United States General Accounting Office

GAO

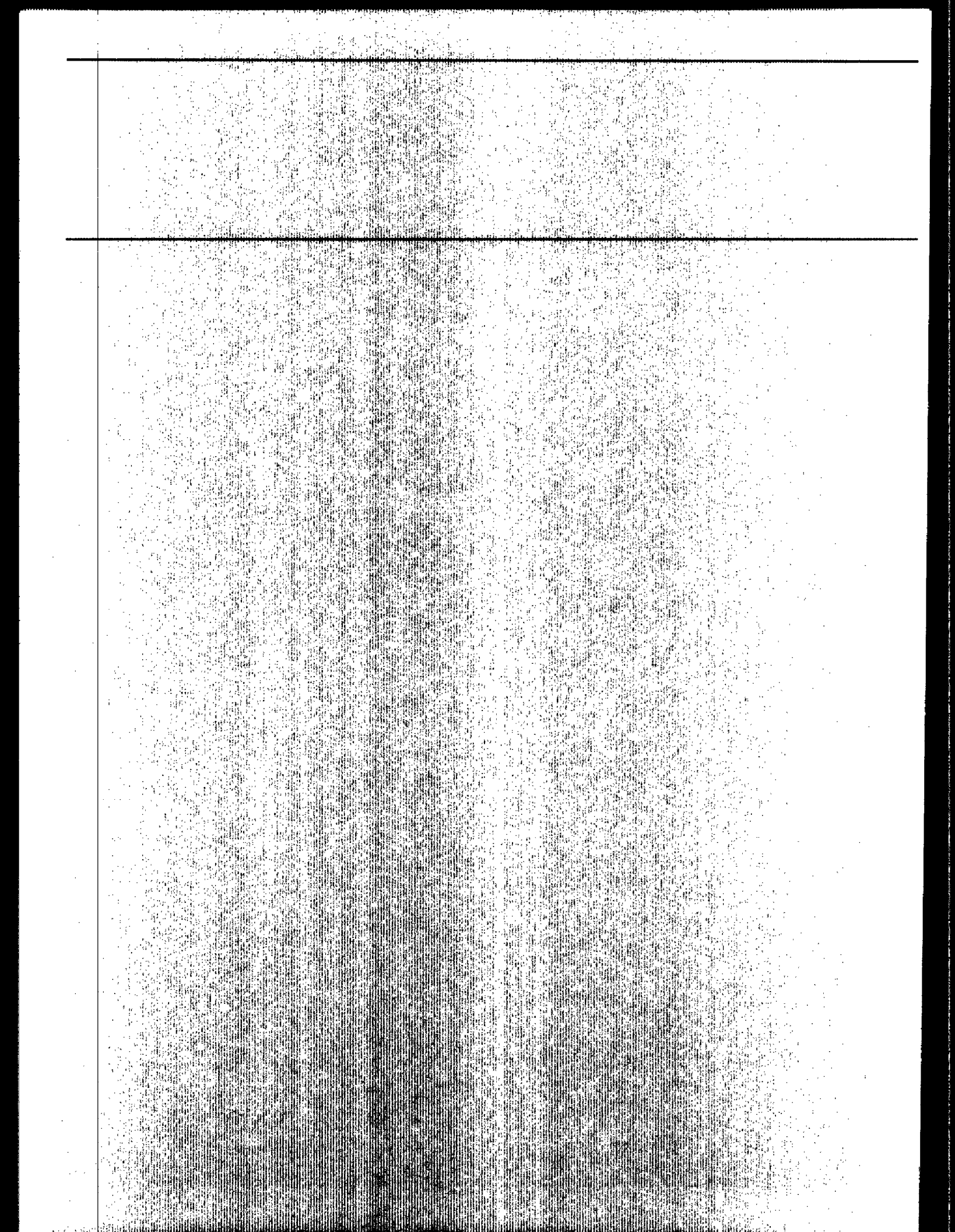
Briefing Report to the Chairman, Committee on Foreign Relations, U.S. Senate

January 1994

BALLISTIC MISSILE DEFENSE

Information on Theater High Altitude Area Defense (THAAD) System

GAO/NSIAD-94-107BR



GAO

United States
General Accounting Office
Washington, D.C. 20548

150790

National Security and
International Affairs Division

B-223094

January 27, 1994

The Honorable Claiborne Pell
Chairman, Committee on
Foreign Relations
United States Senate

Dear Mr. Chairman:

The Ballistic Missile Defense Organization is developing the Theater High Altitude Area Defense (THAAD) weapon system to counter theater ballistic missiles. In response to your request, we are providing information on (1) the expected cost, schedule, and acquisition quantities of THAAD; (2) the relationship envisioned for the capabilities of THAAD, Patriot Advanced Capability-Three (PAC-3), and a National Missile Defense system; (3) the relationship of range to peak reentry velocity for ballistic missiles against which systems such as THAAD would defend; and (4) the ranges and types of ballistic missiles of developing countries. On January 14, 1994, we briefed your office on the results of our work. This report documents the information presented in that briefing (see app. I).

BACKGROUND

THAAD is to engage theater ballistic missiles at high altitudes and long ranges using hit-to-kill technology. High-altitude intercepts reduce the probability that debris and chemical or biological agents from a ballistic missile warhead will reach the ground in damaging amounts. Long-range intercepts provide protection to wide areas, dispersed assets, and population centers. THAAD is to be deployed with the PAC-3 system and will consist of missiles, mobile launchers, ground based radars, a tactical operations center, and support equipment.

RESULTS

The estimated cost for the THAAD system, including radars, is $14.5 billion. The Department of Defense plans to buy 1,422 THAAD missiles, 99 launchers, and 18 radars. The THAAD demonstration/validation contracts were awarded in 1992. The program is scheduled to begin engineering and

manufacturing development in 1996 and begin low-rate initial production in 1999.

THAAD is being designed to defend against medium- to long-range theater ballistic missiles. It will constitute the upper tier of a two-tier theater defense system, with PAC-3 as the lower tier. The peak reentry velocity of the missiles THAAD is to counter is proportional to their maximum range and increases as the range increases. In developing countries, there are more than 30 types of theater ballistic missiles either operational or under development. In addition, the number of countries that possess longer range theater missiles is expected to increase.

SCOPE AND METHODOLOGY

To accomplish our objectives, we reviewed Department of Defense threat documents; a threat study prepared for the Ballistic Missile Defense Organization and reviewed by its Advisory Committee; THAAD and PAC-3 operational requirements documents; and THAAD cost estimates, schedules, and other program documents. We met with Department of Defense and Arms Control and Disarmament Agency officials. In Huntsville, Alabama, we met with THAAD system project officials and U.S. Army Space and Strategic Defense Command officials.

We performed our work between December 1993 and January 1994 in accordance with generally accepted government auditing standards. THAAD system project officials and Ballistic Missile Defense Organization and Arms Control and Disarmament Agency officials reviewed the information in this briefing report and generally agreed with the facts presented. We have made changes where appropriate.

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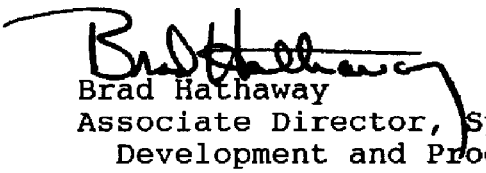
As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from its issue date. At that time, we will send copies to the Chairmen of the Senate and House Committees on Armed Services and on Appropriations; the Secretaries of Defense and the Army; the Director of the Ballistic Missile Defense Organization; and the Director of the Arms Control and Disarmament Agency. Copies will also be made available to others upon request.

If you or your staff have any questions concerning this report, please contact me at (202) 512-4841. The major contributors to this report are listed in appendix II.

Sincerely yours,



Brad Hathaway
Associate Director, Systems
Development and Production Issues

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Abbreviations

ABM	anti-ballistic missile
BM/C^3I	battle management/command, control, communication, and intelligence
EMD	engineering and manufacturing development
FSP	full-scale production
ICBM	intercontinental ballistic missile
LRIP	low-rate initial production
NMD	national missile defense
PAC-3	Patriot Advanced Capability-Three
THAAD	Theater High Altitude Area Defense
TMD	theater missile defense
TMD-GBR	Theater Missile Defense-Ground Based Radar
UOES	User Operational Evaluation System

APPENDIX I

GAO Briefing for Senate Committee on Foreign Relations

Ballistic Missile Defense

Information on Theater High Altitude Area Defense (THAAD) System

January 14, 1994

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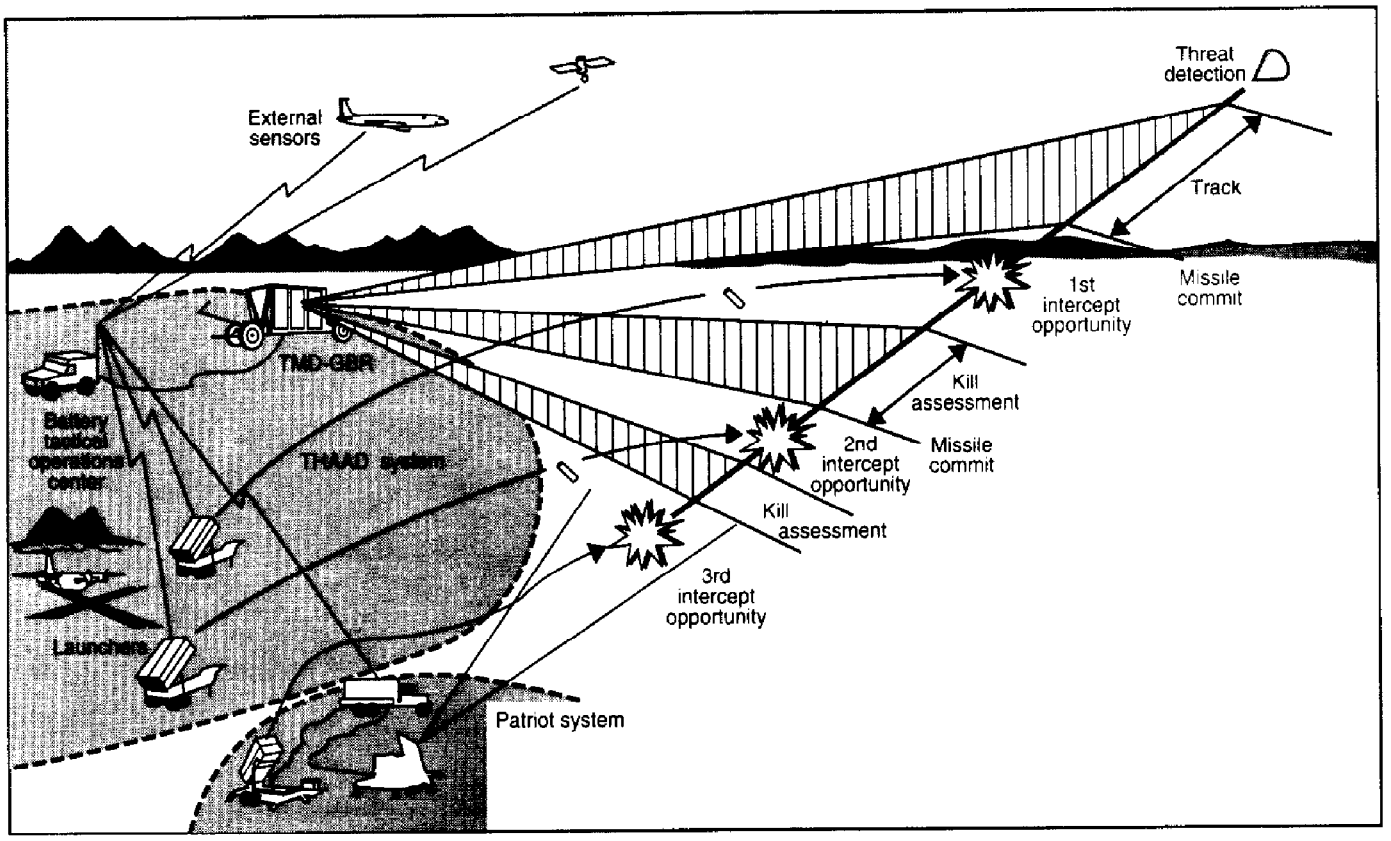
APPENDIX I

GAO Theater Missile Defense Operating Concept



In a potential sequence of operations, an external early warning sensor, if available, would detect the target and cue the THAAD system for an interceptor launch before the Theater Missile Defense-Ground Based Radar (TMD-GBR) could acquire the target. With or without the external sensor, the TMD-GBR would eventually acquire and track the target. After receiving target identification and guidance information from the radar, the THAAD interceptor would engage the target, and a kill assessment would be conducted by the TMD-GBR and tactical operations center. Then, if necessary, a second THAAD interceptor would be launched. If the subsequent kill assessment again shows that the target was not destroyed, the TMD-GBR would cue the PAC-3 system to engage the missiles that evaded THAAD.

APPENDIX I

GAO THAAD Costs (In millions of escalated dollars)

THAAD	$9,096.4
TMD-GBR	5,384.4
Total	$14,480.8

GAO Details of THAAD Costs (In millions of escalated dollars)

THAAD	
Development	$3,195.4
Production	3,397.9
Operation and support	2,503.1
Total THAAD	$9,096.4
TMD-GBR	
Development	$1,303.4
Production	2,141.4
Operation and support	1,939.6
Total TMD-GBR	$5,384.4

APPENDIX I

GAO THAAD Acquisition Quantities

Missiles	1,422
Launchers	99
TMD-GBR	18

GAO Details of THAAD Acquisition Quantities

Component	Testing	UOES system	THAAD system	Total
Missiles				
Research & development	69	40		109
Production			1,313	1,313
Total	69	40	1,313	1,422
Launchers				
Total	15	4	80	99
Radars				
Research & development	1	2	1	4
Production			14	14
Total	1	2	15	18

Of the 1,422 THAAD missiles, 69 would be produced during research and development for test purposes; 40 would be produced as User Operational Evaluation System (UOES) prototypes that could be fielded if necessary; and 1,272 would be produced and available for fielding with the THAAD system. The other 41 would be used for reliability testing. Of the 99 launchers, 15 would be produced during research and development for test purposes; 4 would be produced for deployment with the UOES system; and 80 would be produced and available for fielding with the THAAD system. Of the 18 radars, one would be produced during research and development for test purposes; two would be produced for deployment with the UOES system; and 15 would be produced and available for fielding with the THAAD system. These quantities of missiles, launchers, and radars would support two THAAD battalions.

GAO THAAD Schedule (in fiscal years)

1992	Demonstration/validation contracts awarded
1994	First flight test
1995	Exercise option to buy 40 User Operational Evaluation System (UOES) missiles
1996	Make decisions on engineering and manufacturing development (EMD)
1999	Start low-rate initial production
2001	First unit equipped
2002	Start full-scale production

GAO Details of THAAD Schedule

Fiscal year	Major events planned
1994	Final design review - (Nov 1993) Final design review update - (May 1994) First flight test in 4th quarter of 1994
1995	Integration of the BM/C^{3}I, TMD-GBR, and launcher for flight tests Right to exercise option for 40 UOES missiles Begin system tests
1996	Continue system tests UOES available at end of fiscal year Milestone II (EMD) decision (4th quarter 1996) EMD contract award
1998	Begin deliveries of EMD flight test vehicles
1999	Review for low-rate initial production (LRIP) LRIP buy #1 for 58 missiles
2000	LRIP buy #2 for 111 missiles
2001	LRIP buy #3 for 106 missiles Milestone III (production) decision First unit equipped date
2002	Full scale production (FSP) buy #1 for 210 missiles FSP buy #2 for 302 missiles
2003	FSP buy #3 for 302 missiles
2004	FSP buy #4 for 224 missiles
2005-6	Missile deliveries continue

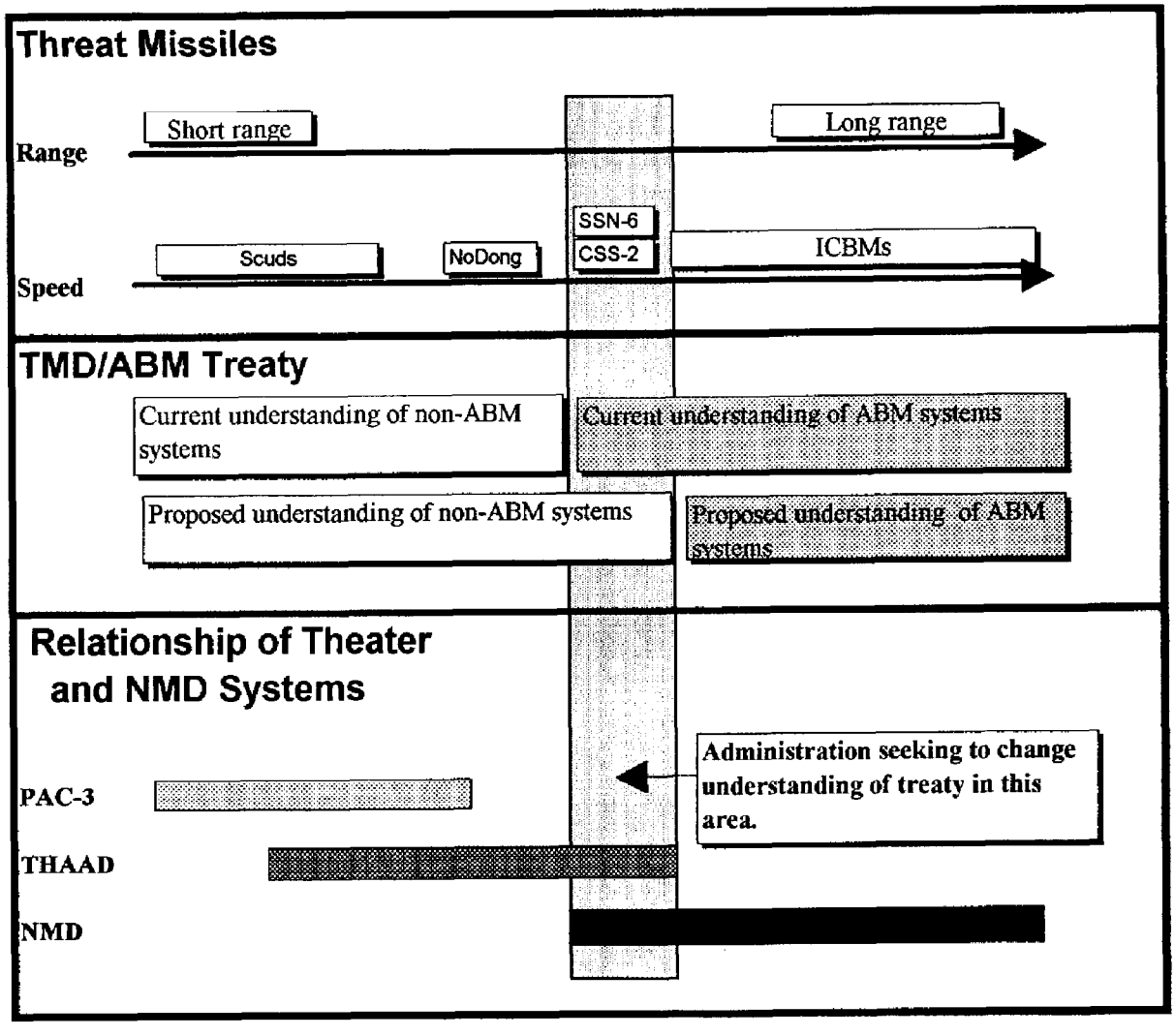
GAO Capabilities of THAAD, PAC-3, and NMD Systems

- THAAD will be upper tier of a two-tier theater defense system.
- PAC-3 will be lower tier.
- Two-tier defense is possible when THAAD and PAC-3 capabilities overlap.
- One-tier defense would result at ranges shorter than THAAD's minimum coverage or longer than PAC-3's maximum coverage.
- NMD, if deployed in defense of United States, would counter long-range strategic missiles.

The Ballistic Missile Defense Organization plans a two-tier theater missile defense architecture. The THAAD system constitutes the upper tier and provides a wide area of defense, to include coverage of dispersed assets and population centers. Intercepts will occur either outside the atmosphere or high in the atmosphere. PAC-3 comprises the lower tier, with intercepts inside the atmosphere, and will provide defense of critical assets. This two-tier architecture is designed to intercept threat missiles as far away as possible, maximize the number of intercept opportunities, and minimize the number of ballistic missiles that "leak" through the defense. However, this two-tier defense is possible only when the THAAD and PAC-3 capabilities overlap. Single-tier coverage results when defending against missiles with ranges either less than THAAD's coverage capability or greater than PAC-3's coverage capability.

APPENDIX I

GAO Relationship of THAAD, PAC-3, and NMD Systems

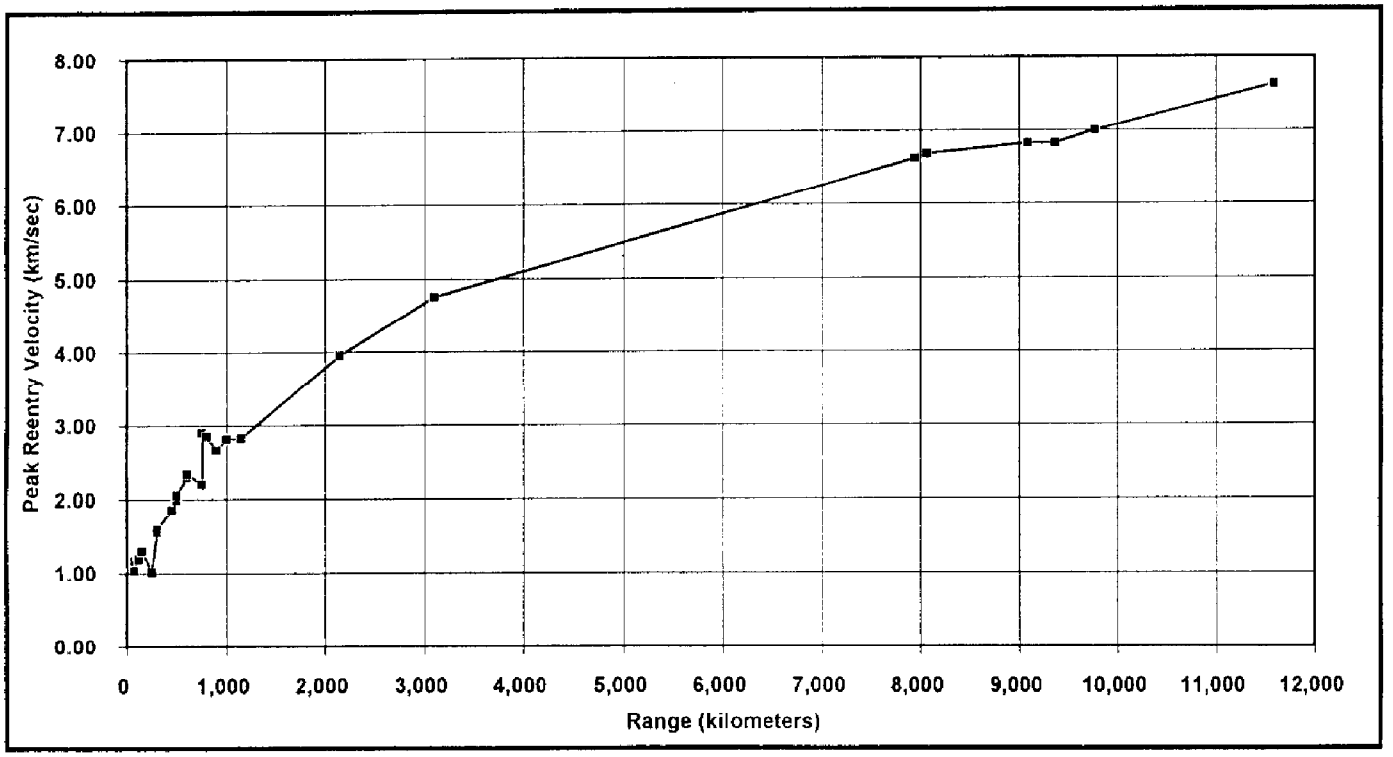


APPENDIX I

GAO Relationship of Range to Peak Reentry Velocity

- Peak reentry velocity increases as range of missile increases.
- Relationship of peak reentry velocity to range is nonlinear.

GAO Graph of Relationship of Range to Peak Reentry Velocity



GAO Table of Relationship of Range to Peak Reentry Velocity

	Km/Sec	Range (km)	Mi/sec	Range (mi)
1	1.03	70	0.6	43
2	1.16	80	0.7	50
3	1.19	120	0.7	75
4	1.30	150	0.8	93
5	1.02	250	0.6	155
6	1.55	300	1.0	186
7	1.60	300	1.0	186
8	1.86	450	1.2	280
9	1.99	500	1.2	311
10	2.05	500	1.3	311
11	2.30	600	1.4	373
12	2.34	600	1.5	373
13	2.20	750	1.4	466
14	2.90	750	1.8	466
15	2.85	800	1.8	497
16	2.66	900	1.7	559
17	2.82	1,000	1.7	621
18	2.83	1,150	1.8	715
19	3.95	2,150	2.5	1,336
20	4.75	3,100	3.0	1,926
21	6.62	7,949	4.1	4,939
22	6.68	8,068	4.2	5,013
23	6.82	9,092	4.2	5,650
24	6.82	9,363	4.2	5,818
25	7.00	9,773	4.3	6,073
26	7.00	9,772	4.3	6,072
27	7.62	11,589	4.7	7,201

GAO Ballistic Missiles of Developing Countries

- More than 30 types of ballistic missiles are either operational or under development.
- Thirteen countries have produced or are in the process of producing, missiles with ranges greater than 300 kilometers.
- Number of countries that possess longer range (>1,000 km) missiles is expected to increase.

A Ballistic Missile Defense Organization-requested study in 1992 found that more than 30 types of guided ballistic missiles with ranges of 30 kilometers or greater are either operational or under development in 19 developing nations. Thirteen countries have produced, or are in the process of producing, missiles with ranges greater than 300 kilometers. In addition, the number of countries possessing longer range (greater than 1,000 kilometers) missiles is expected to increase significantly over the next decade.

GAO Missiles Owned by Developing Countries

Country	Range in kilometers						Supplier
	Up to 300	500-650	900-1200	1500-2000	2001-2500	2501-3500	
Afghanistan	Scud B						USSR
Argentina	Alacran		Condor 2				Indigenous
Brazil	SS-300 SS-150 MB/EE-150 MB/EE-300	MB/EE-600	SS-1000 MB/EE-1000				Indigenous
China	B-610 M-11	M-9	M-?			CSS-2	Indigenous
Egypt	Scud B Scud B	Scud C	Vector				USSR North Korea franchise Indigenous (Condor technology)
India	Prithvi				Agni		Indigenous
Iran	Scud B Scud B Iran-130	Scud C					USSR North Korea franchise Indigenous
Iraq	Scud B Scud B	Scud C Al Hussein	Al Abbas Badr 2000	Al Aabed			USSR North Korea franchise Indigenous (Scud technology) Indigenous (Condor technology)
Israel	Lance	Jericho 1		Jericho 2			Indigenous United States
Libya	SS-21 Scud B	Scud C M-9	Al Fatah				USSR USSR North Korea China Indigenous
North Korea	Scud B	Scud C	No Dong 1	No Dong 2			Indigenous
Pakistan	Hatf 1 Hatf 2 M-11						Indigenous Indigenous China
Saudi Arabia						CSS-2	China
South Africa		Arniston					Indigenous (Jericho 1 technology)
South Korea	NHK-1,2 Lance NHK-A						Indigenous United States Indigenous
Syria	SS-21 Scud B Scud B	Scud C M-9					USSR USSR North Korea China
Taiwan	Green Bee		Sky Horse				Indigenous
Vietnam	Scud B						USSR
Yemen	SS-21 Scud B						USSR

Source: System Planning Corporation, Ballistic Missile Proliferation: An Emerging Threat, 1992.

APPENDIX II

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