UNITED STATES EUROPEAN COMMAND THEATER MISSILE DEFENSE COORDINATION CELL

A thesis presented to the Faculty of the U.S. Army Command and General Staff College in partial fulfillment of the requirements for the degree

MASTER OF MILITARY ART AND SCIENCE

by

CAREY S. THOMPSON, MAJOR, USAF
B.S., United States Air Force Academy, Colorado, 1985

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Major Carey S. Thompson, United States Air Force

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This study analyzes the centralized operations and intelligence fusion functions in an equipment system known as the United States European Command's Theater Missile Defense Coordination Cell. Under the Ballistic Missile Defense Organization Commander in Chief Assessment Program, U.S. European Command developed the Theater Missile Defense Coordination Cell to help in the fusion of centralized operations and intelligence information. The Theater Missile Defense Coordination Cell facilitates the activities of Passive Defense, Active Defense, Attack Operations, and the C4I that integrates procedures, voice and data communications, processing equipment, as well as supporting intelligence and targeting.

This study examines U.S. European Command's Theater Missile Defense Coordination Cell to answer the primary question: Is the U.S. European Command Theater Missile Defense Coordination Cell an important vehicle to exploit new technologies in countering the theater ballistic missile threat?

The study concludes that no single service or nation possesses all the necessary assets to counter the theater ballistic missile threat. The Theater Missile Defense Coordination Cell and the funding program from Ballistic Missile Defense Organization Commander in Chief Assessment Program provide a valuable vehicle to test and leverage new technologies in countering the theater missile threat.

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Name of Candidate: Major Carey S. Thompson

Thesis Title: United States European Command Theater Missile Defense Coordination Cell

Approved by:

Randall W. Buddish, Thesis Committee Chairman
Major Randall W. Buddish, M.S.

Krewasky A. Salter, Member
Major Krewasky A. Salter, Ph.D.

Keith B. Bartsch, Member
Major Keith B. Bartsch, M.A.

Accepted this 5th day of June 1998 by:

Philip J. Brookes, Director, Graduate Degree Programs
Philip J. Brookes, Ph.D.

The opinions and conclusions expressed herein are those of the student author and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other governmental agency. (References to this study should include the foregoing statement.)

ABSTRACT

UNITED STATES EUROPEAN COMMAND THEATER MISSILE DEFENSE COORDINATION CELL by Major Carey S. Thompson, USAF, 86 pages.

This study analyzes the centralized operations and intelligence fusion functions in an equipment system known as the United States European Command's Theater Missile Defense Coordination Cell. Under the Ballistic Missile Defense Organization Commander in Chief Assessment Program, U.S. European Command developed the Theater Missile Defense Coordination Cell to help in the fusion of centralized operations and intelligence information. The Theater Missile Defense Coordination Cell facilitates the activities of Passive Defense, Active Defense, Attack Operations, and the C4I that integrates procedures, voice and data communications, processing equipment, as well as supporting intelligence and targeting.

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LIST OF ABBREVIATIONS

A	
AAR	After Action Report/Review
ABL	Airborne Laser
ABM	Anti-Ballistic Missile
ACC	Air Component Command
AOC	Air Operations Center (USAF)
AOI	Area of Influence
AOR	Area of Responsibility
ATACMS	Army Tactical Missile System
ATO	Air Tasking Order
AWACS	Airborne Warning And Control System
B	
BDA	Bomb or Battle Damage Assessment
BM/C4I	Battle Management Command, Control, Communications, Computers, and Intelligence
BMD	Ballistic Missile Defense
C	
C4I	Command, Control, Communications, Computers, and Intelligence
CALL	Center for Army Lessons Learned
CAOC	Combined Allied Operations Center
CAP	Combat Air Patrol
CAS	Close Air Support
CARL	Combined Arms Research Library
CAX	Computer Assisted Exercise
CINC	Commander In Chief
CJTF	Commander Joint Task Force
COA	Course of Action
CPX	Command Post Exercise
CTAPS	Contingency Theater Automated Planning System
D	
DIA	Defense Intelligence Agency
DOD	Department Of Defense

E	
ELINT	Electronics Intelligence
ENDEX	End of Exercise
EO	Electro-Optical
ETCC	European Theater Command Center
F	
FASCAM	Family of Scatterable Mines
FLTSAT	Fleet Satellite
FTX	Field Training Exercise
G	
GALE	Generic Area Limitation Environment
GCCS	Global Command and Control System
GPS	Global Positioning System
H	
HARM	High-Speed Anti-Radiation Missile
HMMWV	High-Mobility Multipurpose Wheeled Vehicle
HUMINT	Human Intelligence
I	
ICBM	Intercontinental Ballistic Missile
INMARSAT	International Maritime Satellite
IPB	Intelligence Preparation of the Battlespace
J	
J-2	Intelligence Directorate
J-3	Operations Directorate
JAC	Joint Analysis Center
JAO	Joint Area of Operations
JAOC	Joint Air Operations Center
JDISS	Joint Deployable Intelligence Support System
JFACC	Joint Force Air Component Commander
JFC	Joint Force Commander
JFLCC	Joint Force Land Component Commander
JFMCC	Joint Force Maritime Component Commander
JIC	Joint Intelligence Center
JMCIS	Joint Maritime Communication/Information System
JPOW	Joint Project Optic Windmill
JSTARS	Joint Surveillance, Target Attack Radar System
JTF	Joint Task Force
JTIDS	Joint Tactical Information Distribution System
JTMD	Joint Theater Missile Defense

L	
LAN	Local Area Network
LOCE	Linked Operations Intelligence Centers Europe
M	
MARFOR	Marine Corps Forces
MEADS	Medium Extended Air Defense System
METT-T	Mission, Enemy, Terrain and Weather, Troops and Support
MLRS	Multiple Launch Rocket System
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MSE	Mobile Subscriber Equipment
N	
NAEW	NATO Airborne Early Warning
NATO	North Atlantic Treaty Organization
NBC	Nuclear, Biological, and Chemical
NCA	National Command Authorities
NRO	National Reconnaissance Office
NSA	National Security Agency
O	
OPCON	Operational Control
OPR	Office of Primary Responsibility
OSD	Office of the Secretary of Defense
R	
RECON	Reconnaissance
ROE	Rules of Engagement
S	
SAT	Satellite
SATCOM	Satellite Communications
SECDEF	Secretary of Defense
SHAPE	Supreme Headquarters Allied Powers Europe
SHOC	SHAPE Headquarters Operations Center
SIGINT	Signal Intelligence
SINCGARS	Single-Channel Ground and Airborne Radio System
SOF	Special Operations Forces
SOP	Standard Operating Procedures
STU-III	Secure Telephone Unit
T	
TACSAT	Tactical Satellite Radio

TADIL A	Tactical Data Link A – series (NATO LINK-11)
TADIL B	Tactical Data Link B – series (NATO LINK-11B)
TADIX	Tactical Data Information Exchange System
TBM	Theater Ballistic Missile
TBMD	Theater Ballistic Missile Defense
TENCAP	Tactical Exploitation of National Capabilities Program
TIBS	Tactical Interface Broadcast System
TMD	Theater Missile Defense
TMDCC	Theater Missile Defense Coordination Cell
TPFDD	Time Phased Force Deployment Data
TPFDL	Time Phased Force Deployment List

U

UAV	Unmanned Aerial Vehicle
USACOM	United States Atlantic Command
USAF	United States Air Force
USCENTCOM	United States Central Command
USEUCOM	United States European Command
USMC	United States Marine Corps
USN	United States Navy
USPACOM	United States Pacific Command
USSOCOM	United States Special Operations Command
USSOUTHCOM	United States Southern Command
USSPACECOM	United States Space Command
USSTRANSCOM	United States Transportation Command

V - Z

WMD	Weapons Of Mass Destruction
ZULU	Time Zone Indicator for Universal Time

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CHAPTER 1

INTRODUCTION

Problem Statement

> Locating and destroying mobile missiles proved very difficult and required substantially more resources than planned. This could be a more serious problem in the future against an enemy with missiles that are more accurate or one who uses weapons of mass destruction![1]
>
> Conduct of the Persian Gulf War, Final Report to Congress

The worldwide proliferation of ballistic missiles presents a serious and increasing threat to U.S. and allied forces.[2] Ballistic missiles have emerged as a weapon of intimidation for third world countries such as Iraq.[3] The United States Secretary of Defense Richard Cheney remarked following the Gulf War:

> The Persian Gulf War was not the first in which ballistic missiles were used, and there is no reason to think that it will be the last. Indeed, ballistic missiles were the only weapon systems with which Saddam Hussein was able to take significant offensive action against U.S. forces and allies, and the only one to offer him an opportunity (via attacks on Israel) to achieve a strategic objective. We must expect that even more countries will acquire ballistic missiles and will be prepared to use them in the future.[4]
>
> U.S. Secretary of Defense Richard Cheney

Iraq's use of Scud and derivative theater ballistic missiles in the 1990-1991 Gulf War, coupled with the development of such weapons by other countries (notably the People's Republic of China and the Democratic People's Republic of Korea), has focused attention on the need to defend against such threats. Much of the effort devoted to this problem by the United States, other Western countries, and Israel over the past few years has concentrated on intercepting theater ballistic missiles in flight. However, destroying the mobile Transporter-Erector-Launchers before they can fire their weapons reduces the number of ballistic targets that have to be engaged later and prevents the vehicle from reloading.[5] The dangers posed by proliferation require a major emphasis on developing and rapidly deploying theater ballistic missile defenses.

In 1988, the Office of the Secretary of Defense directed the Department of the Army to find the most cost-effective techniques to reduce the Theater Missile threat. Out of the directive grew the Ballistic Missile Defense Organization's Commander in Chief Assessment Program. This program provided funds to the unified U.S. European Command to develop a credible tool to counter the theater missile threat. With this funding, U.S. European Command developed the deployable Theater Missile Defense Coordination Cell to serve as a platform for experimentation with new emerging technologies in the field of theater

missile defense. Currently with shrinking defense budgets, the Commander in Chief Assessment Program is in danger of being reduced or even eliminated.

The significant problem is that U.S. European Command cannot afford to risk losing the valuable tool that both counters the theater missile defense threat and serves as a platform to experiment with new technologies.

Research Question

The primary question this study seeks to answer: Is the U.S. European Command Theater Missile Defense Coordination Cell an important vehicle to exploit new technologies in countering the theater ballistic missile threat? This study will also attempt to answer the following subordinate questions:

1. Does a single service (Air Force, Navy, or Army) or Nation possess the assets to effectively counter the emerging theater missile defense threat?

2. Are Combined/Joint Theater Missile Defense operations essential to take advantage of the synergy provided by combining all service and national strengths.

3. Is increased involvement by Allies in the U.S. European Command Theater Missile Defense effort required?

4. Should continued emphasis be placed on attack and counterforce operations?

Attack/counterforce operations include incorporation of systems and sensors that aid in the conduct of operations of "get him before he shoots." It does not make operational sense to try to build systems to counter two thousand missiles when the bad guy has only eighteen launchers. It is far easier and makes more sense to kill the eighteen launchers!

Background

Potential adversaries within U.S. European Command's Areas of Responsibility and Interest possessing tactical missiles pose a threat to United States security interests and forward-deployed forces.[6] The proliferation of tactical missiles and advances in missile technology, combined with potential nuclear, biological, and chemical capabilities, can provide adversaries with decisive attack capabilities. This threat includes the use of weapons of mass destruction against critical military targets. Tactical missiles are as much a political weapon as a military weapon. In many cases, the political impact of their use overshadows their military significance.[7] The precise time and location tactical missiles will be employed is uncertain, thus complicating force composition and power projection methods to overcome the threat. The

nature and extent of U.S. interests within the U.S. European Command area of responsibility require theater missile defense forces to be rapidly deployable and flexible to meet the diverse operational environments of the theater.

U.S. European Command has experimented and exercised with an evolving theater missile defense operational architecture for more than eight years. Primary funding and support for this effort comes from the Ballistic Missile Defense Organization through funding labeled the Commander in Chief Assessment Program.

U.S. European Command Theater Missile Defense Architecture

Within the flexibility afforded by Joint Publication 3-01.5, the U.S. European Command concept centralizes the operations/intelligence fusion functions in a Theater Missile Defense Coordination Cell. The Theater Missile Defense Coordination Cell facilitates the activities of Passive Defense (early warning), Active Defense, and Attack Operations (destroying the missile launcher and missile storage sites).[8]

To ensure a joint effort, Headquarters U.S. European Command developed a centralized operations and intelligence cell to coordinate and execute theater missile defense. The cell's mission is to deploy and augment the Combined/Joint Task Force (C/JTF) with the capability to

facilitate defense of critical assets from theater missile threats and attack to neutralize weapon systems and support infrastructure.[9]

Positioning the Theater Missile Defense Coordination Cell is dependent on the conflict environment, available communications infrastructure, available space, and mission focus. After weighing these considerations, the location decision rests with the Joint Force Commander. There is no intent to repeatedly associate the Theater Missile Defense Coordination Cell with any particular service component. Training and exercises focus on augmenting any service component, with linkages to the remaining components' essential systems and functions. Linkages into the cell provide intelligence and targeting data, missile launch detection, an integrated battlespace picture, and terrain cartographic data.

Outputs from the Theater Missile Defense Coordination Cell focus on the following primary functions:

1. Provide "voice warning" of impending or actual missile launch to military and political assets, collection, tracking, and counterforce systems.

2. Provide "early warning" of missile launch over the Tactical Data Dissemination System and the Tactical Information Broadcast System to defensive command, control, and communications nodes; intelligence collection assets; and attack systems coordinators.

3. Provide "near real time" target data to joint and combined attack operations and collection systems on the missile launcher location (goal is 3-5 minutes with 500 meter Circular Error Probable), egress route prediction, and probable hide sites with supporting infrastructure.

4. Provide launch point, hide site, and infrastructure targeting for preplanned fires and missions.

It is important to emphasize the point that the Theater Missile Defense Coordination Cell facilitates the activities of Passive Defense (early warning), Active Defense (shooting the missile in flight), and Attack Operations (going after the missile launcher). Descriptions of each of the four pillars of theater missile defense follow.

Passive Defense

Passive Defense focuses on providing immediate warning of impending or actual missile launch to deployed forces and political targets within the Combined/Joint Task Force area of responsibility. Flexibility and redundancy allow detection from both the "in and out of theater systems." Similarly, "voice warning" of missile launch can originate from both the "in and out of theater systems," or optimally, from the Theater Missile Defense Coordination Cell.

Voice warning not only warns, but can cue defensive assets and alert attack systems. A formatted broadcast provides the missile launch

point, weapon characterization, azimuth, and impact risk area to deployed elements. Given the short flight time of theater ballistic missiles, it is imperative to disseminate warning information to as many critical nodes as possible, in the shortest amount of time. A tactical satellite radio based Missile Warning Net has emerged as the optimal solution of getting the warning out to soldiers and civilians. The critical nodes to receive the voice warning are designated based on the joint force commander's guidance and intent.

"Data warning" is a digital message broadcast over the Tactical Data Dissemination System and the Tactical Information Broadcast System networks from both in-theater and continental United States based detection systems. The broadcast is sent to all capable receivers soon after the voice warning. This function provides the earliest detailed missile launch information required for accomplishing active defense and attack operations.

Active Defense

Active Defense involves systems and procedures to disrupt or intercept tactical missiles in flight to protect critical assets. Current U.S. systems in U.S. European Command include the Patriot air defense system, and a developing capability from the Navy's Aegis cruiser. Additionally, effective active defense requires a focused intelligence

preparation of the battlefield for probable launch sites and targets, as well as wide-area launch surveillance of the area of responsibility.

Both voice and data warning from the Theater Missile Defense Coordination Cell are provided via data links to available defensive assets. Voice warning is just that. It is a voice-warning broadcast sent out via a telephone or tactical satellite radio. Data warning is where the warning information is sent out in computer style message format then received by the intended warning users that possess a computer style tactical terminal. The voice warning architecture and data warning architecture intentionally provide a redundant path thereby ensuring the receiver actually gets a heads-up when a missile may impact near their location. This provides initial launch warning and required intercept information to systems such as the Patriot air defense system. The Theater Missile Defense Coordination Cell simultaneously interfaces with the area air defense commander. If the cell is not physically located with the area air defense commander, the warning data gets to him by either voice or data link. If the cell is positioned with the area air defense commander, he will immediately see the required information. Either way, the cell is there to facilitate command and control for the area air defense commander.

Attack/Counterforce Operations

Attack/counterforce operations are intended to destroy and disrupt the tactical missile system before, during, and/or after launch. U.S. European Command dedicates a specific element (Theater Missile Defense Coordination Cell) to focus on the tactical missile target set. Additionally, the concept includes efforts to retask collection assets to track tactical missile targets to aid formal target development as an Attack/counterforce function.[10]

Using the incoming intelligence, operations, and detection system information, the cell performs analysis, prediction, detection, and target production functions. The Theater Missile Defense Coordination Cell places their priority on short dwell targets, as this is the most difficult and time critical target to locate. The specific procedures and types of links to the component attack systems will vary with the location of the Theater Missile Defense Coordination Cell, available assets, rules of engagement, and the joint force commander guidance for attack of theater ballistic missile targets. Whether preemptive or reactive, Attack/counterforce operations support component procedures for counterair, strategic attack, fire support, deep attack, strike warfare, and special operations, as well as "sensor-to-shooter" architectures.[11]

Command, Control, Communications, Computers, and Intelligence

The U.S. European Command concept for Command, Control, Communication, Computers and Intelligence (C4I) of Joint Theater Missile Defense uses existing joint and service C4I systems to ensure integration with their operational functions and to optimize the use of scarce resources. The peculiar Theater Missile Defense Coordination Cell C4I capabilities support the principles of centralized planning, decentralized execution, and coordinated efforts by forces assigned Joint Theater Missile Defense tasks. At no time does the Theater Missile Defense Coordination Cell revoke decision-making, command, or control procedures employed by defensive or offensive command and control nodes. Rather, the Theater Missile Defense Coordination Cell and its associated architecture and procedures expedite the flow of information, provide a dedicated focus on the joint theater missile defense mission, and provide a "translation" node between different service systems. The C4I system facilitates rapid communications among intelligence assets, fusion and decision-making facilities, detection and warning systems, and weapon systems.[12]

While the Theater Missile Defense Coordination Cell has been extremely successful in providing interoperability between the service C4I systems, it does not replace service C4I systems. The Theater Missile Defense Coordination Cell translates and fuses information from existing

systems and uses these same systems to distribute a composite "picture" and provide command and control as required. Service C4I systems with some inherent theater missile defense functionality and interoperability are beginning to emerge from the normal acquisition process. These theater missile defense capable systems cannot yet replace the Theater Missile Defense Coordination Cell because of their slow evolutionary progress dictated by the acquisition process, requirements to optimize current systems, and funding constraints. The result is that these systems are two to five years behind the capabilities hosted in the Theater Missile Defense Coordination Cell. Eventually service C4I systems will achieve seamless interoperability allowing prosecution of the theater missile defense threat from any C4I node. However, accelerating rates of change and improvements in information and systems integration technologies far out pace this current acquisition process. The same accelerating rates of change will make the future environment more unpredictable and less stable.[13]

Currently, the Theater Missile Defense Coordination Cell employs systems from several National and Theater agencies. This "borrowed" equipment has allowed U.S. European Command to test procedures and develop equipment requirements to best accomplish the mission. U.S. European Command's "in-theater" primary tactical missile launch detection system is the Joint Tactical Ground Station.[14] This system

provides direct downlink capability from satellite sensors for coverage of the entire U.S. European Command area of responsibility. One of only two systems forward deployed and fully operational (the other is in Korea), the Joint Tactical Ground Station has proved to be the most rapid means of missile launch and warning dissemination in the European theater. The Joint Tactical Ground Station is an integral component of the Theater Missile Defense Coordination Cell.

Outlook for the Theater Missile Defense Coordination Cell

The Theater Missile Defense Coordination Cell will retain the current fielded technology and add several new capabilities, maintaining its prototypical and experimental nature, pushing the developmental window even further. Theater ballistic missiles equipped with counter measures will require weapons, sensors and C4I systems with the ability to rapidly integrate innovative technology to counter the threat.[15]

The Theater Missile Defense Coordination Cell's open architecture and experimental nature facilitate rapid integration of emerging technology. New capabilities can be fielded and effectively integrated with existing systems years before a service system can be procured using the current cumbersome acquisition process. This early introduction of new technology greatly enhances fielded capability, and increases the flexibility to counter a rapidly changing threat. The

Theater Missile Defense Coordination Cell's experimental nature provides a means to evaluate developing weapon systems and sensors in the field that streamlines the developmental process and ensures an effective system is procured.

Additional requirements for a Theater Missile Defense Coordination Cell like system can be found in Joint Vision 2010, the Joint Staff's "... conceptual template for how America's Armed Forces will channel the vitality and innovation of our people and leverage technological opportunities to achieve new levels of effectiveness in joint warfighting."[16]

Joint Vision 2010 spells out requirements to fuse all source data with fluid integration of sensors, platforms, and command organizations utilizing advances in computer processing, precise global positioning, and telecommunications to determine accurate locations of friendly and enemy forces.[17] Improved command and control, based on fused, all-source intelligence will provide improved targeting information directly to the most effective weapon system. The Joint Vision 2010 requirements encompass capabilities currently fielded in the Theater Missile Defense Coordination Cell, a system designed to "leverage technological opportunities" and rapidly achieve "full spectrum dominance" to fulfill its theater missile defense role.[18]

With tighter defense budgets, increased interest in force protection, and the real threat of theater ballistic missiles, the Theater Missile

Defense Coordination Cell stands out as a means to provide an interoperable, effective, and relatively inexpensive theater missile defense system.[19]

Terms and Definitions

This section introduces terms that may be helpful in understanding the remainder of the thesis. While this is not a comprehensive appendix of missile defense terminology, it does cover most of the terms used later in the text that may require some explanation.

Active Defense. Active Defense involves in-flight destruction of incoming missiles and airborne launch platforms, and includes multi-tiered defense in depth to achieve maximum engagements, and active electronic warfare measures to disrupt remote or onboard guidance systems.[20]

Apportionment. In the general sense, distribution for planning of limited resources among competing requirements. Specific apportionment (e.g., air sorties and forces for planning) is described as apportionment of air sorties and forces for planning.[21]

Area Air Defense Commander. Within a unified command, subordinate unified command, or joint task force, the commander will assign overall responsibility for air defense to a single commander.

Normally, this will be the component commander with the preponderance of air defense capability and the command, control, and communications capability to plan and execute integrated air defense operations. Representation from the other components involved will be provided, as appropriate, to the area air defense commander's headquarters. Also called AADC.[22]

Area of Responsibility. The geographical area associated with a combatant command within which a combatant commander has authority to plan and conduct operations. In naval usage, a predefined area of enemy terrain for which supporting ships are responsible for covering by fire on known targets or targets of opportunity and by observation. Also called AOR.[23]

Attack Operations. Attack operations are designed to prevent the launch of theater missiles by attacking each element of the overall system, including such actions as destroying launch platforms, reconnaissance, surveillance, and target acquisition platforms, command and control nodes, and missile stocks and infrastructure.[24]

Boost Phase. That portion of the flight of a ballistic missile during which the booster and sustainer engines operate. During this phase, which usually last three to five minutes for a ballistic missile, the missile reaches an altitude of about 200 kilometers whereupon powered flight ends and the missile begins to dispense its reentry vehicles.

Commander in Chief Assessment Program. In 1988, Congress directed the development of a Master Plan for Joint Tactical Missile Defense. This Master Plan, delivered to Congress in 1989, established the Joint Tactical Missile Defense Experiments Program, now known as the Commander in Chief Assessment Program. This program has been the primary means to support the execution of various exercises and to provide the basis for the assessments, development, improvement, and eventually the establishment of requirements for theater missile defense operations and capabilities within U.S. European Command.

Combatant Commander. A commander in chief of one of the unified combatant commands established by the President. Also called CINC.[25]

Defense Support Program (DSP). Please see figure 3 in appendix for a graphic of the satellite. Defense Support Program satellites are an essential part of North America's early warning systems. In their 22,300 miles geosynchronous orbits, the satellites help protect the United States and its allies by detecting missile launch, space launch and nuclear detonations. The satellites use an infrared sensor to detect heat from missile and booster plumes against the earth's background. In 1995, a new means of processing Defense Support Program data called Attack and Launch Early Reporting to Theater was brought on line. This

capability provides improved warning of attack by short-range missiles launched against U.S. and Allied forces overseas.[26]

Fusion. In intelligence usage, fusion is the process of examining all sources of intelligence and information to derive a complete assessment of activity.[27]

Fusion Center. In intelligence usage, a physical location to accomplish fusion of intelligence data. It normally has sufficient intelligence automated data processing capability to assist in the process.[28]

Intelligence Preparation of the Battlespace. An analytical methodology employed to reduce uncertainties concerning the enemy, environment, and terrain for all types of operations. Intelligence preparation of the battlespace builds an extensive database for each potential area in which a unit may be required to operate. The database is then analyzed in detail to determine the impact of the enemy, environment, and terrain on operations and presents it in graphic form. Intelligence preparation of the battlespace is a continuing process. Also called IPB.[29]

Joint Force Commander. A general term applied to a combatant commander, sub-unified commander, or joint task force commander authorized to exercise combatant command (command authority) or operational control over a joint force. Also called JFC.[30]

Joint Tactical Ground Station. Please see figure 4 for graphic of the system. Joint Tactical Ground Station, also known as JTAGS, provides the theater Commander in Chief a deployable in-theater capability to receive, process, and disseminate space based sensor information on tactical ballistic missile launches. This system provides the launch point(s), time of launch, time to warhead impact(s), predicted impact point(s), and number of missiles launched. This information is used to support all pillars of joint theater missile defense.

Joint Theater Missile Defense. The integration of joint force capabilities to destroy enemy theater missiles in flight or prior to launch, or otherwise, disrupt the enemy's theater missile operations through an appropriate mix of mutually supportive passive missile defense; active missile defense; attack operations; and supporting command, control, communications, computers, and intelligence measures. Enemy theater missiles are those which are aimed at targets outside the continental United States.[31]

Midcourse Phase. That portion of a ballistic missile's trajectory between the boost phase and the reentry phase when reentry vehicles travel at ballistic trajectories above the atmosphere. During this phase, a missile releases its warheads and decoys and is no longer a single object, but rather a swarm of reentry vehicles falling freely along present trajectories in space.[32]

Rules of Engagement. Directives issued by competent military authority which delineate the circumstances and limitations under which United States forces will initiate and/or continue combat engagement with other forces encountered. Also called ROE.[33]

Tactical Warning. A warning after initiation of a threatening or hostile act based on an evaluation of information from all available sources. In satellite and missile surveillance, a notification to operational command centers that a specific threat event is occurring. The component elements that describe threat events are: Country of origin--country or countries initiating hostilities. Event type and size -- identification of the type of event and determination of the size or number of weapons. Country under attack-- determined by observing trajectory of an object and predicting its impact point. Event time--time the hostile event occurred. Also called integrated tactical warning.[34]

Terminal Phase. The final portion of a ballistic missile's trajectory between midcourse phase and trajectory termination. With most ballistic missiles, the terminal phase is unguided.[35]

Theater Missile. A missile, which may be a ballistic missile, a cruise missile, or an air-to surface missile (not including short-range, non-nuclear, direct fire missiles, bombs, or rockets such as Maverick or wire-guided missiles), whose target is within a given theater of operation.[36]

Delimitations

Currently the Ballistic Missile Defense Organization provides Commander in Chief Assessment funds to U.S. Atlantic Command, U.S. Central Command, U.S. Pacific Command, U.S. Southern Command, and U.S. European Command. This study will be limited to the theater missile defense efforts conducted only by the U.S. European Command Theater Missile Defense Coordination Cell.

The second delimitation is that this study will not focus on all four pillars of theater missile defense (passive defense, active defense, attack operations, and C4I). Instead, this study will focus on the phase known as attack operations. Much of the effort devoted to theater missile defense by the United States over the past few years has concentrated on intercepting theater ballistic missiles in flight. However, destroying Transporter-Erector-Launchers before they can fire their weapons reduces the number of ballistic targets that have to be engaged later and prevents the vehicle from reloading.

Significance of the Study

The significance of this paper is that theater ballistic missiles are becoming a common battlefield weapon and the United States must continue to develop ways to defeat the proliferation of missiles. From the Gulf War, two significant lessons were learned in the area of theater

missile defense. One, we realized that missiles will have a substantial role in future conflicts. Two, finding, targeting, then attacking the mobile missile transporter-erector-launchers is not only very difficult, but also very time and resource intensive.

The 1988 Iran-Iraq War of the Cities, Operation Desert Storm, and even the Civil War in Yemen demonstrated the readiness of warring factions to use ballistic missiles, and their ability to both threaten military forces and terrorize civilian population centers.

For many third-world nations, theater ballistic missiles are a substitute for the intercontinental capabilities of the two cold war superpowers, resulting in a powerful political presence.[37] In peacetime, possession of theater ballistic missiles gives threat countries a certain level of influence in regional and global matters. During a conflict, the threat of theater ballistic missile operations can encourage or discourage nations from participating in the hostilities. For example, the use of the Scud missile by Iraq against Israel very nearly succeeded in drawing Israel into the conflict. Within 24 hours of the opening of Desert Storm, Iraq launched its first of at least 88 missiles at Israel and Saudi Arabia.[38]

Countering the theater ballistic missile threat is a significant problem. Theater ballistic missiles are a threat right now to our U.S. forces in the U.S. European Command area of responsibility as well as our allies. Libya presently has the capability to launch missiles from its

soil onto Italy. As this paper is being written, the United States is threatening to launch air strikes against Iraq because they possess and are hiding their weapons of mass destruction. The threat is real and American lives are at risk!

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[1] *Conduct of the Persian Gulf War: Final Report to Congress* (Washington, D.C.: Government Printing Office, 1992), 1. This report to congress emphasized the importance that Department of Defense and the Air Force intensify their efforts to develop doctrine, tactics, techniques, and procedures for neutralizing enemy ballistic missiles.

[2] U.S. President William Jefferson Clinton, Text of President Clinton's Address on Iraq (speech presented at the Pentagon addressing the crisis in Iraq. Please reference Figure 2 in the appendix for a detailed map showing all countries with ballistic missile technology), [http:www.washingtonpost.com/wp-srv/inatl/longterm/iraq/stories/text021798.htm], 17 February 1998.

[3] See Figure 1 in appendix for view of Iraq's threat ring for launching its missiles at its neighbors.

[4] Secretary of Defense Richard Cheney, *Conduct of the Persian Gulf Conflict: An Interim Report to Congress* (Washington, D.C.: Department of defense, July 1991), Introduction.

[5] Mark Hewish and Joris Janssen Lok, "Stopping the Scud Threat, Engaging Theater Ballistic Missiles on the Ground," *Jane's International Defense Review*, No. 30, June 1997, 40.

[6] Keith Hall, Director of the National Reconnaissance Office, Remarks to the National Network of Electro-Optical Manufacturing Technologies Conference 9 February 1998, [http://www.nro.odci.gov/speeches/Hall9802.html], last accessed 3 March 1998.

[7] Joint Task Force Headquarters Policies, Procedures, and Organizations, *Chapter 22 – Theater Missile Defense Coordination Cell*, (European Command Directive Number 55-11, 7 July 1995), 1.

[8] Ibid., 2.

[9] Ibid., 3.

[10] Ibid., 7.

[11] Ibid., 7.

[12] Ibid., 8.

[13] Young, Gregory A. Lieutenant Colonel (USAF), *U.S. European Command Theater Missile Defense Bottom up Review*, March 1997, 84.

[14] See Figure 3 for picture of DSP satellite that detects the infrared heat from a hot missile plume. The DSP satellites are in geosynchronus orbits and send missile detection data to the Joint Tactical Ground Stations. Joint Tactical Ground Stations are transportable/mobile, in-theater elements of the Theater Event System that provide theater commanders with a capability to process data and immediately send a warning of a theater ballistic missile launch. The systems process data (multiple source) from DSP satellites and can tie in directly to theater communications systems to send theater ballistic missile position information to support early warning, targeting, and cueing requirements.

[15] Young, Gregory A. Lieutenant Colonel (USAF), *U.S. European Command Theater Missile Defense Bottom up Review*, March 1997, 84.

[16] United States Department of Defense, Chairman, Joint Chiefs of Staff, *Joint Vision 2010* (Baltimore: U.S. Government Printing Office, 1996), 1.

[17] Ibid., 23.

[18] Young, Gregory A. Lieutenant Colonel (USAF), *U.S. European Command Theater Missile Defense Bottom up Review*, March 1997, 84.

[19] Ibid., 84.

[20] United States Department of Defense, Joint Publication 3-01.5: *Doctrine for Joint Theater Missile Defense* (Washington, D.C.: United States Government Printing Office, 22 February 1996), III-7.

[21] Ibid., GL-2.

[22] United States Department of Defense, Joint Publication 3-01.5: *Doctrine for Joint Theater Missile Defense* (Washington, D.C.: United States Government Printing Office, 22 February 1996), GL-2.

[23] Ibid., GL-2.

[24] Lieutenant Colonel Charles A. Anderson and Colonel Richard G Kurtz, "Air and Missile Defense: Who's in Charge?" *Air Defense Artillery* (El Paso: United States Army Air Defense Center and School, July-August 1996), 2.

[25] United States Department of Defense, Joint Publication 3-01.5: *Doctrine for Joint Theater Missile Defense* (Washington, D.C.: United States Government Printing Office, 22 February 1996), GL-2.

[26] "Defense Support Program Satellites", *Air Force Space Command Fact Sheet*, 20 January 1998, [http://www.spacecom.af.mil/hqafspc/library/facts/dsp.htm].

[27] United States Department of Defense, Joint Publication 3-01.5: *Doctrine for Joint Theater Missile Defense* (Washington, D.C.: United States Government Printing Office, 22 February 1996), GL-2.

[28] Ibid., GL-2.

[29] Ibid., GL-2.

[30] Ibid., GL-2.

[31] Ibid., GL-2.

[32] United States Department of Defense, *Ballistic Missile Defense Organization Glossary Version 2.0* (Washington, D.C.: United States Government Printing Office, 1997), 1.

[33] United States Department of Defense, Joint Publication 3-01.5: *Doctrine for Joint Theater Missile Defense* (Washington, D.C.: United States Government Printing Office, 22 February 1996), GL-3.

[34] Ibid., GL-3.

[35] United States Department of Defense, *Ballistic Missile Defense Organization Glossary Version 2.0* (Washington, D.C.: United States Government Printing Office, 1997), 1.

[36] United States Department of Defense, Joint Publication 3-01.5: *Doctrine for Joint Theater Missile Defense* (Washington, D.C.: United States Government Printing Office, 22 February 1996), GL-4.

[37] Lieutenant Colonel Rocky Farry and Major Bill Treu, *An Intelligent Approach to Theater Ballistic Missile Attack Operations* [http://www.cdsar.af.mil/cc/farry.html], February 1998.

[38] *Gulf War Air Power Survey (GWAPS) Report: Summary Report* (Washington, D.C.: Government Printing Office, 1993), 87. After the Gulf War Iraq claimed it fired 93 Scud missiles to United Nations authorities documenting and destroying Iraqi weapons of mass destruction programs.

CHAPTER 2

LITERATURE REVIEW

Introduction

There is an overwhelming amount of publications pertaining to the subject of theater missile defense. There is sufficient information concerning the history, importance, and need for an effective theater missile defense. However, while there is much written about the subject, none collectively document the history, importance, or need for the U.S. European Command Theater Missile Defense Coordination Cell.

The information for this literature review was collected from July 1997 through March 1998. It involved the use of the Combined Arms Research Library (CARL) at Fort Leavenworth, Kansas; the Center for Army Lessons Learned (CALL) also located at Fort Leavenworth, Kansas; multiple background documents, after action reports, and white papers from U.S. European Command EC-J36[1]; conversations with personnel from the U.S. European Command EC-J36 theater missile defense staff; U.S. Ballistic Missile Defense Fact sheets; and from many theater missile

defense related sites located on the unclassified World Wide Web Internet.

The cornerstone publication detailing theater missile defense is Joint Publication 3-01.5, Doctrine for Joint Theater Missile Defense, published in February 1996.[2] This joint publication provides the doctrine on how the unified commands will execute joint theater missile defense.

A source where one can normally find research material related to theater missile defense and related equipment is Jane's International Defense Review, which is published monthly. This journal has published articles discussing the importance of killing the missile launchers on the ground instead of focusing on shooting the missile while in flight. Jane's International Defense Review went to the effort to send one of their journalists to cover and report on the joint and combined theater missile defense exercise, "Optic Windmill," conducted in the Netherlands during February 1997.

The magazine Aviation Week and Space Technology is another source for information in the theater missile defense arena. This publication has articles on the Airborne Laser, the Airborne Surveillance Testbed[3], and the types of missiles possessed by rouge nations such as North Korea, Iran, and Iraq.

There are multiple World Wide Web sites containing information regarding theater missile defense. For example, the Ballistic Missile Defense Organization[4] has an Internet homepage with numerous fact sheets and articles discussing the status of equipment, budget, threats, and policies related to missile defense. This defense organization also publishes a monthly newsletter focusing on current issues dealing with theater missile defense.

Historical examples regarding the threat of ballistic missiles on civilian populations are highlighted in Michael J. Neufeld's book, The Rocket and the Reich. His book details the history and effects that Hitler's infamous V-2 rockets had on London, Paris, and Antwerp during World War II.

Additional articles in Air Force Magazine, the Air Force Times, Joint Force Quarterly, United States Space Command's Guardians on the High Frontier, and Space and Missile Defense Command's Vision 2010 provide excellent information on theater missile defense. [5]

Summary

Numerous sources have been collected that provide a balanced and comprehensive overview of research that supports this thesis. There is sufficient information concerning the history, importance, and need for an effective theater missile defense. While there is a considerable

amount of literature covering the subject, none concentrate or document the history, importance, or need for the U.S. European Command Theater Missile Defense Coordination Cell.

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[1] EC-J36 stands for the "U.S. European Command Joint Staff, Command and Control Branch of the J-3 Directorate." J-3 is the Operations Directorate commanded by a U.S. Navy Rear Admiral (O-8). EC-J36 Division is commanded by an Air Force Colonel (O-6). The Theater Missile Defense Branch is headed by a U.S. Navy Commander (O-5) who oversees a staff of 3 U.S. field grade officers and one civilian contractor which provide both Space and Theater Missile Defense advice to the Commander in Chief of U.S. European Command.

[2] United States Department of Defense, Joint Publication 3-01.5: *Doctrine for Joint Theater Missile Defense* (Washington, D.C.: United States Government Printing Office, 22 February 1996).

[3] The Airborne Surveillance Testbed (AST) is a Boeing airplane equipped with a side-looking radar and an Electro-optical sensor capable of detecting and tracking missile warheads in their ascent and mid-course phases. This data can be transmitted to help cue the U.S. European Command Theater Missile Defense Coordination Cell, and the PATRIOT missile defense system.

[4] United States Department of Defense, Ballistic Missile Defense Organization (BMDO). *The Commander-In-Chief's (CINCs) Assessment Program* [http://www.acq.osd.mil/bmdo/bmdolink/html/cinc.html], 8 January 1998.

[5] *Guardians of the High Frontier* is a funded U.S. Air Force magazine and authorized publication for members of the U.S. military services. It is edited and prepared by the Internal Information Division, Headquarters Air Force Space Command Office of Public Affairs, Peterson Air Force Base, Colorado.

CHAPTER 3

METHODOLOGY

Introduction

The goal of this study is to demonstrate that the U.S. European Command Theater Missile Defense Coordination Cell and the Ballistic Missile Defense Organization sponsored Commander in Chief Assessment Program are critical to continued success of theater missile defense efforts within U.S. European Command. The Commander in Chief Assessment Program allows for the development of doctrine and operational procedures, as well as an avenue to introduce new technologies into theater architectures.

The plan to is to review various joint publications; theater missile defense related literature in professional publications, exercise after action reports from recent U.S. European Command theater missile defense exercises, and other selected readings regarding theater missile defense. Next, the many significant new theater missile defense systems that were tested or leveraged through the U.S. European Command

Theater Missile Defense Coordination Cell and the Commander in Chief Assessment Program will be highlighted.

The methodology will be in four phases. Phase one will be the collection of materials, to include personal experiences. Phase two will be to strongly define theater missile defense. In this phase, strengths versus the weaknesses will be examined. Phase three will present an extremely strong case for the consequences of not having theater missile defense by emphasizing the threat and threat capabilities. In phase 4, an analysis will be made of theater missile defense in U.S. European Command with and without the Theater Missile Defense Coordination Cell. Lastly, a strong conclusion will be presented regarding why theater missile defense is necessary and important enough to continue funding the Theater Missile Defense Coordination Cell.

By using this methodology, this thesis will answer the question; is the U.S. European Command Theater Missile Defense Coordination Cell an important vehicle to exploit new technologies in countering the theater ballistic missile threat? This methodology will also support answers to the following subordinate questions:

1. Does a single service (Air Force, Navy, or Army) or Nation possess the assets to effectively counter the emerging theater missile defense threat?

2. Are Combined/Joint Theater Missile Defense operations essential to take advantage of the synergy provided by combining all service and national strengths?

3. Is increased involvement by our allies in the U.S. European Command theater missile defense effort required?

4. Should continued emphasis be placed on attack and counterforce operations?

Summary

The methodology encompassing the review of various literatures on theater missile defense, highlighting significant systems tested with the Theater Missile Defense Coordination Cell in joint exercises, and comparing the European theater with and without a Theater Missile Defense Coordination Cell, will demonstrate the requirement to develop and fund a Theater Missile Defense Coordination Cell.

CHAPTER 4

THEATER MISSILE DEFENSE COORDINATION CELL ANALYSIS

> The Theater Missile Defense Mission is to protect U.S. forces, allies and other countries, including areas of vital interest to the U.S., from theater missile attacks. The Theater Missile Defense mission includes protection of population centers, fixed civilian and military assets and mobile military units.[1]
>
> U.S. Ballistic Missile Defense Organization

Introduction

Thanks to Saddam Hussein, biological and chemical weapons continue to make national and world headlines.[2] The idea of killing one's enemy with germ warfare has been around for a very long time. In 1346, the Tartars used crude catapults to launch plague-infested corpses into the Crimean city of Kaffa, in southwest Ukraine.[3] Today, scientists tinker with some of the most deadly ingredients known to man; and men such as Saddam Hussein have hopes of delivering these deadly ingredients to their enemies via theater ballistic missiles.

Ballistic missiles can and increasingly will be used by hostile states to blackmail, terrorize, and drive wedges between the United States and its allies.[4] Ballistic missiles are becoming a dangerous factor

in international relations, yet the United States has not fully dealt with the threat.

On the night of 25 February 1991, near the end of the Gulf War, a Scud missile was fired from Iraq. The missile launch was detected by the American Defense Support Program surveillance satellite, which computed the missile's launch point and estimated impact area. The information revealed the target area as Dhahran, Saudi Arabia. Dhahran was the city where American forces were stationed. This critical information was transmitted instantly back to earth, but not to Dhahran's two Patriot missile batteries. Because of political concerns, the data instead went all the way back to the U.S. Space Command Headquarters in Colorado Springs, Colorado, via "Bent Pipe"[5] communications architecture. There, missile-warning analysts were supposed to evaluate the information and send it on to Saudi Arabia to alert forces in the threatened area. Because of the short flight time of a launched missile, this time consuming process cost valuable seconds in getting the warning out to the troops.

On that night, the missile warning analysts were so unsure of the data that they did not even telephone a warning to the Patriot batteries. Unfortunately, there was no attempt to intercept the missile. The result was a direct impact on a hanger barracks in Dhahran, killing twenty-eight servicemen and injuring one hundred. [6]

There is a perception that the United States can shoot down incoming missiles. For example, if a theater ballistic missile was fired today in the European Command's theater of operations, where thousands of U.S. troops are stationed, here's what would happen. The network of Defense Support Program surveillance satellites would detect the missile launch with its infrared sensors and compute its trajectory and predicted impact area. The missile early warning would get to both the European Command and NATO headquarters alerting these commands of an incoming missile. This information would then be relayed to the troops in the region, warning them that a missile is inbound and to take cover. That is the extent of the theater missile defense! Currently, there is nothing set up to engage the incoming missiles.

The analysis of the U.S. European Command's theater missile defense in this chapter will be presented in four phases. The first phase will demonstrate that the author has personal experience working with the European Command Theater Missile Defense Coordination Cell project. The author gained his experience with theater missile defense while serving as a staff officer with the J-3 directorate at Headquarters U.S. European Command in Stuttgart, Germany.

The second phase will clearly define theater missile defense and its components. What it does, and some of its substantiated capabilities will be explained.

In the third phase, a strong case for not having an effective theater missile defense program will be discussed, emphasizing both the threat and capabilities to counter the threat. Here the threat to Europe and U.S. soldiers stationed abroad will be identified with two examples. The first case occurred over fifty years ago when Europe was threatened and terrorized by Adolph Hitler's V-2 rockets during World War II. The second case is presently making world headlines due to the real threat posed by Iraq's probable possession of weapons of mass destruction and the missiles to deliver them.

The final phase of this chapter will demonstrate the significance of developing the Theater Missile Defense Coordination Cell and why it should be the system of choice to counter the threat from theater ballistic missiles. This phase will analyze theater missile defense in the U.S. European Command area of responsibility with and without the U.S. European Command Theater Missile Defense Coordination Cell. While reading this section it will become clear the numerous capabilities the Theater Missile Defense Coordination Cell brings to the fight in a joint environment.

Phase One: Personal Experience and Collection of Materials

U.S. European Command has experimented and exercised with an evolving theater missile defense operational architecture for more than nine years. Although the project started in 1988 when the Office of the Secretary of Defense wanted to find a cost-effective way to counter the theater missile threat, the past few years have seen tremendous strides in the realm of theater missile defense.

The author was fortunate to be part of the process in developing a method to facilitate theater missile defense as he served as a staff officer with the J-3 directorate at U.S. European Command. He gained personal experience working with the European Command Theater Missile Defense Coordination Cell project from the fall of 1995 to the spring of 1997. The European Command Space and Theater Missile Defense staff consisted of five U.S. officers (Navy commander, Army lieutenant colonel, Air Force major and two Air Force captains) and a civilian contractor.

A wealth of information and material on the subject of theater missile defense was gathered during this time due to the Theater Missile Defense Coordination Cell and staff participating in many multinational theater missile defense exercises throughout Europe.[7] Important details and lessons learned documented in after action reports and in-process reviews came from some of the major theater missile defense exercises conducted with our allies such as the Dutch, Germans, Italians, and

Spaniards. These exercises included Optic Windmill I and II, Central Enterprise, Dynamic Mix, and Matador, respectively.

Phase Two: Theater Missile Defense Clearly Defined

It is important for the reader to understand there are certain phases of theater missile defense. Therefore, the following paragraphs will explain segments such as launch detection; passive defense; active defense, boost, ascent, midcourse, and terminal phase; attack operations; and command and control of each respective phase.

Launch Detection

Once a launch is observed, the launch warning, impact point/time predictions, and missile type are passed to various commands, military units, and civil authorities, thus allowing passive defense actions to be initiated. In addition, trajectory data, launch point estimates, missile types, and impact points are passed to active missile defense units, intelligence assets, and counterforce assets.

Passive Defense

Passive defense is necessary to provide essential individual and collective protection for friendly forces, population centers, and critical assets. Passive defense measures are planned whenever our forces

might face a theater ballistic missile threat. Passive Defense focuses on providing immediate warning of impending or actual missile launch to deployed forces and political targets within the Combined/Joint Task Force area of responsibility.

Command and Control

The main support C4I provides for passive defense is warning. Tactical warning is provided to the theater over the geographic combatant commander's early warning net. The geographic combatant commander's early warning net links space, air, and surface based sensors that detect missile launches or track missiles in flight. Warning times associated with theater ballistic missile attacks are minimal because of short missile flight times and difficulty of detection. Regardless of time available, warning is required to allow for the use of all possible protective measures for exposed personnel and equipment.

Active Defense

Current active defense systems in U.S. European Command include the Patriot, I-HAWK, and a developing capability from the Navy's Aegis cruiser. The role of active defense operations is to protect important assets and forces from attack by destroying theater ballistic missiles in flight. Defense in depth provides multiple opportunities to

neutralize the theater ballistic missiles with distinct capabilities, increases probability of kill, and stops the enemy from countering the defensive system with a single methodology.

Boost Phase

It is important to try to kill the enemy missile while it is still in his territory. Attacking the missile in its early trajectory offers the greatest likelihood for eliminating uncertainty associated with the type of warhead and the intended target. Therefore the network involved in detection and acquisition of the launched missile must be linked with the active defense weapon systems such as Patriot or the airborne laser. Space-based assets, such as the Defense Support Program[8] satellites, provide theater assets a cue for launch warning; launch point and time; threat type; and missile impact point and time prediction.

Ascent and Mid-Course Phases

In the missile's ascent and mid-course phases, active defense systems continue to receive warning and cueing information from Defense Support Program sensors in order to determine whether incoming theater ballistic missiles are threats that warrant engagement.

Terminal Phase

In the missile's terminal phase of trajectory, surface-to-air missiles or gun systems, depending on theater ballistic missile type, destroy the incoming missiles.

Active Defense Command and Control

The Joint Force Commander exercises control of active defense operations by integration of joint theater missile defense systems and forces into the C4I systems supporting Theater/Joint Operations Area air defense. Short flight times of theater ballistic missiles require that air, land, sea, and space-based sensor assets reports be integrated to provide a complete and current air and space picture.

Attack Operations

Attack Operations are characterized by offensive actions intended to destroy and disrupt enemy theater ballistic missile capabilities before, during, and after launch. The objective of attack operations is to prevent the launch of theater ballistic missiles by attacking each element of the overall system, including such actions as destroying launch platforms, command and control nodes, and missile stocks and infrastructure. Attack operations are extremely difficult because theater ballistic missile systems are generally hard to detect. They are hard to detect for the

reasons that they will normally be widely separated, transportable, electronically quiet, and redundant.

Attack Operations Command and Control

The Joint Force Commander will normally task the Joint Force Air Component Commander as the supported commander. This person is responsible to plan for and conduct attack operations against longer range theater ballistic missiles outside the other component commanders' Area of Operations. The Joint Force Commander will normally have each component commander plan and execute attack operations against theater ballistic missiles within their assigned Area of Operations. Coordination of attack operations involves the detection, acquisition, and identification of enemy theater ballistic missiles and the circulation of the targeting information to the designated counterforce system.

PHASE 3: Consequences of not having a Theater Missile Defense

> It remains, nevertheless, an ingenious and diabolical robot conception translated into fact. It belongs to a world of hideous phenomena. It comes without sound, without warning and without discrimination. Its inaccuracies are so vast that it becomes a weapon of monstrous chance, neither aeronautical nor military in its value and power.[9]
>
> H.E. Bates, The German V-2 Campaign 1944-1945.

V-2 Rocket Threat

On 8 September 1944, as Londoners arrived home for the weekend reading their evening newspapers with headlines declaring the end of the German V-1 cruise missile attacks on their city, a huge explosion blasted the quiet suburb of Chiswick in West London. The blast destroyed six homes, killed three people and seriously injured seventeen others.[10] There had been no early warning provided by the air raid sirens, no sound of an attacking aircraft or the familiar drone of the flying V-1 bomb. Londoners only heard a bang after the explosion and saw a white vapor trail cloud hanging vertically in the air.

The West London explosion was the result of the first German V-2[11] rocket salvo fired at England and marked a turning point in the history of warfare. The V-2 ballistic missile offensive against London from 8 September 1944 through 27 March 1945 represented the first military attacks by theater ballistic missiles on a city. During the campaign of terror, over five hundred V-2 rockets hit London resulting in 21,380 civilian casualties (2,511 deaths, 5,869 serious injuries, and 13,000 minor injuries).[12]

The V-2 rocket (Vergeltungswaffeswei or Vengeance Weapon - II) was originally intended for use by the German army to attack battlefield rear areas beyond the range of conventional artillery. However, the rocket's designer, twenty-four year-old Wernher Von Braun, convinced

Hitler of the weapon's potential as a terror weapon.[13] Eager to exploit this new weapon, Hitler ordered the V-2 weapon to be mass-produced as quickly as possible.

The German V-2 offensive had significant strategic, political, and psychological effects on Britain. Its population knew there would be no early warning in order to take cover from an inbound V-2 rocket. The V-2 traveled at supersonic speeds that made the first indication of an incoming missile the explosion from the missile's impact. Next, there was no active defense against the V-2. The civilians were terrified knowing their military had no way to shoot down the incoming V-2. Also, there was a higher rate of damage and casualties from the V-2 as compared to the V-1 cruise missile.

Although more V-2 rockets were eventually fired at the Belgian port of Antwerp than at London, Hitler felt that it was very important to retain the capability to directly attack London with his V-2 rockets. Hitler's desperate strategic concept relied upon knocking the British out of the war by terrorizing the war-weary civilian British population.[14]

In addition, Hitler's V-2 campaign had an adverse effect on the allied military operations for it created a compelling need to destroy the German V-2 launch sites in the Netherlands. It also meant the allies had to divert valuable and scarce aircraft from their primary missions of bombing German production facilities to the new mission of launching

airstrikes against V-2 launch sites.[15] This operation was known as Operation Crossbow.

The airstrikes during Operation Crossbow had little effect on eliminating the German V-2 threat. The allied aircraft had problems locating the V-2 missiles partly because the launchers were camouflaged and partly because they were mobile. Unfortunately for London but fortunately for the German missile batteries, the allied advance had slowed to a crawl in September 1944. This mistake left German-occupied areas in western Holland that were still within 300 kilometers of London. The heavily bombed bunker at Wizernes had been abandoned during the German retreat, as were a number of prepared sites for mobile missile batteries, but the rocket troops launched their V-2 rockets from completely unprepared launch areas.[16] This method worked quite well and helped keep the missile launchers safely hidden from attacking allied aircraft.

The bottom-line on Hitler's V-2 campaign; in the absence of an effective theater missile defense, attacks by unreliable and inaccurate missiles had major strategic effects on London, particularly psychologically. Without a theater missile defense, the 518 V-2 missile strikes had a greater adverse psychological effect on the population than the 2,420 V-1 missiles, although the V-2 caused less damage and fewer casualties than the V-1 rocket.[17]

Present Day Threat

Five decades later rogue regimes and aspiring regional powers hold similar conceptions of the role of ballistic missiles. The theater ballistic missile threat to U.S. forces abroad is real and growing.[18] Thousands of short-range missiles are deployed in up to thirty countries, some quite hostile to the United States. The threat from Iraq was underscored in a White Paper recently released by the U.S. State Department. It stated that Baghdad has not given up its plans to build larger, longer-range missiles. The United Nations Special Commission inspectors have uncovered evidence that Iraq has continued missile research since the imposition of sanctions.[19] If the sanctions were lifted, Iraq could acquire enough material to resume full-scale production of Scud-type missiles within one year. The threat has to be taken very seriously. The proliferation of short-range ballistic missiles in the world today poses an immediate threat to many of our allies and U.S. forces deployed abroad in defense of our national interests.[20]

If a rogue regime such as in Iran, Iraq, Libya or others were able to acquire a longer-range missile, it would put many NATO countries and many of the European capitals under threat.[21]

The consequences of having no theater missile defense capability to counter the threat from these rogue nations would have the same

effect on the population and military as the German V-2 rockets had during World War II.

PHASE 4: Analysis

The final phase of this chapter establishes the significance of developing the Theater Missile Defense Coordination Cell and why it should be the system of choice to counter the theater ballistic missile threat from countries such as Libya, Syria, Iran, and Iraq. This phase analyzes theater missile defense in the U.S. European Command area of responsibility by highlighting the numerous capabilities the Theater Missile Defense Coordination Cell brings to the fight in today's joint and multinational environment.

Not only does the Theater Missile Defense Coordination Cell facilitate all pillars of theater missile defense, its experimental nature allows other weapon systems a platform to exercise and test their capabilities in combating against theater ballistic missiles. Finally, in today's environment of shrinking and costly strategic airlift assets, the Theater Missile Defense Coordination Cell's small footprint affords the ease of being transported by a single C-130 aircraft.

Exercise Optic Windmill

To illustrate the importance and numerous capabilities the Theater Missile Defense Coordination Cell boasts as the only truly interoperable joint operations and intelligence fusion cell, a case study will help show the cell's role as an essential participant during a major joint and multinational theater missile defense exercise. The showcase exercise took place in the Netherlands in the spring of 1997 and is known as *Optic Windmill.* Exercise Optic Windmill provided an excellent arena for the Theater Missile Defense Coordination Cell to demonstrate its capabilities and interoperability with not only all the U.S. services, but also with multinational allies. With senior civilian and military officials in attendance, the cell successfully exercised all four pillars of theater missile defense.

Optic Windmill: Synopsis

Exercise Optic Windmill is a premier multinational and joint theater missile defense assessment that included Dutch, German, and U.S. forces. Units defended strategic targets against simulated SS-21, Scud-B, Scud-C, and Al Hussein missiles fired from northern Germany and Denmark. Patriot surface-to-air missile launchers on the Oksbul range in Denmark, defended by Stinger and Roland surface-to-air missiles, simulated Transporter-Erector-Launchers. The simulated

Transporter-Erector-Launchers provided representative signatures in terms of their radar and visual appearance as well as movement patterns.[22]

Optic Windmill included an evaluation of all pillars of theater missile defense. However, an emphasis was placed on attack operations against mobile missile launchers located at realistic distances. Attack aircraft involved USAF B-1B Lancer bombers and F-15E Strike Eagles, German Air Force Tornado strike aircraft, and Royal Netherlands Air Force F-16s. The aircraft, flying combat air patrols over the North Sea, were given snap vectors toward the missile launch coordinates by NATO E-3A AWACS aircraft on the instructions provided by the Theater Missile Defense Coordination Cell.[23]

Optic Windmill: Passive Defense

The Theater Missile Defense Coordination Cell was instrumental and the heart of the Missile Early Warning Architecture. The Theater Missile Defense Coordination Cell received instantaneous missile launch data directly from the Joint Tactical Ground Station in Stuttgart via a 9.6-baud rate telephone line. Receiving the missile launch data directly from the ground station saves seconds of valuable early warning time by not having to rely on the data coming via long-haul communications from U.S. Space Command in Colorado Springs.

The following sequence of events took place after a missile launch was detected. A Naval Petty Officer operating the Joint Tactical Ground Station computer in the cell analyzed missile launch data displayed on the monitor at his workstation. The computer attempts to classify the missile flight profile based on preprogrammed algorithms. The operator quickly analyzed the data on the screen which displayed missile launch time, launch location, azimuth, missile type, estimated missile impact area and time to impact. The published goal of the Theater Missile Defense Coordination Cell is to get the voice warning out on a broadcast within sixty seconds. After verifying a valid launch had occurred, the operator provided a voice warning broadcast over a tactical satellite radio where the missile impact area was estimated. Anyone with a tactical satellite radio received the voice warning. If they happened to be located near the estimated impact area, they had approximately three to five minutes to don protective gear and take shelter.

It is important to point out the tremendous difference between this voice warning and the warning soldiers received during Desert Storm in 1991. Not only is today's voice warning more timely, it is more accurate. During Desert Storm, the voice warning was slow in getting to the theater and warned an entire region they were under threat of the missile impact. For example, instead of warning the soldiers and population in Riyadh to take cover, the entire country of Saudi Arabia was warned

about the incoming missile. The lack of accurately predicting the missile impact area unnecessarily caused personnel in Dhahran to stop working on turning fighter aircraft so that they could don their protective clothing, then take cover from a missile that was not coming.

During Optic Windmill, the voice warning consistently was broadcast within sixty seconds of launch detection and the accuracy of predicting the missile impact areas allowed personnel in the affected areas to take cover while the personnel out of harm's way continued with their tasks uninterrupted. An additional benefit from the voice-warning broadcast over the radio is that the active defense shooters received a tip-off that a missile was coming into their sector. The cue from the Theater Missile Defense Coordination Cell saved them valuable seconds in knowing which direction to look in guiding their attempts to shoot the incoming missile out of the sky.

As an important backup to the voice warning architecture in case it failed, an additional tactical data-link warning architecture provided users such as the Dutch, German, and U.S. Patriot batteries a cue that missiles were inbound.

Optic Windmill: Active Defense

Normally, the Patriot missile batteries receive a cue of a missile launch from data broadcast over the Tactical Information Broadcast

Service network. However, this information comes from processed data that had to be analyzed, then up-linked to a satellite that beamed the broadcast out to anyone with a capable receiver with the necessary cryptographic gear. Again, time is of the essence, and this process takes up valuable seconds that could mean the difference between successfully engaging a missile in the air and letting it slip through to cause damage and casualties on the ground. The Theater Missile Defense Coordination Cell has an alternative solution that speeds up the process.

During Optic Windmill, the Dutch, German, and U.S. Patriot missile batteries were connected to the Theater Missile Defense Coordination Cell via tactical data links. As discussed earlier, the Theater Missile Defense Coordination Cell received instantaneous missile launch data directly from the Joint Tactical Ground Station in Stuttgart via the 9.6-baud rate telephone line. This data was translated by the cell's Air Defense System Integrator and automatically relayed directly to the Dutch, German, and U.S. Patriot missile batteries.

In addition to data coming in from the Joint Tactical Ground Station, the Theater Missile Defense Coordination Cell experimented with a data-link to an airborne platform sensor known as the Airborne Surveillance Testbed. The Airborne Surveillance Testbed has a sensor that can detect and track an inbound missile warhead well beyond the distance a ground-based sensor can provide.

The Airborne Surveillance Testbed received a cue from the Theater Missile Defense Coordination Cell that a missile had been launched because the cell received its information from space-based sensors. Subsequently, the tip-off from the Theater Missile Defense Coordination Cell enabled the airborne sensor to cue its sensors toward the approximate direction of the incoming warhead. After the airborne sensor acquired the missile warhead, its high-speed computers calculated two vital pieces of information. First, it refined the missile's estimated impact area, transmitted this data back to the Theater Missile Defense Coordination Cell, who then broadcasted an update to the theater over the tactical satellite radio its estimation of where the missile would land. The refined data was also sent to the multinational Patriot missile batteries that provided them a better prediction on where to focus their radar. Second, the Airborne Surveillance Testbed calculated the reverse path of the missile and provided the Theater Missile Defense Coordination Cell with very accurately refined missile launch-point coordinates. The refined launch-point coordinates then became extremely useful in the attack operations phase of theater missile defense.

Another platform the Theater Missile Defense Coordination Cell plans to eventually link data to, but was unable during Optic Windmill because the system will not be ready until 2002, is the newest, high-tech

weapon, known as the Airborne Laser. Since the platform is not yet operational, the data-links with the Theater Missile Defense Coordination Cell were exercised through simulation.

The capabilities of the Airborne Laser are immense and the payoff is expected to be high. The operational concept calls for the Airborne Laser to orbit in airspace over friendly territory and watch for theater ballistic missiles. Theater Missile Defense Coordination Cell can provide the tip-off via data-link to the platform that a missile has been launched. From hundreds of miles away, the Airborne Laser will then be able to track the missile, target it with a low power laser, and then focus a multi-megawatt chemical oxygen-iodine laser on its body. A reinforcing deterrent value is the fact that the Airborne Laser will be able to engage multiple targets in quick succession and carry enough fuel onboard to shoot down as many as forty missiles.[24]

The goal of the Theater Missile Defense Coordination Cell is to provide a cue to the active defense shooters within ninety seconds of launch detection. During exercise Optic Windmill the cell consistently provided timely and accurate data to the multinational Patriot missile batteries well within its standard of ninety seconds.

In addition to missile launch data being sent to the U.S. Army's and multinational Patriot missile batteries, the information is also translated by the cell's Air Defense System Integrator and sent via

tactical data link to the U.S. Navy's Aegis cruiser. Due to the complexity in obtaining an Aegis cruiser for Optic Windmill, this capability was demonstrated by sending the data to a U.S. Navy Multiple User Link Translator unit, that was positioned off the coast of Denmark. The significance of this capability means that the U.S. Navy's Aegis cruiser can get a missile launch cue from the Theater Missile Defense Coordination Cell, which enables the Navy to provide force protection to soldiers in a littoral environment. With the Patriot missile batteries in short supply around the world, a considerable advantage is realized when the Navy's Aegis cruiser can pull into a port and provide the force a theater missile defense capability against a probable missile threat.

The Army and the Navy are not the only services that received launch data from the Theater Missile Defense Coordination Cell during Optic Windmill. Again, missile launch data was received via the Joint Tactical Ground Station 9.6 baud-rate phone line, translated by the cell's Air Defense System Integrator, then transmitted into the Recognized Air Picture that provided situation awareness to the Combined Air Operations Center and the U.S. Air Force Airborne Warning and Control System (AWACS). Having an accurate air picture which displayed the position of all air assets and possible surface to air missile threats, overlaid with the theater ballistic missile data, provided the good guys

with a valuable tool to execute attack operations against the enemy's missile launchers.

Optic Windmill: Attack Operations or Counterforce

Air Force Colonel John Warden proclaims in his book, *The Air Campaign*, the most difficult and costly place to attack enemy aircraft is in the air. Historical experience has shown it is far easier and cheaper to destroy aircraft on the ground rather than in the air.[25] Similarly, it is much more efficient and effective to kill the enemy's missiles on the ground before they are launched.

In the attack operations phase of Optic Windmill, the Theater Missile Defense Coordination Cell facilitated the process by providing three target sets to the assets, that resulted in our offensive weapons putting steel on target. The cell calculated the three target sets by combining missile launch data from the Joint Tactical Ground Station, Airborne Surveillance Testbed, and Joint Surveillance Target Attack Radar System with terrain delineation information from the cell's computer system called, Generic Area Limitation Environment. The resultant target sets were the refined initial missile launch coordinates, the possible search route for the mobile enemy Transporter-Erector-Launcher, and possible hide and infrastructure sites. The goal of the cell

was to calculate all three sets of targets, then get the information in the hands of the offensive assets within five minutes.

After the first few simulated missile launches, the team working in the Theater Missile Defense Coordination Cell consistently calculated the missile launch coordinates, probable movement model of the mobile missile launcher, and the possible hide and reloading sites well within its goal of five minutes. In an effort to attack the mobile missile launchers in as many different ways as possible, the cell provided the information to air assets including the USAF B-1B, F-15E, F-16s; the Dutch F-16s; and German Tornadoes. In one instance, a B-1B bomber demonstrating its global-reach-global-power mission by flying nonstop from Ellsworth Air Force Base, received the three targets set data from the Theater Missile Defense Coordination Cell while en route to its Scud Combat Air Patrol orbit. Armed with the probable location of the missile launcher, the B-1B bomber proceeded to the vicinity of the launch area, dropped Gator mines at all the major road intersections, and effectively eliminated the escape route of the mobile missile launcher. The cell also transmitted the information via secure-voice satellite communications to Navy special operations forces. The special operations forces used the data to seek and destroy the simulated missile launchers through clandestine methods.

In addition to the special operations forces receiving the launch point coordinates over the secure satellite communication network, the USAF AWACS listened in and received the same information. Armed with this information on the predicted launch point, the AWACS gave snap vectors to aircraft already orbiting in a Scud Combat Air Patrol over the North Sea, thus pointing the attack aircraft in the general direction of the launch location.

While the aircraft sped toward the general vicinity of the launch coordinates from their orbit point, the Theater Missile Defense Coordination Cell set about using all their fused intelligence sources to come up with their three target sets. With the aircraft already closing in on the launch area, the Theater Missile Defense Coordination Cell broadcasted their calculated refined launch coordinates to the AWACS, who then relayed the information to the fighters.

The result was the fighters were able to save approximately five minutes of cruise time in getting to the target. This meant the mobile missile launcher, that doctrinally takes up to thirty minutes to break down its equipment to start racing to its hide site, subsequently had five less minutes to do so. This five minutes could have been the difference between success and failure in locating and killing the mobile missile launcher before it arrived at its hide site.

Optic Windmill: C4I

The Theater Missile Defense Coordination Cell's concept of operations requires that it overlay existing C4I systems and be interoperable with the joint services and NATO allies. During Optic Windmill, the Theater Missile Defense Coordination Cell used existing communication and data architectures to facilitate rapid communications among intelligence assets, decision-making facilities, detection and warning systems, and weapon systems. The cell successfully translated and fused information from the available sensor systems, then used those same systems to distribute missile data to all necessary customers that needed the information to execute theater missile defense.

No matter if the Navy needed the data via their communications architecture known as Joint Maritime Communication Information System, or the Air Force needed data via its system known as Contingency Theater Automated Planning System, the Theater Missile Defense Coordination Cell had the flexibility and interoperability to adapt.

The cell provided voice warning to critical nodes by way of two methods. The first and most preferred method was through a tactical satellite broadcast. As a backup, the same warning was relayed to the critical nodes by voice communication called out over one of the cell's

seven Motorola STU-III telephones. As a backup to the voice warning, the missile launch data was also sent digitally via TADIL A and TADIL B data links to the multinational Patriot units and the U.S. Navy Multiple Data Link Translator System.[26]

Through the cell's final redundant missile warning system during this exercise, NATO allied headquarters received warning of simulated missile launches over the NATO approved intelligence sharing network known as the Linked Operations Center Europe (LOCE) system. This system let each respective headquarters know a missile had been launched and could possibly impact in one of their countries.

Experimental Nature

During Optic Windmill, the Theater Missile Defense Coordination Cell provided the services and our NATO allies a platform that allowed them to test and exploit new technologies and ideas in countering the theater ballistic missile threat. Because of the cell's open architecture and experimental nature, two new systems were brought into the exercise to see if they added value to theater missile defense. The two systems were the B-1B bomber aircraft, and the brand new "Stalker" terrain delineator.

USAF B-1B Lancer

As mentioned earlier, the B-1B bomber demonstrated its effectiveness by flying nonstop from Ellsworth Air Force Base, entered an orbit over the Netherlands in a Scud Combat Air Patrol, then waited for missile launch coordinates to be relayed from the Theater Missile Defense Coordination Cell. After receiving the location of the missile launcher, the B-1B bomber proceeded to the vicinity of the launch area, then dropped Gator mines at each major road intersection, which ultimately boxed in the mobile missile launcher.

Stalker

The "Stalker" terrain delineator was a system developed in less than forty-five days that used commercial-off-the-shelf software to help pinpoint the location of the mobile missile launcher.[27] Its function was to help make the process of searching for a needle in a haystack much easier by using terrain analysis software to eliminate almost the entire haystack.

Stalker is a user-friendly computer tool that assisted in locating, tracking, and destroying enemy mobile Transporter-Erector-Launchers. Given theater ballistic missile launch point estimates, Stalker has the ability to identify launch areas and model the movement of the mobile missile launcher and support vehicles along predicted movement paths

to determine the most likely hide sites and support areas. The database is compiled by fusing intelligence data such as satellite photos and known operational areas with detailed digital maps of terrain, geologic features, roads, and possible launch locations.

At the conclusion of exercise Optic Windmill it was evident both the B-1B bomber aircraft and the Stalker terrain delineator system proved valuable with their contributions to conducting successful attack operations.

C-130 Transportable

With all the capabilities the Theater Missile Defense Coordination Cell brings to the table, one would think that deploying this system downrange with the Joint Force Commander would tie up quite a few strategic airlift assets. However, the exact opposite is the case. All this capability is neatly packaged into one High-Mobility Multipurpose Wheeled Vehicle known as a HMMWV. The total weight of the entire equipment suite including the vehicle and its shelter is a little less than ten thousand pounds.

In today's environment of shrinking and costly strategic airlift assets, the Theater Missile Defense Coordination Cell's small footprint affords the ease of being transported by a single C-130 aircraft sortie.

Deductions

1. The Theater Missile Defense Coordination Cell provides early warning to the soldiers and civilian population in theater.

2. The Theater Missile Defense Coordination Cell provides a cue to active defense assets such as multinational Patriot missile defense batteries, the Navy's Aegis cruiser, and the Airborne Laser.

3. The Theater Missile Defense Coordination Cell provides three target sets in order to facilitate attack operations in killing the fixed and mobile missile launchers.

4. The experimental nature of the Theater Missile Defense Coordination Cell provides a platform for other theater missile defense systems to experiment with and test their new technologies.

5. The Theater Missile Defense Coordination Cell does not require any new communications architecture. It overlays any of the service component architectures and is interoperable in the joint and combined arena.

6. Because of the way the Theater Missile Defense Coordination Cell is packaged, it is transportable via a single C-130. Therefore, it is not dependent on scarce strategic airlift assets to get it to the fight.

Summary

This chapter examined the many capabilities of the Theater Missile Defense Coordination Cell by looking at its participation in the joint and multinational theater missile defense exercise called *Optic Windmill.* Until a single service develops and fields an operational theater missile defense coordination system of its own, U.S. European Command's Theater Missile Defense Coordination Cell currently stands as the system of choice. It is the way to go because right now, the cell is the only operations and intelligence fusion system that facilitates all four pillars of theater missile defense; is truly joint; can operate in a multinational environment; provides a platform for other assets to experiment with; and is small enough to be transported on a single C-130 aircraft.

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[1] United States Department of Defense, "The Ballistic Missile Defense Fiscal Year 1997 Budget," *Fact Sheet* (Washington, D.C.: Ballistic Missile Defense Office, July 1997), 2.

[2] Gordon M. Burck and Charles C. Flowerree, *International Handbook on Chemical Weapons Proliferation* (New York: Greenwood Press, 1991), 516.

[3] E.J. Gong Jr., *The Invisible Weapons,* ABCNEWS.com [http://www.abcnews.com/sections/science/dailynews/deadlygas0210.html], 24 February 1998.

[4] Dorian Benkoil, *Proliferation of Missiles, Weapons Goes Beyond Iraq: A Changing Power Balance* (New York, Feb 27 1998) [http://www.abcnews.com/sections/world/DailyNews/weapons0227.html].

[5] *The Army Satellite Communications (SATCOM) Architecture,* (Reston, Virginia: Information Technology and Applications Corporation, April 1997), G-1. Bent Pipe communications architecture is a non-regenerative channel that does nothing to the signal received by the satellite, except relay it toward earth.

[6] *Gulf War Chronology, Events of the 1991 Persian Gulf War,* 3 March 1991, 11:18 EST [http://wire.ap.org/?FRONTID=NATIONAL]. On 25 February 1991 the Iraqis scored a direct hit with a Scud missile attack on a U.S. barracks in Dhahran, Saudi Arabia, killing 28 troops and injuring 100.

[7] The European Command J-36 Staff and the "Theater Missile Defense Coordination Cell" were directed by CINC EUCOM to participate in at least four major exercises per year in the EUCOM's area of responsibility. His intent was for the staff to conduct theater missile defense training with each of the service components, which allowed that service the opportunity to have control of the TMD Cell. This meant the TMD Cell was placed with the Land Component Commander during one exercise, then the Air Component Commander, the Naval Component Commander, and the Marine Component Commander during subsequent exercises. In addition, the staff also participated in many Computer Assisted Exercises (CAX), Planning Exercises (PLANEX), and TMD conferences.

[8] See Figure 3.

[9] H. E. Bates, The German V-2 Campaign, 1944-45, *Center for Defense and International Security Studies* [http://www.cdiss.org/v2.htm].

[10] The German V-2 Campaign, 1944-45, *Center for Defense and International Security Studies* [http://www.cdiss.org/v2.htm], 1.

[11] Please see Figure 5.

[12] The German V-2 Campaign, 1944-45, *Center for Defense and International Security Studies* [http://www.cdiss.org/v2.htm], 1.

[13] Ibid., 1.

[14] Michael J. Neufeld, *The Rocket and the Reich: Peenemunde and the Coming of the Ballistic Missile Era* (New York: The Free Press, 1995), 249.

[15] Richard Davis, *Carl A. Spatz and the Air War in Europe* (Washington, D.C.: Smithsonian Institution Press, 1992), 428.

[16] Michael J. Neufeld, 249.

[17] The German V-2 Campaign, 1944-45, 3.

[18] George J. Tenet, Director of Central Intelligence Speech 1/28/98 Before the Senate Select Committee on Intelligence Hearing On Current and Projected National Security Threats [http://www.odci.gov/cia/public_affairs/speeches/dci_speech_012898.html].

[19] United States Department of Defense, "Iraq Weapons of Mass Destruction Programs," *U.S. Government White Paper*, released 13 February 1998 [http:www.state.gov/www/regions/nea/iraq_white_paper.html].

[20] Paul G. Kaminski, *DoD's Ballistic Missile Defense Programs,* Volume 12, Number 14, Prepared statement by, Undersecretary Of Defense For Acquisition And Technology, to the Military Research and Development Subcommittee, House National Security Committee, March 6, 1997, [http://www.defenselink.mil/pubs/di97/di1214.html].

[21] Dorian Benkoil, 2.

[22] Mark Hewish and Joris Janssen Lok, "Stopping the Scud Threat, Engaging Theater Ballistic Missiles on the Ground," *Jane's International Defense Review*, No. 30, June 1997, 40.

[23] Ibid., 40.

[24] John R. Tirpak, "Defense at the Speed of Light." *Air Force Magazine*, Vol. 80, No. 11 (November 1997), 38.

[25] John A. Warden III, Colonel, USAF, *The Air Campaign: Planning for Combat* (Washington, D.C.: Brassey's, 1989), 36.

[26] TADIL-A and TADIL-B stand for Tactical Data Information Link series A and B. TADIL-A is a secure, half-duplex, netted digital data link

that uses parallel transmission frame characteristics and standard message formats at either 1,364 or 2,250 BPS. It is normally operated in a roll-call mode under control of a net control station to exchange digital information among airborne, land-based, and shipboard systems. TADIL-B is a secure, full duplex, point-to-point digital data link that uses serial transmission frame characteristics and standard message formats at 2,400, 1,200, or 600 BPS. It interconnects tactical air defense and air control units.

[27] United States Department of Defense, *Project STALKER*, U.S. Army Space and Missile Defense Command, Public Affairs Office, P.O. Box 1500 Huntsville, AL 35807 [http://www.ssdc.army.mil/FactSheets/STALKER.html].

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

Thesis Question

The primary question this study seeks to answer is if the U.S. European Command Theater Missile Defense Coordination Cell is an important vehicle to exploit new technologies in countering the theater ballistic missile threat. This study also seeks to answer the following subordinate questions:

1. Does a single service (Air Force, Navy, or Army) or nation possess the assets to effectively counter the emerging theater missile defense threat?

2. Are Combined/Joint Theater Missile Defense operations essential to take advantage of the synergy provided by combining all service and national strengths?

3. Is increased involvement by allies in the U.S. European Command Theater Missile Defense effort required?

4. Should continued emphasis be placed on attack and counterforce operations?

Conclusion

The U.S. European Command Theater Missile Defense Coordination Cell is an important system that provides the services and our NATO allies a platform for them to test and exploit new technologies and ideas in countering the theater ballistic missile threat. The cell's open architecture and experimental nature facilitate a more rapid integration of new technologies. Emerging capabilities can be fielded and integrated with existing systems long before a service system can be procured utilizing the present acquisition process. This early introduction of new technology greatly enhances already fielded capabilities, which increases the flexibility to counter the theater missile threat. The experimental nature of the cell provides a means to evaluate developing weapon systems and sensors in the field. This helps to streamline the developmental process and ensures an effective system is procured.

Currently, no single service or nation possesses the assets to effectively counter the proliferating theater missile defense threat. Since no single service has the capability to accomplish the task independently, joint operations with all services of the U.S. military are essential to defeat the theater missile threat.

The services should put aside their fight for their share of the rice bowl and instead work together to develop and field a truly joint

deployable theater missile defense coordination cell. If a Commander in Chief owned a truly joint Theater Missile Defense Coordination Cell, he would have the flexibility to place the cell with the service component best suited to execute the theater missile defense mission based on the preponderance of assets and the command and control architecture available.

Similarly, no nation has all the resources available to protect its citizens from a theater missile attack. Therefore, it is imperative for individual nations to pool their missile defense technologies, intelligence, training, and assets together if they intend to seriously overcome the threat from attacks by theater ballistic missiles. The joint cell the individual services field must be interoperable and flexible enough to roll in and operate with a multinational coalition.

Increased involvement with our allies will be required to realistically have a chance to counter the proliferation of theater ballistic missiles. With the tremendous costs associated with fielding systems to counter a theater ballistic missile threat, it is extremely important to share the burden of funding with our allies. The U.S. and its allies must take advantage of the synergy provided by melding all the service and national strengths if they want to have a legitimate chance at defeating a theater missile threat in their region.

If they are planning to combine their assets and personnel into an effective force then they must have a common way of doing things. Not only must each service and nation be familiar with the operation of each other's equipment, they must train together in exercises. During joint and multi-national theater missile defense exercises, each service and nation can practice together developing the tactics, techniques, and procedures over a common C4I architecture.

Although it is important to develop tactics, techniques, and procedures for all pillars of theater missile defense, it makes strategic and economic sense to focus more on attack and counterforce operations. It is vital that continued emphasis should be placed on the attack operations pillar for one simple reason. Just as it would be much easier and more efficient to kill wasps in their hive rather than kill every wasp, the same goes for killing theater ballistic missiles. It is much easier and more efficient to destroy missiles in their storage areas or on their Transporter-Erector-Launchers on the enemy's turf than to try to shoot the streaking warhead out of the sky with the risk of debris falling on our territory and troops.

With practice and understanding of common procedures used in all four pillars of joint theater missile defense, the United States and its allies have a better chance in defeating the threat of attack by rogue nations possessing theater missiles. Fortunately, the U.S. European

Command Theater Missile Defense Coordination Cell system is available to all services and NATO allies, providing a vehicle for training together in the realm of theater missile defense.

The U.S. European Command Theater Missile Defense Coordination Cell serves four highly valuable functions. First, when the cell is deployed with either the Joint force Commander or any of the service components, its function is to facilitate all phases of theater missile defense. Second, the cell functions to provide the perfect interoperable testbed for all U.S. services and NATO allies to exercise their systems against theater missile attacks. Third, it provides a centralized operations and intelligence fusion cell that is completely interoperable with not just the Air Force, Navy, Army, and Marines but also with most members of NATO. Its open architecture and flexibility allows for seamless interoperability between U.S. service stove-piped systems as well as potential allied systems. Finally, all the radios and computers necessary for the cell are all packaged neatly into the back of one High-Mobility Multipurpose Wheeled Vehicle, which makes it function as the only deployable Theater Missile Defense/Operations and Intelligence Fusion Cell in the European theater.

Bottom line. Until a single service develops and fields an interoperable intelligence and fusion cell to defeat the threat of theater

ballistic missiles, presently the U.S. European Command's Theater Missile Defense Coordination Cell is the answer!

Recommendation for Follow-on Research

While researching this paper, it became obvious that the types of systems available to help prosecute theater missile defense are vast. Personnel from the Unified Command staffs involved in making decisions on how to plan and execute an effective theater missile defense should have a clear understanding of the various systems that are out there and available to help with their theater missile defense effort.

Of the many systems currently available to the U.S. government to help counter the proliferation of theater ballistic missiles, the following systems warrant further study to see how feasible it may be to incorporate them into a credible defense against the theater missile threat: Airborne Laser, Airborne Surveillance Testbed, Aegis cruiser, Israel Arrow anti-missile system, Unmanned Aerial Vehicles, Special Ops Forces, P-3 Orion Electro-Optical Airplane, and the B-1 Bomber.

Also interesting for further study: The Army is developing their version of a Theater Missile Defense Coordination Cell and call it the "Army Theater Missile Defense Element Force Projection Tactical Operations Center." Although similar to U.S. European Command's Theater Missile Defense Coordination Cell in its function, the size of the

system requires up to five C-141 aircraft to get it to the fight. With that kind of requirement for strategic airlift, one wonders what weapon system is being bumped from its priority on the Time Phased Force Deployment List. It would be an excellent opportunity for someone with an economics background to study the tradeoff of its capabilities, large footprint, and heavy strategic airlift burden verses the Theater Missile Defense Coordination Cell's capabilities, small footprint, and requirement for only a single C-130 sortie.

Figures

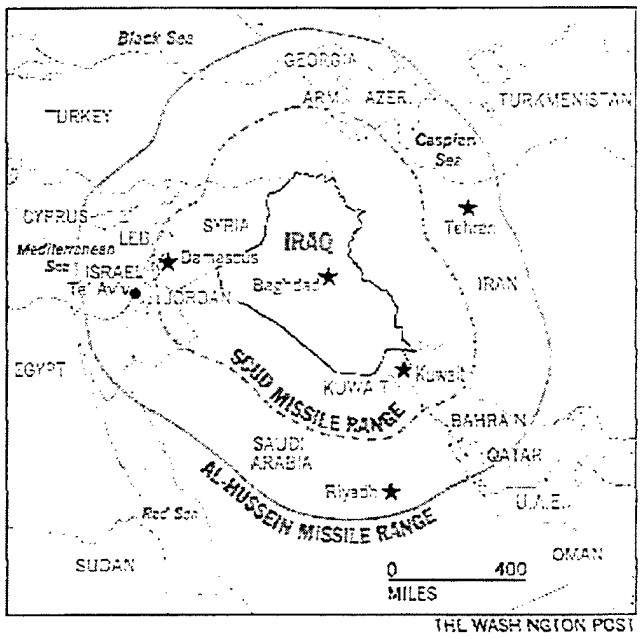

Figure 1. Scud and Al Hussein Missile Ranges. Washington Post.

A Scud missile packed with germs could reach approximately 185 miles; an Al- Hussein missile could penetrate about 400 miles and more than a dozen countries.[1]

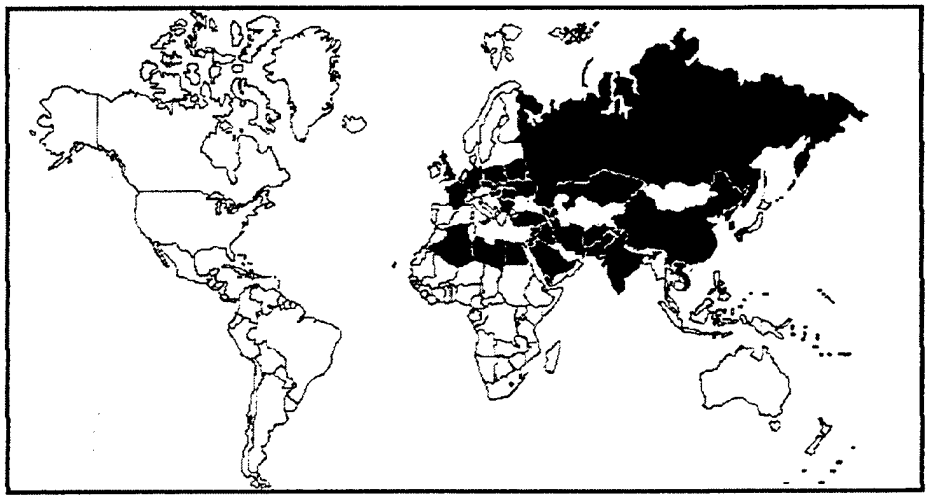

Figure 2. Countries with Theater Ballistic Missile Capability.

Map provided by United States Space Command. Countries in black currently have, produce, or are developing the technology for theater ballistic missiles.[2]

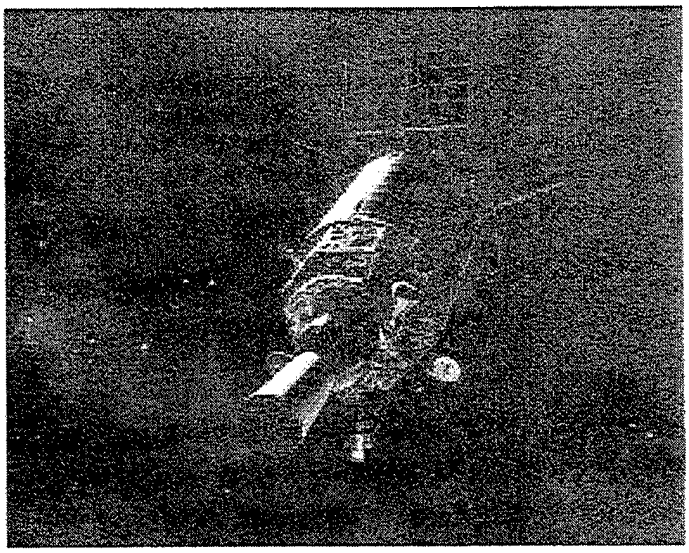

Figure 3. Defense Support Program Satellite. U.S. Space Command.

Defense Support Program satellites are stationed in a geosynchronus orbit 22,300 miles above the earth's surface. Their infrared sensors detect heat from missile and booster plumes against the Earth's background. [3]

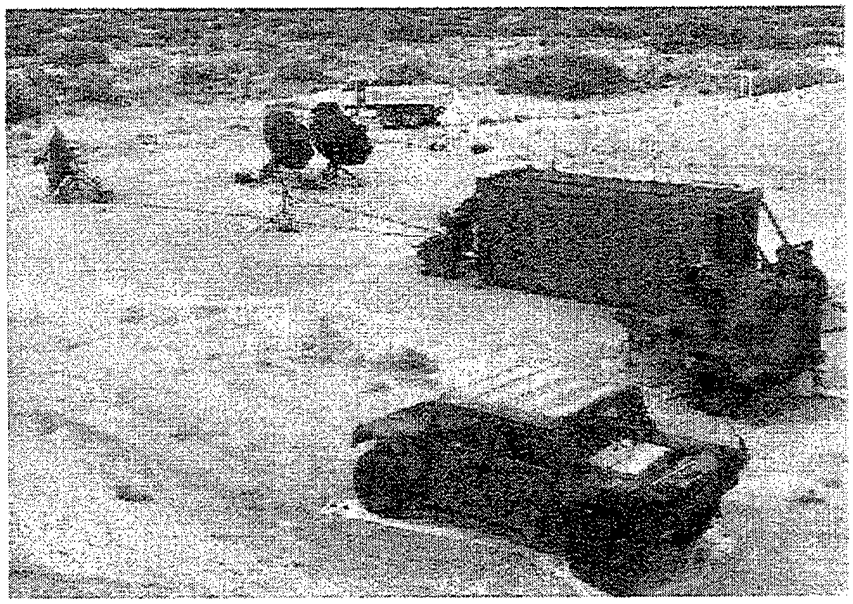

Figure 4. Joint Tactical Ground Station. U.S. Army Space Command.

The Joint Tactical Ground Station (JTAGS) is the transportable, in-theater element of the U.S. Space Command's Tactical Event System and will provide Theater Commanders with a capability to process data and disseminate warning of Theater Ballistic Missile launches. [4]

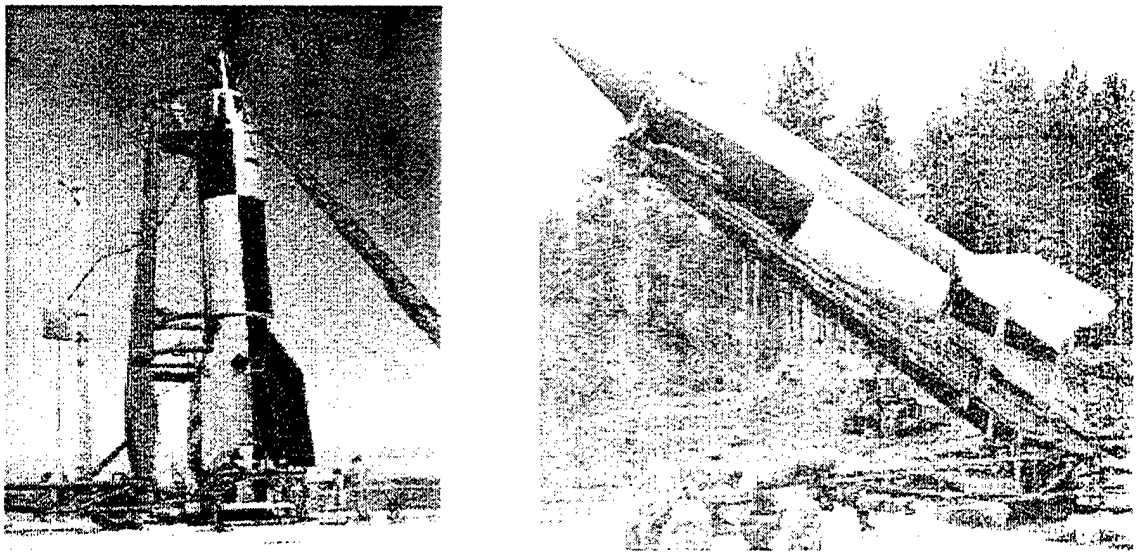

Figure 5. Adolph Hitler's V-2 Rocket. WWW.CDISS.ORG/V2.HTM.

Hitler's V-2 Rocket (or Vergeltungswaffezwei) was the world's first operational ballistic missile. [5]

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[1] Figure 1. "Pentagon Suspects Iraqi Military", Washington, D.C.: [Associated Press) http://www.washingtonpost.com/ (last accessed Thursday, December 11, 1997; 5:53 p.m. EST]. The Iraqis, throughout the crisis over the United Nations inspections for weapons of mass destruction, have moved their missiles around. That could be seen both as a defensive move -- to keep the missiles hidden -- or an offensive maneuver because it makes it difficult for them to be pinpointed in a counterattack. Pentagon spokesman Kenneth Bacon told reporters the United States is keeping a "very robust military force" consisting of 29,000 soldiers, sailors, airmen and Marines in the Persian Gulf region. In addition, about 300 military aircraft are in the region, including more than 200 combat aircraft, and a wide range of Navy ships accompanied by two aircraft carriers, the USS Nimitz and USS George Washington.

[2] Figure 2. U.S. Space Command: Theater Ballistic Warning, Map provided by United States Space Command, [http://www.spacecom.af.mil/usspace/tbm.htm], last accessed 3 March 1998.

[3] Figure 3. U.S. Space Command Defense Support Satellite. Defense Support Program satellites use an infrared sensor to detect heat from missile and booster plumes against the Earth's background, [http://www.spacecom.af.mil/usspace/dsp.htm], last accessed 3 March 1998.

[4] Figure 4. The van and the satellite dish antennae make up the system known as the Joint Tactical Ground Station (JTAGS). The system is the transportable, in-theater element of the U.S. Space Command's Tactical Event System and will provide Theater Commanders with a capability to process data and disseminate warning of Theater Ballistic Missile launches. [http://armyspace.com/JTAGS.htm], last accessed 3 March 1998.

[5] Figure 5. The V-2 Rocket developed by German Wernher Von Braun, [http://www.cdiss.org/v2.htm]. The V-2 was the fourth weapon in a German Army research program known as Aggregat which had been initiated under the technical direction of Von Braun. The system was thus known as A-4. The first successful launch occurred on 3 October 1942. The V-2 had a height of 46 feet; diameter of 5 feet, 6 inches; weighed 28,380 pounds including a 2,201 pound warhead; maximum range of 200 miles; guided by a primitive three-axis gyro which gave the V-2 a Circular Error Probable of 11 miles. Unlike the V-1 developed by the Luftwaffe, which flew low, and slow enough to be intercepted by fast aircraft, the V-2 was a true, guided, ballistic missile, rising into the stratosphere before plunging down to the target. The only warning of an approaching V-2 was the double boom as it broke the sound barrier shortly before impact. There was no defense against the V-2, so the English went after the launching sites. They did this very effectively in the Pas de Calais so that only mobile V-2s could be launched. None of these systems were ever successfully attacked.

BIBLIOGRAPHY

Books

Burrows, William E. *Deep Black.* New York: The Berkley Publishing Group, 1988.

Burck, Gordon M. and Charles C. Flowerree. *International Handbook on Chemical Weapons Proliferation.* New York: Greenwood Press, 1991.

Damon, Thomas. *Introduction to Space: The Science of Spaceflight.* Florida: Orbit Book Company, 1990.

Davis, Richard. *Carl A. Spatz and the Air War in Europe.* Washington, D.C.: Smithsonian Institution Press, 1992.

Duffner, Robert W. *Airborne Laser: Bullets of Light.* New York: Plenum Press, 1997.

Neufeld, Michael J. *The Rocket and the Reich: Peenemunde and the Coming of the Ballistic Missile Era.* New York: The Free Press, 1995.

Walker, James A., Francis Martin and Sharon S. Watkins. *Strategic Defense: Four Decades of Progress.* Historical Office of the U.S. Army Space and Strategic Defense Command, 1995.

Warden, John A., III, Colonel, USAF. *The Air Campaign: Planning for Combat.* Washington, D.C.: Brassey's, 1989.

Articles and Periodicals

Anderson, Charles A. and Richard G. Kurtz. "Air and Missile Defense: Who's in Charge?" *Air Defense Artillery*, July-August 1996.

Anselmo, Joseph C. "United States Faces Growing Arsenal of Threats." *Aviation Week and Space Technology*, 24 February 1997: 44.

Dornheim, Michael A. "Missile Defense Soon, But Will It Work?" *Aviation Week and Space Technology*, 24 February 1997: 38.

Durham, George A. "Developing TTP for Theater Missile Defense." *Field Artillery*, September-October 1995: 17-21.

Hewish, Mark and Joris Janssen Lok. "Stopping the Scud Threat, Engaging Theater Ballistic Missiles on the Ground." *Jane's International Defense Review*, June 1997: 40-47.

Kipphut, Mark Lieutenant Colonel, USAF. "Theater Missile Defense: Reflections for the Future." *Airpower Journal*. 10, no. 4, Winter 1996: 35-52.

Tirpak, John R. "Defense at the Speed of Light." *Air Force Magazine*, 80, no. 11 November 1997: 36-40.

U.S. Military Services Press, *Aerospace Daily*, Special Report, 181, no. 30. 13 February 1997: 234.

Commercial Pamphlets

Inside Missile Defense: An exclusive biweekly report on U.S. missile defense programs, procurement and policy making. Inside Washington Publishers, P.O. Box 7167, Ben Franklin Station, Washington, D.C. 20044, Volume 3, No. 5, 12 March 1997.

Government Documents

Chairman, Joint Chiefs of Staff. Joint Publication 1-02. *Department of Defense Dictionary of Military and Associated Terms*. Baltimore: U.S. Government Printing Office, 23 March 1994.

_____. Joint Publication 3-01.5, *Doctrine for Joint Theater Missile Defense*. Baltimore: U.S. Government Printing Office, 22 February 1996.

_____. *Joint Vision 2010.* Baltimore: U.S. Government Printing Office, 1996.

Department of Defense. *Ballistic Missile Defense Organization (BMDO).* "CINC Theater Missile Defense Assessment Program, Program History and Exercise Findings." August 1995.

_____. *BMDO Fact Sheet 97-11,* "The Hawk System." Washington, D.C.: Office of the Secretary of Defense, July 1997.

_____. *BMDO Fact Sheet 97-20,* "Patriot Advanced Capability-3." Washington, D.C.: Office of the Secretary of Defense, July 1997.

_____. *BMDO Fact Sheet 97-21,* "Theater High Altitude Area Defense System." Washington, D.C.: Office of the Secretary of Defense, July 1997.

_____. *BMDO Fact Sheet 97-36,* "The Ballistic Missile Defense Fiscal Year 1997 Budget." Washington, D.C.: Office of the Secretary of Defense, July 1997.

_____. *Guardians of the High Frontier.* U.S. Space Command pamphlet, 1997: 1-23.

_____. *Conduct of the Persian Gulf Conflict: An Interim Report to Congress.* Washington, D.C.: Office of the Secretary of Defense, July 1991.

_____. *Conduct of the Persian Gulf War: Final Report to Congress.* Washington, D.C.: Government Printing Office, 1992.

Gulf War Air Power Survey (GWAPS) Report: Summary Report. Washington, D.C.: Government Printing Office, 1993.

The Army Satellite Communications (SATCOM) Architecture. Reston, Virginia: Information Technology and Applications Corporation, April 1997.

U.S. Army. Field Manual 100-18: *Space Support to Army Operations.* Washington, D.C.: Department of the Army, July 1995.

_____. *U.S. Army Space Reference Text.* U.S. Army Command and General Staff College, Fort Leavenworth, Kansas, January 1995.

_____. *Vision 2010.* U.S. Army Space and Missile Defense Command pamphlet, 1997.

Internet

Air Force Space Command Fact Sheet. "Defense Support Program Satellites." [http://www.spacecom.af.mil/hqafspc/library/facts/dsp.html] last accessed 20 January 1998.

Associated Press. "Pentagon Suspects Iraqi Military." [http://www.washingtonpost.com/] last accessed 11 December 1997.

Ballistic Missile Defense Organization (BMDO). "The Commander-In-Chief's (CINC's) Assessment Program." [http://www.acq.osd.mil/bmdo/bmdolink/html/cinc.html] last accessed 8 January 1998.

Benkoil, Dorian. "Proliferation of Missiles, Weapons Goes Beyond Iraq: A Changing Power Balance." New York, Feb 27 1998. [http://www.abcnews.com/sections/world/DailyNews/weapons0227.html] last accessed 2 March 1998.

Farry, Rocky, Lieutenant Colonel (USAF) and Major Bill Treu (USAF). "An Intelligent Approach to Theater Ballistic Missile Attack Operations." [http://www.cdsar.af.mil/cc/farry.html] last accessed 8 February 1998.

Gong, E.J. Jr. "The Invisible Weapons." [http://www.abcnews.com/sections/science/dailynews/deadlygas0210.html] last accessed 25 February 1998.

Gulf War Chronology. "Events of the 1991 Persian Gulf War." [http://wire.ap.org/?FRONTID=NATIONAL] last accessed 14 March 1998.

Kaminski, Paul G. "DoD's Ballistic Missile Defense Programs." Volume 12, Number 14. Prepared statement by Undersecretary of Defense For Acquisition And Technology, to the Military Research and Development Subcommittee, House National Security Committee,

March 6, 1997.
[http://www.defenselink.mil/pubs/di97/di1214.html] last accessed 8 January 1998.

Kuska, Dale. "Micro-UAVs Possible in Near Future." Special to the American Forces Press Service.
[http://www.dtic.mil/afps/news/9801072.html] last accessed 8 January 1998.

Missile Resources. "Classifications of Ballistic Missiles by Range."
[http://www.cdiss.org/bmrange.html] last accessed 8 January 1998.

The German V-2 Campaign, 1944-45. Center for Defense and International Security Studies [http://www.cdiss.org/v2.htm] last accessed 7 February 1998.

U.S. Army Space and Missile Defense Command Public Affairs Office. "Project STALKER."
[http://www.ssdc.army.mil/FactSheets/STALKER.html] last accessed 16 March 1998.

U.S. Army Space Command. "Joint Tactical Ground Station (JTAGS)."
[http://armyspace.com/JTAGS.htm] last accessed 3 March 1998.

U.S. Government White Paper. "Iraq Weapons of Mass Destruction Programs."
[http:www.state.gov/www/regions/nea/iraq_white_paper.html] last accessed 14 March 1998.

U.S. Space Command. "Theater Ballistic Warning." Map provided by United States Space Command.
[http://www.spacecom.af.mil/usspace/tbm.htm] last accessed 3 March 1998.

Unpublished Works

European Command Directive number 55-11. "Joint Task Force Headquarters Policies, Procedures, and Organizations. Chapter 22 – Theater Missile Defense Coordination Cell." 7 July 1995.

Young, Gregory A. Lieutenant Colonel, U.S. Air Force. *U.S. European Command Theater Missile Defense Bottom up Review.* March 1997.

Interviews

Young, Gregory A. Lieutenant Colonel, U.S. Air Force. Commander of the 32nd Air Operations Group Theater Missile Defense branch. 20 February 1998.

Speeches

Clinton, William Jefferson, President of the United States. Text of President Clinton's Address on Iraq (speech presented 17 February 1998 at the Pentagon addressing the escalating crisis in Iraq). [http://www.washingtonpost.com/wp-srv/inatl/longterm/iraq/stories/text021798.html] last accessed 17 February 1998.

Hall, Keith. Director of the National Reconnaissance Office. Remarks to the National Network of Electro-Optical Manufacturing Technologies Conference 9 February 1998. [http://www.nro.odci.gov/speeches/Hall9802.html] last accessed 3 March 1998.

Tenet, George J. Director of Central Intelligence Speech 1/28/98 Before the Senate Select Committee on Intelligence Hearing On Current and Projected National Security Threats. [http://www.odci.gov/cia/public_affairs/speeches/dci_speech_012898.html] last accessed 14 March 1998.

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