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DNA-TR-92-102

Theater Missile Defense Integration Issues

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June 1993

Technical Report

CONTRACT No. DNA 001-89-C-0040

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REPORT DOCUMENTATION PAGE	Form Approved OMB No. 0704-0188

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	930601	Technical - 920401 - 921130

4. TITLE AND SUBTITLE
Theater Missile Defense Integration Issues

5. FUNDING NUMBERS
C - DNA 001-89-C-0040
PE - 62715H
PR - RF, RN
TA - RB, RN
WU - DH052450

6. AUTHOR(S)
MG Randall D. Peat, USAF (ret.) and Dr. Richard C. Goodwin

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Logicon RDA-Europe
DNA Field Office
CMR 451
APO AE 09708

8. PERFORMING ORGANIZATION REPORT NUMBER
RDA-92-002

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Defense Nuclear Agency
6801 Telegraph Road
Alexandria, Virginia 22310-3398
NAFS/Sanders

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
DNA-TR-92-102

11. SUPPLEMENTARY NOTES
This work was sponsored by the Defense Nuclear Agency under RDT&E RMC Codes B4662D RF RB 00108 NSSD 2530A 25904D and B4662D RN RN 00187 NAFS 2420A 25904D

12a. DISTRIBUTION/AVAILABILITY STATEMENT
Further dissemination only as directed by the Defense Nuclear Agency, 6801 Telegraph Road, Alexandria, VA 22310-3398, 19 January 1993, or higher DoD authority.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)
The Strategic Defense Initiative (SDI) has undergone numerous revisions since it was announced by then-President Reagan in 1983. Perhaps there has been no more fundamental evolution of SDI than that announced by President Bush in January 1991. After the major European reaction to Reagan's original concepts, reaction to subsequent revisions to SDI programs and priorities has been low key—even though President Bush's approach places greater emphasis on Allied cooperation and theater missile defense (TMD). It is apparent that there are a number of military and political questions and concerns that must be addressed if TMD is to be supported and planned for in the European environment. Some of them have been articulated by members of the U.S. defense community. However, while this paper notes the progress that many European actors have made in resolving TMD issues, for example, the United Kingdom Ministry of Defense's Strategic Defense Initiative Program Office has performed three major missile defense architecture studies and the SHAPE Technical Center has been a lead actor in the Extended Air Defense Test Program, clearly there is a need for a more thorough understanding in the U.S. Government of the Alliance perspective and their requirements. After reviewing recent, theater-related TMD activity, this paper suggests a program of study to identify and detail options to meet Allied concerns, to present those concerns to key U.S. Government agencies, and to provide strategic vision for theater missile defense integration.

14. SUBJECT TERMS
Theater Missile Defense
Strategic Defense
Alliance Strategic Concept

15. NUMBER OF PAGES
32

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	SAR

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

CLASSIFIED BY:
N/A since Unclassified.
DECLASSIFY ON:
N/A since Unclassified.

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SECTION 1

INTRODUCTION

1.1 GLOBAL PROTECTION AGAINST LIMITED STRIKES.

Global Protection Against Limited Strikes (GPALS) was introduced on 29 January 1991 in President Bush's State of the Union Address. GPALS reflects the Bush administration's perceptions of the changed strategic environment of the 1990s compared to the accelerating arms race of the 1980s, as well as the growing problem of ballistic missile proliferation. President Bush stated:

> Looking forward, I have directed that the SDI [Strategic Defense Initiative] Program be refocused on providing protection from limited ballistic strikes, whatever their source. Let us pursue an SDI program that can deal with any future threat to the United States, to our forces overseas and to our friends and allies.[1]

Significant harbingers of the new epoch were (a) the reduced likelihood of theater nuclear war attained through the INF Treaty; (b) the reduced capacity for theater conventional war after CFE Treaty reductions; (c) the potential for real reductions in the former Soviet Union's offensive forces and concomitant stability enhancements stemming from the ongoing START Treaty; and regional instabilities wherein traditional deterrence may be ineffective.[2] In addition to recognizing the overall change in the strategic environment, GPALS also recognizes the growing threat from third party missile proliferation.

The International Institute for Strategic Studies' research shows that many nations, such as Iraq prior to the Gulf War, possess surface-to-surface missiles (SSMs). These missiles come from various sources: (a) importation from countries like the former Soviet Union or China, (b) local modification of imported systems (like the FROG and SCUD produced in exporting states), or (c) indigenous production (the *Al Abbas* and *Al Husayn*). Many of these missiles are so-called triple capable, that is, they are capable of delivering conventional, chemical/biological, or nuclear warheads.[3] While recent trends—such as increased export controls, cancellation of some indigenous production, and the destruction of Iraqi missiles required by United Nations Resolution 687—have lessened the immediate threat, missile proliferation continues.[4] The Strategic Defense Initiative Organization (SDIO) estimates that, while only 18 nations can presently produce relatively long-range ballistic missiles (i.e., ranges over "a few hundred miles"), by the year 2000 over 24 nations will be able to do so.[5] In addition to the growing proliferation of Third World missiles, SDIO Director, Henry F. Cooper, also notes that instability within the former Soviet Union could lead to an unauthorized or accidental missile launch against the United States.[6]

It is envisioned that the GPALS system will retain some aspects of the SDI Phase I architecture and many aspects of the Brilliant Pebbles design. A GPALS defensive system is shown in Figure 1.[7] All missile defense systems have three essential elements, namely, battle

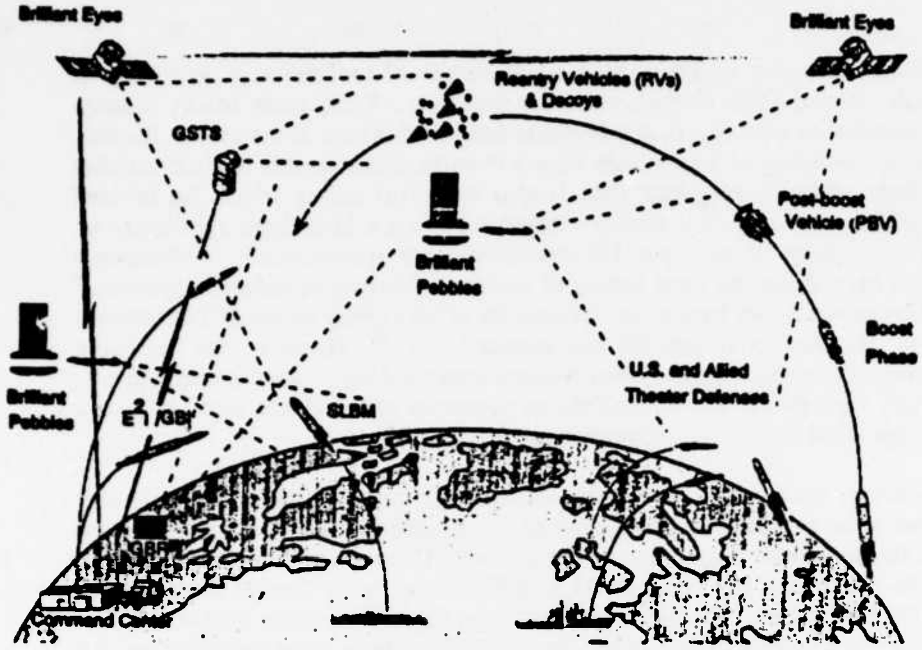

Figure 1-1. Theater and strategic GPALS elements.

management, sensors, and interceptors. The latter two GPALS functions are described below:

> Space- and surface-based *sensors* to provide global, continuous surveillance and tracking, from launch to intercept or impact, of ballistic missiles of all ranges... . *Interceptors*, based both in space and on the ground or at sea, capable of providing high-confidence protection of targets under attack. Space-based interceptors could provide continuous, global interdiction capabilities against missiles with ranges in excess of 600-800 kilometers. The surface-based interceptors, located in the U.S., deployed with U.S. forces and, potentially deployed by U.S. allies, could intercept missiles of any range and with any type of warhead [conventional, chemical, or nuclear]. Interceptors would utilize non-nuclear, hit-to-kill technology.[8]

Major differences from earlier SDI proposals will be the addition of theater-oriented mobile radars and interceptors integrated into the overall SDI command and control system. Some argue that GPALS may be more acceptable than earlier versions of SDI, for cost and political reasons, as well as because it is more compliant with the ABM Treaty (which is silent on theater missile defenses).[9] Rather than focussing on destroying a fixed percentage of a Soviet missile attack against the United States, GPALS' objective is to completely destroy a limited attack—on the order of 10 to 200 missiles—aimed at either the continental United States or deployed Allied forces.[10]

In order for a limited defensive system to have a high degree of confidence in destroying all incoming warheads, several TMD characteristics are necessary. First, space basing of long-range sensors is essential to detecting hostile launches from a wide area of the globe. Second, in the long-term, space-basing of interceptors allows them to attack theater ballistic missiles (TBMs) during their critical boost phase (this is also the phase during which the infrared signature of the hostile missile is most readily detectable.) Thus a multi-layer system can be optimized if its early-phase sensors and kill-mechanisms are space-based.[11] Numerous architecture studies have shown the clear benefit of additional *layering* of defensive systems.[12] While individual components may have system probability of kills (PKs) against ICBM boosters or RVs of .40 to .50, the net system PK can approach .99 .[13] However, for maximum effectiveness, a complex, multiple layer system requires integrated battle management and C^3I. Thus it is possible, through the use of multiple engagements and multiple tiers, to gain a significant advantage when individual components are integrated.

In addition to layering, space-basing, and battle management issues, there are several other factors which need to be considered when appraising the suitability of GPALS for use as the basis upon which theater missile defense can be constructed. There are programmatic issues to be addressed. For example, a key future GPALS/TMD element is the Theater High Altitude Area Defense (THAAD) system. THAAD poses additional operational issues as it could attrit both the air-breathing and ballistic missile risks. Second, TMD defense poses new questions for doctrine and strategy as there is a complex interaction between three strategy elements: offense, defense, and arms control. Third, there are economic issues associated with TMD. How does U.S. Congressional support translate into funded programs and how much active Alliance participation should be expected, particularly when is comes to dwindling NATO infrastructure funds. Finally, there are issues of technology tranfer to be resolved. All of these issues need consideration if the Alliance is expected to strongly support the U.S. GPALS approach to theater defense requirements. Additional TMD issues and activities will be addressed shortly.

1.2 THE ALLIANCE'S STRATEGIC CONCEPT.

Meeting in Rome on 7-8 November 1991, the Heads of State and Governments of the Alliance endorsed the Alliance's New Strategic Concept which also reflected the changing conditions in the security environment outlined earlier by President Bush. While the leadership of the Alliance recognized that "the threat of a simultaneous, full-scale attack on all of NATO's European fronts has effectively been removed," they also noted that the Alliance was still faced with a multi-dimensional, multi-faceted threat stemming from instabilities and regional tensions.[14] Thus the fundamental tasks of the Alliance endure, namely: (1) to provide a foundation for a stable security environment in Europe; (2) to serve as a forum for consultations on security issues and interests; (3) to deter and defend against any threat of aggression; and (4) to preserve the strategic balance within Europe.[15]

While reaffirming the need for collective defense and the traditional roles of the component services, the Alliance recognized an emerging new threat:

> In light of the potential risks it poses, the proliferation of ballistic missiles and weapons of mass destruction should be given special consideration. Solution of this problem will require complementary approaches including, for example, export controls and missile defenses.

Export controls to limit proliferation of key technologies could be considered in various European fora, NATO, the European Community, the Conference on Security and Cooperation in Europe, or others.[16] However, integration of proposed theater missile defense (TMD) systems—ground radar sensors, space-based sensors or interceptors, and ground-based interceptors—seems to clearly fall under NATO auspices.

1.3 THE U.S. MISSILE DEFENSE ACT OF 1991.

The Defense Authorization Act for 1992 directs the "deploying [of] an ABM system [as] a national goal... by Fiscal Year 1996." Congressional support (through efforts spearheaded by Senators Lugar, Warner, and Cohen, and supported by Senator Nunn and Representative Aspin) is strong due, most likely, to the Gulf War experience. The act contains $857.5 million for theater and anti-tactical missile defenses funded through the new Joint Tactical Missile Defense Program.[17] The Act also articulates a goal for theater missile defense which is to "provide highly effective theater missile defenses to forward deployed and expeditionary elements of U.S. Armed Forces and to U.S. friends and Allies."[18] The foci of TMD will be:

- Aggressively pursue the development of advanced TMD systems with the objective of down selecting [sic] and deploying such systems by the mid-1990s.
- Development of deployable and rapidly relocatable advanced TMD capable of defending forward-deployed and expeditionary elements of the Armed Forces of the United States
- Cooperation with friendly and allied nations in the development of theater defenses against tactical or ballistic missiles[19]

1.4 THEATER MISSILE DEFENSE.

Within the NATO environment, indications are that the SDIO proposed TMD architecture will complement (that is, be in addition to and integrated with) the NATO Air Command and Control System (ACCS). A notional far-term (CY 2000 or later) architecture for TMD is shown in Figure 2.[20] This system is based upon several architecture studies accomplished since 1986 and reflects the operational experience of Operation Desert Storm. Key findings of these studies include the following:

- Threat determines increasing need for TMD
- Active defense is essential
- Protection levels across theaters drives multi-tier, multi-shot requirements

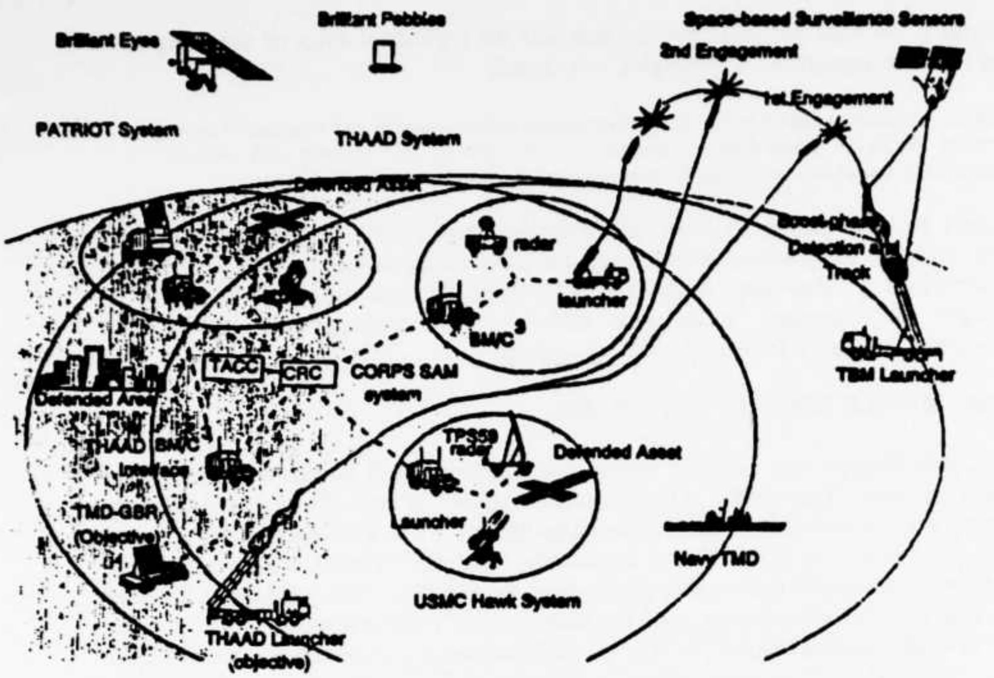

Figure 1-2. Notional Far-Term TMD Architecture.

- Technology—including increasing threat range, NBC warheads, and efficiency/coverage of transported elements—drives need for space[-based] asset cuing for all ground sensors, [and] THAAD/ground-based radar (GBR)-like performance for upper tier
- Need to protect deployed forces in contingency theaters... drives near-term, stand-alone TMD[21]

The U.S. Army Strategic Defense Command uses "four pillars" to describe TMD concepts. These are passive defense, active defense, attack operations, and theater missile defense command, control, communications, and intelligence (TMD/C^3I).[22] Active defense is designed to counter short-range ballistic missiles (SRBMs), medium range ballistic missiles (MRBMs), cruise missiles (CMs), air-to-surface missiles (ASMs), anti-radiation missiles (ARMs), and aerial delivery platforms for ASMs and ARMs. Attack operations are tailored toward destroying launch platforms, support bases, C^3I systems, and reconnaissance, intelligence (INTEL), surveillance, and target acquisition (RISTA) assets. Threats to, or means to circumvent, passive defenses include radars, RISTA, INTEL sensors, and terminal guidance systems. The threat to TMD BM/C^3I includes ARMs, jammers, INTEL sensors, RISTA, and terminal guidance systems.[23] The latest U.S. approaches to global missile defenses were outlined to NATO Alliance governments via the NATO Council and the NATO Defense Planning Committee/Nuclear Planning Group. Included in these briefing were considerations of shared launch warning data and consolidated command and control centers.[24]

1.5 GLOBAL PROTECTION SYSTEM.

The U.S. approach to global missile defense which was presented to the Alliance was subsequently presented by President Bush to Russian President Boris Yeltsin at their June 16-17, 1992 Summit. At this meeting a general agreement was reached that the U.S. and Russia would simultaneously pursue further reductions in offensive arms and increase cooperation on a global protection system (GPS). Further, it was agreed that participation in such a protection system against limited ballistic launch should be broadly based, that is, GPS should involve the U.S., Russia, Allies, and other interested states. President's Bush's statement reflects the revolutionary framework of the GPS concept:

- **President Yeltsin and I have also agreed to work together, along with the allies and other interested states, to develop a concept for a global protection system against limited ballistic missile attack.**
- **And we will establish a senior group to explore practical steps towards that end, including the sharing of early warning and cooperation in developing ballistic missile capabilities and technology. This group will explore the development of a legal basis for cooperation, ... necessary to implement the global protection system.**
- **In conclusion, these are remarkable steps for our two countries, a departure from the tensions and suspicions of the past, and a tangible, important expression of our new relationship. They also hold major promise for a future world protected against the danger of limited ballistic missile attack...[25]**

The June Summit Meeting directed high-level consultations which were initiated in Moscow on July 13-14, 1992. In addition to establishing working groups on GPS Concepts, Technology Cooperation, and Non-Proliferation, the delegations issued a joint statement that they would continue to pursue the following issues:

- **The potential for sharing of early warning information through the establishment of an early warning center.**
- **The potential for cooperation with participating states in developing ballistic missile defense capabilities and technologies.**
- **The development of a legal basis for cooperation, including new treaties and agreements and possible changes to existing treaties [especially the ABM Treaty] and agreements necessary to implement a global protection system.[26]**

The objectives of GPS parallel the joint statement. Specifically, GPS would be a multilateral system in which the participants would (a) share ballistic missile early warning data to enhance missile defense performance; (b) cooperate in developing ballistic missile defense (BMD) capabilities and technologies; and (c) cooperate in BMD activities. It is necessary to clearly delineate between GPS and GPALS. According to Douglas Graham (OSD/ISP) and Edward Gerry (SDIO), GPALS is strictly a U.S. program with major components of (a) national missile defense; (b) theater missile defense; and (c) global missile defense. They suggest that the U.S.

would offer GPALS capabilities and early warning data to GPS. Further, they emphasize that, rather than being a acquisition program, GPS is a "mechanism" for coordinating the launch warning and missile defense assets of the participants, and also, will be evolved within existing security commitments.[27]

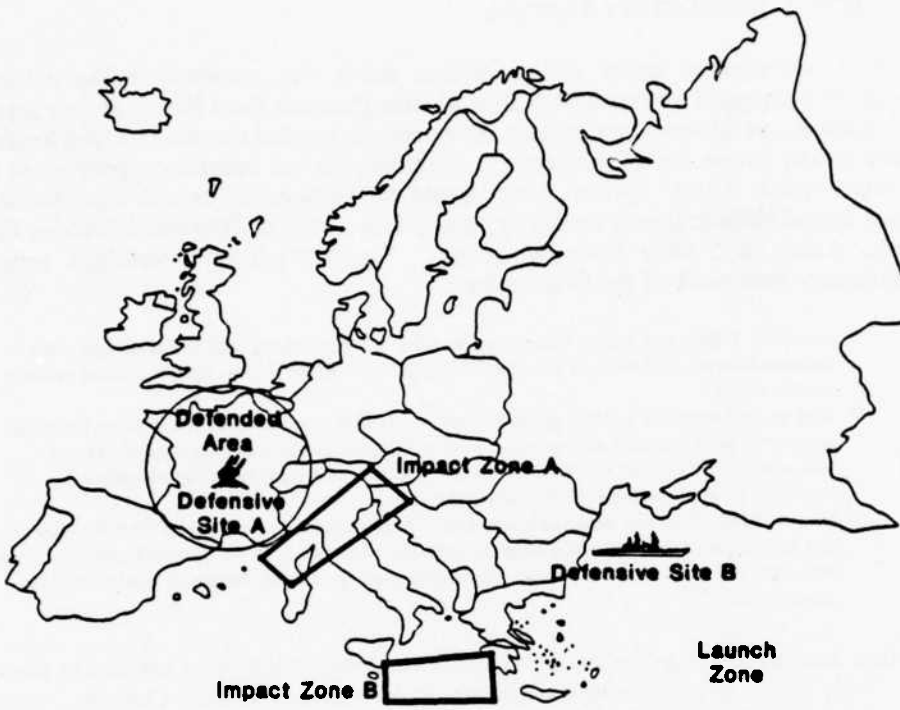

Figure 1-3. A conceptual global protection system deployment.

Concern has been expressed in the Alliance concerning detailed cooperation between the United States and Russia in a Global Protection System or even in the formation of a Russian-United States Early Warning Center. The fears are based upon the perceptions of the possibilities for the transfer of advanced Western technology to the East and also upon the creation of new strata of "friends and allies." Perhaps some of these concerns would be alleviated, if a thoughtful approach is taken to the sharing of launch warning data and to a new form of defensive cooperation. Such a considered approach—a "cooperative deployment" arrangement—was suggested by Mr Peter Mantle, Chairman of NATO's Industrial Advisory Group (NIAG), in a briefing presented to the NATO Defense Research Group.[28] If one postulates an attack with a Chinese exported, chemically armed CSS-2 missile from the Middle East (Iraq-Iran-Syria axis) towards a target in France, interception with a THAAD missile (cued by either Russian or U.S. space launch detection sensors) deployed in a wide area of Europe is feasible. Regrettably, the debris from the intercept and the chemical agent would fall upon Northern Italy. However if a cooperative NATO-Russian deployment and launch warning agreement were achieved, a THAAD equipped AEGIS cruiser could be deployed in the Black Sea. With Russia cuing data and an optimal intercept, the debris could be scattered in less populated area, the Eastern Mediterranean. This arrangement would also benefit the Russians by protecting their capital against attack from the same region. With more advanced technology it would be possible to scatter the debris exo-atmospherically and thus completely eliminate the chemical impact.[29] The NATO Council is currently in the process of establishing an "Ad Hoc Group on Global Protection System" in order to provide an appropriate forum for addressing the US GPS concept.

1.6 ONGOING EUROPEAN TMD RESEARCH EFFORTS.

There are several groups—ranging from senior committees of the NATO Alliance, to military staffs of international headquarters, to national military staffs, and to military research centers—working various aspects of GPALS/TMD Integration in Europe. Within the structure of NATO's Committee of National Armament Directors—the highest level in NATO for armaments cooperation in research, development, and production—the following activities are taking place. The Defense Research Group/Research Study Group 16 is studying Command and Control for Extended Air Defense. The NATO Industrial Advisory Group/Sub Group 37 (NIAG SG 37) sponsored an extension of its Post-2000 Technology Forecast Study to assess "solutions required for a wide variety of ballistic missile threats." The NATO Air Force Armaments Group/Air Group VI/Project Group on Active Tactical Ballistic Missile Defense has now taken over sponsorship of the NIAG SG 37 study. In another change, the NATO Army Armaments Group had examined the Defense Industrial View of Technologies for Extended Air Defense, but is no longer actively involved in review of TMD subject matter with its panels. The NATO Air Defense Committee (NADC) is tasked by the NATO Council to address TMD issues in general. Two NADC panels, one on Air Defense Weapons and the second on Air Defense Philosophy, are examining the implications of including TMD coverage in NATO's extended air defense concept. NATO's Military Committee has tasked the Advisory Group for Aerospace Research and Development (AGARD, Paris) to examine "NATO Ballistic Missile Defense in the Post-Cold War Era" (AAS-38 Study). Previously AGARD had examined "Integrated C^3I Systems for Future Air and Space Operations."[30] Recognizing both the importance of TMD to the Alliance and the complexity of potentially overlapping studies, the NADC and Defense Research Group have formed a "Informal Extended Air Defense Coordination Group" consisting of the chairmen of the above study groups in order to minimize duplication of effort.[31]

At SHAPE, the NATO Theater Missile Defense working group (NTMD WG) has been formed at the direction of the SHAPE Chief of Staff to identify long-term requirements, to assess the threat, and to develop operational concepts for TMD integration. In addition, the SHAPE Technical Center has developed a memorandum of agreement with the U.S. SDIO to serve as an Extended Air Defense Test Bed (EADTB) node and evaluate operational concepts and architectures for SHAPE. In addition, there have been various bi-lateral contacts between the U.S. Government and Alliance members and directly between SDIO and foreign manufacturers.[32] On the U.S. side and in accordance with the U.S. Department of Defense Directive DOD 5000.1, EUCOM as a unified command is responsible for submitting a mission need statement to the Joint Requirements Oversight Committee (JROC). Subsequently, EUCOM is then responsible for refining operational requirements with the Joint Staff. The U.K. Ministry of Defense through its U.K. SDI Participation Office (U.K. SDIO PO) has engaged is a series of bilateral research activities with the U.S. SDIO. These activities have included the following: (a) performing a series of defensive architecture studies whose objectives were to determine the technical and operation feasibility of defending the U.K. and Europe from attack from within or outside of Europe; (b) serving as a test node of the EADTB; and (c) chairing the Advisory Group for Aerospace Research and Development (AGARD) study on "NATO Ballistic Missile Defense in the Post-Cold War Era."[33]

1.7 NEED FOR SENIOR LEVEL OVERSIGHT.

The SHAPE Chief of Staff tasked the NTMD Working Group to develop TMD objectives and requirements, and to assess associated issues. In addition, as noted above, there are at least six NATO organizations working on varying aspects of theater missile defense. On the United States' side, there are at least as many organizations working theater missile defense issues. These include OSD/ISP, SDIO, the Joint Staff, the services, and the Joint Theater Missile Defense Program Office. Earlier U.S. approaches to the Alliance on TMD issues have been bilateral or, in some cases, U.S. SDIO has dealt directly with foreign manufacturers. There have been senior level presentations of the U.S. TMD approach to NATO's High Level Group (HLG), NATO's Defense Planning Committee, and the Nuclear Planning Group.[34] Yet, perhaps due to the numerous messages and target audiences, the impact of major revisions to programs, like GPALS and its TMD elements, have not yet filtered down to the military staffs who must plan for, coordinate upon, and start infrastructure funding processes moving in the response to those changes. There is considerable expert knowledge in Europe about specific elements of programs, but there appears to be little long-range thinking on major issues; e.g., how active-defense could place further demands upon already sparse air assets. It seems reasonable to assume that clear lines of oversight and responsibility—perhaps a general officer steering group—would help ensure that issues are considered in a more orderly and integrated manner. It is also apparent, from an European perspective, that the U.S. government is still pondering elements of its new TMD approach and how roles and missions, not to mention sensor data and equipment, are to be shared in this operational environment.

SECTION 2

RESEARCH APPROACH

2.1 RESEARCH QUESTIONS.

Given the scope and time compression of the "refocussing" of the U.S. Strategic Defense Initiative, as well as an apparent U.S. Government policy shift (to approach the Alliance as a whole rather than pursue bilateral approaches to nations), it may be time for an examination of TMD issues from an European perspective. Allies have numerous concerns and questions, some of which were identified by Assistant Secretary of Defense, Stephen J. Hadley:

- **What form of commitment would be asked of countries joining a global missile defense?**
- **What is the character of the defense commitment members should undertake?**
- **Is it enough for countries to share such early warning and missile defense capabilities as they possess?**
- **Within such a system, should the U.S. ... be prepared to use its early warning and defense systems to protect others?**
- **How would such a system be organized and what would be the form of the agreement?[25]**

To further complicate the issue, even if the United States takes a multi-lateral approach to TMD integration, three European nations require singular attention, the United Kingdom, France, and Russia. There is a perception in Europe, accurate or not, that the United States has basically "repackaged" its original SDI program and is now attempting to get Alliance members to support the space-based aspects of GPALS over the theater's preference for ground-based, deployable TMD. Thus it seems worthwhile to have a study performed by personnel who are both knowledgeable of the U.S. TMD positions, priorities, and issues and who also have access to key U.S. decision makers in the Office of the Secretary of Defense/International Security Policy, Department of State, and SDIO. Their charter would be to meet with the varying levels of actors involved in the European TMD efforts, assess their concerns, and relay those back to the U.S. Government. Suggestions concerning the long-term objective for TMD integration and an appropriate forum for GPALS/TMD oversight in Europe might prove beneficial.

2.2 ADDITIONAL ISSUES TO BE ADDRESSED.

In addition to the primary questions discussed above, there are numerous concerns which have been raised during discussions at SHAPE, the SHAPE Technical Center, the EADTB Conference, and at NATO. While a study can address some of the following issues or could identify potential courses of action, it is unequivocally apparent that governments or the Alliance will have to address and resolve the more complex issues raised. Additional issues are presented below in question format.

2.2.1 Doctrine.

Given the mixture of services, nations, and missions involved in the "Four Pillars," identify common operational concepts and doctrinal issues that might arise in the development of complete operational plans and employment procedures. Identify if specialized joint or Allied doctrine, as found in General Operating Procedures for the Joint Attack of the Second Echelon (J-SAK), needed. That is, should new joint or Alliance doctrine and operational concepts be developed? By whom and where?

2.2.2 Consultations and Oversight.

Identify groups and bodies in the European environment that are involved in European TMD planning and systems integration. How should consultations be structured so that the unique requirements of the United Kingdom and France, as independent nuclear powers, are adequately addressed? In what forum and at what level should oversight of GPALS/TMD integration take place? Who should identify Alliance and national concerns? In what forum and how often? Should a new, special NATO standing committee be formed? Should NATO consultations be with or without the addition of France? Alternatively, should the scope of TMD planning be expanded to either the Western European Union (WEU) or the Conference on Security and Cooperation in Europe (CSCE)? What role should Russia play viz-a-viz the U.S. and NATO? Some would argue that the NATO Air Defense Committee (NADC) is the most logical focal point for consultations and oversight, as it includes France and has regular and well established contacts with other organizations such as AGARD and the STC. There may be a need to draw a clear line between military planning coordination and political consultations on deployments.

2.2.3 Form of Agreement.

Identify those areas which lend themselves to multi- and bi-lateral forms of agreement. Does the United States need to negotiate a pan-European Memorandum of Agreement which would outline task specialization among NATO countries? In addition to providing sensor (launch warning) data to the Alliance, would the U.S. provide specific Patriot and THAAD coverage for Europe (for both fixed sites and NATO's Rapid Reaction Forces) and, at some point in the future and *if* NATO decided to conduct them, for out-of-area operations?

2.2.4 Integration with Existing C3I/BM.

In Europe, how will the sensors, radars, and BM/C^3I elements of the proposed TMD be meshed with existing and planned ACCIS/ACCS elements? Can an agreement of baseline standards for C^3I be established prior to GBR or interceptor deployment? Identify existing BM/C^3I architectures which can be built upon. If deployment of TMD is to be accomplished in a "piecemeal" manner, suggest steps that could be taken to insure maximum interoperability. SHAPE Technical Center (STC) has a key role here.

2.2.5 Accomplishment of the Mission with Existing Platforms.

Closely related to doctrinal issues, are the questions: "How will already burdened theater combat aircraft be tasked?" and "What priority level will attack operations have?" Can an incremental approach to TMD, i.e., using existing systems, then adding national layers as they become available, produce a satisfactory defensive architecture? Identify a figure of merit, perhaps, TMD PK times dollar cost per area covered.

2.2.6 Task or Mission Specialization.

Could individual Allies be responsible for specific TMD components? For example, could the U.K. develop Corps SAM, Germany develop the TMD ground-based radar, and the U.S. develop THAAD? In what NATO forum should such task and development specialization be addressed?

2.2.7 Integration with Planning, Staff Coordination Requirements.

How would defensive priorities be made for fixed and deployed TMD assets? In the future, if NATO's forces were providing Kurdish refugee support in Northern Iraq, then the homelands of supporting countries could be threatened by surface-to-surface missile (SSM) attack. (This may provide motivation for space-based GPALS assets.)

2.2.8 Sensor and Intelligence Downlinks.

Where should launch warning and potential target data be fed into SHAPE and SACLANT? Would it be most effectively input at Principal Subordinate Commands (PSCs), Sector Operations Centers (SOC), or the proposed Consolidated Air Operations Center (CAOC) in order to provide time-sensitive launch data into the command structure at a point that has both command authority and rapid communications capability? Should there be a difference between day-to-day and crises operations?

2.2.9 Validation and Assessment of the Risks, Residual Former Soviet Union (FSU) and Proliferators.

Should SDIO and Defense Intelligence Agency (DIA) threat data be reviewed by SHAPE INTEL or NATO Military Committees in order to establish credibility for the theater TMD program? How often?

2.2.10 Program Review.

Should NATO committees review planned air and missile defense programs of members to identify potential redundancies of national programs? This is closely related to task specialization and form of agreement.

2.2.11 Identification of Military Requirements.

Who in NATO and its military subordinates, SHAPE and SACLANT, should be formally tasked to provide program oversight, guidance, write policy and operations procedures for TMD?

2.2.12 Revision of Deterrent Paradigm.

Does the advent of effective theater missile defenses, especially when coupled to the tremendous reduction in strategic and sub-strategic stockpiles, herald the end of the Alliance's concept of deterrence—that is, does defense obviate the need for a NATO Triad of conventional forces, theater-based sub-strategic forces, and central strategic systems? The validity of this strategic construct has been a source of Alliance stability for over 40 years.

2.2.13 Scope of Participation.

Should a European TMD be limited to NATO, or should it encompass the North Atlantic Cooperation Council (NACC), the Western European Union (WEU) or the Conference on Security and Cooperation in Europe (CSCE)?

2.2.14 Command and Control.

A major focal point of several NATO study groups is the issue of command and control of theater missile defense assets. The NATO Air Defense Committee's Study Group on Air Defense Philosophy addresses some of the key issues of defensive priorities, the above questions about sensor data fusion suggests some alternatives, yet, in the complex, multi-national operational environment of NATO, who *commands* TMD assets? In a think-piece presented to the NATO Defense Research Group, a team of NATO staff officers suggested the possibility of merging the "Composite Warfare Commander" and the Navy's "Space and Electronic Warfare Commander" into a new "Battlespace Commander." Instead of adding another bureaucratic layer in the chain of command, this would allocate TMD responsibilities "from the surface to the heavens" to an "Air Battlespace Commander."[36] Consider the complexity of the problem when U.S. Space Command would control the detection and space-based interceptors, naval and ground-based THAADs provide a second layer of protection, and the NATO Rapid Reaction Force Commander controls his Hawks, Rapiers, and Patriots. Who takes the first shot? What is the optimal engagement sequence? How much time is there to decide?

SECTION 3

CONCLUSION

There are a number of key political and military issues which have to be resolved in order to realize adequate planning and support for TMD in the European environment. Some of them have been articulated by members of the U.S. defense community. However, due to the level and limited audience at which key changes to U.S. TMD policy have been briefed, there remains some confusion and uncertainty as to the next steps in TMD integration. There appears to be a need for both senior level oversight and guidance before these complex, and inter-related issues can be resolved. At a minimum, GPALS and its theater missile defense components deserve close consideration in long-range theater acquisition plans and full integration into NATO conventional and nuclear force assessments and planning. While most TMD actors recognize that SDIO has done an excellent job of technical program oversight, it appears that additional assistance in military planning, systems integration, and policy integration would be beneficial. Therefore, it is strongly recommended that SDIO/DNA sponsor a program of study which identifies and provides options to meet Allied concerns—as articulated by several NATO bodies and nations, presents these to key U.S. Government agencies, and provides strategic vision for the path of TMD integration.

SECTION 4

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11. U.S. Congress, Office of Technology Assessment, Ballistic Missile Defense Technologies, OTA-ISC-254 (Washington, D. C.: U.S. Government Printing Office, September 1985), pp. 25-28. (UNCLASSIFIED) In addition, space basing of components would be required to see the launch of a protagonist's ICBM, to allow global coverage with the minimum number of weapons platforms, and to minimize the attenuation effects of the atmosphere.

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$$(1-TotEff) = (1-B)(1-P)(1-M)(1-T)$$

where TotEff = Total Defense Effectiveness
B = Boost Effectiveness
P = Post-Boost Effectiveness
M = Midcourse Effectiveness
T = Terminal Effectiveness

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- Research on all ABMs, including those urging [sic] exotic technologies is permitted.
- Testing and development of fixed, land-based exotics is permitted.
- Testing and development of mobile/space-based exotics is prohibited.
- Deployment of all exotics (whether fixed, land-based or mobile/space-based) is prohibited unless the parties agree to amend the Treaty.

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APPENDIX

GLOSSARY OF ACRONYMS AND TERMS *

ABM. Anti-ballistic missile.
ABM Treaty. The Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile, October 3, 1972.
ACE. Allied Command Europe.
ACCS. NATO Air Command and Control System.
ACCIS. ACE Command and Control Information System.
AGARD. Advisory Group for Aerospace Research and Development.
Al Husayn. Iraqi surface-to-surface missile.
Al Abbas. Iraqi surface-to-surface missile.
AN/TPS-59. U.S. Marine Corps surveillance radar sensor for the HAWK surface-to-air missile. The TPS-59 provides low-cost surveillance for HAWK providing cuing data through the Air Defense Command Post to HAWK battery command post.
ARM. Anti-radiation missiles, also HARM, homing anti-radiation missiles
ASM. Air-to-surface missile.
BM/C³I. Battle management and command, control, communications, and intelligence.
BMD. Ballistic missile defense.
Boost Phase. Boost phase (3 to 5 minutes), in which the missile is launched and has a highly distinctive plume of hot gases
Brilliant Eyes. Brilliant Eyes is a satellite system whose missions are to perform battle management, to coordinate defensive strategy, to provide precise post-boost vehicle tracking and radiometric discrimination, and to provide targeting information for Brilliant Pebbles interceptors, ground-based interceptors, and total system C³I and battle management.
Brilliant Pebbles. Brilliant Pebbles would be a two layer missile defense system consisting of the following elements: Boost Surveillance and Tracking System (BSTS), Space-Based Surveillance and Tracking System (SSTS), Ground-Based Surveillance and Tracking System (GSTS), Ground-Based Radar (GBR), Brilliant Pebbles (BP), Ground-Based Interceptor (GBI), and Command Center (CC). Brilliant Pebbles is actually the name for an autonomous, space-based targeting, tracking, and interceptor module that fires out individual, hardened kinetic hit-to-kill pellets.
Bus. The carrier space ship or post-boost vehicle (PBV) which deploys the individual reentry vehicles (RVs) and any decoys used.
CAOC. Combined Air Operations Center, integrates offensive and defensive air command and control. Also a C³I node.
C³I. Command, control, communications, and intelligence. Command and control functionally comprises one third of a missile defensive system's components (e.g., sensors, command and control elements, and interceptors.
CFE. Conventional Armed Forces in Europe Treaty signed in November 1990, yet to be ratified by all state parties. Greatly reduces the deployed forces in the Atlantic-to-the-Urals (ATTU) region and provides additional stability measures.
CMS. Cruise missiles.

Corps SAM. Corps (an army maneuver element) surface-to-air missile. A highly mobile, C-130 transportable, lower-tier theater defense element. Could replace Hawk

CRC. Control and Reporting Center. A C^3I element.

Cueing. Information which tells mid- and terminal-phase sensors where to look for incoming missiles.

DNA. The Defense Nuclear Agency.

Downlink. The flow of intelligence, or other data, from satellite to a earth receiver or C^3I node. A flow from ground to satellite, which can also include satellite maneuver instructions, is called an "uplink."

DPC. NATO's Defense Planning Committee

DSP. Defense Support Program, a satellites system which provides ballistic missile early warning and other surveillance information.

E^2I/GBI. Endoatmospheric and Exoatmospheric Interceptor/Ground-based Interceptor. A ground-based, maneuvering, multi-spectral color sensor equipped, larger kill radius, kinetic energy kill interceptor. Replaces the high endoatmospheric defense interceptor (HEDI) proposed earlier.

EADTB. Extended Air Defense Test Bed. A computer-based analysis center for evaluation of components and overall systems designs postulated for theater missile defense; in NATO, the EADTB node is at the SHAPE Technical Center.

EUCOM. The United States European Command.

FROG. Soviet built mobile rocket launcher.

FSU. The former Soviet Union, also consists of most of the Commonwealth of Independent States (CIS).

GBI. Ground-based interceptor. One of three missile defense components. Can be a kinetic energy kill (e.g., a surface-to-air missile) or directed energy device.

GBR. Ground-Based Radar. A mobile, deployable theater fire control radar. Replaces the earlier proposed GBRT and is smaller, more mobile, and consumes less power.

GBRT. Ground-Based Radar-Terminal. A mobile, deployable theater fire control radar. Superseded by GBR.

GPALS. Global Protection against Limited Strike. Introduced on 29 January 1991 by President Bush. Reflects the administration's perceptions of the changed strategic environment and refocuses SDI on providing protection for deployed U.S. and Allied forces from limited ballistic strikes, whatever their source. According to the SDIO, "GPALS is an antimissile system designed to protect against limited ballistic missile strikes, be they deliberate, accidental, or unauthorized—whatever their source." A GPALS defensive system would consist of surface- and space-based sensors, interceptors, and integrated battle management.

GPS. Global Protection System. Introduced by President's Bush and Yeltsin in June 1992. A multilateral, multi-tier defensive system which provides all participants, U.S., Allies, Russia, and interested parties protection against limited ballistic missile strikes. The U.S. GPALS system would be considered as the U.S. contribution to the multinational GPS.

HAWK. A U.S. Marine Corps mobile surface-to-air system which is being modified through a product improvement program to have increased capability against short-range TBMs. While the U.S. Army also uses the Hawk, it has not presented plans for an enhanced Hawk ATBM. Hawk is used by Belgium, Germany, Greece, Italy, Netherlands, Norway (NOAH), and Spain.

ICBM. Inter-continental ballistic missile.

INF. The Treaty Between the United States of America and the Union of Soviet Socialist Republics on the Elimination of their Intermediate-Range and Shorter-Range Missiles, December 1987. Intermediate-range missiles have ranges in excess of 1,000 kilometers, but not in excess of 5,500 kilometers. Short-range missiles have ranges equal to or greater than 500 kilometers, but less than 1,000 kilometers.

INTEL. Intelligence.

Interceptors. That components of a missile defense system which physically destroy or neutralizes the incoming missile.

J-SAK. Joint Attack of the Second Echelon. U.S. Army and Air Force doctrine for attacking deeper elements of an aggressors's ground forces. Known in NATO as Follow-on Force Attack (FOFA).

JSTARS. Joint surveillance target attack radar system. An airborne system for detecting and tracking mobile targets, as well passing targeting data to attack elements.

Launcher. A weapons system component, often mobile, from which a missile is launched.

Mid-Course Phase. Mid-course phase which lasts up to 20 minutes for ICBMs and from 5 to 15 minutes for SLBMs depending upon their launch site and trajectory profile.

MRBM. Medium-range ballistic missile system.

NATO. North Atlantic Treaty Organization, also known as the Alliance, with its members collectively known as the Allies.

NTMD. NATO Theater Missile Defense.

PATRIOT. A currently fielded theater air defense system (SAM) which is undergoing modifications, PAC-I (self-defense software), PAC-II (limited, corollary point defense capability, and Multi-mode seeker (MMS, addition of an active seeker in the missile and improvements in the missile's autopilot and guidance systems), and PAC-III (TMD and air defense upgrades).

PBV. Post-boost vehicle.

Post-Boost Phase. Post-boost or "bus" phase (up to 6 minutes), in which the bus or post-boost vehicle (PBV) deploys the individual reentry vehicles (RVs) and any decoys used.

PK. Probability of Kill. A statistical measure of the effectiveness of a weapons system. A PK of unity indicates that in all engagement the interceptor will destroy the incoming missile, a PK of zero indicate that the system is completely ineffective. For an assessment of how layering increases effectiveness, see endnote 13.

PSC. Principal Subordinate Command, e.g., Allied Air Forces Central Europe (AAFCE) is a PSC of Allied Forces Central Europe (AFCENT). AFCENT is a major subordinate command (MSC) of SHAPE.

RISTA. Reconnaissance, intelligence, surveillance, and target acquisition. Sensors and systems which are used to detect and locate targets for subsequent strike planning.

RV. Reentry vehicle, the front end of a missile system, usually containing warhead and guidance.

SACEUR. Supreme Allied Commander, Europe. One of NATO's two senior commanders, commands SHAPE (The third command, CINCHAN, will be disestablished on/about 1 Jan 93).

SACLANT. Supreme Allied Commander Atlantic. One of NATO's two senior military commanders.

SAM. Surface-to-air missile. Often the layer of missile defense closest to the target.

SCUD. Soviet built surface-to-surface missile.

SDI. The Strategic Defensive Initiative, which was introduced by President Ronald Reagan on 23 March 1983. SDI's objective was to render nuclear weapons impotent and obsolete. President Reagan directed a comprehensive and intensive effort of long-term research and development program to begin eliminate the threat posed by strategic nuclear missiles. Over the years, the goals of SDI have become less ambitious, with the latest focus of SDI provided by President Bush in the U.S. GPALS program.

SDIO. Strategic Defense Initiative Organization. The U.S. Department of Defense Organization directed by Congress to perform research, development, and acquisition of strategic and theater missile defenses.

Sensors. Those elements of a ballistic missile defense system which detect missile launches (e.g., a wide-area search-radar or infrared detector) and provide tracking data to interceptors (a narrower field of view tracking radar or optical tracker). One of three missile defense components.

SHAPE. Supreme Headquarters Allied Powers Europe. Senior headquarters for Allied Command Europe (ACE). One of two military headquarters in NATO.

SLBM. Sea-launched ballistic missile.

SOC. Sector Operations Centers. An air defense command and control node.

SPY-1 Radar. A U.S. naval ship-based surveillance and tracking radar found on AEGIS class cruisers. It is used in conjunction with the Block IV Standard Missile-2 (SM-2) which can be upgrade to equivalent lethality to Patriot, PAC-2. SM-2 range and speed equals Patriot.

SRBM. Short-Range Ballistic Missile.

SSM. Surface-to-surface missile.

START. Strategic Arms Reduction Talks, led to the START Treaty which reduces strategic offensive forces by 60 percent from 1990 levels. Signed on July 31, 1991 by the United States and the Soviet Union, but yet to be ratified.

STC. The SHAPE Technical Center at the Hague, Netherlands; SHAPE's analytic support organization and the site of the European Extended Air Defense Test Bed.

TAAC. Tactical Air Control Center. A C^3I element.

Terminal Phase. Terminal or reentry phase (less than 1 minute) in which the RVs reenter the earth's atmosphere.

THAAD. Theater High Altitude Area Defense. A hyper-velocity, ground-launched tactical weapon capable of engaging reentry vehicles in the upper atmosphere and over large ground regions to provide area defense in contingency operations.

TMD/C^3I. Theater Missile Defense Command, Control, Communications, and Intelligence. In essence, TMD battle management, when coupled with sensors and interceptors constitutes all three elements of TMD.

TMD. Theater Missile Defense.

TMD-GBR. Theater Missile Defense, Ground-based Radar. A more capable radar which doubles the Patriot search area and is intended as the primary initiation and fire control radar for the THAAD interceptor.

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