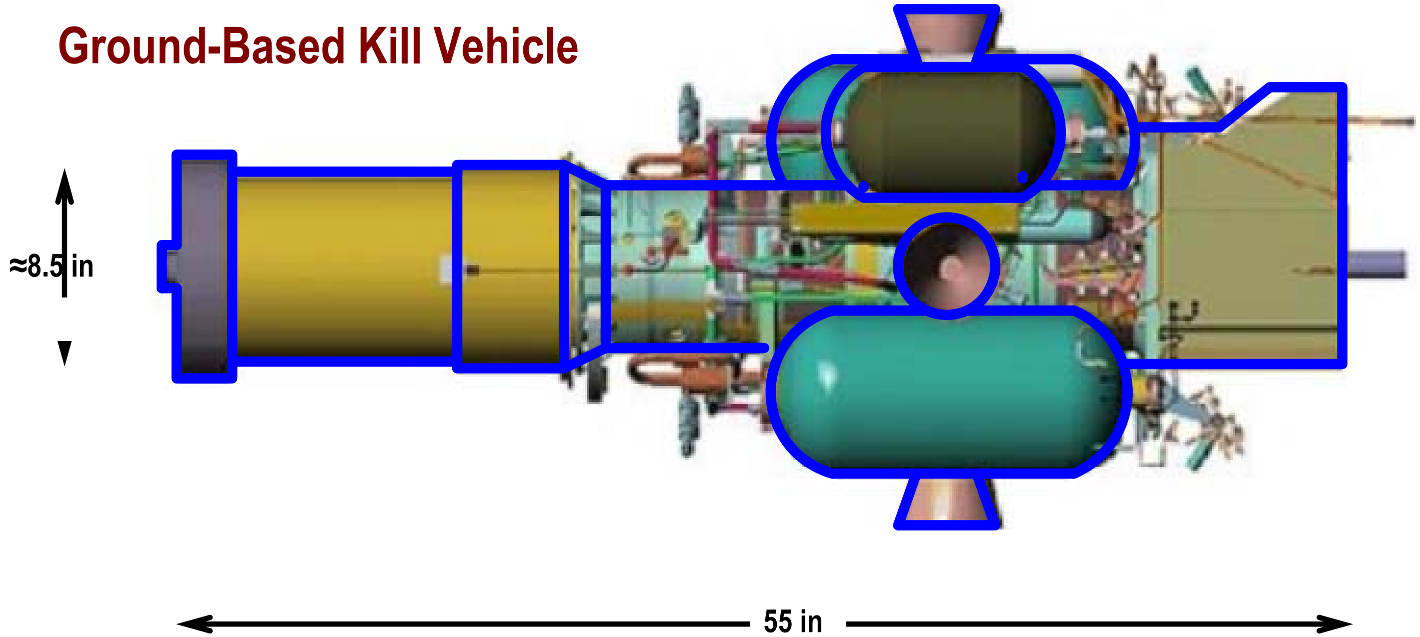
Estimated Performance Parameters of the National Missile Defense Launch Vehicle

Rocket Components	Burn Time (sec)	Vacuum Specific Impulse (sec)	Vacuum Thrust (lbs)	Component Weight (lbs)	Propellant Weight (lbs)	Empty Weight (lbs)	Empty/Full Mass Fraction
Shroud	–	–	–	200	–		
Payload (Kill Vehicle)	–	–	–	155	–		
Payload Adaptor	–	–	–	–	–		
1st Stage (Orion 50XLG)	70	295	149,500	37,800	35,480	2,320	0.0614
2nd Stage (Orion 50XL)	70	289	36,000	9,500	8,680	820	0.0859
Total	140	–	–	47,655	–		

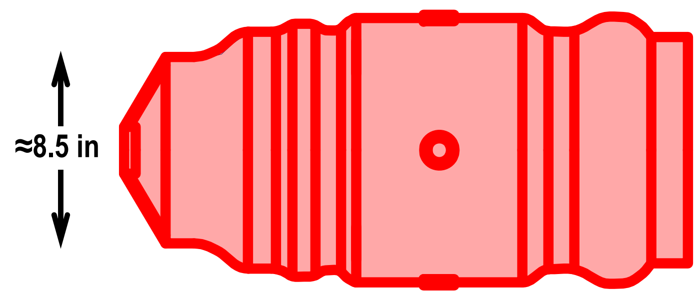


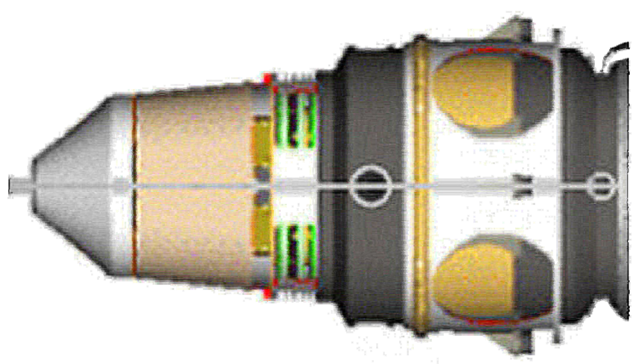
All of the Missile Defense Kill Vehicles Use the Same Infrared Technology to Identify and Home on Targets

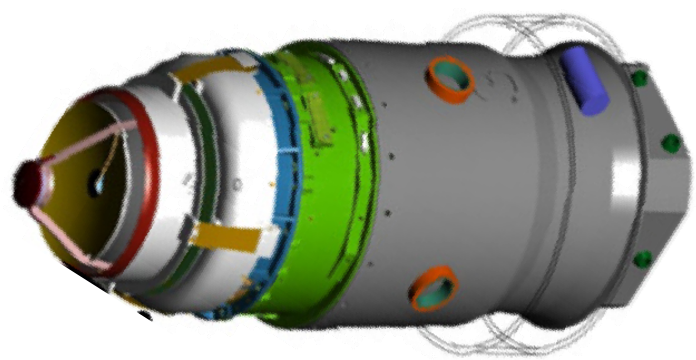
Ground-Based Kill Vehicle



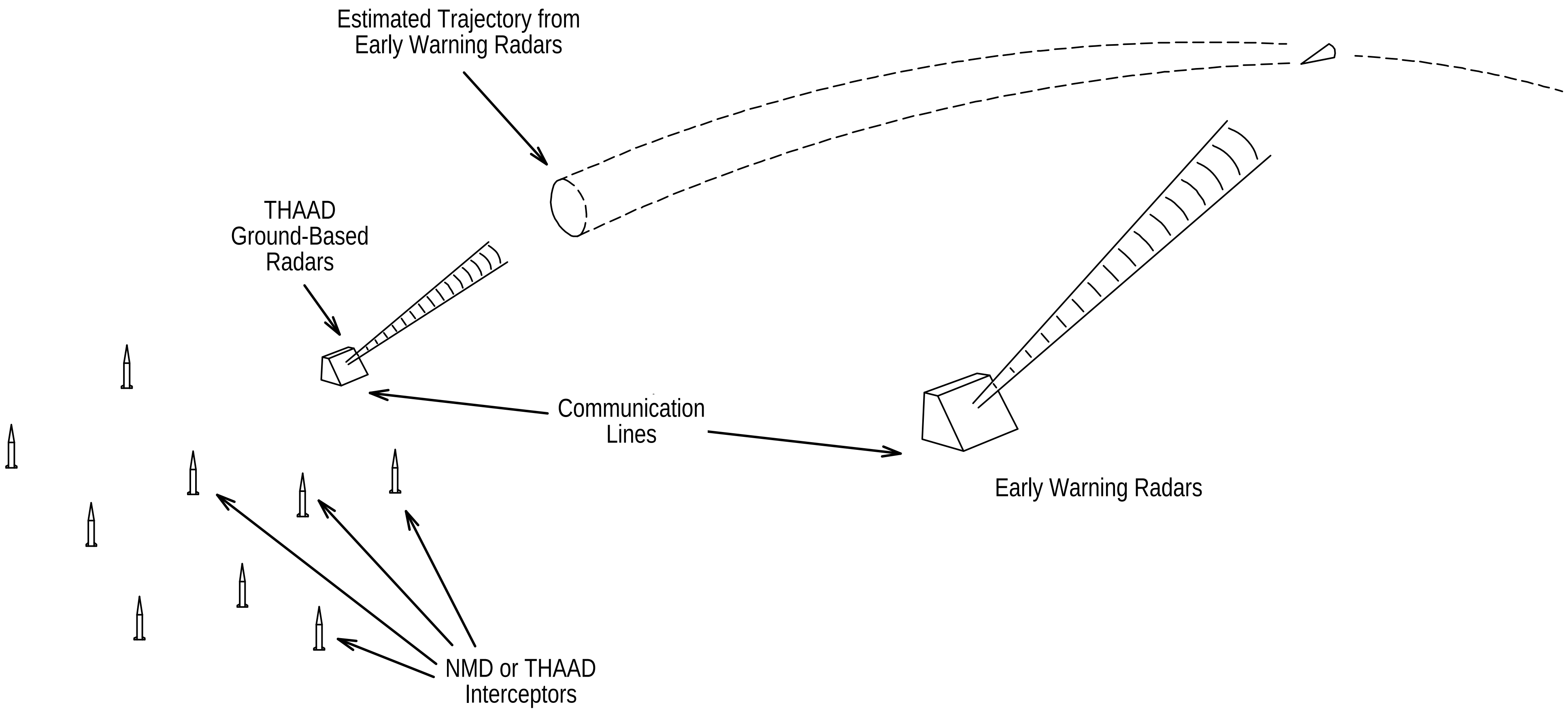
Navy Large-Aperture High Divert-Speed SM-3 Block II Kill Vehicle



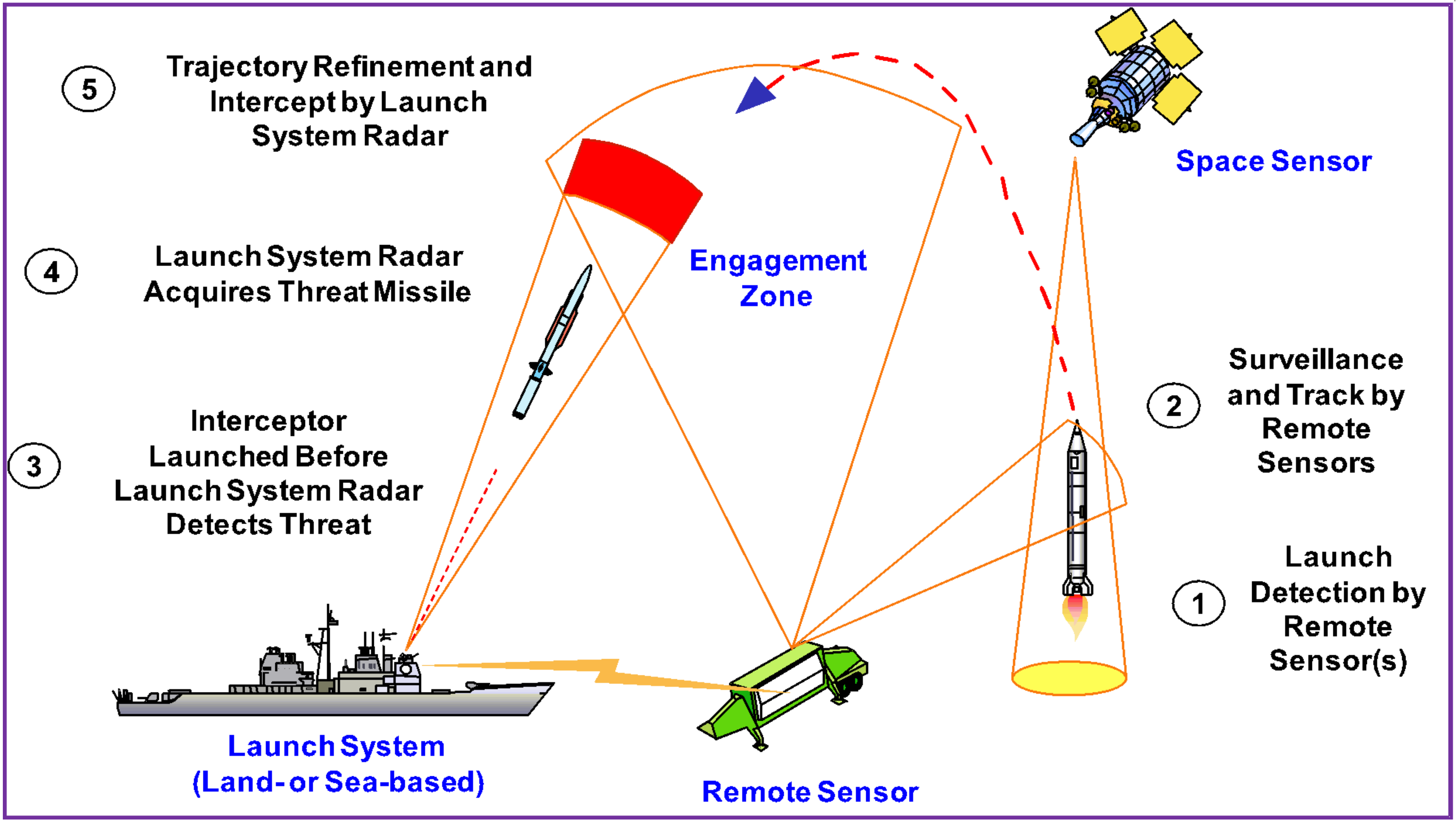




Basic Functional Architecture of a Baseline and Expanded National Missile Defense



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



Radar Search, Acquisition and Tracking Capabilities in the Phased Adaptive Approach is Very Weak

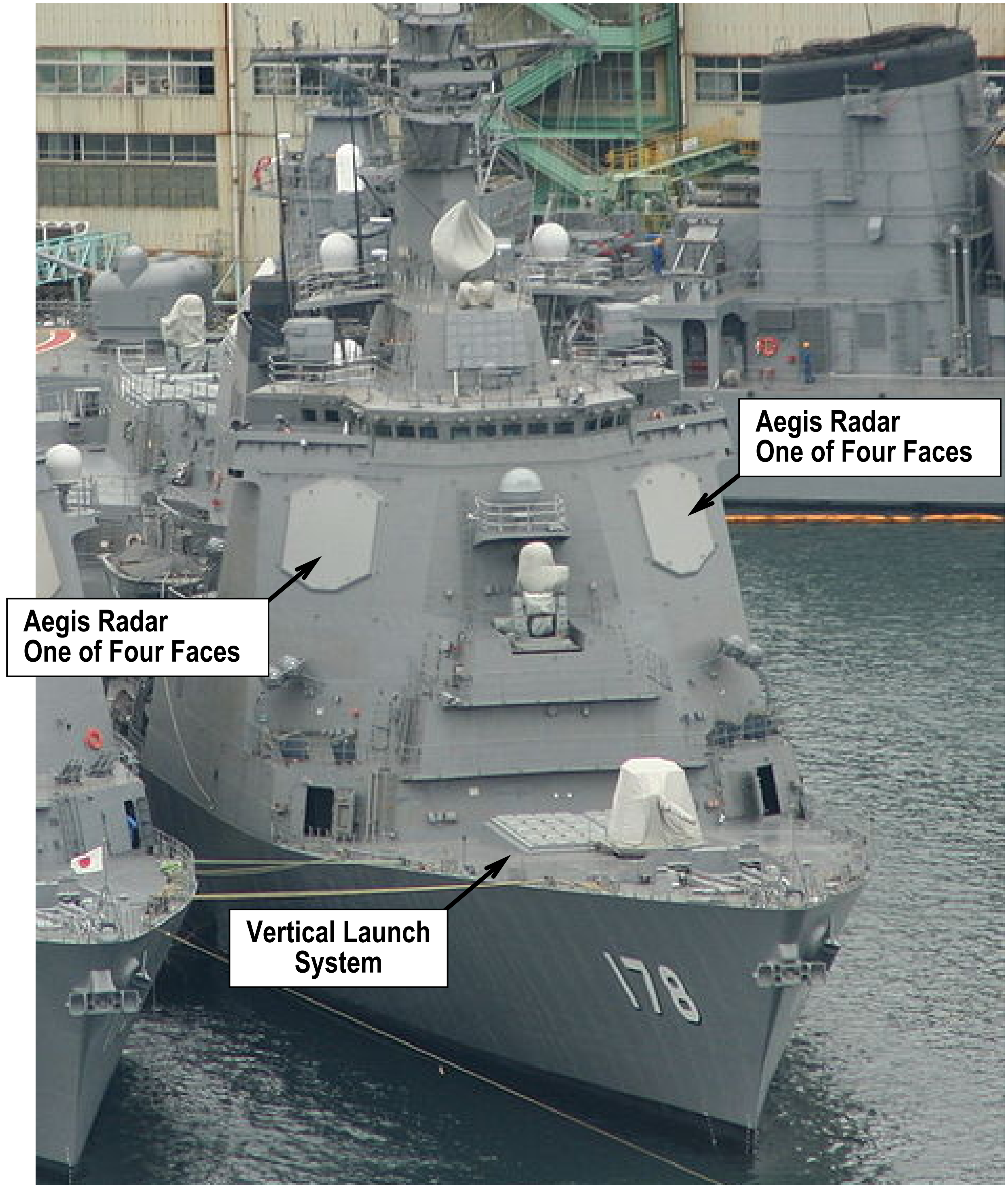
Aegis Cruiser and Destroyer Radar System

Radar Characteristics

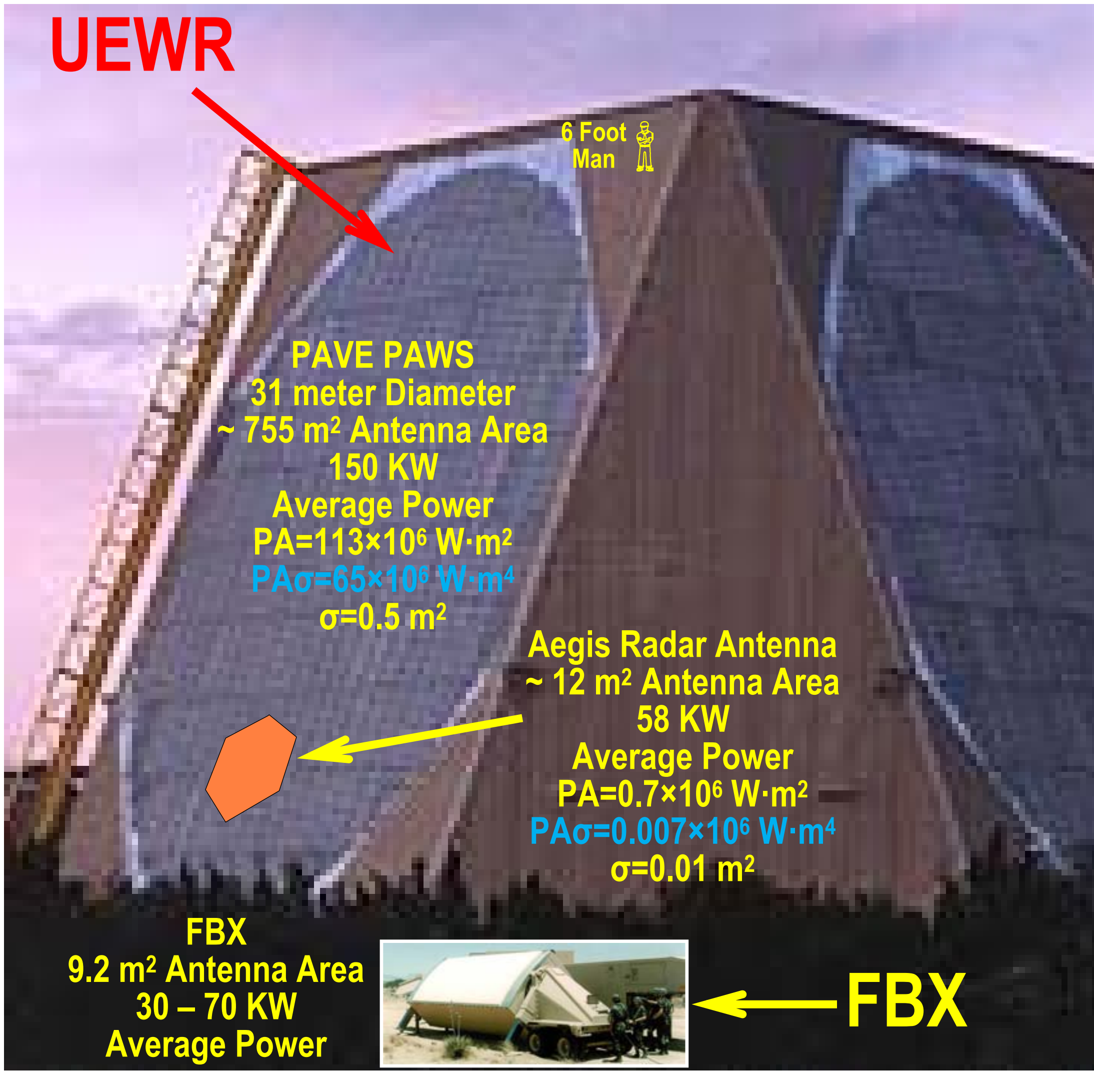
Average Power per Radar Face = 58 KW
Face Area = 12 M^2
3.3 GHz Frequency (S-Band)
Assumed System Losses = 10
Known System Temperature = 500°K

Estimated Performance per Dwell

Range Against $1M^2$ Target ≈ 900 – 1000 km
(Single 0.1 Second Dwell)
Coherent S/N = 56, Incoherent S/N ≈ 20 -25
Range Against $0.01M^2$ 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

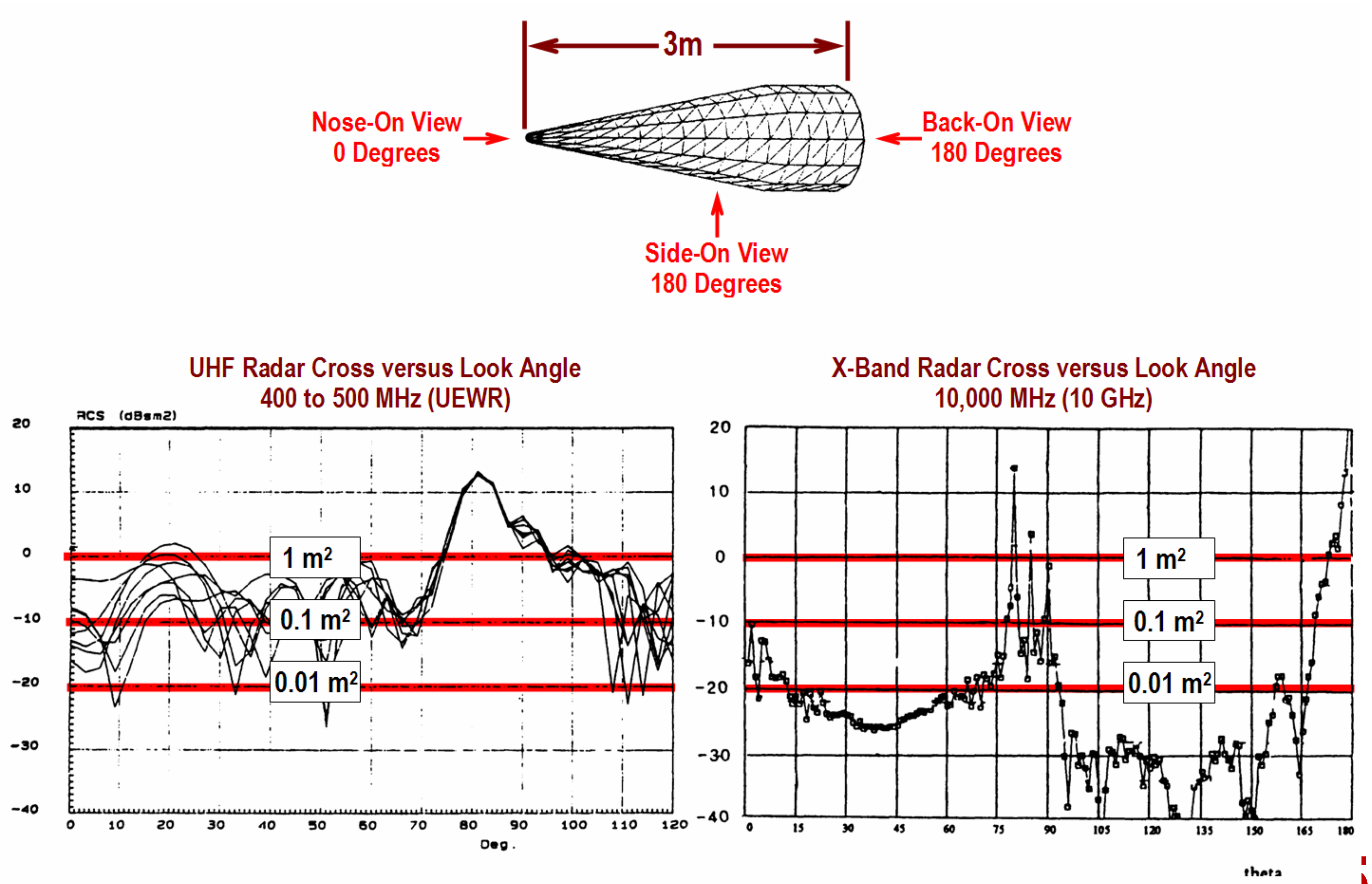


Comparison of the Relative Sizes and Average Power of the Fylingsdale UEWR, the GLOBUS II Radar at Vardo, Norway, and the Forward-Based X-Band (FBX) Radar



Aegis Radar
Average Power per Radar Face = 58 KW
Face Area = 12 M^2
3.3 GHz Frequency (S-Band)

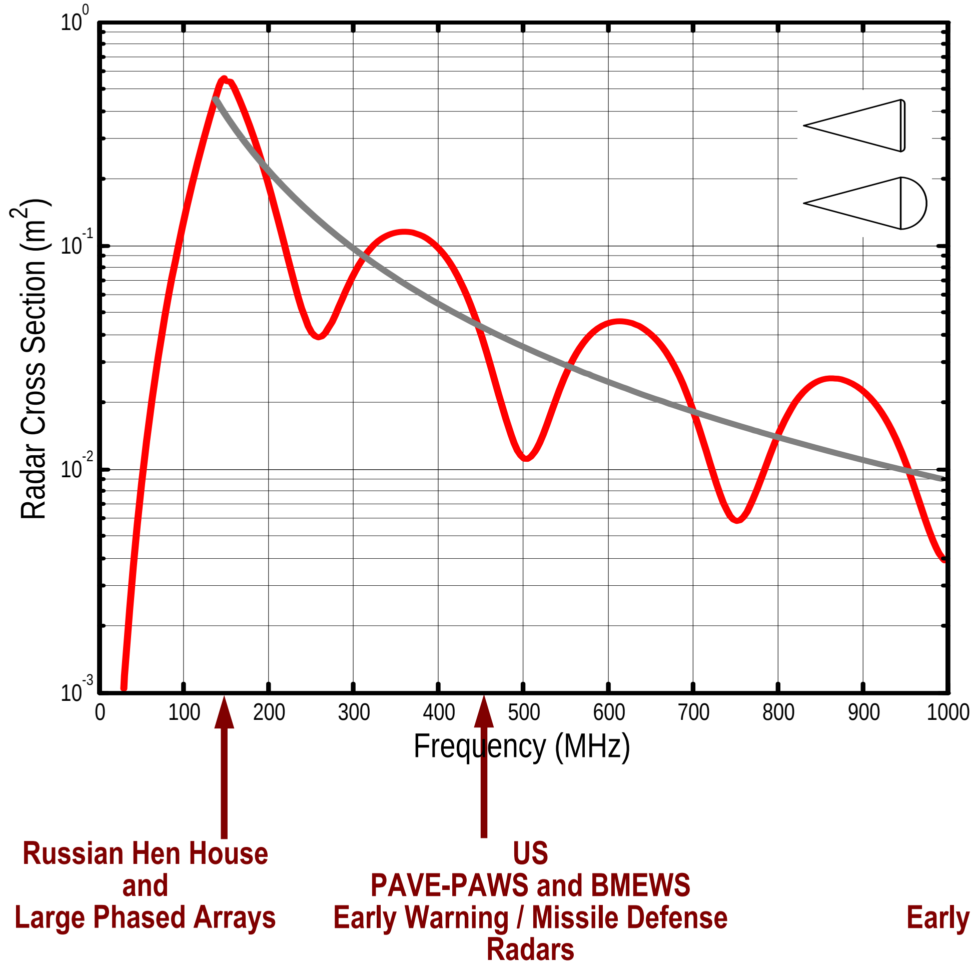
Radar Cross Section of Large Round-Nose Warhead

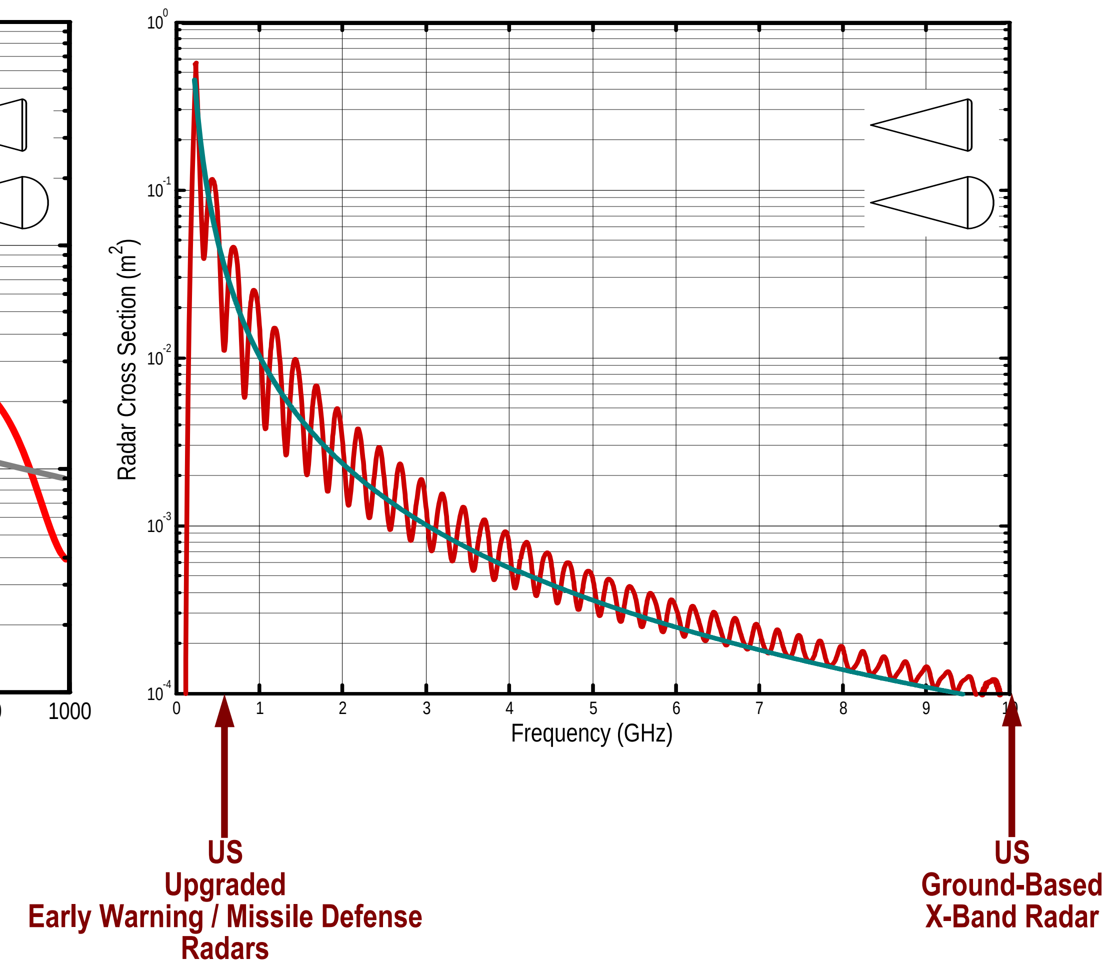


Operating Frequencies of Early Warning and Missile Defense Radars

Radar Cross Section of Rounded-Back Cones

The operating frequency of Russia's Early Warning Radars was chosen so that the radar reflectivity of warheads approaching Russia would be as large as possible, thereby making it easier for the radars to detect the approaching warheads at very long range. However, a serious drawback associated with radars operating at these frequencies is that they highly vulnerable to blackout effects from high-altitude nuclear explosions.



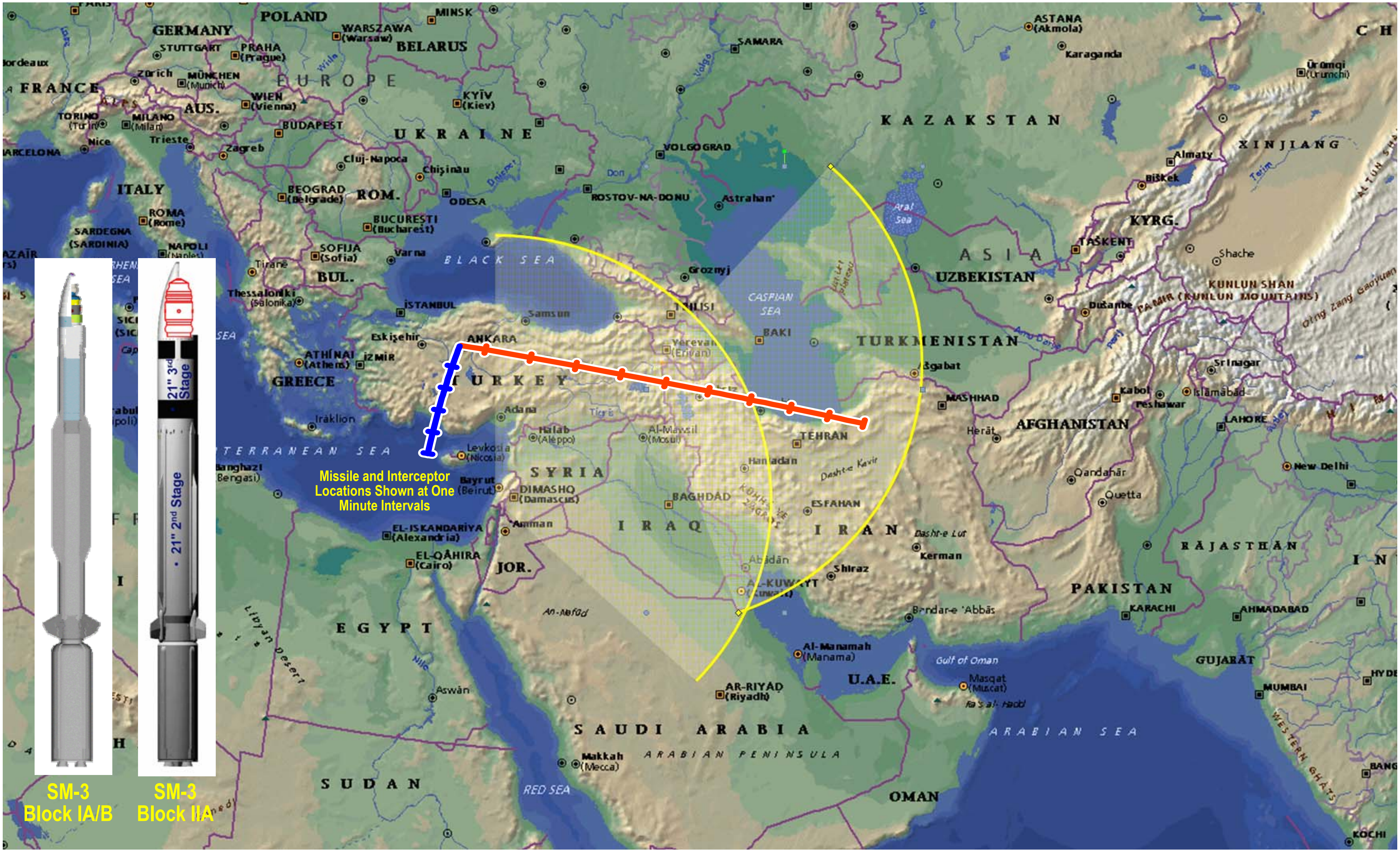


The Forward-Based X-Band Radar (FMX) Has Limited Acquisition Abilities Against 0.01 m^2 Cone-Shaped Warheads at Ranges Greater Than 600 to 700 km and Against 0.001 m^2 Targets at Ranges Greater Than 300 to 400 km

FBX Range ≈1300 km Against Targets with RCS 0.1 m^2 to 0.2 m^2 Targets

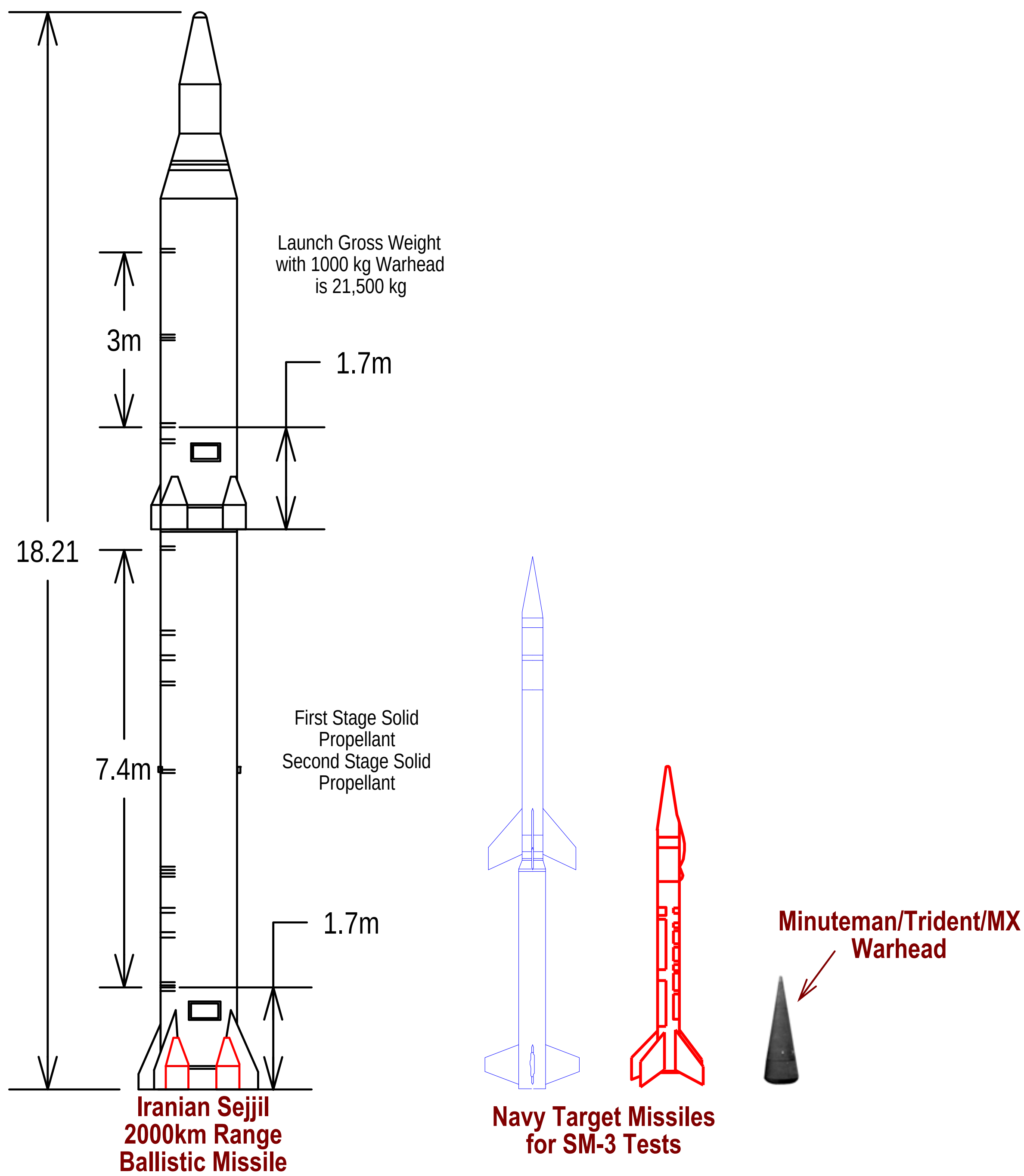
FBX Range ≈1300 km against Targets with RCS 0.1 m^2 to 0.2 m^2 Targets

FBX Range ≈1300 km Against Targets with RCS 0.1 m² to 0.2 m² Targets

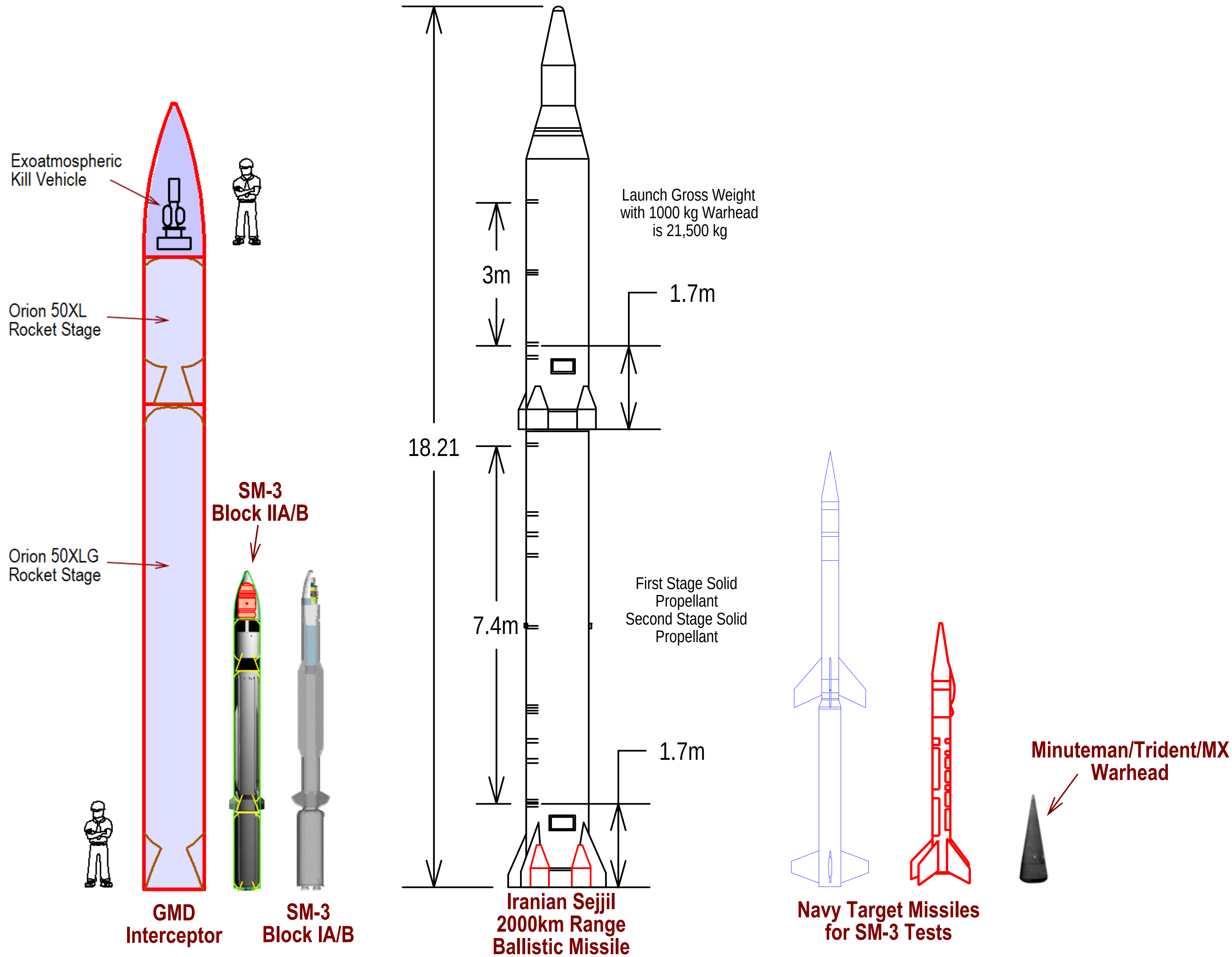


FBX Range ≈1300 km against Targets with RCS 0.1 m² to 0.2 m² Targets

Missile Defense Targets

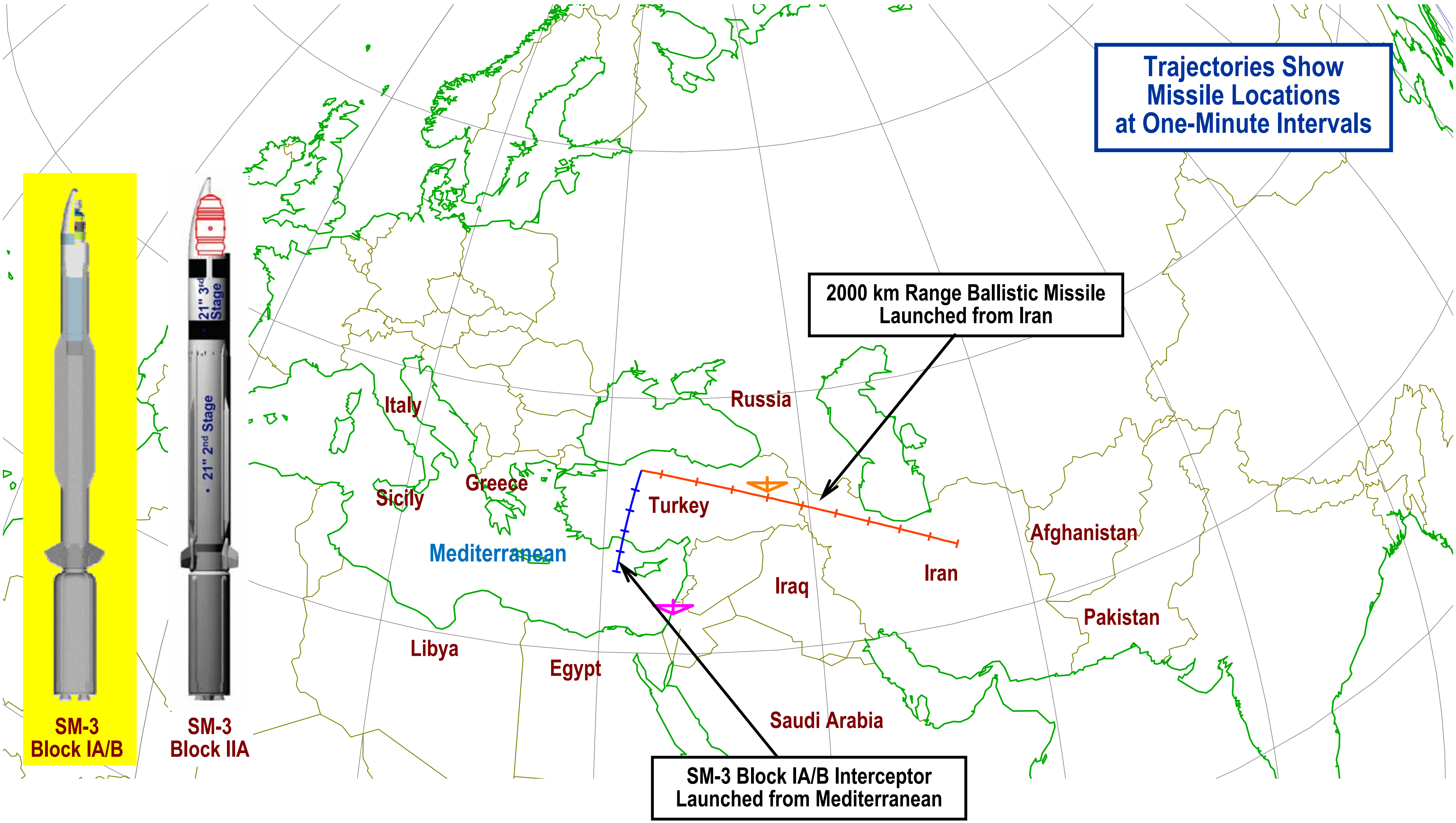


Missile Defense Targets and Interceptors



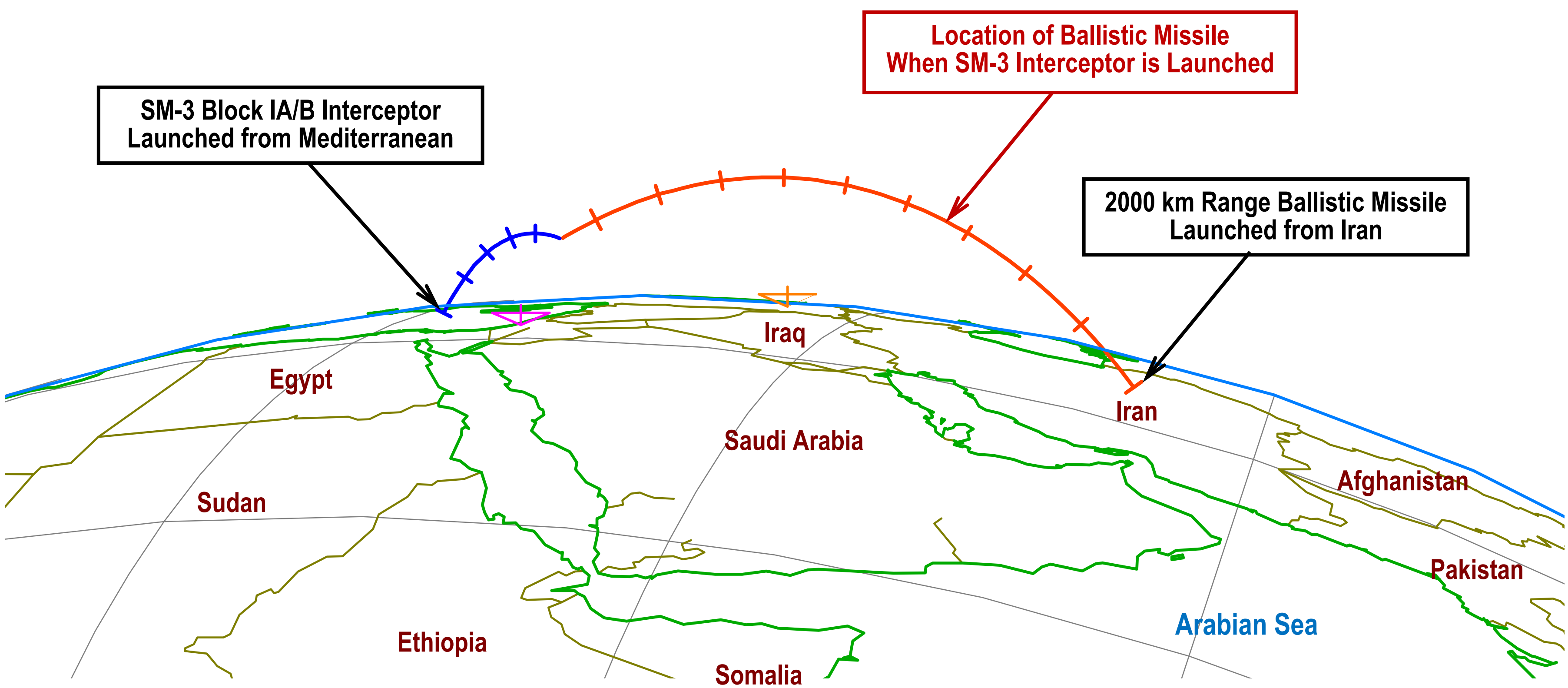
Notional Intercept Trajectory of Standard Missile 3 Block IA/B (SM-3 Block IA/B) Against 2000 km Range Iranian Ballistic Missile

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

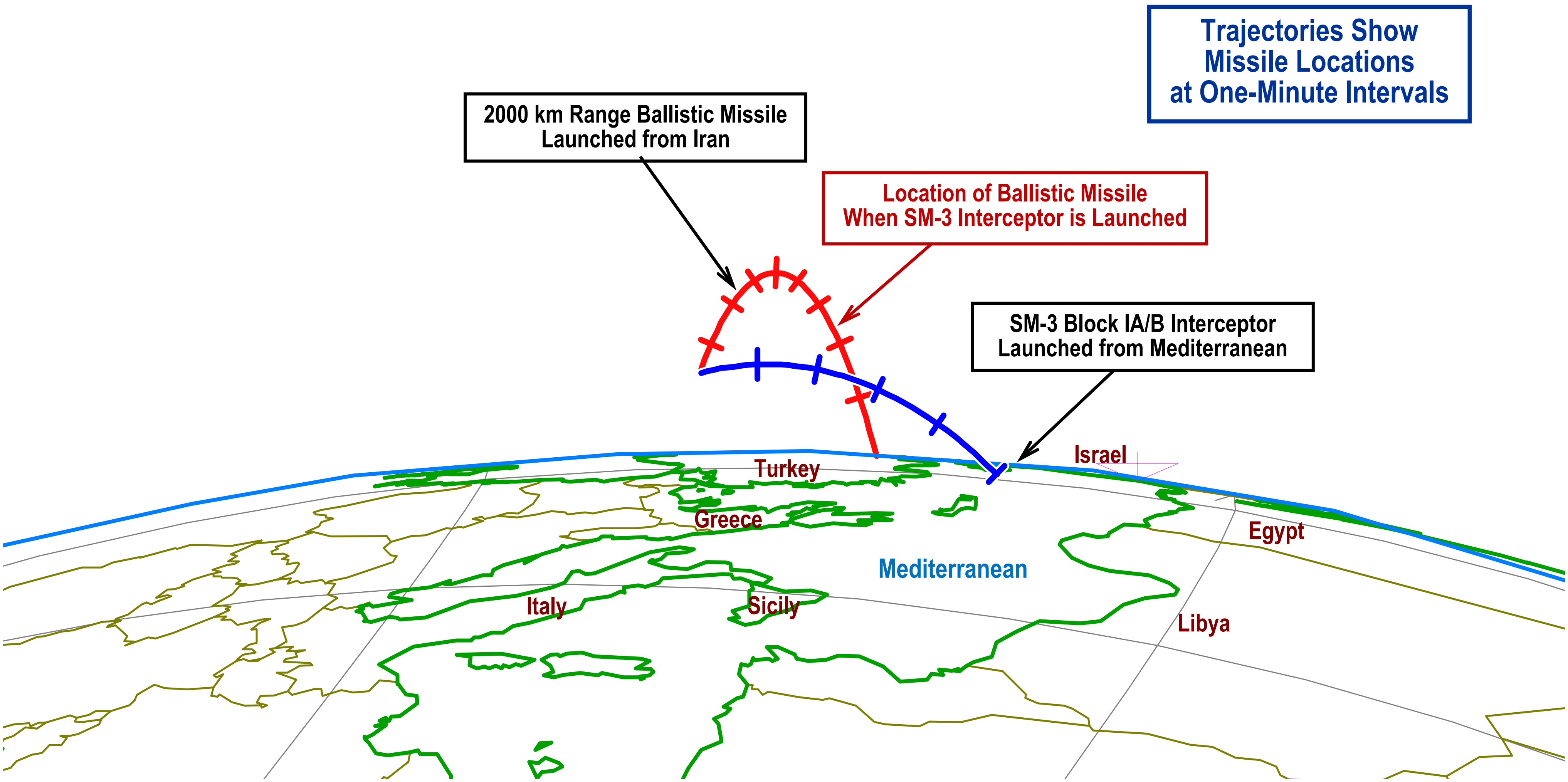


Notional Intercept Trajectory of Standard Missile 3 Block IA/B (SM-3 Block IA/B) Against 2000 km Range Iranian Ballistic Missile

Trajectories Show Missile Locations at One-Minute Intervals



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



What the Failure of the January 31, 2010 FTG-06 Missile Defense Test Shows About the Vulnerability of the X-Band Radars Abilities to Identify Warheads Relative to Decoys

NOTE:
All of the US Missile Defense Systems (GMD and SM-3) Depend on X-Band Radars to Identify Warheads Relative to Decoys

Why Did the FTG-06 Missile Defense Test Fail?

- The solid propellant upper rocket stage, which deployed the warhead, and possibly other objects, exhibited an unexpected phenomenon known as "chuffing."
- When a solid rocket motor burns out, sections of the remaining fuel in the spent rocket stage can spontaneously combust, causing tens or hundreds of mini-explosions per second in the shut down motor.
- This phenomenon can cause chunks of unburned fuel, insulator material, and the like to be expelled from the shut down rocket.
- The chunks of expelled rocket motor pieces have dimensions of less than one inch to 6 to 8 inches or more.
- From the point of view of the motor's mission, to accelerate a payload to a given velocity and altitude, this is an inconsequential phenomenon.

Potential Sources of TBM Natural/Countermeasure Debris

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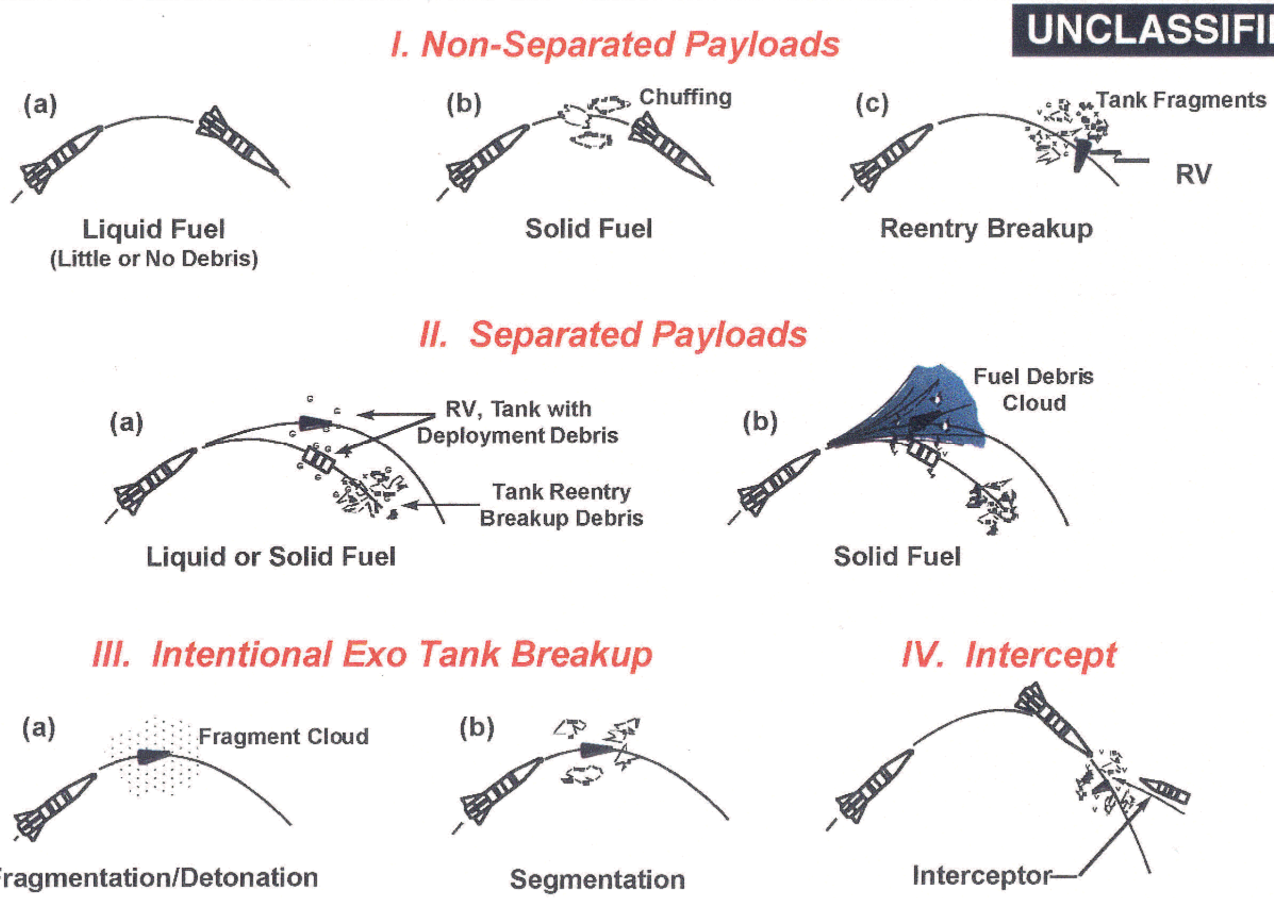

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EDE-GR32-117
12/9/99

Why Did the FTG-06 Missile Defense Test Fail?

- In the FTG-06, the chuffing rocket motor expelled chunks of material that created numerous radar signals comparable in magnitude to the radar signal from a warhead.
- The radar signal therefore contained numerous unexpected targets.
- This "scene data" was passed to computers that were programmed to look for a scene that was expected.
- Since the scene was totally unexpected, the computer analysis failed catastrophically, resulting in a failure to identify the warhead, and possibly even a failure to properly track the entire complex of targets.

Conclusion that follows from the FTG-06 Failure

- This failure reveals the fundamental vulnerability to catastrophic failure of the GMD, SM-3 and all similar such systems.
- An adversary can inadvertently, or by design, change the scene and target appearance using simple measures, like cutting the upper stage into pieces.
- The adversary can also change the appearance of the warhead by covering it with radar absorbing materials, or surrounding it with a balloon, or by yet other methods, with totally devastating consequences for the defense.

Radar Discrimination Capabilities

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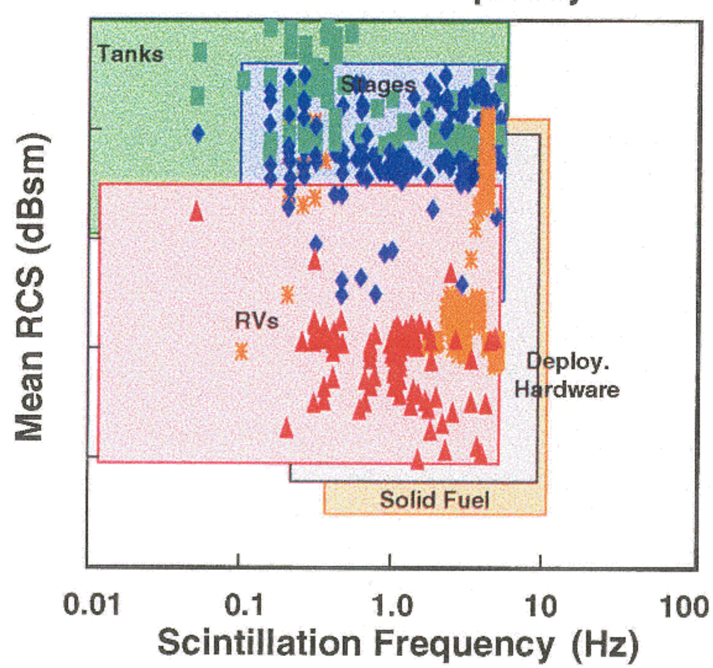
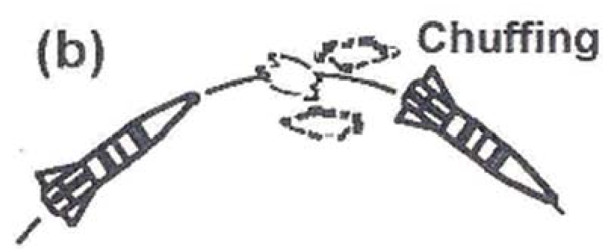
Narrowband

Mean Unresolved RCS vs Scintillation Frequency



Non-Separated Payloads



Solid Fuel

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Missile Defense Agency's Claimed Solution to the Problem

- Measure the "length" of the different targets observed by the X-Band radar.
- Pieces of rocket fuel will have lengths of centimeters and warheads will have lengths of meters.
- All of the short objects can be immediately rejected as not being a warhead
- In radar terminology, this process is called "Bulk Filtering"

Radar Discrimination Capabilities

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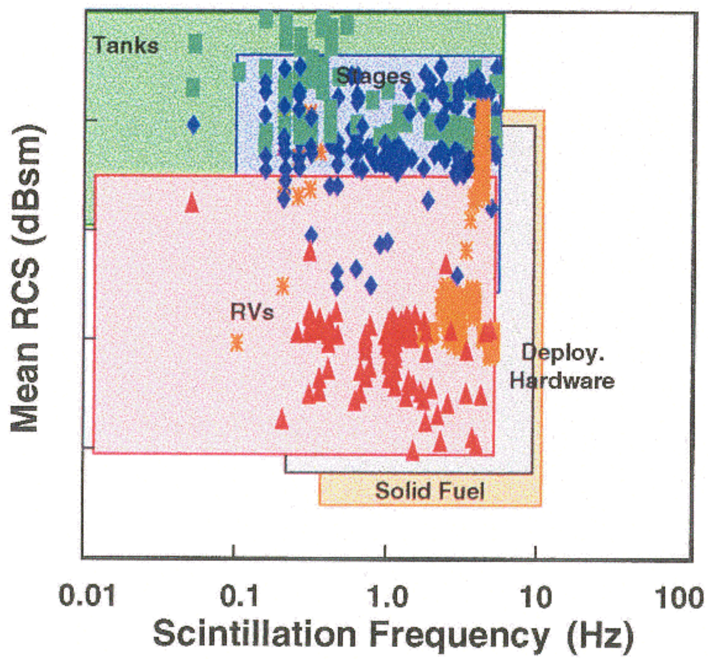
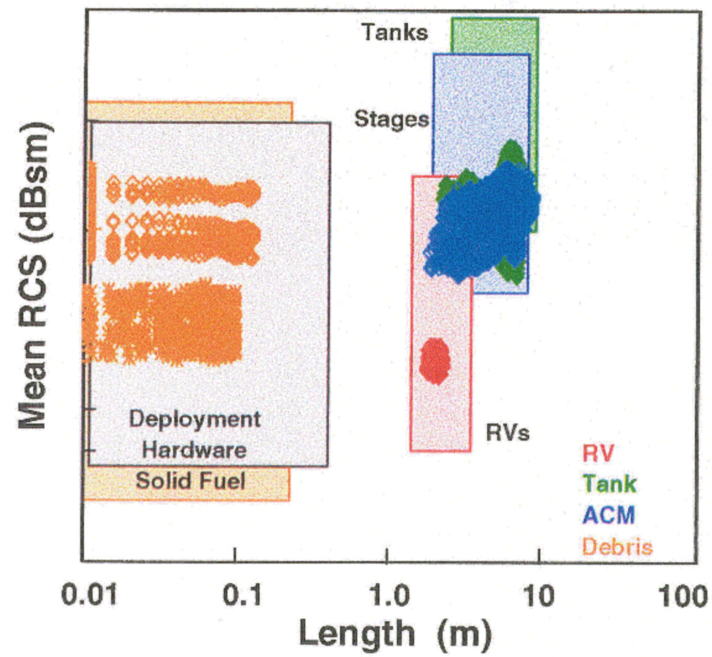
Narrowband

Mean Unresolved RCS vs Scintillation Frequency



Wideband

Mean Unresolved RCS vs Length



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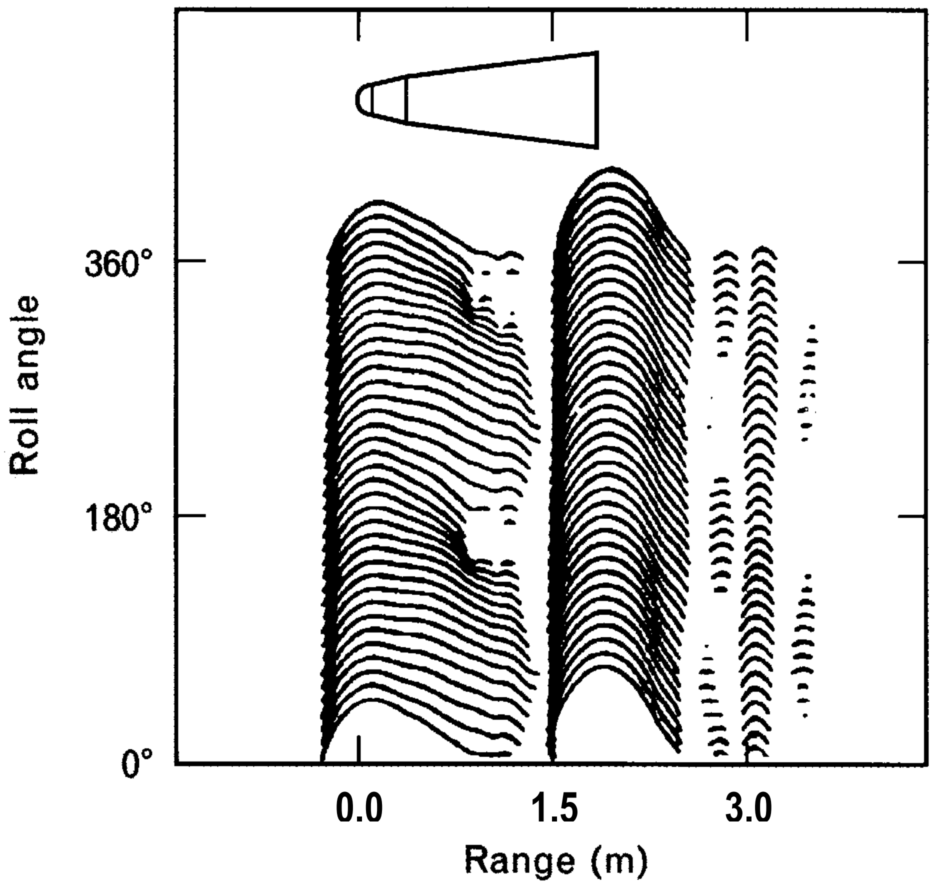
Make it *impossible* to measure the "length" of the warhead!

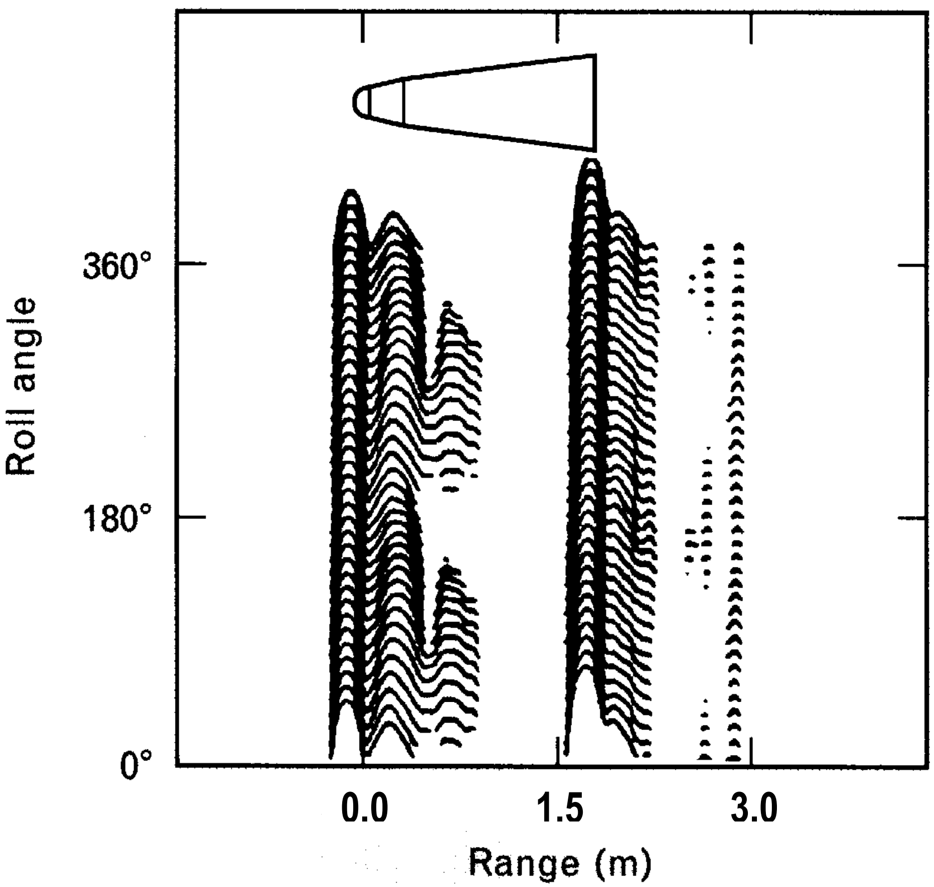
Examples of Radar Signals from Warheads

C-Band (5Ghz) Radar Signal
Against 1.5 Meter Long Warhead

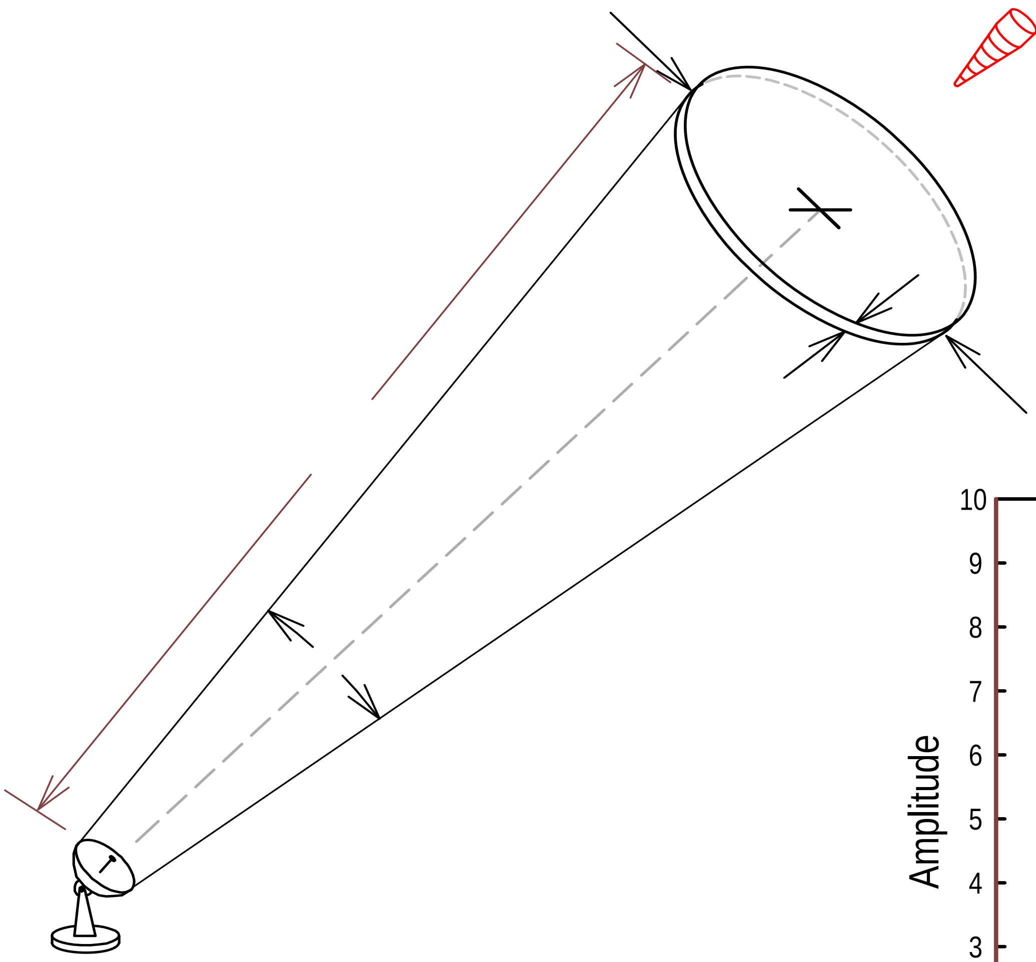


(a)

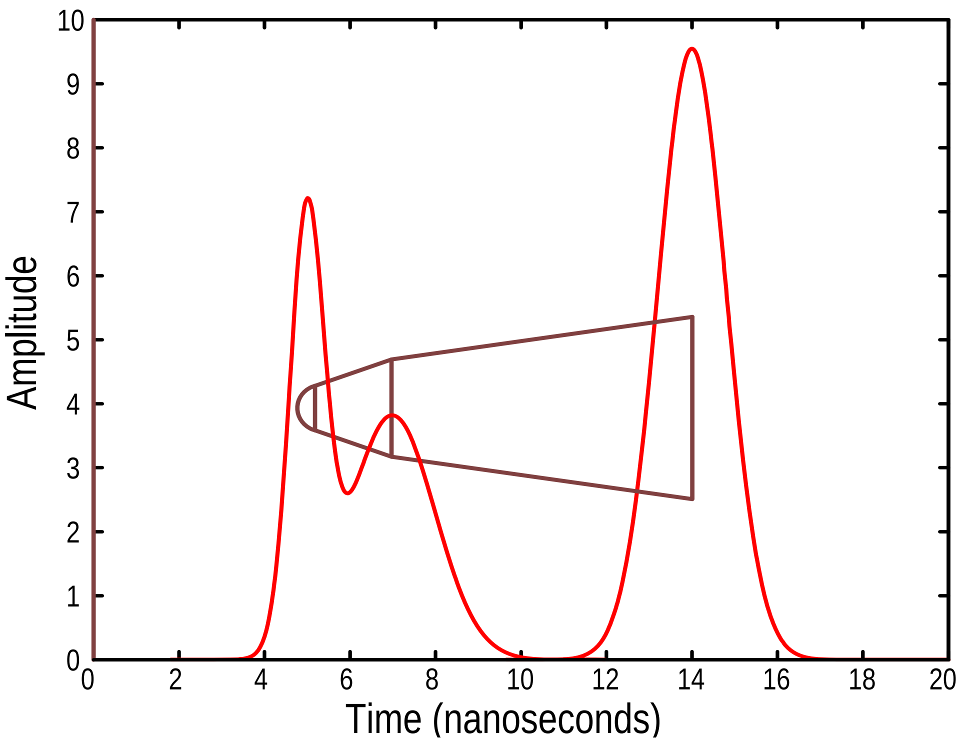
X-Band (10GHz) Radar Signal
Against 1.5 Meter Long Warhead



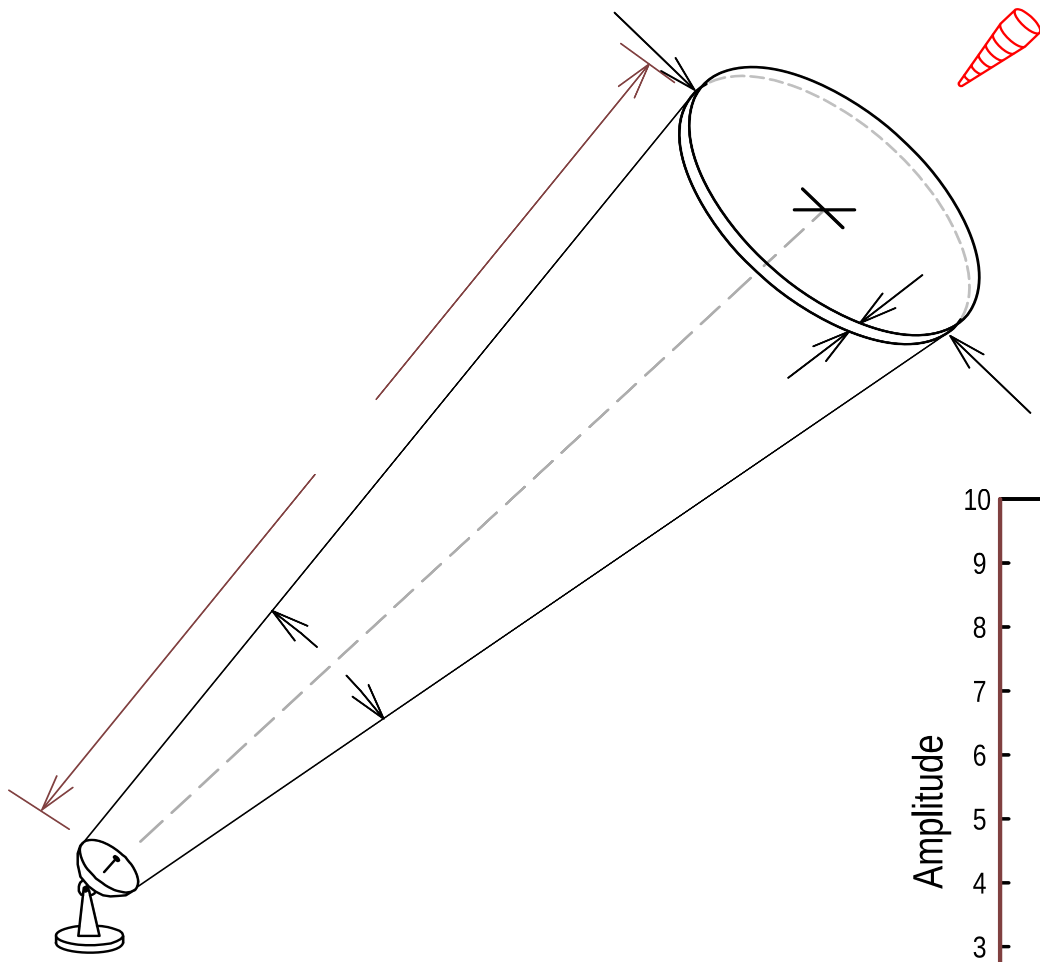
(b)



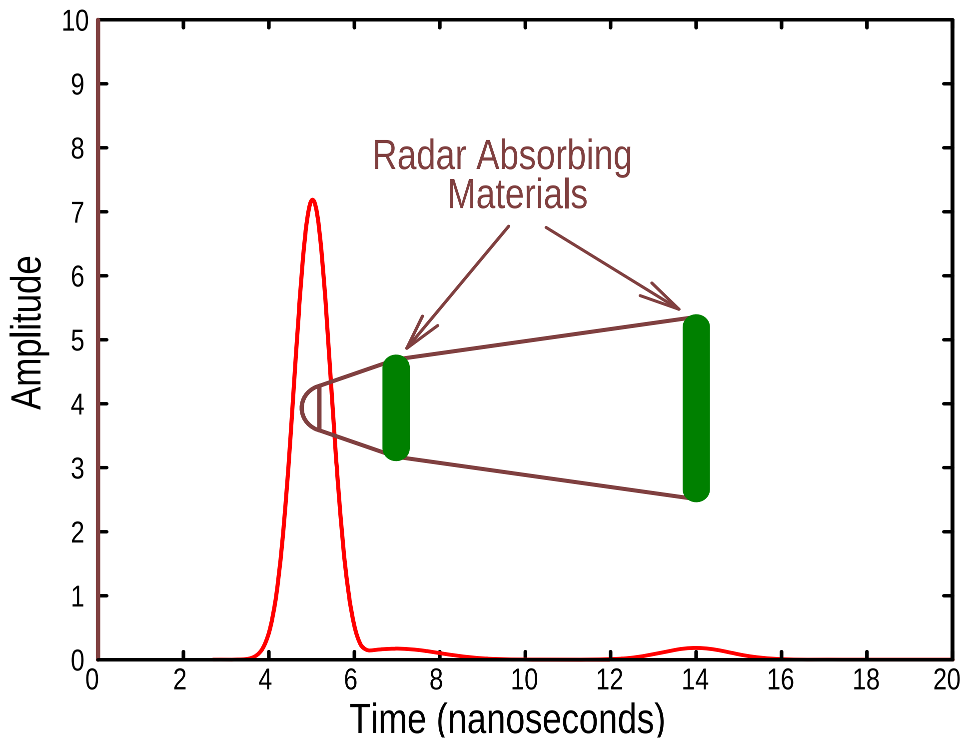
X-Band (10GHz) Radar
Can Measure the Length
of the Warhead



Some Aspects of Radar Measurement Capabilities



X-Band (10GHz) Radar
<u>Cannot</u> Measure the Length of the Warhead



Briefing on Theater Missile Defense Technology Provided to Military Officers Visiting the MIT Security Studies Program in 1999 for Command School Training

MIT Lincoln Laboratory
244 Wood Street
Lexington, MA 02420-9108

Missile Defense Technology

(Can BMD Systems Work?)

Eric D. Evans
MIT Lincoln Laboratory

Mini DTS Course

10 December 1999

EDE-GR32-111 Series
12/9/99

What the Failure of the July 8, 2000 IFT-05 Missile Defense Test Shows About the Vulnerability of the GMD and SM-3 Systems to Infrared Countermeasures

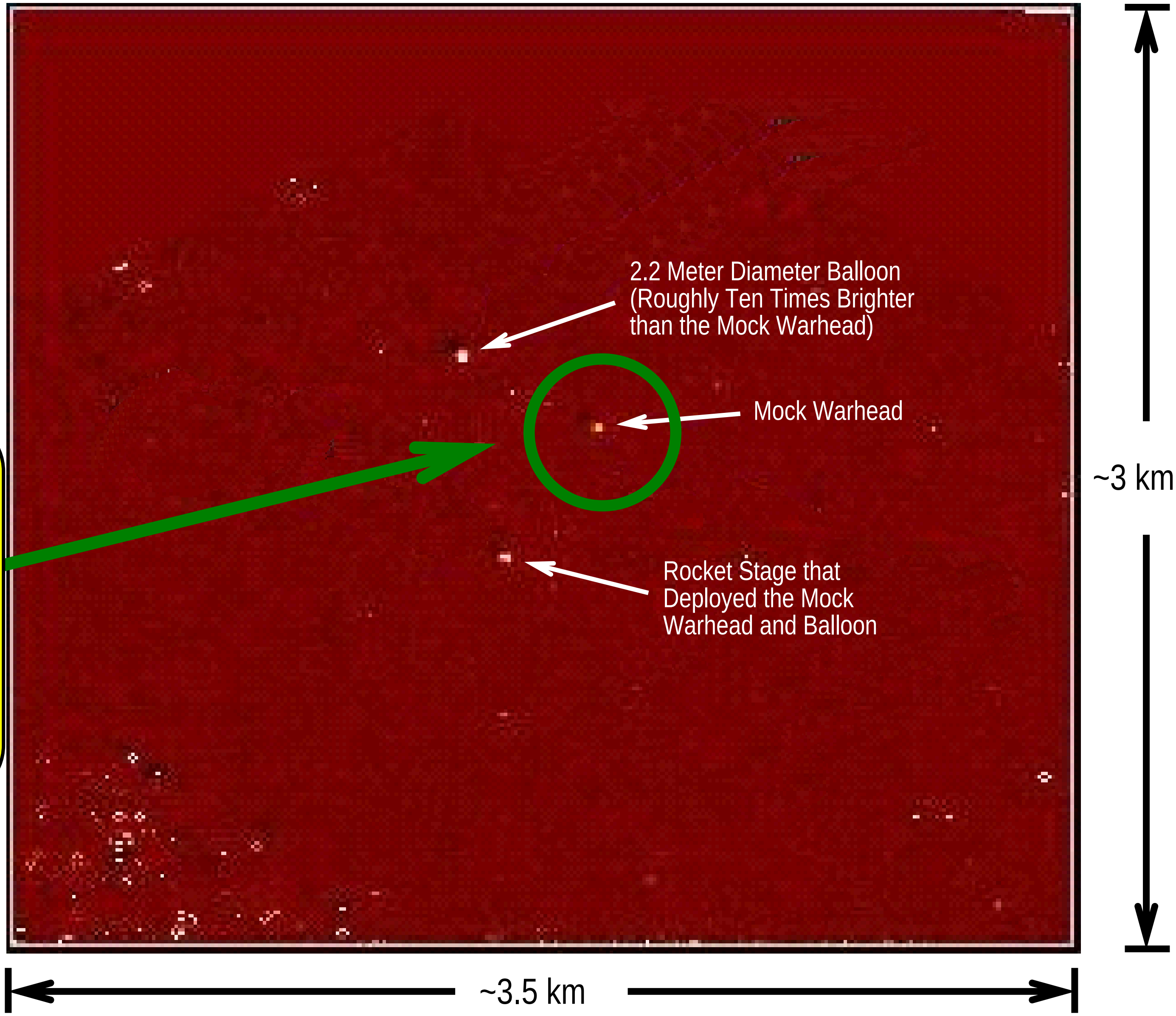
IFT-6 Target Complex as Seen By Distant Approaching EKV

Range of Observed Target Complex ~ 230 – 250 km for FOV 1 – 1.5º

The Inflated Balloon is Heated by the Sun and is 7 to 10 Times Brighter Than the Warhead at Infrared Wavelenghts

The Kill Vehicle Has Been Programmed In Advance to Select the Least Bright Object It Is Supposed to See.

As Long As Nothing Is Done to Cause Another Object to Be the Least Bright Object, the Kill Vehicle Will Correctly Select the Warhead



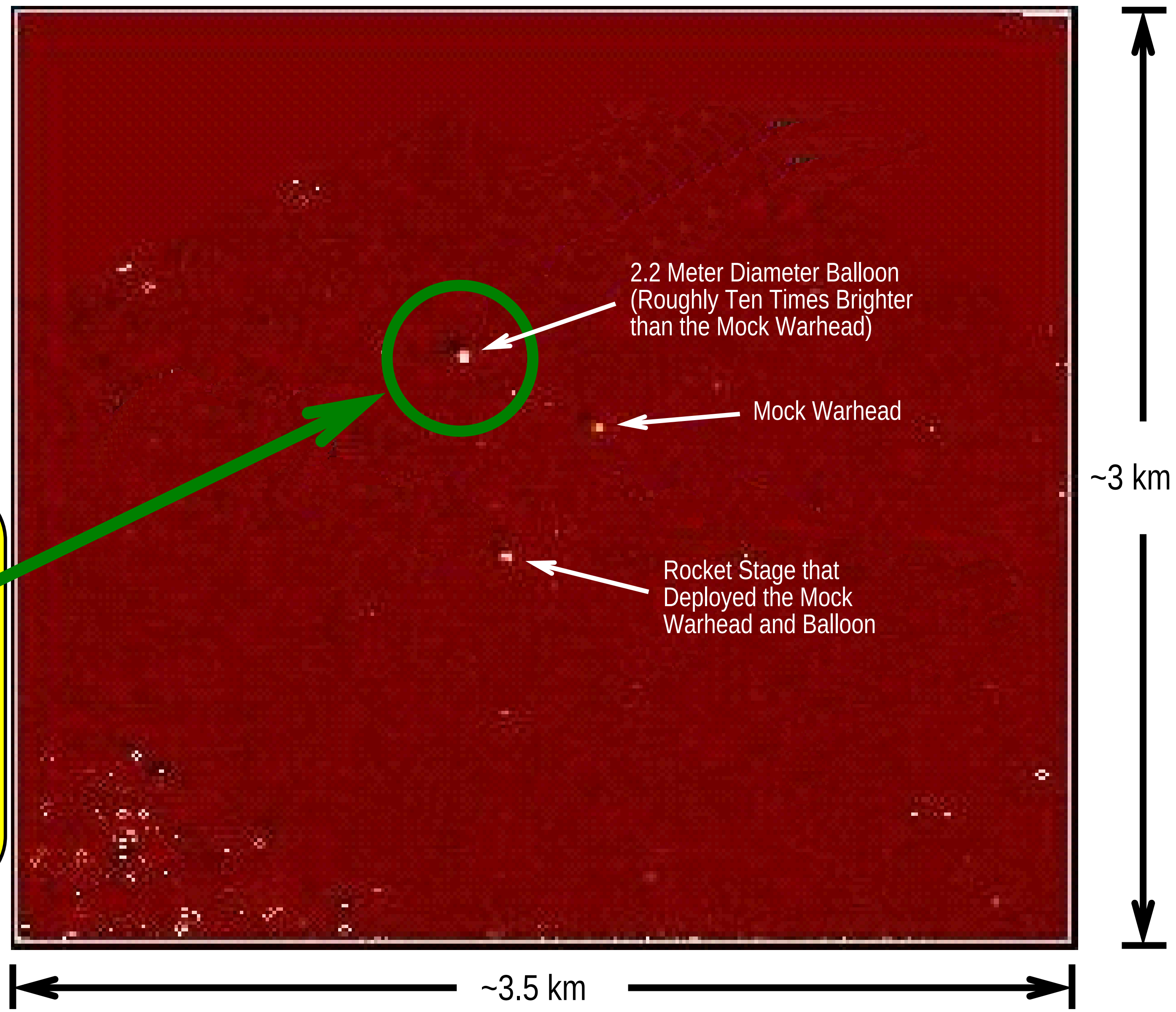
Statement Indicating that Top Management of the Ballistic Missile Defense Organization Knew About the Discrimination Problems Identified in the IFT-1A Experiment

"So the decoy is not going to look exactly like what we expected. It presents a problem for the system that we didn't expect,"

Statement of
Lieutenant General Ronald Kadish,
Director of the Ballistic Missile Defense Organization,
while being filmed by 60 Minutes II after learning that
the 2.2 meter balloon misdeployed (did not inflate properly)
during the IFT-5 experiment

IFT-6 Target Complex as Seen By Distant Approaching EKV

Range of Observed Target Complex ~ 230 – 250 km for FOV 1 – 1.5º

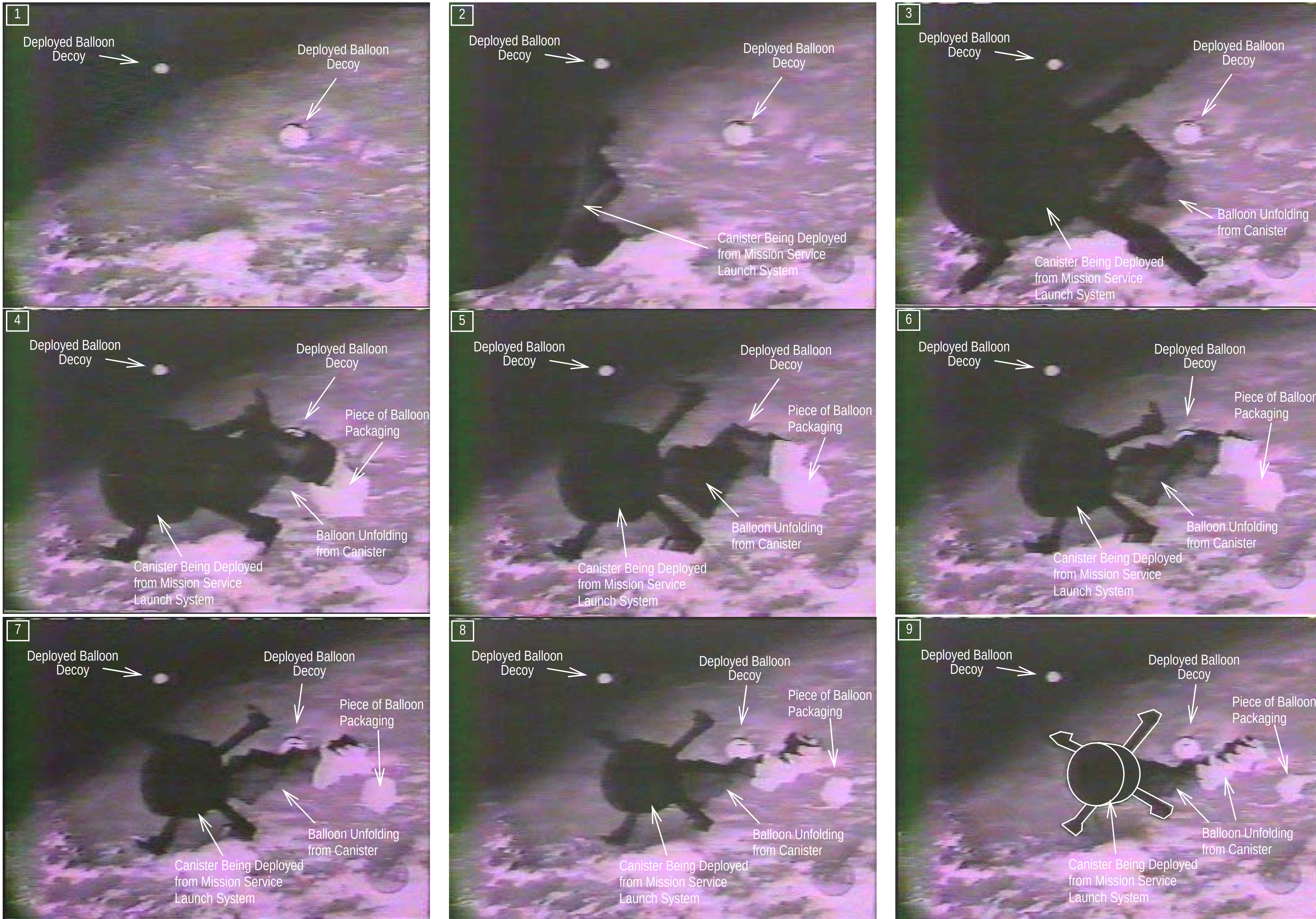


In The IFT-5, The Balloon Failed to Inflate, So Only the Canister, Instead of the Hot Inflated Balloon, Would Have Been Observed By the Kill Vehicle.

Since the Cannister Has a very Small Signal in the Infrared, It Is Now the Least Bright Object Observed by the Kill Vehicle

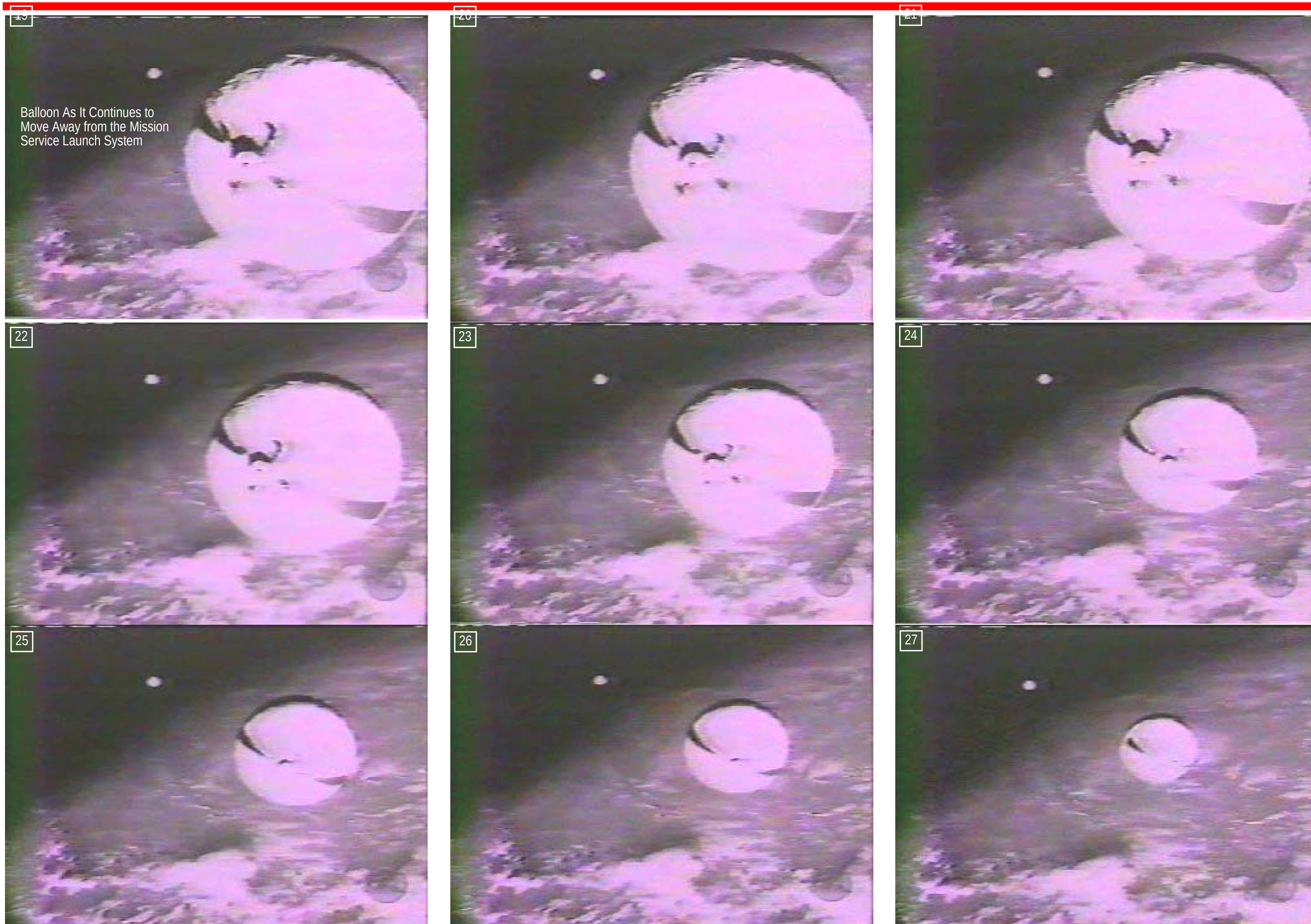
Hence, The Kill Vehicle Would Now Select the Cannister as the Warhead

Sequence of Events During Deployment of a Space-Balloon Decoy (1 of 3)

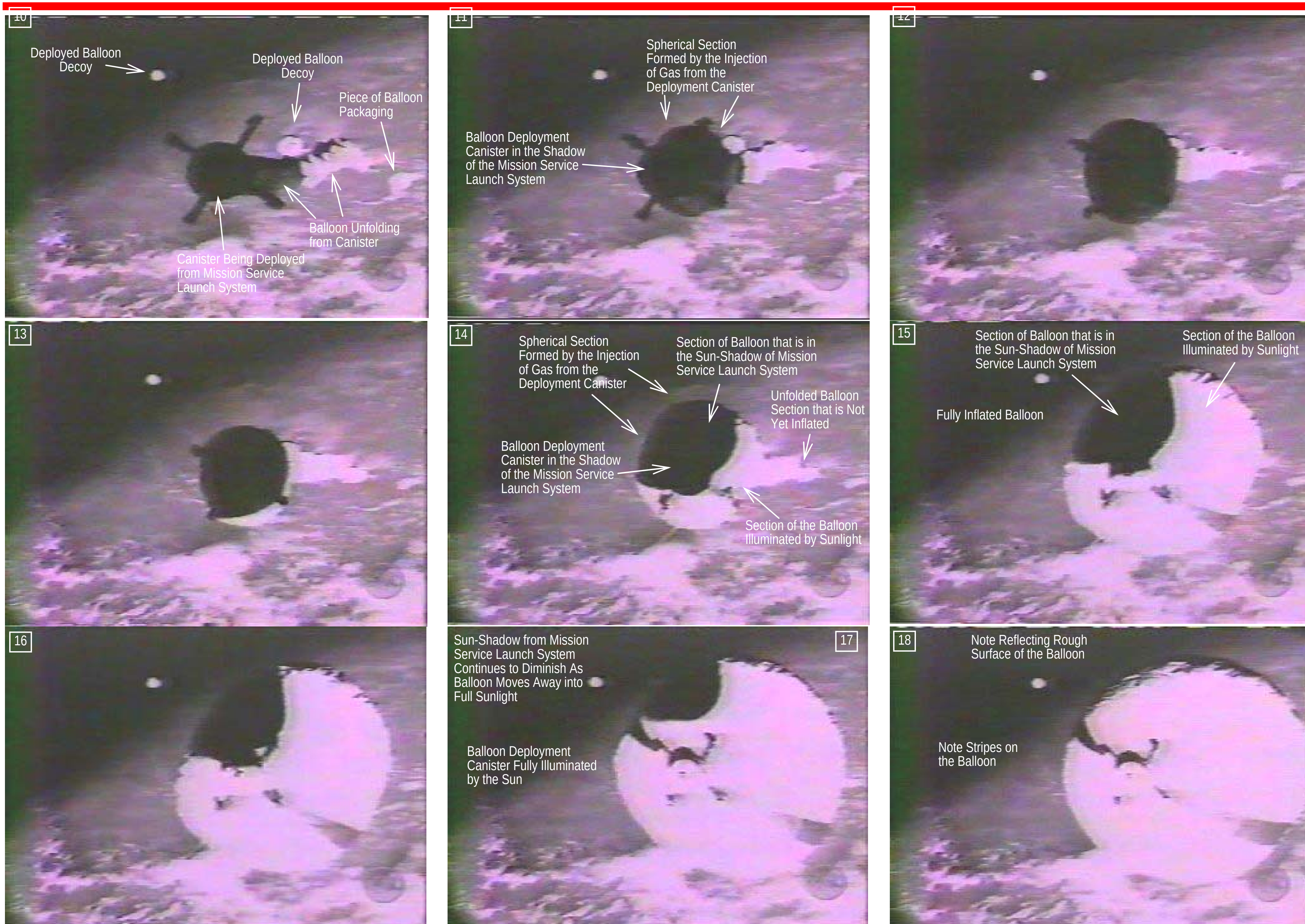


Sequence of Events During Deployment of a Space-Balloon Decoy (2 of 3)

Sequence of Events During Deployment of a Space-Balloon Decoy (3 of 3)



Sequence of Events During Deployment of a Space-Balloon Decoy (2A of 3)



TMD Countermeasure Concepts

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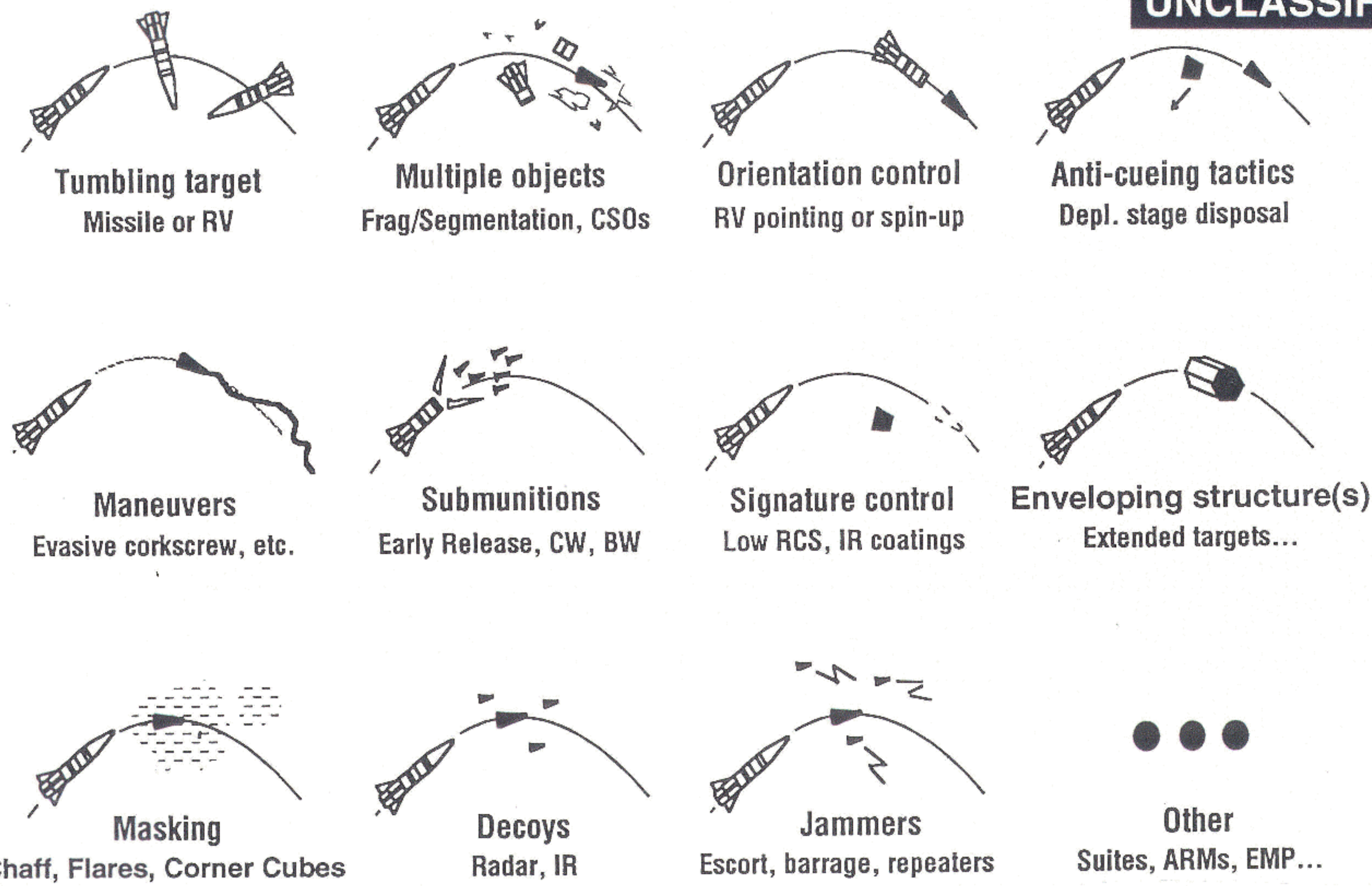

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IR Seeker Discrimination Capabilities

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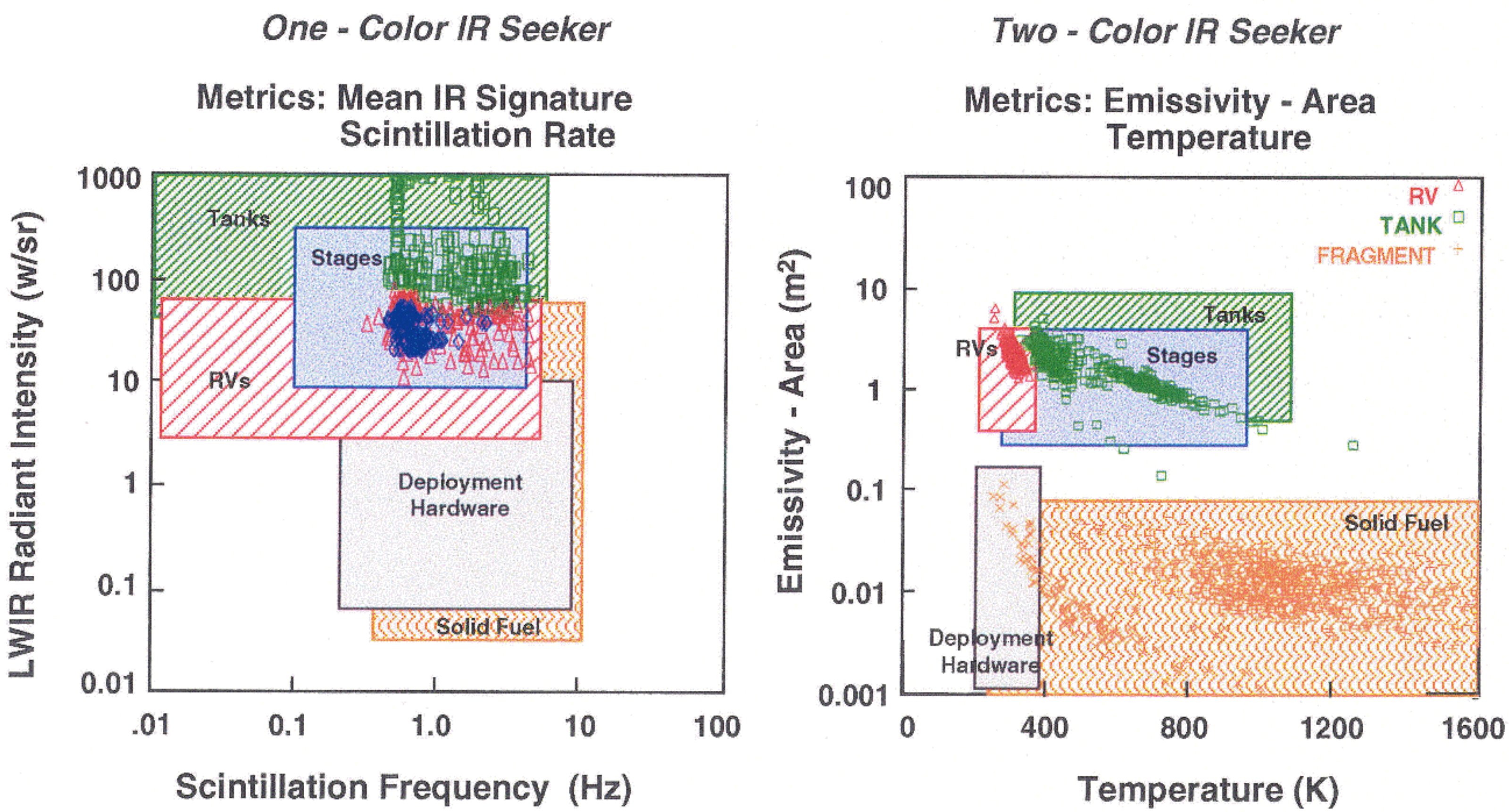

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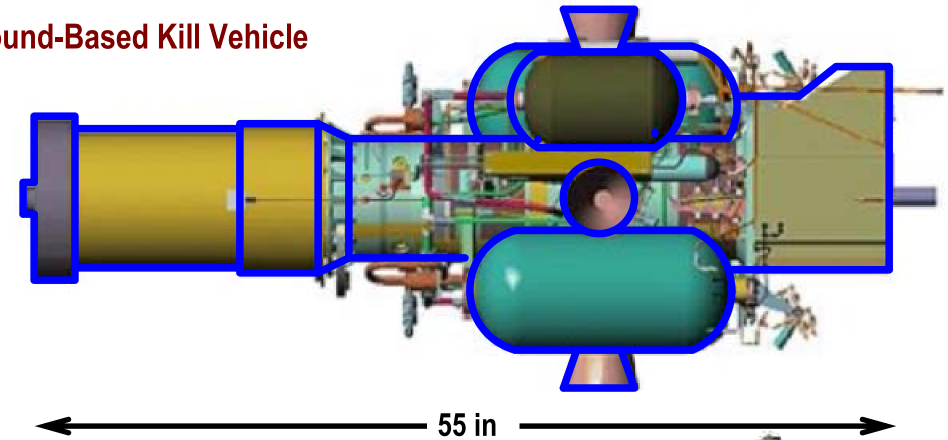
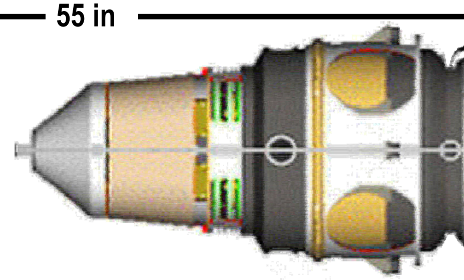
All the Interceptors in the GMD and PAA Systems Home on Targets Using Infrared Telescopes

The Same Basic Physics Governs the Homing of All the Kill Vehicles

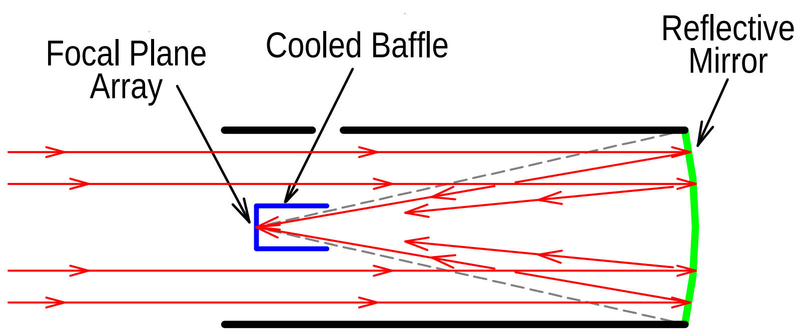
Ground-Based Kill Vehicle



Navy SM-3 Block IA Kill Vehicle



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

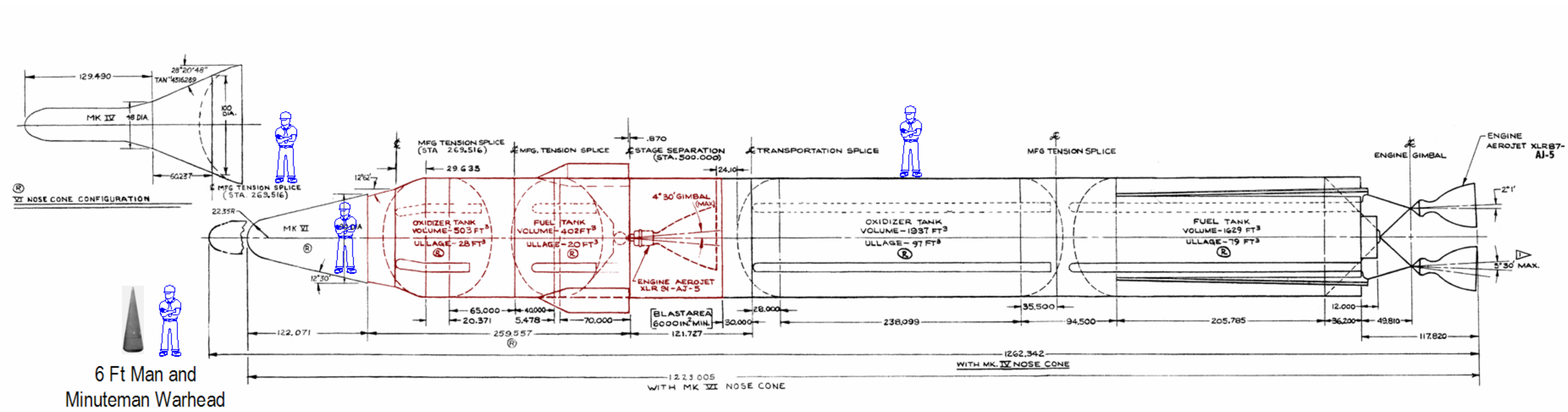
What the Infrared Sensor on the Homing Interceptor Might Actually See!

EXTREMELY IMPORTANT INFORMATION NEEDED BY THE INTERCEPTOR TO IDENTIFY WHICH OBJECT IS THE WARHEAD

- The interceptor must know how the warhead looks relative to other objects in its field of view
- This information is essential for matching what it sees to what it expects to see.
- If the warhead appears different from what is expected, the interceptor will not be able to identify it relative to other objects.
- If the other objects match, or nearly match, the expected appearance of the warhead, then the interceptor will not be able to identify the warhead relative to the other objects.
- If all the objects look different from what is expected, and all the objects look different from each other, then the interceptor will not be able to identify the warhead relative to the other objects.
- HENCE, all an adversary needs to do to defeat the interceptor is to alter the appearance of the warhead and surround it with other unidentifiable objects

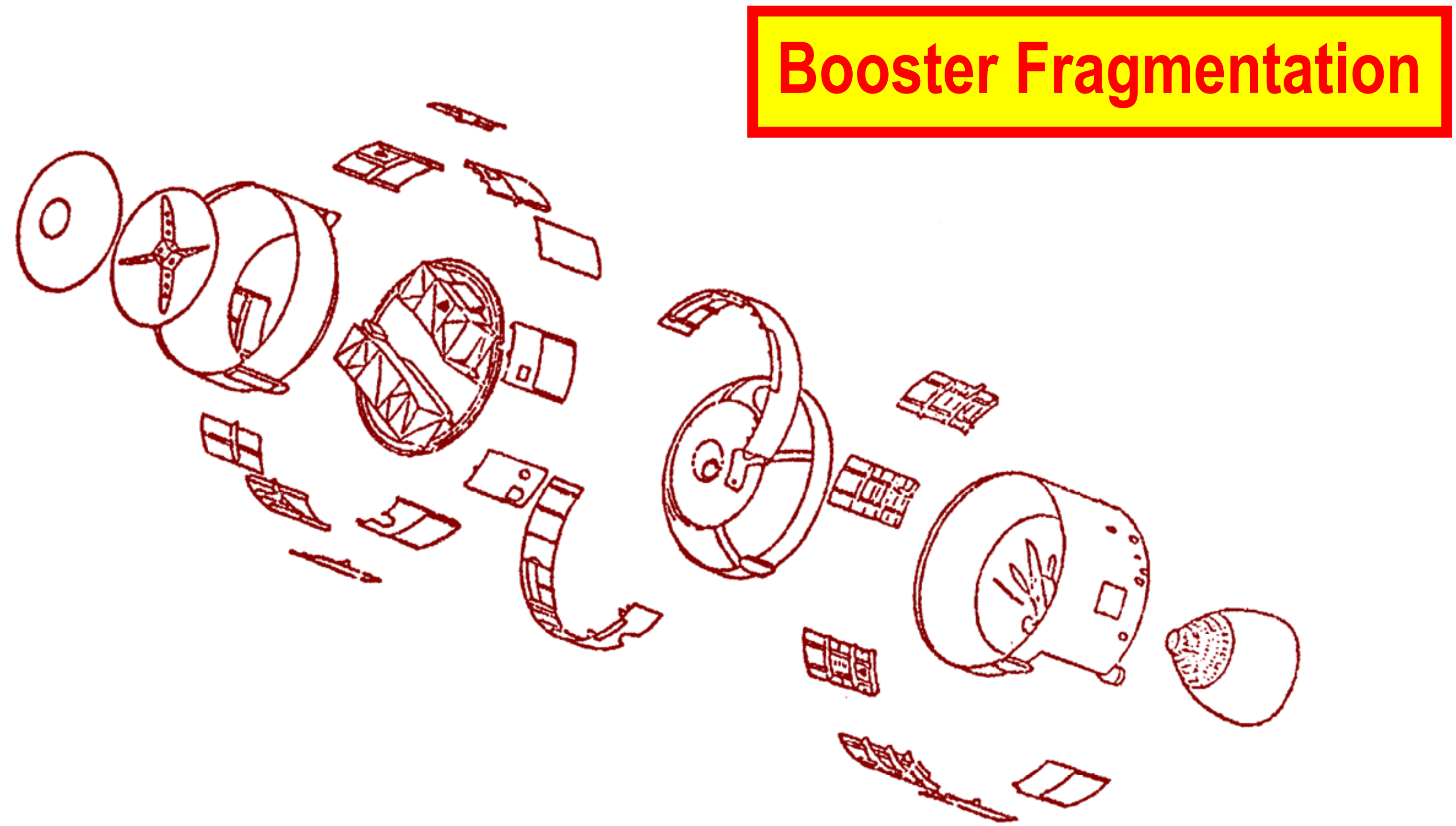
False Targets Cloud Created in Army Ballistic Missile Development Agency Test Using a Titan II ICBM on January 10, 1975, Signature of Fragmented Tanks (SOFT)

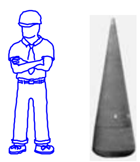
Booster Fragmentation



Titan II outboard configuration.
6 July 1960. The Martin Co., Denver.

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)





6 Ft Man and
Minuteman Warhead

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

False Targets Cloud Created by a "Simple" One-Stage Ballistic Missile

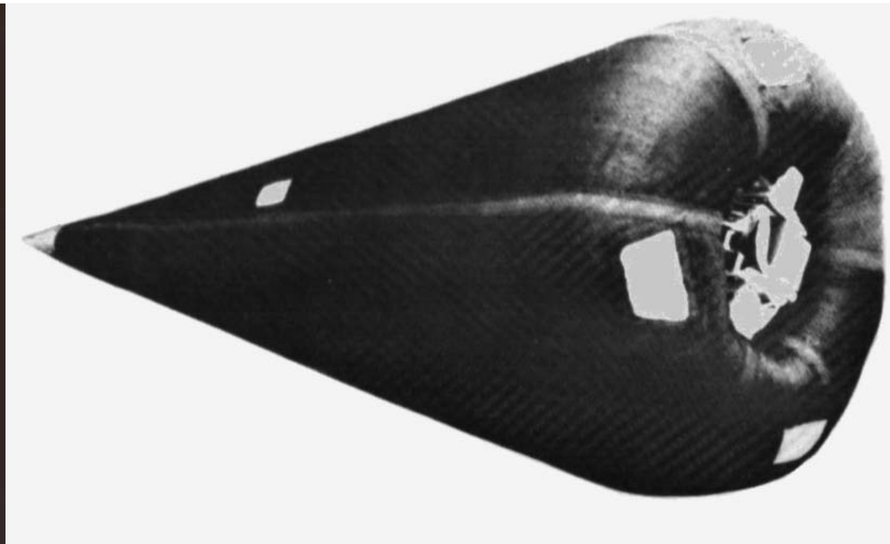
Figure 3: The images below show how North Korea or Iran could defeat the SM-3 or GMD homing systems by simply using technology they already have demonstrated in flight tests. The technology used to separate rocket stages is exactly the same as that needed to cut a rocket or rocket stage into separate fragments. It would then not be possible for the sensor on the homing interceptor to tell which end of a fragment has the warhead, or which fragment has the warhead. The homing process could be yet further degraded by deploying balloons that would look like warheads to the distant Kill Vehicle. There is no publicly available information that indicates this last countermeasure technology has yet been demonstrated by North Korea or Iran.

Balloons that Could Be Used to Make the Warhead Look Different from What is Expected

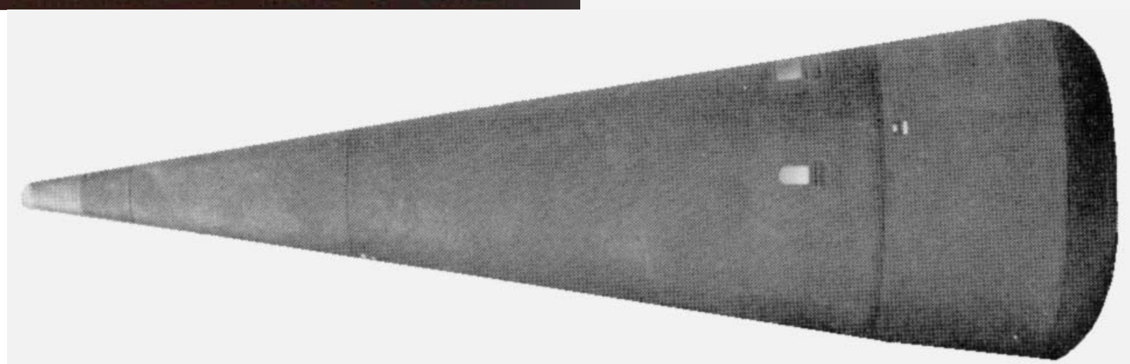
These Could Be Used as Decoys
or to Surround Warheads Disguising Them as Balloons

Balloons that Have Been Flown in Space

The Kill Vehicle Must Determine Which of These Are Warheads and Which are Decoys from 50 (SM-3) to Several Hundred (GMD) Kilometers Range!



The IEO, an inflatable erectable decoy for Minuteman
(L'Garde, Inc. Photo)



Mk 12A Minuteman III Reentry Vehicle

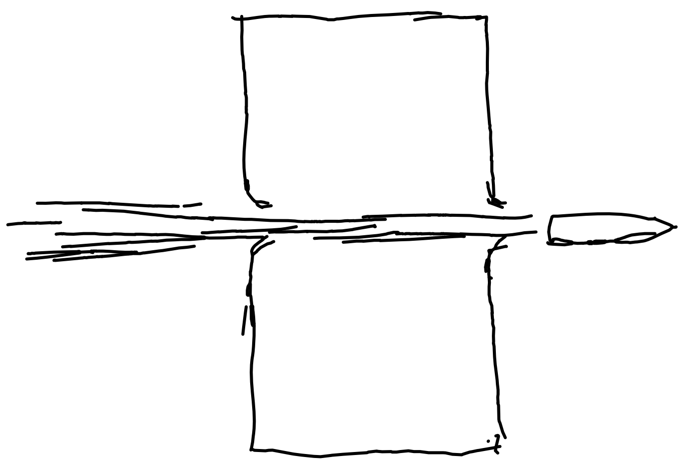
Most Recent MDA Misrepresentation

The SM-3 is a "Ballistic Missile Defense System [that] *has demonstrated 20 hit-to-kill intercepts* [italics added] out of 24 at sea firing attempts." **

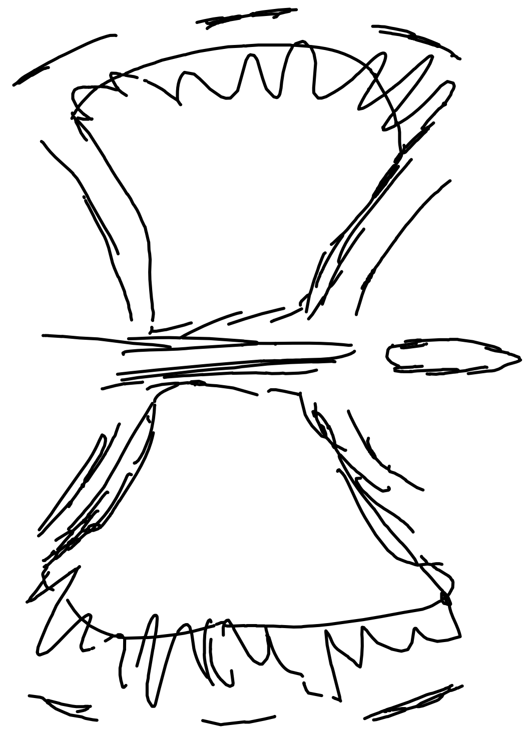
** MDA Fact Sheet, November 24, 2009 09-MDA-5060

Other Problems with the Homing Process
The Kill Vehicle Must Hit the Warhead to Destroy It

Bullet Passes Through an Empty Container

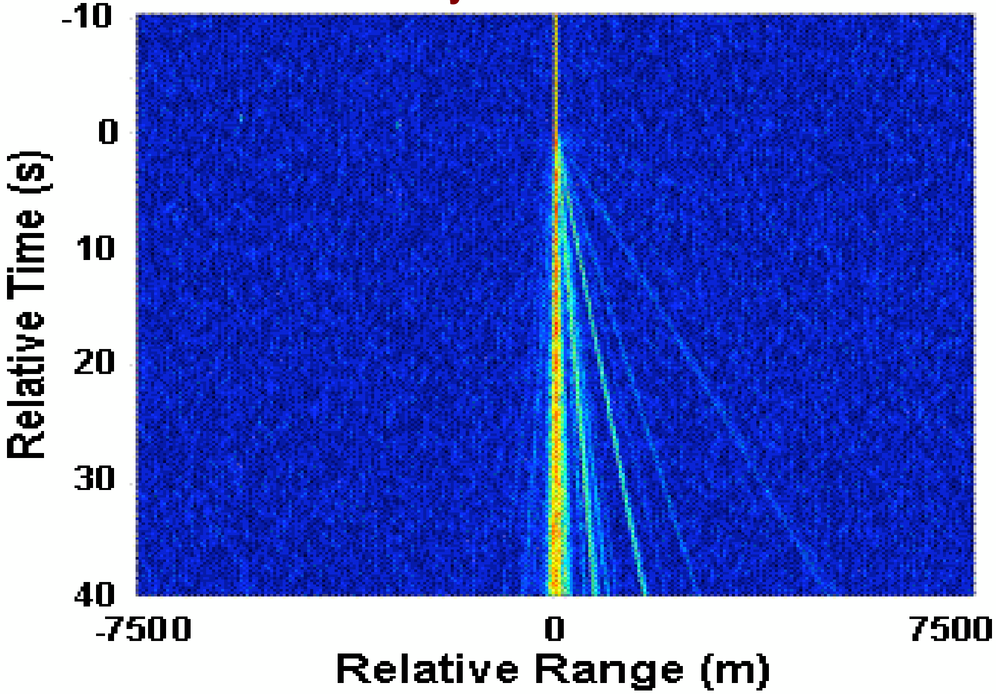


Bullet Creates A Shock as It Passes Through the Material in a Filled Container

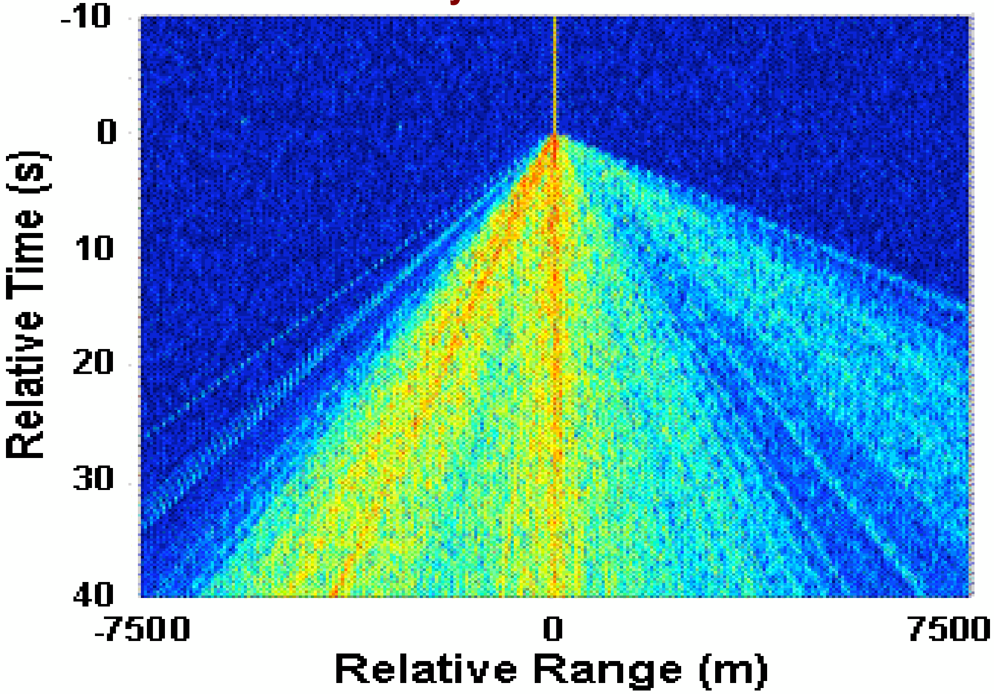


Predictions Made by the Missile Defense Agency for a Hit on US Satellite 193 that Misses and Hits a Full Hydrazine Tank in the Satellite

Predicted Infrared Image for a Kill Vehicle Hit that ***Misses*** the Satellite's Hydrazine Tank

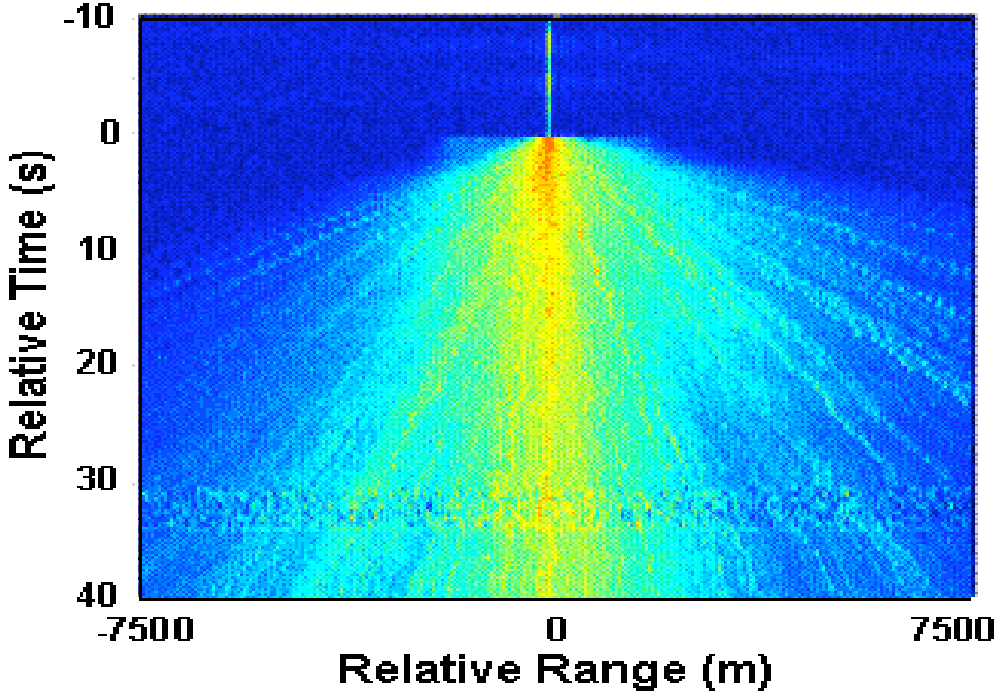


Predicted Infrared Image for a Kill Vehicle Hit that ***Strikes*** the Satellite's Hydrazine Tank



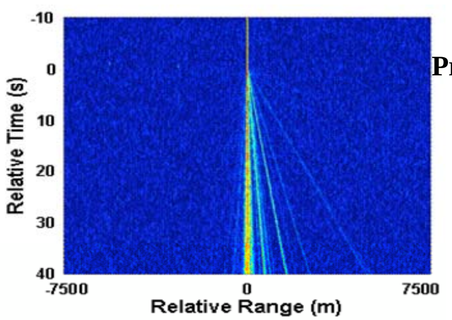
Actual Infrared Image of the Kill Vehicle Hit on US Satellite 193

Actual Infrared Image for
the Kill Vehicle Hit that
Struck the Satellite's
Hydrazine Tank

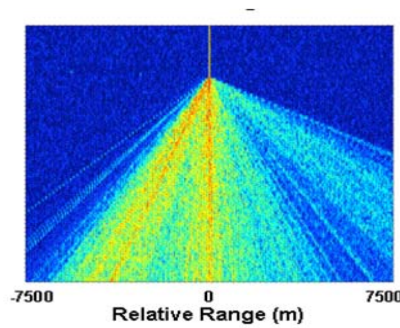


Real World Event
Satellite Intercept – 20 FEB 08

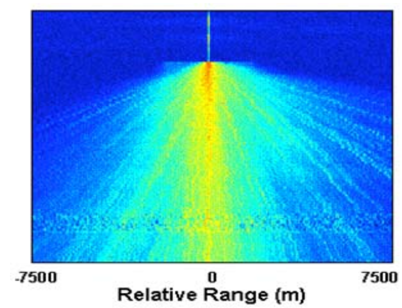
- **Objective**
  - **Protect against potential loss of life due to uncontrolled reentry of ~ 5,400 lb (2,450 kg) satellite**
  - **Destroy ~ 1,000 lbs (450 kg) hydrazine fuel tank**
- **Preparation**
  - **3 Standard Missiles-3 (SM-3), radars and system software extensively modified to enable intercept**
- **Engagement**
  - **1 SM-3 launched by USS Lake Erie northwest of Hawaii**
  - **Successful intercept occurred ~153 miles (250 km) above the earth verified by 3 different phenomenlogies**



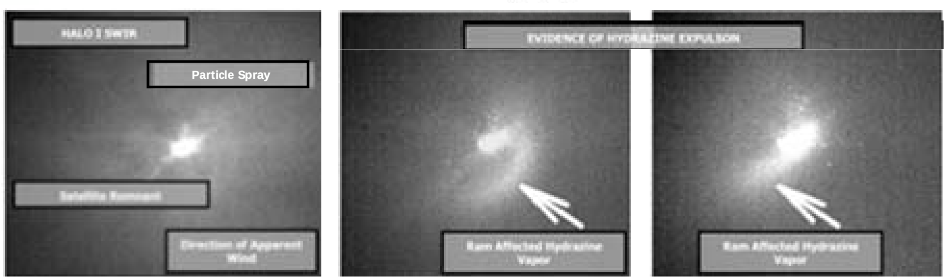
Predicted Radar Image Non-Lethal Intercept



Predicted Radar Image Of Lethal Intercept



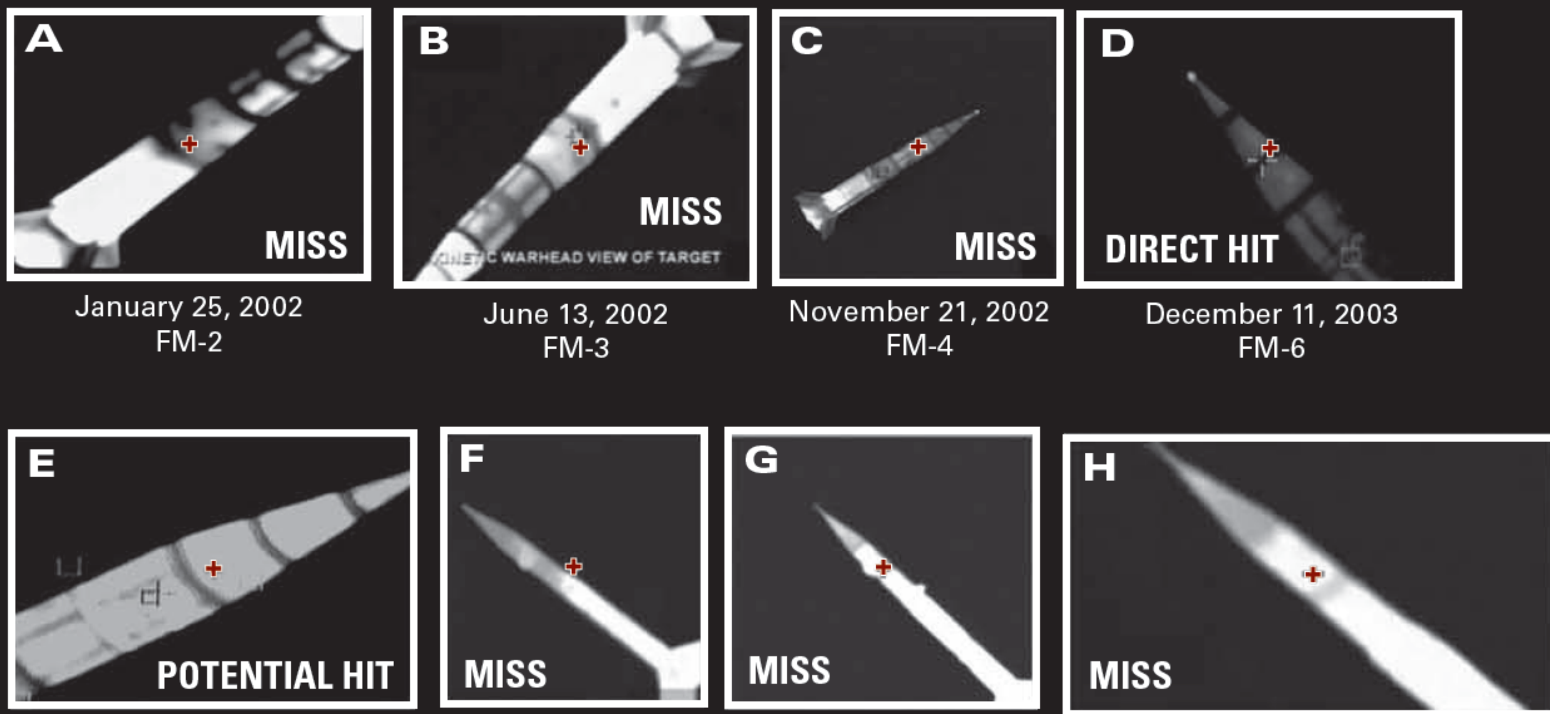
Screen Capture Of Actual Intercept



- **Post Intercept**
  - **Analysis (as of 25 FEB 08) shows vast majority of intercept debris has already burned up upon reentering the Earth's atmosphere, or will do so shortly – there have been no reports of debris landing on earth**
  - **The 3 Aegis ships have already been reconfigured to support BMD mission**

Results of SM-3 Flight Tests Derived from MDA's Published Video Data

Results of U.S. Standard Missile 3 Flight Tests



A: January 25, 2002 FM-2

B: June 13, 2002 FM-3

C: November 21, 2002 FM-4

D: December 11, 2003 FM-6

E: February 24, 2005 FM-7

F: April 26, 2007 FTM-11

G: November 6, 2007 Target 1, FTM-13

H: November 6, 2007 Target 2, FTM-13

I: November 1, 2008 Pacific Blitz

J: July 30, 2009 FTM-17

These images show the estimated hit points in 10 SM-3 flight tests that the Pentagon's Missile Defense Agency (MDA) reported as successful hits. In eight to nine of these successful flight tests, the warhead, which must be struck directly by the kill vehicle to guarantee its destruction, was not hit. The warhead is the cone-shaped section on the front end of the rocket. (The images are from MDA video; the authors of this article added the red crosses indicating the estimated hit points and the text characterizing the test as a "miss," "potential hit," or "direct hit.")

Most Recent Concrete Example

Misrepresenting the SM-3 system test results to the press, and almost certainly to the President and the Secretary of Defense.

"There were subsequent views not publicly released to preclude potential adversaries from seeing exactly where the target was struck, so the authors were basing their assessment on incomplete information," Rick Lehner, a spokesman for the agency, told AOL News.

May 15, 2010, *MIT Gadflies Take Aim at Obama Missile Defense Plan*, **Sharon Weinberger,**

http://www.aolnews.com/nation/article/mit-gadflies-take-aim-at-obama-missile-defenseplan/19477831

Incidents of Repetitive Misrepresentations by the Missile Defense Agency – (FM-6)

"There were subsequent views not publicly released to preclude potential adversaries from seeing exactly where the target was struck, so the authors were basing their assessment on incomplete information," Rick Lehner, a spokesman for the agency, told AOL News.

HIT ON WARHEAD IN THE FM-6 TEST ON DECEMBER 11, 2003 – ABSOLUTELY NO EVIDENCE OF SIGNIFICANT LATERAL ACCELERATION DURING HOMING

Credible Evidence of Repetitive Lying by the Missile Defense Agency – (FM-6)

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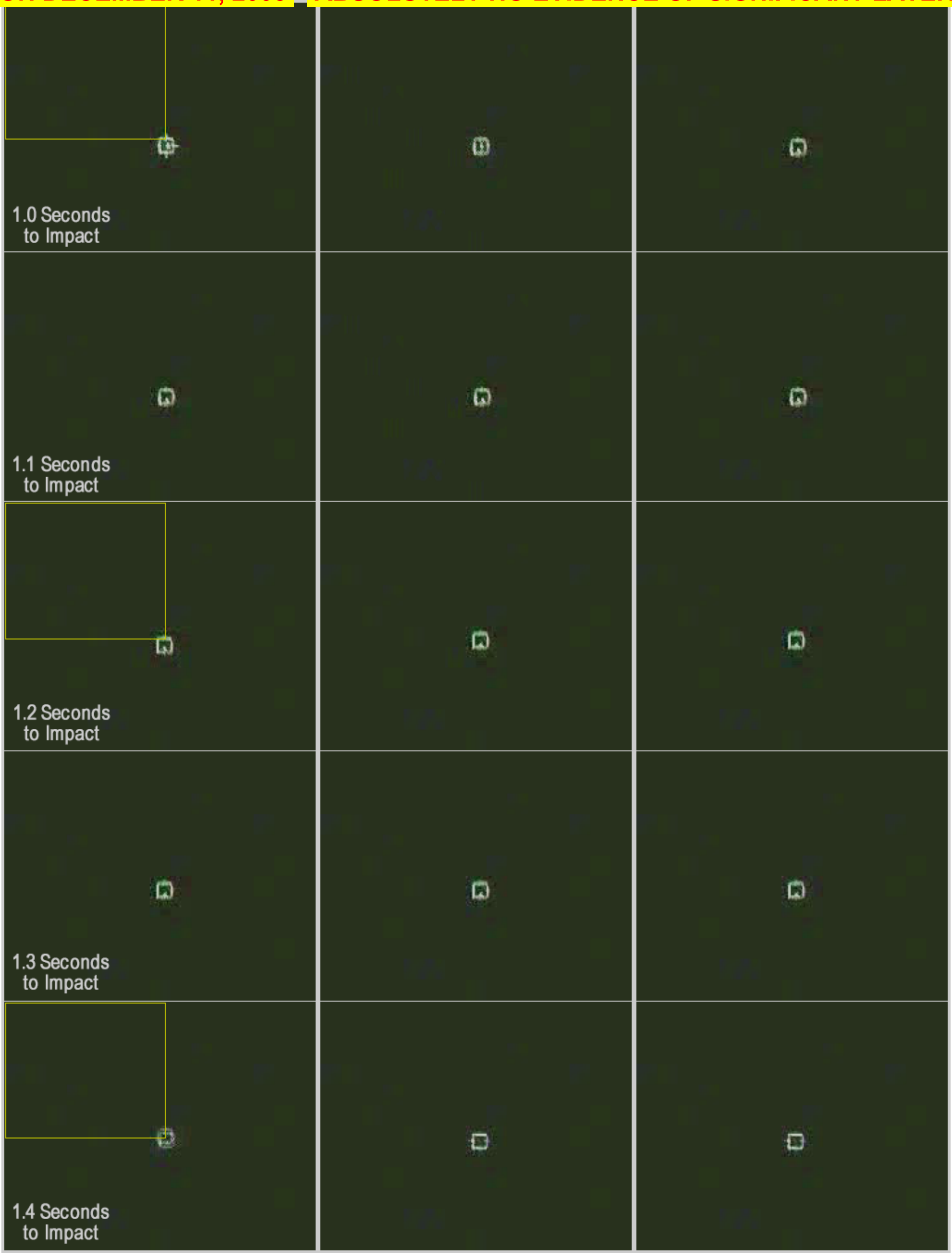
HIT ON WARHEAD IN THE FM-6 TEST ON DECEMBER 11, 2003 – ABSOLUTELY NO EVIDENCE OF SIGNIFICANT LATERAL ACCELERATION DURING HOMING



Credible Evidence of Repetitive Lying by the Missile Defense Agency – (FTM-11)

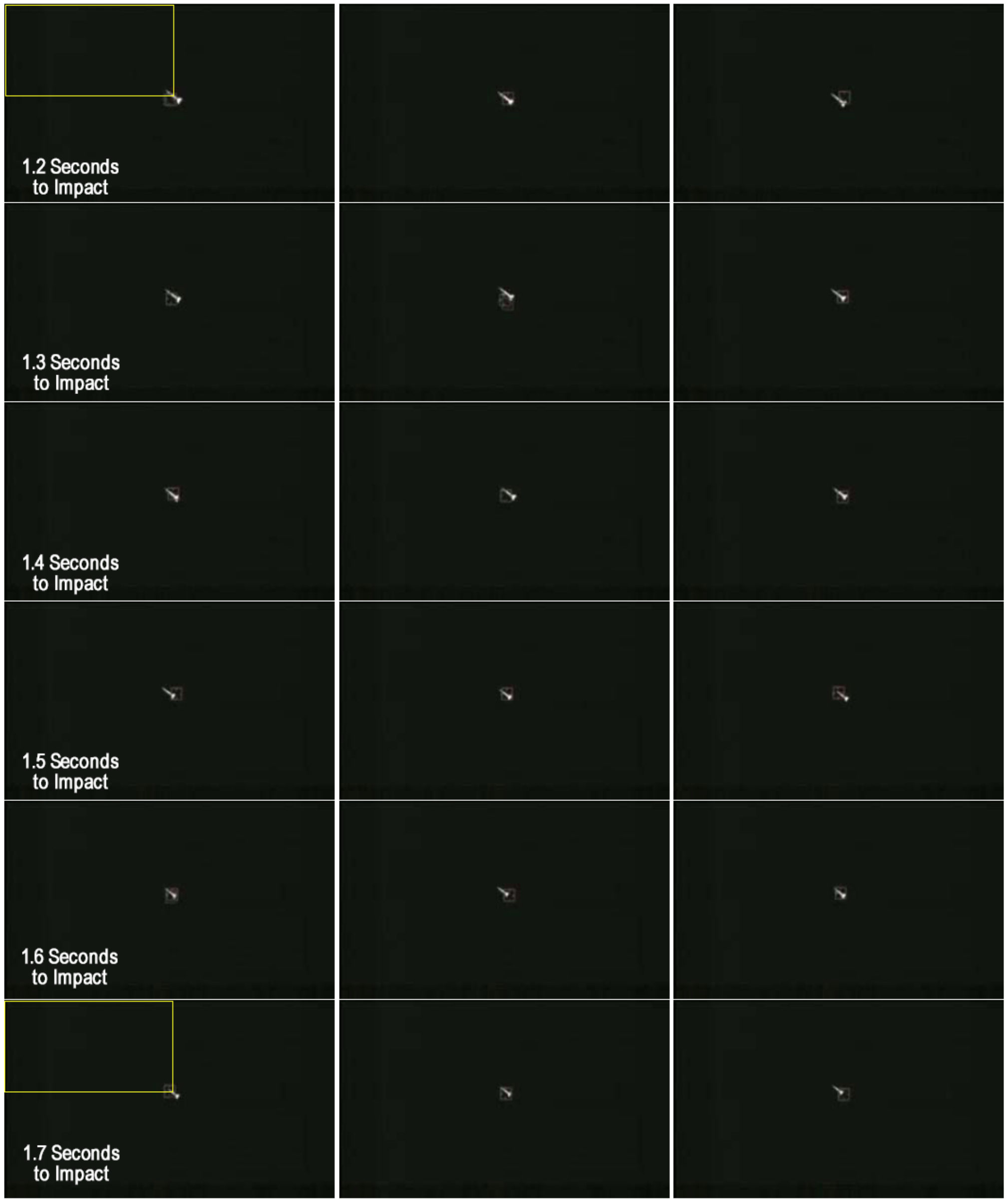
"There were subsequent views not publicly released to preclude potential adversaries from seeing exactly where the target was struck, so the authors were basing their assessment on incomplete information," Rick Lehner, a spokesman for the agency, told AOL News.

WARHEAD MISS IN THE FTM-11 TEST ON DECEMBER 7, 2006 – ABSOLUTELY NO EVIDENCE OF SIGNIFICANT LATERAL ACCELERATION DURING HOMING

Credible Evidence of Repetitive Lying by the Missile Defense Agency – (FTM-11)

"There were subsequent views not publicly released to preclude potential adversaries from seeing exactly where the target was struck, so the authors were basing their assessment on incomplete information," Rick Lehner, a spokesman for the agency, told AOL News.

WARHEAD MISS IN THE FTM-11 TEST ON DECEMBER 7, 2006 – ABSOLUTELY NO EVIDENCE OF SIGNIFICANT LATERAL ACCELERATION DURING HOMING



Incidents of Repetitive Misrepresentations by the Missile Defense Agency – (FM-6)

"There were subsequent views not publicly released to preclude potential adversaries from seeing exactly where the target was struck, so the authors were basing their assessment on incomplete information," Rick Lehner, a spokesman for the agency."

Lateral Accelerations Required to Shift the Impact Point 1 Meter Within 1/30th of a Second

$$\text{Distance} = \frac{\text{acceleration} \times \text{time}^2}{2} = \frac{a\,t^2}{2}$$

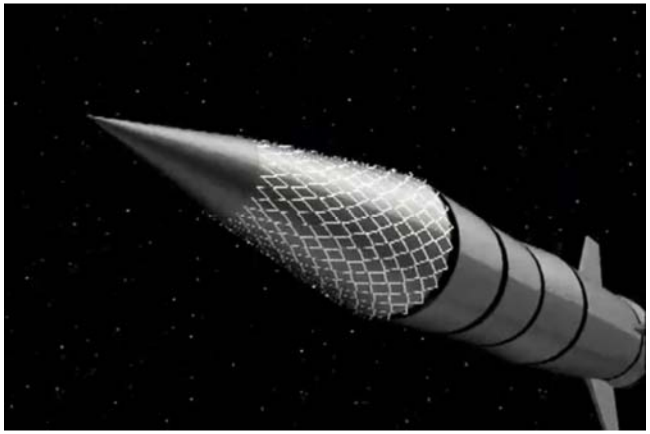
$$\text{acceleration} = \frac{2D}{t^2} = \frac{2 \times 1}{0.033^2} = 1800\ \text{m/sec}^2$$

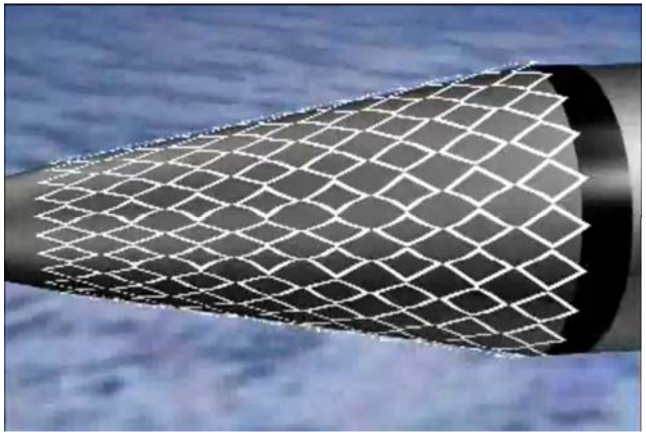
$$\text{Acceleration in Gs} = \frac{a}{g} = \frac{1800\ \text{m/sec}^2}{9.8\ \text{m/sec}^2} = 184G$$

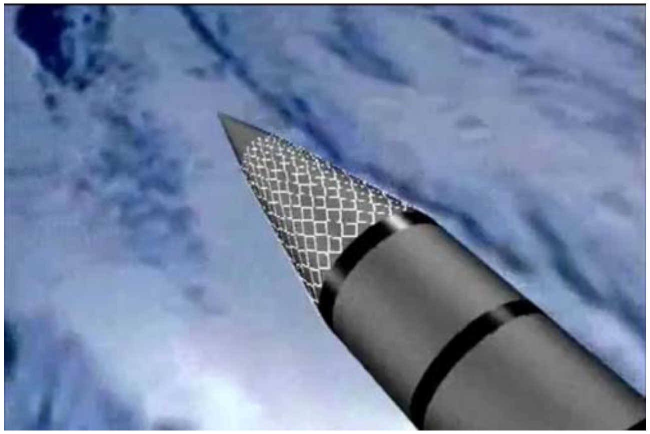
$$\text{Required Rocket Thrust (Tonnes)} = \frac{1800\,\text{m/sec}^2 \times 25\,\text{kg}}{1000\,\text{kg/Tonne}} = 45\,\text{Tonnes} \approx$$

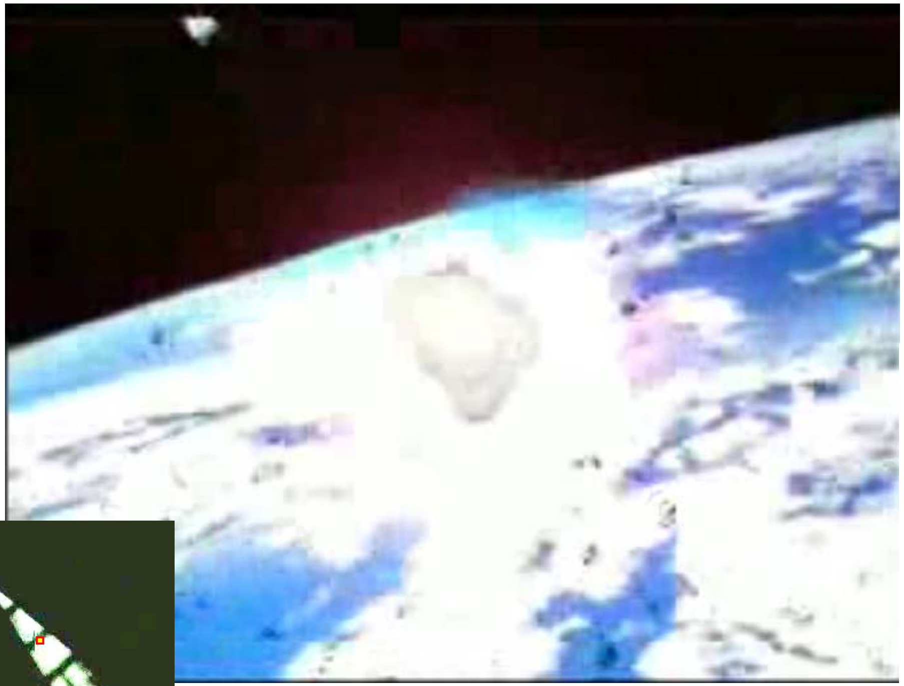
3 Times the Thrust of a SCUD-B Rocket Motor

Video Animation Images Used by Missile Defense Agency to Describe the Instrumentation Used in the FM-6 Flight Test to Determine If Warhead Was Hit





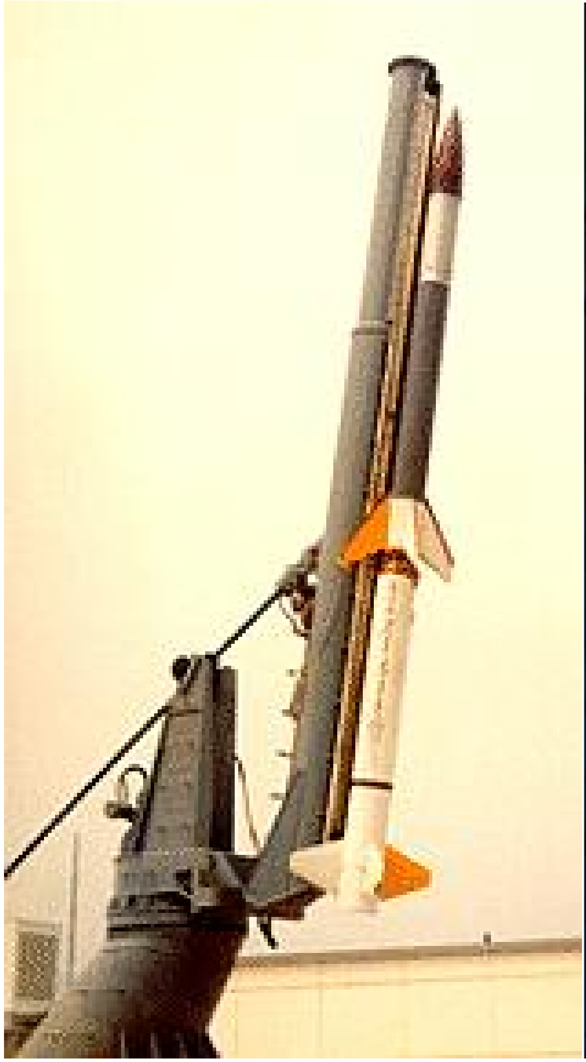


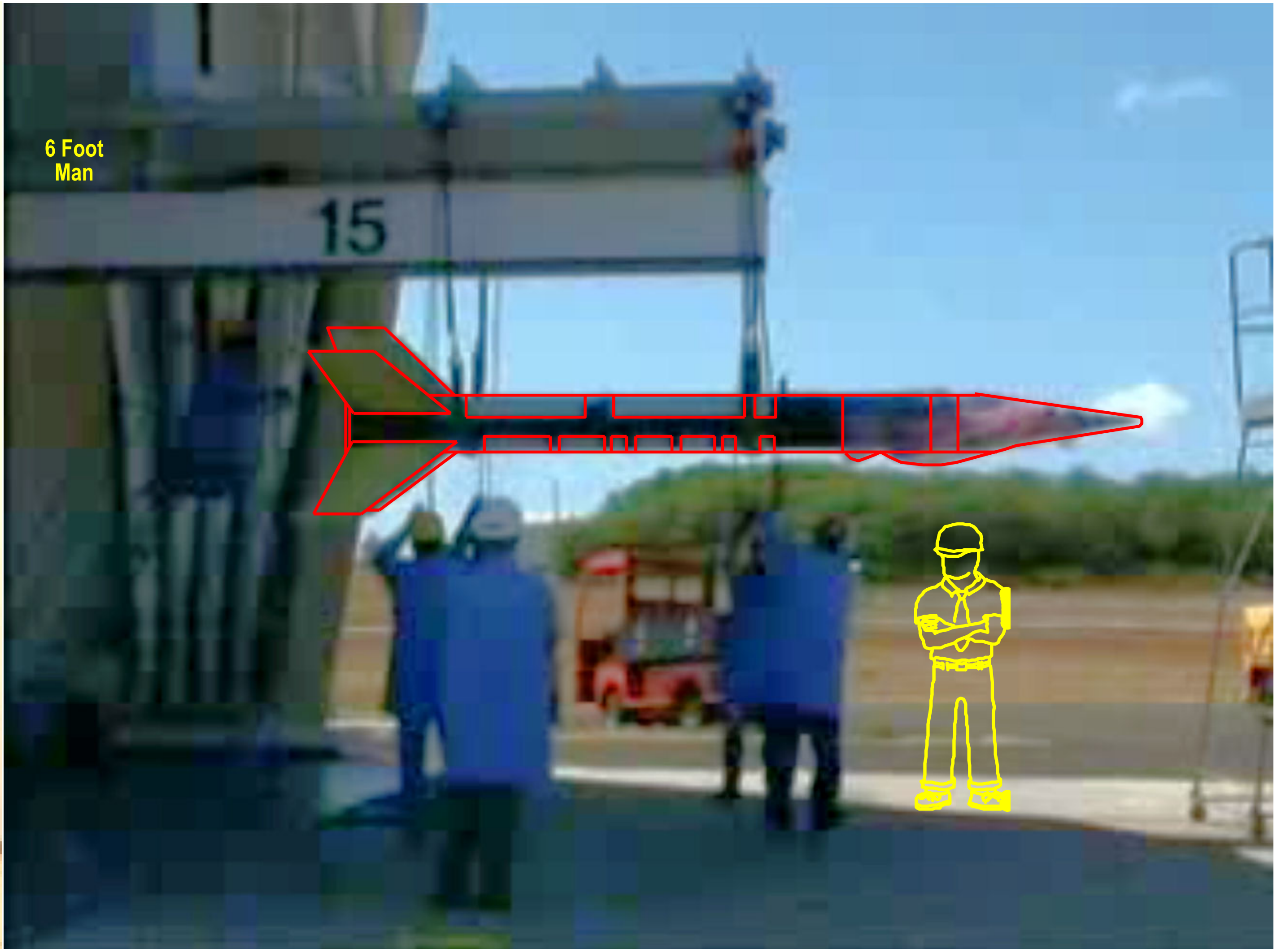


FM-6 – Only Direct Hit on Warhead

How the Pentagon Has Been Rigging the Testing of the the SM-3 Missile Defense

Current Testing of Missile Defense Systems





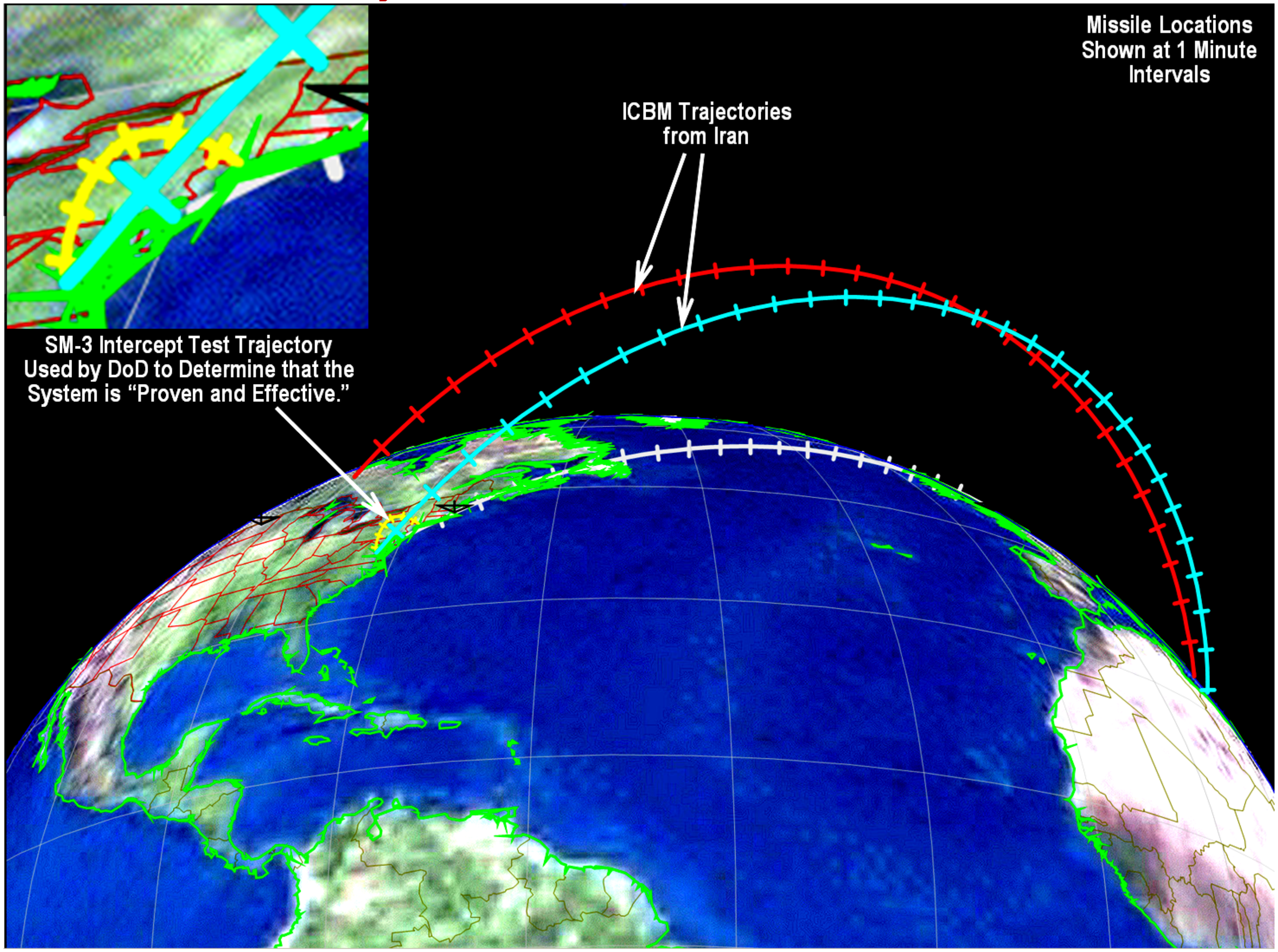
Current Testing of Missile Defense Systems

Terrier orion

Current Testing of Missile Defense Systems

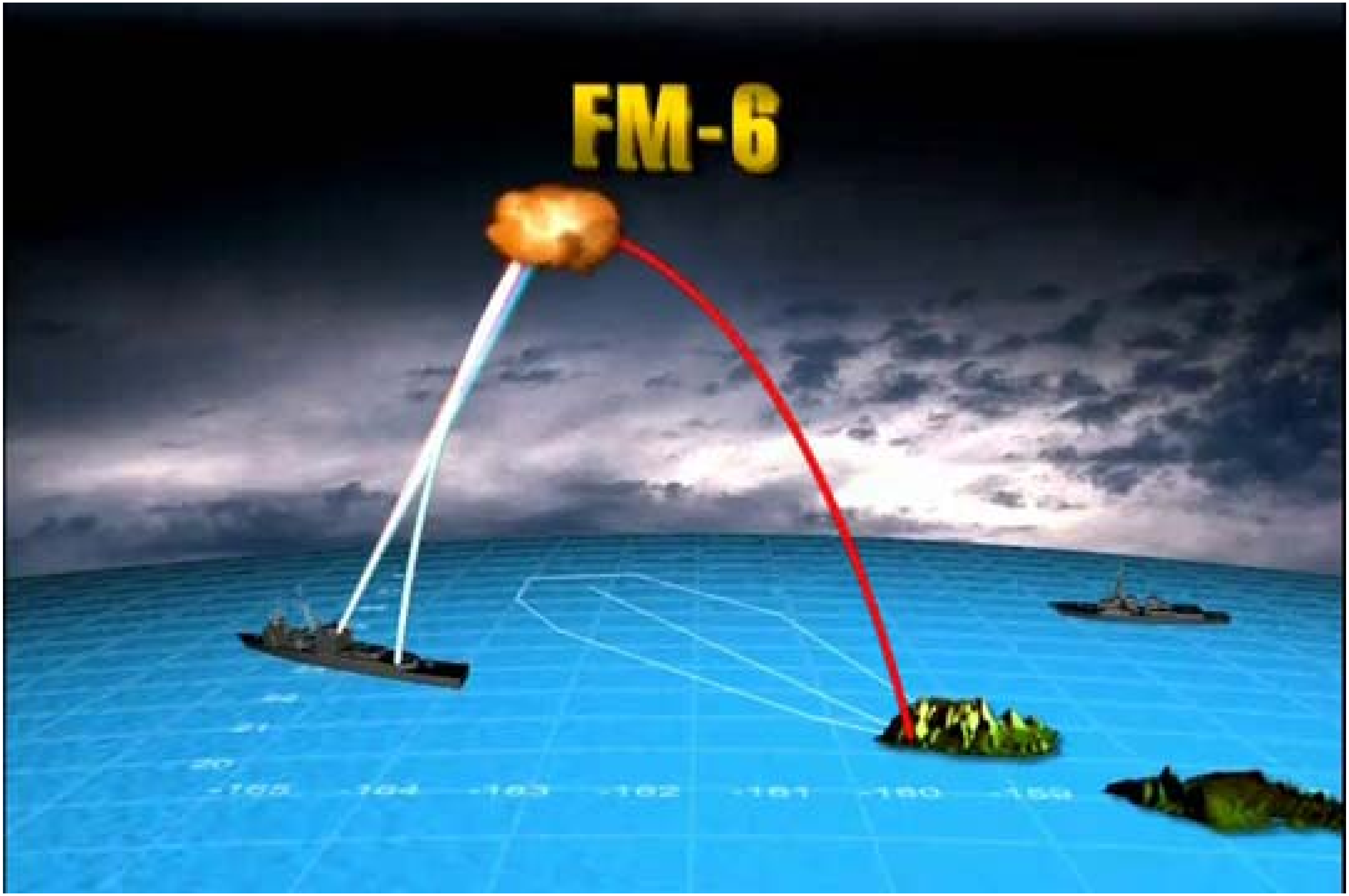
Has the Department of Defense Tested the SM-3 Defense System Adequately to Determine that It Will Be Robust and Reliable in Combat Conditions?

SM-3 Intercept Test Trajectory Used by Department of Defense to Determine that the System is "Proven and Effective"

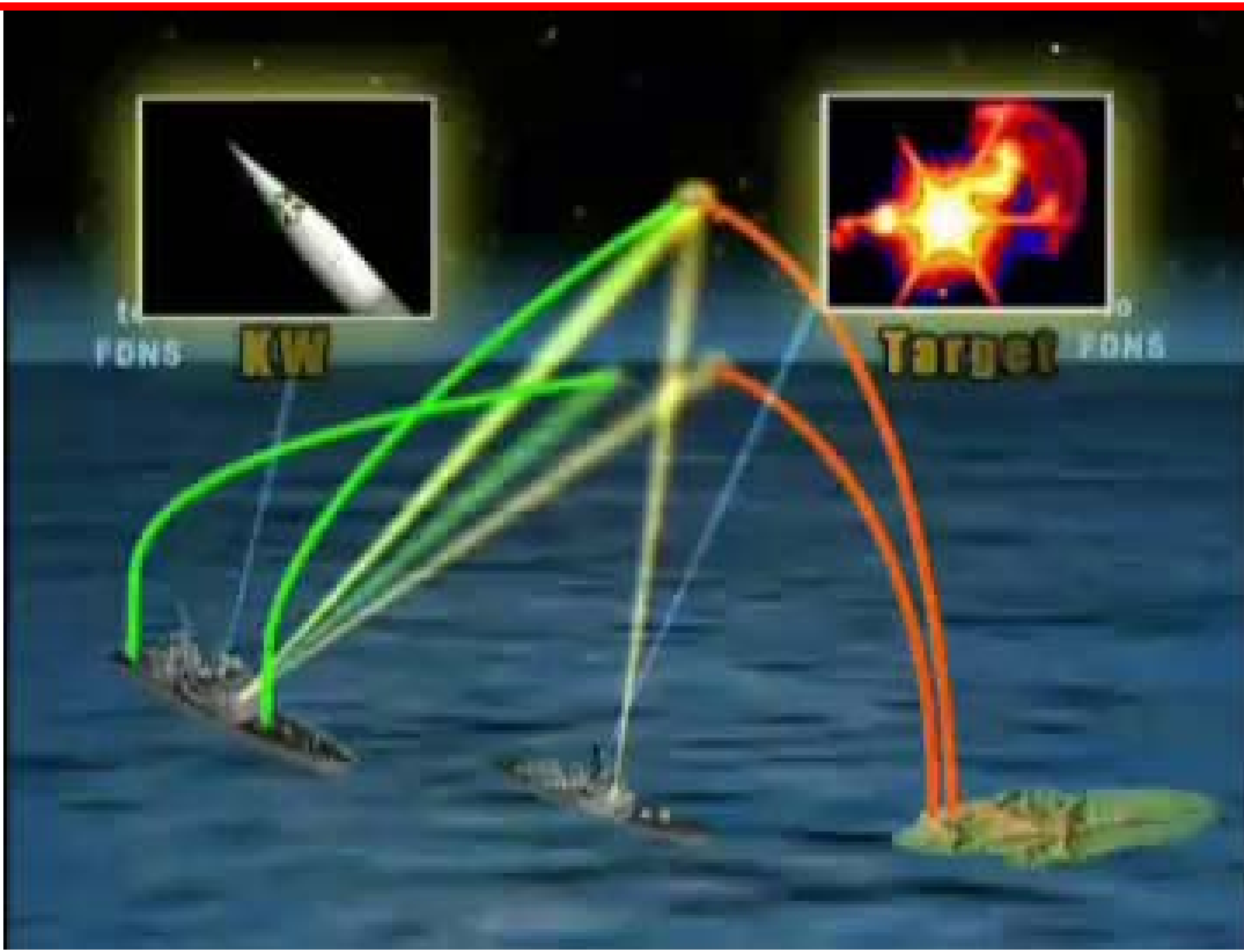


Current Testing of Missile Defense Systems

Location Off Kauai Island Where SM-3 Tests Have Been Conducted

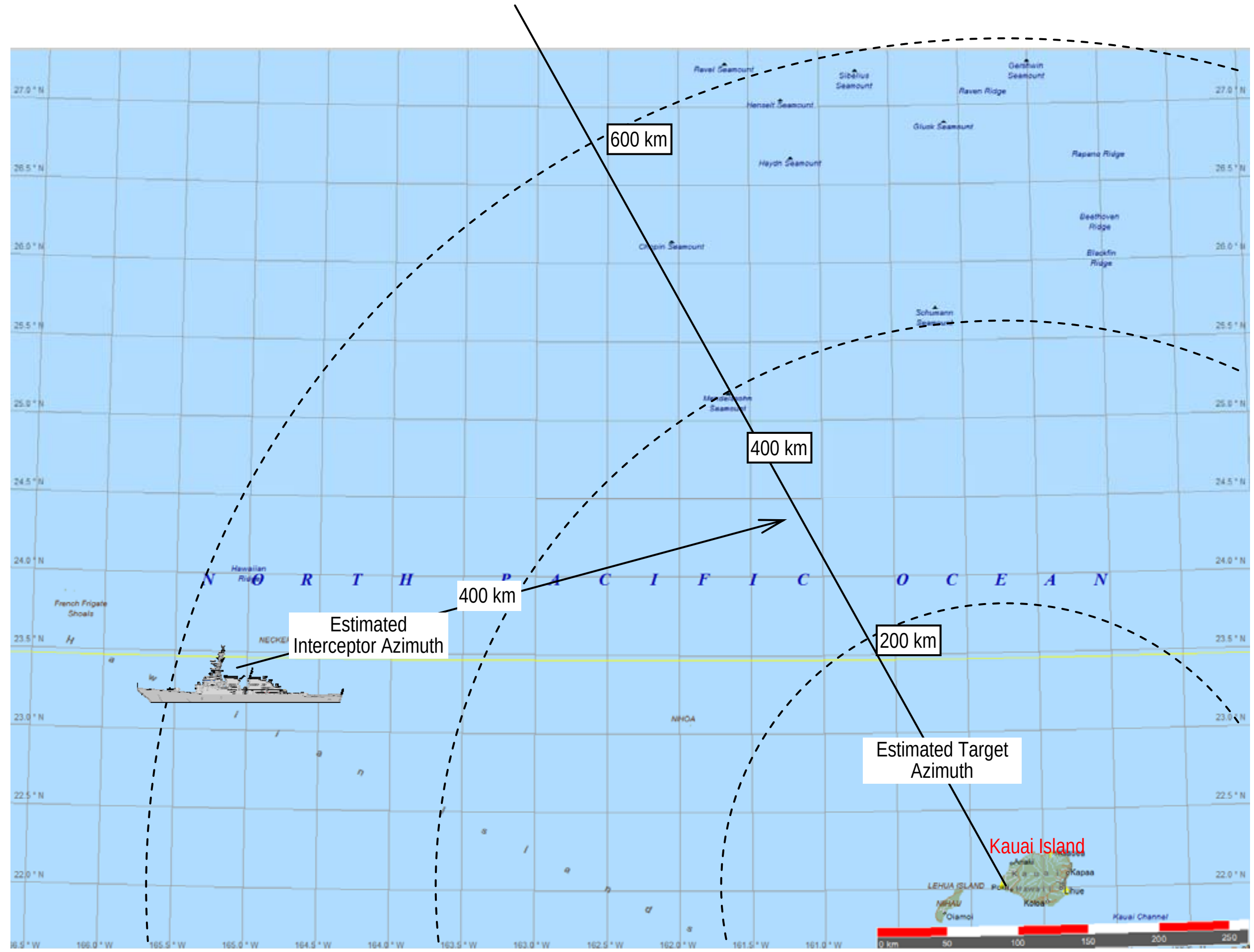


Current Testing of Missile Defense Systems



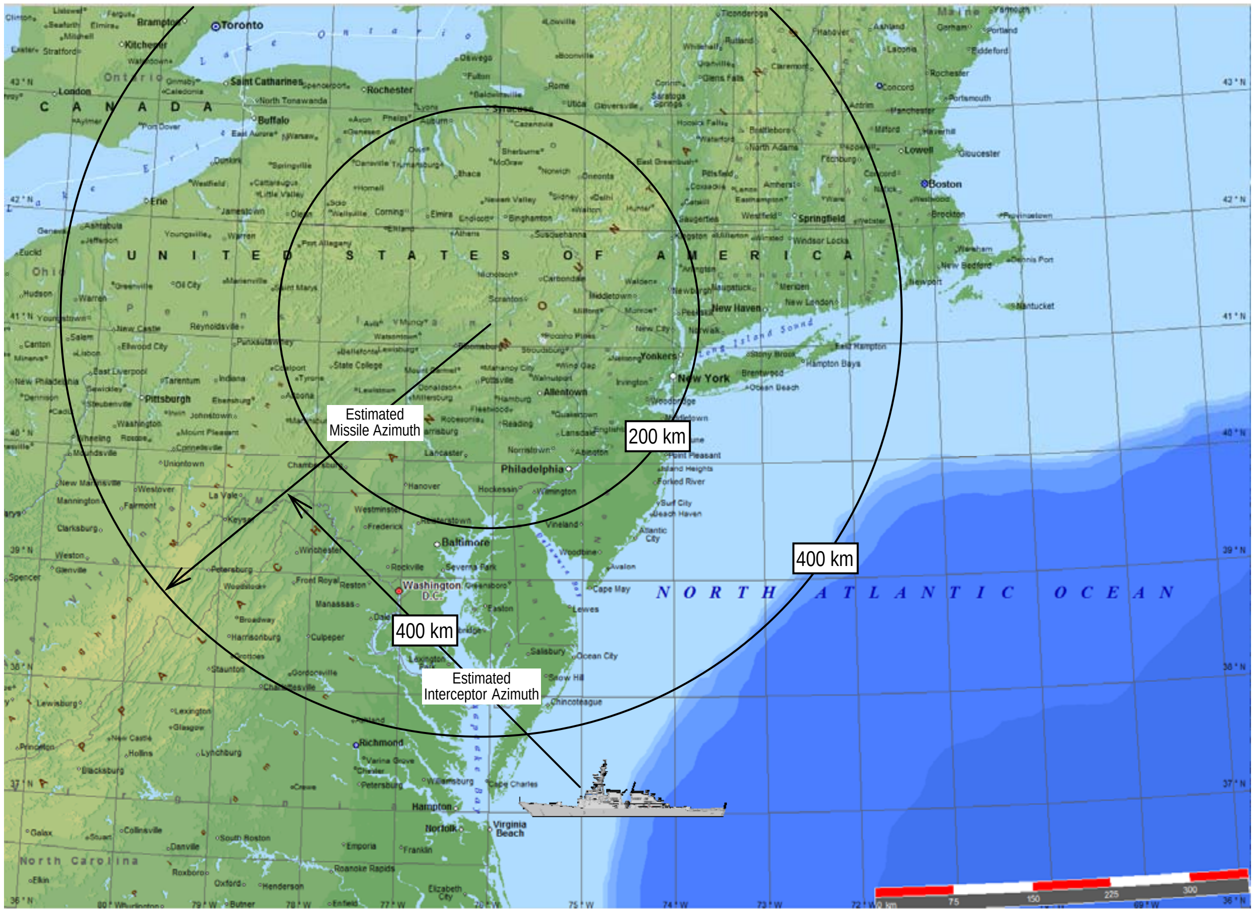
Current Testing of Missile Defense Systems

Estimated Distances and Geometry of SM-3 Flight Tests



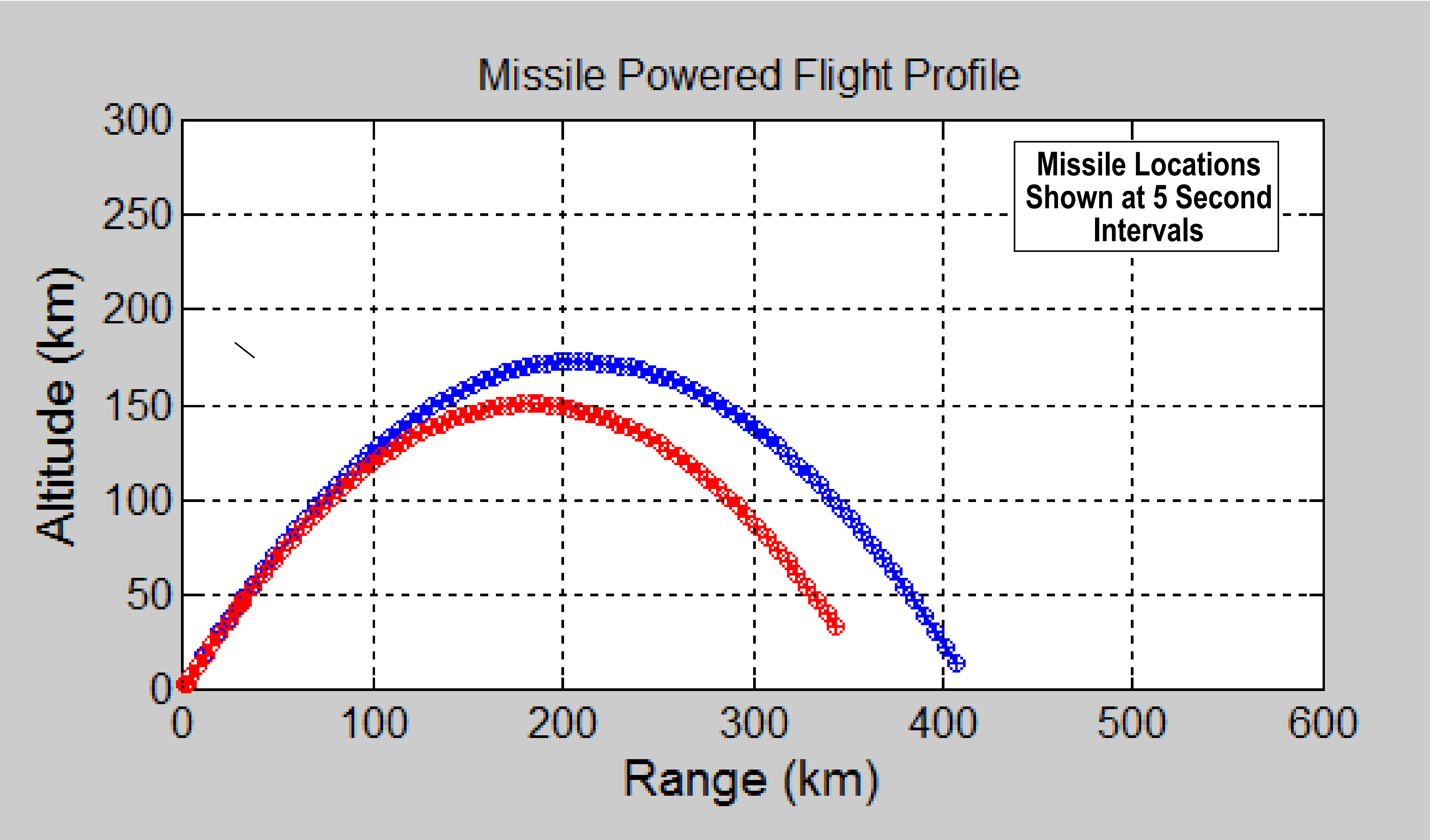
Current Testing of Missile Defense Systems

Estimated Distances and Geometry of SM-3 Flight Tests
Projected Over Northeast of the United States for Perspective



Estimated Test Target Altitudes and Ranges Based on Statements Made in MDA Videos and Rocket Target Calculations

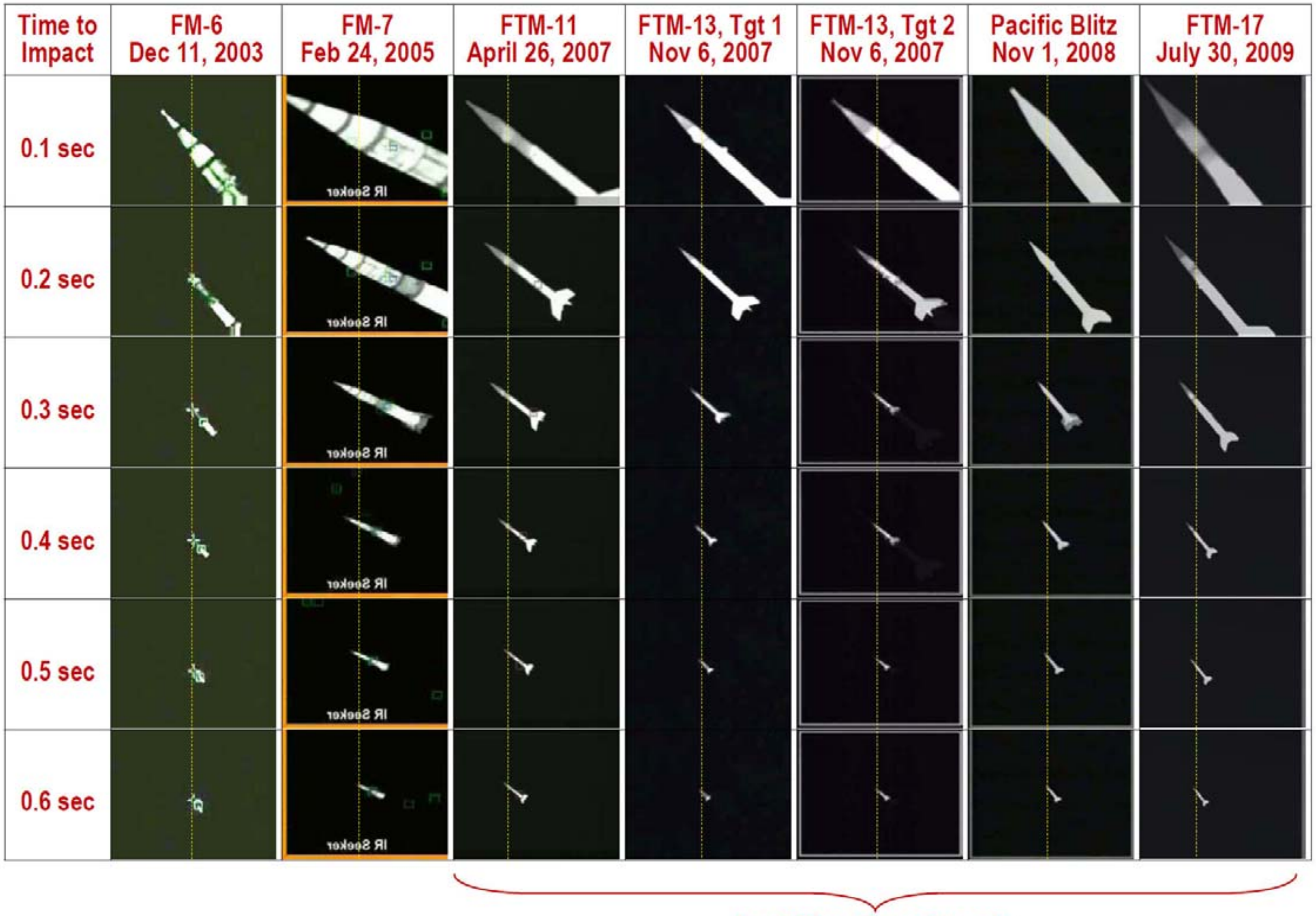
Current Testing of Missile Defense Systems



Current Testing of Missile Defense Systems

Last Five SM-3 Tests are Exact Replicas of the Same Experiment

Even Though The Tests Were Exact Replicas of the same Simplified Experiment, the DoD Advised the President that the Tests Prove that the SM-3 Would be Effective Against Varied Missile Targets

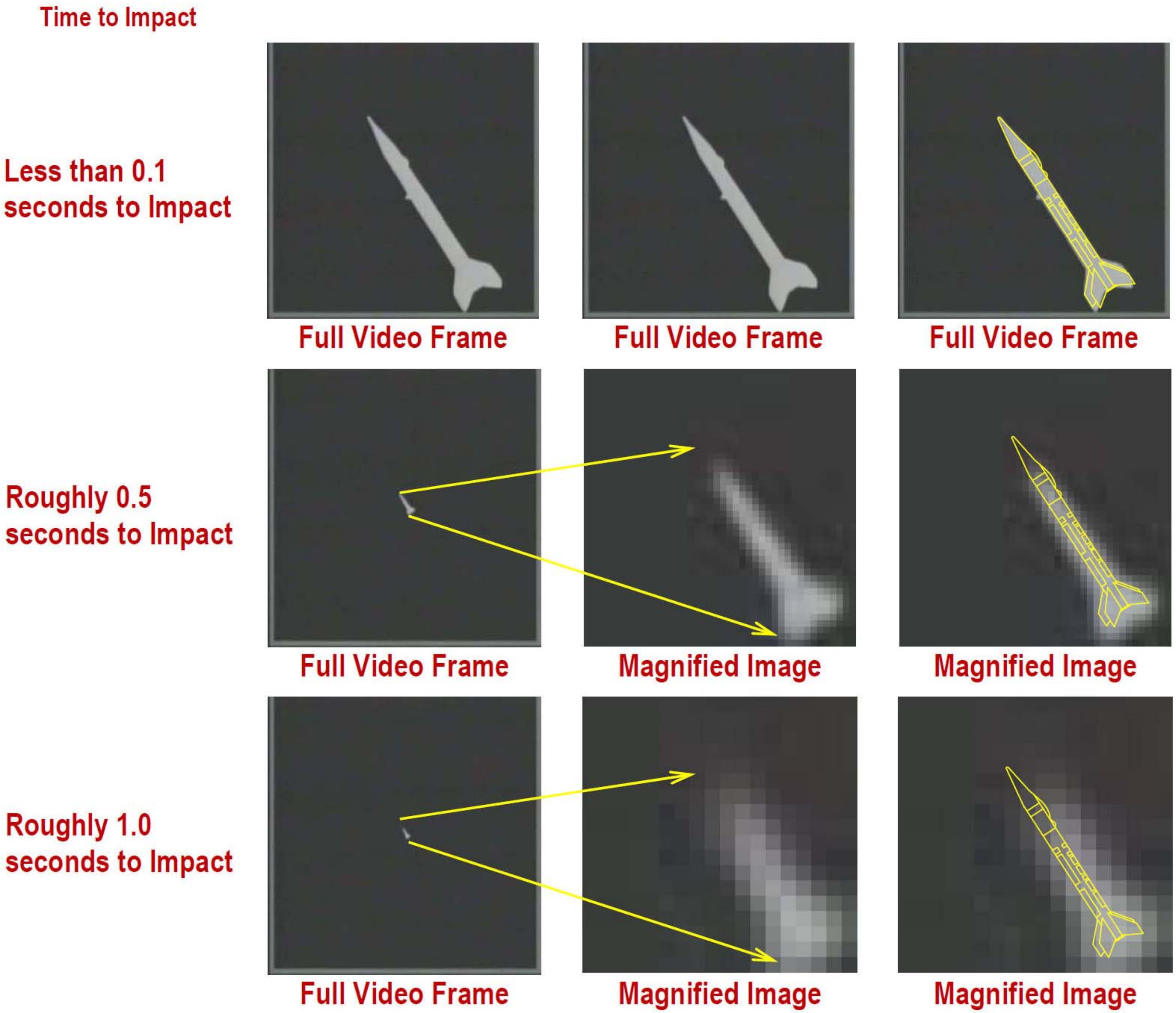


Last Five Experiments
Exact Replicas of the Same Experiment

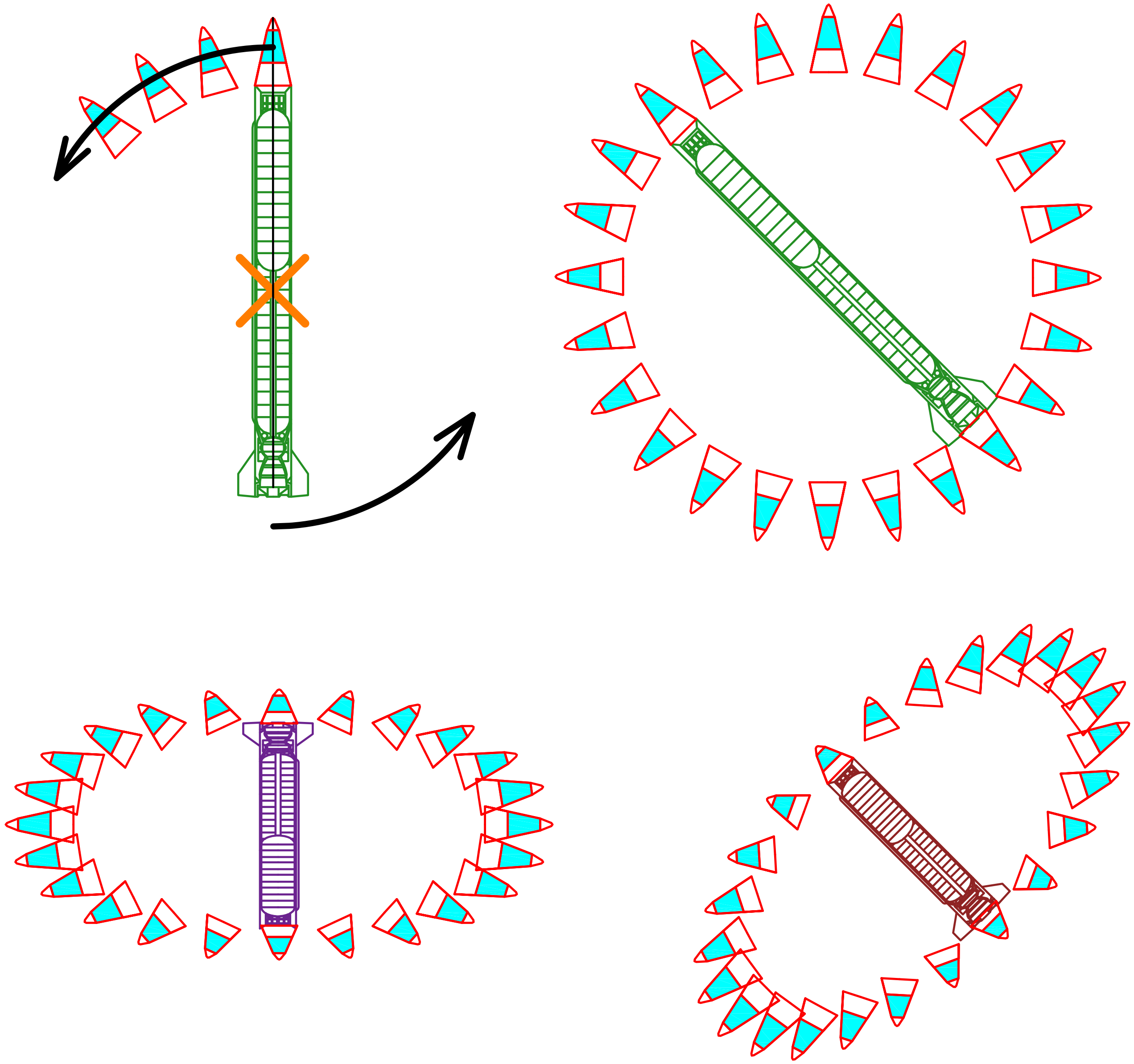
Exact Replicas of the Same Experiment

- Targets exactly the same length
- Warheads located in the same position
- Tail fins large and located in same position
- Targets always perpendicular to the line-of-sight of the closing interceptor
- Large tail fins allow identification of front from back ends
- Targets not tumbling perpendicular to interceptor line-of-sight
- Targets not tumbling in direction of interceptor line-of-sight
- Targets not broken into multiple pieces
- Warhead locations and appearances not distorted by inflated balloons
- Gulf War of 1991 – Targets Tumbled at High Altitudes, Targets Broke Into Pieces During Interceptor Homing

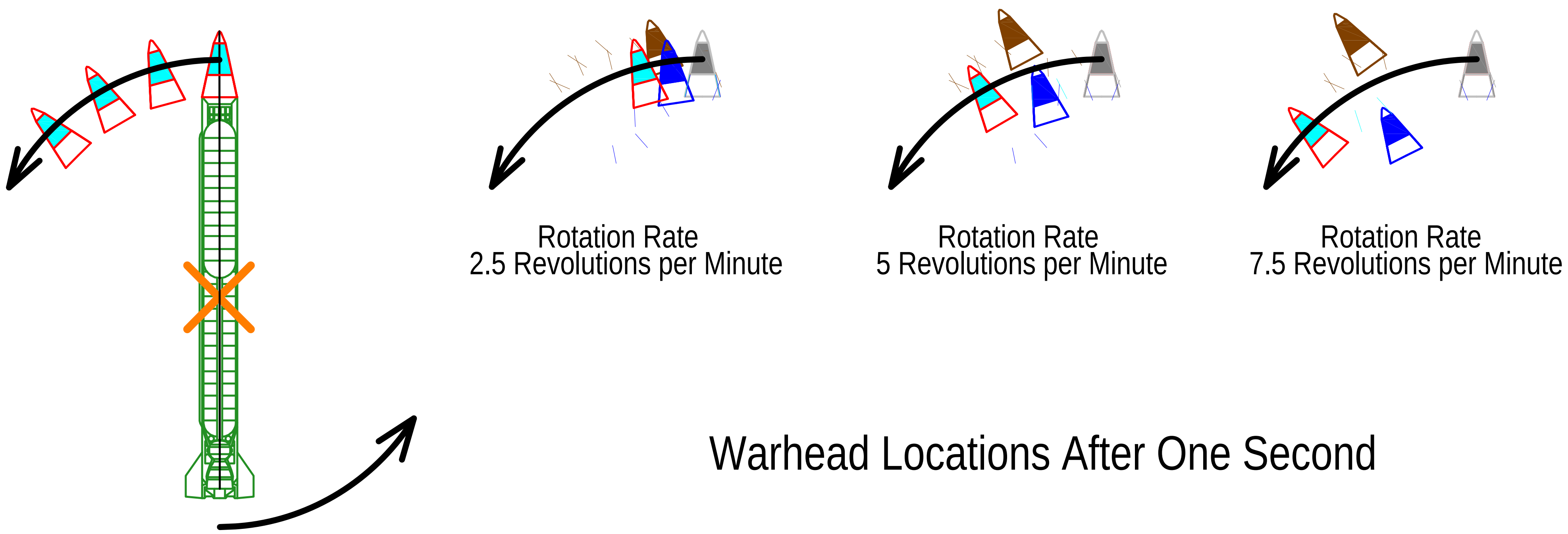
Current Testing of Missile Defense Systems



Current Testing of Missile Defense Systems



Current Testing of Missile Defense Systems



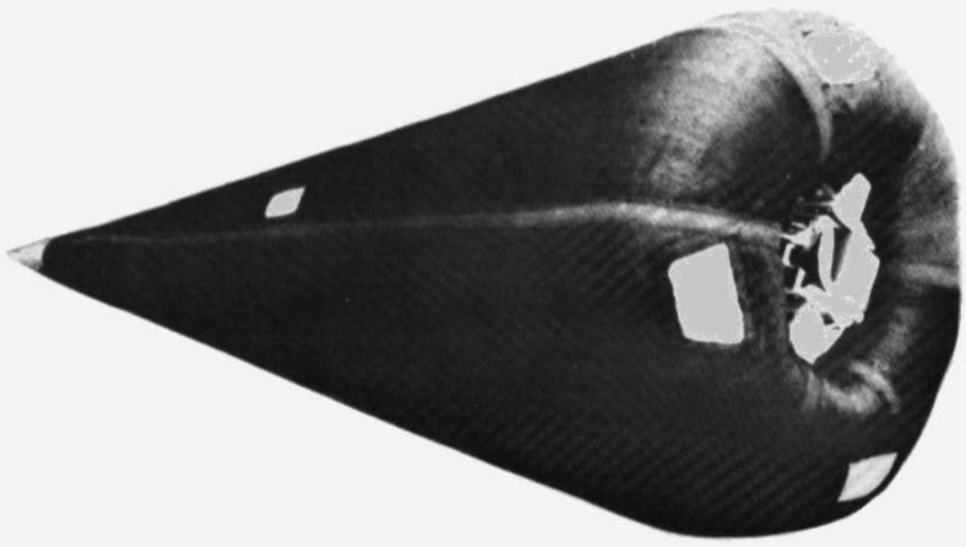
Conclusion from US Navy Videos of “Successful Intercepts

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

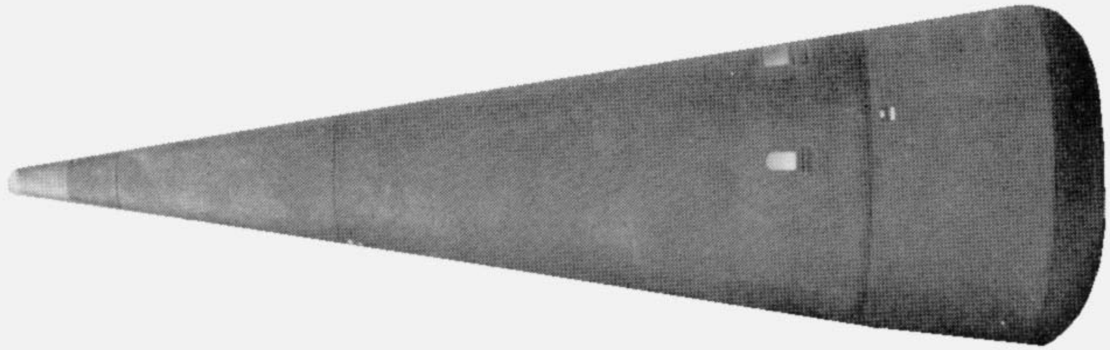
These Could Be Used as Decoys
or to Surround Warheads Disguising Them as Balloons

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!



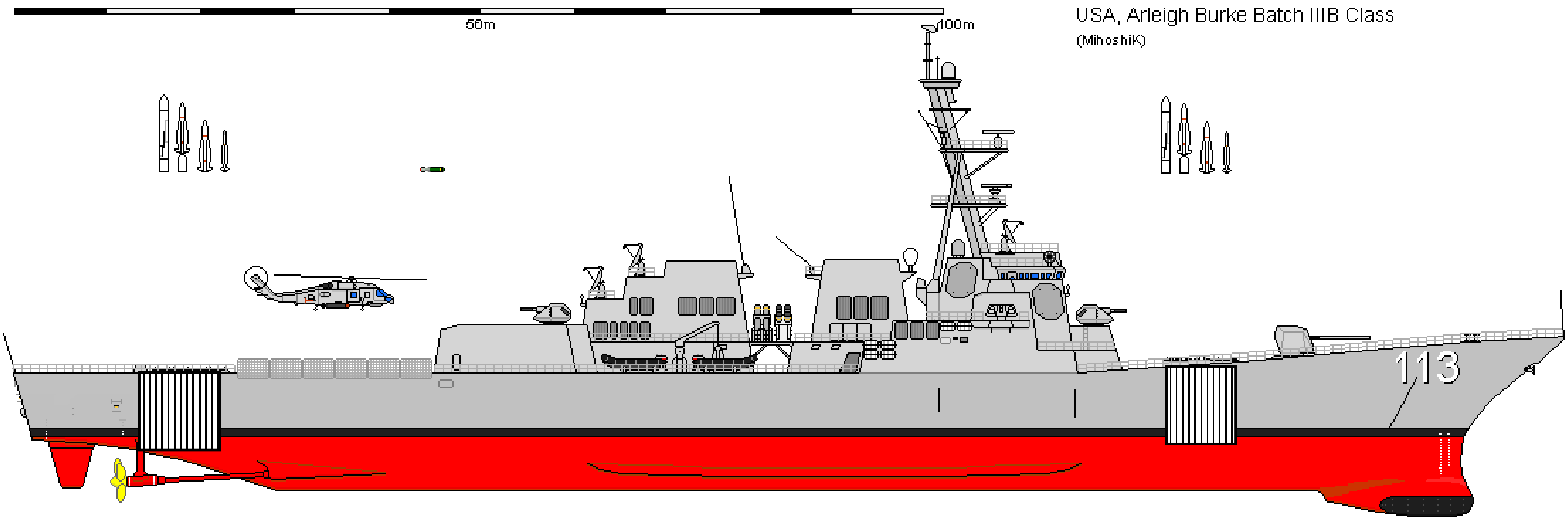
The IEO, an inflatable erectable decoy for Minuteman
(L'Garde, Inc. Photo)

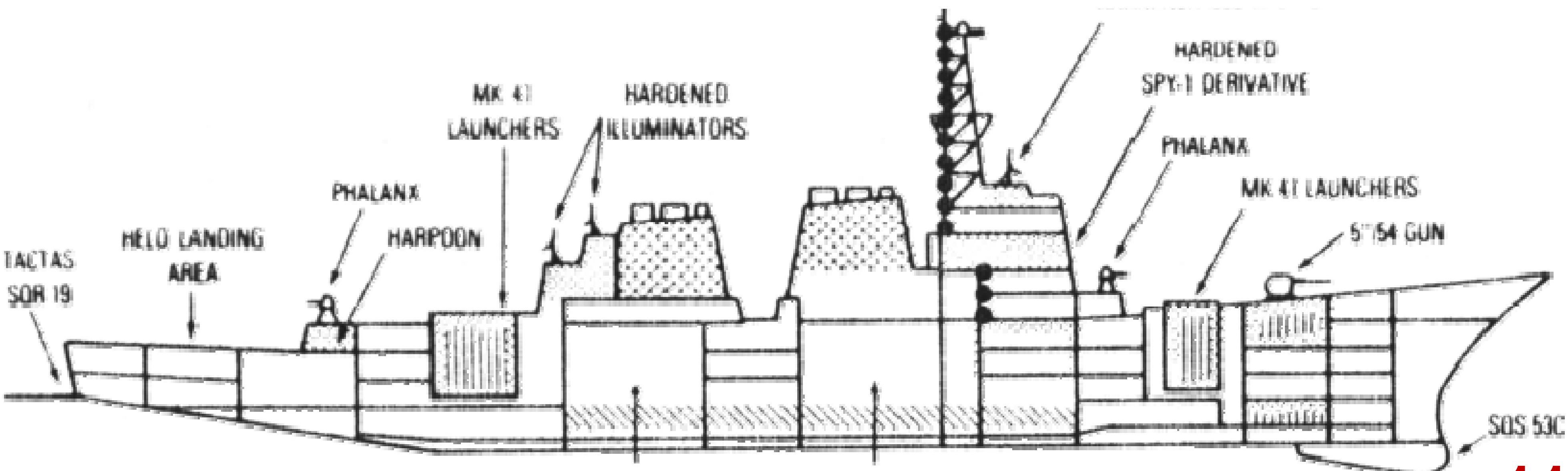


Mk 12A Minuteman III Reentry Vehicle

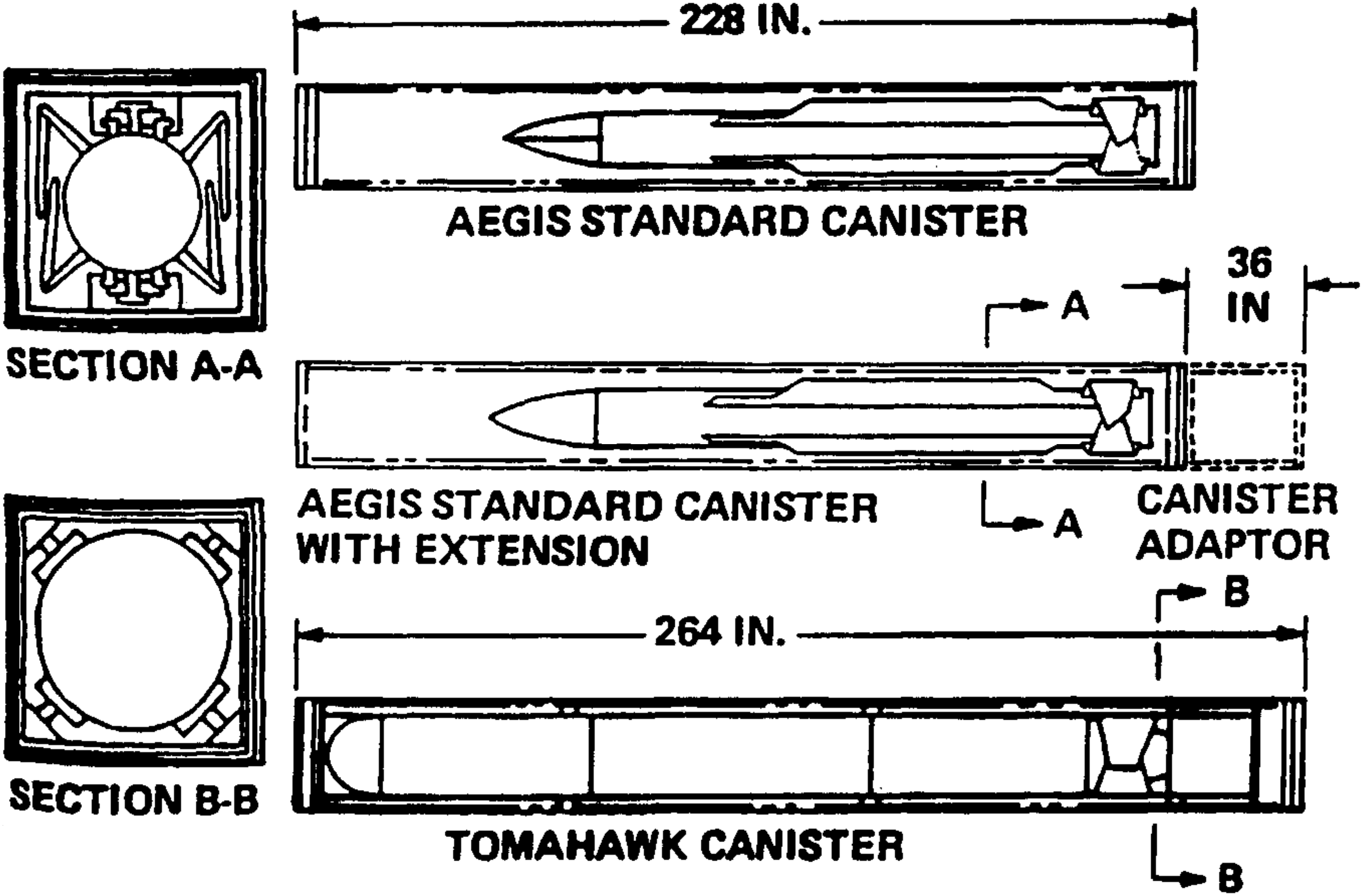
Why the SM-3 Missile Defense Could Appear to Be Threatening Even Though Its Capabilities are Obviously Limited

Locations of the Vertical Launch System Boxes on Two Different Variants of the DDG-51 Navy Destroyer

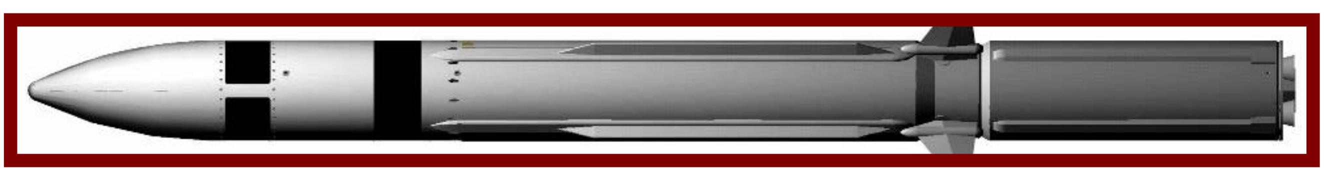




Basic Characteristics of the Vertical Launch System Components

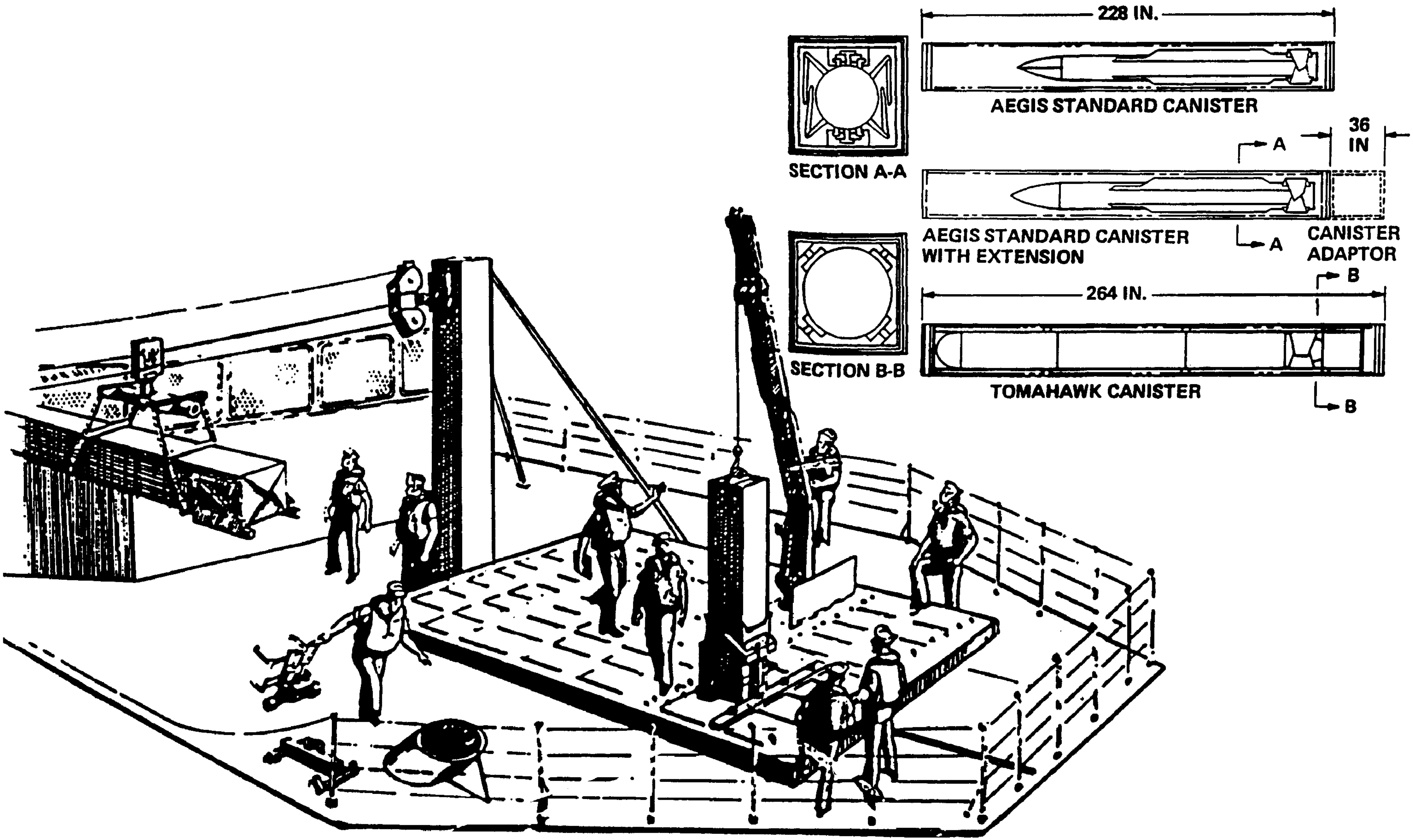


SM-3 Block IIA
21” Diameter
4,000 lb
Interceptor

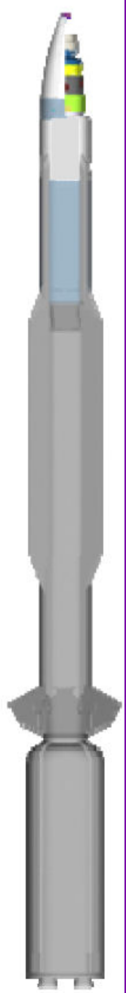
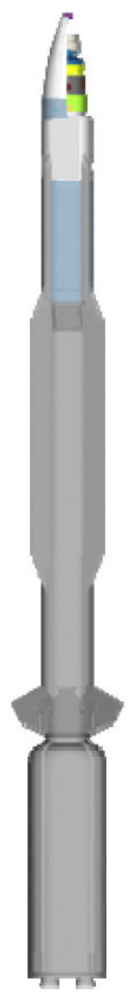


Aegis Block IA Interceptor and Vertical Launch Cannister

Basic Operational Characteristics of the Vertical Launch System Components



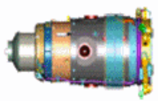
Variants of the Aegis SM-3 Interceptor and Kill Vehicles

Burnout Speed ≈ 3 km/sec		Burnout Speed ≈ 4.5 km/sec	Burnout Speed ≈ 5.5 – 6 km/sec
Block IA	***Block IB***	***Block IIA***	***Block IIB***
Kill Warhead (KW) • 1-Color Seeker • Divert & Attitude Control System (DACS)	**KW** • 2-Color Seeker • Improved Optics • Advanced Signal Processor • Improved DACS	**21″ Nosecone** **Large Diameter KW** • Advanced Discrimination Seeker • High Divert DACS	**Improved KW** **High Performance Upper Stage**
Stage 2 & 3: • 13.5″ Propulsion	**Stage 2 & 3:** • 13.5″ Propulsion	**Stage 2 & 3:** • 21″ Propulsion	**Stage 2:** • 21″ Propulsion
Stage 1: • MK 72 Booster • MK 41 Vertical Launch System (VLS) Compatible	**Stage 1:** • MK 72 Booster • MK 41 VLS	**Stage 1:** • MK 72 Booster • MK 41 VLS	**Stage 1: Existing MK 72 Booster**
			

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

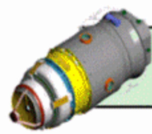
Block IA



Block 2004
- 1-Color Seeker
- Pulsed DACS

Block 2004

Block IB



- 2- Color Seeker
  - Increased IR Acquisition
  - Improved Discrimination
- TDACS
  - Increased Divert
  - Lowers AUR Cost
- All-Reflective Optics (ARO)
- Advanced Signal Processor (ASP)

Block 2008

Block II

High Velocity Variant

- Block IB Seeker
- 21" Propulsion
  - 2nd & 3rd Stage
  - Increased Missile Vbo = xx
- 21" Nosecone
- MK 41 VLS Compatible

Block 2010 / 2012

Block IIA

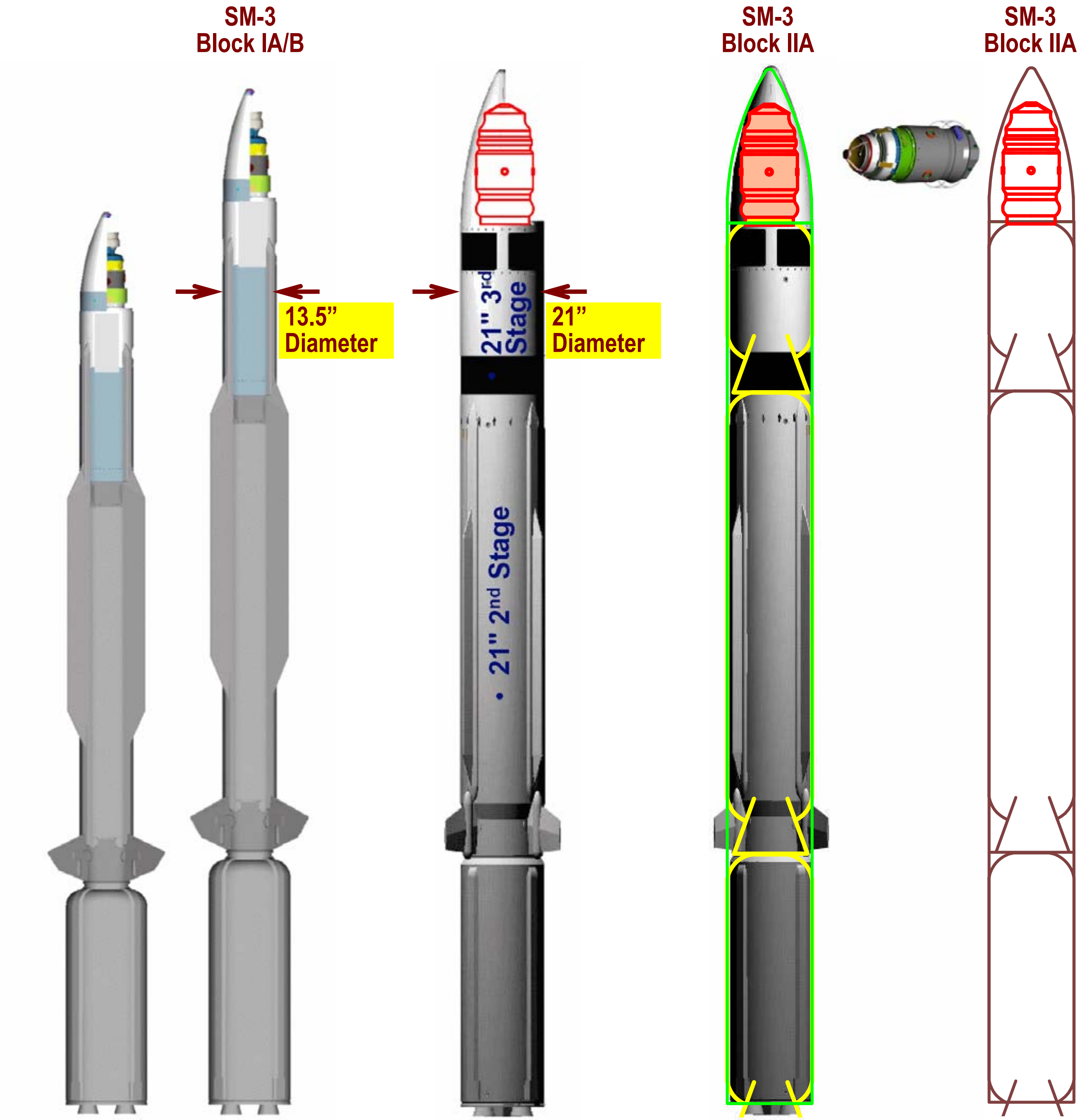
High Divert Variant

- 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 2012 / 2014

Funded Since PB06 | Capability Change From Previous Block

Variants of the Aegis SM-3 Interceptor and Kill Vehicles



Model Interceptor Parameters

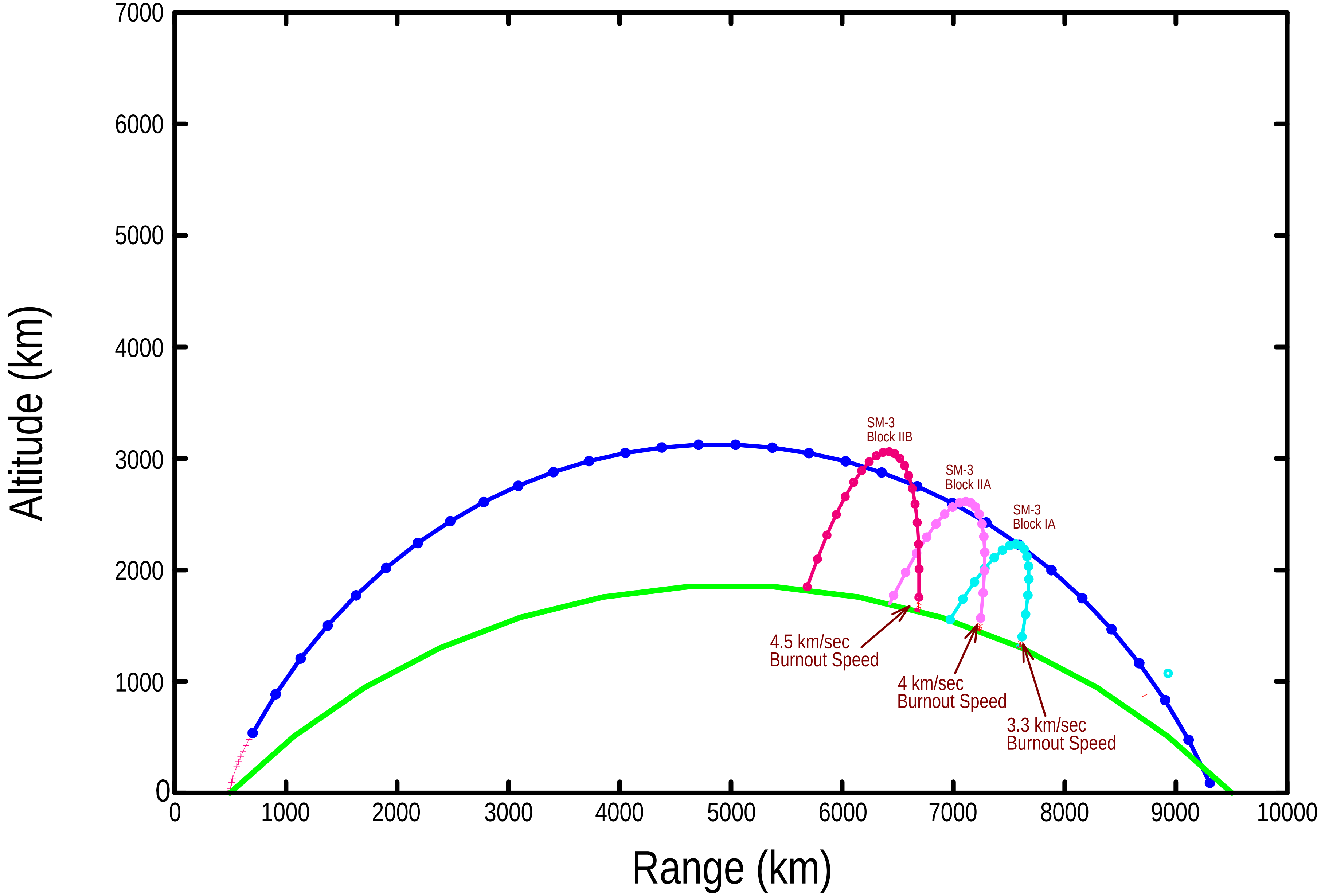
Kill Vehicle
Weight≈132? lbs

Third Stage Motor
I_{sp}≈289 sec
Weight≈600 lbs
Fuel Load≈0.90

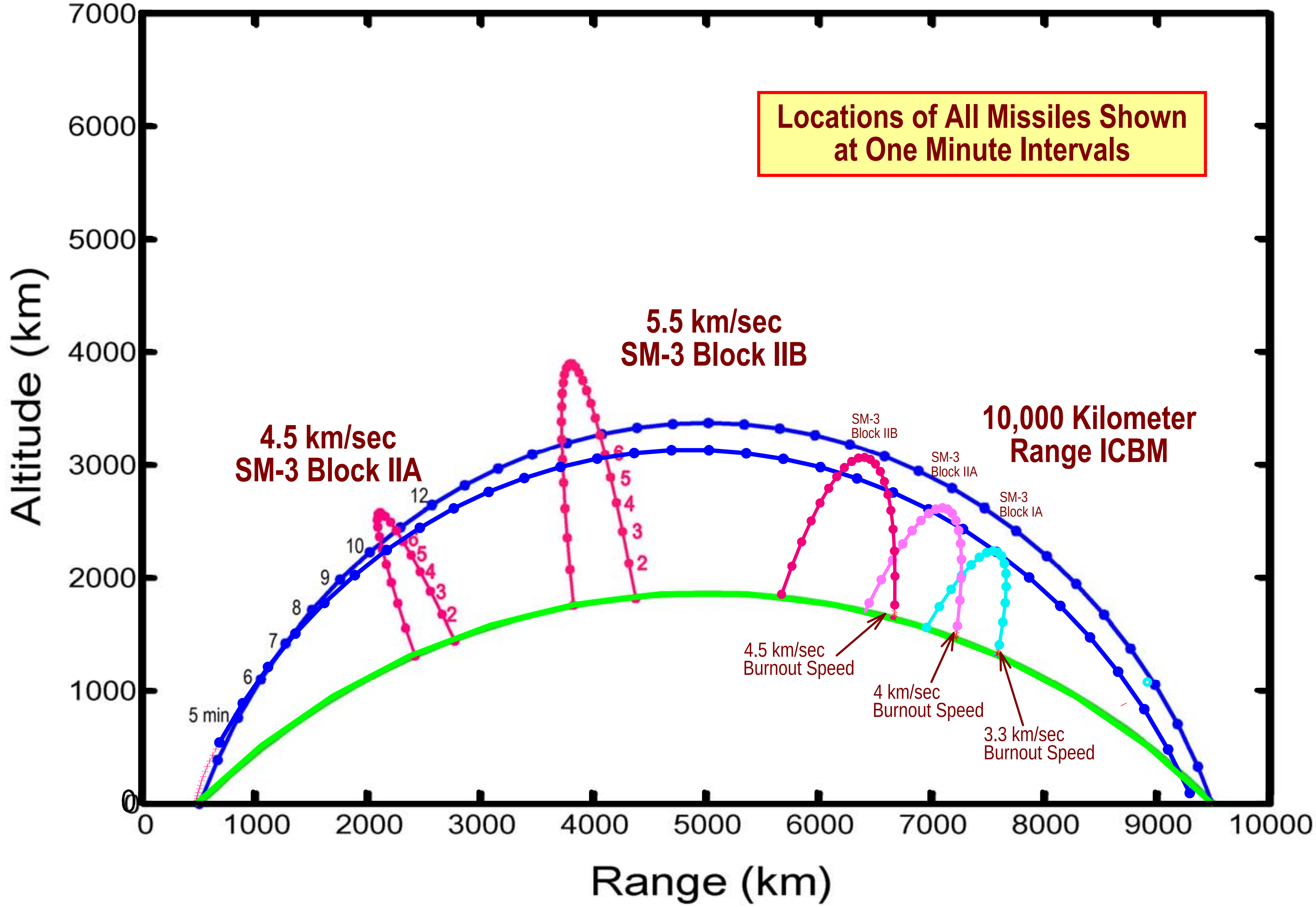
Second Stage Motor
I_{sp}≈280 sec
Weight≈2000 lbs
Fuel Load≈0.85

First Stage Motor
I_{sp}≈220 sec
Weight≈1200 lbs
Fuel Load≈0.75

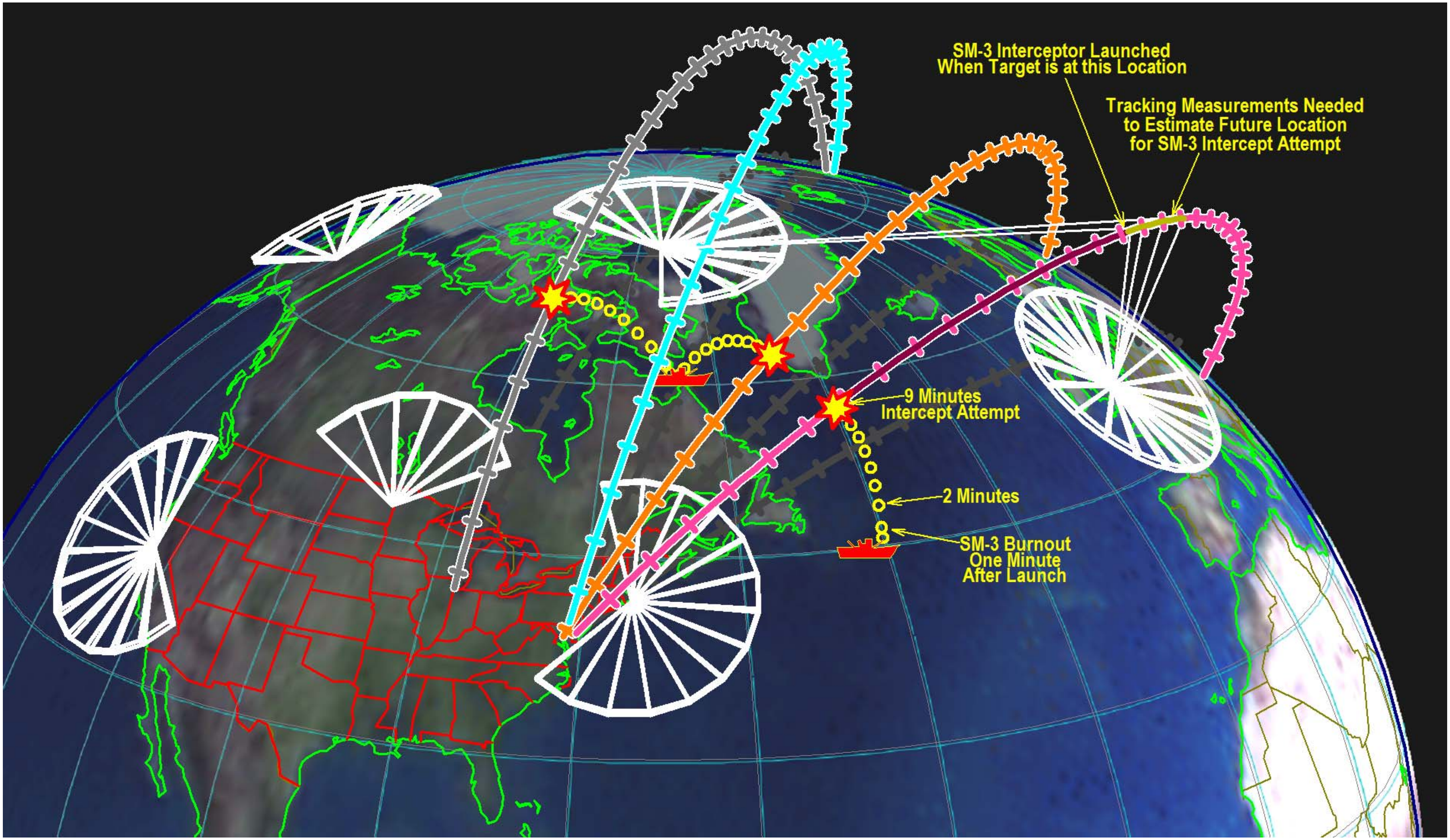
Capabilities of the Future 4.5 km/sec and 5.5 km/sec Variants of the SM-3 Block IIA and Block IIB Interceptors to Engage ICBMs



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



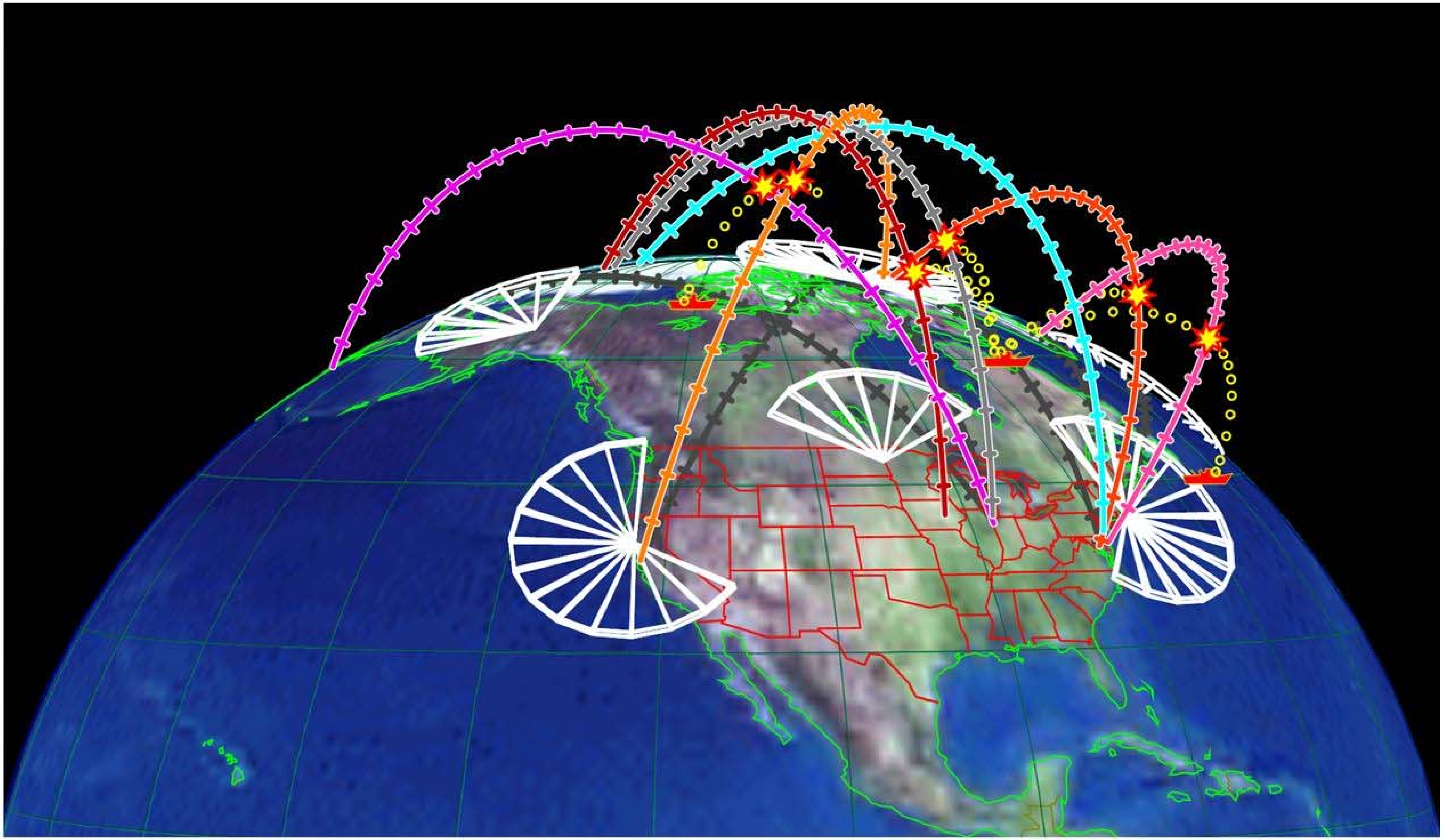
Kinematic Capabilities of Future 4.0 km/sec and 4.5 km/sec Variants of the SM-3 Block II Interceptors to Engage ICBMs



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.



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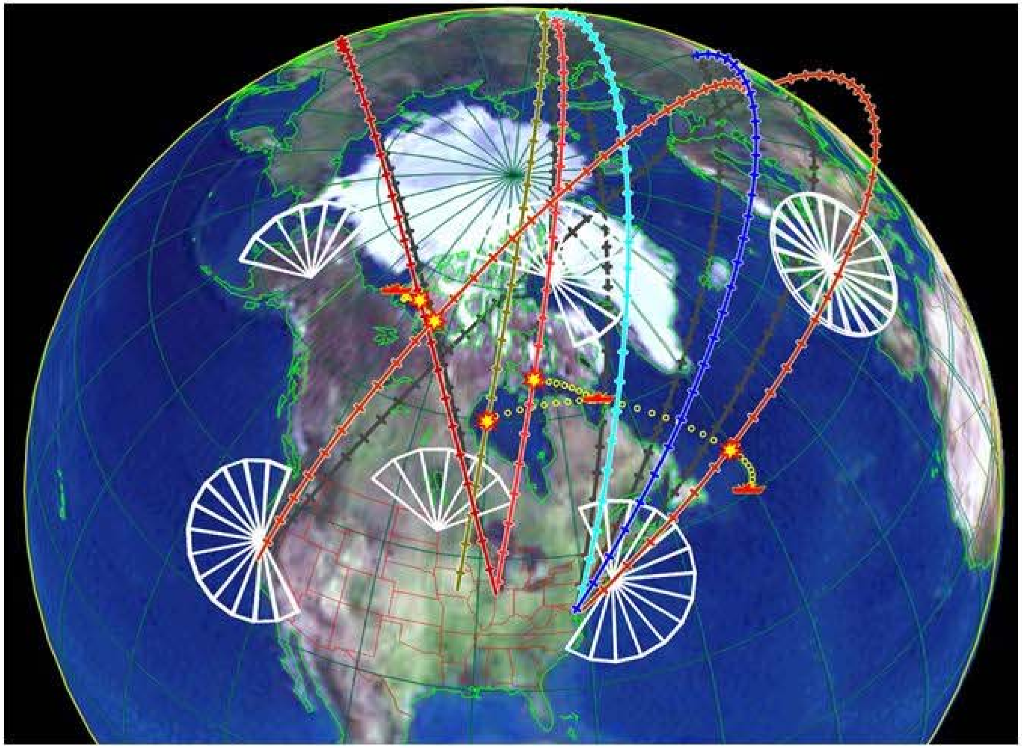
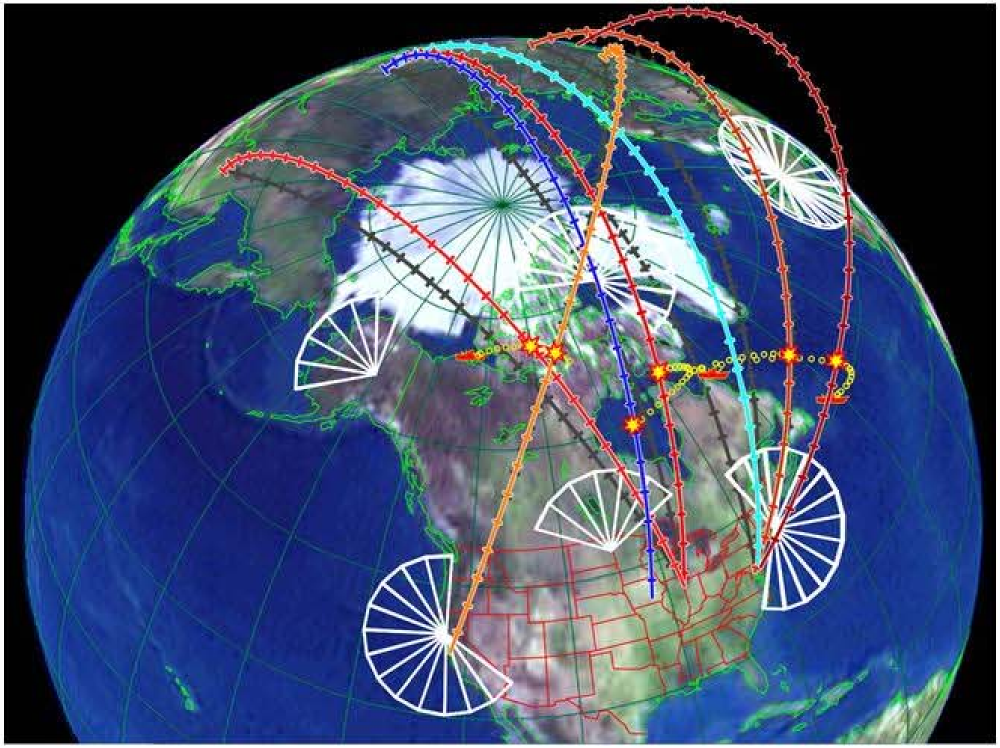
All ICBM and Interceptor trajectory locations marked at one minute intervals.





The End Result of the Phased Adaptive Approach and the US Domestic Political Failures that Led to It

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 US missile 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 coud create the worst of two worlds for both China and the US, US defenses that are not reliable, and a Chinese reaction that would be expensive and dangerous to the security of both China and the US.

An example from history.

Vast expansion of US nuclear strike forces in response to the Russian Moscow missile defense

Appendix

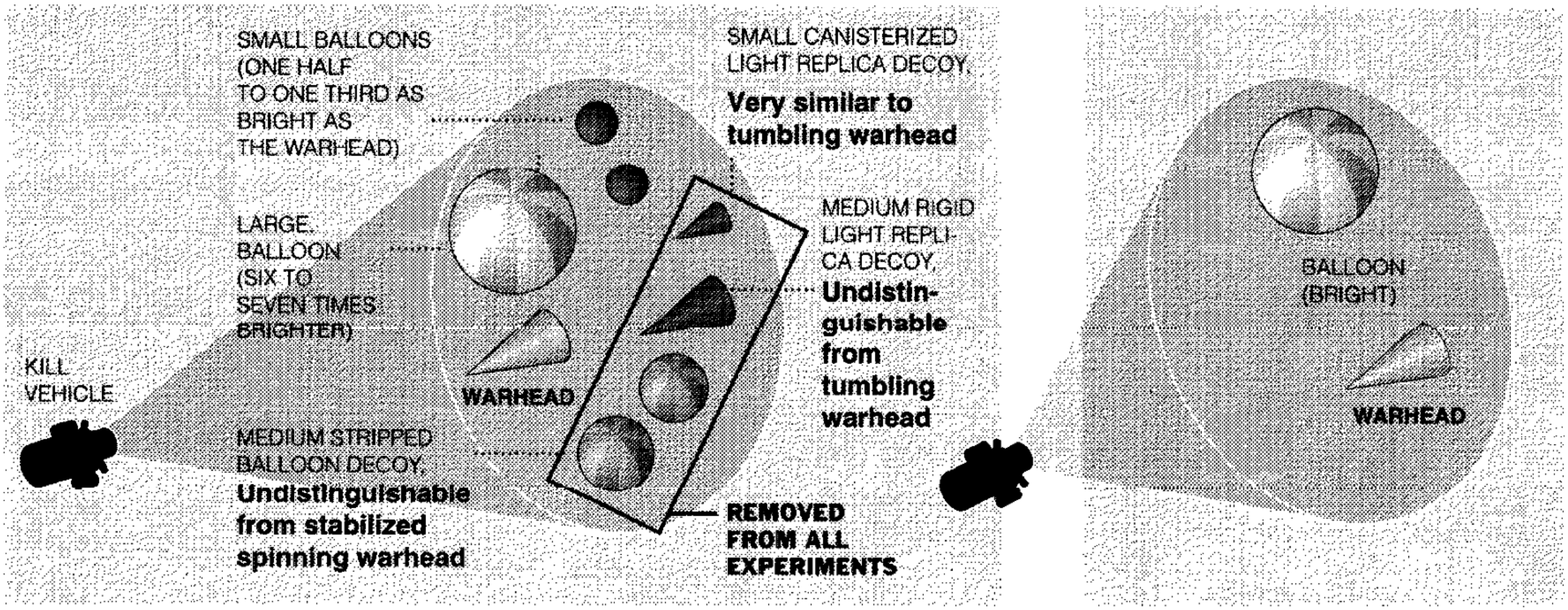
US Missile Defense
Lessons That Have Still Not Been Learned

Testing of Missile Defense Systems

Those Who Ignore the Errors of the Past Are Destined to Repeat Them

Fraudulent Testing of Missile Defense Systems

The Only Two Fundamental Proof-of-Concept Missile Defense Tests Experiments Yet Performed:
The IFT-1A in June 1997 and January 1998



Source: Theodore A. Postol, M.I.T.

New York Times Reports Major Fraud in Missile Testing in Front Page Story

The New York Times

Copyright © 2000 The New York Times NEW YORK, FRIDAY, JUNE 9, 2000 $1 beyond the greater New York metropolitan

Antimissile Testing Is Rigged To Hide a Flaw, Critics Say

By WILLIAM J. BROAD

Citing the Pentagon's own plan, critics of the proposed antimissile defense and even some military experts say all flight tests of the $60 billion weapon have been rigged to hide a fundamental flaw: The system cannot distinguish between enemy warheads and decoys.

In interviews, they said that after the system failed to achieve this crucial discrimination goal against mock targets in its first two flight tests, the Pentagon substituted simpler and fewer decoys that would be easier for the antimissile weapon to recognize.

The Pentagon's plan was obtained by Theodore A. Postol, an arms expert at the Massachusetts Institute of Technology who opposes the weapon. It covers the four tests that have taken place as well as future tests up to the system's projected deployment in 2005.

Other technical experts who have seen it, including both antimissile and decoy designers, concurred with his criticism, as did a senior government official who has examined the Pentagon's testing plan.

"It is clear to me," said the official, who spoke on condition of anonymity, "that none of the tests address the reasonable range of countermeasures," or decoys that an enemy would use to try to outwit an antimissile weapon.

While acknowledging the plan Dr. Postal obtained as authentic, Pentagon officials strongly defended the testing program. Lt. Gen. Ronald T. Kadish of the Air Force, director of the Pentagon's Ballistic Missile Defense Organization, denied that his program had engaged in any deception or dumbing down. General Kadish said that the testing program would be extremely useful and that the resulting weapon would defeat crude warheads launched by inexperienced nuclear powers that might emerge in the future, like Iran, Iraq or North Korea.

Though unclassified, the plan is considered sensitive. Dr. Postol said he obtained it from a Pentagon source he would not identify.

Dr. Postol, who is preparing a report for the White House on what he sees as the plan's flaws, made his argument on Monday at a meeting of the State Department's advisory board on arms control, along with another antimissile critic, Nira Schwartz. Dr. Schwartz, a former senior engineer at the military contractor TRW, lost her job after challenging the claims the company made about the weapon's ability to distinguish warheads from decoys.

Dr. Postol, who worked in the Reagan administration on such issues as antimissile defense, says that the Pentagon has ignored earlier criticism like Dr. Schwartz's and instead put flawed testing methods at the heart of all its plans to develop and build a weapon. The upshot, he says,

Continued on Page A22

Critics Maintain Pentagon Has Been Rigging Antimissile Tests to Hide a Crucial Flaw

Continued From Page A1

is that any real attacker — no matter how inexperienced — would be able to easily outwit the weapon.

Pentagon officials "are systematically lying about the performance of a weapon system that is supposed to defend the people of the United States from nuclear attack," Dr. Postol said in an interview.

General Kadish conceded that "this technology is difficult." As a result, he said, his organization's approach "is to walk before we run, with increasingly stressful decoys to match what we expect" by way of enemy threats. "When we get to that end point," he said, "we'll have the confidence to put this on alert."

But far from increasing the complexity of future tests, the Pentagon has made them easier, military experts who examined the testing plan agreed. Two rigorous experiments, in 1997 and 1998, to have the weapon simply observe the targets, they said, have been followed by interception tests designed to make discriminating between decoys and mock warheads as easy as possible.

"They did a good fox trot for the first couple of tests and then slowed down to a crawl," said Bob Dietz, a retired former designer of warhead decoys for American missiles. "You have to ask why they don't build better decoys. They've always said they'd get better with time."

Michael W. Munn, a retired scientist for the military contractor Lockheed and a pioneer in designing and testing antimissile weapons, said: "The only way to make it work is to dumb it down. There's no other way to do it. Discrimination has always been the No. 1 problem, and it will always remain that way."

He said manipulation of antimissile flight tests was nothing new. "It's always been a wicked game," Mr. Munn said.

The Pentagon itself is sharply divided on the testing issue. In February, Philip E. Coyle III, the Defense Department's director of testing and evaluation, faulted the antimissile tests as insufficiently realistic to make decisions about moving from research to building the weapon.

The 16 interception test flights called for in the development program would cost at least $1.6 billion, Pentagon experts say. So far, the two observation tests have been followed by two interception attempts, the first successful, the second a failure. Another test is scheduled in July.

The Clinton administration plans to make a decision later this year on whether to start building the antimissile system, which is to shield the United States from limited missile attacks by so-called rogue states.

Dr. Postol, a professor of science and national security studies at M.I.T. and the author of many private and federal weapon reports, was a top Navy science adviser in the Reagan administration and for decades has studied enemy counter measures to antimissile weapons.

After the 1991 Persian Gulf war, he challenged the Army's claims of success for its Patriot antimissile system, saying it had, in fact, destroyed no Iraqi missiles at all. Though the Pentagon at first denied his assertion, it later conceded that initial reports of the Patriot success had been exaggerated.

The current scientific fray centers on the interceptor's 120-pound homing device, known as a kill vehicle. Fired on a rocket, it is designed to use a telescopic sensor, a computer and jet thrusters to steer itself through space toward a warhead, destroying it by force of impact.

Dr. Postol's critique involves its hardest job, distinguishing between actual enemy warheads and the cloud of decoys considered sure to be launched to disguise them. If unable to tell decoys from warheads, a defender would be forced to fire interceptors at every threatening object, quickly exhausting a defensive force.

Dr. Postol began digging into the first antimissile flight test, in June 1997, after reviewing Pentagon data gathered by Dr. Schwartz.

The sensors at issue are cooled to more than 300 degrees below zero and work in the icy void of space to track faint heat emissions from warm targets, just as ordinary telescopes track light. They see warheads and decoys as twinkling points of light, like stars.

The June 1997 flight test, Dr. Postol asserted, showed that the infrared twinkles were random and insufficiently different from one another to let the interceptor distinguish among them, and that the Pentagon had conspired to hide this surprising discovery. The Pentagon, he said, has altered future tests to artificially heighten any differences that could be detected between warheads and decoys.

His accusation is based mainly on a detailed chart from the Pentagon's Ballistic Missile Defense Organization that gives an overview of its program for Integrated Flight Tests of the kill vehicle. Entitled "I.F.T. Targets Selections," the chart is dated May 5, 2000, and at the top is labeled "For Planning Purposes." The chart's bottom warns, "Configuration controlled by N.M.D. J.P.O.," or the National Missile Defense Joint Program Office. "Do not alter this document."

The chart starts with the June 1997 test, lists another sensor flight and then goes through the 16 intercept tests scheduled for the kill vehicle's entire development. The last flight is listed as June 2004, right before the antimissile weapon is to begin operating in 2005. In each case, the chart spells out the exact type and number of test decoys and warheads and depicts them in small pictures.

Dr. Postol said the chart shows how the initial suite of challenging decoys, the ones that twinkled a lot, making them hard to distinguish from a warhead, had been replaced by fewer and simpler decoys that twinkled as little as possible, accentuating their differences from warheads that fluctuate a lot in infrared intensity.

Long and conelike, pointy at one end, flat at the other, the warheads can wobble and shift in complex ways while moving through space, presenting differing heat emissions to a distant sensor. By contrast, the spherical decoy balloons have more uniform signatures.

The removed decoys, Dr. Postol said in his report, all had infrared signatures similar to the warheads. Abandoned were spherical balloons whose stripes made their infrared emissions fluctuate, rigid decoys that looked like warheads and balloons that inflated to conelike shapes.

"These decoys," he wrote, "have brightness and time-dependent oscillating signals that can be quite similar to the signals from either warheads that are spinning around their axis of symmetry, or tumbling end over end."

The only retained decoys, he said, were spherical, uniform in materials and substantially brighter or dimmer than warheads. Their signatures, he said, "will have very uniform and controlled intensities."

All the program's interception tests, Dr. Postol said in the draft report to the White House, "have been carefully orchestrated to avoid encountering the discrimination problems." In an interview, he said he hoped to get the report, a draft of which runs to 20 pages, to the White House next week.

General Kadish, while saying the planning chart was authentic, if tentative, strongly denied that the testing program had been structured to become increasingly easy. To the contrary, he said, the decoys were selected to make the evolving tests increasingly hard.

"Complexity is increasing," he said.

Asked how a smooth balloon could be more difficult to track than a rigid decoy shaped to look like a warhead, he replied, "That's a valid technical argument," but he added that just because a decoy seemed effective "doesn't mean its credible."

The test program, he said, was structured to make the weapon flexible and robust. Testing it against decoy shapes that were too specific might allow an enemy to fool the weapon by changing them "a little bit," General Kadish said. "What we're after is a basic physics approach."

Previously, Pentagon officials have said they reduced the complexity of some antimissile testing when the government cut the program's goal from trying to knock out advanced warheads from countries like Russia and China to more primitive ones from rogue states.

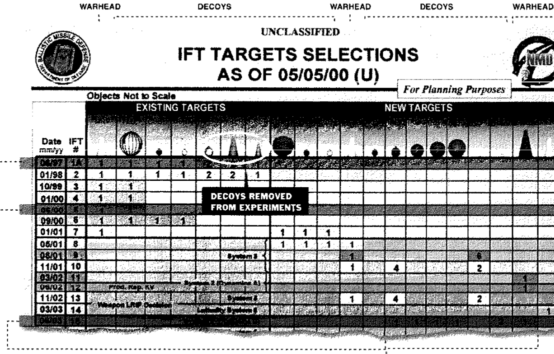
Lt. Col. Richard Lehner of the Air Force, an antimissile spokesman, said the current testing diagram depicts provisional goals rather than a hard and fast plan. The only decoy configuration set in concrete, he added, was the next test flight, which has been delayed repeatedly and is now scheduled for the first week of July.

Yesterday, Dr. Postol belittled the Pentagon's retorts, saying they were misrepresenting the program's logic. "They've been caught in one outright lie after another," he said.

KEEPING TRACK

Bar Reported Lowered For Missile Defense Tests

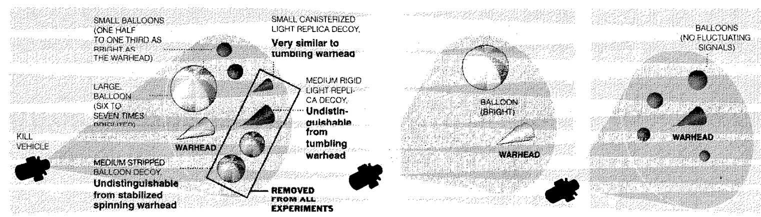
Theodore A. Postol and other critics of the proposed National Missile Defense system argue that future tests of the system are being manipulated to hide the fact that it cannot differentiate between realistic decoys and the warheads it is intended to intercept. The next test is set for July.



June 1997 and Jan. 98 Tests:
TWO TESTS WITH CREDIBLE DECOYS
The Exoatmospheric Kill Vehicle (EKV) sees the signals from distant objects as fluctuating points of light. The light from a rotating ballon covered with stripes fluctuates like that of a warhead changing its orientation as it rotates and/or tumbles in space. If the balloon is not clearly brighter or darker it becomes undistinguishable from the target.

July 2000 Test:
DECOYS REMOVED
After the second test, the only decoys retained were those that are spherical, and substantially brighter or dimmer than target warheads, and thus easily distinguishable.

June 2003 Test:
DECOYS REPLACED
All new decoys are modified to be featureless spheres so they have no time-varying signals like those of the non-spherical spinning and tumbling warheads.



Source: Theodore A. Postol, M.I.T.

The New York Times

Rick Friedman for The New York Times

Theodore A. Postol, the M.I.T. professor who obtained the Pentagon's antimissile testing plan.

Purpose of the Baseline Algorithm (BLA)

- Identify Known Objects By Matching ***Expected*** Appearance to ***Observed*** Appearance.
- Similar to Visually Identifying Suitcases at an Airport

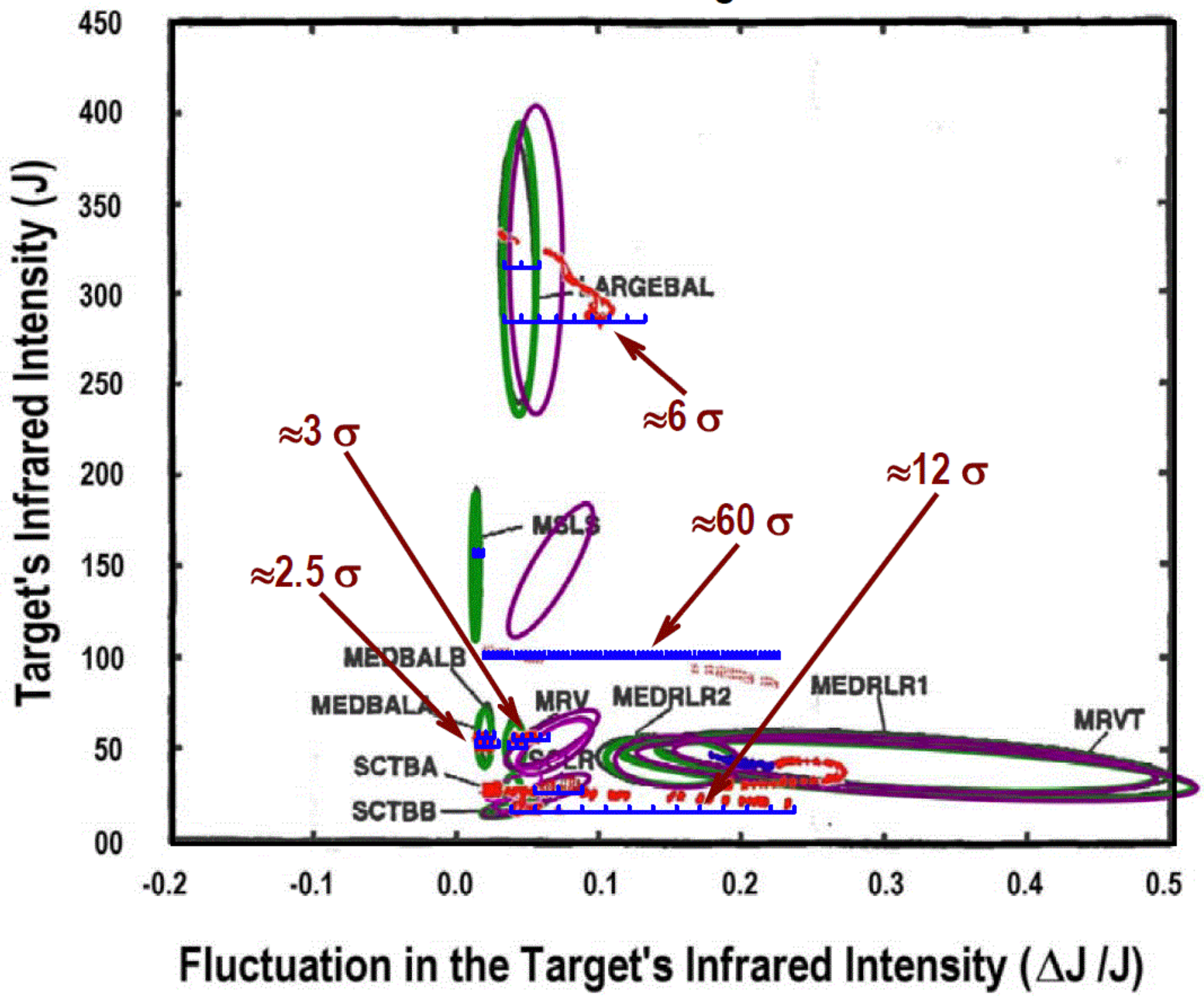
Objects Flown in the IFT-1A and IFT-2 NMD Tests

LARGEBAL	Large Balloon (2.2 Meter Diameter Balloon)
SCLR	Small Canisterized Light Replica (Balloon)
MEDBALA	Medium Balloon A (0.6 Meter Diameter Balloon)
MEDBALB	Medium Balloon B (0.6 Meter Diameter Balloon)
MEDRLR1	Medium Rigid Light Replica 1 (2 Meters Long & 0.6 Meter Base)
MEDRLR2	Medium Rigid Light Replica 2 (2 Meters Long & 0.6 Meter Base)

MSLS	Mission Service Launch System (Rocket Upper Stage)
SCTBA	Small Cannisterized Traffic Balloon A (Small Balloon)
SCTBB	Small Cannisterized Traffic Balloon B (Small Balloon)
MRV	Medium Reentry Vehicle (2 Meters Long & 0.6 Meter Base)

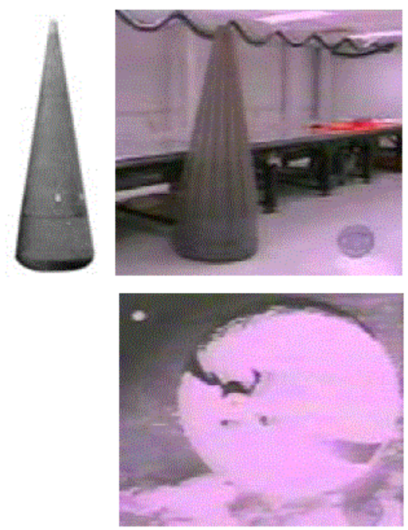
Non-Gaussian Behavior of the Data from the IFT-1A Experiment

Expected Values (One-σ Ellipse) for the Composite Intensity and Fluctuation in Composite Intensity for IFT-1A Target Set



Example of Warhead

Example of Possible "Replica" Decoy



Example of Striped Balloon Decoy

Reference:

Transparent Overlay of Figures 4 and 5 from the POET Report 1998-5

Original Plans to Fly Ten or More Objects in IFT-3 and IFT-4 Experiments

UNCLASSIFIED

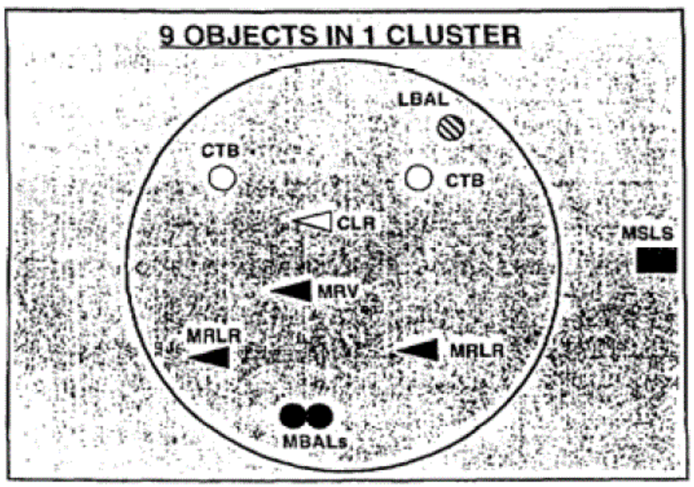
Nichols Research

TSRD TARGET REQUIREMENTS SUMMARY (IFT-1 – 1FT-4) (U)

Setac NRC

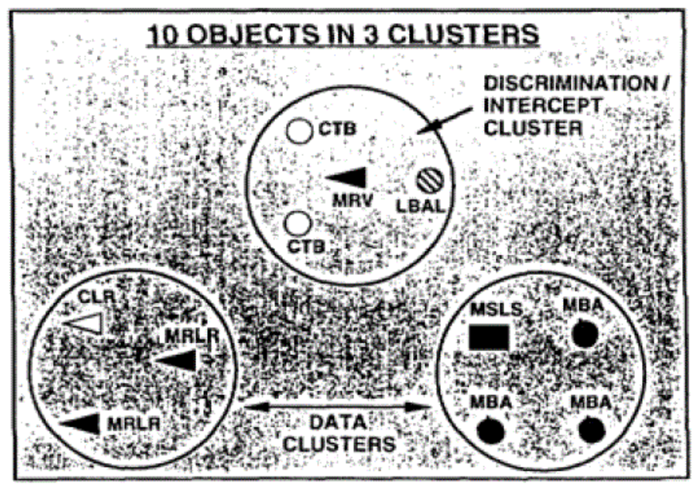
IFT 1&2
SENSOR FLIGHT TESTS
AUG 96 / NOV 96

- 1 MED RV (I)
- 2 MED RIGID LIGHT REPLICAS (MRLR) (I)
- 2 MED BALLOONS (MB) (U)
- 1 CANISTERIZED LIGHT REPLICA (CLR) (I)
- 2 CANISTERIZED TRAFFIC BALLOONS (CTB) (I)
- 1 LG BALLOON (LB) (U)



IFT 3&4
EKV FLIGHT TESTS
OCT 97 / JAN 98

- 1 MED RV (I)
- 2 MED RIGID LIGHT REPLICAS (MRLR) (I)
- 3 MED BALLOONS (MB) (U)
- 1 CANISTERIZED LIGHT REPLICA (CLR) (I)
- 2 CANISTERIZED TRAFFIC BALLOONS (CTB) (I)
- 1 LG BALLOON (LB) (U)



I - INSTRUMENTED
U - UNINSTRUMENTED

LARGE CL
MED. CLA
SMALL CL

After First Test Failed, All Subsequent Tests Rigged to Avoid the Further Failures

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IFT TARGETS SELECTIONS AS OF 05/05/00 (U)

For Planning Purposes

Objects Not to Scale

Date mm/yy	IFT #	MRV	LB	CSB-1	CSB-2	MB	MRLR	SCLR	LSB	SSB-A	SSB-B	MTRV	IRB-1	IRB-2	IRB-3	IRB-4	IRB-5	RB-1	RB-2	GROW	MLRV
		EXISTING TARGETS							NEW TARGETS												
06/97	1A	1	1	1	1	2	2	1													
01/98	2	1	1	1	1	2	2	1													
10/99	3	1	1																		
01/00	4	1	1																		
06/00	5	1	1																		
09/00	6	1	1	1	1																
01/01	7	1							1	1	1										
05/01	8								1	1	1	1									
08/01	9	System 5										1						6			
11/01	10											1		4				2			
03/02	11																			1	
06/02	12	Prod. Rep. KV — System 2 (Dynamics A)																		1	
11/02	13	Weapon LRIP Decision — System 5										1		4				2			
03/03	14	Lethality System 5																			1
06/03	15	System 2 (Dynamics B)												1	1	1	1		2	1	
11/03	16	Lethality System 5																			1
02/04	17	Lethality System 5																			1
06/04	18	System 2 (Dynamics B, CSOs)												1	1	1	1		2	1	
11/04	19																				
03/05	20												OTA TESTS								
05/05	21																				

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▒ = Nighttime Engagement

NMD Forging America's Shield

5/5/00 NMD Flight Test Targets and Scenarios Task Update

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4

After First Test Failed, All Subsequent Tests Rigged to Avoid the Further Failures

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IFT TARGETS SELECTIONS AS OF 05/05/00 (U)

For Planning Purposes

Objects Not to Scale

Date mm/yy	IFT #	MRV	LB	CSB-1	CSB-2	MB	MRLR	SCLR	LSB	SSB-A	SSB-B	MTRV	IRB-1	IRB-2	IRB-3	IRB-4	IRB-5	RB-1	RB-2	GROW	MLRV
		EXISTING TARGETS							NEW TARGETS												
06/97	1A	1	1	1	1	2	2	1													
01/98	2	1	1	1	1	2	2	1													
10/99	3	1	1																		
01/00	4	1	1																		
06/00	5	1	1																		
09/00	6	1	1	1	1																
01/01	7	1							1	1	1										
05/01	8								1	1	1	1									
08/01	9							System 5				1						6			
11/01	10											1		4				2			
03/02	11																			1	
06/02	12	Prod. Rep. KV				System 2 (Dynamics A)														1	
11/02	13							System 5				1		4				2			
03/03	14	Weapon LRIP Decision				Lethality System 5															1
06/03	15					System 2 (Dynamics B)								1	1	1	1		2	1	
11/03	16					Lethality System 5															1
02/04	17					Lethality System 5															1
06/04	18					System 2 (Dynamics B, CSOs)								1	1	1	1		2	1	
11/04	19													OTA TESTS							
03/05	20																				
05/05	21																				

Scintillating Targets Removed from Test Program

Scintillating Stripes Removed

Scintillating Stripes Removed

Strongly Scintillating Tumbling Warhead

Configuration controlled by NMD JPO – Do not alter this document.

▭ = Nighttime Engagement

NMD Forging America's Shield

5/5/00 NMD Flight Test Targets and Scenarios Task Update

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4

Claims of Success in the IFT-1A and IFT 2 Experiments Made to Congress

Opening Statement By *Lieutenant General Lester L. Lyles*, USAF
Director, Ballistic Missile Defense Organization
before the Subcommittee on Defense Committee on Appropriations *(April 22, 1998)*

"During the past year, Mr. Chairman, ***we conducted two very successful*** NMD exoatmospheric kill vehicle - or EKV - ***flight tests***. Two different industry teams supported those efforts and are competing against each other. ***We demonstrated*** in those initial tests ***that we can*** use an EKV sensor to ***identify and track*** objects in space - including ***threat representative targets and decoys*** - and allow us to discriminate and determine what is an actual target and what is not."

Statement of
***Lieutenant General Ronald T. Kadish*, USAF**
Director, Ballistic Missile Defense Organization
Before the
House Armed Services Committee
Subcommittee on Military Research & Development
Thursday, *June 22, 2000*

This significant countermeasures package [in the IFT-1A and IFT-2 experiments] contained more objects than the countermeasures packages we employed during IFT-3 and IFT-4 because ***we wanted to see how well the EKVs could discriminate within the target complex and identify the warhead. We gathered an immense amount of data that increased our confidence in our ability to meet the discrimination challenge***. ***IFT-1A and 2 demonstrated a robustness in discrimination capability that went beyond the baseline threat*** for purposes of designing the Expanded C-1 system.

This phase began with IFT-3, a partially integrated intercept test, when we successfully demonstrated our ability to do on-board discrimination and target selection as well as hit-to-kill.

Claims of Success in the IFT-1A and IFT 2 Experiments Made to the Press

EKV prototypes discriminate 'spectacularly well,' boeing nmd chief says
Inside Missile Defense, September 30, 1998 -

"[The] particular target complex that these seekers were launched against was a quite sophisticated target complex, far more than we have to handle for an initial deployment," Peller noted. "Without going into details let me say that each seeker, using its own discrimination algorithms, positively nailed the reentry vehicle identified in the set of all those objects. . . . It picked it all up -- objects of all types," he said.

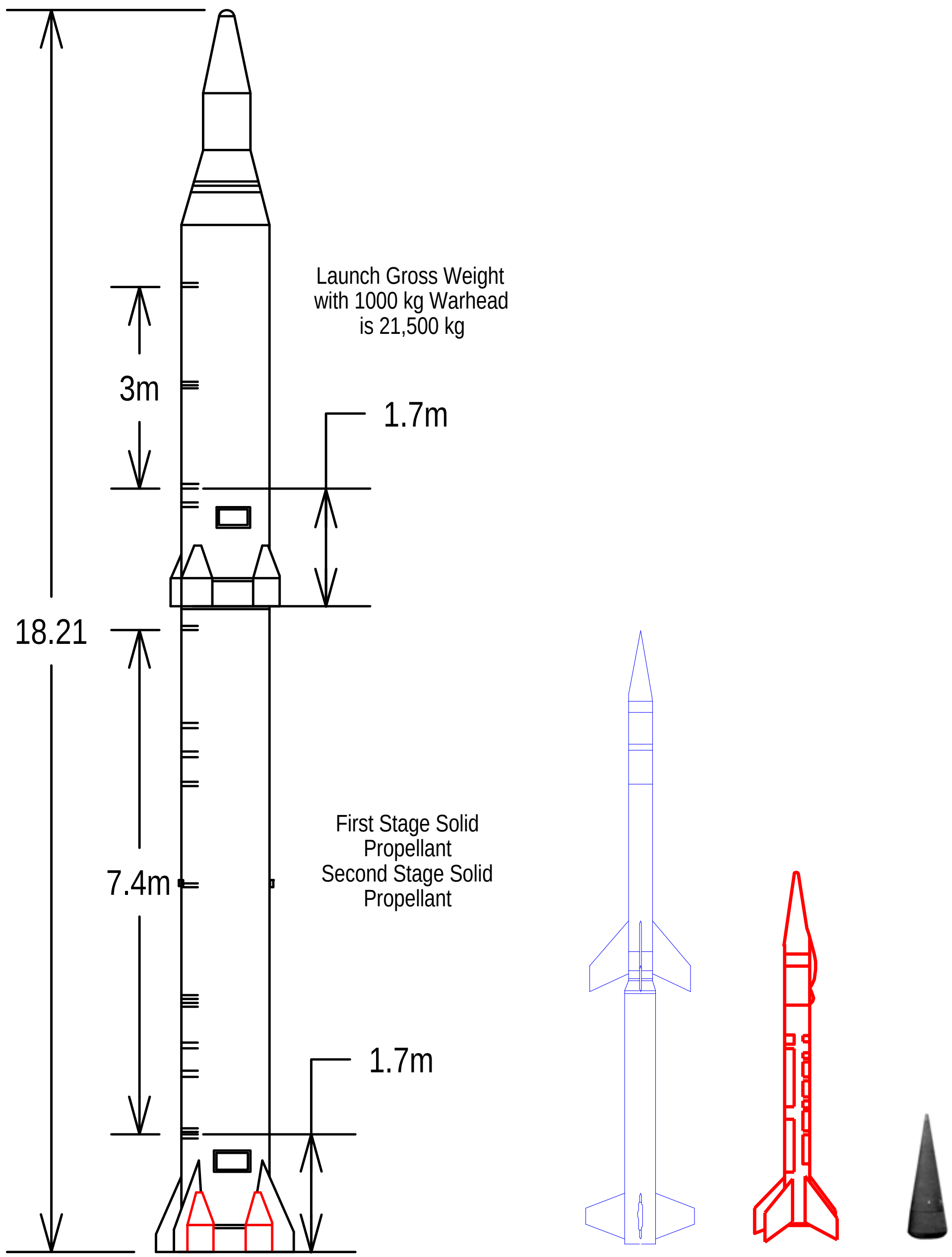
"We went from the case of not having any demonstrated optical discrimination to all of a sudden having an abundance of it."

BMDO BEGINS 'ORDERLY PHASEOUT' OF BOEING BACKUP NMD KILL VEHICLE
Inside Missile Defense, May 19, 2000 -

"We found that in both cases we were able to pick the reentry vehicle out of the target complex. There was just some minor adjustments done after that based on what they learned, but with the data that they had, they were able to pick it out in both cases."

Data from those tests will benefit the NMD program over the next 10 years, Englander noted.

Current Testing of Missile Defense Systems

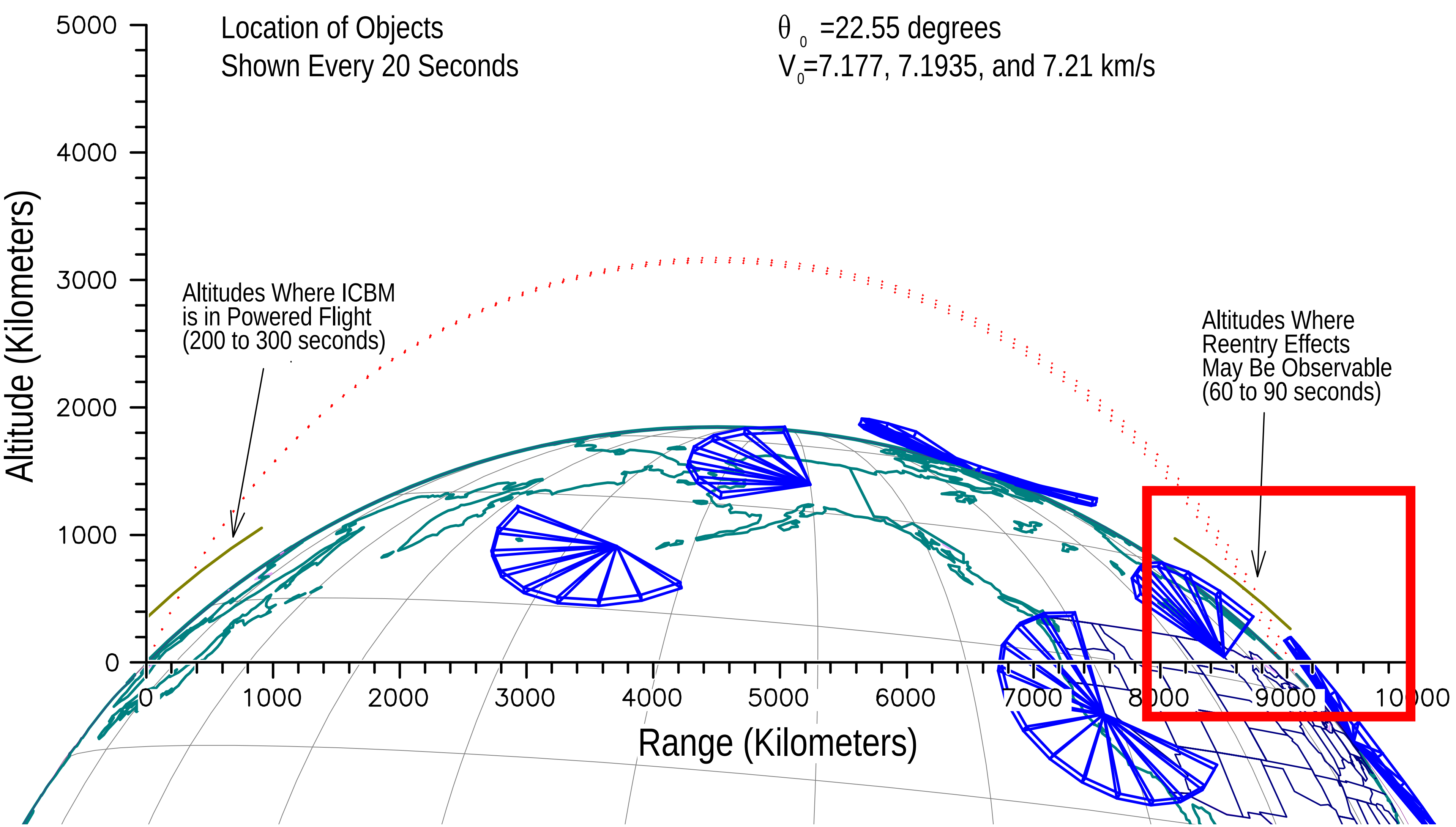


Current Testing of Missile Defense Systems

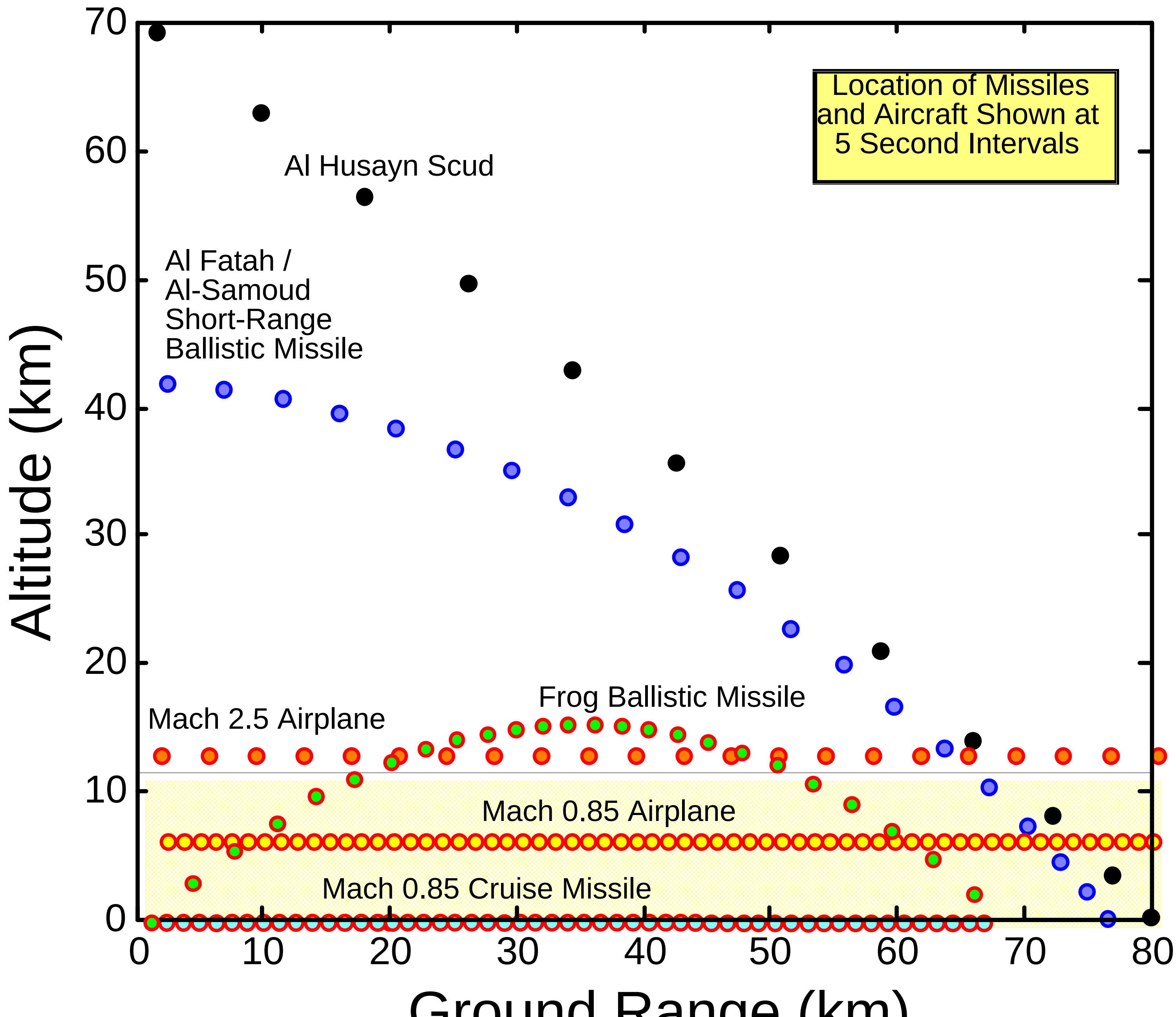
Reentry-Phase Defense Systems

Characteristics of Aircraft and “Short-Range” Ballistic Missiles Engaged by Patriot in the Gulf Wars of 1991 and 2003

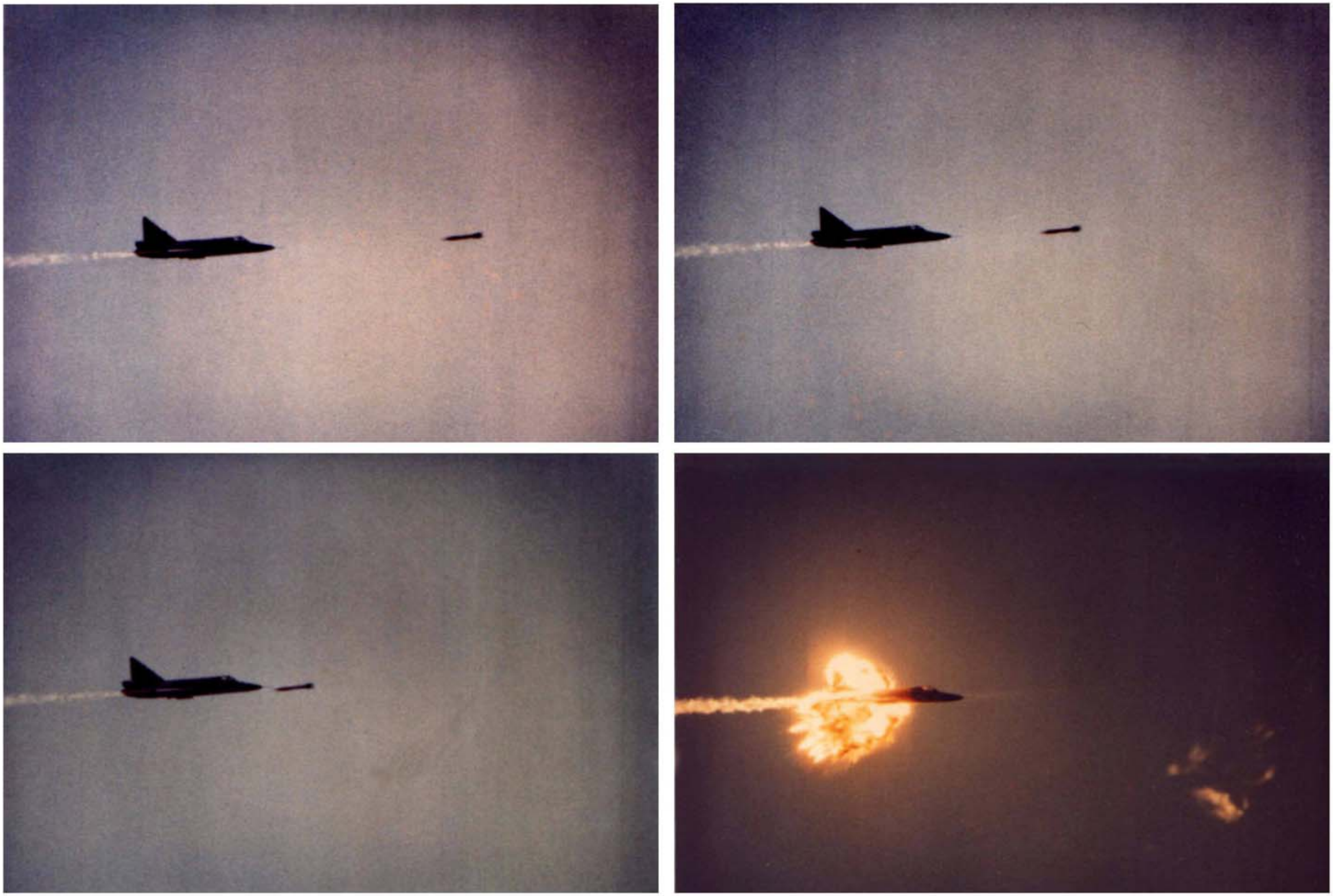
Boost-Phase, Mid-Course, and Reentry Phases of Ballistic from North Korea



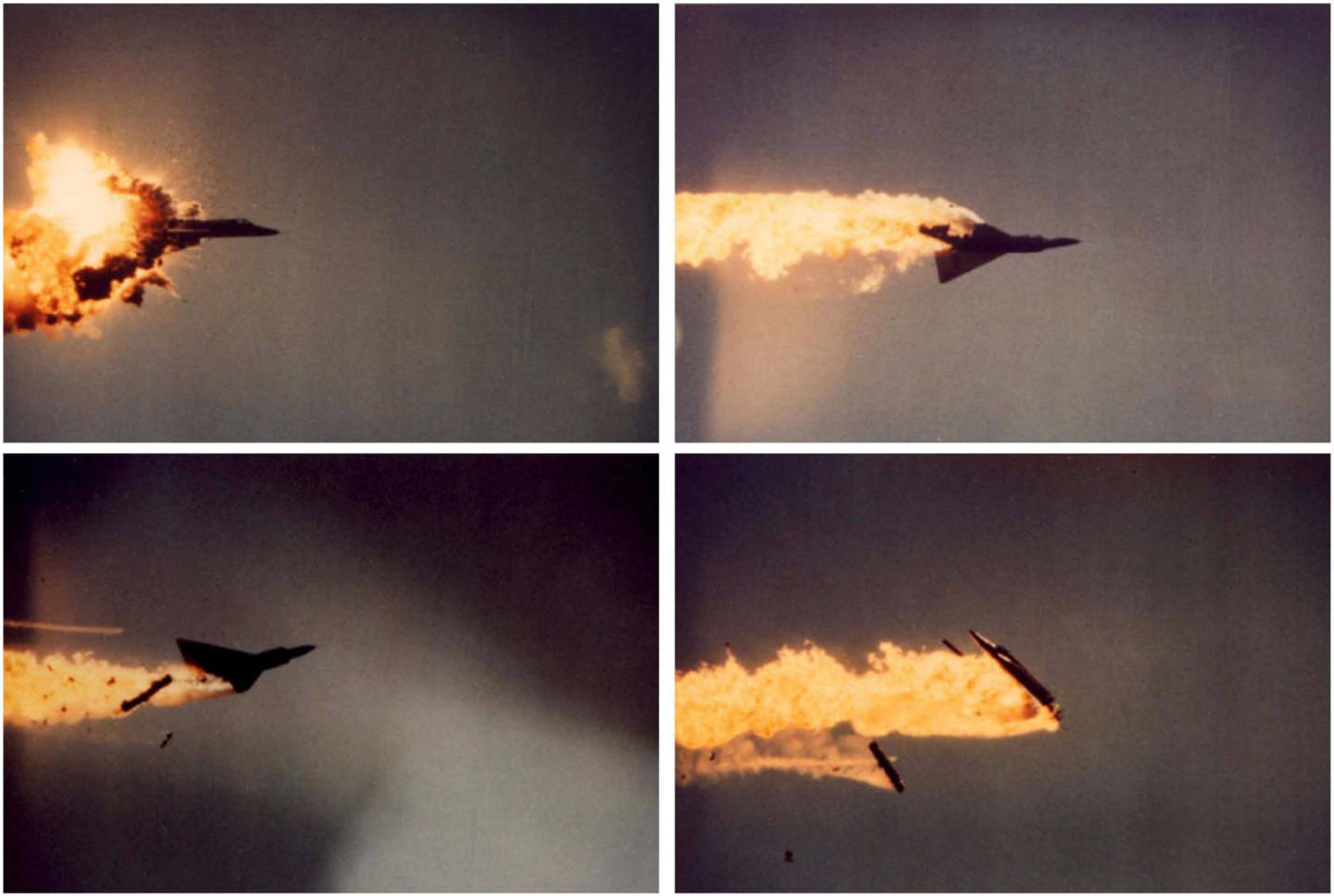
The Challenges Posed by Ballistic and Aircraft Targets

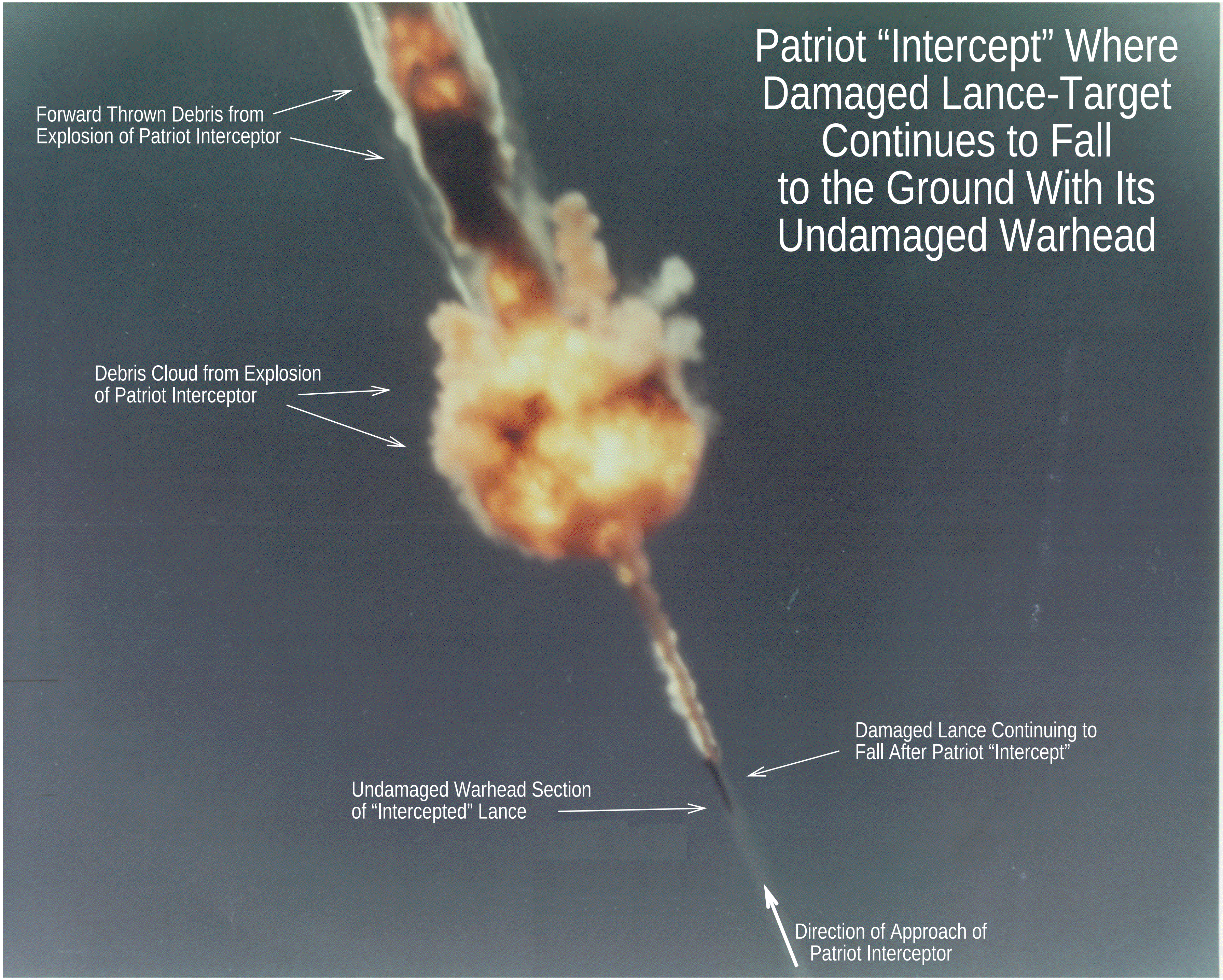


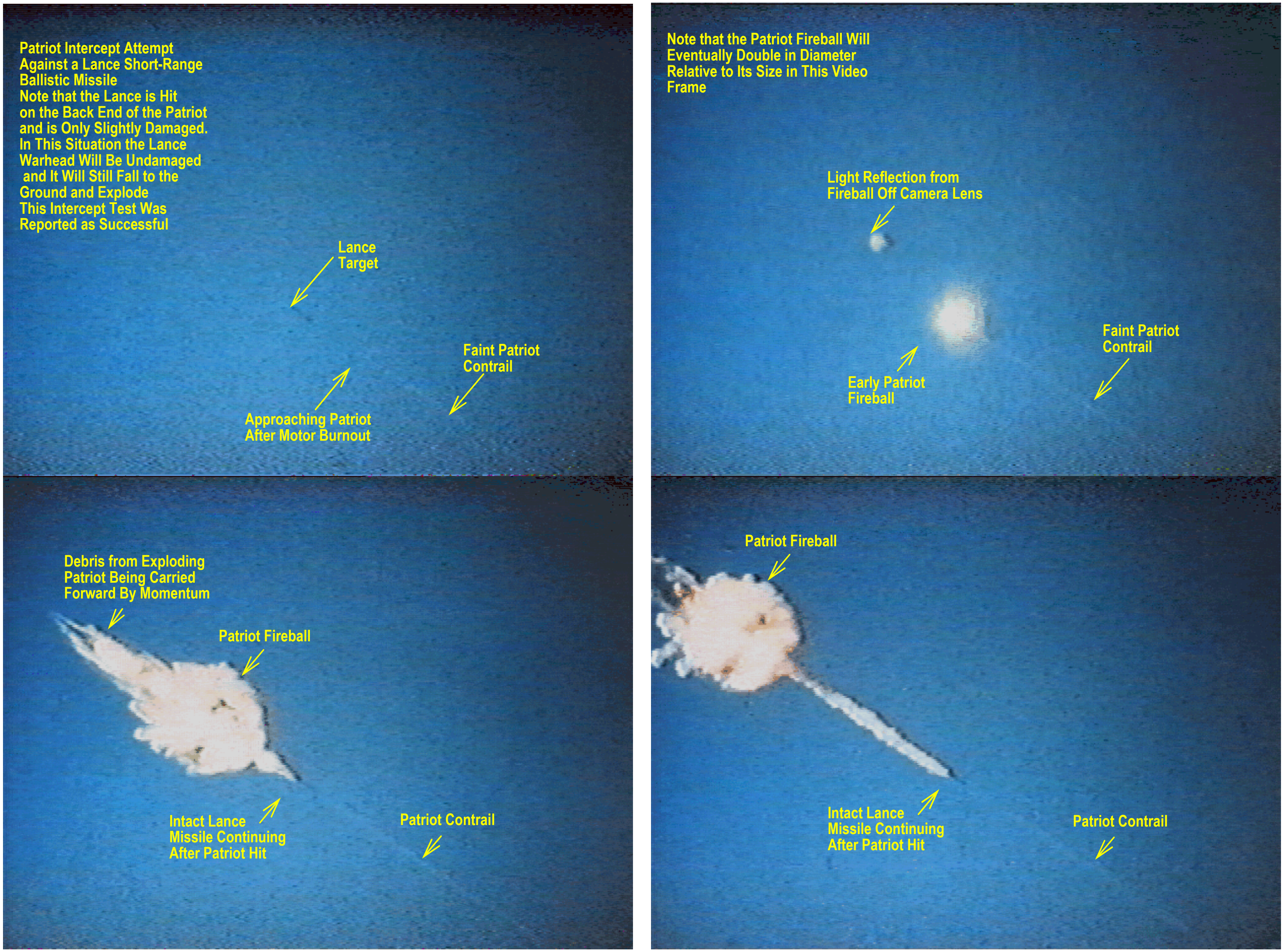
Why Intercepting Airplanes is Much Less Challenging than Intercepting Ballistic Missiles (1 of 2)



Why Intercepting Airplanes is Much Less Challenging than Intercepting Ballistic Missiles (2 of 2)




Patriot "Intercept" Where
Damaged Lance-Target
Continues to Fall
to the Ground With Its
Undamaged Warhead
Forward Thrown Debris from
Explosion of Patriot Interceptor
Debris Cloud from Explosion
of Patriot Interceptor
Damaged Lance Continuing to
Fall After Patriot "Intercept"
Undamaged Warhead Section
of "Intercepted" Lance
Direction of Approach of
Patriot Interceptor


Patriot Intercept Attempt
Against a Lance Short-Range
Ballistic Missile
Note that the Lance is Hit
on the Back End of the Patriot
and is Only Slightly Damaged.
In This Situation the Lance
Warhead Will Be Undamaged
and It Will Still Fall to the
Ground and Explode
This Intercept Test Was
Reported as Successful
Lance
Target
Faint Patriot
Contrail
Approaching Patriot
After Motor Burnout
Note that the Patriot Fireball Will
Eventually Double in Diameter
Relative to Its Size in This Video
Frame
Light Reflection from
Fireball Off Camera Lens
Faint Patriot
Contrail
Early Patriot
Fireball
Debris from Exploding
Patriot Being Carried
Forward By Momentum
Patriot Fireball
Intact Lance
Missile Continuing
After Patriot Hit
Patriot Contrail
Patriot Fireball
Intact Lance
Missile Continuing
After Patriot Hit
Patriot Contrail