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Theater ballistic missile defenses: an emerging role for the Navy?

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Theater Ballistic Missile Defenses: An Emerging Role for the Navy?

by

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The end of the Cold War has brought about significant changes in the international and national security environments that present tremendous implications for the US military. The strategic threat of global nuclear war has diminished considerably. While that threat is diminished, an new threat is emerging. Ballistic missile proliferation and related weapons of mass destruction are one of the major threats to stability in the new security environment. Ballistic missile systems are seen as destabilizing weapons that are a threat to regional peace and American vital interests in certain regions. This thesis addresses the possible need for theater ballistic missile defenses in the US Navy as one element of a national strategy to defeat ballistic missiles in future regional conflicts. Specifically, it addresses the naval role for ballistic missile defenses, including an analysis of the present and future threat, an examination of how the missile defenses dovetail into the national security strategy of regional contingencies, and the means by which the defenses can be employed. The issue of the threat involves demonstrating that a threat presently exists and that technological improvements in the future will greatly increase their utility and put many more targets, including US Navy ships, at risk. The issue of the role that missile defenses fill in the national security strategy deals with their contributions to the fundamental pillars of that strategy. The issue of naval roles addresses the missions and tasks that a sea-based system can provide across the spectrum of naval warfare. The means which the defenses can be employed is addressed to demonstrate how the US Navy can be a major contributor using the Aegis construct.

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ABSTRACT

The end of the Cold War has brought about significant changes in the international and national security environments that present tremendous implications for the US military. The strategic threat of global nuclear war has diminished considerably. While that threat is diminished, a new threat is emerging. Ballistic missile proliferation and related weapons of mass destruction are one of the major threats to stability in the new security environment. Ballistic missile systems are seen as destabilizing weapons that are a threat to regional peace and American vital interests in certain regions. This thesis addresses the possible need for theater ballistic missile defenses in the US Navy as one element of a national strategy to defeat ballistic missiles in future regional conflicts. Specifically, it addresses the naval role for ballistic missile defenses, including an analysis of the present and future threat, an examination of how the missile defenses dovetail into the national security strategy of regional contingencies, and the means by which the defenses can be employed. The issue of the threat involves demonstrating that a threat exists and that technological improvements in the future will increase their utility and put more targets, including US Navy ships, at risk. The issue of the role that defenses fill in the national security strategy deals with their contributions to the fundamental pillars of that strategy. The issue of naval roles addresses the missions and tasks that a sea-based system can provide across the spectrum of naval warfare. The means which the defenses can be employed is addressed to demonstrate how the US Navy can be a major contributor using the Aegis construct.

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EXECUTIVE SUMMARY

The end of the Cold War has been the watershed event for changes in the international and national security environments that present tremendous implications for the US military. The strategic threat of global nuclear war has diminished considerably. Yet, while that threat is diminished, a new threat is emerging. In the new international security system, ballistic missile proliferation and related weapons of mass destruction are one of the major threats to stability in the new security environment. Ballistic missile systems are becoming increasingly prominent in Third World arsenals and are seen as destabilizing weapons that are a threat to regional peace and American vital interests in certain regions. This thesis addresses the possible need for theater ballistic missile defenses in the U.S. Navy as one element of a national strategy to defeat ballistic missiles in future regional conflicts. Specifically, it addresses the naval role for theater ballistic missile defenses, including an analysis of the present and future threat, an examination of how missile defenses dovetail into the national security strategy of regional contingencies, and the means by which the defenses can be employed.

The issue of the threat involves demonstrating that a threat presently exists and that the future threat will be even greater. Today, some twenty nations either possess or are in the process of acquiring ballistic missiles. These nations have pursued ballistic missiles for a number of reasons that fall under the categories of military-strategic, political-diplomatic, and economic reasons. The majority of the present generation of ballistic missiles in the Third World are generally conventionally armed warheads that are combined with being relatively inaccurate. However, they can be quite useful for political reasons and

psychological terror and can be effective against large area targets and civilian population centers. In the future the threat from ballistic missiles is likely to grow due to the development and application of technology. The lethality of the systems will grow with the development of nuclear, chemical, biological, and advanced conventional warheads. The range, payload, and overall technical sophistication of ballistic missiles will continue to improve. Additionally, the introduction of terminal guidance on ballistic missiles will provide a dramatic step jump in accuracy to these weapons. These applications will greatly increase their utility and put many more targets, including U.S. Navy ships, at risk.

The issue of the role that theater ballistic missile defenses fill in the national security strategy deals with the contributions defenses can give to deterrence, forward presence, crisis response, and reconstitution. With defenses, the United States would have the capability to defeat enemy ballistic missile attacks against cities, bases, ports, and troops. Ballistic missile defenses can be a part of U.S. peacetime engagement through forward presence, either on land or sea, and by being forward deployed, particularly at sea, they can enhance U.S. crisis response capability. In a crisis, theater ballistic missile defenses could be used to limit escalation, for offense suppression, and for joint task force and ground warfare support. Continued research and development can contribute to the United States maintaining its technological edge over all potential enemies.

The issue of naval roles addresses the missions and tasks that a sea-based theater ballistic missile defense can provide across the spectrum of naval warfare. As just one element of U.S. naval forces, theater ballistic missile defenses can contribute to the operational capabilities needed to successfully execute the new direction of the Navy and Marine Corps. In doing so, they can provide the task

force commander a broad area of mission assignments to which they can be tasked. Working in coordination with land-based systems and space and air assets, the defenses can provide a theater-wide defense against ballistic missile attacks. The advantages of a sea-based system lies in the fact that Navy forces will generally be the first into a crisis region and may have the only on-the-scene ballistic missile defense capability and a sea-based system has the inherent mobility that can let them cover assets that a land-based system cannot.

The means by which the defenses can be employed is addressed to demonstrate how the U.S. Navy can be a major contributor using the Aegis construct. A major part of the infrastructure is already in place with the Aegis Combat System. It is cost effective and lower risk because there are already existing platforms and some existing capability that can be upgraded to provide an effective theater ballistic missile defense system. There are a number of software and hardware upgrades that can be made with existing technology right now that will help improve performance against ballistic missiles. The two most critical items needed to make Aegis an effective, flexible and mobile theater ballistic missile defense platform are external sources of cueing and a defensive warhead with proper guidance and control that can defeat all future ballistic missile threats. Other potential problems are the 1972 ABM Treaty, declining defense budgets, and operational tradeoffs for Aegis operating in ballistic missile defense mode.

I. INTRODUCTION

The Cold War is over and suddenly the United States finds itself facing fundamental questions concerning its role in the new world order. Finding the answers to these questions is made all the more difficult by a domestic environment that is increasingly pressing for change. This pressure is over concerns about the US economy and is manifesting itself by calls for the reaping of a "peace dividend" following the Cold War. The fact that this debate is ongoing during a presidential election year seems to make the pressure even more intense. The outcome of this debate will have serious implications for the national security of the United States and the roles and missions of the US military.

The US military was not immune from economic or political considerations even during the Cold War. Issues related to national defense were common foundations of presidential campaigns, including the supposed "missile gap" during the 1960 campaign and the issue of US military weakness during the 1980 campaign.[1] In those times the common underlying factor was the threat of the Soviet Union and the shadow of Soviet nuclear armed ballistic missiles. The Soviet Union set the boundaries for all debates concerning US national security and military strategies. The military directed its efforts towards the Soviet threat.

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[1]For further discussion of the impact of political campaigns on defense decisions see Desmond Ball, *Politics and Force Levels: The Strategic Missile Program of the Kennedy Administration* (Berkeley: University of California Press, 1980); and Strobe Talbott, *Deadly Gambits: The Reagan Administration and the Stalemate in Nuclear Arms Control* (New York and Toronto: Random House, 1985).

The strategy of containment was clearly necessary during the Cold War.[2] Now that the Cold War is over, the threat from the former Soviet Union has diminished considerably and has led to the current debate on the purpose, roles and missions of the US military establishment.

As is usually the case, when one threat fades away, another threat emerges in its place. In particular, concerns have been raised about the spread of ballistic missiles. The extensive use of ballistic missiles in the "war of the cities" in 1988 during the Iran-Iraq War and the use of Scud missiles by Iraq against Israel and Saudi Arabia during Desert Storm highlighted the rapid proliferation of these weapons, and served as a premonition of worse things to come if and when developing states deploy ballistic missiles armed with weapons of mass destruction. Ballistic missile systems are becoming increasingly prominent in Third World arsenals and are seen as destabilizing weapons that are a threat to regional peace and American vital interests in certain regions. Technological improvements to those arsenals in the areas of accuracy, guidance and range, combined with a variety of warheads will make them a more direct threat to the United States, US forces overseas, its allies, and its vital interests in the not too distant future.

The United States government has reacted to the changing events and threats throughout the world, as well as to the concerns of its people, by proposing a new national security strategy.[3] This strategy recognizes the decline of what

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[2]See National Security Council, *The Report by the Secretaries of State and Defense on United States Objectives and Programs for National Security, April 7, 1950 (NSC-68)* (Washington, D.C.: GPO, 1950); and Mr. X (George F. Kennan), "Sources of Soviet Conduct," *Foreign Affairs* 25 (July 1947): 572-82.

[3]See President, *National Security Strategy of the United States* (Washington, D.C.: GPO, 1991).

remains of the Soviet Union as a threat and recognizes the emergence of new threats and regional crises as the new focus of US national security concerns. It is a strategy that translates militarily into a strategy of regional contingencies.

A litmus test of that strategy was the Gulf War which soon followed. The world watched while a US led coalition showcased its technological and military superiority over a rogue Third World regional power. However, of major concern to the US political and military establishment was Iraq's use of ballistic missiles, especially their possible use with chemical warheads. A major contributing factor in keeping the coalition together, limiting escalation, and protecting civilians and military forces was the Army's Patriot missile defense system in destroying numerous Iraqi Scud missiles over Israel and Saudi Arabia. Therefore, missile defense showed their utility in regional contingencies.

In the Gulf War, the United States had the luxury of host nation support from Israel and Saudi Arabia. It also had four months to produce and position the improved Patriot batteries so they could be used most effectively to defeat the perceived threat and use of Iraqi ballistic missiles. In the next contingency, the United States may not have the use of a host nation or the time to preposition theater missile defenses into the theater on land. That proposition begs the question of what will protect our introductory forces from ballistic missiles in such a regional contingency or our vital interests or allies from ballistic missile attack in an unexpected or rapidly developing crisis? That fundamental question leads to the purpose of this thesis which is to examine the question: Should the United States have theater missile defenses at sea and how can they be employed?

A. SCOPE OF THE STUDY

This thesis will examine the possible need for ballistic missile defenses in the United States Navy. Specifically, it will address the naval role for ballistic missile defenses, including an analysis of the present and future threat, an examination of how the missile defenses dovetail into the national security strategy of regional contingencies and forward presence, and the means by which the defenses can be employed.

The major threat that this thesis will examine is that posed by Third World ballistic missiles.[4] Chemical, biological and nuclear weapons are also examined because of the possibility of putting a warhead of that type on a ballistic missile system. Cruise missiles are not a focus of this thesis but are looked at in the role they can play in causing tradeoffs in the entire air defense package for a platform.[5]

This thesis will also examine the roles that ballistic missile defenses can play in supporting the national security strategy. In particular, the four major pillars of deterrence, forward presence, crisis response and reconstitution, with the emphasis on crisis response. The approach used in this research has been to determine the contributions a ballistic missile defense system adds to the ability of the US armed forces to defend and promote national security interests. Additionally, some potential problems and tradeoffs are examined to determine their possible impact on theater missile defense deployment.

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[4]For the purpose of this thesis the term ballistic missile refers to a self-propelled weapon delivery system that is guided during a portion of its ascent, then follow a ballistic (unguided and unpowered) trajectory over the remainder of the flight. The more advanced missiles may also have terminal guidance to direct the weapon to the target.

[5]Cruise missiles are powered by an air-breathing engine and are generally guided for their entire flight.

A major question that this thesis will attempt to answer is, should the United States have theater missile defenses at sea? It will examine the roles that ballistic missile defenses in the Navy can play in supporting a strategy of regional contingencies. The approach used in this examination has been to determine how the Navy can add to a joint ballistic missile defense effort in future regional contingencies.

The means by which missile defenses can be employed in the Navy will be done within the context of adapting them to the Aegis defense system currently on *Ticonderoga*-class cruisers and *Arleigh Burke*-class destroyers. Specific questions to be studied include: What type of upgrades are required for the radar system? How can external cueing improve the capability for ballistic missile defense? What type of warhead is needed to defeat the variety of warhead threats that are likely to be present in the near future? What are some of the tradeoffs or possible pitfalls that might prohibit defense deployment?

B. METHODOLOGY

The research methodology utilized in this thesis will be to first conduct an examination of the threat, both present and future, that Third World ballistic missiles may pose. The roles that naval ballistic missile defenses can fill in the new national security posture of regional contingencies will then be examined. Finally a study of the feasibility of the defenses and what is needed to employ a missile defense system on current Aegis assets. Thus, this thesis can be seen as one element of the strategic planning process, that theoretically starts with the enunciation of a threat, that leads to the development of a national military strategy, and then progresses to the determination of individual elements of that strategy.

II. NATURE OF THE THREAT

A. PRESENT THREAT

For years, the United States has lived in the shadow of Soviet nuclear armed ballistic missiles. As the Cold War has ended and tensions between the United States and the former Soviet Union have eased, the strategic threat of global nuclear war has diminished considerably. Yet, while that threat is diminishing, a new threat is emerging. In particular, concerns have been raised about the spread of ballistic missile systems and technologies to areas of the world, such as the Middle East, in which there are strong regional tensions. In the past two years attention has become more focused on ballistic missile proliferation due to Iraq's arsenal of ballistic missiles, which it used against Israel and Saudi Arabia during Operation Desert Storm in January and February 1991, and Iran and Iraq's use of ballistic missiles against population centers in the 1988 "War of the Cities".[1] Such missiles can have ranges of a hundred to a few thousand kilometers and can carry payloads of up to one or two thousand kilograms. Ballistic missile systems are becoming increasingly prominent in Third World arsenals and are seen as destabilizing weapons that are a threat to regional peace and American vital interests in certain regions.

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[1]For additional discussion of the "War of the Cities", see Thomas L. McNaugher, "Ballistic Missiles and Chemical Weapons: The Legacy of the Iran-Iraq War," *International Security* 15 (Fall 1990), 5-34; and Robert D. Shuey et al., "Missile Proliferation: Survey of Emerging Missile Forces," *Congressional Research Service Report* (3 October 1988), 1-2.

1. Present Extent

Although used initially in World War II, ballistic missiles have spread relatively slowly to states other than the major powers. In the 1960s there were reports that Egypt had developed liquid-propellant rockets. The spread gradually increased and by 1980 India had launched an earth satellite.[2] By that time, it appeared that several developing countries had acquired the technologies needed to build modern guided rockets.[3] The disclosure of the purchase by Saudi Arabia of Chinese medium-range ballistic missiles in 1988, and the "war of the cities" focused attention on the extent of proliferation to the developing world.[4]

Already some twenty Third World countries either possess ballistic missiles or are in the process of acquiring them. Table 1 contains a list of developing countries, missiles, ranges and accuracy.[5] Former Central Intelligence Agency (CIA) Director William Webster has predicted that at least

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[2]John Harvey et al., *Assessing Ballistic Missile Proliferation and its Control*, Center for International Security and Arms Control Stanford University (Stanford, CA: Stanford University Press, 1991), 13.

[3]The technologies used to develop and manufacture ballistic missiles for delivering warheads, and space-launch vehicles for launching satellites and lifting astronauts into orbit, are often one and the same. The early Atlas ICBM also served as the booster that carried John Glenn into orbit.

[4]A short-range ballistic missile (SRBM) is defined as a ballistic missile with a maximum range of 1,000 km or less, a medium-range ballistic missile (MRBM) is one with a range between 1,000-3,000 km's, an intermediate-range ballistic missile (IRBM) has a range of between 3,000-5,500 km's, and an intercontinental ballistic missile (ICBM) has a range of 5,500 km or greater.

[5]Table derived from multiple sources including Arms Control and Disarmament Agency, "Ballistic Missile Proliferation in the Developing World," *World Military Expenditures and Arms Transfers 1988; The World's Missile Systems*, (August 1988); "The Missile Tables," *Strategic Policy* 19 (March 1991); and *Missile Non-Proliferation: Implications for the United States Navy*, Prepared by Science Applications International Corporation for the Defense Nuclear Agency (22 January 1990).

fifteen developing countries will be producing their own ballistic missiles by the year 2000 and that three countries will have missiles with ranges of up to 2,500 miles.[6] In order to develop an idea of the trends in ballistic missile proliferation, an understanding is needed of the motives behind the pursuit of ballistic missiles and their possible utility.

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[6]Congress, Senate, Committee on Governmental Affairs, *Nuclear and Missile Proliferation*, 101st Cong., 1st Sess.; 12-14,26-27. Testimony of William Webster, Director, Central Intelligence Agency. The three countries expected to have missiles with ranges of up to 2,500 miles are Israel, India and Brazil.

TABLE 1. BALLISTIC MISSILES IN THE THIRD WORLD

Country	Missile	Payload (kg)	Range (km)	Accuracy (meters)	Status
Afghanistan	Scud B	500	300	900	Deployed
Algeria	Frog-7	450	70	400	Deployed
Argentina	Condor I	400	100	?	R & D
	Condor II	450	900	900	R & D
Brazil	MB/EE-150	500	150	?	R & D
	MB/EE-350	500	350	?	R & D
	MB/EE-600	?	600	?	R & D
	MB/EE-1000	?	1,000	?	R & D
	SS-300	1,000	300	?	R & D
	SS-1000	?	1,200	?	R & D
Egypt	Frog-7	450	70	400	Deployed
	Sakr 80	200	80	?	Deployed
	Scud B	500	300	900	Deployed
	Improved Scud	1,000	300	900	R & D
	Badr-2000	450	1,000	750	R & D
India	Prithvi	1,000	250	250	Tested 1988
	Agni	900	2,500	?	Tested 1989
Iran	Frog-7	450	70	400	Deployed
	Iran-130	?	130	?	Deployed
	Scud B	500	300	900	Deployed
	Al-Husayn	135	625	500	Deployed
Iraq	Scud B	500	300	900	Deployed
	Al-Husayn	135	625	500	Deployed
	Al-Abbas	500	900	300	Deployed
Israel	Lance	275	130	365	Deployed
	Jericho I	226	625	?	Deployed
	Jericho II	226	1,500	?	Deployed
Libya	SS-21	450	120	300	Deployed
	Scud B	500	300	900	Deployed
	Otrag	?	500	?	R & D
North Korea	Scud B	500	300	900	Deployed
	Scud B PIP	?	600	?	Adv. R & D
North Yemen	SS-21	450	120	300	Deployed
Pakistan	Hatf I	500	80	?	Tested 1989
	Hatf II	500	300	?	Tested 1989
Saudi Arabia	CSS-2	2,000	3,000	2,500	Deployed
South Africa	unknown	?	1,500	?	Tested 1989
South Korea	Honest John	1,600	40	?	Deployed
	Korean SSM	?	260	?	Deployed
South Yemen	SS-21	450	120	300	Deployed
	Scud B	500	300	900	Deployed
Taiwan	Sky Horse	?	1,000	?	R & D
UAE	Scud B	500	300	900	Deployed
Vietnam	Scud B	500	300	900	Deployed

2. Motives

The main question with ballistic missile proliferation is why does a nation develop and acquire missiles when there are other options to deliver payloads? The reasons for such acquisitions appear to fall into three major categories. That is to say, countries acquire or develop ballistic missile systems for military-strategic, political-diplomatic, and economic reasons. All, some, or even one of these reasons can be the rational behind the effort to procure ballistic missile systems.

Under the military-strategic reasoning there are a couple of different variations. The first and most common reason is to increase the offensive capability of a nation. Ballistic missiles provide another means of delivering payload on targets besides aircraft. This will give a nation a spread in their strike capabilities and not have their "eggs all in one basket" in order to have some diversity in delivery capability to hedge against an emerging vulnerability to one or another system. Studies have shown that for normal attrition rates (around 20 percent or less), aircraft are much more effective, militarily and economically, at delivering warheads on target than ballistic missiles.[7] However, there are other factors to consider. For example, if ones opponent has an extensive and highly capable air defense network, which are becoming more prominent in the developing world, then missiles might be a good choice for a strike package so that aircraft are not wasted. The main advantage that ballistic missiles present over delivery via manned aircraft are speed and certainty. Missiles travel several times faster than aircraft, are not

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[7]See Steve Fetter. "Ballistic Missiles and Weapons of Mass Destruction," *International Security* 16 (Summer 1991), 9-11; and Harvey, 25-62.

subject to human fears and errors, and avoid interdiction by most defenses. The proven exception is ballistic missile defense systems such as the Patriot, successfully employed during the Gulf War against Iraqi Scud missiles.

The second major military-strategic reason to pursue ballistic missiles is for deterrence. A strong case can be made that the majority of the Middle Eastern countries have acquired ballistic missiles to deter Israel from a preemptive or first strike against them, as Israel did in destroying Iraq's nuclear reactor in 1983, and to counteract their nuclear capability. The same can be said of Pakistani developments and acquisitions of both ballistic missiles and nuclear weapons with respect to their neighbor India.

Political-diplomatic reasons are other motives behind the acquisition or development of ballistic missiles. First among these is the political and psychological impact that ballistic missiles have. States desire missiles because of their perceived role as psychological weapons of terror that invokes more fear than from aerial bombing. Even when armed with conventional explosives, missile attacks may induce civilian panic out of proportion to the damage or casualties they actually inflict. A case in point is the record of Germany's V-2 strikes on London in 1944. Winston Churchill wrote that Germany's missile war:

> ...imposed upon the people of London a burden perhaps even heavier than the air raids of 1940 and 1941. Suspense and strain were more prolonged. Dawn brought no relief and cloud no comfort. The man going home in the evening never new what he would find.... The blind impersonal nature of the missile made the individual on the ground feel helpless. There was little that he could do, no human enemy that he could see shot down.[8]

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[8]McNaugher, 12. citing Winston S. Churchill, *Triumph and Tragedy*, vol. 6 of *The Second World War* (Boston: Houghton Mifflin, 1953), 39.

Iraq used its ballistic missile forces to such effect in the latter stages of the war with Iran, after the civilian population had grown tired of the fighting, and was believed to be instrumental in bringing about the cease fire. In Tel Aviv and Riyadh during the Gulf war, missile attacks had a psychological and political impact that was very apparent and, arguable more important than the actual physical damage. Who can forget the images of Charles Jaco, television commentator for Cable News Network (CNN), hurriedly putting on his gas mask and frantically running for the bomb shelter when the missile attack sirens went off in Riyadh?

Second among political-diplomatic reasons is that ballistic missiles are symbols of national prestige and technological achievement. In many developing countries the ballistic missile is the symbol of prestige that the battleship, and in recent times, the aircraft carrier holds for major powers. This can be characterized as the "bigger stick syndrome", where the kid on the block with the biggest stick, or in this case the most technologically advanced missiles, wields the most power in the neighborhood. The capability for indigenous manufacture of ballistic missiles calls attention to a state's technical prowess and military self-sufficiency, and suggests a degree of independence from foreign military suppliers and political influence. This further heightens stature. India is an example of a country that prides itself on its technological achievements. They have used their space launch missile program for military defensive purposes and have produced two ballistic missile systems, the Agni and the Prithvi. In addition, some press reports have suggested that India is working on a missile with an estimated

range of 3,000 miles.[9] Janne Nolan puts it succinctly when she states: "India seems to have used its civilian space program to evade international restrictions on the supply of military manufacturing technology and to achieve the international status accorded states with advanced satellite (and missile) capabilities. Demonstrations of its technological prowess, both civilian and military, are part of its broader strategy to challenge the enduring stratification of the international system that it believes has deprived it of its rightful status as a regional superpower."[10]

By acquiring missiles a regime can demonstrate to its citizens a commitment to a strong defense. During wartime, firing missiles against ones enemy may increase domestic morale, regardless of the actual military results of the attack. In the Iran-Iraq War, at one time or another, each side tried to strengthen public resolve by announcing its missile strikes against the adversary's cities.[11]

The final major category under which states pursue ballistic missile technology is for economic reasons. Many states, including China, North Korea, Brazil, Argentina, Egypt, Israel, and South Africa, have pursued, or are pursuing, indigenous missile production capability in order to generate missile export sales.[12] Demand for ballistic missiles is currently high, and

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[9]Janne E. Nolan, *Trappings of Power: Ballistic Missiles in the Third World* (Washington, D.C.: Brookings Institution, 1991), 44.

[10]Ibid., 60.

[11]Harvey, 81.

[12]For an additional discussion of Chinese arms sales, see Eden Y. Woon, "Chinese Arms Sales and U.S.-China Military Relations," *Asian Survey* 24 (June 1989). For an additional discussion of other economic imperatives see Harvey, 81; Nolan, 16-20; and Kathleen C.

their sale can be an excellent source of hard currency flowing into an economically depressed country. In addition, production of missiles, and other sophisticated weapons systems, is a means to promote economic development by enriching and strengthening the national R & D and industrial base. It creates research and manufacturing infrastructures, including facilities for designing, testing, and producing high technology military systems. Such activities strengthen the overall economic base of a nation.

3. Utility

Ballistic missiles possess certain characteristics that have traditionally accorded them special status as military instruments, including their speed and range in striking targets, their ability to penetrate defenses, and their ability to deliver warheads of increasing destructiveness and lethality (particularly nuclear, biological, or chemical warheads).

The high speed of ballistic missiles enables an attacker to strike with little warning and makes it very difficult for the defender to destroy incoming missiles. Because ballistic missiles are unguided for most of their flight, they generally cannot be defeated or diverted with electronic countermeasures. Unlike bomber aircraft, missiles do not place crew members at risk of being killed or captured. The speeds at which ballistic missiles travel imparts considerable energy to the target when they land. The Scud-B travels at three times the speed of sound when it lands, not only exploding unexpended fuel

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Bailey, *Doomsday Weapons in the Hands of Many: The Arms Control Challenge of the 90s* (Urbana and Chicago: University of Illinois Press, 1991), 106-121.

but causing considerable damage with the impact of its two-ton missile fuselage.[13]

More powerful rocket motors can also extend a missile's range. Achieving the ability to launch ballistic missiles to intercontinental range was a critical threshold in the Cold War. It made it possible to target the other side with weapons deployed from within one's own territory. Developing countries also need missiles of sufficient range to target adversaries and to be able to deploy and launch them from secure sites within their own territory. In most regions the importance of range depends more on geography, including the distance between adversaries, the size of the territory being defended or attacked, and the proximity of population centers and key military targets to an adversary's forces.[14]

In the developing world, where many antagonists share a common border, the traditional U.S.-Soviet definitions for short-, intermediate-, and long-range missiles have limited usefulness. In many regions even missile systems classified as short-range (less than 1,000 kilometers) could reach deep into the territory of an adversary. Most third world missiles are also mobile and can be moved closer to an adversary's border and thus increase their effective range. Several countries listed in Table 1 have missiles that can travel several hundred kilometers, and some are developing missiles that will be able to travel over one-thousand kilometers. Countries aiming to achieve longer-range systems can extend their reach outside of their region.

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[13]Nolan, 67.

[14]Ibid., 64.

For example, both Israel and India already have missiles that can reach targets within the southern territory of the former Soviet Union.[15]

Increasing the range of systems, however, does not automatically accord greater military capability. There is currently a tradeoff between a given missile's range and its weight. Iraq reduced the weight of the warhead on its Scud-B missiles as one measure to extend their range. China reduced the range of the missile it sold to Saudi Arabia when it replaced the nuclear warheads with much heavier conventional warheads.[16] Longer missile ranges also place a higher demand on the missiles accuracy.

A missiles accuracy is achieved primarily by its guidance and control systems which are its most sophisticated systems. The farther a ballistic missile travels, the farther off course it will wander for a given degree of inaccuracy in its guidance and control systems. Compared to the current generation of missiles produced in the industrial world, some of which have terminal guidance that gives them an accuracy of a few feet, most models in the third world are relatively inaccurate. Current ballistic missiles in the third world have a Circular Error Probable (CEP) of approximately 300 meters or greater.[17]

The possession of even inaccurate missiles provides the ability to conduct strategic bombardment with the objective of surprise attack, retaliation, or demoralization of an enemy population. To be effective in

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[15]Ibid., 65.

[16]Shuey et al., 9.

[17]See David Rubenson and Anna Slomovic, "The Impact of Missile Proliferation on U.S. Power Projection Capabilities," *A RAND Note* (June 1990), 13; Harvey et al., 26-30; and Nolan, 70-71. Define CEP!

executing a surprise attack that gains a significant military advantage, missiles must pose a danger to the opponent's forces. However, to achieve militarily significant objectives, they must have a warhead and accuracy suitable to the target. To compensate for inaccuracy, a missile can be fired at a large area target, such as a city or military installation, where even an inaccurate missile is likely to hit some portion of the target. Alternatively, inaccuracy can be offset by using a warhead that will destroy or contaminate a large area. A surprise attack against an undefended civilian population is a powerful signal in a crisis, but also an escalation that invites retaliation and possible the intervention of other parties.

Inaccurate missiles seem better suited to a role of retaliation through strikes against population centers. In this way, a disadvantage on the battlefield might be compensated for by escalating hostilities to a level that is unacceptable to the enemy. The resolve of a government can be effectively communicated by a retaliatory strike against a city or economic center. Ballistic missiles have a potential to provide retaliatory deterrence, as the superpowers used them during the Cold War, however, they must possess significantly destructive warheads in order to be perceived as a real threat. They must also have the ability to survive an enemy attack and then penetrate enemy defenses to fulfill the requirements of deterrence.[18]

The use of missiles to demoralize the enemy population is also a possibility. As discussed earlier, missiles used as a weapon of terror for its psychological impact can be quite useful. The German government in 1944,

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[18]William K. Domke, *Missiles and the Proliferation of Mass Destruction*, Lawrence Livermore National Laboratory (Livermore, CA: University of California, March 1989), 13.

which was losing the war on the battlefield, launched rockets at London to demoralize the British population and undermine the government's resolve. The Iraqi government in 1988, while it was winning on the battlefield, launched missiles at Iran to demoralize the Iranian population. Ballistic missiles generate fear in civilian populations and military forces because they strike without much warning, can cause great damage, and absent a dedicated missile defense system, cannot be defended against.

Since the present generation of third world ballistic missiles are relatively inaccurate against anything but large area targets, the ability to deliver destructive warheads is one of the key attributes that makes ballistic missiles militarily significant. As countries acquire more powerful rocket motors, they can deliver larger, more destructive warheads. Many countries have the Scud-B ballistic missile which can carry warheads of up to 500 kilograms. Several of the countries listed in Table 1 have or are developing missiles that carry 1,000-kilogram or greater warheads and the modified CSS-2 missiles Saudi Arabia bought from China are capable of delivering a 2,000-kilogram high-explosive warhead. Most of these missiles were designed for conventional warhead delivery, however, the inefficiency of conventionally armed missiles seems to be well understood by the new missile states, since most of them are actively seeking nuclear, chemical, and biological weapons.[19]

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[19]See John S. McCain, III, "Proliferation in the 1990s: Implications for U.S. Policy and Force Planning," *Strategic Review* 17 (Summer 1989), 11-16; Earl I. Ficken, Jr., *Tactical Missile Defense: A Chink in the Armor?* (Newport, R.I.: Naval War College, 19 June 1992), 8; and Fetter, 6.

Many of the missiles listed are powerful enough to deliver a small nuclear warhead (less than 500 kilograms). A few could even carry a larger nuclear warhead that could be produced by a newer nuclear state. Nearly all the missiles could also be adapted without a great deal of difficulty to deliver chemical or biological warheads. Chemical warheads are becoming easier to acquire and can kill as many people as dozens or even hundreds of conventionally armed missiles if employed in favorable conditions.[20] Even worse, biological warheads that disperse anthrax spores offer the possibility of inflicting casualties on the scale of small nuclear weapons.[21] With chemical, biological, or nuclear warheads the terror becomes very real and the accuracy is not as important.

In this section it has been shown that ballistic missile proliferation is a real and growing threat. There are a variety of reasons for acquiring ballistic missiles and even though their utility presently appears to be limited, many countries are trying to overcome those limitations. One question that should be addressed is what methodology is there in place to deal with this growing threat?

B. MEANS OF CONTROL

There are three major means presently in place or being developed to deal with the growing ballistic missile problem throughout the developing world. These means include arms control, export controls and defenses. The first method in place is that of arms control. One of the roadblocks to

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[20] Fetter, 6.

[21] Ibid.

utilizing weapons of mass destruction is the 1972 Biological Weapons (BW) Convention. This affects the problem indirectly by limiting the type of warhead that can be employed on a ballistic missile. The 1972 BW Convention prohibits the development, production, stockpiling or acquisition by other means, or retention of biological agents or toxins, as well as weapons, equipment or means of delivery designed to use such agents or toxins for hostile purposes or in armed conflict.[22] It should be noted that the prohibitions apply only to types and to quantities of biological agents and toxins that have no justification for prophylactic, protective or other peaceful purposes.[23] A loophole is that "protective purposes" can be used to investigate into the properties of biological and toxin agents in the name of defense. An additional problem with the BW Convention is that there is no real verification provision.

The 1925 Geneva Protocol prohibits the use of chemical and biological weapons in war, but not the production or stockpiling of such weapons. Efforts to ban chemical weapons have been continuing since that time. Presently, negotiations on a Chemical Weapons (CW) Convention are continuing in the multilateral Conference on Disarmament in Geneva.[24] This may develop an international norm with respect to chemical weapons, but some Arab states such as Syria, Egypt, and Iraq appear to use chemical

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[22]Jozef Goldblat, *Arms Control Agreements* (Solna, Sweden: Stockholm International Peace Research, 1982), 47-50.

[23]The term "prophylactic" encompasses medical activities such as diagnosis, therapy, and immunization; while the term "protective" covers development of protective masks and clothing, air and water filtration systems, deflection and warning devices, and decontamination equipment. Goldblat, 47-48.

[24]Fetter, 32.

weapons as the main instrument to offset the Israeli nuclear arsenal. The use of chemical weapons in war by Iraq and the fact that the CW Convention is multilateral will both tend to make it harder to come to a consensus.

Another way presently in place to control ballistic missile proliferation is through export controls. The Australia Group, a loosely knit group of 23 countries including the United States, has for some time limited the export to certain countries of selected equipment and chemicals that can be used in production of chemical agents. The group has identified nine chemicals on its "core list" and forty-one chemicals on its "warning list". These lists are circulate to industry in an effort to control sales.[25] Yet, chemical weapons have spread, with key technologies often slipping through the export controls of U.S. allies.

The basis of U.S. efforts to control proliferation of ballistic missiles is the Missile Technology Control Regime (MTCR). On April 16, 1987, the establishment of the MTCR was announced by the seven major Western industrial countries: the United States, Britain, Canada, France, Italy, Japan, and Germany.[26] The MTCR consists of a basic policy statement, a set of guidelines to limit the conditions under which missile technology may be transferred, an annex listing technologies to be controlled, and an informal mechanism by which the partners can share information about potential transfers. The MTCR has undoubtedly succeeded in identifying the threat

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[25]McNaugher, 25.

[26]Congress, House, Foreign Affairs Committee, *Missile Proliferation: The Need for Controls (Missile Technology Control Regime)*, 101st Cong., 1st Sess., 12 July 1989. Statement of Dante B. Fascell, Chairman, House Foreign Affairs Committee on the Subcommittees on Arms Control, International Security and Science, and on International Economic Policy and Trade.

and creating an awareness of the missile proliferation problem among Western suppliers. U.S. officials have also claimed that the MTCR has been effective in stopping at least one ballistic missile program and has inhibited the development of programs by other states making it more difficult and expensive for countries to obtain relevant systems and technologies.[27] However, it has probably only slowed an exponential proliferation. There have been reports that the MTCR has been circumvented by French and German companies and some evidence exists that India enhanced its indigenous capability to develop certain missile system components and technologies as a result of MTCR constraints.[28] As one Representative put it: "while we're trying to turn off the ballistic missile technology tap through the establishment of MTCR, it would appear that the spigot can't be closed all the way."[29]

The final tool to combat the threat of ballistic missiles is through active ballistic missile defenses. Due to the fact that third world countries are developing and acquiring ballistic missiles for a variety of reasons and that arms controls and export controls to date need more "teeth" in them, defenses will play a major role in countering the threat of ballistic missiles. It is for this reason, this thesis addresses the role that missile defenses can play

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[27]Harvey et al., 16.

[28]When further purchase from the United States of key material for solid-propellant rocket fuel became impossible, the Indian space program developed other materials. Western embargoes on high technology were beaten in the fabrication and operation of a high-precision tracking radar, a key part of missile testing. See "Development of Polar Satellite Launch Vehicle Told," *The Hindu* (Madras), reprinted in FBIS September 27, 1989.

[29]Statement of Rep. Dante B. Fascell,4.

in the future national security and how the Navy can be a part of that defense effort. If defenses are to be a part of national security in the future, then one must also look at the future threat from ballistic missiles.

C. FUTURE THREAT

Although the Third World ballistic missile threat to the United States, its forward deployed forces, and vital interests is currently mitigated by low warhead accuracy, payload type, and the size of threat nation arsenals (although they presently are politically and psychologically destabilizing and threaten large area targets), several trends generate concern. First, as nations continue to supplement their strike aircraft force with ballistic missiles to ensure the penetration of enemy air defense networks, there has been a corresponding emphasis on the development of nuclear, chemical, biological, and advanced conventional warheads. Secondly, the range, payload, and overall technical sophistication of ballistic missiles in the developing world is continually improving. Additionally, the introduction of terminal guidance on ballistic missiles would provide a dramatic step jump in accuracy to these weapons. Whereas improvements in payload, accuracy, and technical sophistication tend to increase the tactical utility and lethality of a weapon system, extending the range of a missile places more targets at risk and increases safe standoff distances for opposing forces.[30]

The value of ballistic missile arsenals in the developing world will be enhanced in the future, and therefore be an even more significant threat, by

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[30]Richard A. Holzknecht, *Ballistic Missile Proliferation in the Third World: The Impact on U.S. Naval Operations* (Master's Thesis, Naval Postgraduate School, September 1990), 24.

weaponizing missiles with more lethal warheads, improving warhead range and accuracy, and increasing the number of indigenously produced missiles and launchers. These enhancements also seem to be well understood by the new missile states, since most of them are engaged in ongoing efforts in each of these areas.

1. Warhead Issues

As discussed earlier, one of the key military attributes of ballistic missiles is their ability to deliver destructive warheads. even the relatively inaccurate missiles currently deployed can be effective against unprotected large targets and can be even more effective against such targets if they can deliver warheads that destroy or contaminate large areas. Nuclear, chemical, and biological warheads can be especially effective against such targets. Some modern conventional, or high-explosive, warheads are also effective over relatively large, soft areas and can be even more dangerous when delivered by accurate missiles.

The most common conventional warheads contain large amounts of high explosives (HE) that cause blast waves when detonated, showering an area with shrapnel and debris. The blast from the detonation of 500 kilograms of HE would generally destroy buildings within a radius of 110-140 feet, would cause serious damage to buildings of standard construction within a radius of 150-180 feet, and would cause deaths and injuries out to 300-350 feet.[31] Larger warheads like those associated with the CSS-2 missile that China sold to Saudi Arabia can carry as much as 2,000 kilograms of high explosive. Detonating a warhead of this size would seriously damage

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[31]Shuey et al., 23.

buildings out to 350 feet and kill or injure personnel out to more than 650 feet.[32] It is intuitively obvious from this that the larger the warhead, the greater the lethality radius. The lethality of a ballistic missile system can be increased by many orders of magnitude if nuclear, biological, chemical or advanced conventional warheads are employed. For this reason, many nations with a ballistic missile arsenal are attempting to pursue, and will continue to pursue, one or more of these payloads. Table 2 depicts the current state of proliferation in the developing world.[33]

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[32]Ibid., 24.

[33]Estimates are based on a variety of sources, See Fetter, 14; McCain, 11; and includes unclassified testimony by ex-CIA Director William Webster, Seth Carus, David Goldberg, Elisha D. Harris and others, and do not reflect the estimates of the U.S. Government. Suspected-includes suspected and suspected but doubtful; Possible-includes possibility to develop or possible weapons stocks; Likely-likely to have weapons stocks either developed indigenously or supplied from other nations; Research-includes low level research; R & D-includes a dedicated research and development program and/or procurement.

TABLE 2. CURRENT STATE OF PROLIFERATION IN DEVELOPING WORLD

Country	Chemical Weapons?	Biological Weapons?	Nuclear Weapons?
Afghanistan	Suspected		
Angola	Suspected		
Argentina	Possible	R & D	R & D
Brazil	Possible	Research	R & D
Burma	Likely		
Chile	Possible		
Cuba	Suspected		
Egypt	Yes		Research
Ethiopia	Likely		
India	Likely	Research	Yes
Indonesia	Possible		
Iran	Yes	R & D	R & D
Iraq	Yes	Likely	R & D
Israel	Yes	Research	Yes
Korea, North	Yes	Likely	R & D
Korea, South	Likely	Research	Research
Libya	Yes	Research	Research
Pakistan	R & D	Research	Likely
Peru	Suspected		
Philippines	Suspected		
Saudi Arabia	Possible		
South Africa	Likely	Research	Likely
Syria	Yes	Likely	Research
Taiwan	Likely	Research	Research
Thailand	Suspected		
Vietnam	Likely		

In several developing countries, the development of nuclear weapons is closely linked to the development of ballistic missiles. The continuing spread of ballistic missiles would be most dangerous if some non-nuclear weapons states become able to produce nuclear explosives suitable for the warheads of their missiles. Missiles provide the surest means of delivering nuclear weapons deep into hostile territory and increase the credibility of a nuclear deterrent force and effectiveness of a nuclear strike force. Nuclear weapons greatly enhance the utility of inaccurate missiles and help justify the costs of their purchase or development. The combination of missiles and nuclear warheads provides a substantial means of inflicting great damage almost anywhere within the missile's range, and provides a powerful psychological device for international relations.[34]

Of the countries listed in Table 1, eight either currently possess nuclear warheads or have the capability to develop them within the next few years.[35] Israel is believed by many to have nuclear weapons and nuclear warheads for its missiles.[36] India, with its substantial nuclear industrial base and the experience of its 1974 nuclear explosive test, clearly could produce nuclear warheads if it were so inclined, and may already have done so.[37] South Africa has been able to build nuclear weapons since 1980 and may have an undeclared nuclear arsenal of a few weapons and is further rumored to be

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[34]Robert Shuey, *Missile proliferation: A Discussion of U.S. Objectives and Policy Options*, CRS Report for Congress (21 February 1990), 9.

[35]*Third World SRBM Systems and Programs*, U.S. Army Missile & Space Intelligence Center, U.S. Army Intelligence Agency (May 1989), preface.

[36]Shuey et al., 24.

[37]Ibid., 25.

involved in nuclear testing.[38] The above are just a few examples of the development of nuclear warheads in the Third World. From Table 2 we see that there are currently four Third World nations with known or suspected nuclear capability and 14 involved in various levels of nuclear research.

The spread of long-range, inaccurate missiles among countries that do not have nuclear weapons has led several of them to acquire chemical weapons to increase the effectiveness and significance of their missile forces. As depicted in Tables 1 and 2, most countries with a ballistic missile arsenal are also engaged in some level of chemical weapons research. Substituting chemical agents for high explosives can significantly increase the lethality of a warhead. Due to their potential lethality, chemical weapons have long been considered a "poor man's Atom bomb".

Any country with a chemical industry can produce chemical weapons agents.[39] Four general types of agents are available for use as weapons causing serious injury or death through inhalation and/or body surface contact. These four are: (1) blister agents, general tissue irritants such as mustard gas that can burn or blister the skin or lung tissue if inhaled; (2) blood gases, agents such as hydrogen cyanide that interferes with cell respiration after entering the blood circulation through the lungs; (3) lung irritants, choking agents such as phosgene that irritate and damage lung tissue; and (4) nerve agents, chemicals such as tabun, sarin, and soman that

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[38]Holzknecht, 29; Shuey et al., 30.

[39]Chemical warheads are munitions containing liquid or gaseous chemical agents that cause toxic damage to living tissues rather than damage through physical impact from blast, through shrapnel or heat. Chemical agents do little damage to buildings or vehicles, though persistent agents can be used to deny use of structures and areas.

interferes with the transmission of nerve impulses and disrupt vital bodily functions such as breathing.[40] The technology and expertise needed to produce chemical agents are very similar to those common to the petrochemical, pharmaceutical, fertilizer, and insecticide industries. Any country with a modest amount of technical expertise that produces and refines petroleum could make mustard gas without having to import any chemicals.

Chemical weapons proliferation and the use of chemical agents in missile warheads is likely to figure significantly in the future for several reasons. First, Iraq demonstrated that chemical agents do have military uses by employing them in the Iran-Iraq War. The war provided the Third World with a case study of how to organize chemical forces, in the kind of chemical agents required, in the need to solve targeting and weather-prediction problems, and in the ways in which conventional weapons systems could be adapted do deliver chemical agents.[41] Iraq demonstrated that chemical weapons could be used against static military targets, against the rear area of attacking forces, and against forces near the front lines. Second, the international community had a relatively muted reaction to Iraq's use of chemical weapons. Finally, the perceived need of other states to consider the development of a chemical weapon capability to protect themselves.[42]

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[40]Shuey et al., 31.

[41]See McNaugher, 17-24; McCain, 13.

[42]Edwin W. Besch, "How the Technology Explosion is Changing World Power Relationships," *Strategic Policy*, 19 (March 1991), 10.

Chemical proliferation is likely to propel countries into development of biological weapons as well.[43]

The threat of biological warheads is also likely to increase in the future. Biological weapons contain living organisms that can cause disease or death.[44] For weapons purposes, disease agents can be produced in quantity by various fermentation processes. The lethal potential of these weapons has been increased recently by advances made in genetic engineering and biotechnology. For example, normally harmless, non-disease producing microorganisms can now be modified to become highly toxic or to produce diseases for which an opponent has no known treatment or vaccine.[45]

Biological weapons can be divided into two distinct categories: toxins (toxic chemicals produced by living organisms) and pathogens (living organisms that produce disease). One of the most studied toxins is botulinal toxin, which has a 50 per cent lethality to human beings at an estimated dose of 50 millionths of a gram.[46] However, botulinal toxin is not suitable to air delivery because it decays rapidly upon exposure to air.[47] Pathogens, on the other hand, may have significant advantages over toxins as far as air delivery is concerned. In particular, *bacillus anthracis*, the bacteria that causes anthrax,

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[43]For a more complete collection of essays and testimony on chemical and biological weapons, See Congress, Senate, Committee on Governmental Affairs, *Global Spread of Chemical and Biological Weapons*, 101st Cong., 1st Sess., 1990.

[44]Toxins produced by bacteria and other living organisms block bodily functions or destroy organs and can also be effective as weapons.

[45]Shuey et al.,31.

[46]McCain, 14.

[47]Fetter, 24.

seems especially well suited for dissemination by missiles or bombs because of its ability to form spores that can survive violent dissemination methods and exposure to sun, air, and rain.[48] Anthrax is nearly 100 per cent fatal when a human being is exposed to as few as 8,000 spores.[49]

Presently, this data must be kept in perspective. Biological agents have never been tested in combat. Although it is readily conceivable that a country could develop a biological weapons capability, and according to Table 2 approximately 13 developing nations are involved with some level or research and/or development, the degree of expertise and care required in processing and handling the agent to prevent contamination, and the difficulty of developing and producing a warhead to disseminate the agent effectively would generally be greater than for chemical weapons. Since countries are pursuing a biological weapons program, they should be considered when discussing warhead issues on future ballistic missiles.

To improve lethality and circumvent the problem of low warhead accuracy, developing countries may attempt to weaponize their ballistic missiles with advanced conventional warheads. In order for a weapon to have a reasonable probability of damaging the intended target, the kill radius of the warhead should be larger than its CEP. For this reason, area attack munitions like cluster bombs and fuel-air explosives (FAE) have sparked considerable interest. FAE weapons disperse a mist of liquid fuel over the target area and then ignite the droplets to initiate an earth-shattering blast. FAE warheads are known to generate sufficient overpressure to damage

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[48]Ibid.

[49]McCain, 14.

above-ground concrete structures such as hardened aircraft shelters and munitions bunkers.[50]

As in the case of chemical weapons, there appears to be a correlation between the proliferation of ballistic missiles and the spread of cluster bomb technology. Even though cluster bomb technology pre-dated the spread of ballistic missiles, there has been a renewed interest in the Third World in cluster bomb technology and its possible application to ballistic missiles. Cluster bombs are particularly effective against soft targets like parked aircraft, radars, and personnel, and can also be used to crater roads and runways. Ballistic missiles armed with cluster bombs or submunitions represent a greater threat than unitary HE warheads because of their greater and more uniform coverage. An even greater threat with significant possibilities in the future is a submunitions warhead for a ballistic missile with the submunitions filled with chemical or biological agents.

2. Accuracy Issues

As listed in Table 1, most of the current ballistic missiles have a CEP of 300 meters or more. Armed with a unitary HE warhead, these weapons have a soft-target kill radius of 200 meters or less, depending on warhead size. This means that a conventionally armed missile has little chance of inflicting damage on the intended aim point, especially if the target is a small area or point target.

The accuracy of a ballistic missile system is affected by both endo- and exo-atmospheric effects. Because of this we must make the distinction

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[50]Keith B. Payne and Marc J. Berkowitz, "Anti-tactical Missile Defense, Allied Security, and the INF Treaty," *Strategic Review* (Summer 1988), 28.

between guidance accuracy and re-entry (RV) accuracy. Guidance accuracy can be improved by commanding exo-atmospheric corrections and adjusting booster burn time. RV accuracy is affected by endo-atmospheric effects such as wind, atmospheric density, nose-cone erosion, and RV asymmetry. To improve the accuracy of the RV, one must minimize drag. This will increase penetration speed and therefore reduce the time that the RV is exposed to lower atmospheric effects. Advanced nose-cone technology is one of the critical items that Third World missile states will continue to pursue.

There are a number of other technologies and methods that developing missile states will pursue in order to improve the accuracy of their systems. One method is to use terrain matching sensors which require detailed terrain maps and pertain mainly to fixed targets. Inertial guidance is another method to overcome inaccuracy. As mentioned in the previous section, another means of coping with the demand for high accuracy is to use dispersed submunitions patterns to extend the lethal radius of the weapon. Other future solutions may include using "smart" submunitions to seek out the target or terminal guidance like homing anti-radiation seekers on warheads. A final possibility includes the combination of terrain matching sensors or inertial guidance with terminal guidance to strike at mobile targets and significantly increase the accuracy of future missiles.[51] The improved accuracy that terminal guidance brings would mean that ships could be threatened and hit by ballistic missiles. This would mean that the Navy

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[51]For additional discussion of future accuracy improvement possibilities, See David Rubenson and James Borono, "NATO's Anti-Tactical Ballistic Missile Requirements and Their Relationship to the Strategic Defense Initiative," *RAND Corporation Series*, A Project AIR FORCE report prepared for the United States Air Force (December 1987), 8-11; and Holzknecht, 48-53.

would have to patrol at a greater stand-off distance from shore to remain out of reach of ballistic missiles or develop an active defense system and countermeasures to protect themselves.

3. Range Issues

Another trend that will continue in the future is the development of longer range missile systems. As indicated in Table 1, most current missiles fall within a 300 to 1000 kilometer range. Israel, India, and Iraq are attempting to produce missiles with much longer range. Those nations unable to indigenously produce longer range missiles have been resourceful in extending the range of systems purchased. The range of these systems has been improved by reducing warhead weight (as in the case of Iraq's Al-Husayn missile), lengthening the missile and enabling it to carry more fuel (as in the case of the Al-Abbas), and reducing the missile weight through the use of light-weight alloys and composites (as in the case of Scuds being produced by Iran and North Korea).[52]

Several Third World nations have extended the range of their ballistic missile systems by applying technology derived from national space programs. If a nation is able to place a satellite in orbit, it is potentially capable of delivering ballistic missiles of up to intercontinental range. India has used its space program to develop a ballistic missile that is capable of striking targets outside of its region into the Middle East, Central Asia, or China.[53] It

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[52]Holzknecht, 53.

[53]For an additional discussion of India's adaptation of space-launch vehicles to its ballistic missile program, See Nolan, 40-48.

is only a matter of time before more developing systems achieve intermediate and intercontinental range.

D. CONCLUSIONS

The proliferation of military technology, especially ballistic missile technology, is receiving more and more attention. In the new international system, ballistic missile proliferation and related weapons of mass destruction are one of the major threats to stability in the new security environment. Today, some twenty nations either possess or are in the process of acquiring ballistic missiles. These nations have pursued ballistic missiles for a number of reasons that fall under the categories of military-strategic, political-diplomatic, and economic reasons. The actual military utility of these systems is relatively low at the present time because the missiles are generally conventionally armed warheads of relatively low yield that is combined with being relatively inaccurate. However, it has been shown that they can be quite useful for political reasons and psychological terror and can be effective against large area targets like airfields and bases. In the future this minimized threat is likely to grow due to the development and application of technology that exists today. That application will greatly increase their utility and put many more targets, including naval vessels, at risk.

The Secretary of Defense has recently stated that by the year 2000, some of the nations that have or are pursuing ballistic missiles may be able to arm those weapons with chemical, nuclear, and biological weapons and that the requisite technology is available to allow those nations to increase the range,

accuracy, and lethality of their ballistic missile systems.[54] As missile ranges increase due to technology, and missile accuracy increases due to improved guidance, and warhead lethality increases, the civilian populations of U.S. allies (and in 10 to 15 years, possibly the United States itself) will become increasingly vulnerable to these weapons. Also, forward deployed U.S. military facilities and forces, on both land and sea, could be threatened by these weapons. The greatest risk in the near future may be the delivery of chemical weapons, either by unitary warhead or submunitions. Chemical weapons was a key concern of the U.S. military as it moved to deal with Iraq's aggression in Kuwait. As the then Secretary of State George Shultz said in San Francisco in 1988: "The worst nightmare of all would be the eventual combination of ballistic missiles and chemical weapons in the hands of governments with terrorist histories....These weapons increase the potential for devastation in unstable regions of the Third World. And the conflicts themselves may be far more difficult to contain or isolate."[55]

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[54]Statement of Secretary of Defense Richard B. Cheney before the Senate Armed Services Committee on Strategic Arms Reduction Treaty, 28 July 1992, 8.

[55]"Two Weapons Troubling to Shultz," *Washington Post*, 30 October 1988, A35.

III. THEATER MISSILE DEFENSES (TMD) IN NATIONAL SECURITY

A. NATIONAL SECURITY STRATEGY

A new national security strategy was unveiled by President Bush on August 2, 1990. A litmus test of that strategy was the Gulf War which soon followed. During the war, Iraqi ballistic missiles and possible chemical warheads were of grave concern to the United States and coalition forces. In the not too distant future, United States forces, its allies, and its vital interests may be threatened by Third World missiles. Because of this threat, the focus of this section is the role that theater ballistic missile defenses can play in the new national security strategy.

That focus is important because the United States is facing a new strategic environment. The Soviet Union has broken up into a Commonwealth of Independent States and is no longer considered enemy number one. A new danger is considered to be the spread of, and acquisition of, ballistic missiles and weapons of mass destruction by many Third World countries. As discussed in the previous chapter, the threat these weapons will pose to the United States, its forces, its allies, and its vital interests are not insignificant. The defense strategies in the recent bipolar world of Mutual Assured Destruction (MAD) and deterrence through the threat of retaliation and punishment may no longer be viable in the new international system. Theater missile defenses may be required to defeat such a threat and are just one part of a national security strategy.

The end of the Cold War has resulted in a change of focus in terms of United States national security. The United States is now concerned less with a global adversary capable of destroying our country and more with lesser adversaries capable in the near term of threatening our regional national interests and in the long term of threatening the United States itself. This translates militarily into a regionally focused defense strategy.[1] The *National Military Strategy* describes this shift.[2] It calls for reduced armed forces capable of meeting the military requirements of the new regional defense strategy. These forces will be capable of supporting the four pillars of the strategy, mainly: deterrence and strategic defense, crisis response, forward presence, and reconstitution.[3] The role that theater missile defenses can play in each of those fundamental pillars will be examined in the following sections.

1. Deterrence

As stated in the *National Military Strategy*: "... maintenance of a modern, fully capable, and reliable strategic deterrent remains the number one defense priority of the United States. A credible deterrent requires a reliable warning system, modern nuclear forces, the capability and flexibility to support a spectrum of response options and a defensive system for global protection against limited strikes."[4] Theater ballistic missile defenses fit in

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[1]See President, *National Security Strategy of the United States* (Washington, D.C.: GPO, 1991) and General Colin L. Powell, *National Military Strategy 1992* (Washington, D.C.: GPO, January 1992).

[2]*National Military Strategy 1992*, 1.

[3]Ibid., preface.

[4]Ibid., 6.

this foundation by adding to the flexibility of response options and as a defensive system against ballistic missile strikes.

Missile defenses are explicitly stated as an integral part of the National Security Strategy under deterrence.[5] To understand the role that they are explicitly envisioned to fill a little background is needed. For eight years the Strategic Defense Initiative (SDI) has explored advanced technologies with the aim of determining the feasibility of effective, non-nuclear ballistic missile defenses. The initial focus of SDI reflected U.S. concerns about growing Soviet first-strike capabilities. Thus, an initial deployment of defenses, or Phase I Strategic Defense System (SDS) was to have provided the minimum defensive capability that would add meaningfully to deterrence of a possible Soviet first-strike. The minimum defensive capability would have 7,000 Brilliant Pebbles interceptors in space and approximately 4,000 ground-based interceptors to destroy a percentage, on the order of one-half, of a massive Soviet attack involving several thousand Re-entry Vehicles (RV) launched against the United States.[6] By knocking out a large number of warheads, less would get through to hit U.S. bases, silo's, and bombers on the ground. Therefore the U.S. would have a strong retaliatory force remaining and that possibility would add to deterrence against the Soviet Union. That deterrence threat was one of severe retaliation to almost punishment.

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[5]*National Security Strategy of the United States*, 27.

[6]Dennis McDowell, "Changing Roles for Ballistic Missile Defenses: From Deterrence to Protection," *Strategic Review* 19 (Summer 1991), 44-53; and John L. Piotrowski, "SDI and Missile Proliferation," *Global Affairs* 6 (Spring 1991), 62-76.

However, since 1987 the world has changed dramatically, with significant implications for U.S. strategy and missile defenses. The strategic realities of Third World ballistic missiles and political and security instabilities in the Commonwealth of Independent States have not been lost on President Bush. The Gulf War and the role of the Patriot missile in defending against Iraq's Scud missile attacks may have reinforced the message. SDI was refocused after the Gulf War when President Bush stated in his State of the Union Address of January 30, 1991: "I have directed that the SDI program be refocused on providing protection from limited ballistic missile strikes, whatever their source. Let us pursue an SDI program that can deal with any future threat to the United States, to our forces overseas, and to our friends and allies."[7] This defense system is now known as Global Protection Against Limited Strikes (GPALS). It is envisioned to be a defense against accidental or unauthorized launches from the former Soviet Union or deliberate launches by Third World states. The GPALS system would eventually be less than half the size of a Phase I system involving about 1,000 Brilliant Pebbles and about 750 ground-based interceptors. The limited threat it would be capable of defending against would be approximately 200 re-entry vehicles maximum.[8]

GPALS does not enhance deterrence as envisioned by SDI Phase I. By being able to intercept only 200 re-entry vehicles, it would not ensure a larger

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[7]"President Bush's State of the Union Address," *New York Times*, 1 February 1991.

[8]Bruce W. McDonald, "Strategic Nuclear Policy in a Time of Fundamental Change," in *Reconstituting National Defense: The New U.S. National Security Strategy*, eds. James J. Tritten and Paul N. Stockton, (Monterey, CA: Naval Postgraduate School, 30 September 1991), 124.

retaliatory force against a massive Russian nuclear attack. What GPALS does do though is provide some protection against lesser strikes from most Third World missile states or the remaining nuclear states of the former Soviet Union. GPALS is the explicit missile defense system in the new strategy that provides a global strategic protections system.

Another significant implication for U.S. strategy under deterrence is the question of how to deter Third World nations. Deterring the use of nuclear weapons against U.S. allies, forces or interests is a relatively easy proposition because the United States has an overwhelming nuclear superiority over all Third World nuclear nations. Any first-use of nuclear weapons by a regional adversary would face nuclear retaliation and severe punishment that could totally destroy them. The real question is how to deter a regional adversaries use of chemical or biological weapons. That prospect raises a number of questions. Would the U.S. respond with a proportional response using chemical or biological weapons? That would make it seem like the U.S. was playing the adversary's game of conflict escalation. In a time where America expects casualties to be limited, that response would definitely not limit casualties. Another question is would the U.S. respond with nuclear weapons? That would have significant international implications. The international community would probably condemn us for using nuclear weapons first and at the same time that use would send a signal to the world that it is okay to use nuclear weapons. A final question is would the U.S. respond with strictly conventional forces. The problem here is that threat may not carry enough weight to deter an adversary from using chemical or biological weapons. Deterrence of Third

World nations use of ballistic missiles is a very difficult problem facing the United States. Theater ballistic missile defenses can help in providing certain solutions.

The first role that theater ballistic missile defenses can fill in the security foundation of deterrence is that they can ameliorate the need for deterrence. With theater missile defenses, the United States would have the capability to deny the enemy their objective of using ballistic missiles to attack cities, bases, ports, and troops. An effective ballistic missile defense system can defeat the ballistic missiles and provide protection for the task force. The question of how the deter a regional adversary does not pose such a significant problem with defenses that can defeat ballistic missile attacks. Ideally, the United States would prefer to deter the use of ballistic missiles and weapons of mass destruction, but should it fail, defenses will ease the burden of how to respond and the contingency operations can continue.

In conjunction with the first role, a related benefit of theater ballistic missile defenses is the possibility of devaluing ballistic missiles. An opponent may be less likely to use its ballistic missiles if it knows that the United States has missile defense systems in theater to protect its forces and interests. This may be especially true if any future systems have a high enough probability of kill factor. By making missile attacks futile, the perceived utility militarily, politically, and psychologically can be lessened considerable. Additionally, if it is known that the U.S. has effective missile defense systems that can be moved into theater quickly, it may devalue ballistic missiles such that nations will decide not to pursue them. Of course this does not say anything about a nations other possible opponents, but it

may prevent them from using ballistic missiles if there is a chance of the U.S. being drawn into the conflict.

2. Forward Presence

Forward presence of United States forces has been a key part of U.S. foreign policy since the end of World War II. Forces in regions and areas of vital interest to the United States have been instrumental in preventing crises' from erupting. Yet defense cuts and the closing of many overseas bases have prompted the Department of Defense to reevaluate the traditional definitions of forward presence in order for the United States to continue to fulfill its many obligations. In the new strategy, forward presence has been expanded to include periodic and rotational deployments, access and storage agreements, combined exercises, security and humanitarian assistance, port visits, and military-to-military contacts.[9] Due to budgetary constraints the number of personnel on the ground or at sea is going to be reduced, but missions and activities considered as presence are going to expand.

A theater ballistic missile defense system can play a part of the presence mission also. One possibility is a U.S. supported defense system in allied countries that request it until they can develop one of their own. An example is the Patriot batteries that were in Israel, Saudi Arabia, and Turkey during the Gulf War and that remain in Turkey at the present time. One question that this brings up is how willing will the U.S. leadership be to "renting" American troops and defenses out to other countries, especially during a period of America looking inward and withdrawing overseas forces? Another possibility is to put ballistic missile defenses on ships and in that way

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[9]*National Military Strategy 1992*, 7.

the United States can avoid the diplomatic and political complications of having forces on the territory of other countries. The defenses would be part of the naval diplomacy and peacetime engagement without having to be in country. These defenses at sea would be able to protect ports, bases, the fleet, pre-positioned equipment, and other allied civilians and interests from possible missile attack. This of course depends on the area the sea-based systems can defend. Finally, countries that buy or lease Patriot missile batteries from the United States, like Saudi Arabia and Kuwait have, will need United States forces to train them in its use and that can also be considered presence or peacetime engagement.[10]

With the focus of the new strategy on regional contingencies, a theater ballistic missile defense system can enhance crisis response capability. The missile defense system, particularly a naval theater missile defense system, can be relocated quickly during the initial phases of a crisis to provide added stability and a wider range of prompt responses to the operational commander. The missile defense system as an element of a maritime action group (MAG),[11] serves as an important contributor to the immediate operational capability of the United States in a crisis region. Thus, the theater ballistic missile defense system contributes to the rapid-response capability of U.S. forces.

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[10]Eric Schmitt, "Saudis to Buy 14 More Batteries of Patriot Missiles From the U.S.," *New York Times*, * November 1991, A3.

[11]For a further discussion of the MAG concept, see Vice Admiral William Owens, "Mediterranean Fleet: A Test-bed for Navy's Future," *Armed Forces Journal*, July 1992, 32-35.

3. Crisis Response

The capability to respond to a regional crises is another of the four fundamental demands on the new strategy. There are a number of regional contingencies that the United States could face and the strategy will be to limit vertical and horizontal escalation and the time required to deal with the crisis. Ballistic missiles threaten both vertical and horizontal escalation control. Chemical, biological, or nuclear warheads cause a higher level of destruction and provide incentive for the opposition to increase its retaliation effort. Also, it is difficult to keep ballistic missiles within the borders of the conflict, especially in areas like the Middle East where countries are only a few hundred kilometers in length or width. A future United States theater ballistic missile defense system on the ground or off-shore in a crises area could take out ballistic missile attacks and help prevent vertical and horizontal escalation of a conflict.

One of the most important roles that a theater ballistic missile defense system can play in crisis response is that of rapid response and offense suppression. A land-based missile defense in theater or a sea-based defense that can be moved in quickly can perform offense suppression of ballistic missile threats. It will reduce the threat to follow-on forces from ballistic missiles by destruction or degradation of the adversary's attempts. This role would be especially useful for a naval-based defense if the situation should arise where the United States sees a need to respond to a crisis even though it does not have any host nation support. The defense would prove useful in protecting the amphibious troops and equipment from possible ballistic

missile attack while they conduct their landing and establish a beachhead in the Amphibious Objective Area (AOA).

Other major roles that a theater ballistic missile defense system can play in crisis response is that of joint task force support and ground warfare support. In joint operations, the missile defense systems can simultaneously support both offensive and defensive tasks as designated by the operational commander. Assuming the United States has been invited in to a crisis region, the host nation will have provided port facilities, airfields, and supply depots. Ballistic missile attacks on ports, airfields, and supply depots and lines can severely delay actions and interrupt communications, supplies and air support for troops on the ground. If there is any lesson learned by a potential adversary of the United States from the Gulf War it would be to not allow the United States to build up its forces in theater without some sort of opposition early in a crises. A good way to do that would be with ballistic missile strikes, particularly with non-conventional warheads, on ports of entry, airfields, bases, and communications and command centers. Space, ground, and sea based interceptors could all work jointly to prevent that from happening and support a U.S. introduction force effort. Ballistic missile defenses will also support the ground warfare troops by providing protection from ballistic missile attacks when the offensive begins and protecting rear echelon troops and supplies.

4. Reconstitution

The final fundamental pillar of the new defense strategy is the ability to reconstitute totally new forces to fight a global war within a certain amount of warning time. Reconstitution includes mobilizing manpower and fielding

totally new combat units. It is also a reactivation of the defense industrial base. Preserving that capability means protecting the infrastructure, the defense industrial base, maintaining the lead in critical technologies, and stockpiling critical materials.[12] Theater ballistic missile defenses fall into the category of "maintaining the lead in critical technologies." If these defenses are not fully funded through deployment or are cut, they could be maintained in research and development under the "Reconstitution" aspect of the strategy. In this way the technology will continue to be investigated and maintained. Then if the political leadership of the nation determines that a system is needed to face a significant threat, a system could be put together in a relatively short time. Research and development would be needed so the time to produce a system would not be as long as trying to develop a system from ground zero.

B. CONSEQUENCES OF NOT FUNDING

One thing that should be examined is what effect not funding a theater missile defense system would have on the new strategy. Even though the Gulf War has probably given theater defenses a boost reflective in the new Theater Missile Defense Initiative (TMDI) passed by Congress,[13] it is important to examine the consequences because of the possibility of a change in administration, which may not wish to fund them, or a significant change

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[12]For a further discussion of what is considered under reconstitution, see *National Security Strategy of the United States*, 29-31; *National Military Strategy 1992*, 7-8; and James J. Tritten, "The New National Security Strategy and Base Force," in *Reconstituting National Defense: The New U.S. National Security Strategy*, eds. James J. Tritten and Paul N. Stockton (Monterey, CA: Naval Postgraduate School, 30 September 1991), 13,30-33.

[13]Edward J. Walsh, "Navy Moves to Counter Ballistic Missiles," *Sea Power* (September 1992), 3 9.

in the strategic environment. Canceling the development of theater missile defenses could have significant impacts on the new strategy.

The first impact that not funding missile defenses would have on strategy is in the area of deterrence. With defenses, the United States has the ability to ease the deterrence problem against Third World nations by having the capability to defeat the ballistic missiles. Defenses are not the only way to defeat ballistic missiles though; preemption is another option to have the same capability. If the United States wants to maintain the capability to defeat ballistic missiles before they become a problem to our allies, forces, and interests, and not fund defenses, then the other option will be by using preemptive strikes against those countries ballistic missile and mass destruction weapons capability. The problem is that as the Gulf War showed, it is extremely difficult to target and hit mobile ballistic missiles and their launchers. As the case of Iraq showed, it is also difficult to detect an actual chemical or biological weapons production facility. Finding the targets to strike will require more intelligence assets, both technical and human, inside the specific country to identify the targets. It will be even harder to launch a preemptive strike if the opponent has the possibility of a retaliatory capability against U.S. citizens abroad or vital interests.

If the United States does not want to deploy theater ballistic missile defenses, then it will rely on deterrence through the threat of retaliation or punishment. The problem here is that the United States will have to determine what each separate Third World country values in order to hold that at risk through the threat of retaliation or punishment and determine the proper response. The other problem is that the rationality of some leaders

are in question and rationality of the opposition is one of the requirements for deterrence to be effective. However, rationality is not as important if defenses or preemption are utilized as it is with deterrence through the threat of retaliation or punishment because defenses or preemptive strikes take care of the weapons if deterrence fails. It would also be important for the United States to strengthen its efforts to limit proliferation of ballistic missiles through multilateral arms controls and export controls.

In the area of forward presence, the lack of a theater ballistic missile defense system would only have a minimal impact on the strategy. The United States would not be able to offer the added stability a missile defense system could give in certain presence regions. The defenses could also prevent forward deployed U.S. forces from being exposed to excessive vulnerability. It would also take away from a United States initial crisis response capability.

Arguably the major impact of not funding theater ballistic missile defenses would have on strategy is in the area of crisis response. Without them it will be more difficult to limit the escalation of a conflict if ballistic missiles are used. Iraq tried to draw Israel into the Gulf War by launching ballistic missiles against them. That would likely have broken up the allied coalition and caused a horizontal escalation of the conflict at the very least. Also, there would not be protection for the joint task force or troops and supplies in theater against ballistic missile attack.

The final impact of not funding missile defenses is in reconstitution. As explained earlier, if theater missile defenses are not at least kept in research and development, then it will take significantly longer to reconstitute a new

missile defense system. Maintaining technological superiority is one of the key aspects of reconstitution and if missile defenses are not actually deployed, then research and development should continue. This will ensure the United States maintains its technological edge and the capability to reconstitute within a relatively short amount of time.

C. CONCLUSIONS

This discussion of the roles that theater ballistic missile defense systems can play in support of the new strategy is important for a number of reasons. First, it demonstrates that ballistic missile defenses are implicitly an integral part of the new national security strategy of regional contingencies. Second, it shows how missile defense systems can support the joint contingency force response in a crisis situation. They can add to the stability of regions due to their presence alone. Third, the defenses can ease the burden of how the deter Third World nations. Finally, continued research and development can contribute to the United States maintaining its technological edge over all potential enemies.

This discussion is not meant to portray the theater ballistic missile system as the ultimate weapons system for the new world order. Instead, the purpose of the presentation is to outline the various means in which a missile defense system can contribute in this new international security environment. It is an important contributor to deterrence, forward presence, crisis response, and reconstitution. Table 3 summarizes these contributions below.

TABLE 3. THEATER MISSILE DEFENSE ROLES

FOUNDATION	ROLES
DETERRENCE	Ease Third World Deterrence Problem
	Devalue Ballistic Missiles
FORWARD PRESENCE	Peacetime Engagement
	Enhance Crisis Response Capability
CRISIS RESPONSE	Limit Escalation
	Offense Suppression
	Joint Task Force Support
	Ground Warfare Support
RECONSTITUTION	Technological Superiority

IV. NAVAL ROLE

A. WHAT USE AT SEA?

The end of the Cold War has been the watershed event for change in the international and national security environments. The Soviet Union no longer exists as a tangible global threat to American national security interests. The uncertain threat of regional crises and contingencies has replaced the fear of global war as the basis for U.S. defense forces. This fundamental change, as enunciated in the *National Security Strategy of the United States* and the *National Military Strategy*, requires a comprehensive reexamination of service strategies and programming. This examination is well underway as each service struggles to determine its contribution in the post-Cold War world.

The U.S. Navy has outlined its vision for the future in *...From The Sea: Preparing the Naval Service for the 21st Century*.[1] This vision develops a general framework for the contributions of naval forces to the new regional defense strategy. What has yet to be determined is the exact contributions of each element of U.S. naval forces. With that in mind, the purpose of this chapter is to describe the contributions a naval theater ballistic missile defense system can make to the Navy's new direction as derived from the new military strategy. The naval contributions and associated missions or tasks will be discussed at the strategic, operational, and tactical level. Additionally, the advantages of a sea-based system over a land-based system will be discussed where they apply.

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[1]Department of the Navy, *...From The Sea: Preparing the Naval Service for the 21st Century* (Washington, D.C.: US Department of the Navy, 30 September 1992).

1. Strategic Direction

In facing the strategic demands of a new international security environment the Navy has derived a new strategic direction from the *National Security Strategy of the United States.* This new direction of the Navy and Marine Corps is to provide the United States with Naval Expeditionary Forces that are shaped for joint operations and to operate forward from the sea, tailored for national needs.[2] This strategic direction represents a fundamental shift away from open-ocean warfighting on the sea toward joint operations conducted from the sea. The Navy and Marine Corps will be able to respond to crises and can provide the initial capability for joint operations as well as continued participation in any sustained effort. In addition to the new direction, the Navy continues to be a major part of the nations strategic deterrent.[3]

The first two strategic directions for the Navy are to provide Naval Expeditionary Forces that are shaped for joint operations and operating forward from the sea. These two directions are derived from the strategic fundamentals of forward presence and crisis response as stated in the new national security strategy. The expeditionary forces will be available for tasking in the full range of joint operations with the other services to provide a cohesive joint team that is capable of rapid and decisive action from peacetime forward presence and exercises to joint missions in a major crisis. These Naval and Marine Corps forces can be continuously tailored to meet the presence missions or to meet any developing crisis. As discussed in the previous chapter, a theater ballistic missile defense system can have significant roles to play with these forces that includes

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[2]*...From The Sea: Preparing the Naval Service for the 21st Century*, 2.

[3]Ibid.

peacetime engagement, naval diplomacy, and enhanced crisis response capability in presence missions and limiting escalation, offense suppression, joint task force support, and ground warfare support in crisis response missions.

The third strategic direction for the Navy is to continue to be a major part of the nations strategic deterrent. This direction includes both nuclear deterrence and conventional strategic defense. This direction is the only area the Navy explicitly states that it is examining theater missiles defenses and the naval capabilities that can contribute to a strategic defense.[4] Here again a theater ballistic missile defense can ease the burden of how the deter Third World nations by providing the capability to defeat and to possibly devalue an adversary's ballistic missile force.

2. Operational Capabilities

With a new strategic direction for the Navy and Marine Corps team comes new operational directions. Instead of the intercontinental power projection and command of the seas during the Cold War, the Navy is entering a transoceanic phase that will focus on littoral operations. The littoral is the "near land" areas of the world and is defined as two segments of the battlespace. The first segment is the seaward area from the open ocean to the shore which must be controlled to support operations ashore. The second segment is the landward area inland from shore that can be supported and defended directly from the sea.[5] The littoral region will include narrow seas and coastal areas and can be characterized by confined and congested water and air space. Command of the littoral is not the same as command of the high seas and it will require new forces

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[4]Ibid.

[5]Ibid., 5.

and adaptations of existing forces and new operational capabilities to counter littoral threats. ...*From the Sea* delineates that the four key operational capabilities needed to successfully execute the new direction of the Navy and Marine Corps are: (1) Command, Control, and Surveillance; (2) Battlespace Dominance; (3) Power Projection; and (4) Force Sustainment.[6]

a. Command, Control, and Surveillance

The Navy and Marine Corps will continue to structure command and control capabilities to promote efficient joint and combined operations as part of an overarching command, control, and communications architecture that will be able to adapt from sea to shore. This way there can be a smooth transition from sea to land in a regional contingency effort once the task force commander is shifted to land. The surveillance efforts will continue to emphasize exploitation of space and electronic systems to provide commanders with immediate information, while denying and/or managing the data available to the enemy. Command, control, and surveillance systems enable domination of the battlespace and power projection, and are central to the precise application of power.[7]

A naval-based missile defense system and its supporting components can be an important part of the command, control, and surveillance capabilities. Space-based surveillance systems such as DSP and Brilliant Eyes (BE) or aircraft surveillance could provide early detection of ballistic missile launches and pass that information to sea-based and/or ground-based defense systems in theater. These assets could also be used to localize the ballistic missile

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[6]Ibid., 7.

[7]Ibid., 7-8.

launchers and supporting infrastructure so that counterfire strikes could be brought in to disable the enemy's further use of that launch platform. For command and control, the naval-based radar could be integrated with sensor data from aircraft, satellites, and the Ground Based Radar (GBR) to create a network that would provide theater-wide capabilities in detecting and tracking incoming missiles, and cueing interceptors to target them.[8] Once land forces have entered the theater, sea-based and land-based systems could be able to communicate with one another to provide joint coordination through cooperative engagements and therefore provide a larger overall engagement footprint throughout the theater.[9]

b. Battlespace Dominance

Battlespace dominance is at the heart of future naval warfare. It means that the United States forces can maintain access from the sea to permit the effective entry of equipment and resupply. This dominance implies that Naval Forces can bring to bear decisive power on and below the sea, on land, and in the air.[10] This also implies that Naval Forces will be the "enabling" force that will enable joint combat operations to begin and proceed in a regional contingency. They must have the capability to deny access to a regional adversary, interdict the adversary's movement of supplies by sea, and control the local sea, shore, and air. Dominating the battlespace means ensuring effective

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[8]James Hackett, "Give Antimissile Role to Navy: Mobile Ships Could Offer Wide-Area Scud Defense," *Defense News*, August 17-23, 1992, 19; and "SDI Request of $4.36 Billion Represents 30 Percent Boost," *Defense News*, February 3, 1992, 8-10.

[9]Presentation prepared by Capt. R.P. Rempt, OP-75, *Navy TBMD Program* (Washington, D.C.: US Department of the Navy, OP-75, 4 March 1992).

[10]*...From the Sea: Preparing the Naval Service for the 21st Century*, 8.

transition from open ocean to littoral areas, and from sea to land and back, to accomplish the full range of potential missions.[11]

As battlespace dominance is at the heart of future naval warfare, sea-based theater ballistic missile defenses are at the heart of battlespace dominance. In future regional contingencies the battlespace to be dominated will be in and around the littoral area. In order for the Navy to be the enabling force, it must have control of the littoral. Ballistic missile attacks in littoral areas could severely hamper or delay any U.S. joint combat operations. These attacks could be against airfields that the joint task force would use, ports that the task force would use to bring in heavy equipment and supplies, Amphibious Objective Areas (AOA) that the Marines are attempting to establish, and with the addition of terminal guidance, on naval and amphibious ships themselves. With reduced maneuverability due to being in congested and confined waters of the littoral, it may not be as difficult for an adversary to target naval vessels with ballistic missiles. In order to gain control of the littoral, the Navy must be able to defeat this anticipated threat. In order to be the enabling force, it must gain control of the littoral. A sea-based theater ballistic missile defense system can protect the enabling force and protect vital ports and airfields for the follow-on ground and air combat units. That can prevent any delay or disabling of a U.S. crisis response ability. Without a ballistic missile defense, naval forces may have to standoff outside of ballistic missile range and not be able to move in and gain control of the littoral.

An example of this kind of potential problem to ports and ships can be shown from the Gulf War. During the Gulf War, an impressive armada of

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[11]Ibid.

Western warships surrounded the Arabian Peninsula. Led by five U.S. aircraft carrier battle groups operating in the Persian Gulf, Red Sea, Arabian Sea, and the eastern Mediterranean, the naval force in the region was enormous. Yet, when Iraq began firing Scud missiles at Israel and Saudi Arabia, the force was not much help. The carrier attack jets did not have the range to go Scud hunting and the Scuds turned out to be much harder to find than anyone expected. The ships were unable to defend U.S. forces on land or allied population centers, even though most Scud targets were close to sea. The protection of U.S. forces and allies was left to the limited-area defense of the Patriot. The Navy did not consider the Scud much of a threat to its ships, but there was concern for the safety of ammunition and supply ships tied for days unloading their cargoes at docks at Dhahran. While none were hit, they presented an inviting target and several Scuds fell in the water nearby.[12] This is just an example of how ports and ships were targeted and in the future they are likely to be more at risk. If the Navy is going to gain battlespace dominance of the littoral, a sea-based ballistic missile defense should be a part of that "enabling" force.

c. Power Projection

Once the enabling force has gained control of the littoral, U.S. combat power will be projected inland to deal with any regional adversary. The Navy and Marine Corps supports the decisive sea-air-land battle by providing the sea-based support for the application of the complete range of U.S. combat power.[13]

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[12]Hackett, 19.

[13]*...From the Sea: Preparing the Naval Service for the 21st Century*, 8-9.

A sea-based theater ballistic missile defense system can play the critical role of protecting the Marines from ballistic missile attack when they go ashore. Initially, the defenses can be used to protect the ground troops and heavy equipment as it is being landed and the airfields where heavy airlift is coming into theater. Once the control of the contingency force is shifted to land and land-based defenses are in place, the sea-based defenses can be freed up for whatever missions the joint task force commander sees fit. This can include patrolling of the coast of coalition partners to provide protection and stability, moving to cover mobile ground units that have moved forward outside the land-based systems footprint, and continuing to protect the sea-based assets in theater.

d. Force Sustainment

America's influence and regional contingency capability is dependent upon its ability to sustain military operations where needed. The Navy is a large part of that logistics support required for any sustained military operations. It is tasked to provide a comprehensive and responsive logistics support system, including air and sealift, replenishment ships, mobile repair facilities, and advanced logistic support hubs. The Navy is also responsible to ensure open sea lanes of communication so that passage of shipping is not impeded by an adversary.[14]

A sea-based theater ballistic missile defense system can play an important role in force sustainment by protecting the forward logistics and sealift vessels. As these ships move through straits, into confining littoral waters, and pierside to unload their cargo, they will be inviting targets to an adversary. One of the best ways to reach them is via a ballistic missile attack. A sea-based

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[14]Ibid., 9.

defense system can provide protection and prevent an adversary from interrupting the resupply and combat support effort. The advantage of a sea-based system here is its inherent mobility so that it could move with the Maritime Prepositioned Ships (MPS) or the sealift vessels as they move into the theater.

Included in the operational capabilities of a sea-based theater ballistic missile defense system, there are also tactical uses. Those are to specifically use them for protection of ships operating in the littoral and Marines as they move ashore. Without defenses, if a terminally-guided ballistic missile is launched into a Surface Action Group (SAG) or Amphibious Ready Group (ARG) in the littoral, it can be almost assured to hit some unit. Due to their high-speed, the reaction time for passive countermeasures would be very short. An active defense is required to defeat such a future threat and protect sea-based assets.

B. SCENARIO EXAMPLE

In order to help demonstrate how a theater ballistic missile defense system can be useful in future regional contingencies a scenario was examined to determine their possible impact. The scenario examined was the Tactical Missile Defense Warfare Analysis Laboratory Exercise (TMD WALEX) done by the Johns Hopkins University Applied Physics Laboratory in support of the U.S. Army Anti-Tactical Missile Program Review Panel.[15] The actual scenario parameters, weapons parameters, timelines, and responses are classified and will not be discussed. The general scenarios and the general findings made by this study are

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[15]*Tactical Missile Defense Warfare Analysis Laboratory Exercise (TMD WALEX) Report*, Johns Hopkins University Applied Physics Laboratory (Laurel, MD: Johns Hopkins University, October 1990). All of the major ideas and findings described in this section can be directly attributed to the above report.

discussed below to show the importance a ballistic missile defense system can have in regional contingencies.

The TMD WALEX was directed to focus upon the Third World TBM threat in the late 1990's. Korean and Persian Gulf scenarios were chosen to provide representative operational situations that would illustrate TMD requirements. In the Korean scenario, North Korea invades South Korea and initially makes rapid progress south. However, the tide turns against North Korea and BLUE forces begin to win. A month-or-so into the war, BLUE executes an amphibious landing campaign to cut North Korean forward forces off from their northern logistical base. The Persian Gulf scenario assumed that U.S. forces have withdrawn from Saudi Arabia within a couple of years after the 1990 Persian Gulf crisis. Then several years later, Iraq again invades Kuwait, and, in this scenario, continues into Saudi Arabia, advancing down the Persian Gulf coast nearly as far as Bahrain. U.S. and other Western forces do not become involved until after Iraqi forces have established themselves in these positions. From an analysis of these two scenarios and the way they played out a few general conclusions were found.

The first general finding was that without a theater missile defense, ballistic missile use by an adversary in a regional conflict can deny some significant BLUE missions. For example, adversary ballistic missile attacks could deny the U.S. use of an airfield or port as a major entry point for U.S. forces into the regional theater. Some BLUE missions could be denied by ballistic missiles with any kind of warhead; other missions could be denied if ballistic missiles are employed as weapons of mass effect by using chemical or nuclear warheads. Sophisticated use of different kinds of warheads (e.g., target-activated submunitions on some

TBMs, chemical warheads on others) can make clean-up after a TBM attack very difficult. Ballistic missiles may provide a weapons delivery mechanism to attack targets at ranges that otherwise could not be reached by the adversary and allow him to do so with minimum warning time.

The next general finding was that it is better to prevent ballistic missile launch, either by attacking TBM sites and supporting infrastructure or by denying required targeting and C^3 which supports TBMs, than to counter TBMs after launch. However, it was recognized that some operational situations may make it impossible to attack TBMs prior to launch and it is unlikely that BLUE would always be able to destroy or deny launch by every adversary TBM. Adversary use of ballistic missiles at the commencement of hostilities is likely to ensure that at least the first volley of missiles is launched. The cost of attacking TBM launch sites and supporting infrastructure could result in large aircraft losses.

The third general finding was that ballistic missile defense system transportability and mobility required are situation dependent. If a defense system is not in place prior to commencement of the war, it can be brought in the same way as other heavy forces. It is important that ballistic missile defense capability exist as heavy forces enter the area. It is unlikely that heavy-lift aircraft would be flown into an airfield subject to TBM attack. Here we see how a sea-based system could be vitally important in the beginning of a crisis to protect airfields and ports as forces are being moved into theater.

Fourth, space assets were recognized as very important for TMD but specific roles and integration were not addressed. Problems associated with rapid introduction of a TMD system into a new area would be greatly alleviated if

initial target detection and tracking could be accomplished by space-based or airborne assets.

Finally, ballistic missiles bring a new dimension into regional conflict. TBMs give an adversary the ability to reach far into BLUE territory with a high likelihood of mission success. Without effective TMD, BLUE forces will not be able to perform some missions, especially in regions where the U.S. does not have predeployed forces, and the adversary has the ability to control conflict escalation. For example, TBM use against the airport of Riyadh in the Persian Gulf scenario would have prevented use of that airport by heavy-lift aircraft. BLUE adaptation to a campaign under such conditions could be very costly in terms of the larger size and longer duration of the operations required. BLUE operational flexibility could be severely limited without effective TMD.

C. CONCLUSIONS

The U.S. Navy has derived a new vision from the *National Military Strategy*. ...*From the Sea: Preparing the Naval Service for the 21st Century* develops a general framework for the contributions to the new regional defense strategy. The Navy has recognized the threat that ballistic missiles can pose in the future and is specifically examining the role that theater ballistic missile defenses can fill in strategic defense. What this chapter has tried to show is that these defenses can play a much bigger role across the spectrum of naval warfare in future contingencies. As just one element of U.S. naval forces, they can contribute to the operational capabilities needed to successfully execute the new direction of the Navy and Marine Corps. In doing so, they can provide the task force commander a broad area of mission assignments to which they can be tasked. Working in coordination with land-based systems and space and air assets, they

can provide a theater-wide defense against ballistic missile attacks. The advantages of a sea-based system lies in the fact that the Navy forces may be the first into a crisis region and the inherent mobility that can let them cover assets that a land-based system cannot. Table 4 summarizes the missions and tasks that a sea-based defense system can perform to support the Navy's operational capabilities.

TABLE 4. NAVAL TMD OPERATIONAL CAPABILITIES

DIRECTION	ROLES	MISSIONS & TASKS
OPERATIONAL CAPABILITIES	Command, Control & Surveillance	Detection, Cueing, Tracking & Localizing
		Cooperativ e Engagement
	Battlespace Dominance	Littoral Control
		Enabling Force Protection
	Power Projection	Amphibious Support
		Ground Warfare Support
		Airfield Protection
	Force Sustainment	Sealift Protection
		Port Protection

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V. HOW DO WE GET THERE?

A. AEGIS

The last chapter demonstrated that the Navy can make a substantial theater missile defense contribution beyond traditional Navy missions. The Navy may have the only on-the-scene missile defense capability at the onset of many conflicts and will be sorely needed for defense of both sea and air ports-of-entry and for protection of amphibious landing forces. With that in mind, this chapter examines how the Navy could deploy a sea-based theater ballistic missile defense system in the not too distant future. It will examine the platform to be used, certain upgrades required, and potential problems that could prevent actual employment.

The Navy's Aegis Combat System (ACS) is the most obvious answer to the question of what platform to use. It is attractive because there are already existing platforms, with more being built in cruisers and destroyers, that have launchers, sensors, and supporting infrastructure. This way the Navy does not have to build a theater ballistic missile defense platform from the keel up, but can upgrade the existing platforms. This can save money, which is important during a period of declining budgets, and can provide the defense capability sooner than if it had to construct a totally new platform.

Aegis provides an all-weather capability for independent and Task Force Antiair Warfare (AAW) operations. To support AAW operations, the ACS provides surveillance systems for target detection and identification; tracking computers to maintain a target track file of targets detected by ownship

surveillance systems or reported over data links and to evaluate target threats and assign weapons; weapon systems for target engagement; and countermeasures systems to mask ownship and to decoy weapons launched by an enemy.[1] The following systems are used to detect targets and provide data to the computer track file:[2] multifunction Radar System AN/SPY-1B/D, Identification, Friend or Foe (IFF) System, and Electronic Warfare (EW) System. AN/SPY-1B/D is the air surveillance and fire control radar system that searches preassigned volumes in space and automatically detects and tracks targets. The IFF System interrogates targets, maintains a file of IFF target reports, and provides this data to the Command & Decision (C & D) system in both video and digital format. The EW System detects target emitters, analyzes target signatures, and provides an early warning of targets.

The ACS has significant proven capability against a broad variety of AAW threats. However, it was not designed to counter theater ballistic missiles. Even so, the current ACS can provide ballistic missile tracking via the AN/SPY-1 radar as well as a limited engagement capability against the low end ballistic missile threat with some modification.[3] However, to effectively improve the current ACS capability against today's more advanced third world ballistic missile threats and the projected future threats, certain upgrades and developments should be initiated. The major upgrades that will be discussed are in cueing and defensive warhead lethality issues.

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[1] *Near-Term Department of the Navy T/TBMD Capability Final Report*, Fleet Systems Department, Johns Hopkins University Applied Physics Laboratory (Laurel, MD: Johns Hopkins University Applied Physics Laboratory, November 1991), 4-1.

[2] Ibid.

[3] Ibid., 4-13.

1. Cueing

A cue is information from an external source that a ballistic missile launch has occurred and provides some information which identifies and characterizes the ballistic missile and its trajectory. An external cue can minimize the effect of the reaction-time delays of the defensive system. This can permit firing of the defensive missile several moments sooner. In turn, this can permit increased depth of fire. This corresponding increase in kill probabilities for a given defended area translates into an increased effective footprint. Possible sources that could cue the Aegis system are discussed in the following paragraphs.

Space systems, such as the Defense Support Program (DSP) system and its upgrades, and more capable systems, such as the Brilliant Eyes (BE) satellite constellation, can provide significant contributions to all theater ballistic missile defense systems, including Aegis. A cue from space providing the location of a ballistic missile launch or a more exact threat-missile flight path can allow a ground-based or sea-based system to defend areas two to four times larger than could be defended without assistance from space.[4] Two DSP spacecraft could view a launch event to improve the accuracy of the tracking and trajectory prediction and then pass that information to the defense systems. BE is a distributed satellite system that will use infrared (IR) sensors to track threat missiles from launch through midcourse and reentry.[5]

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[4]*Defense Science Board Study Final Report on Ballistic Missile Defense* (Washington, D.C.: US Department of Defense, 19 March 1992), 2.

[5]Ibid., 25.

The contribution of space systems is "alerting", that is recognizing that a missile has been launched and sending a message used to turn on radars or change modes and warn personnel. An example of the use of such a cue would be if the Aegis platform was performing its normal AAW surveillance, the cue would provide it a chance to switch to ballistic missile surveillance. If the cue were sufficiently accurate, the Aegis would only have to look into a limited search volume to acquire the target. The benefit of the cue would be in minimizing the time it takes the AN/SPY-1 to acquire the target. This would allow for earlier engagement and minimize the impact of its ballistic missile defense mission on the overall AAW mission.

The related result is that cueing from space assets can enhance a defense systems footprint. Under uncued operation, the Aegis radar would search a relatively large threat volume and, when the incoming object is detected, track it for eventual intercept. By providing early launch detection, localization, and trajectory information, a space system can allow the cued radar to search a much smaller threat volume, and therefore detect the threat objects at longer ranges.[6] This leads to larger areas that can be defended.

Other external cueing sources that can provide the Aegis with quicker reaction time and larger defense areas are airborne surveillance, such as the E-2C, and ground-based radars, such as the theater Ground Based Radar (GBR) the Strategic Defense Initiative Organization (SDIO) is developing.[7] Potential problems here are that at the beginning of a crisis the GBR or other land-based

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[6]Ibid., 27.

[7]Concept of operations for the E-2C in theater missile defense was derived from a presentation by Capt. R.P. Rempt, OP-75, *Navy TBMD Program* (Washington, D.C.: US Department of the Navy, OP-75, 4 March 1992).

radars may not be in place. Until control of the littoral is established, Navy assets may be all that is in theater. If an adversary has an extensive air defense network, the airborne surveillance may not be able to provide the coverage needed to detect a launch. Additionally, airborne or ground-based radars may not be able to discriminate threat objects from decoys, fragments, or other penetration aids during the exoatmospheric phase of the missile flight.

Once any or all of these external sources are in place, they can provide early warning cues to both sea- and land-based defense systems. They can be a significant part of the effort to provide the operational commander an effective, cooperative theater-wide ballistic missile defense system.

2. Defensive Warhead Lethality

Successful fleet or theater defense against ballistic missiles requires an ability to neutralize all types of ballistic missile payloads. Future warhead threats that one can reasonably expect to see fielded might employ nuclear, chemical, biological, incendiary, and conventional high-explosive, with the possibility that any of these (except nuclear) may be contained in submunitions. The robust physical makeup of some ballistic missile payloads drives antiair defensive weapons systems to achieve higher energy levels on target than has ever been previously required. Intercept of a biological warfare or chemical warfare weapon, which consists of a large tank at inside a reentry shield, involves some very tricky lethality problems. Unlike a nuclear or high-explosive weapon, the agents are ready to work when released from their tanks. The intercept may actually perform part of the attacker's job by spreading the agent around. However, if the intercept occurs at a sufficiently high altitude, laboratory tests show that a chemical agent will be dispersed enough to be

innocuous.[8] Knowledge of biological agents dispersal has not been fully developed at this time although it seems that even an intermediate altitude intercept may help the aggressor with dispersal of the agent for its intended use.[9] Lethality against ballistic missiles carrying submunitions of any type involves new considerations for the defense community. The submunitions shield each other and may be very hard so that a massive kinetic energy impact may be needed to provide assurance of killing all or a significant fraction of the submunitions.[10] Therefore, any upgrades to the Standard (SM-2) missile planned for a theater ballistic missile defense role will probably require a new ordnance package at the very least.

Once an intercept is made, the issue of whether or not a kill occurred remains. The two ways to look at this are hard kill and mission kill. Hard kill means that no damage has been done to allied assets, and mission kill means that no damage has been done to the intended targets. Mission kill means that the incoming ballistic missile has been diverted to miss the intended target. This is usually better than a miss, but there is probably no way to count on this kill mechanism in defense of population centers or if the warhead on the ballistic missile is nuclear, chemical or biological. Killing the incoming missile warhead is not the only problem because missile debris, including the missile body, can impact a target area and cause a great deal of disruption, although less than if the warhead had detonated on target. Part of the solution to this problem is to engage the ballistic missile for a hard kill at as high an altitude as far from the

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[8] *Defense Science Board Study Final Report on Ballistic Missile Defense*, C-2.

[9] Ibid., C-14.

[10] Ibid., C-2.

defended area as possible. The two main kill mechanisms being assessed for theater missile defense warheads are fragment warheads, as on the SM-2, and hit-to-kill (HTK) warheads, as in the case of the Extended Range Intercept Technology (ERINT) being developed by LTV Missiles and Aerospace Co. and the Theater High-altitude Area Defense (THAAD) weapon planned for development by SDIO.[11]

The effectiveness of a fragment kill is determined by a variety of factors: the number of fragments hitting the incoming missile/warhead body, the energy and size of the fragments, where the fragments hit, fragment strike angle, fragment material, fragment mass, and the shape and on the nature of the target warhead. The use of the SM-2 missile and present warhead to defeat incoming ballistic missiles presents two areas of concern. The high interceptor-to-ballistic missile closing velocity and the forward area of the target's vulnerable area make it difficult to place fragments on the vulnerable area and, given that the warhead fragments strike the vulnerable portion of the target, they may be too small to cause sufficient damage.[12] The current recommendations in response to those concerns for SM-2 warhead upgrades are to increase the velocity of the fragments and change their ejection angle to get better shot at the vulnerable areas of the incoming missile and to increase the fragment size.[13] These are meant to give a higher probability of hitting and killing the incoming missile.

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[11]Edward J. Walsh, "Navy Moves to Counter Ballistic Missiles," *Sea Power* (September 1992), 39-40; and *Defense Science Board Study Final Report on Ballistic Missile Defense*, C-20.

[12]*Near-Term Department of the Navy T/TBMD Capability Final Report*, 4-140.

[13]Ibid., 4-146.

However, the difficulty of accomplishing fragment kills varies drastically among threat warhead types. In the case of unitary high-explosive or chemical warheads, the fragments can hit with enough mass and velocity to achieve a hard kill.[14] It is still unclear though as to their effectiveness against biological/chemical submunition warheads.

A great deal of progress has been make over the last few years in HTK technology. The appeal of the HTK approach is the possibility of imparting large amounts of energy to a target system with the promise of totally destroying the target. The energy imparted is largely dependent on the mass and it will be important for the development of HTK warheads that the minimum effective HTK mass be quantified for the various target warheads.[15] HTK holds a great deal of promise, yet it is once again unclear as to how effective it may be against biological/chemical submunitions. Further testing and evaluation of ERINT and THAAD, and the more advanced HTK technology like the hypervelocity projectile to be used in the Lightweight Exoatmospheric Agile Projectile (LEAP) Program being developed by Boeing and Hughes, will hopefully make this capability a reality in the not too distant future. Table 5 summarizes the assessed destruction capabilities of the two kill mechanisms.[16]

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[14] *Defense Science Board Study Final Report on Ballistic Missile Defense*, C-22.

[15] Ibid., C-24,25.

[16] Ibid., C-32.

TABLE 5. KILL MECHANISM CAPABILITY

Incoming Warhead Types	Fragments	Hit-to-Kill
Conventional		
unitary	Yes	Yes
enhanced	Yes	Yes
submunitions	Yes	Yes
hard submunitions	uncertain	Likely
Chemical		
unitary	Yes	Yes
submunitions	unlikely	Likely
Biological		
submunitions	uncertain	uncertain
Nuclear		
implosion	Yes	Yes
hardened	uncertain	uncertain

The principal problem with the HTK mechanism is that, as the name implies, the warhead must hit the ballistic missile to kill it. HTK missiles will also have to hit the ballistic missile at the right place to be totally effective. That will require precise guidance and control. This is a significant problem considering the complicated geometry involved in intercept. With extremely high closing velocities between the ballistic missile and the interceptor,

complicated by ballistic missiles with possible maneuvering warheads, this problem will take significant effort to overcome.

B. POTENTIAL PROBLEMS AND TRADEOFFS

The threat recognition of ballistic missiles in the Third World and a recognition of the roles that theater ballistic missile defenses can play in a regional defense strategy may not be enough. An Aegis-based theater ballistic missile defense, and for that matter, any theater ballistic missile defense must face some potential problems and tradeoffs before becoming a realistic capability. First, it must face the hurdle of political-ideological opposition, which has leaned towards enforcing a narrower view of United States obligations under the 1972 Anti-Ballistic Missile (ABM) Treaty with the Soviet Union. Second, it must face the issue of costs required to build and deploy such a system, particularly in a period of increasingly limited defense budgets. Finally, the Aegis-based missile defense must face the critical tradeoffs and critical pacing technologies that must be accounted for to produce an effective ballistic missile defense system.

To advocates of arms control, the ABM Treaty is the signal achievement of U.S.-Soviet arms controls efforts. To the Reagan and Bush Administrations, it is an undesirable obstacle to the development and deployment of a strategic defense system. The ABM Treaty constrains the development and deployment of strategic ballistic missile defenses with the exception that both sides are allowed 100 ground-based interceptors to be deployed at one site each.[17] Neither country is allowed to deploy or develop sea-, air-, space-, or mobile land-based

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[17]The United States decided to place its system at an ICBM site at Grand Forks, ND while the Soviet Union deployed their system around Moscow.

ABM systems or transfer the technology to any third parties.[18] Nowhere does the ABM Treaty explicitly refer to theater missile defenses. It addresses only so-called "ABM systems" and defines them as defenses against "strategic missiles". The Treaty is an issue because the distinction between the performance and technical capabilities of ABM and theater systems is unclear today and likely to become progressively less clear as ballistic missile threats grow in range and capability and as technology increases the effectiveness of defenses against them.

The strategic situation has changed considerably since the treaty was signed some twenty years ago. The reality of a larger global problem, particularly after the Gulf War, appears to have been recognized by Congress. Last year, Congress directed the SDIO to develop a limited defense system compliant with the 1972 ABM Treaty that could be deployed by 1996, directed that the U.S. to open talks with the Soviets (Commonwealth of Independent States or individual republics) to allow more than 100 interceptors at more than one site, and for the U.S. to consider all options available within the ABM Treaty (to many Congressmen, this includes the possibility of unilateral withdrawal from the Treaty).[19] This year, Congress directed SDIO to create a new theater missile defense initiative. At the present time, theater missile defenses may be safe from the ABM Treaty, but the United States should either reach an understanding with the former Soviet Union about theater missile defenses or recognize that in the new security environment, the ABM Treaty may have outlived its usefulness.

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[18]William J. Durch, *The Future of the ABM Treaty*, Adelphi Paper 223, (London: International Institute for Strategic Studies, 1987), 5-8.

[19]*Congressional Quarterly*, 9 November 1991, 3295.

A second major obstacle to the development and deployment of a theater ballistic missile defense system is the reducing defense budget. The defense budget is expected to drop by approximately fifty billion dollars over the next five years.[20] The new administration may reduce the defense budget even more. With that in mind, it is important to look at the record of the SDI/GPALS program. A total of 25.5 billion dollars has been spent on research and development for SDI/GPALS up through the 1992 budget cycle.[21] It has run from 4.4% of the R & D budget in 1985 to 10% of the R & D budget in 1992. That is a significant portion of the R & D budget for a program that has not been deployed yet. The Congressional Budget Office has considered the costs for various alternatives.[22] Pursuing the Bush Administration's plan of deploying theater defenses, multiple interceptor sites covering the U.S. and space-based interceptors, and continuing advanced research would cost 87.5 billion from 1993-2005. Eliminating the space-based interceptors would cut the cost to 53.9 billion. Research, theater defenses and a 100 interceptor site would cost 36.4 billion. Finally, an option that would deploy only theater defenses and maintains 1.2 billion a year in research would cost 27.5 billion. President-elect Bill Clinton has stated that he wants to develop and deploy theater missile defense systems immediately and possibly a ground-based strategic system compliant with the

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[20]U.S. Department of Defense, Budget Briefing with Secretary of Defense Dick Cheney; Deputy Secretary of Defense Donald Atwood; and General Colin Powell, Chairman, Joint Chiefs of Staff, 29 January 1992.

[21]All raw numbers on SDI/GPALS budget came from *Congressional Quarterly*, 1985-1992.

[22]James R. Asker, "ABM Enthusiasm Wanes in Congress, Sets Stage for New SDI Funding Fight," *Aviation Week & Space Technology*, (March 16, 1992), 45.

ABM Treaty.[23] A good sign is that all options discussed by the Congressional Budget Office and the President-elect include funding for theater ballistic missile defenses.

A sea-based missile defense from an Aegis construct has an advantage with budgets because of its possible lower costs and risks. Projected funding for upgrades described in this report to provide a theater missile defense capability on Aegis through the year 2000 is between 3 and 4.5 billion dollars.[24] Upgrades for a more limited area defense capability is projected to be around 1.5 billion dollars.[25] The main performance differences between the two capabilities are that the limited area defense would have a minimum defended radius of 50-200 kilometers and a minimum keep-out altitude of 10 kilometers, while the theater defense would have a minimum defended radius of greater than 200 kilometers and keep-out altitude of 20-50 kilometers.[26] The full theater defense capability on Aegis would only be about 12% of the funding for the Congressional Budget Office's third option and the President-elect's plan. The potential problem is that most of the funding is projected to come from SDIO through the theater missile defense initiative and not Navy funding. If it does not, and has to come from Navy funding, that could pose a significant problem in that the funding would have to come from other planned Navy projects or not at all.

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[23]William Matthews and Tom Philpott, "Bush vs. Clinton," *Navy Times* 52 (October 5, 1992), 8-10.

[24]Capt. R.P. Rempt, presentation on *Navy TBMD Program*.

[25]Ibid.

[26]Ibid.

The final obstacle comes from critical tradeoffs and critical pacing technologies that could effect the employment of a ballistic missile defense on Aegis cruisers and destroyers. First among these involves the detection and tracking of ballistic missiles. Because of the ballistic missile's extremely high speed and high trajectory, the energy required in upgrades to direct the radar to higher altitudes and to search a larger space volume in a ballistic missile defense mode is very significant. Detection and tracking also requires more energy because of the complicated geometry of the problem. While the Aegis is in a ballistic missile defense mode, significant degradations are made to its other AAW missions. Since it will be operating in the littoral, it is reasonable to assume that there will be other threats from an adversary's aircraft and cruise missiles at the same time. As discussed in earlier sections, external cueing sources can minimize the degradation of ballistic missile defense on the other AAW missions. However, if these external sources are not available for whatever reasons, then the Navy must operationally consider having at least two Aegis platforms in each area of the littoral it is trying to defend. One would perform ballistic missile defense and one would perform the conventional AAW missions. This is significant because this operational requirement could possible be one of the future drivers for force structure requirements on the number of Aegis platforms in the Navy.

Arguably, the most critical item facing the deployment of a sea-based theater ballistic missile defense is the issue of developing a warhead that can defeat all possible future ballistic missile threats. As discussed earlier, fragmentation warheads may not be that effective against all future threats, although upgrades in fragment velocity, ejection angle, and fragment mass may make them slightly

more effective. The key right now is to develop a HTK warhead that can intercept and defeat any future ballistic missile. The development of a warhead to kill future ballistic missile warheads at as high an altitude and as far away from the defended area as possible is critical to the deployment of an effective theater ballistic missile defense as envisioned in this report.

Even with the development of such a warhead with proper guidance and control, there may be tradeoffs to consider. That warhead may be unique in that it could only be used for ballistic missile defense. If that is the case, there would have to be a magazine mix on the Aegis. That would mean that some cells and launchers would have to be dedicated to ballistic missile defense. That would take away from the number of missiles available for other AAW and strike missions. Therefore, each ship would have a limited number of shots at ballistic missiles and a limited number of shots at aircraft and/or cruise missiles. This leaves open the possibility for the ship or the area it is trying to defend to be saturated or overwhelmed by the adversary. Once again this might lead to the operational necessity of having at least two Aegis platforms in the area for defense with one ship dedicated to ballistic missile defense and one ship to conventional AAW.

C. CONCLUSIONS

The Navy has the capability to make a substantial contribution to theater missile defense. A major part of the infrastructure is already in place with the Aegis Combat System. It is more cost effective and lower risk because there are already existing platforms and some capability that can be upgraded to provide an effective theater ballistic missile defense system. An example is how the PATRIOT was upgraded from a conventional AAW defense to include capability

against ballistic missiles. There are a number of software and hardware upgrades that can be made with existing technology right now that will help improve performance against ballistic missiles. However, the two most critical items needed to make Aegis an effective, flexible and mobile ballistic missile defense platform are external sources of cueing and a warhead and missile with proper guidance and control that can defeat all future ballistic missile threats. While those items are being investigated, the Navy should still press on so that even a limited sea-based missile defense system can be deployed as soon as possible so that it will not take much effort to integrate future enhancements that will provide the United States with an effective theater ballistic missile defense capability.

There are some potential problems or "show stoppers" involved with this endeavor. The most worrisome are budgets and the development of a warhead to defeat the future missile threats. Without the funding, the program will go nowhere. Without an effective warhead or funding, U.S. forces, allied forces and civilians, and U.S. interests may be at stake.

VI. CONCLUSIONS AND RECOMMENDATIONS

For years, the United States has lived in the shadow of Soviet nuclear armed ballistic missiles. As the Cold War has ended and tensions between the United States and the former Soviet Union have eased, the strategic threat of global nuclear war has diminished considerably. Yet, while this threat is diminishing, a new threat is emerging. In the new international system, ballistic missile proliferation and related weapons of mass destruction are one of the major threats to stability in the new security environment. In the past two years attention has become more focused on ballistic missile proliferation due to Iraq's arsenal of ballistic missiles, which it used against Israel and Saudi Arabia during the Gulf War, and Iran and Iraq's use of ballistic missiles against population centers in the 1988 "War of the Cities". Ballistic missile systems are becoming increasingly prominent in Third World arsenals and are seen as destabilizing weapons that are a threat to regional peace and American vital interests in certain regions.

Today, some twenty nations either possess or are in the process of acquiring ballistic missiles. These nations have pursued ballistic missiles for a number of reasons that fall under the categories of military-strategic, political-diplomatic, and economic reasons. Military-strategic reasons are to increase the offensive capability of a nation in order to improve their strike capabilities and for deterrence. Under political-diplomatic reasons are the political leverage and psychological impact that ballistic missiles give, the fact that ballistic missiles are symbols of prestige and technological achievement, and they show a commitment to a strong defense. Economic reasons are to promote economic development and to possibly use them as export sales.

Due to the fact that Third World countries are developing and acquiring ballistic missiles for a variety of reasons and will continue to do so, present means of control may not be enough to diffuse the threat of ballistic missile proliferation. The present methods of export controls, arms control, and deterrence do not hold much promise of stopping the proliferation of ballistic missiles, although they may slow it somewhat. It is for those reasons that ballistic missile defenses will be needed in the future.

The majority of the present generation of ballistic missiles in the Third World are generally conventionally armed warheads that are combined with being relatively inaccurate. However, it has been shown that they can be quite useful for political reasons and psychological terror and can be effective against large area targets like airfields and bases and against civilian population centers. In the future the threat from ballistic missiles is likely to grow due to the development and application of technology that exists today. As nations continue to supplement their strike aircraft force with ballistic missiles, there has been a corresponding emphasis on the development of nuclear, chemical, biological, and advanced conventional warheads. The range, payload, and overall technical sophistication of ballistic missiles will continue to improve. Additionally, the introduction of terminal guidance on ballistic missiles will provide a dramatic step jump in accuracy to these weapons. These applications will greatly increase their utility and put many more targets, including U.S. Navy ships, at risk.

By the year 2000, some of the nations that have or are pursuing ballistic missiles may be able to arm their weapons with chemical, biological, nuclear, and submunition warheads and the requisite technology is available to allow them to

increase the range, accuracy, and lethality of their ballistic missile systems. With that, the civilian populations of U.S. allies will become increasingly vulnerable to these weapons. Also, forward deployed U.S. military facilities and forces, on both land and sea, could be threatened by these weapons. The greatest risk in the near future may be the delivery of chemical weapons, either by unitary warhead or submunitions.

The United States government has reacted to the changing events and threats throughout the world by proposing a new national security strategy. This strategy recognizes the decline of what remains of the Soviet Union as a threat and recognizes the emergence of new threats and regional crises as the new focus of U.S. national security concerns. It is a strategy that translates militarily into a strategy of regional contingencies. Since ballistic missiles have proliferated to every region in the world, theater ballistic missile defenses should be a part of that strategy.

A theater ballistic missile defense system can be an important contributor to deterrence, forward presence, crisis response, and reconstitution, which are the four fundamental pillars of the *National Military Strategy*. Under deterrence, theater ballistic missile defenses ease the burden of the deterrence problem against Third World ballistic missiles. The United States would have the capability to defeat enemy ballistic missile attacks against cities, bases, ports, and troops. Ballistic missile defenses can be part of U.S. peacetime engagement through their forward presence, either on land or sea, and by being forward deployed, particularly at sea, they can enhance U.S. crisis response capability. In a crisis, the defenses could be used to limit escalation, for offense suppression, and for joint task force and ground warfare support. Finally, continued research

and development can contribute to the United States maintaining its technological edge over all potential enemies.

The U.S. Navy has derived a new vision for the future from the *National Military Strategy*. *...From the Sea: Preparing the Naval Service for the 21st Century* develops a general framework for the contributions of naval forces to the new regional defense strategy. The Navy has recognized the threat that ballistic missiles can pose in the future. However, this thesis has shown that the defenses can play a much bigger role across the spectrum of naval warfare in future contingencies. As just one element of U.S. naval forces, they can contribute to the operational capabilities needed to successfully execute the new direction of the Navy and Marine Corps. In doing so, they can provide the task force commander a broad area of mission assignments to which they can be tasked. Working in coordination with land-based systems and space and air assets, they can provide a theater-wide defense against ballistic missile attacks. The advantages of a sea-based system lies in the fact that the Navy forces will generally be the first into a crisis region and would have the only on-the-scene missile defense capability and a sea-based system has the inherent mobility that can let them cover assets that a land-based system cannot. Table 6 summarized the missions and tasks that a sea-based defense system can provide to support the operational capabilities of the Navy.

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DIRECTION	ROLES	MISSIONS & TASKS
OPERATIONAL CAPABILITIES	Command, Control & Surveillance	Detection, Cueing, Tracking & Localizing
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		Airfield Protection
	Force Sustainment	Sealift Protection
		Port Protection

The Navy has the capability to make a substantial contribution to theater missile defense. A major part of the infrastructure is already in place with the Aegis Combat System. It is cost effective and lower risk because there are already existing platforms and some capability that can be upgraded to provide an effective theater ballistic missile defense system. There are a number of software and hardware upgrades that can be made with existing technology right now that will help improve performance against ballistic missiles. However, the two most critical items needed to make Aegis an effective, flexible and mobile ballistic missile defense platform are external sources of cueing and a

defensive warhead with proper guidance and control that can defeat all future ballistic missile threats. Other potential problems are the 1972 ABM Treaty, declining defense budgets, and operational tradeoffs for Aegis operating in ballistic missile defense mode.

The fundamental question that this thesis set out to examine was: Should the United States have theater missile defenses at sea and how can they be employed? The answer to that question is a resounding yes, with the means to achieve that end being the Aegis construct. Without ballistic missile defenses, U.S. forces, allied forces and civilians, and U.S. vital interests may be at stake in the future. The Navy should deploy a sea-based missile defense as soon as possible. As future enhancements and critical technologies come available, they can be rapidly integrated to provide the United States Navy with a complete system, that when combined with other systems, will provide the United States with an effective theater ballistic missile defense capability.

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