REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	5June 1998	Master's Thesis 3 August 1997 - 5 June 1998

4. TITLE AND SUBTITLE

Nuclear Attack on U.S. Space-Based Assets: Current Strategy, Policy, Reality, and Implications for the Future

5. FUNDING NUMBERS

6. AUTHOR(S)

MAJ Steven A. Sliwa, U.S. Army

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

USA CGSC
1 Reynolds Avenue
Fort Leavenworth, Kansas 66027

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT

Approved for public release, distribution unlimited.

12b. DISTRIBUTION CODE

A

13. ABSTRACT *(Maximum 200 words)*

This study examines what changes need to be made in U.S. strategy, policy, and programs in order to prevent a nuclear attack on its space-based assets. The study was inspired by an event, which occurred during the Army After Next Winter Wargame conducted at Carlisle Barracks, Pennsylvania, in the winter of 1997. Although this attack took place in a wargame set in the year 2020, the threat is relevant today. As the proliferation of nuclear weapons continues, the possibility of a rogue nation using a nuclear weapon as what has been called the "cheapest form of ASAT" (Anti-satellite Weapon) is a contingency that the political and military leaders of the U.S. cannot dismiss. This study will review the technical aspects of the use of nuclear weapons in space, deterrence, strategy, and policy issues that affect such an attack. Finally, this thesis will identify the gaps in U.S. strategy and policy and demonstrate how these same gaps potentially leave the U.S. vulnerable to this form of attack in the present time frame. It concludes that the nation cannot currently prevent a nuclear attack on its space-based assets, the best it can achieve is to attempt to deter such an attack and limit the effects should deterrence fail. It proposes what is needed to augment the mission of space

14. SUBJECT TERMS	15. NUMBER OF PAGES
nuclear, space-based assets, attack	129
	16. PRICE CODE

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

NUCLEAR ATTACK ON U.S. SPACE-BASED ASSETS: CURRENT STRATEGY, POLICY, REALITY, AND IMPLICATIONS FOR THE FUTURE

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

STEVEN A. SLIWA, MAJ, USA
B.S., United States Military Academy, West Point, NY, 1986

Fort Leavenworth, Kansas
1998

MASTER OF MILITARY ART AND SCIENCE

THESIS APPROVAL PAGE

Name of Candidate: MAJ Steven A. Sliwa

Title of Thesis: Nuclear Attack on U. S. Space-Based Assets: Current Strategy, Policy, Reality, and Implications for the Future.

Approved by:

______________________________, Thesis Committee Chairman
LTC Deborah D. Gregoire, M.B.A.

______________________________, Member
Maj Randall W. Buddish, M.S.

______________________________, Member
James R. Daron Jr., M.S.

______________________________, Member, Consulting Faculty
LTC John M. Rogers, J.D.

Accepted this 5th day of June 1998 by:

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

The opinions and conclusions expressed herein are those of he 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

NUCLEAR ATTACK ON U.S. SPACE-BASED ASSETS: CURRENT STRATEGY, POLICY, REALITY, AND IMPLICATIONS FOR THE FUTURE by MAJ Steven A. Sliwa, 129 pages.

This study examines what changes need to be made in U.S. strategy, policy, and programs in order to prevent a nuclear attack on its space-based assets. The study was inspired by an event, which occurred during the Army After Next Winter Wargame conducted at Carlisle Barracks, Pennsylvania, in the winter of 1997.

Although this attack took place in a wargame set in the year 2020, the threat is relevant today. As the proliferation of nuclear weapons continues, the possibility of a rogue nation using a nuclear weapon as what has been called the "cheapest form of ASAT" (Anti-satellite Weapon) is a contingency that the political and military leaders of the U.S. cannot dismiss. This study will review the technical aspects of the use of nuclear weapons in space, deterrence, strategy, and policy issues that affect such an attack.

Finally, this thesis will identify the gaps in U.S. strategy and policy and demonstrate how these same gaps potentially leave the U.S. vulnerable to this form of attack in the present time frame. It concludes that the nation cannot currently prevent a nuclear attack on its space-based assets, the best it can achieve is to attempt to deter such an attack and limit the effects should deterrence fail. It proposes what is needed to augment the mission of space control under the present circumstances.

ACKNOWLEDGMENTS

This acknowledgment is longer than one may expect from such a thesis; however, there are numerous individuals that I would like to recognize and thank for their individual efforts that contributed to the completion of this thesis. Each individual had their own special impact on the final work in one way or another, and I would feel remiss not to take the time to mention them here.

First, I would like to thank Colonel Jimmy Slade of the U.S. Army Space and Missile Defense Command. It was Colonel Slade who first planted the seeds in my mind to pursue a Master of Military Art and Science prior to my arrival at Fort Leavenworth. His advice was excellent, and as I continued the process, I realized just how correct it was.

I would like to sincerely thank my Chairman, Lieutenant Colonel Deborah Gregoire. Her help and understanding allowed me the flexibility to complete this project while completing other studies and reacting to minor personal crises. Lieutenant Colonel (R) Jim Daron and Major Randy Buddish also deserve praise for all of their assistance while serving as committee members for this thesis. I would also like to recognize Lieutenant Colonel John Rogers who served as the Consulting

Faculty Member from afar in Kentucky. He was instrumental in sharpening my focus throughout this thesis.

Several students, all of which were in my CGSC small group, also contributed to this work. Major Kirk Nilsson served as a constant source of encouragement throughout this process and was always willing to assist in any appropriate manner. Major Eric Wesley served as an informal reader whose frankness and insight I relied upon greatly. Air Force Major William "Bif" Mott whose discipline in working on his own thesis served as an excellent example for me to follow; his friendship and camaraderie throughout the process kept spirits in perspective. Finally, Major Cedric Carroll provided me constant encouragement on a daily basis.

Lieutenant Colonel Mike Bradley, Mr. Harry Looney, and Mr. George Jacques all deserve mentioning. They were always available to provide insight and direction during the research process. Their friendship and encouragement throughout this process has been truly appreciated.

I would also be remiss not to mention some special people who simply provided encouragement for this effort. Major Gary Hisle and Ms. Erin Shea continuously provided moral support, especially during the "low points" during this endeavor.

Major Dave Troilet and Major Sharon Hamilton of the CGSC faculty also deserve recognition. Major Troilet served as a constant source of encouragement and understanding. Major Hamilton served as an informal reader and provided excellent feedback, and suggestions.

Finally Lieutenant General Edward G. Anderson III, whose mentorship and encouragement inspired and reminded me that this accomplishment was worth the effort. I would have had no exposure to the numerous and broad mission areas of space had it not been for him. His influence has been paramount in this effort and has had an impact on the direction I have chosen to pursue my career in the future.

Finally, I would like to thank my parents, Tony and Lee Sliwa. They have always been there for me and provided a constant source of encouragement to complete this document.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF ABBREVIATIONS

AAN	Army After Next
ABM	Anti-Ballistic Missile
ASAT	Anti-Satellite Weapon
DoD	Department of Defense
DUSD (S)	Deputy Under Secretary of Defense, Space
GEO	Geostationary Orbit
IO	Information Operations
LEO	Low Earth Orbit
MEO	Medium Earth Orbit
NMS	National Military Strategy
NPS	National Space Policy
NSS	National Security Strategy
USSPACECOM	United States Space Command
WMD	Weapon of Mass Destruction
WWG	Winter Wargame

CHAPTER 1

INTRODUCTION

The purpose of this thesis is to examine a particular vulnerability to the space-based assets possessed by the U.S. and possibly determine what must be done to limit or eliminate this vulnerability. This weakness is the possible attack in space of U.S. assets by nuclear weapons either to destroy or to damage the systems operating within that medium. An example of such an attack occurred notionally during the Army After Next (AAN) Winter Wargame (WWG) conducted at Carlisle Barracks, Pennsylvania, which concluded 6 February 1997. During this wargame, set in the year 2020, U.S. space assets were attacked by several means including nuclear devices. It is the events of that wargame that serve as the inspiration of this thesis.

There are numerous circumstances and factors that make this sort of attack both possible and very undesirable for the U.S. Upon close examination, the events of the AAN WWG with regard to space, in many ways reveal how our assets in space may be vulnerable today. This thesis examines the factors that make this form of attack so dangerous to the U.S., why it is feasible, how it possibly could be conducted, and most importantly address the policies and programs (or lack thereof) that make this form of attack worthwhile to a future enemy. At the conclusion of the thesis, it will address what the U.S. should do about its gaps in its policies and programs regarding this vulnerability.

Background

Few question the importance space and the assets operating in that medium to the prosperity and security of the U.S.. Although a debate could rage on both ways as to just how important space is in this realm and just how reliant the nation truly is on space, several facts cannot be debated. Space has emerged to affect the everyday lives of all the citizens of the U.S.. It has emerged with the importance to be addressed in both the National Security Strategy (NSS) as well as the National Military Strategy (NMS). The Department of Defense as well as each branch of the Armed Services have also recognized the importance of space and have formulated their own policy with regard to this medium.

The importance of space at the national level is echoed in the U.S. National Space Policy. It addressees not only military assets, but investments the nation has in its infrastructure and economy. The importance of space is apparent in the policy which President Clinton signed in September 1996 establishing goals for the U.S. Space Program. These goals are:

> Enhance knowledge of the Earth, the solar system and the universe through human and robotic exploration;
>
> Strengthen and maintain the national security of the United States;
>
> Enhance the economic comprehensiveness, and scientific and technical capabilities of the United States;
>
> Encourage State, local and private sector investment in, and use of space technologies;
>
> Promote international cooperation to further U.S. domestic, national security and foreign policies.[1]

It is obvious that space means much more to the U.S. than just a medium for military intelligence, communications, weather, and navigation/positioning aides. However, as the armed services forge ahead into the twenty-first century, reliance on space may become so great that losing any portion significantly places the U.S. at a disadvantage. This is a possibility that is currently being explored by every space agency within the Department of Defense (DoD). What becomes apparent is that as great strides are made in the technology that is employed in space, the military will likely become more dependent on its space-based systems. The bottom line is that uninhibited use of space is important to the U.S. Numerous documents cite that U.S.

access and control of space contributes to advancing national interests, the ability to use space must be protected. With these factors in mind, it is interesting to examine the events of the AAN WWG and how they impact on this issue.

The AAN WWG revealed sobering issues as it attempted to portray what the look of war might be like in the year 2020. The AAN WWG was the Army's first attempt at a large-scale "free-play" wargame at the political-strategic level. Players filled key roles all the way up to the Presidential level and made decisions based on only slightly modified versions of current strategy and policy. Commanders were equipped with forces far more modern than that of today and operated on the doctrinal principles of war. The wargame was based on a scenario that placed the U.S. in a situation to respond to a nation with the intent, capability, and will to invade Ukraine. The importance of space was represented in this wargame; however, the actual wargame was not confined to space activities and exercised the full spectrum of military operations.[2]

In one of the key events of this wargame, the belligerent nation anticipated the involvement of the U.S. and conducted preemptive strikes against U.S. space assets to level the information warfare playing field. The enemy perceived that the U.S. had a clear advantage in information operations and that the center of gravity for many of the systems that supported that advantage were space assets. The enemy attacked the space assets with lasers initially and in a final blow launched and detonated numerous (approximately 30) nuclear weapons in space. This nuclear attack greatly affected all space assets (not merely U.S. assets) in low and medium earth orbit in the region of the nuclear attack.

This sort of attack was realistic even though some would argue that it was not. It is true that U.S. surveillance satellites would not have missed the final launch of so many nuclear missiles. Upon detecting such a launch, the U.S. would surely interpret an attack and would likely have deployed its strategic nuclear forces. However, what many who observed the game pointed out is that launches of much fewer systems could have occurred without prompting such a response. A launch of this type with the same intentions, just more limited, is possible. Upon closer examination, and more important, we find that it is possible today.[3]

Several other lessons became apparent concerning space from this wargame. First, space control is vital to any warfighting doctrine based on information dominance. Even during the Persian Gulf War, it became obvious that the Army was placing greater reliance on its space-based intelligence and communications satellites than ever before.

Second, an enemy preemptive strike in space is the greatest threat to the projected American way of war in the twenty-first century. Third, an able opponent with less sophisticated technology can still achieve strategic surprise and seize the initiative. This final lesson forcibly drove home to the Army's leadership that it is still possible, in the era of high-tech warfare, for an enterprising opponent to find an "asymmetrial response," enabling it to catch the U.S. unaware and inflict a major defeat of its forces at the onset of a war, even a war in space.[4]

The attack in space created numerous issues for the leadership playing the game. A general confusion over some key areas existed that is revealed through several questions which were noted in the wargame after action review (AAR). Will the next war start in space as it did in the WWG? Are the attacks against Blue (the name used for the U.S. role in the wargame) space assets equivalent to attacks on blue territory? A lack of national policies and treaties regarding space complicated National Command Authority (NCA) decision making; What mix of arms control measures, policies, passive defenses and offensive systems are needed to support U.S. interests in space? In the WWG, space assets were vulnerable to attack and difficult to replace; Wow heavily should Blue rely on space as a host of military assets that serve as force multipliers? WWG space operations affected information capabilities;

What is the relationship between space operations and information operations (IO)? To what extent are they interdependent? The critical impact of the loss of space was not on the immediate tactical fight, but on the global and strategic perspective and logistical connectivity; How can these vulnerabilities be reduced? What will the impact be on other agencies? The numerous questions that were formulated are not easily answered, and thus exemplifies the additional impact that this attack achieved.

Examining the enemy's actions in this futuristic wargame leads one to ask the question, "Could this happen today or in the near future?" The answer is yes and no. Few nations have a sophisticated space program to produce anti-satellite satellites or lasers capable of tracking and engaging satellites. The U.S. Army only recently tracked and lased a satellite using low and high power lasers from White Sands, New Mexico, with mixed results.[5] The U.S. can expect in time, a few nations may follow suit in achieving this feat; however, the majority of nations cannot afford to build these types of lasers, and do not possess a space program which would be necessary to support other ASAT weaponry.

Unfortunately, a nuclear attack on space assets is possible by any nation that can build or obtain nuclear warheads and rockets to deliver them. Although nuclear weapons are not inexpensive, the are relatively cheap as an ASAT weapon. It is far more likely that rogue nations will join the "nuclear club" far sooner than the "space club." Nations could effectively have an ASAT program (although very limited) by merely possessing nuclear warheads and a booster to carry them into space. In terms of expense, nuclear weapons probably remain the cheapest way to attack a properly designed and hardened space system.[6]

Nuclear weapons have been proven effective in damaging satellites. The U.S. learned this as early as 1958 when it detonated three nuclear devices above the Atlantic Ocean at altitudes between 125 and 300 miles. The results of the tests reported to the President observed that:

> A nuclear explosion in space produces three kinds of effects of military importance. The high energy radiation including particles from the explosion produces effects on space; the whirling high energy electrons generate radio noise; and the delayed radiation from the fission products can affect radio transmission. All these effects are matters of degree, depending on yield, location and geometrical considerations.

The report continues:

> The effect in space itself is of importance to apparatus such as satellites and ballistic missiles exposed to this effect. The high energy electrons generate X-rays when they strike any material objects; these X-rays are very penetrating and can damage electronic equipment.[7]

Although this test was not aimed at satellites specifically, its results indicate clearly that satellites would be affected. Further tests produced the same conclusion. In 1962 the United Stated detonated a 1.4

megaton nuclear devices at an altitude of 248 miles above Johnston Island in the Pacific. This test, known as Starfish Prime, once again was not directed to study the effects of nuclear weapons against satellites. However, there was an unforeseen result; damage to at least three satellites by the trapped radiation from the explosion. "Permanent effects" to the solar cells of the British Ariel, U.S. TRAAC, and Transit IV-B satellites were reported in congressional testimony on the test.[8]

Nuclear blasts in space do not have the same effect as they do on earth. The vacuum of space alters the blast, as well as its effects. The blast and heat of the burst are severely reduced due to the vacuum. Shock waves cannot be created by the blast and the lack of air retards the heat and fireball associated with a detonation within the atmosphere. The greatest effect the detonation creates in terms of affecting space assets is from the radiation, electromagnetic pulse (EMP), and system generated EMP (SGEMP).

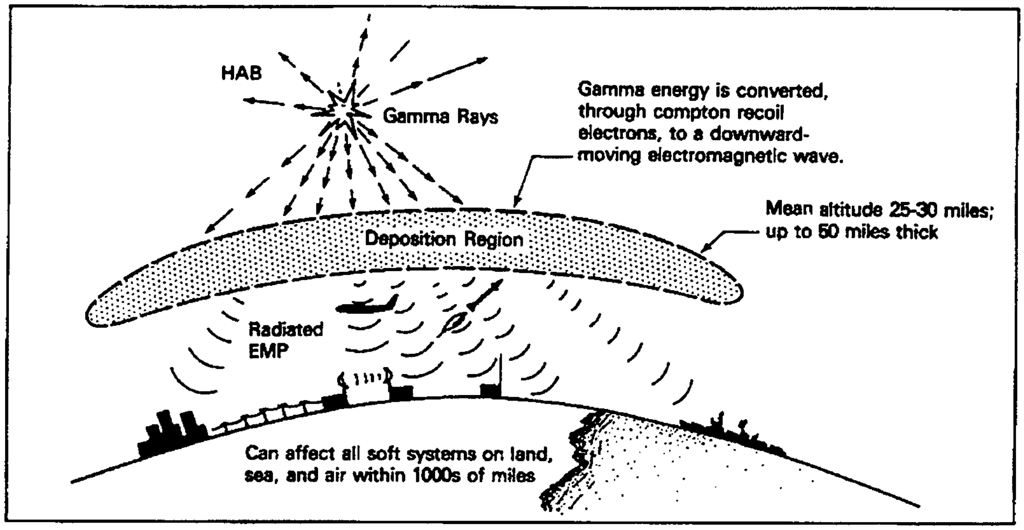
The radiation that can damage satellites is in the form of X rays Detonations in the atmosphere produce X rays, however, they can only radiate a few feet from the burst prior to being absorbed into the atmosphere. In space, these X rays travel at the speed of light for thousands of miles. These X rays can peel metal skins and destroy delicate mechanisms through intense heat and shock waves that are created within the object upon absorption of the X rays.[9]

EMP is another effect of a nuclear blast that can be damaging to a satellite. The solid state circuitry packed into the smallest feasible space use miniature components that cannot bear the high currents produced during the blast. Immense overvoltages sufficient to melt semiconductor materials can render highly sophisticated electronics instantaneously into irreparable trash.[10]

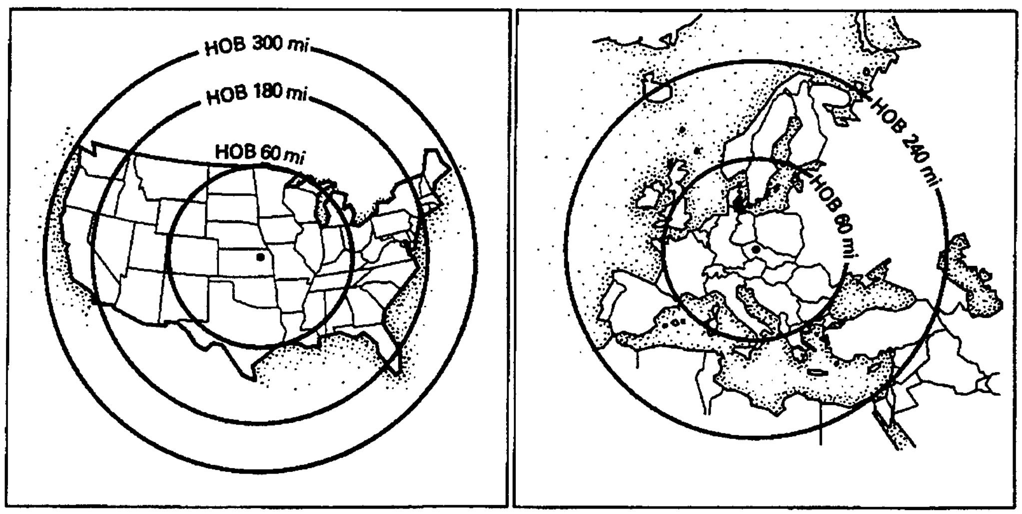
SGEMP originates much like EMP. When gamma rays strike solids instead of atmosphere, the highly energetic rays create this phenomenon. Pulse effects similar to EMP are produced by the object itself and are contained within the system. Poorly protected satellites and solar power systems in orbit are particularly vulnerable to SGEMP created by gamma rays due to radii extending hundreds (sometimes thousands) of miles in space, far more than they would in absorbent air.[11]

Finally, a nuclear detonation in space also enhances the Van Allen belts with electrons.[12] These electrons become trapped in the belts and continue to damage satellites over time as they pass through the belts.[13] The belts can maintain a high radiation state for over a year.[14] Satellites that were not anywhere close to the detonation can still encounter

Gamma Rays Related to EMP



Radii Related to HOB



1. HAB is high altitude burst.
2. HOB is height of burst in miles.
3. EMP is electromagnetic pulse.
4. Average EMP within each circle is 25,000 volts per meter. Peaks are twice that high.

Figure 1. Effects of a Nuclear detonation in Space (Electromagnetic Pulse Propogation and Gamma Rays related to EMP). Source: John M. Collins, <u>Military Space Forces: The Next 50 Years</u> (Washington, DC: Pergamen-Brassey's International Defense Publishers, Inc., 1989), 30.

failures due to this "pumping" of the Van Allen belts.[15] An example of a nuclear high altitude burst is depicted in figure 1.

An attack in space with nuclear weapons is not something that is confined only to the future. The likely spread of nuclear devices, the unique characteristics of their effects in space, and the reliance on space are becoming more apparent. Several nations have the capability to use nuclear weapons as ASATs now. Additionally, a number of nations have been active in developing the ability to build their own nuclear weapons or obtaining them from outside sources.[16] With these facts in mind, there are several possible scenarios in which this type of hostility could happen today or in the near future. These scenarios involve a nation firing a nuclear weapon straight up over its own territory, beyond its own airspace, into the region of space that is above its own territory.

The first scenario is the type described in the AAN WWG; however, it is not in the year 2020 but today or the near future. A nation-state at war with the U.S. may believe this sort of action is warranted and necessary to level the playing field fully due to an advantage in information warfare favoring the U.S. through its space assets. A country in this position may choose to ignore any treaties it has signed concerning space and sacrifice its own space assets to ensure denying the U.S. use of its space-based assets. A nuclear attack of space assets could be preemptive in nature like that in the AAN WWG, or as a countermeasure once the U.S. has committed itself to the conflict. The U.S. would be at an obvious disadvantage if it had to fight on foreign soil without all of the assets that provide it the necessary information about the enemy, terrain, location, etc. This case may well make the loss of the belligerent's space assets through its attack of U.S. assets worth while in the end if it contributes in any extent to ending the war on terms favorable to the belligerent nation. In this option, the number of missiles launched would have to be carefully limited by the enemy as to not give the impression that a large strike may be heading for the U.S. mainland or her allies.

Another scenario could involve an independent actor on the world scene that may not observe nor care about the protocols observed by the rest of the world. This rogue, which may be in a position of fighting a war with the U.S. for any number of reasons, may find attacking the U.S. space assets fully worth while from the onset also. A nation that has no satellites and/or little access to their products has even less to lose in such a strike. Such an attack as this could once again level the field. After all, here is a nation that uses no space assets, retains an informational advantage about his own nation and has not killed any U.S. citizens in its attack.

Additionally, an advanced or rogue nation attempting to retaliate against any number of U.S. actions or sanctions could attack these assets under a guise of a "test." Once again, the weapon would be detonated *over its own territory.* Loss of U.S. space assets may be portrayed as an "accident," requiring the replacement of those assets nonetheless.

Finally, an enemy may use a nuclear weapon as an EMP generator. This would involve exploding a nuclear weapon at a high altitude with the specific intention of taking advantage of the EMP effects on the ground. This scenario could place a nation that is about to attack another at an advantage by knocking out command and control communications prior to attack. The aggressor shuts down all of his own communications and electronic equipment just prior to the detonation thus preserving the majority of his own capabilities. The unsuspecting adversary absorbs the brunt of the effective EMP and becomes severely degraded and placed at a significant disadvantage to defend. Although not an attack directly aimed at U.S. space systems, an attack of this type could effectively destroy or degrade systems in orbit through the collateral damage of the attack.[17]

A nuclear attack on U.S. space assets, although clearly an act of war, has a much different face than one usually imagines when thinking about the effects of a nuclear attack. This type of attack is bloodless. No U.S. citizens or soldiers would be affected by the action. Additionally, it would most likely be employed by a nation over its own airspace and territory. It does not create the same emotional response that an attack of a nation or a nation's soldiers by nuclear means warrants. This type of attack presents an interesting and difficult dilemma for the U.S., a situation that it does not have to react to if it can effectively deter the attack from ever happening.

Each scenario paints a picture of an enemy willing to use nuclear devices in an aggressive war like manner. Each can raise the question: What of deterrence? After all, nuclear deterrence has been a cornerstone of U.S. policy for years. It is the unique aspects of using nuclear weapons in this manner that may not allow what we have considered traditional countervailing or punitive theories of extended nuclear deterrence to prevent their use. Once again, warranted responses can come in many forms. However a response is already too late once the damage has been done. The enemy can be punished, but he is already at war or anticipating war in the first two scenarios and merely risks escalation in terms supported by the nation as a whole. Once again the lack of deaths from this attack will have a challenging effect on the sentiment of the decision makers on how and what form punishment or escalation will be.

Scope

This thesis will focus on the present and near future, not the time period in which the scenario for the AAN WWG was created. Although the threat of nuclear weapons for use as ASAT weaponry may be more prolific come the year 2020, it is more important to discuss the present and near future since this is not new technology.

Significance of the Thesis

This work is significant in identifying any potential gaps in U.S. strategy and policy causing the possibility that an attack of U.S. space assets by a belligerent nation through the use of nuclear weapons can occur. Based on the assumptions already cited, something was missing to deter the nuclear attack during the AAN WWG. When the enemy embarked on its course of action to attack space assets via nuclear weapons, he had come to the realization that it was worth it. The U.S. failed to make that action simply *"not worthwhile."*

As we embark into a new era as the world's only superpower, we must continue to deter the aggressive use of nuclear weapons. An attack of this sort would not only affect U.S. assets, but the assets of any other nation whose satellites' orbits pass through the affected region in space (this may even include those of the enemy). As nuclear proliferation continues, it is likely that there will be nations in the position to attack space assets with nuclear weapons with no fear of damaging their own assets because they simply possess none.

Primary Research Question

What are the shortcomings in the strategies and policies of the U.S. that can allow attack of its space-based assets by belligerent nations using nuclear weapons to be effective, and what changes are required to prevent this problem.

Secondary Questions

Several secondary questions affect the primary research question. How has the U.S. deterred this type of nuclear attack previously? Why hasn't this type of attack occurred? What type of response is warranted should the U.S. be attacked in this manner? What nations can conduct this type of attack today? What countries may be capable of this type of attack in the near future? Can all U.S. assets in space be attacked by this method?

Key Definitions

ASAT. Anti-satellite weapon. Any weapon designed to or capable of destroying a satellite.

Deterrence. A strategy, often pertaining to nuclear weapons, intended to persuade an opponent that the costs and risks accompanying certain acts greatly outweigh any possible advantage to be gained from those acts.[18]

Force Application. Force application involves the conduct of combat operations from space.[19]

Force Enhancement. Space related support operations conducted to improve the effectiveness of both terrestrial and space-based forces. Force enhancement includes such capabilities as communications, navigation, and surveillance.[20]

Information Dominance. The degree of information superiority that allows the possessor to use information systems and capabilities to achieve an operational advantage in a conflict or control the situation in operations short of war, while denying these capabilities to the adversary.[21]

Information Operations (IO). Information operations integrate all aspects of information to accomplish the full potential for enhancing the conduct of military operations. Information operations are not new. In their simplest form they are the activities that gain information and knowledge and improve friendly execution of operations while denying an adversary similar capabilities by whatever possible means. Effects of IO produce significant military advantage for forces conducting such operations. Information is an essential foundation of knowledge-based warfare. It enables commanders to coordinate, integrate, and synchronize combat functions on the battlefield. To gain the relative advantage of position (maneuver) and massing of effects (firepower), commanders must act while information is relevant and before the adversary can react. Targeting an adversary's information flow to influence his perception of the situation or prevent him from having or using relevant information contributes directly to decisive operations. As the commander targets the adversary's information systems (INFOSYS), he protects his own. Realizing that absolute and sustained dominance of the information environment is not possible, commanders seek to achieve information dominance at the right place, the right time, and in the right circumstances. They seek information dominance that defines how the adversary sees the battlespace, creating the opportunity to seize the initiative and set the tempo of operations.[22]

Nuclear Deterrence. The ability through a nuclear threat to make an opponent refrain from what he otherwise might do. Effective deterrence is a matter of convincing an opponent that certain harm will accompany the act one wishes to deter; and thus deterrence amounts to the imposition of a calculus of risk and value of the act sought to be deterred doe not exceed the risk, which is an assessment of the likelihood and extent of harm.[23]

Satellite. A manmade object in space that is in an orbit around the earth to perform a designated function. Typical satellites perform communication, remote sensing, reconnaissance and surveillance, navigation, and weather support for government, military and commercial users.

Space. For the purpose of this thesis, space is defined as the region of the earth's atmosphere in which the lowest perigee may be attained by an orbiting space vehicle. Space cannot be considered to start at a particular altitude based on the dynamics which can alter the earth's atmosphere. In practical terms, the lowest altitude in which space vehicles can orbit is about 150 kilometers (93 miles) above the earth's surface. International law considers any orbiting spacecraft to be in space regardless of altitude.[24]

Space Control. Space control consists of operations that ensure freedom of action for friendly forces while limiting or denying enemy freedom of action. It includes satellite negation and satellite protection.[25]

Space Support. The functions required to deploy and maintain military equipment and personnel in space. They include activities such as launching and deploying satellite, maintaining and sustaining space vehicles while in orbit, and recovering space vehicles if required.[26]

Assumptions

There are several assumptions related to this thesis. The first is that the experience from the AAN WWG represents a valid and feasible action from present and future enemies. Additionally, it is assumed that the nuclear attack represented in the AAN WWG could occur today and is not linked to any sophisticated technology that only the U.S. possesses or is yet to be developed. Taking these assumptions into account also leads one to assume that the strategies that have prevented aggressive use of nuclear weapons for over forty years may not apply to preventing the use of nuclear weapons as ASAT weaponry. However, when testing current strategies to deter this action, the strategies that were successful may be applied as an example and test of successful nuclear deterrence for comparison.

It is assumed that space control will be required to conduct IO effectively and is a key element in achieving information dominance. This thesis also assumes that nuclear capable nations will increase in number and that nuclear weapons will remain the cheapest form of ASAT weaponry available.

Limitations

This document will be limited to examining only the use of nuclear weapons as ASATs and not lasers, other satellites, or any other emerging technology. It will also be limited to the military aspects of response/protection from such an attack with regard to the instruments of power employed by the U.S. (Diplomatic, Informational, Military, Economic).

Delimitations

This thesis will not focus on the numerous methods available to neutralize or destroy a satellite, nor will it venture into describing in detail the functions of all the key U.S. satellite assets that could be affected by a nuclear attack in space. It will describe basic functions when it is applicable to illustrate a point.

Preview of the Study

Chapter 1, "Introduction," contains the relevant background information that that has formed the primary research question. This chapter describes the AAN WWG, possible scenarios, lessons learned, as well as establishing the importance of our space assets. These provide the necessary information for the establishing the significance of the thesis. This chapter also includes assumptions used throughout the thesis, limitations established, and delimitations of the thesis.

Chapter 2, "Review of Literature," evaluates and summarizes existing information and current studies on the thesis subject matter. Since this is a unique subject that has not been thoroughly researched, there is limited amount of information that directly supports the thesis. This will be discussed further in this chapter.

Chapter 3, "Research Methodology," outlines the specific research methods and techniques applied in answering the primary research question. In this chapter the theories of deterrence will be examined in detail as will the strategies and policies employed by the U.S. in the subject matter area. All will be critically analyzed for the essential elements that make them effective. This process will determine and identify the gaps in the policies set forth in the strategies.

Chapter 4, "Analysis," presents and explains the evidence produced from the thesis methodology. The analysis will synthesize the facts discovered through the methodology and provides a basis for thesis conclusion and recommendations.

Chapter 5, "Conclusions and Recommendations," will state the discoveries made during the thesis research. It will also provide limited recommendations and possible related topics that may require additional research and study.

---

[1] President William J. Clinton, National Space Policy (Washington, DC: The White House, September, 1996), 1.

[2] Colonel Stephen J. Kirin, Margaret A. Fratzer, Michael C. Ingram, David L. Fuller, Dorothy J. Burns, and Rumiko Dodson, Army After Next Integrated Analysis Report (Fort Leavenworth: United States Army Training and Doctrine Command Analysis Center, 1997), p. 12a.

[3] Harry Looney, U.S. Army Space and Strategic Defense Command Representative and Player, Army After Next Winter Wargame, Telephonic interview by author, Tinton Falls, NJ, 21 December 1998.

[4] Dr. Jonathon Lockwood, "Lessons of the Winter Wargame," Army Times, 10 March 1997, 54.

[5] John Donnelly, "Secret Results of Controversial Test Revealed: Laser of 30 Watts Blinded Satellite 300 Miles High," Defense Week, 8 December 1997, 1.

[6] Michael M. May, "Safeguarding Our Space Assets," In Seeking Stability in Space: Antisatellie Weapons and the Evolving Space Regime, Edited by Joseph S. Nye and James A. Schear (Lanham: University Press of America, Inc., 1987), 77.

[7] Paul B. Stares, The Militarization of Space, U.S. Policy, 1945-1984 (Ithaca: Cornell University Press, 1985), 108.

[8] Ibid.

[9] John M. Collins, Military Space Forces: The Next 50 Years (Washington, DC: Pergamen-Brassey's International Defense Publishers, Inc., 1989), 31.

[10] Ibid.

[11] Ibid.

[12] R. C. Webb, Les Palkuti, Lt. Col. Glenn Kweder, Al Constantine, "The Commercial and Military Satellite Survivability Crisis" Defense Electronics, 20, no. 8, (August, 1995), 27.

[13] Ibid., 28.

[14] Ibid.

[15] Ibid.

[16] Leonard S. Spector, Mark G. McDonough, and Evan Medeiros, Tracking Nuclear Proliferation: A Guide in Maps and Charts, 1995 (Washington, DC: Carnegie Endowment for International Peace, 1995), 9.

[17] Dr. Steven D. Harrison, Senior Priciple Member, Technical Staff at Litton-TASC, Advisor to Deputy Under Secretary of Defense (Space), Interview by Author, Telephonic, Fort Leavenworth, KS, February 9, 1998.

[18] Philip Bobbitt, Democracy and Deterrence, The History and Future of Nuclear Strategy (New York: St. Martin's Press, 1988), 342.

[19] Department of the Army, U.S. Command and General Staff College, U.S. Army Space Reference Text (Fort Leavenworth: U.S. Army Command and General Staff College, January 1995), 5-1.

[20] Ibid., 3-5.

[21] U.S. Army, FM 100-6, Information Operations (Washington, DC: Department of the Army, 1996), 1-9.

[22] Ibid., iv.

[23] Bobbitt, 346.

[24] Department of the Army, U.S. Army,Space Reference Text, 5-1.

[25] Ibid., 3-5.

[26] Ibid.

CHAPTER 2

LITERATURE REVIEW

The quantity of literature written to address the specific problem raised in this thesis is limited. Although an attack on space assets with nuclear weapons is addressed in several works, they are usually addressing technically whether such an a attack is feasible. Although the thesis question is very specific and narrows the research to be conducted, it will require examining several broad areas that support the key issues raised in the thesis question. There are a number of broad areas that address issues that support answering the thesis question. Therefore these broader areas must be examined to pull out and piece together the key elements that support the thesis question and its answer. The elements that contribute to the study are the subjects of the AAN WWG, space, nuclear weapons, deterrence, and finally strategy and policy.

This chapter discusses the current information available in these subject areas that support this thesis. They are reviewed by subject area to keep the review clear and focused on how these works contribute to the thesis, as well how they are not linked completely to the issues to be researched. Additionally, trends and themes that become apparent in the literature are be identified and discussed.

Army After Next Winter Wargame

The literature discussing the AAN WWG is limited. This after all, was a new wargame, the first of its type played by the U.S. Army. This type of wargame will be played again in the future to test future warfighting capabilities, doctrine, and scenarios. However, for use in this thesis, only the first wargame will be cited. The primary source of information on this wargame is the after action review (AAR) which was produced by the U.S. Army Training and Doctrine Command (TRADOC). It utilizes the findings from participants and observers, as well as input from the RAND Corporation. It provides a wealth of information about the game setup and execution, and most importantly, it identifies several of the lessons learned from this exercise. Articles from professional military periodicals provide the remainder of written information on this subject matter.

The AAR presents the scenario which inspired this thesis. It describes the direction the Army is moving in with regard to future forces and operations, as well as documenting the attack in space with nuclear weapons as played in the wargame. Unfortunately, while addressing several lessons learned, the AAR presents more questions for thought than proposes answers. The questions raised, while thought provoking, are not easily answered and display the level of confusion this type of attack presented to the leadership participating in the wargame.[1]

One theme that is apparent in the AAR is the reliance on highly technical and sophisticated equipment to support a leaner force than that employed today.[2]

Space

The examination of space for the purpose of this thesis is limited to establishing its overall importance to the nation and the military, growing dependency for certain functions (communications, intelligence, etc), and specifically why space presents such a unique environment for this manner of employment of nuclear weapons.

Several gvernmental documents address the importance of space. President William J. Clinton has contributed two references that address the space: National Security Strategy for a New Century (NSS) and the National Space Policy (NSP). In the NSS, he addresses the role of space in advancing national interests and states that the U.S. must maintain its role as the leader in space.[3] The NSP goes into much greater detail concerning the role of the U.S. in space as well as its importance to the

U.S.. It defines the National Space Goals (see chapter one) and addressees the National Security Space Activities which he charges oversight of to the Secretary of Defense (SecDef) and the Director of the Central Intelligence Agency (DCI). It articulates that National Security Space Activities will contribute to U.S. national Security by:

> Providing support for the U.S.'s inherent right of self-defense and for our defense commitments to allies and friends;
>
> Deterring, warning, and if necessary defending against enemy attack;
>
> Assuring that hostile forces cannot prevent our own use of space;
>
> Countering if necessary space systems and services used for hostile purposes;
>
> Enhancing operations of U.S. and allied forces;
>
> Ensuring our ability to conduct military and intelligence space-related activities;
>
> Satisfying military and intelligence requirements during peace and crisis as well as through all levels of conflict; and
>
> Supporting the activities of national policymakers, the intelligence community, the National Command Authority (NCA), combatant commanders, and the military Services, other federal officials, and continuity of government operations.[4]

The President's references address the level of attention that space is recognized. However, they do not discuss the attack by nuclear weapons and the environment of space, nor do they address reliance on space-based systems.

General John M. Shalikashvili, Chairman of the Joint Chiefs of Staff, addresses space in his national military strategy (NMS) Shape, Respond, Prepare Now--A Military Strategy for a New Era and Joint Vision 2010. In the NMS he recognizes the asymmetrical threats to the nations space-based systems and states that capabilities to counter threats as these must be increased.[5] In Joint Vision 2010 space-based technologies are discussed, and one can draw inferences as to just how important these systems are. While these documents address the attack of the space-based systems, reliance, on space as a unique operating environment is not examined.

Robert V. Davis, Deputy Under Secretary of Defense (Space) (DUSD-S), recognizes the role space plays in national security. The Department of Defense Space Program, An Executive Overview for FY 1998-2003 details the importance of space to national security. It echoes both the NSS and the NSP, as well as establishing the missions the military are assigned with regard to space: space support, force enhancement, space control, and force application. Additionally, he cites the contributions that space plays in the "Revolution in Military Affairs" (RMA). The current RMA in information relies heavily on technologies operating in space.[6]

General Howell M. Estes III, Commander, U.S. Space Command (USSPACECOM) clearly emphasizes the importance of space in his United States Space Command Vision 2020. He cites that space power is vital to the attainment of the operational concepts established in Joint Vision 2010. He discusses the proliferation of space systems, both commercial and military, as well as their importance globally.

> Indeed, so important are space systems to military operations that it is unrealistic to imagine that they will never become targets. Just as land dominance, sea control, and air superiority have become critical elements of current military strategy, space superiority is emerging as an essential element of battlefield success and future warfare.[7]

General Estes places such importance on space that he feels it should be established as an Area of Responsibility (AOR):

> Space is a region with increasing commercial, civil, international, and military interests and investments. The threat to these vital systems is also increasing. The space AOR is global and requires a combatant commander with a global perspective to conduct military operations and support regional warfighting CINCs. USSPASCECOM is the only military organization with operational forces in space. Establishing space as an AOR merely states an operational reality.[8]

General Estes, although thoroughly addressing the importance of space and possible attacks upon these assets, does not specifically address an attack with nuclear weapons, or the unique operating environment of space. Altough, Reliance on space is implied throughout the document, it is not specifically addressed.

There are a number of nongovernment sources that recognize space as addressed in this thesis. Seeking Stability In Space: Anti-Satellite Weapons and the Evolving Space Regime edited by Joseph S. Nye Jr. and James A. Schear contains several works that contribute to the issue. "Anti-Satellite Weapons and U.S. Military Space Policy: an Introduction" by William J. Perry, Brent Scowcroft, Joseph S. Nye Jr., and James Schear highlights the importance of space to the nation and the military, and discusses reducing reliance on space-based systems. Yet, they do not cover attacks by nuclear weapons, only conventional ASATs in general. In addition, they do not address the uniqueness of the space environment in a technical sense. "Safeguarding Our Space Forces" by Michael M. May discusses the use of nuclear weapons as ASATs and why they are effective in space. He concentrates on attacks on the satellite network and questions if a viable defense can be built to protect satellites from attack. He does not address reliance, nor does he address the overall importance of space; however, one can infer it from his presentation. Finally, in Ted Ralston's contribution to the book, "Verifying Limits on Anti-Satellite Weapons," he also discusses the possible use of nuclear weapons in a role to destroy U.S. satellites. His work concentrates on verification of ASAT systems, and does not discuss other topics germain to this work.

Paul B. Stares has written two works that contribute to this thesis. The Militarization of Space, U.S. Policy, 1945-1984 and Space and National Security both recognize the importance of space and discuss attacks on space systems with nuclear devices. The Militarization of Space presents historical background on actual tests involving nuclear explosions in space and their unique effects in the space environment.

Major Jeffrey L. Caton's article "Joint Warfare and Military Dependence on Space" in the Joint Forces Quarterly, winter 1995-96 covers the importance of space, current growing dependency on space systems, and possible attack by nuclear weapons in space. Canton's citation of Stares in his article is both timely, and very applicable to this thesis.

Military Space Forces: The Next 50 Years by John M. Collins discusses the unique environment of space, the use of nuclear weapons in space, and the effects nuclear weapons will have on satellites. It provides considerable detail on the effects nuclear weapons can have on space-based systems and the space environment and is very technically based throughout. While he does not discuss the importance of space, it is apparent in his writing that he assumes that it is. Additionally, reliance on space is not evaluated in this work.

The Strategic Defense Initiative, Progress and Challenges by Douglas C. Waller, James T. Bruce III, and Douglas Cook; Strategic Defense Issues for the 1990s by James T. Quinlivan, George L. Donahue, and Edward R. Harshbarger; and The Strategic Defense Initiative, Shield or Snare edited by Harold Brown all discuss the numerous issues of the Strategic Defense Initiative (SDI) of the President Regan era. While not directly contributing to the thesis question, they provide background on the many unique issues that accompany military space operation and the proposed arming of space. These works will contribute to the analysis and conclusions made by this thesis since many of these issues (cost, arming, etc.) may be a consideration in policy and program formulation. The Intelligent Layperson's Guide to "Star Wars" by Joyce E. Larson and William C. Bodie provide issues and answers surrounding many of the issues of the Star Wars program that will also contribute to this thesis. It also addresses the use of nuclear weapons as an effective tool for destroying the system, thus nuclear ASATs.

Although many of these works cited above do not focus on the central theme of this thesis, they do however provide supporting information about the validity and ability of nations to use nuclear weapons in space to defeat U.S. space assets and the many issues that would be created with this type of attack. One theme that is apparent throughout these works is an assumption that space will eventually be armed and that military operations will occur in that medium. An additional trend throughout these works, although not always specifically cited, is, as space continues to be a useful medium and its exploitation continues, future technology may create the possibility of reliance and dependency.

Nuclear Weapons

One of the assumptions made in this thesis is that nations are more likely to obtain nuclear weapons that can be used as ASATs than they are to build their own space program that can support the launch and control of satellites. This portion of the literature review will focus on literature that pertains to the proliferation and counter proliferation of nuclear weapons.

President Clinton addresses both the proliferation and the need to limit weapons of mass destruction (Nuclear, biological, and chemical) in the National Security Strategy for a New Century. Additionally, General Shalikashvili echoes the President's sentiment in Shape, Respond, Prepare Now--A Military Strategy for a New Era. There is no indication that either the President or the Chairman are addressing this with regard to space, but to a more broad concept of use at all by any belligerent nation.

Tracking Nuclear Proliferation by Leonard S. Spector, Mark G. McDonough, and Evan S. Medeiros is a source that provides information exposing which nations are conducting their own research in nuclear weaponry. This supports the thesis by providing insight to those actively attempting to join the circle of nuclear capable countries and supporting the assumption that nuclear proliferation is continuing.

Deterrence

Deterrence is examined in this thesis because it has been a cornerstone of U.S. policy. With regard to an attack in space with nuclear weapons, it is not clear whether nuclear deterrence will suffice as an effective deterrent for this type of attack. Nuclear deterrence is so unique and complicated, that it will be covered aside from other strategies and policies covering this subject matter.

Stephen J. Cimbala has produced several works that provide insight to several issues in this thesis. First Strike Stability, Deterrence After Containment, Challenges to Deterrence, Resources, Technology, and Policy, and Military Persuasion, Deterrence and Provocation in Crisis and War all provide sound explanations and explanations of both nuclear and conventional deterrence. His work Nuclear War and Nuclear Strategy, Unfinished Business recognizes that space-based systems may not be able to be protected from nuclear attack in all out nuclear war. However, he does not suggest any form of deterrent measures for the type of attack presented in this thesis.

The American Atom, A documentary History of Nuclear Policies from the Discovery of Fission to the Present, 1939-1984 by Robert C. Williams and Philip L. Cantelon and The Limits of Coercive Diplomacy edited by Alexander L. George and William E. Simons chart the historical uses of deterrence and nuclear deterrence. Although they do not address the question of this thesis, they do show how theories of deterrence changed with time, technology, and threat. This is useful to apply how the U.S. changed its deterrence policies when discussing what it must do in the situation presented in this thesis.

Nuclear Strategy and National Style by Collin S. Gray and Democracy and Deterrence, The History and Future of Nuclear Strategy by Philip Bobbit are two sources that provide excellent detail on the issues which have what made nuclear deterrence effective for so long. For the purpose of this thesis, they provide information that can be used in critiquing nuclear deterrence strategies in the case of the bloodless attack against systems in space.

Extended Deterrence by Paul K. Huth and Nuclear Deterrence in a Regional Context by Dean Wilkening and Kenneth Watman concentrate on deterrence other than attacks on U.S. soil. These provide interesting concepts worthy of study because although they do not address the type of attack in question, they do examine deterrence in a scenario that is more likely to occur--outside of the territory of the U.S.

The study of deterrence for this thesis is complicated by the fact the majority of information on deterrence focuses on the attack of people on the surface of the earth and not equipment orbiting in space. Since the majority of works on deterrence do not address the thesis question, it leaves a gap in one of the key supporting questions of the thesis question. However, the theories of nuclear deterrence, be they regional, extended, countervailing, or punitive are well articulated throughout the works. These key definitions and sound theories on the use of nuclear weapons and deterrence which will be applicable to formulating the answer to the thesis question in chapter four.

The general theme of the cited works is that whatever form of deterrence is employed, a carefully articulated policy must be formulated for the deterrent to be successful. All of these works discuss the application of military power, and the majority focus on nuclear responses.

Strategy and Policy

Close examination of the U.S. strategies and policies is key to answering the thesis question proposed in this document. The focus of this work is to address whether or not the U.S. is poised to keep belligerents from attacking it's space-based assets, or in a position of saying much with little to back up the words. A wealth of information is available in the areas of strategy and policy. However, for the purpose of this thesis, only policies with regard to the subject matter will be explored.

The President's National Security Strategy outlines the vital interests and what elements are essential to their protection. Shape, Respond, Prepare Now--A Military Strategy for a New Era by the Chairman, Joint Chiefs of Staff, outlines the use of military power in support of the NSS. Although the thesis is not directly answered in either of these documents, both address space and its control. Space control is a key element addressed later in this thesis. Both strategies will be used as foundations in the analysis of the thesis.

The National Space Policy as well as the Department of Defense Space Policy are closely examined. As already stated earlier in this work, each Armed Service has devoted effort to creating a policy for space that also supports elements of the thesis question.

Works on strategy and policy formulation are also numerous and allow the policies cited above to be critically analyzed and tested. These works concentrate on the elements that make strategies and policies sound, logical and effective. They are instrumental in addressing the gaps that create the problem cited by the thesis question. Strategic Art: The New Discipline for 21st Century Leaders and Evaluating National Security and National Military Strategy by Lieutenant Colonel (Retired) Ted Davis and A Brief Introduction to Strategic Concepts by Major General Richard A. Chilcoat are works in this genre and will provide the tools to test conceptual elements required of successful strategies and policies.

---

[1] Colonel Stephen J. Kirin, Margaret A. Fratzer, Michael C. Ingram, David L. Fuller, Dorothy J. Burns, and Rumiko Dodson, Army After Next Integrated Analysis Report, Fort Leavenworth: United States Army Training and Doctrine Command Analysis Center, 1997, 12a.

[2] Ibid., A-9 - A-12.

[3] President William J. Clinton, A National Security Strategy for a New Century, The White House, Washington, DC, May 1997, 14.

[4] President William J. Clinton, National Space Policy, The White House, Washington, DC, September 1996, 8.

[5] General John M. Shalikashvili, Shape, Response, Prepare Now--A Military Strategy for a New Era, Office of the Chairman, Joint Chiefs of Staff, Washington, DC, 1997, 5.

[6] Robert V. Davis, Department of Defense Space Program, An Executive Overview for FY 1998-2003, Office of the Deputy Under Secretary of Defense (Space), Washington, DC, March 1997, 4.

[7] General Howell W. Estes, United States Space Command Vision for 2020, Office of the Commander in Chief, U.S. Space Command, Colorado Springs, February, 1997, p. 3.

[8] Ibid., 4.

CHAPTER 3

RESEARCH METHODOLOGY

This thesis will examine one of the specific events that occurred during the AAN WWG. The circumstances that allowed the threat to attack U.S. assets in space is not tied to future technology or doctrine. These attacks were merely an example of something that could happen today, perhaps less in scale, but still creating far reaching implications for the U.S.. This thesis attempts to prove that certain gaps in policy and programs exist and that these gaps may make it lucrative for a belligerent nation to execute this type of nuclear attack against U.S. assets in space and achieve a degree of success in damaging or destroying them. Finally, once identified, recommendations for changes to these policies and programs are presented.

Since there is little literature directed at this specific aspect of the thesis question, a series of documents are examined (as mentioned in chapter 2) and pieced together. The goal in examining this scope of literature is to bring together the elements and issues concerning this sort of attack today--and why it may be feasible, acceptable, and suitable to an enemy of the U.S. Any gaps in information were filled by contacting the agencies responsible for the action in question.

Contacting the office of Deputy Under Secretary of Defense for Space (DUSD-S) and the U.S. Space Command (USSPACECOM) and its subordinate component commands was necessary to gain the current information in programs, trends, and policies with regard to the factors surrounding the thesis.

For the U.S. to be successful in preserving its interests, it must achieve its political and military objectives. Henceforth, it must also have a sound strategy and policy to support those objectives. The next step in the methodology employed for this thesis is to closely examine the strategies and policies of the U.S. in addressing a threat of this nature. An examination was made of the logical flow from the National Security Strategy down to the "ways and means" of the instruments of power to examine the soundness of the policy. Is it merely rhetoric, or a solid policy based on programs and resources capable of convincing an enemy that such attacks of U.S. assets through this method of warfare is simply not worthwhile? A review was conducted of the current programs that are directed to protect out space-based systems and compared and contrasted them against ones that may be required in order to prevent this type of attack from achieving success or being an option for the enemy. Key agencies such as DUSD (S) and USSPACECOM, were contacted to acquire the most current information available on these matters as well as the direction for the future.

Deterrence is also examined closely and reviewed in order to determine if our current deterrent strategies in the arena of enemy use of nuclear weapons covers these scenarios fully. Deterrence must be critiqued in this circumstance because in the AAN WWG it failed to prevent the enemy's action. It has already been cited that the attack would not likely be in the magnitude presented in the AAN WWG; however, the action is still a valid capability and possible course of action for foes and future enemies possessing such weapons. Deterrence has been a cornerstone of U S. policy; however, traditional deterrence (countervailing and punitive) may not apply as a sound approach to prevent this type of use of nuclear weapons. An assesment of the recently released Presidential Directive (PD/NSC 60) determines its applicability on this type of attack since it addresses rogue nations with intentions to use weapons of mass destruction (WMD).

Upon dissecting the strategies and policies (to include current nuclear deterrence strategies) and logically examining them, an assessment determines what "gaps" exist. Upon identifying these gaps, recommendations are presented as to what the U.S. should do about these potential problems. The goal of this methodlogy is to bring to highlight this form of attack, reinforce its potential for disaster, and provide insights on what U.S. policies are with regard to this type of attack and what they should be in order to prevent the same.

CHAPTER 4

ANALYSIS

Introduction

The AAN WWG demonstrated a unique attack on U.S. space-based assets, an attack that could happen today. This attack was technically feasible, substantiated as effective, far reaching in damaging U.S. capabilities in space. This chapter will answer the thesis question by identifying the gaps in strategy and policy and propose what the U.S. must do about this problem. It will review in detail strategy and policy with regard to this type of attack, examine the applicability of current nuclear deterrence policy, and compare and contrast the current programs established by the Department of Defense in the arena of Space Control.

Currently, the U.S. cannot prevent an attack on its space-based assets with nuclear weapons. Although the wording found in the NSS, NMS, and NSP is very strong, the programs established to achieve space control are incapable of meeting the requirements as defined by the NSP. This is an asymmetrical attack that may never be fully preventable. However, despite the fact that it is an asymmetrical attack, the U.S. must still do all it can to prevent it, or limit its impact on the nation and any military operations it may be associated with. The current programs and nuclear deterrence policy do little to achieve this. The only way the U.S. can possibly deter or limit the impact of this form of attack is through a program of hardening additional space assets, building a launch infrastructure that can launch on demand stockpiled replacement satellites, reducing the trend of reliance on the current inventory of space assets, and formulating a strong, flexible, and legitimate retaliatory attack plan to serve as both a possible deterrent and punishment if deterrence fails.

Strategy

Despite its sound approach and all encompassing coverage in protecting U.S. interests, an inconsistency arises between the NSS and the NMS. The NSS basically states that space cannot be denied to the U.S. and the NMS notes that there are asymmetrical threats that may not be preventable. This attack may be one of those threats identified by the Chairman. This creates a gap in strategy as does the failure of the current nuclear deterrence strategy employed by the U.S.

In the National Security Strategy (NSS), the President cites the importance of space and the nation's information infrastructure.

> We are committed to maintaining our leadership in space. Uninhibited access to and use of space is essential for preserving

> peace and protecting U.S. national security as well as civil and commercial interests. It is essential to our ability to shape and respond to current and future changes in the international environment. Our space policy objectives include deterring threats to our interests in space and defeating hostile efforts against U.S. space assets if deterrence fails, preventing the spread of weapons of mass destruction to space, and enhancing global partnerships with other space-faring nations across the spectrum of economic, political and security issues.[1]

Based on this paragraph alone an attack in space is truly not in the nation's interest. It definitely challenges the premise of "uninhibited access to and use of space." The President clearly cites a concern over the migration of WMD to space. This statement alone place this form of attack as a threat to U.S. interests.

The President also addresses interests based on the information infrastructure. Space assets contribute to this infrastructure, and can be included in this interest. Clearly an attack of any form on space assets violates this interest; a nuclear attack, by nature would be far more damaging to this network than ASATs capable of attacking only one target at a time.

> Information Infrastructure. The national security posture of the United States is increasingly dependent on our information infrastructures. These infrastructures are highly interdependent and are increasingly vulnerable to tampering and exploitation. Concepts and technologies are being developed and employed to protect and defend against these vulnerabilities; we must fully implement them to ensure the future security of not only our national information infrastructures, but our nation as well.[2]

Although space is not specifically mentioned in this interest, the information infrastructure of the U.S. relies heavily on space-based assets. Once again, an attack of this nature directly challenges another interest in the broad area of information.

It is clear that the President has articulated interests that would be greatly affected by a nuclear attack in space. If these interests are valid, it becomes obvious that an attack of this nature must be prevented. These interests are also key to formulating the nation's objectives as well as the national military strategy.

Achieving key objectives is stated well in the national military strategy. The national military strategy conveys the advice from the Chairman of the Joint Chiefs as well as that of the Joint Chiefs of Staff on the strategic direction of the Armed Forces in implementing the guidance in the President's national security strategy. It recognizes the President's broad interests and defines them as issues presented into military objectives.

> Shaping the International Environment. US Armed Forces help shape the international environment through deterrence, peacetime engagement activities, and active participation and leadership in alliances. Critical to deterrence are our conventional warfighting capabilities and our nuclear forces. Deterrence rests on a potential adversary's perception of our capabilities and commitment, which are demonstrated by our ability to bring decisive military power to bear and by our communication of U.S. intentions. Engagement activities, including information sharing and contacts between our military and the armed forces of other

> nations, promote trust and confidence and encourage measures that increase our security and that of our allies, partners, and friends. By increasing understanding and reducing uncertainty, engagement builds constructive security relationships, helps to promote the development of democratic institutions, and helps keep some countries from becoming adversaries tomorrow.[3]

These are strong words and demonstrate sound logic. They clearly address goals that if achievable, would preclude an attack in space would never take place. However, at this level of strategy development, objectives are being stated that must be backed up by policy and programs. Without further examination this statement may lead one to believe that the U.S. is capable of achieving what the Chairman has said in this paragraph. Examining closely the words "deterrence, demonstrating, and communication of U.S. intentions" are key to the prevention of a nuclear attack in space. It would be an excellent strategy if achievable. These concepts will be revisited during the review of policy and programs which represent the "ways and means" to achieve this.

The chairman recognizes the importance of deterrence and defines its meaning with regard to the NMS.

> Peacetime Deterrence. Deterrence means preventing potential adversaries from taking aggressive actions that threaten our interests, allies, partners, or friends. It is the military's most important contribution to the shaping element of the President's strategy. Deterrence rests in large part on our demonstrated ability and willingness to defeat potential adversaries and deny them their strategic objectives. Our deterrence capability gives allies and friends the confidence necessary for normal political discourse and peaceful resolution of differences. The critical elements of

> deterrence are our conventional warfighting capabilities: forces and equipment strategically positioned, our capability to rapidly project and concentrate military power worldwide; our ability to form and lead effective military coalitions; and our capacity to protect our homeland, forces, and critical infrastructure from the full range of potential threats. Our strategic nuclear forces complement our conventional capabilities by deterring any hostile foreign leadership with access to nuclear weapons from acting against our vital interests. Our nuclear forces may also serve to convince such leaders that attempting to seek a nuclear advantage would be futile.[4]
>
> Deterring Aggression or Coercion in Crisis. The practical response in any crisis normally consists of steps to deter an adversary so the situation does not require a greater US response. This generally involves signaling our commitment by enhancing our warfighting capability in a theater or by making declaratory statements to communicate US intentions and the potential cost of aggression to an adversary. We may also choose to emphasize our resolve by responding in a limited manner, for example, by enforcing sanctions or conducting limited strikes. The deterrent posture and activities of our armed forces ensure we remain prepared for conflict should deterrence fail.[5]

The Chairman's recognition of the role of deterrence and nuclear deterrence is critical. However, in this situation, broad uses or interpretations of the role of deterrence to this specific form of attack may need further and more specific clarification from the national level. True, deterrence is exactly what the nation wants to achieve in this situation. The goals of this strategy are good, it is the implementation and the specifics of this strategy that must be examined closer.

The chairman cites specifically the importance of nuclear deterrence influencing hostile foreign leadership with access to nuclear weapons from acting against our vital interests. This begs the question of nuclear deterrence as a form of prevention of an attack in space with nuclear weapons. Today's nuclear deterrence will not deter this attack from happening. Nuclear deterrence may have had an impact in the past, however too many factors have changed.

History explains much about nuclear deterrence and why this sort of attack has not occurred. Since this technology is not new, and the current world situation differs little from the one presented in the AAN WWG with regard to capabilities--why hasn't this form of attack happened before--and what has changed to make it a concern today? After all both satellites and nuclear weapons have coexisted for over thirty years. Time is part of the answer. The U.S. has been able to enjoy a situation in which an attack of this nature provided no adversary a clear advantage. Nuclear weapons and space programs are not cheap, nor easy to create. The U.S. emerged as the leader in both nuclear weapons development and space. Although the Soviet Union launched the first satellite, the U.S. was able to emerge as the leader in space through the commitment of extraordinary goals that placed humans on the surface of the moon and created reusable space vehicles. However, just as for many years there were only two nuclear powers, there were only two space powers, opposed ideologically throughout the cold war.

As new members joined the "nuclear club" linkage to the technology allowed only a select few nations to also join the "space club." What existed for many years was a situation where the nations who belonged to both had a parity of interest in the survival of their space systems.[6] Destroying one nations through use of a nuclear device would actually have the likelihood of destroying their own. The risk and utility was not realized to be worth the cost of operational capability or replacement. Additionally the pay off was not that large. Satellite technology had not advanced to the point in which nations retained overwhelming advantages because of it, it was not worth the cost of a nuclear weapon based on their limited capabilities. By far the immaturity of satellite based systems, at what ever level, coupled with the risk of losing investments made to their own space assets served as deterrent in of itself to keep this sort of attack being worth while. Additionally, none of the nations that the U.S. engaged during this time period had the capability to conduct such an attack.

However, with time and technology, things have changed considerably. The U.S., as the worlds only superpower, enjoys a robust space architecture that allows it to dominate the informational functions associated with operational capabilities.[7] As the Soviet Union collapsed, so did the only other true competitor in space. Now there exists an imbalance of capabilities in space. Although the Russians still rely heavily on their space assets for all the same reasons the U.S. does, their economy is struggling to keep current systems operational.[8] U.S. technological advances can be perceived now as an overwhelming advantage worthy of attack, even at the risk of losing their own systems.

The current nuclear deterrence policy, Presidential Directive 60 (PD/NSC 60), does not plan for this type of attack.[9] Although it does address rogue nations, it will be ineffective in deterring an attack in space with nuclear weapons.[10] Major portions of the policy are confidential, and if these portions were to address this form of attack, it serves the nation little to keep them secret. It would serve much better to inform the the nations capable of such attacks what to expect if they conduct one. This would clearly place them on notice and perhaps serve as a deterrent. The current nuclear deterrence policy is applicable for the majority of issues facing the U.S. in a world that is no longer bipolar - that is why it was formulated. However, this is a significant gap in the U.S. strategy in combating this threat--nuclear deterrence that does not deter a nuclear attack in space. This challenges the U.S. to formulate a response. A response is not what you want to have to conduct, it is prevention. The U.S. lacks a stated policy for either prevention or response.

The regional orientation of this threat is another aspect that contributes to the failure of our nuclear deterrence policy with regard to this form of attack. This attack is regional in two aspects. A nuclear weapon fired over a country's own airspace will affect the area on the ground below the detonation (the country that launched the weapon as well as neighboring countries depending on size of countries, yield, and altitude of the burst). It also affects space, satellites orbitting near the blast and through the pumped belts hours and days after the attack.. This attack has not struck at the U.S. proper, only her interests in that region on the earth and in space.

Perhaps one of the most interesting aspects of this attack is its bloodless nature. The resulting effects from a nuclear detonation in space would kill no U.S. citizens. This creates a situation which determining a correct response for such an attack. U.S. and world opinion will likely keep the use of nuclear weapons from being an option. After all, what equal attack could the U.S. achieve, especially against a country with no space assets and that has only destroyed propery, not lives. Once again an aspect that that is not covered by our current nuclear deterrence poliy.

Nuclear deterrence has succeeded in keeping the use of nuclear weapons from becoming a reality for several reasons; however, it may have little use in this scenario. The aspects of the relative worth of such an attack, as well as the fear of retaliation cannot play as they did before in a bi-polar world. Additionally, many have found nuclear war so unthinkable, that policy makers themselves find themselves unwilling to commit to such escalation.[11] This attack does not fit this mold. In fact, a nuclear attack in space is very clean in the aspect that it kills no one, only allows EMP to affect the situation on the ground (this is likely to cause collateral damage, and surely lives may be lost when electrical systems on the ground fail to operate--hospitals, vehicles, etc., but will still remain confined to a region). However, if a belligerent nation fires this weapon over its own nation, it bears the brunt of these effects. What sort of response is warranted? Yes, the U.S. had assets attacked with a nuclear weapon, but does the outcome justify response with a nuclear weapon, and against what?

Just as the Chairman placed great emphasis on deterrence, he places great stock in the ability to achieve information superiority. An attack in space would clearly challenge that ability.

> Information Operations. Success in any operation depends on our ability to quickly and accurately integrate critical information and deny the same to an adversary. We must attain information superiority through the conduct of both offensive and defensive information operations. Information operations are, however, more than discrete offensive and defensive actions; they are also the collection and provision of that information to the warfighters. Superiority in these areas will enable commanders to contend with

information threats to their forces, including attacks which may originate from outside their area of operations. It also limits an adversary's freedom of action by disabling his critical information systems. We are developing joint doctrine for offensive and defensive information operations that assigns appropriate responsibilities to all agencies and commands for assuring committed forces gain and maintain information superiority. This emerging joint doctrine must fully integrate interagency participation allowing us to leverage all existing information systems.[12]

Placing such stock in the area of information operations would lead one to believe that great care would go into protecting every aspect of it. Yet, this would be challenged by an attack in space. Surely this must be recognized, however, recognizing the importance and taking steps to protect ourselve within this realm are two very different issues. If IO is so critical to future success, its protection should be paramount. The Chairman states the U.S. must achieve this. Unless an attack in space can be stopped or attenuated, the U.S. does not.

Perhaps the most important portion of the NMS with regard to an attack in space is presented by the Chairman's recognition of asymmetrical challenges. The attack in space with nuclear weapons is exactly that, an asymmetrical challenge to the U.S.

Asymmetric Challenges. Some state or irrational actors may resort to asymmetric means to counter the 'US military. Such means include unconventional or inexpensive approaches that circumvent our strengths, exploit our vulnerabilities or confront us in ways we cannot match in kind. Of special concern are terrorism, the use or threatened use of WMD, and information warfare. These three risks in particular have the potential to threaten the US homeland

> and population directly and to deny us access to critical overseas infrastructure. Other challenges include exploiting commercial and foreign space capabilities, threatening our C4I/Battle Command systems, interrupting the flow of critical information, denying our access to strategic resources, and environmental sabotage. Hostile actors may use such means by themselves or in conjunction with conventional military force. Such asymmetric challenges are legitimate military concerns. We must increase our capabilities to counter these threats and adapt our military doctrine, training, and equipment to ensure a rapid and effective joint and interagency response.[13]

The chairman recognizes that there may be threats to key U.S. vulnerabilities by means we simply cannot counter. This is what the attack in space would represent to the nation. However, he contends that the U.S. must find ways to fully counter these threats. This appears contradictory. Is he stating the U.S. cannot currently contend with the threat? This presnets another gap in U.S. strategy. Additionally, he specifically mentions commercial space assets; many military space assets are no more less vulnerable than the commercial ones. Since the U.S. is embarking on programs relying on greater use of commercial space assets, does that really make them commercial or military? The fact is that if the military is going to lease a commercial asset, and it is destroyed, the military has in the end lost a capability and a resource.

The chairman also addresses what he calls "Wild Cards." This certainly describes the type of threat that may possibly use a nuclear weapon in space.

> "Wild Cards." We can never know with certainty where or when the next conflict will occur, who our next adversary will be, how an enemy will fight, who will join us in a coalition, or precisely what demands will be placed on US forces. A number of "wild card" threats could emerge to put US interests at risk. Such threats range from the emergence of new technologies that neutralize some of our military capabilities, to the loss of key allies or alliances and the unexpected overthrow of friendly regimes by hostile parties. While an individual "wild card" may appear unlikely, the number of possible "wild cards" make it more likely that at least one of them will occur with disproportionately high consequences. While asymmetric challenges and Transnational dangers are serious in themselves, a particularly grave "wild card" is the combination of several such threats. Acting in collusion with other hostile entities, for example, an adversary might attempt to combine multiple asymmetric means with the seizure of a strategic objective before we could respond. Such an attack- timed to avoid US forces while they are committed elsewhere, and supported by diplomatic and propaganda efforts -- could be directed against an important national interest. This could critically undermine US will, credibility, access, and influence in the world.[14]

The ability for a "wild card" to use emerging technology, asymmetrical attacks, and direct assault on U.S. interests as cited by the chairman is once again a confirmation and recognition of the type of attack the nuclear assault in space by a rogue nation represents. It fits the mold. It is of concern that he proposes no strategy to counter them. His statemant is more of a reflection or realization that these nations exist and have the capability to cause far reaching problems for the U.S.

Both the NSS and NMS present clear issues that can be associated with a nuclear attack in space. The President articulates interests that must be protected which the attack in space would affect. He cites genuine concerns that contribute to the problem such as uninhibited access and use of space as well as the proliferation of nuclear weapons. The NSS does a good job of presenting the interests that must be protected and easily allows us to see how an attack in space with nuclear weapons threatens several U.S. interests.

The NMS takes the President's strategy and sharpens the focus through military objectives. The Chairman addresses numerous missions that the military must be able to perform to protect the interests cited by the President. Although never citing this specific type of attack, the broad issues address it. The NMS is sound, and if all of the goals cited in it were achievable the U.S. may never be at conflict. The issues that surround an attack in space are well covered and recognized, although not directly stating such an attack. Everthing the Chairman has said reinforces the need to prevent this form of attack; the NMS overlooks little. However, does this form of attack affect so many issues presented--national interests, information superiority, access to space - that perhaps it should have been mentioned? Few attacks are capable of disturbing so many wide ranging yet integrated interests as this form of attack in space.

It may be unrealistic to think the U.S. can deter all forms of attack. However when one examines how many interests are linked to the assets in space, and how vital they are to the military in IO, perhaps addressing this specific form of attack by a "wild card" is necessary. The objective of preventing an attack of space assets has been established and certainly implied. Strategy is only the first link in a chain of functions that contribute to the possible prevention of this attack.

Despite these initial gaps, the NSS and the NMS make the goals of what must be protected very clear. Based on what they both have presented, it is logical that the policy formulated to support the strategy would cover the necessary issues to ensure the strategy is capable of being implemented. The strategy identifies the very problem--numerous threats, space is critical to the nation and interests, however some attacks may not be preventable. The gaps in nonprevention of certain attacks against what is deemed as interests as well as the gap created by nuclear deterrence illustrate that this problem is not easily preventable and displays shortcoming in the strategy itself. Policy will have to make up for these shortcomings in the strategy, unfortunately, in this case, it does not

The next portion of this analysis will examine the next link, policy developed to implement the strategy of trying to prevent damage to space systems.

Policy

Policy is a key element of achieving and protecting the interests of the U.S. Policies reinforce the strategies established in the NSS and NMS. This section will examine the National Space Policy (NSP). The NSP wording is sound in identifying what must be achieved, but fails to meet its own challenges through the programming of resources to achieve its goals.

The President's National Space Policy establishes key guidelines for space that address the type of attack under study in this thesis. It states that the U.S. must be able to perform the following:

> Assuring that hostile forces cannot prevent our own use of space;
>
> Countering, if necessary, space systems and services used for hostile purposes;
>
> Enhancing operations of U.S. and allied forces;
>
> Ensuring our ability to conduct military and intelligence space-related activities;
>
> Satisfying military and intelligence requirements during peace and crisis as well as through all levels of conflict;
>
> Supporting the activities of national policy makers, the intelligence community, the National Command Authorities, combatant commanders and the military services, other federal officials, and continuity of government operations.[15]

Additionally, the policy continues:

> Critical capabilities necessary for executing space missions must be assured. This requirement will be considered and implemented

at all stages of architecture and system planning, development, acquisition, operation, and support.[16]

The Presidents policy formulated for space is very clear and specific. It supports the goals established in the NSS. This policy establishes the "ways" by which the interests and objectives will be supported. Additionally, if executable it would achieve the numerous goals as stated in the NMS. It assigns the Department of Defense with the Defense Space Sector Guidelines:

> DoD shall maintain the capability to execute the mission areas of space support, force enhancement, space control, and force application.
>
> In accordance with Executive Orders and applicable directives, DoD shall protect critical space-related technologies and mission aspects.
>
> DoD, as launch agent for both the defense and intelligence sectors, will maintain the capability to evolve and support those space transportation systems, infrastructure, and support activities necessary to meet national security requirements. DoD will be the lead agency for improvement and evolution of the current expendable launch vehicle fleet, including appropriate technology development.[17]

It directs the responsibility for these functions to the Department of Defense for programming. This establishes a responsible agency which will control the means to which the policy is executed.

Perhaps the most important portions of the President's policy is his intentions with regard to space control.

> Consistent with treaty obligations, the United States will develop, operate and maintain space control capabilities to ensure freedom of action in space and, if directed. deny such freedom of action to adversaries. These capabilities may also be enhanced by diplomatic, legal or military measures to preclude an adversary's hostile use of space systems and services. The U.S. will maintain and modernize space surveillance and associated battle management command, control, communications, computers, and intelligence to effectively detect, track, categorize, monitor, and characterize threats to U.S. and friendly space systems and contribute to the protection of U.S. military activities.[18]

The formulation of this policy to support the interests and objectives is sound. It addresses all that must be achieved in broad terms. Once again, if executable to the fullest extent, an attack in space would not be an issue (provided we found a means to ensure freedom of action in space as directed in the President's direction on space control). However, once again we have the President directing very sound activities and goals. However, they can only be deemed sound if they are achievable. He is directing the Department of Defense to do these things. Meanwhile the NMS has identified that there may be some asymmetrical attacks that we cannot prevent. Once again, since the attack in space represents an asymmetrical attack, can the President's directive to ensure freedom of action in space be achieved? Only with sound programs that give the policy "teeth" will such directives be achieved.

It is apparent that the key element of the President's National Space Policy is space control. Successful application of this element would surely safeguard space. However, one must examine the means that allow the DoD to achieve space control. This is the heart of the problem in preventing an attack on our space assets with a nuclear weapon--what the U.S. actually has to achieve space control at this time. This will be examined in the programs sponsored by the DoD.

Currently, the U.S. is in the precarious position of failing to meet the needs of her own policy and strategy at the program level, despite what has been mentioned about asymmetrical attacks earlier. Space control implies, all functions that prevent U.S. negation of space. A nuclear weapon launched into space would certainly negate numerous assets as discussed earlier. One must now analyze the current programs the DoD uses to conduct its space control mission. DoD programs designed for space control will be evaluated for all three segments it is designed to control. The first is the ground/user segment which consists of ground stations that control the space-based assets and stations that transmit and receive data from the platforms.[19] The second is the link segment, which is the actual transmission between satellites and ground stations.[20] Finally, the space segment represents the actual systems in orbit providing necessary functions.[21]

The only programs the U.S. has in the terms of space control at this time are in the areas of Space Surveillance and Battle

Management/C4I, Protection, Prevention, and Negation.[22] Each one of these will be compared against the asymmetrical attack in space to identify how they generally contribute to each segment of space control, but fail in the case of a nuclear attack.

This first program of the DoD to contribute to space control is space surveillance and battle management/command, control, communications, computers and intelligence (C4I). The DoD Space Program defines it as follows:

> Space surveillance & Battle Management/C4I. Space surveillance Network: Cataloguing and identification, satellite attack warning, timely notification to U.S. forces of satellite fly over, space treaty monitoring, and scientific and technical (S & T) Intelligence gathering.[23]

The focus of this program is to collect data and protect the space segment. It contains the space surveillance network which identifies and catalogues items in space. It consists of twenty-six multi-phenomnon sensor sites located around the globe.[24] It is comprised of phased array radars as well as optical and mechanical trackers.[25] The system is complemented by several satellites which can assist the system through passive radio frequency (RF) means.[26] The mission of the space surveillance network is: Surveillance of space in support of space, air, ground, and sea operations to detect, track, identify, characterize, and catalog all manmade objects in space and selected natural objects near

Earth and to monitor their movement to provide situational awareness of all space related activities.[27]

The items of primary interest are satellites (of all nations) and space debris from launch vehicles.[28] Linked with the BMC4I program, it contributes to the protection of U.S. space-based systems from damage by allowing ground controllers to maneuver and place vehicles in orbits that are clear of debris and other satellites. However, it contributes nothing to the prevention of a nuclear attack in space. It could possibly identify a nuclear weapon if it was placed into orbit as a space mine, but that is not the scenario of concern.

The system assists in identification of hostile satellites. This allows U.S. forces to be forewarned of hostile satellite fly over.[29] This function also contributes nothing to deter or protect the nation's space assets from a nuclear attack. The ability to provide satellite attack warning in the case of a nuclear weapon is very limited. A portion of the system can identify some launches from other nations into space.[30] Although this may assist in identifying the attacker, all the system can do is track the events. In the event of a nuclear weapon launched into space, this system provides little other than the opportunity to "watch" the attack happen, and track the debris that would result from the attack.

The second program is protection. For the protection of space-based assets, the DoD has several measures that also fail to deter or limit a nuclear attack. The DoD Space Program cites the following in protection:

> Protection. DoD space systems are inherently protected by appropriate measures such as design, satellite proliferation, hardening, comm cross-links, and security protection.[31]

This program is designed to protect the space segment as well as the link segment of space control.

In terms of protection, the measures listed do not go far enough. Design is an ambiguous term. U.S. satellites are designed to serve a function in the unique and challenging environment of space. In these terms they are protected by design, specifically to shield themselves from the natural radiation of the portion of space they orbit within.[32] Of the military series of satellites, only MILSTAR is hardened against nuclear effects.[33] MILSTAR flies at GEO and is not likely to fall prey to an attack for that reason alone.[34] To conserve weight and maximize payload, few satellites are hardened against conventional attacks in space.[35] This level of hardening, which is for the natural radiation in space, is insufficient to protect against a nuclear detonation in space.[36]

The second basis for protection, proliferation, is also inadequate. Currently the U.S. has approximately 600 satellites in orbit.[37] It is projected that it will launch 1200 by the year 2003.[38] However, they are not all redundant and capable of performing the same missions. The satellites placed into LEO are there to take advantage of that orbital plane and distance from the earth.[39] Not all of the same things can be achieved by satellites in MEO or GEO, especially with regard to imaging and intelligence collection.[40]

Very few spares are in orbit for each system. For example, the Global Positioning Satellite (GPS) has only three operational spares in orbit for a twenty-four satellite network occupying six orbital planes.[41] Many systems employed have no spares prepositioned in orbit, nor are there replacements readily available stored on the ground.[42] Additionally, the U.S. does not have the number of satellites in orbit to handle hostile actions in space.[43]

The proliferation of satellites has been based on peacetime and operational requirements and the potential of loss based on failures not associated with hostile forces.[44] A representative of USSPACECOM noted "In terms of satellite proliferation, we simply do not have the wartime reserves required to replace losses encountered by hostile actions in space."[45]

Communication Cross Links, another element of protection, enable satellites to "talk" to each other.[46] This can be useful when certain links have been negated through the destruction of a ground station or actual jamming or interference with a link segment.[47] However, not all satellites can communicate with each other due to bandwidth and antenna design on the satellite.[48] Although several systems operating on like frequencies can communicate with each other, this may simply allow certain communications and activities to be performed after an attack, it certainly is not enough to deter an attack, nor will the current cross linking be able to fully make up for the loss of communications and functions should an attack occur.

Security Protection, the final element of protection, measure is the security to keep U.S. communications and downlinks confidential.[49] This is a protection aimed at securing the link segment only. This provides nothing in the ways of defense against a nuclear weapon. It only inhibits the ability of belligerents to break into our system and gain the information being transmitted.

Although the protection portion program for space control appears to be robust because of programs for hardening, proliferation and robust design, these activities are not enough to deter an enemy from attacking. The limited redundancy and hardening do not reduce the battle damage of a nuclear attack in space.

An additional program area of the DoD in space control is termed prevention. In terms of prevention, the DoD Space Program cites the following:

> Prevention. Military missions are also enhanced by diplomatic, legal, or military measures to preclude an adversary's use of space systems or services.[50]

This program also focuses on the space and link segments. The Limited Test Ban Treaty of 1963 prohibits nuclear testing in the atmosphere, in outer space, and underwater.[51] Article 1 states that "States may not conduct nuclear weapons tests or other nuclear explosions in outer space or assist or encourage others to conduct such tests or explosions."[52] This ban includes nuclear explosions for peaceful purposes as well.[53] When nations observe this treaty, the space segment is protected from nuclear effects. However, only 112 nations have signed this document.[54] It is unlikely that this ban will truly be recognized by an irrational actor considering war. It will contribute little, if anything at all in convincing a nation not to attack space with nuclear weapons.

Diplomacy can prevent enemy access to space products. An example of this was the diplomatic efforts of the U.S. during Desert Storm. Working closely with France, the U.S. was able to deny SPOT multispectral imagery from being sold to Iraq.[55] This placed Iraq at a clear disadvantage, and denied it the ability to observe the repositioning of forces that allowed the main effort of the attack to attack into Iraq and achieve surprise. Unfortunately, denying space products through diplomatic means will have no effect on denying the enemy the ability to fire a nuclear weapon into space. In fact, it could give him more reason to do just that. Denying space products may make the targeting of U.S. space assets more attractive to an enemy.[56]

Military means to prevent the enemy's use of space will not deter a nuclear attack. The only way this could be achieved is if the U.S. had the information that such a launch by a nation had the intentions of attacking its space-based assets and the capability to prevent the missile that was launched from entering space. There are concepts to develop a space-based laser that may someday be able to achieve this. Currently, deployment of such a laser in space is a violation of the Anti-Ballistic Missile (ABM) treaty of 1972.[57] This would place the U.S. in the predicament of violating a treaty, while expecting others to observe the ones they have signed.

Diplomatic and legal measures provide little restraint to a country willing to risk placing a nuclear weapon in space. A country willing to perform an aggressive attack of this nature will dismiss anything that has been agreed to diplomatically or legally. It is an act of war it is performing.

Finally, the DoD has programs for negation. Once again this program achieves little to prevent a nuclear attack in space.

> Negation. Hostile space systems or their data links can be negated.[58]

Negation can affect all three segments of space control. The easiest way for the U.S. to negate an adversary's space system is to attack the enemy's ground station.[59] The link segment can be jammed or spoofed[60]. However, the DoD has nothing in its inventory currently to negate the space segment.[61]

A nuclear weapon fired into space becomes a hostile space system. It is crude by design and incapable of maneuvers and orbit, but hostile nonetheless. The U.S. has nothing in the inventory to attack it or prevent its operation at this time. The negation program is currently conducted primarily by jamming assets that prevent the enemy use of his systems. These systems are classified and can only be discussed in broad terms.[62] Jamming is the only means the U.S. has at this time to negate space to adversaries other than attack of ground stations.[63]

In terms of negating the space segment, the U.S. decided to inactivate its only ASAT capable F-15 wing at Langley Air Force Base and the President recently line-item vetoed a newly proposed ASAT program based off of a ground based interceptor/booster. Hostile space systems could only fall prey to the Mid-Infrared Advanced Chemical Laser

(MIRACL), a laser that has been demonstrated by the Army as effective, but only under certain conditions.[64] The MIRACL is not mobile, and can only laze systems orbiting over portions of the U.S. The administration and DoD claim that the MIRACL is not an ASAT type weapon, and that recent tests were merely to test the vulnerability of our own satellites.[65] Despite these claims, the MIRACL can be effective for some negation missions, but not all. It is unlikely that until the decision is made to weaponize space, and capable lasers are placed there, that the nuclear attack can be prevented by the current systems. Additionally, it is doubtful that the inactivated wing or vetoed ASAT would have any real deterrence or ability to attack a nuclear weapon in space. The attack takes too little time, and unless an unsophisticated nation obtains the ability to place a nuclear weapon into orbit, these measures would both prove useless. This provides all the reason for an enemy to simply place a nuclear device into fission as soon as it achieves its optimum altitude for the assets it is attacking.

This lack of programs to protect space assets either passively or actively allows the dominoes to begin to fall in the execution of the policy. The failure of the policy can result in the failure of the strategy. Had the programs directed to provide space control been effective, the Commander in Chief, U.S. Space Command, probably would not have had to make this comment during his recent congressional testimony. General Estes states:

> Today, the region of space is a military and economic center of gravity. Life on earth is rapidly being inextricably linked to space capabilities. Because of our military strategy, economic investment, and social dependence on space systems, space has become a region of vital national interest. To fully capitalize on this growing source of military, economic and political power and to prepare for the future security environment, we will not only provide "support from" space as we do today, but will also "operate in" space tomorrow. Competitors and adversaries already recognize our reliance on space power. We must guard against turning our dependence into a vulnerability. Protecting our freedom to use space assets will become increasingly important. As adversaries also increase their ability to exploit space systems, it may become unacceptable to share this high ground in times of crisis or war. To keep our troops out of danger, we may need to deny an adversary's access to space or use of his space systems.[66]

General Estes' comments appear as a warning that the nation is not achieving the missions the President has assigned DoD to protect space. He makes it very clear that we are not complying with the directives at this time. His testimony lies at the heart of the issue--the strategy and policy say one thing, yet the U.S. fails to comply with it. All the functions listed under "Space Control" do not truly control space. They are passive in nature, and do not truly protect against all sorts of threats to space-based assets and they do not necessarily deny access to space by an adversary, let alone the use of nuclear weapons in space. Additionally, these programs are ambiguous for security reasons.[67] It is also likely that they are ambiguous to conceal shortcomings. The ability to accomplish what the President said the nation must do in his strategy and policy, complemented by the Chairman's NMS, has failed to be achieved by DoD, and has left the CINC to state reality to congress.

What Must Be Done

The attack cannot be stopped if a belligerent truly wants to achieve it and has the assets. Some nations can be deterred from conducting such an attack by several means. The first way is to make the attack not worth while in relative cost and advantage. The second is by a threat of punitive retaliation which may serve as a deterrence in of itself. The best the nation can do until radically new technology provides a suitable answer is do its best to try to prevent such an attack and limit the impact involved with it.

In order to limit the impact of such an attack, the nation must control the risk associated with this form of attack. The likelihood of such an attack occurring today is relatively low. Despite the low likelihood, should it occur, the losses and costs would be very high. Examining the situation graphically risk will be shown as an area produced by the likelihood multiplied by the cost of such an attack.

The amount of risk from a low likelihood of attack and a high cost of attack can be graphically depicted as on figure 2. Based on all of the factors presented, the likelihood of an attack may not be as likely as the AAN WWG would have us believe. Just because the attack took place during the AAN WWG does not mean that its chances of happening are high, just feasible. In all actuality, the likelihood of attack by this means is comparatively low and is depicted as such in a relative manner on

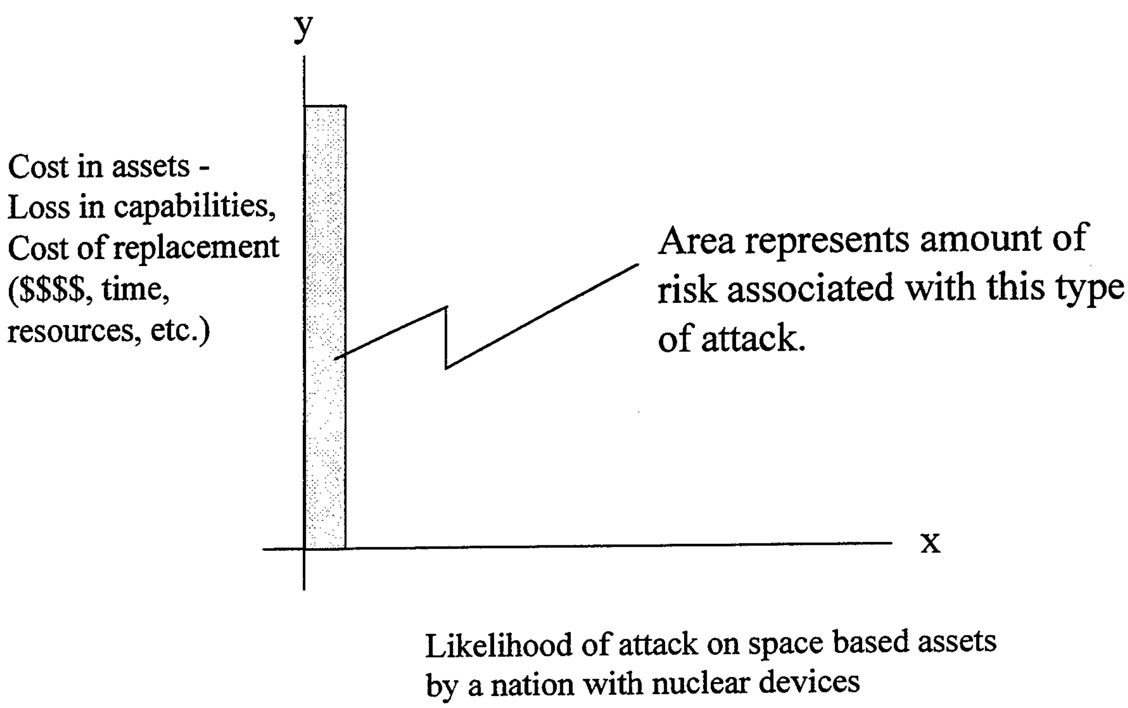


Figure 2. Graphical Depiction of Risk

the x-axis. It is low at this time for several reasons: The nations that currently have nuclear weapons also have much to lose from an attack in space as well; The uncertainty of a U.S. response or world response also provides deterrence; escalation of any crisis would not be welcome--surely this tactic would escalate matters immensely. Despite the low chance of attack, the cost should the attack occur is extremely high, as depicted on the y-axis. The shaded area represents what I term as "risk." The area represents the amount of risk which must be "controlled." Once again, the issue will surface, how much risk is acceptable?

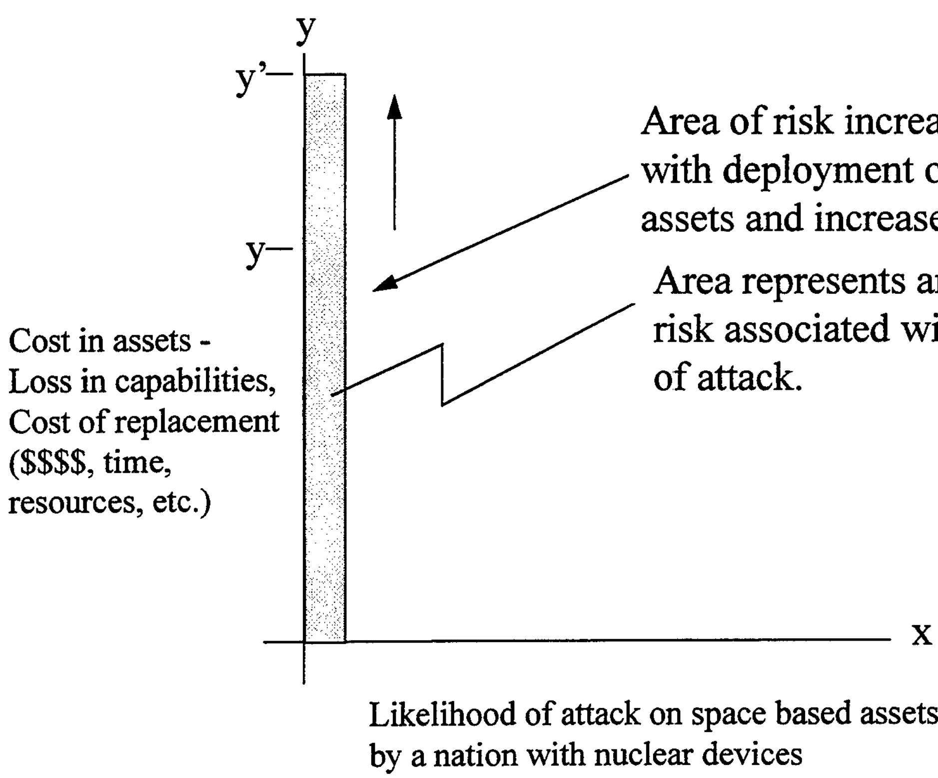


Figure 3. Risk: Assets and Reliance

With time and current trends the graph depicting this situation changes. There are two ways in which the area of risk can change. The first is depicted in figure 3 where the y-axis increases (Costs/losses), and the x-axis, likelihood of the attack remains constant. In this situation, the U.S. continues on a path of increased reliance on space-based assets, and continues to place more assets into orbit using current policies with regard to hardening and launch schedule. The y-axis grows, because if attacked, even more would be lost. Keeping the x-axis constant (assuming nuclear armed nations remains constant), the risk increases nonetheless because of the increase in the y-axis.

The second situation that could occur to increase the area of risk is movement along the x-axis as represented by figure 4. Here, with no change in the y-axis (no additional systems placed into space, no change in reliance), the area of risk grows as a result of nuclear proliferation. In this situation, the x-axis shift based on nuclear proliferation (an assumption of this thesis is that nuclear proliferation will continue despite U.S. efforts to limit it.). As there are more nations capable of achieving such an attack, the area of risk grows, even if the y-axis remains constant.

Unfortunately, it is likely that both situations will occur simultaneously. It is likely that the U.S. will continue to exploit space,

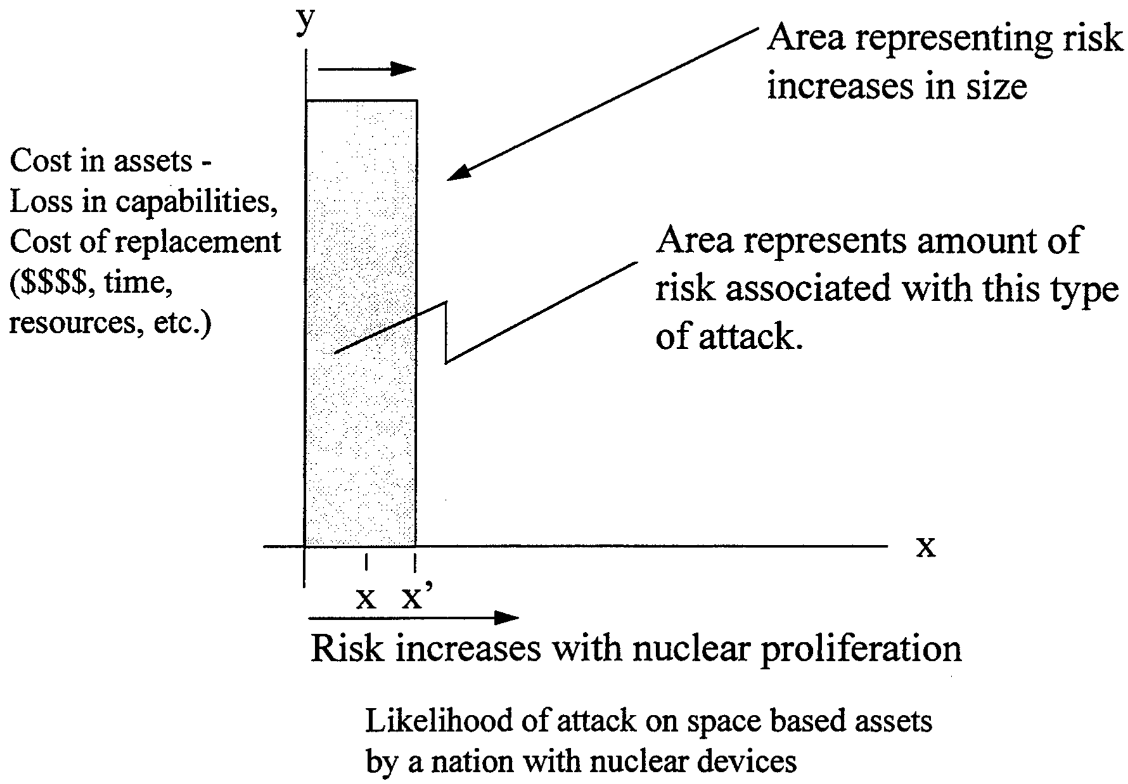


Figure 4. Risk: Nuclear Proliferation

without programming additional systems to achieve space control. Additionally as rogue state actors continue to obtain technology and pursue the development of nuclear devices, it is far more likely that the area of risk will increase in both directions on the graph.

Figure 5 depicts a greater area of risk based on increased assets in space and further reliance on space, as well as growing nuclear proliferation. Here the area has significantly increased due to movement on both the x-axis and the y-axis based on the reasons cited above. The situation, without control, will only get worse, and the U.S. will face greater risk based on this type of attack.

What the U.S. must do is "control" the area of risk. The Chairman stated that there may be asymmetric attacks that simply cannot be prevented. However, we must attempt to prevent them nonetheless.

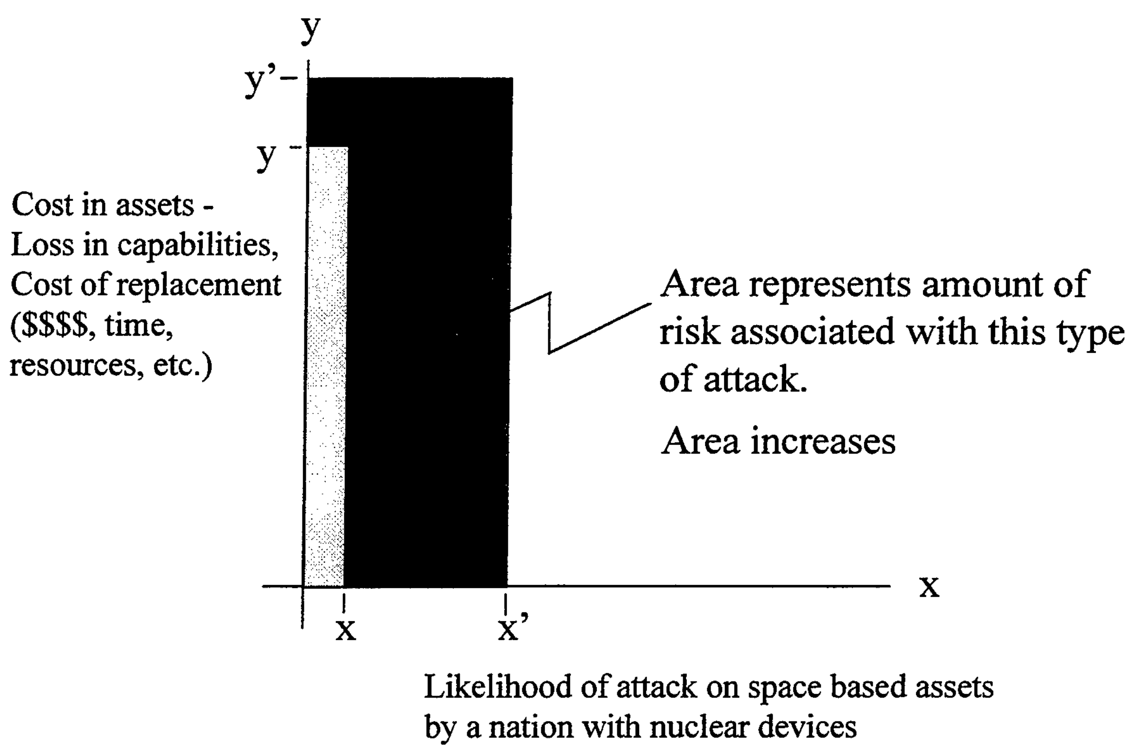


Figure 5. Risk: Combination of Effects

Until the U.S. can develop systems completely capable of protecting ALL of its assets in space by what ever means (weapons stationed in space, etc.) it will continue to face this situation. This is the same situation that challenged the SDI program. Even if space-based weaponry were capable of destroying missiles launched into space, unless they destroy them very early in the launch and allow none to leak through, they themselves may be the first casualties of an attack in space. Controlling this risk may be achieved in several ways without investing in new weapons technology. However it will require a more aggressive approach to applicable defensive measures. The U.S. may not be able to completely control movement on the x-axis; however, it can exercise considerable control on the y-axis.

Figure 6 portrays risk being reduced by a decrease in the y-axis based on programs that make the value of such an attack decrease to an adversary. Reducing the y-axis may be achievable through several means. The first is hardening.

Hardening of satellites can prevent many of the effects created by a nuclear detonation in space.[68] The cost is high, and this technology is not applied to all satellites.[69] The U.S. must reconsider its current policies that provide for the lease of numerous commercial systems. These systems are not hardened beyond that which is required to combat the natural radiation of the space environment.[70] The tradeoff must be

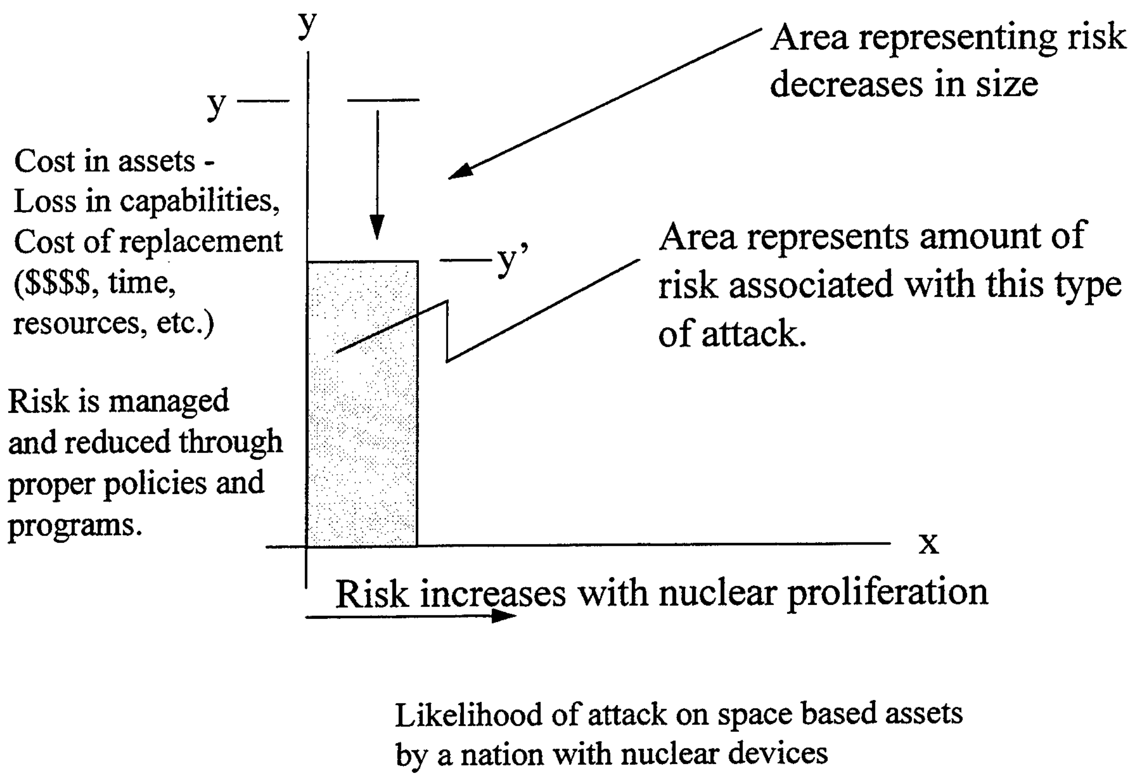


Figure 6. Managing Risk: Policies and Programs

closely examined in terms of cost of hardening vs. the cost of loss (of course likelihood of attack contributes to this equation). Nonetheless, hardening reduces loss and risk.[71]

The greatest threat is to assets that operate in LEO.[72] This is for several reasons. These assets operate in a relatively benign environment and do not encounter the amount of natural radiation as those assets operating at MEO or GEO.[73] Due to the environment in which LEO satellites operate, they are not built as hardeneded as the satellites that operate in MEO or GEO.[74] It is the satellites that operate at LEO that are particularly vulnerable to a nuclear attack in space.[75] This is the likely altitiude in which a rogue nation would attempt such an attack based on the delivery means avaible to those nations. A 50 Kiloton burst at an altitude of 120 Kilometers would effectively cause all satellites that were not hardened beyond that for the natural radiation of LEO to cease to function in only two months time.[76]

Currently there are over forty unclassified LEO satellites performing a variety of military, commercial, and scientific missions that would be affected by the nuclear event just described.[77] Additionally the new LEO communication systems planned will place even more satellites within this area of vulnerability.[78] The Iridium, Teledesic, Orbcom, and Globalstar systems will place 980 satellites into LEO, creating a more lucrative target for a Third World threat.[79]

It should be noted that hardening cannot stop all of the effects of a nuclear weapon in space. This unfortunate event would create other damage by blast and debris. Any satellite close to the blast would be destroyed by the blast itself--all the hardening possible cannot prevent this. Additionally, debris spewed in space from the blast and destroyed satellites could strike other satellites, continuing the collateral damage to space assets.[80] Despite this fact, assets orbiting in LEO need to be hardened in order to survive the radiation saturation effects that will be created by the Van Allen belts that will result from a nuclear detonation.[81]

Hardening can prevent damage to microelectronics within satellites. Unfortunately the technology that has allowed payloads to become smaller and lighter (microelectronics) also created systems in which the radiation level needed to produce instantaneous failure in circuits today is two orders of magnitude less than it was in the technology use to build satellites in the 1970s.[82] Additionally, the number of U.S. contractors who produce radiation-tolerant semi-conductors has fallen from twenty in 1990 to only four in 1995.[83] This trend has continued. Today there are only two venders who produce these hardened products.[84] DoD investment in radiation-hardening technology has also dropped from $50 million in 1989 to only $20 million in 1995.[85] These budget cuts to DoD are an unfortunate result of the end of the Cold War.[86]

Realistically, the cost may be too great to apply hardening to all U.S. military space-based assets, (Furthermore, the civilian sector may show no interest.) The cost of hardening a satellite can be 1 to 5 percent of the cost of the total system.[87] This can equate to millions of dollars in some cases, (Satellites alone do not represent the total system.)

However, currently only one system, MILSTAR, is hardened against nuclear effects and it does not provide all the functions required by the nation. MILSTAR only provides communications capability.[88] All systems must be evaluated (communications, positioning, early warning, weather, surveillance) and a determination made as to which systems are critical to continuing military and other key (diplomatic, economic, etc.) operations. Those systems identified as critical ought to be hardened. For example, as greater reliance on precision weapons increases, the GPS system, which provides data for those systems as well as commercial and military navigation, should be considered for hardening.

As the nation continues to use commercial assets for many of its functions in space, it should explore future partnerships with the civilian space industry. At a minimum, it should require systems to be hardened prior to leasing. There is no question that a demand for these systems exists, therefore a supply would be created. Ventures that could split the cost of hardening certain commercial assets should be examined, this would benefit both the government as well as the commercial industry. Both have an interest in these satellites surviving a nuclear attack.

Second, rapid reconstitution of space-based systems can also reduce risk and have an impact on the y-axis. There are two elements required to achieve rapid reconstitution, or what is known as launch on demand. The first is having capable boosters reserved for such a contingency that are configured to quickly mate with a given payload. The second is having the required satellite assets to achieve the given mission on hand to place into orbit to replace damaged systems. The time to launch to replace systems is dependent on the longest time it takes to either prepare the booster and mate it with a payload, or the time to process the satellite prior to mating.[89]

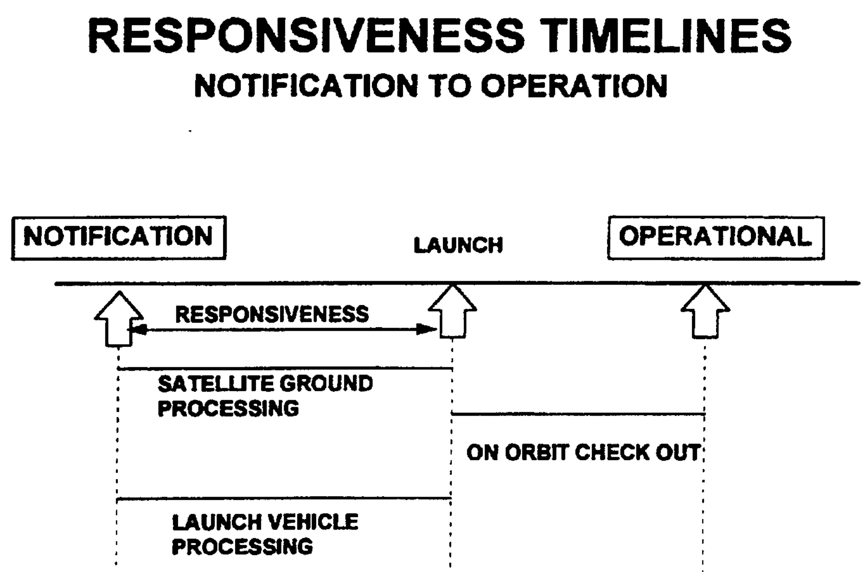


Figure 7. Source: General Howell M. Estes III, Air Force Space Command Operational Document (ORD) II, AFSPC 002-93-II, for the Evolved Expendable Launch Vehicle (EELV) System, Air Force Space Command, Peterson Air Force Base, D-10.

Currently, the U.S. does not have the capability to launch on demand.[90] It should be noted that launching on demand does not equate to capability on demand, this is due to the time required to maneuver the satellite into a proper orbit and test all of its functions.[91] The relationship of these factors are displayed in figure 7.

The current family of boosters (Atlas, Delta, and Titan) the U.S. has in its inventory take a month or more to prepare for launch.[92] The Titan launch vehicle which is used for heavy payloads can take up to six months to prepare for launch.[93] This is due to the fact it must be constructed to meet a specific payload.[94] The future family of boosters, the Evolved Expendable Launch Vehicle (EELV) System, will only improve the time for heavy launches.[95] The time to launch requirements for the EELV are forty-five days for light and medium payloads, and ninety days for heavy payloads.[96] EELV will make great improvements to our launch capability in terms of savings and efficiency.[97] However, in terms of time, it does not go far enough to be considered a system capable of launch on demand. EELV will become fully operational with ground support in 2004.[98]

The second element required to achieve rapid reconstitution is prepared satellites. It is the satellite that takes the longest time to prepare.[99] Typical preparation times are depicted in figure 8. Only when the nation embarks on stockpiling satellites will it come close to achieving rapid reconstitution. Additionally, given the attack in this study, these assets must be hardened. It would make little sense to rapidly launch unhardened satellites into an affected portion of space only to have them malfunction over time as the original assets did as a result of a nuclear attack. It may have its utility depending on the course of action and timing of an action the U.S. is about to embark on. A planned tradeoff to get a limited capability for a limited period of time could be a reasonable solution for a given crisis. However, a hardened

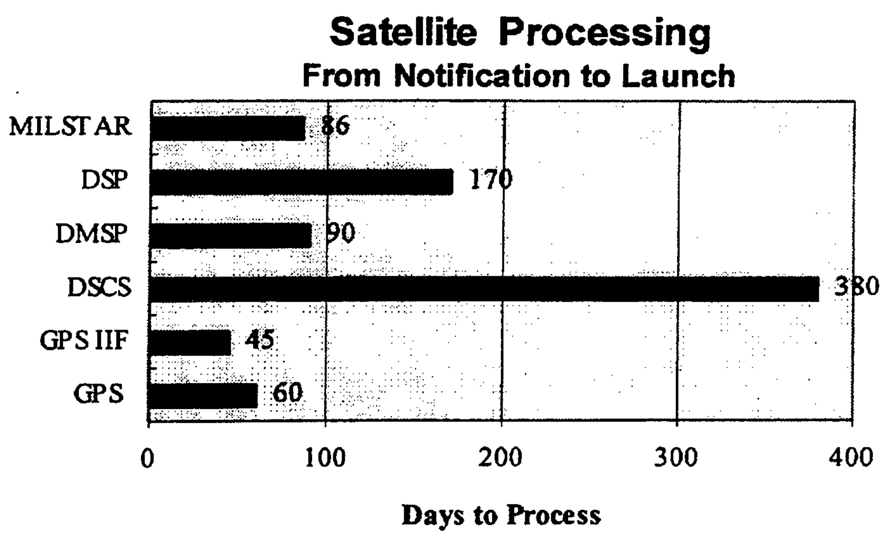


Figure 8. Source: General Howell M. Estes III, <u>Air Force Space Command Operational Document (ORD) II, AFSPC 002-93-II, for the Evolved Expendable Launch Vehicle (EELV) System</u>, Air Force Space Command, Peterson Air Force Base, D-9.

replacement that could operate at an altitude to keep it out of the affected region would be more suitable. Finally, the preparation time for these assets must be decreased considerably for launch on demand to be a reality.

The capability to launch quickly is achievable. The Russians demonstrated this during the Gulf War during which they launched several satellites in a very short period of time to observe the activities of the war.[100] Although the times are classified, they clearly demonstrated a unique capability.[101] They are capable of achieving this due to a different method of configuring boosters and loads.[102] The Russians mate boosters and payloads horizontally, vice vertically which is the method the U.S. uses.[103] This gives them much more flexibility and the capability to have payloads preconfigured and mated to a booster on a much shorter schedule than the U.S.[104] In terms of efficiency (other than time), capability, and other factors, this is not necessarily a better method than that used by the U.S., however; it is much faster.[105]

Launch on demand has been studied extensively by the Space Architect Office. That office has conducted exercises that demonstrate the need in the future (2010-2020) of a launch on demand capability which can be achieved in just a few days.[106] However, the need exists today, and the U.S. simply does not have that capability. The U.S. needs to begin development of launch on demand capabilities now.

Until the capability exists, the U.S. must develop methods to fill the deficiency in the meantime. A method to achieve this is use of Unmanned Aerial Vehicles (UAVS).[107] UAVS cannot fully replace satellites, but they can certainly complement them and fill the gap for short periods of time.[108] UAVS have a limited field of view and cannot serve as a substitute for certain capabilities achieved through space-based assets.[109] Nonetheless, they can be a worthy element to allow key functions to be continued on a limited basis if U.S. satellite assets fall prey to a nuclear attack.

Rapid reconstitution/launch on demand are challenging missions that the U.S. cannot conduct today. The U.S. does not possess the assets to reconstitue reconstituting its space infrastructure with hardened satellites. However, it must begin to achieve the capability immediately. It is not a mission that is impossible as demonstrated on a limited scale by the Russians, and could be a key element in reducing the value of an attack in space as well as a viable means to replenish the system in space if such an attack occurs.

Finally, decreasing reliance could be an additional factor in reducing risk. General Estes warned that the nation's growing reliance on space could create a vulnerability.[110] Reducing reliance may be the toughest challenge for the U.S. with regard to its space systems. However, if achieved, this in and of itself would reduce the overall risk the nation must sustain since it implies the capability to achieve the same functions with other assets, making the space assets a less valuable target to potential enemies.

U.S. reliance on space-based assets has been extensive since 1963.[111] Both the U.S. and the Soviet Union used space capabilities to observe strategic weapon systems that assisted in providing for a stable nuclear deterrence strategy throughout the Cold War.[112] Additionally, two studies in 1976 during the Ford administration identified that the U.S. was growing dependent on its space-based assets.[113] Time and advances in technology has only created more of a dependence on these assets. Assets capable of covering a broad spectrum of functions to the military and the nation have kept this trend moving forward. A science advisor to President Reagan once noted that "Even in a very limited war, we would have an absolutely critical reliance on space today."[114] This was clearly demonstrated when space played a crucial role in a number of limited operations: El Dorado Canyon (Libya, 1986), Earnest Will (The Persian Gulf, 1988), and Just Cause (Panama, 1989).[115]

Space has not only contributed to limited operations. Perhaps the best example of this occurred during Operations Desert Shield and Desert Storm, when space-based assets greatly enhanced the effectiveness of the coalition forces.[116] Once again in this situation, space provided a full spectrum of capabilities: Navigation, weather, missile warning, communications, reconnaissance and surveillance, and target acquisition.[117]

As the nation progresses towards ever more reliance on space assets, the reduction of this dependency that is forming will remain challenging to say the least. Additionally, the dependency on a specific space system is not only linked to the availability of an alternate means, but also to the effectiveness and efficiency of those means.[118] Put in other terms, other nonspace-based systems may be able to perform the functions required, but may not provide as accurate, detailed, or timely product as those provided by space-based systems. In many areas, space-based systems provide the best product. This simply leads to further use and reliance. Some observe the nation will not depart from this path. One officer at USSPACECOM observed "It is unlikely we can truly reduce the reliance the U.S. has placed on its space-based assets."[119] Despite this observation the nation must attempt to do so whenever possible. An avenue to do this, at least in the military, is through training. Brigadier General (R) Huba Wass de Czege noted "We must continue to train with and develop redundant systems that serve as backups (speaking in terms of navigation and targeting), because we simply may not always have all of our primary space systems that allow us to perform these functions the way we do today."[120]

Training to perform missions without space support transcends the strategic to the tactical levels. Training scenarios must be conducted in degraded conditions and with interruptions of space systems support.[121] Only when this is done will creative means to complete the mission be developed. These lessons need to be learned before an actual operation makes their discovery a necessity. It would be tragic to contemplate that the nation became incapable of achieving its military, political, and economic objectives because it was linked too heavily on space-based assets that could be rendered nonfunctional.

Decreasing the value of an attack is critical. Whenever the y-axis is reduced, a phenomenon occurs on the x-axis. Figure 9 shows how reducing the cost/loss may lower the value of such an attack and thus, reduce the area of risk. As the y-axis is controlled, the value of the target becomes less. This may actually help shift x to x', for example, as the value of such an attack to the enemy decreases, the likelihood of him choosing it as a course of action may decrease also. This form of deterrence is known as countervailing deterrence, placing the value of the attack at odds with the relative value of the outcome.[122]

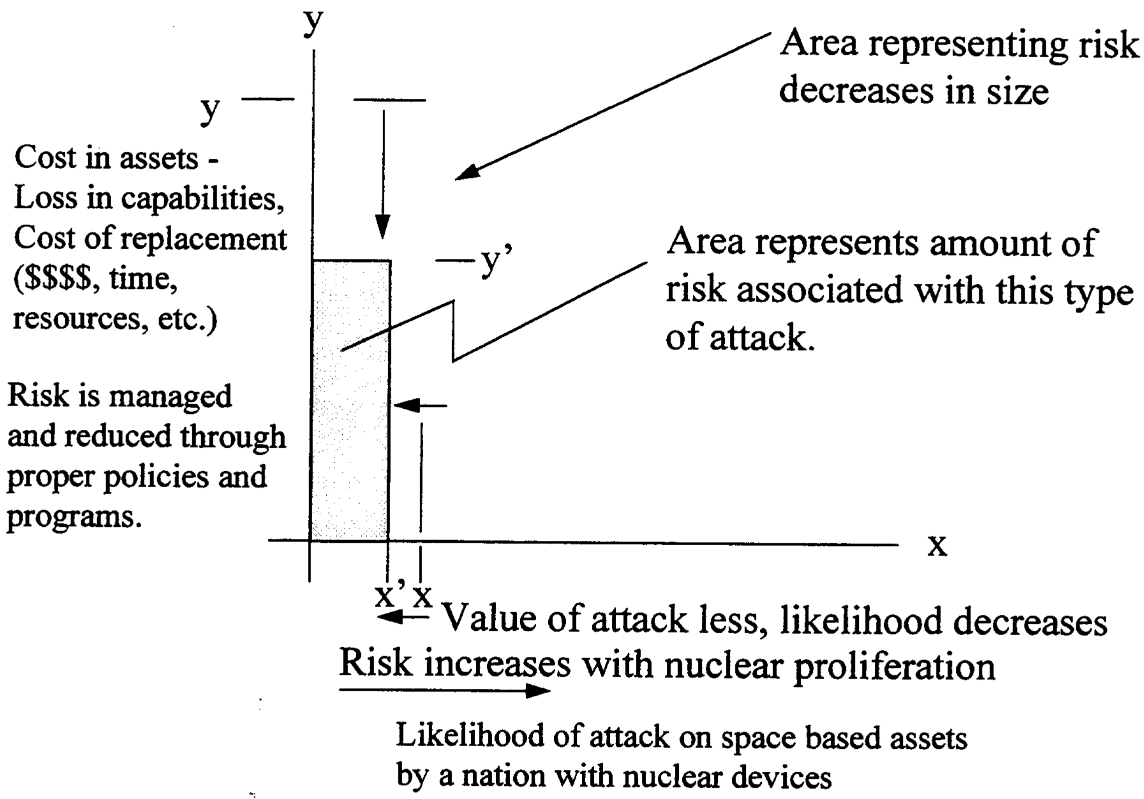


Figure 9. Reducing Value of Attack

A strong statement of retaliation may serve as deterrence in and of itself, and may prove worthy for the U.S. in reducing this risk. Deterrence has many faces and forms. This thesis has already mentioned the possible value of a countervailing strategy of deterrence. No matter what form, if used in and of itself to limit the risk, it must be clearly stated, understood by the target audience, and legitimate.[123] Deterrence of a punitive nature may be the most applicable to this situation. A well articulated statement, that is legitimate, and is established as our official response to an attack of this measure will reduce risk in and of itself.

A large area of risk may be eliminated by a clearly articulated and legitimate threat of retaliation as depicted in figure 10. If many nations cannot stomach the cost of such a retaliation, risk of such an attack may

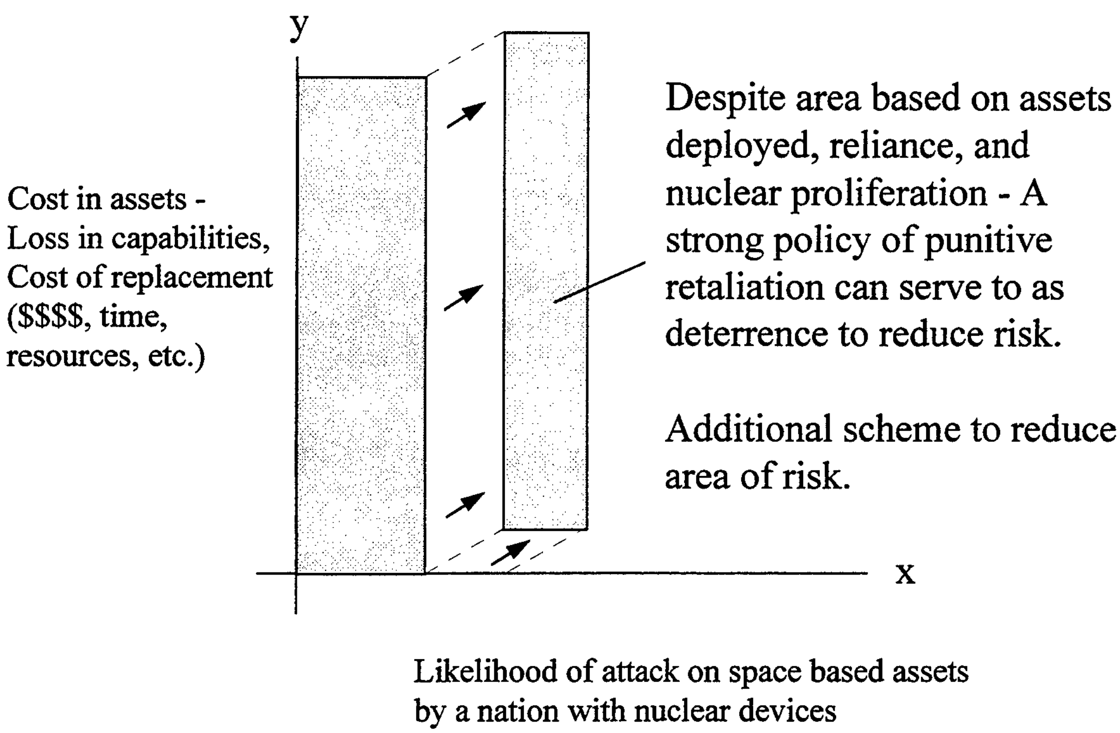


Figure 10. Managing Risk: Deterrence

decrease. Despite the area of risk established by the factors that influence the x-axis and the y-axis, this punitive deterrence policy will independently influence key actors and will effectively "slice away" a significant portion out of the total area. This is because, like the realities of nuclear deterrence, the response would be so punitive to the enemy nations contemplating such an attack that they determine it "unthinkable." Formulating this sort of response is challenging. Retaliation with nuclear weapons may not be acceptable. Perhaps attacks on the infrastructure, or other targets of worth to a given nation would ensure that fear is maximized. The response would have to remain flexible, and differ from nation to nation, further compounding the difficulties in articulating such a response, because what is important to one nation may not be to another.

The details of this component encroach on the analysis of interests and high value targets of other states. Suffice it to say that a detailed analysis of threat nations must be compiled to produce an effective and credible retaliation policy. One must recognize its utility in this situation, and find it a necessary component in attempting prevention of such an attack until the U.S. is capable of funding and employing technology to render this sort of attack useless to a belligerent nation. This retaliatory response, once articulated and publicized could possibly fill the gap created by the current nuclear deterrence strategy presented by Presidential Directive/National Security Council decision number sixty (PD/NSC 60.)

PD/NSC 60 does not contribute to deterring this form of threat.[124] Several issues have muddled its original intent that could affect the deterrence of the use of nuclear weapons in space. PD/NSC 60 does not address space and its intent may not fully address the unique situation that nuclear attack in space presents. PD/NSC 60 incorporates the changes of policy and force structure brought on by the end of the Cold War and builds on the conclusions of the Quadrennial Defense Review (QDR) and on previous policy reviews such as the Nuclear Posture Review (NPR).[125] It recognizes that rogue nations now pose a threat to the U.S. with chemical, biological and nuclear weapons. It provides guidelines for maintaining nuclear deterrence in what is now no longer a bi-polar world.[126] Additionally the directive indicates that the U.S. must maintain the assured response capability to inflict "unacceptable damage" against those assets a potential enemy values most.[127] Furthermore, it states the U.S. must continue to plan a range of options to insure the nation can respond to any aggression in an appropriate manner based on the provocation, avoiding "an all or nothing" response, thus maintaining flexibility.[128]

Despite its initial sound intent, PD/NSC 60 has undergone changes that may have weakened the U.S. threat to use nuclear weapons against certain threats and attacks.[129] These changes specifically change the U.S. response to the use of chemical and biological weapons.[130] The implied threat of the use of nuclear weapons was changed by the administration just three months after it was signed by the President in November of 1997.[131] Of concern here is the fact that the U.S. has limited its response against the use of chemical and biological weapons by changing the wording of the policy to state that a response to such attacks will be conducted with conventional weapons.[132] This change in policy may lead certain rogues to believe the U.S. is losing its lack of resolve to use nuclear weapons in response to certain attacks. This could result in a potential enemy concluding that a nuclear attack in space, which is not aimed at personnel, may not warrant a nuclear reprisal because the U.S. already appears to be weak in using a nuclear reprisal against attacks against personnel with chemical or biological agents. The U.S. could be sending the wrong signs throughout the world with regard to resolve, and could be displaying indecision over the use of nuclear weapons as deterrent threats.

Examining past policy may hold the key to formulating a strong punitive statement that could avoid any initial shortcomings and misunderstandings created by the PD/NSC 60 and its changes. In 1978 the Carter Administration formulated a policy in which the U.S. would respond with nuclear warheads should the Warsaw Pact attack with chemical agents.[133] This was known as a "response in kind" since the U.S. viewed chemical weapons as weapons of mass destruction, just as nuclear warheads constitute weapons of mass destruction. The fear of escalation served as a deterrent to the Warsaw Pact Nations considering assaults with chemical weapons in any attack of Western Europe.

Prior to the start of the ground war in the Persian Gulf in 1991, Secretary of Defense Dick Cheney warned that an Iraqi use of chemical weapons against coalition forces would result in a U.S. response that would be "swift, devastating, and overwhelming."[134] When Cheney was asked if this included nuclear weapons, Cheney would not rule out "anything."[135] This is what James Baker, Secretary of State in the Bush administration, termed as "calculated ambiguity."[136]

Applying these tactics to deter the use of nuclear weapons in space would be useful and should be done. The U.S. should not rule out the nuclear response option as a retaliatory option to a nuclear attack in space. Although U.S. and world opinion may not support such a response, the calculated ambiguity should be employed as it was in 1991. This places the enemy in the frustrating position of assessing a

U.S. response which entails a potentially great cost. The response should also include the sentiments of the 1978 policy with regard to a response in kind. This combination maintains the desired anxiety associated with the 1991 policy's ambiguity and the 1978 policy ensures that this deterrent transcends the full spectrum of the enemy's threat options. Figuring out the U.S. response may present the enemy with dilemmas of his own.

The U.S. must formulate a deterrent statement that says the following: Any attack on U.S. or allied space-based systems with nuclear devices, or any damage inflicted on U.S. and allied space-based systems by belligerents attacking other than U.S. and allied space-based systems with nuclear devices will be considered an attack on the interests of the U.S. and will warrant a response in kind that is immediate, devastating, and completely overwhelming.

This statement would make any belligerent nation capable of such an attack think twice. It gives the nation flexibility and numerous options. It does not rule out nuclear attack. Even if the President were to decide it is inappropriate, any adversary would have to consider it. Additionally, the response in kind to the loss of billions in investments and unique capabilities could force a potential enemy to truly consider what he has of equal value. The cost equal to what an enemy has inflicted on space assets and the risk of nuclear attack may make the attack in space simply not worth while. That nation could lose more in terms of value, such as lives, than what they achieved with the attack in space.

Armed with such a statement, an attack plan that supports it must be developed to make it functional. The U.S. cannot truly hope to respond exactly "in kind" because it will very likely be unachievable. An attack in space is an unlikely option. It is doubtful a nation attacking space in this manner has any resources of their own that are assailable and only more damage of U.S. and allied systems would result. The U.S. must also accept the fact that any punitive attack may kill more people than the nuclear attack in space. The attack should remain in actuality a conventional attack of overwhelming proportion on the adversary's infrastructure and economic base. This form of retaliation would likely be more palatable to U.S. and world opinion.

One of the problems that challenged the leadership at the AAN WWG was the of a preplanned response to an attack in space.[137] Formulating a response once assets are being attacked is too late. The attack plan must be detailed and previously established so it can be implemented immediately to deter further attack with nuclear weapons in space.

Recent statements of the use of overwhelming force have proven successful in convincing certain irrational world actors to comply with United Nations (UN) and U.S. directed actions. The recent threat of force has apparently convinced Iraq to comply with UN arms inspection teams. This is more a form of compellence, which convinces an adversary to undo some action that deterrence may have failed to prevent.[138] However, it is an excellent example of the effect of an unspecified threat of overwhelming force which makes the belligerent second guess the value of his own actions. The fear of a U.S. response is what must be achieved in any statement formulated by the U.S. to deter such an attack in space.

Ideally, a combination of all the measures proposed would be the most effective means to address the dilemma such an attack presents. Figure 11 depicts an area of risk removed through fear of retaliation, and the reducing affect on the area as the cost/loss is reduced through programs, which devalue the attack and make it less likely despite the spread of nuclear weapons. Risk is reduced to the area defined by x''' and y'''. In this situation, the retaliatory deterrence function removes a large portion of risk immediately. Despite the number of nations capable of such an attack, and regardless of how lucrative the target, there will be nations that will not find the resolve to risk the U.S. response. This

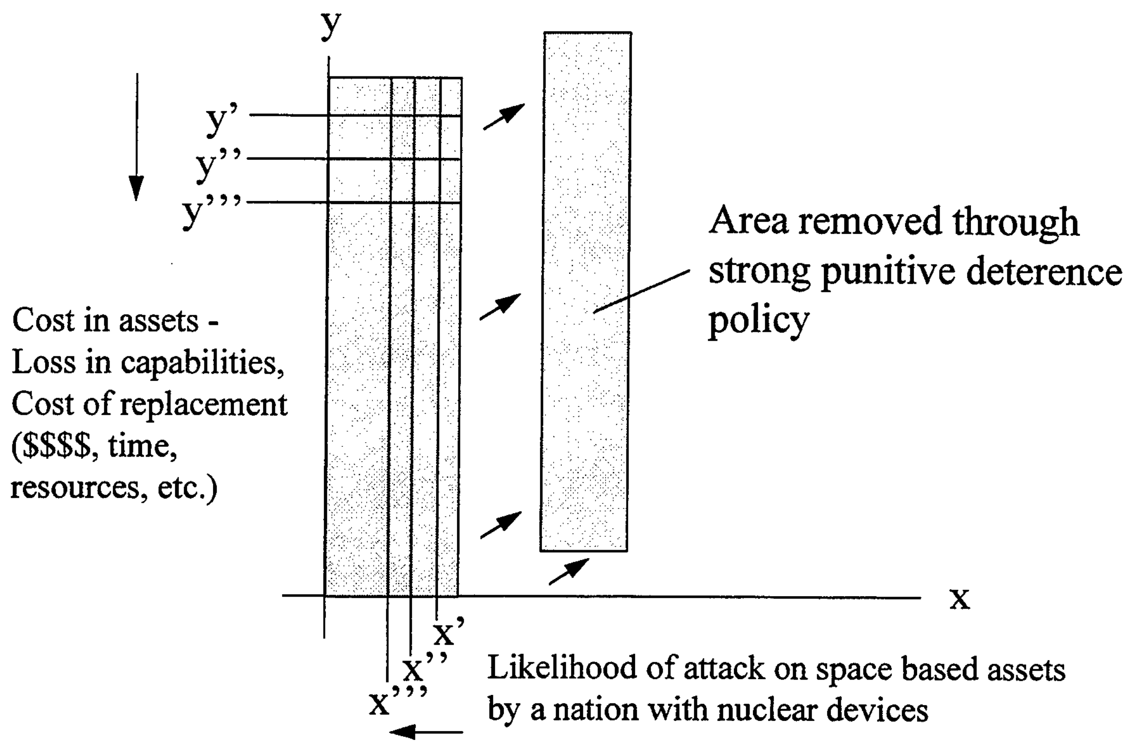


Figure 11. Manging Risk: Combining Effects

leaves a smaller area of risk to be managed through programs. Once again, reducing the y-axis, little by little, pulls back the x-axis for the countries who may believe the deterrence policy is merely rhetoric, the value of the attack itself may not warrant the cost of the nuclear device. These nations that disregard the deterrence policy may find that world response and escalation into the situation that prompted the attack in the first place, simply not worth the headaches that would be associated with such an outcome. This deterrence would be very different than the current nuclear deterrence policy employed today which will not deter this type of attack. The factors surrounding this form of attack simply do not fit the mold of what the nation has planned for with regard to nuclear attack.

So far reaching is an attack on U.S. space-based assets by nuclear weapons that it cannot be ignored. Current strategy identifies the importance of space as a national interest, in fact all of the words are sound and good. However, the gaps in strategy and policy, specifically in programming defenses and functional space control leave the U.S. in a vulnerable position. The nation needs to take the actions proposed to support stated policies. Furthermore, it must employ the current technology that will limit the impact of such an attack while setting forth on a program to develop new technology to ensure this attack does not happen.

---

[1] President William J. Clinton, A National Security Strategy for a New Century (Washington, DC: The White House, May 1997), 14.

[2] Ibid., 14.

[3] General John M. Shalikashvili, Shape, Response, Prepare Now--A Military Strategy for a New Era (Washington, DC: Office of the Chairman, Joint Chiefs of Staff, 1997), 2.

[4] Ibid.,14.

[5] Ibid., 15.

[6] John M. Collins, Military Space Forces: The Next 50 Years (Washington, DC: Pergamen-Brassey's International Defense Publishers, Inc., 1989), 31.

[7] General Howell W. Estes III, United States Space Command Vision for 2020 (Colorado Springs: Office of the Commander in Chief, U.S. Space Command, February, 1997), 6.

[8] Dr. Steven D. Harrison, Senior Priciple Member, Technical Staff at Litton-TASC, Advisor to Deputy Under Secretary of Defense (Space), Telephonic interview by author, Fort Leavenworth, KS, February 9. 1998.

[9] Confirmed by a knowledgeable source on a not-for-attribution basis, Interview by Author, Fort Leavenworth, KS, March 1998.

[10] Ibid.

[11] Collin S. Gray, Nuclear Strategy and National Style (Lanham: Hamilton Press, 1986), 273.

[12] Shalikashvili, 27.

[13] Ibid., 9.

[14] Ibid., 10.

[15] President William J. Clinton, National Space Policy (Washington DC: The White House, September 1996), 4.

[16] Ibid.,

[17] Ibid.

[18] Ibid., 5.

[19] Department of the Army, U.S. Army Command and General Staff College, U.S. Army Space Reference Text (Fort Leavenworth: U.S. Army Command and General Staff College, January, 1995), 8-1.

[20] Ibid.

[21] Ibid., 8-2.

[22] Robert V. Davis, Department of Defense Space Program, An Executive Overview for FY 1998-2003 (Washington, DC: Office of the Deputy Under Secretary of Defense (Space), March 1997), 8.

[23] Ibid.

[24] Space Control Briefing (Unclassified), Space Control Division, United States Space Command, Peterson Air Force Base, Colorado Springs, 24 April 1998, 4.

[25] Ibid., 9.

[26] Ibid.

[27] Ibid., 3.

[28] U.S. Army Space Reference Text, 7-71.

[29] Ibid.

[30] Ibid.,7-74.

[31] Davis, 8.

[32] R. C. Webb, Les Palkuti, Lt. Col. Glenn Kweder, and Al Constantine, "The Commercial and Military Satellite Survivability Crisis," Defense Electronics 20, no. 8 (August, 1995), 28.

[33] Davis, 24.

[34] Ibid.

[35] U.S. Army Space Reference Text, 7-1.

[36] R. C. Webb, The Effects Of A Nuclear Detonation In Space: Briefing to U.S. Army Space Command, Electronics Technology Division, Defense Special Weapons Agency, Alexandria, Virginia, 9 April 1998, 41.

[37] United States Space Command, Space: The New High Ground, (United States Space Command, System Technology Associates, 1998), Video Cassette.

[38] Ibid.

[39] U.S. Army Space Reference Text, 5-21.

[40] Ibid.

[41]Ibid., 7-35.

[42] Harrison, Interview, 9 February 1998.

[43] Major Anothony J. Russo, Chief, Space Control Division, USSPACECOM, Telephonic interview by author, 14 April 1998.

[44] Ibid.

[45] Ibid.

[46] Ibid.

[47] Ibid.

[48] U.S. Army Space Reference Text, 7-11.

[49] Russo, Inteview, 14 April 1998.

[50] Davis, 8.

[51] U.S. Army Space Reference Text, 7-11 - 7-12.

[52] Ibid., 3-7.

[53] Ibid.

[54] Ibid.

[55] Maj Jeffrey L. Caton, "Joint Warfare and Military Dependence on Space" Joint Force Quarterly, winter 1995-1996, 50.

[56] Ibid.

[57] Space Control Briefing (Unclassified), 16.

[58] Davis, 8.

[59] U.S. Army Space Reference Text, 8-2.

[60] Ibid., 8-1.

[61] Russo, Interview, 14 April 1998.

[62] Ibid..

[63] Ibid..

[64] John Donnelly, "Secret Results of Controversial Test Revealed: Laser of 30 Watts Blinded Satellite 300 Miles High," Defense Week, 8 December 1997, 1.

[65] Ibid.

[66] General Howell M. Estes III, CINC Testimony to Congress, [online] Available http://www.SPACECOM.AF.MIL.USSPACE/, March 11, 1998, p. 4-5.

[67] Dr. Steven D. Harrison, Senior Priciple Member, Technical Staff at Litton-TASC, Advisor to Deputy Under Secretary of Defense (Space), Telephonic by author, Fort Leavenworth, KS, April 29, 1998.

[68] See chapter one, 9-11.

[69] Webb, 56.

[70] Webb, Palkuti, Lt. Kweder, and Constantine, 28.

[71] Webb, 56.

[72] Webb, 41.

[73] Webb, Palkuti, Cohn, Kweder, Constantine, 28.

[74] Ibid.

[75] Webb, 41.

[76] Ibid., 45.

[77] Webb, Palkuti, Cohn, Kweder, and Constantine, 28.

[78] Ibid.

[79] Ibid.

[80] Caton, 52.

[81] Webb, Palkuti, Cohn, Kweder, and Constantine, 29.

[82] Caton, 52.

[83] Webb, Palkuti, Cohn, Kweder, and Constantine, 26.

[84] Al Constantine, Defense Special Weapons Agency, Telephonic interview by author, Lansing, KS, 28 April 1998.

[85] Caton, 52.

[86] Webb, Palkuti, Cohn, Kweder, andConstantine, 29.

[87] Webb, 56.

[88] Davis, 24.

[89] Major John Mochowski, Command Lead, Evolved Expendable Launch Vehicle (EELV) System, Air Force Space Command, Telephonic interview by author, Lansing, KS, 29 April 1998.

[90] Harrison, Interview, 9 February 1998.

[91] Harrison, Interview, April 29, 1998.

[92] General Howell M. Estes, III, Air Force Space Command Operational Document (ORD) II, AFSPC 002-93-II, for the Evolved Expendable Launch Vehicle (EELV) System, D-9.

[93] Mochowski, Inteview, 29 April 1998.

[94] Ibid.

[95] Estes, Air Force Space Command Operational Document (ORD) II, AFSPC 002-93-II, D-9.

[96] Ibid.

[97] Mochowski, Interview, 29 April 1998.

[98] Estes, Air Force Space Command Operational Document (ORD) II, AFSPC 002-93-II, 23.

[99] Ibid., D-9.

[100] Russo, Interview, 30 April 1998.

[101] Russo, Interview, 14 April 1998.

[102] Harrison, Interview, 29 April 1998.

[103] Ibid.

[104] Ibid.

[105] Ibid.

[106] Department of Defense Space Architect Office, Launch on Demand (LOD) Study, Alexandria, VA, 1 May 1998, 11.

[107] Harrison, Interview, 29 April 1998.

[108] Ibid.

[109] Ibid.

[110] See pages 75-76

[111] Paul B. Starres, The Militarization of Space: U.S. Policy, 1945-1984 (Ithaca: Cornell University Press, 1984), 240.

[112] Caton, 48.

[113] Starres, 169-170.

[114] Paul B. Starres, Space and National Security (Washington, DC: The Brookings Institutuion, 1987), 46.

[115] Caton, 48.

[116] Ibid.

[117] Ibid.

[118] Starres, Space and National Security, 47.

[119] Russo, Interview, 14 April 1998.

[120] BG (R) Huba Wass de Czege, Telephonic interview by author, Lansing, KS, 10 May 1998.

[121] Caton, 53.

[122] Dean Wilkening, Kenneth Watman, Nuclear Deterrence in a Regional Context (Santa Monica: Rand, 1995), 9.

[123] Stephen J. Cimbala, Military Persuasion, Deterrence and Provocation in Crisis and War (University Park: The Pennsylvania State University Press, 1994), 200.

[124] See page 55.

[125] PDD/NSC 60 Nuclear Weapons Employment Policy Guideance November 1997 [Online] Available http://www.fas.org/irp/offdocs/pdd60.htm.

[126] Ibid.

[127] Ibid.

[128] Ibid.

[129] A Policy Change Undone, U.S. Says Nuclear Threat Not Needed [Online] Available http://www.newsday.com/mainnews/rnmi02ln.htm, 1-2.

[130] Ibid.

[131] Ibid., 1.

[132] Ibid., 2.

[133] Ibid., 3.

[134] Ibid., 1.

[135] Ibid.

[136] Ibid.

[137] Harry Looney, U.S. Army Space and Strategic Defense Command Representative and Player, Army After Next Winter Wargame, Telephonic interview by author, Tinton Falls, NJ, 21 December 1998.

[138] Stephen J, Cimbala Strategy After Deterrence (New York: Praeger, 1991), p. 77.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

Currently the U.S. is unprepared to prevent a nuclear attack on its space-based assets, and it is unable to limit the effects should such an attack occur. Based on the factors explored in this thesis, this is the reality the nation faces placing it in a precarious position. The fact is that any nation possessing a SCUD or NODONG missile, or acquires one in the near future can conduct such an attack once it also possesses a nuclear warhead.

The gaps in U.S. strategy and policy leave the door ajar for nations to achieve success in such an attack. Despite recognizing and stating that its space and information systems must be protected and that space must be controlled, the nation cannot currently fully achieve these goals. An admission that certain asymmetrical attacks cannot be prevented, as well as an ineffective nuclear deterrence policy incapable of preventing this form of attack, place the U.S. in a vulnerable position which it must correct immediately.

The best that the nation can achieve in this situation is to attempt to deter such an attack through making it less worthwhile to potential enemies. There are several means by which this can be achieved. The first is reducing the reliance that is continuing to grow on the space-based platforms currently employed by the nation. Hardening future assets placed into orbit to negate the effects of a nuclear device detonated in space is another means to limit the effects and value of such an attack. To complement the methods already mentioned, the nation should embark on a flexible program which allows the nation to launch on demand hardened replacement satellites which along with the required transport systems, have been stockpiled to respond to contingencies such as an attack of this nature would present.

The nation also needs to develop a punitive response to any attack on its space-based assets. This may be the most economical and timely measure to employ in combating this threat. Many of the means the nation employs to deter the actions of state actors may serve to deter many from considering the option of attacking U.S. assets in space. It certainly does not require additional budgeting to develop such an attack plan, although no simple task, it merely needs to be made a priority and done. This could be developed must faster than any of the other proposed methods to deter a nuclear attack in space. A retaliatory attack of any nature must be clearly articulated to the target audiences, appropriate in nature, legitimate, and well publicized to ensure the world understands U.S. intent on protecting its assets in space. Additionally, it must remain flexible in nature to present the proper element of fear to the nations it is directed at. High value targets may differ from nation to nation, if they perceive a response far more damaging to their unique nation, or interests, deterrence may be achieved by this attack plan in and of itself.

Unfortunately, these factors were not fully explored in the AAN WWG. Although the game is worthy of praise for demonstrating the attack at all, it fell short in several areas. Despite displaying an attack that is technically feasible, it did so in a scenario which is quite unlikely for several reasons. The first is that the country that conducted the attack would not be so likely to destroy its own assets. Although the attempt to level the playing field in information operations may make sense, the other effects, such as EMP directed towards the earth, would have wreaked havoc on the infrastructure it was attempting to gain into its sphere of control. Here the cost does not seem as reasonable to that nation. However, lesser developed nations in regions with limited infrastructure may find it very reasonable. Additionally, the launching of such a large number of weapons would surely place U.S. strategic forces on alert and the attack could have easily been misinterpreted as an attack against the U.S.. It is unlikely a nation would place itself at such risk to achieve effects in space. A limited attack in space is far more likely, and still achieves disastrous effects with very few weapons. Due to this unlikely scenario, many dismissed this attack as something a potential enemy would never do.[1] This is unfortunate from the standpoint that valid lessons of such an attack may have gone unrealized to several of the players of the game.

The AAN WWG also failed to play out the attack to its end result, thus the full effects of such an attack (even with only one warhead) were not realized. Although the attack confounded the leadership present and forced many questions with regarsd to the attack, key lessons were missed. An attack such as this would not have only affected only U.S. assets in space, but all assets in the affected region space, and over time as additional satellites orbitted through the area. The responses of other nations employing space assets were not considered. The fact that U.S. assets (as well as others) that were nowhere near the blast would also be affect over time was not reinforced because the game did not play days past the attack. These were missed opportunities to educate the assembled leaders present of the full ramifications of such an attack. This unfortunate circumstance must not be repeated again in future wargames.

Future wargames employing this form of attack must be better planned with regard to the likelihood of such an attack, the scenario in which it is probable, and remain consistent with the technical challenges it would present. The Army and DoD should continue to explore the outcomes in future wargames, however, a more realistic approach needs to be employed. Otherwise, it is likely that it will be dismissed or the wrong lessons will be reinforced to the players and possibly the post game analysis.

The nation must continue to study the ramifications of such an attack. It must reevaluate its strategies, policies, and programs which can possibly deter it, or at a minimum, limit the effects. Future technology should be explored, it may hold the key to total prevention of such an attack. However, until that technology becomes a reality and is employed operationally, the proposals presented in this thesis must be given full consideration.

As Donald R. Baucom presents in his essay Clausewitz on Space War, An Essay on the Strategic Aspects of Military Operations in Space, the nation can fully expect the ideas of Clausewitz to migrate to space as they have been associated with all warfare conducted on land.[2] Friction and unpredictability will certainly appear wherever man fights, space will certainly be no different. BG(R) Huba Wass De Czege has noted that "Protecting space will become as important to the U.S. as protecting its industrial base was during the Second World War."[3] The last thing that is in the interest of the U.S. is to have to shoulder the burden and cost of replacing an existing space architecture that is measurable by no other nation. Unless the realities of the possibilities presented in this thesis are fully addressed, the future may find the nation facing those unfortunate circumstances.

---

[1] Harry Looney, U.S. Army Space and Strategic Defense Command, Player, Army After Next Winter Wargame, Telephonic interview by author, Tinton Falls, NJ, 21 December 1997.

[2] Donald R. Baucom, Clausewitz on Space War, An Essay on the Strategic Aspects of Military Operations in Space (Maxwell Air Force Base: Air University Press, 1992), 10.

[3] Brigadier General (R) Huba Wass de Czege, Telephonic interview by author, Lansing, KS, 10 May 1998.

BIBLIOGRAPHY

Books

Arquilla, John, and and Paul K.Davis. Extended Deterrence, Compellance and the "Old World Order." Santa Monica: The Rand Corporation, 1992.

Baucom, Donald R. Clauswitz on Space War An Essay on the Strategic Aspects of Military Operations in Space. Maxwell Air Force Base: Air University Press, 1992.

Blow, Tom. Defending against a Space Blockade. Maxwell Air Force Base: Air University Press, 1989.

Bobbitt, Philip. Democracy and Deterrence The History and future of Nuclear Strategy. New York: St. Martin's Press, 1988.

Blechman, Barry M., and Victor A.Utgoff. "The Macroeconomics" of Strategic Defenses" in The Strategic Defense Initiative Shield or Snare. Edited by Harold Brown. Boulder: Westview Press, 1987.

Bobbitt, Philip. Democracy and Deterrence: The History and Future of Nuclear Strategy. New York: St. Martin's Press, 1988.

Bodie, William C., and Joyce E. Larson. The Intelligent Layperson's Guide to "Star Wars." New York: National Strategy Information Center, Inc., 1986.

Bruce, James T., III, and Douglas C. Cook. The Strategic Defense Initiative, Progress and Challenges: A guide to Issues and References. Claremont: Regina Books, 1987.

Catudal, Honore M. Nuclear Deterrence--Does it Deter? New Jersey: Humanities Press International, Inc., 1986.

Cimbala, Stephen J. Nuclear War and Nuclear Strategy Unfinished Business. New York: Greenwood Press, 1987.

_________. Challenges to Deterrence Resources, Technology, and Policy. New York: Praeger Publishers, 1987.

_________. First Strike Stability, Deterrence After Containment. New York: Greenwood Press, 1990.

_________. Military Persuasion, Deterrence and Provocation in Crisis and War. University Park: The Pennsylvania State University Press, 1994.

_________. Strategy After Deterrence. New York: Praeger Publishers, 1991.

Collins, John M. Military Space Forces: The Next 50 Years. Washington: Pergamon-Brassey's International Defense Publishers, Inc., 1989.

Fawcett, J. E. S. Outer Space New Challenges to Law and Policy. Oxford: Clarendon Press, 1984.

Goldberg, Andrew C. Securing Strategic Stability. Washington, DC: The Center For Strategic and International Studies, 1988.

Grabbe, Crocket L. Space Weapons and the Strategic Defense Initiative. Ames: Iowa State University Press, 1991.

Gray, Collin S. Nuclear Strategy and National Style. Lanham: Hamilton Press, 1986.

Hardin, Russell. Nuclear Deterrence Ethics and Strategy. Chicago: The University of Chicago Press, 1985.

Huth, Paul K. Extended Deterrence and the Prevention of War. New Haven: Yale University Press, 1988.

Johnson, Dana J. Trends in Space Control Capabilities and Ballistic Missile Threats, Implications for ASAT Arms Control. Santa Monica: The Rand Corporation, 1990.

Joseph, Robert G., and John F. Reichart. Deterrence and Defense in a Nuclear, Biological, and Chemical Environment. Washington, DC: National Defense University Press, 1996.

May, Michael M. "Safeguarding Our Space Assets." in Seeking Stability in Space: Anti-Satellite Weapons and the Emerging Space Regime. Edited by Joseph S. Nye Jr. and James A. Schear, 71-85. Lanham: University Press of America Inc., 1987.

O'Hanlon, Michael. Defense Planning for the Late 1990s: Beyond the Desert Storm Framework. Washington, DC: The Brookings Institute, 1995.

Spector, Leonard S., Mark G. McDonough, and Evan Medeiros. Tracking Nuclear Proliferation: A Guide in Maps and Charts, 1995. Washinton, DC: Carnegie Endowment for International Peace, 1995.

Stares, Paul B. The Militarization of Space U. S. Policy, 1945-1984. Ithaca: Cornell University Press, 1985.

_________. Space and National Security. Washington, DC: The Brookings Institute, 1987.

Turabian, Kate L. A Manual for Writers of Term Papers, Theses, and Dissertations. 6th Ed. Chicago: The University of Chicago Press, 1996.

Wilkening, Dean, and Kenneth Watman. Nuclear Deterrence in a Regional Context. Santa Monica: The Rand Corporation, 1995.

White, Irvin L. Decision Making for Space: Law and Politics in Air, Sea, and Outer Space. West Lafayette: Purdue University Studies, 1970.

Periodicals

Caton, Jeffrey L., Major. "Joint Warfare and Military Dependence on Space." Joint Forces Quarterly (winter 1995-1996): 48-54.

Donnelly, John. "Secret Results of Controversial Test Revealed: Laser Of 30 Watts Blinded Satellite 300 Miles High." Defense Week, 8 December 1997, 1.

Lockwood, Jonathan, Dr. "Lessons of the Winter Wargame." Army Times, 10 March 1997, 54.

Webb, R. C., Les Palkuti, Lieutenant Colonel Glenn Kewder, and Al Constantine. "The Commercial and Military Satellite Survivability Crisis" Defense Electronics 20, no. 8 (August 1995): 26-30.

Government Documents

Clinton, William J., President. A National Security Strategy for a New Century. Washington, DC, The White House, May 1997.

_________. National Space Policy. Washington, DC, The White House

Davis, Robert V. Department of Defense Space Program, An Executive Overview for FY 1998-2003. Washington, DC: Office of the Deputy Under Secretary of Defense (Space), 1997.

Davis, Ted. "Concepts of National Security and Elements of National Power." Joint and Multinational Operations Course, U. S. Army Command and General Staff College, Fort Leavenworth, KS, 1997.

_________. "Evaluating National SecurityStrategy and National Military Strategy." Joint and Multinational Operations Course, U. S. Army Command and General Staff College, Fort Leavenworth, KS, 1997.

Department of Defense Space Architect Office, Launch on Demand (LOD) Study. Alexandria: Department of Defense Space Architect Office, 1998.

Department of the Army. U.S. Army Space Refererence Text. Fort Leavenworth: U.S. Army Command and General Staff College, 1995.

_________. U.S. Army FM 100-6, Information Operations. Washington, DC: Department of the Army, 1996.

Estes, Howell M. III, General, Air Force Space Command Operational Document (ORD) II, AFSPC 002-93-II, for the Evolved Expendable Launch Vehicle (EELV) System, Peterson Air Force Base: U.S. Air Force Space Command, 1998.

_________. United States Space Command Vision for 2020. Colorado Springs: Office of the Commander in Chief, U.S. Space Command, 1997.

Kirin, Stephen J., Colonel, Margaret A. Frazier, Michael C. Ingram, David L. Fuller, Dorothy J. Burns and Rumiko Dodson. Army After Next Integrated Analysis Report. Fort Leavenworth: U.S. Army Training and Doctrine Command Analysis Center, 1997.

Shalikashvili, John M., General. Shape, Response, Prepare Now--A Military Strategy for a New Era. Washington, DC: Office of the Chairman, Joint Chiefs of Staff, 1997.

_________. Joint Vision 2010. Washington, DC: Office of the Chairman, Joint Chiefs of Staff, 1997.

U.S. Space Command. "Space Control Briefing (Unclassified)." Peterson Air Force Base: Space Control Division, United States Space Command, 1998.

Webb, R. C. The Effects Of A Nuclear Detonation In Space: Briefing to U.S. Army Space Command. Alexandria: Electronics Technology Division, Defense Special Weapons Agency, 9 April 98.

Interviews

Constantine, Al, Defense Special Weapons Agency. Interview by author, 28 April 1998, Lansing.

Harrison, Steven, Senior Priciple Member, Technical Staff at Litton-TASC, Advisor to Deputy Undersecretary of Defense (Space). Interview by author, 9 February 1997, 29 April 1998, Ft. Leavenworth.

Looney, Harry, U.S. Army Space and Strategic Defense Command Representative and Player, Army After Next Winter Wargame. Interview by author, 21 December 1997, Tinton Falls.

Mochowski, John, Major, Command Lead, Evolved Expendable Launch Vehicle (EELV) System, Air Force Space Command. Interview by author, 29 April 1998, Lansing.

Russo, Anthony J., Major, Chief, Space Control Division, USSPACECOM. Interview by author, 14 April 1998, 30 April 1998, Lansing.

Wass de Czege, Huba, Brigadier General (R). Interview by author, 10 May 1998, Lansing.

Electronic Documents

A Policy Change Undone, U.S. Says Nuclear Threat Not Needed. On-line. Available from http://www.newsday.com/mainnews/rnmi02ln.htm.

Estes, Howell M. III, General, CINC Testimony to Congress. On-line. Available from http://www.SPACECOM.AF.MIL.USSPACE/TESTIM98.htm, 1998.

PDD/NSC 60 Nuclear Weapons Employment Policy Guidance November 1997. On-line. Available from http://www.fas.org/irp/offdocs/pdd60.htm.

Films

United States Space Command. Space: The Ultimate High Ground. United States Space Command, System Technology Associates, 1998, Video Cassette.

INITIAL DISTRIBUTION LIST

1. Combined Arms Research Library
U.S. Army Command and General Staff College
250 Gibbon Ave.
Fort Leavenworth, KS 66027-2314

2. Defense Technical Information Center/OCA
8725 John J. Kingman Rd., Suite 944
Fort Belvoir, VA 22060-6218

3. LTC Deborah D. Gregoire
Department of Joint and Multinational Operations
USACGSC
1 Reynolds Ave.
Fort Leavenwoth, KS 66027-1352

4. LTC John M. Rogers
1380 Strawberry Lane
Lexington, KY 40502-2719

5. LTC(R) James R. Daron, Jr.
5703 Lakecrest Dr.
Shawnee, KS 66218

6. Maj Randall Buddish
Department of Joint and Multinational Operations
USACGSC
1 Reynolds Ave.
Fort Leavenwoth, KS 66027-1352

7. Air University Library
Maxwell Air Force Base, AL 36112

8. Naval War College Library
Hewitt Hall
U.S. Navy War College
Newport, RI 02841-5010

9. Marine Corps Staff College
   Breckenridge Library
   MCCDC
   Quantico, VA 22134

10. Commander
    USASMDC
    1941 Jefferson Davis Hwy., Suite 900
    Arlington, VA 22015

11. COL Jimmy Slade
    USASMDC
    1941 Jefferson Davis Hwy., Suite 900
    Arlington, VA 22015

12. MAJ Kirk H. Nilsson
    2085 Palisade Blvd.
    DuPont, WA 98327

13. MAJ Eric J. Wesley
    802 Wesminster Court
    Hinesville, GA 31313

14. Maj. William H. Mott V
    2020 Snyder
    Colorado Springs, CO 80918

15. MAJ Cedric O. Carroll
    4728 Dorsey Hall Dr., 802
    Ellicott City, MD 21042

16. LTC Michael Bradley
    USASMDC
    1941 Jefferson Davis Hwy., Suite 900
    Arlington, VA 22015

17. Mr. Harry Looney
    USASMDC
    1941 Jefferson Davis Hwy., Suite 900
    Arlington, VA 22015

18. Mr. George Jacques
USASMDC
1941 Jefferson Davis Hwy., Suite 900
Arlington, VA 22015

19. MAJ David B.Troilet
616 Meadowlark Rd.
Lansing, KS 66043

20. MAJ Sharon R. Hamilton
13342 E. Asbury Dr.
Aurora, CO 80014

21. MAJ Gary R. Hisle
601 Totem Trail
Harker Heights, TX 76548

22. Ms. Erin Shea
5916 Founders Hill Dr., 304
Alexandria, VA 22310

23. LTG Edward G. Anderson III
Quarters 10, 2nd Ave
Fort McNair, DC 20024-5123

24. Mr. and Mrs. A. R. Sliwa
31 Canterbury Lane
Tinton Falls, NJ 07724

STATEMENT A: Approved for public release; distribution is unlimited. (Documents with this statement may be made available or sold to the general public and foreign nationals).

STATEMENT B: Distribution authorized to U.S. Government agencies only (insert reason and date ON REVERSE OF THIS FORM). Currently used reasons for imposing this statement include the following:

1. Foreign Government Information. Protection of foreign information.

2. Proprietary Information. Protection of proprietary information not owned by the U.S. Government.

3. Critical Technology. Protection and control of critical technology including technical data with potential military application.

4. Test and Evaluation. Protection of test and evaluation of commercial production or military hardware.

5. Contractor Performance Evaluation. Protection of information involving contractor performance evaluation.

6. Premature Dissemination. Protection of information involving systems or hardware from premature dissemination.

7. Administrative/Operational Use. Protection of information restricted to official use or for administrative or operational purposes.

8. Software Documentation. Protection of software documentation - release only in accordance with the provisions of DoD Instruction 7930.2.

9. Specific Authority. Protection of information required by a specific authority.

10. Direct Military Support. To protect export-controlled technical data of such military significance that release for purposes other than direct support of DoD-approved activities may jeopardize a U.S. military advantage.

STATEMENT C: Distribution authorized to U.S. Government agencies and their contractors: (REASON AND DATE). Currently most used reasons are 1, 3, 7, 8, and 9 above.

STATEMENT D: Distribution authorized to DoD and U.S. DoD contractors only; (REASON AND DATE). Currently most reasons are 1, 3, 7, 8, and 9 above.

STATEMENT E: Distribution authorized to DoD only; (REASON AND DATE). Currently most used reasons are 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10.

STATEMENT F: Further dissemination only as directed by (controlling DoD office and date), or higher DoD authority. Used when the DoD originator determines that information is subject to special dissemination limitation specified by paragraph 4-505, DoD 5200.1-R.

STATEMENT X: Distribution authorized to U.S. Government agencies and private individuals of enterprises eligible to obtain export-controlled technical data in accordance with DoD Directive 5230.25; (date). Controlling DoD office is (insert).