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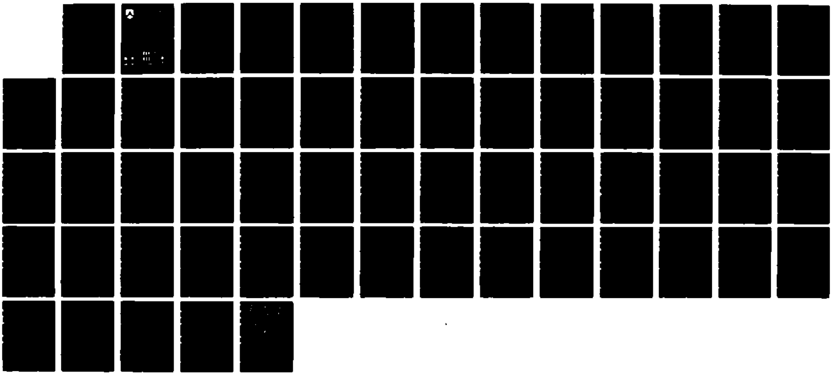

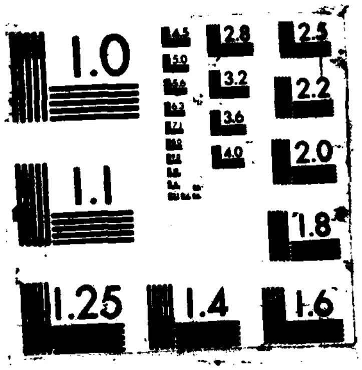
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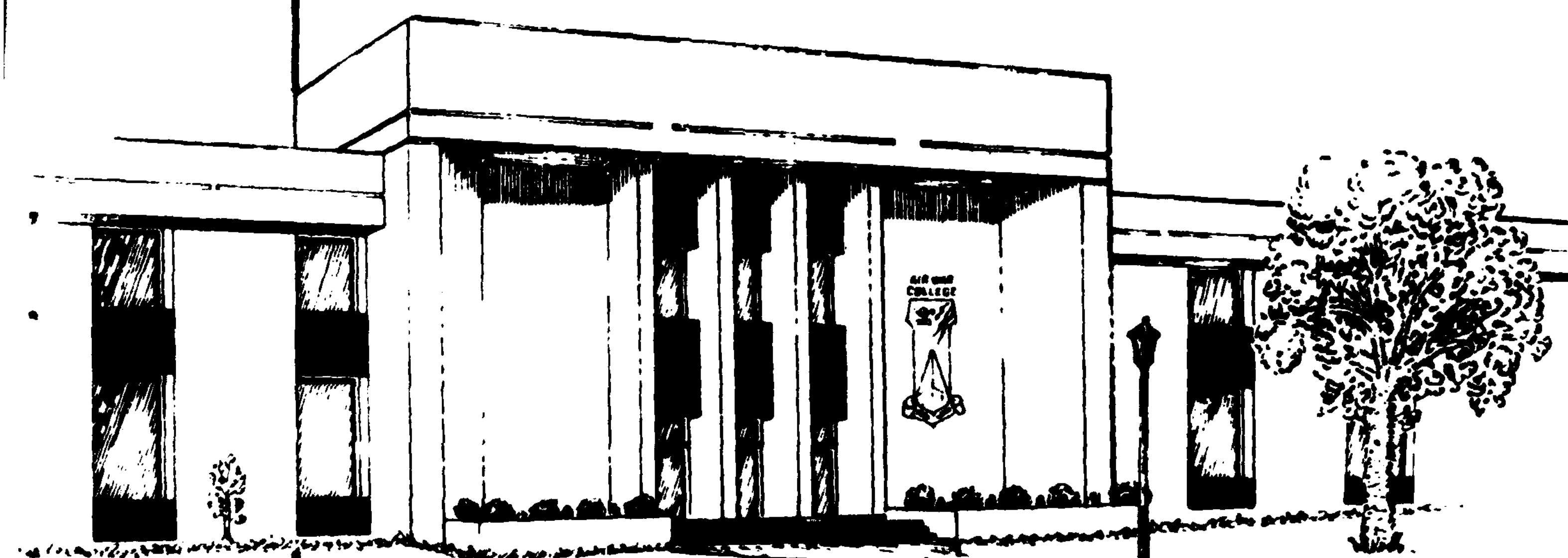
AIR WAR COLLEGE

RESEARCH REPORT

No. AU-AWC-87-043

B-52 MARITIME OPERATIONS: THE ANTI-SURFACE WARFARE MISSION (ASUW)

By LIEUTENANT COLONEL DONALD G. COOK, USAF; COMMANDER CHARLES H. HORNE, USN; AND COMMANDER WALTER W. MANNING, USN



AIR UNIVERSITY
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MAXWELL AIR FORCE BASE, ALABAMA

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B-52 MARITIME OPERATIONS: THE ANTI-SURFACE WARFARE MISSION (ASUW)

by

Donald G. Cook, Lieutenant Colonel, USAF
Charles H. Horne, and Commander, USN
Walter W. Manning, Commander, USN

A RESEARCH REPORT SUBMITTED TO THE FACULTY

IN

FULFILLMENT OF THE RESEARCH

REQUIREMENT

THESIS ADVISOR: Colonel William P. Moore

MAXWELL AIR FORCE BASE, ALABAMA

MARCH 1987

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DISCLAIMER-ABSTAINER

This research report represents the views of the authors and does not necessarily reflect the official opinion of the Air War College or the Departments of the Air Force or Navy.

AIR WAR COLLEGE RESEARCH REPORT ABSTRACT

TITLE: B-52 MARITIME OPERATIONS: THE ANTI-SURFACE WARFARE MISSION (ASUW)

AUTHORS: Donald G. Cook, Lieutenant Colonel, USAF
Charles H. Horne, Commander, USN
Walter W. Manning, Commander, USN

For the past 20 years, significant growth in Soviet naval force structure has occurred. Without question, this build up has allowed Soviet presence and influence to spread on a global scale. Our efforts to counter this threat is of major concern. As a partner with the Navy, the Air Force can provide valuable assistance in successfully defending the Sea Lines of Communications. The B-52 represents a credible, long range weapon system capable of conducting the anti-surface warfare (ASUW) mission.

This paper discusses the Soviet surface threat, how the navy presently counters the threat, and how the B-52 can be intergraded in to naval fleet operations.

BIOGRAPHICAL SKETCH

Lieutenant Colonel Donald G. Cook (MBA, Southern Illinois University), is a Command Pilot with over 3000 hours flying time. He has held various operational and staff positions in the Air Training Command, Hg AFMPC, and the Strategic Air Command. Most recently, LTCol Cook served as the Commander, 325 Bombardment Squadron, Fairchild AFB WA. He is a graduate of the Instrument Pilot Instructor School, Squadron Officer School, Armed Forces Staff College and the Air War College (1987).

Commander Charles H. Horne, is a pilot with 5000 hours flying time. He has flown the EC-130 in Patuxent River, Maryland; P-3Cs in Jacksonville, Florida, and the P-3B in Barbers Point, Hawaii. He has held various operational and staff positions in the Air Training Command, Pensacola, Florida and COMPATWING II, Barbers Point, Hawaii. Prior to attending Air War College, he served as Operations Officer, VP-17, Barbers Point, Hawaii.

Commander Walter W. Manning (M.S., United States Naval Postgraduate School), has been interested in joint maritime missions since serving along with U.S. Air Force units deployed to Keflavik, Iceland in 1975. After the fielding of the Harpoon missile on both the Navy's P-3 and the Air Force's B-52 aircraft, he became interested in exploring joint Anti-Surface Warfare (ASUW) operations. His background includes a tour aboard the destroyer USS Kraus (DD-849) in 1972-73, and he holds the Combat Action Ribbon for this service in Southeast Asia. A pilot with over 3000 hours, he has served as a P-3 Patrol Plane Commander and Mission Commander during operations throughout the Atlantic, Pacific, and Indian Oceans. He is a graduate of the United States Naval Academy, class of 1972 and the Air War College, class of 1987.

INTRODUCTION

In the late 1960s the size of the United States Navy's fleets began to decline significantly. In round figures the Navy's assets dropped from over 1,000 battle force ships in the mid-1960s to fewer than 500 such ships in the latter part of the 1970s. The rational for this decline was predictable and included the decomissioning of aging ships, Department of Defense (DOD) budget cuts, and a conscious decision by the Navy,to down size its fleets to modernize for the future.(1:175) Of key importance in the overall balance of naval power was the decrease in the main element of power projection in the nation's maritime strategy. The United States Navy's aircraft carrier force had fallen to an alarmingly low number: 13 front-line carriers and no escort carriers. Although the ships remaining in the fleet, and those under construction, were steadily improving over their predecessors, "there had been a substantial loss in capability relative to the Soviet Union." The Soviet Navy had advanced in both numbers and sophistication, and had emerged onto the world's oceans as a major "blue-water" naval power.(2:323)

From 1970 to 1977 the Soviet shipbuilding program had provided an increase of 25 percent in missile-equipped ships and a 60 percent increase in nuclear submarines.(2:327) Kiev class carriers, Kresta and Kynda class cruisers, Kashin and Kildin class destroyers, and Nanunchka class corvettes could threaten free-world navies with antiship cruise missiles, some from ranges up to 300 miles. The Charlie class submarines, designed for submerged launching of antiship missiles, could now attack with SSN-7 cruise missiles from a range of 30 miles. This capability vastly complicated the ASW problem and crucially limited response time to counter the incoming missiles. Concurrently, the Soviets amassed a force of over 300 naval bomber aircraft armed with long-range antiship missiles, capable of attacking the carrier battle groups from beyond the engagement ranges of its surface escort ships.(3:299)

Combating this growing Soviet surface threat has been on the DOD agenda for over a decade but not solely in the context of a naval counterthreat. The DOD turned its attention toward the United States Air Force for additional assets, specifically the E-3A Airborne Warning And Control (AWAC) aircraft and the B-52, as potential counter-surface threat platforms. This challenge has been met head-on by the Navy and Air Force Service Chiefs through the exchange of officers, joint exercises, and recent acknowledgment that Aerospace Maritime Operations is a legitmate Air Force mission.

ANTI-SURFACE WARFARE
(ASUW)

Anti-Surface Warfare(ASUW), or as it was formerly known Anti-Surface Ship Warfare, is a fundamental naval warfare task. It is defined as, "the destruction or neutralization of enemy surface combatants and merchant ships." Its primary aim is to deny the enemy the effective use of his surface warships and cargo carrying capacity.(4:1-4-2) While ASUW forces serve primarily to deter or defeat an enemy's heavily armed surface combatants and other lesser naval units, it is also a means to prevent the unrestricted use of the seas by any surface vessel. Further, ASUW can be either offensive or defensive in its application, or threat of application. It is offensively waged in a preemptive strike on enemy naval vessels and during fleet-on-fleet engagements, yet defensive when applied for protection. For example, ASUW is considered defensive against the aggressive actions of an enemy force seeking to attack sea lines of communications (SLOCs), or threatening to strike an amphibious landing force.

The following historical sketch serves to illustrate the evolutionary character of naval warfare, and ASUW in particular, during this century:

> Prior to World War II, enemy surface ships were sought out and engaged by other surface ships. Surface ships had numerous heavy guns that could effectively neutralize enemy shipping as well as base support areas. With the advent of aircraft carrier warfare in World War II, the role of the

surface ship changed to support fast carrier attack operations. Heavy guns were no longer needed for over-the-horizon targeting. The carrier's aircraft and the submarine assumed the responsibilities for neutralizing enemy targets at great distances from the task force. The surface combatant took on the responsibilities of air defense and close-in anti-submarine warfare operations for the carrier battle group.(5:49)

The revolutionary effects that air power would make on the future of anti-surface warfare were apparent early-on in the Pacific. The Battle of the Coral Sea (May 4-8,1942), the first carrier battle of the war, also became the first naval engagement in history where the opposing ships never came within sight of each other, even though there were six separate naval task forces involved in the battle. In addition to carrier aircraft, land-based aircraft were employed by both sides. The Japanese employed search, fighter, and bomber aircraft from Rabaul, New Britain, while the American forces were supported by B-26s from Australia.(6:662/7)

Though tactically exploited with some success, the performance of the land-based aircraft also pointed to one of the basic difficulties of their employment: target identification and recognition. The Japanese pilots from Rabaul returned to their base reporting they had sunk a battleship and a cruiser, when in fact they had attacked a detached United States oil tanker and her escort destroyer. The mistake made in identifying the target, prompted the Japanese to launch a full attack to the vicinity of the stricken oiler. This resulted in a fruitless attempt to find the remainder of the carrier task force which the Japanese assumed they had stumbled upon. Later a potentially more disastrous mistake in identity occurred. A flight of B-26s attacked an Australian cruiser-destroyer force which they mistook for Japanese warships.(6:665)

Scarcely a month later, the scenario was repeated at the Battle of Midway. Again, while the decisive engagements were achieved by carrier-based fighters, bombers, and torpedo planes, land-based aircraft were employed as search, scouts, and attack aircraft. However, the naval vessels from the opposing fleets never sighted or engaged one another during the conflict.

> Like the Coral Sea, the battle was entirely a contest of airpower. The Japanese were never given the opportunity to employ their immense superiority in surface ships.(6:687)

Though these battles clearly demonstrated that the future of naval warfare and sea-based power projection would be shaped by the offensive force of aircraft carrier battle groups, they also left little doubt that the sphere of anti-surface ship warfare had moved beyond the line-of-sight of naval vessels. Naval combat had truly entered the over-the-horizon targeting era.

SOVIET NAVAL SURFACE COMBATANTS

The use of United States Navy carrier aircraft provided the ability to conduct naval warfare from over-the-horizon and to project power ashore with airstrikes. These capabilities had not escaped the concern of the Soviet political and military leadership as early as the late 1940s. Consequently, in the post-war development of Soviet military doctrine and forces, the Soviet Navy was directed to develop an ocean-going navy to challenge the preeminence of United States and Allied naval forces. Under Joseph Stalin, the Russian ship building industry was rebuilt, assisted in part by German technology and scientists. Work began on medium range submarines and surface ships in classes from destroyers to battleships; plans were even undertaken to construct aircraft carriers.

After Stalin's death in 1953, Nikita Kruschev, pursuing a massive building program of intercontinental ballistic missiles, prompted a basic reappraisal of the kind of ships required to carry out the Soviet naval mission and appointed Admiral Sergei Groshkov as Commander-In-Chief of the Soviet Navy:

> In place of Stalin's planned ocean-going fleet, Admiral Groshkov was directed to develop a missile-armed navy of small craft and submarines which could "defend the Soviet Union from possible Western aggression." It was hoped that comparatively inexpensive guided (cruise) missile cruisers could counter the US Naval Forces...the Soviet Military planners were particularly concerned with US aircraft carriers which could

launch planes carrying nuclear bombs aimed against their homeland while several hundred miles at sea, and with amphibious forces which could land troops on Soviet coasts.(7:4)

During the decade following Gorshkov's appointment, the Soviet Navy developed both surface ships and submarines that could launch antiship missiles at Allied and surface forces. The Soviet Navy led the world in the employment of cruise-missiles in naval warfare with the incorporation of the 100 nautical mile range, SS-1 "Scrubber" missile on the Kildin and Krupny class destroyers and modified-Whiskey class sub-marines. They incorporated the 25 nautical mile range, SSN-2 "Styx" missiles on the OSA and Komar, high speed patrol boats which were all fielded in the late 1950s.(7:22) Later, during the early 1960s, the Soviet Navy added more firsts with the launching of the Kynda class guided missile cruisers, the diesel powered Juilet and the Echo II class nuclear powered guided missile submarines. Each platform was armed with the SSN-3 "Shaddock" antiship cruise missiles; a total of 16 missiles on the Kynda (8 with 8 reloads), 6 and 8 on the Juliet and Echo II class submarines, respectively. Receiving over-the-horizon targeting information from "either aircraft, submarines, or surface ships, this missile could deliver up to one ton of high explosives or a nuclear warhead against hostile ships or land bases from over 200 nautical miles away."(8:8)

These forces were but the harbinger of future strides in

Soviet naval force development and building programs. Since the 1960's, the Soviet Navy's surface forces have grown both in size and capability. Soviet naval construction has encompassed new classes of all major combatants, including submarines, three Kiev (CVHG) class vertical/short takeoff and landing (VSTOL) aircraft carriers, two Moskva (CHG) class helicopter cruisers, and finally their first attack aircraft carrier:

> The highlight of the year (1985) in Soviet Navy construction was the launching of a new class of large (65,000-70,000 ton) conventional takeoff and landing aircraft carrier. It is by far the biggest ship ever built for the Soviet Navy and is exceeded in size world wide only by the US Navy's super carriers. The new carrier will be nuclear powered, 300 meters (985 feet) long,and will probably have an airwing of about 60 fixed-wing jet aircraft and helicopters.(9:98)

The major surface ships of the Soviet Navy today have evolved with even greater anti-surface weapon capabilities showing marked improvements in firepower, range, speed and guidance systems. They are among the most heavily armed and capable warships in the world. The true measure of the Soviet Navy's maturity and its capability to conduct anti-ship strikes is emphasized both by the number and types of antiship missiles in their inventory, their great diversity in launch ranges, and the wide-range of naval units that deploy with these missiles. Though excluding the air-launched antiship missiles, the following table serves to illustrate the magnitude of the antiship missile threat from the Soviet Navy's surface ships and submarine forces:

TABLE (1)

ANTISHIP MISSILES

MISSILE	NATO NAME	Approximate RANGE(nm)	Soviet Launch PLATFORMS(CLASS)
SSN-1	SCRUBBER	100	KILDIN, KRUPNY
SSN-2	STYX	25	OSA I/II, NANUCHKA MATKA
SSN-2C	STYX(improved)	50	OSA II,MOD KASHIN MOD KILDIN,MATKA TARANTUL I/II NANUCHKA II
SSN-3B	SEPAL	250	KRESTA I, KYNDA
SSN-3C	SHADDOCK	350	ECHO II, JULIET
SSN-7	----	30	CHARLIE I
SSN-9	SIREN	60	NANUCHKA I/III SARANCHA, PAPA CHARLIE II
SSN-12	SANDBOX	300	KIEV, SLAVA ECHO II
SSN-14	SILEX	30	KARA,KIROV KRESTA II, UDALOY
SSN-19	----	300	KIROV, OSCAR
SSN-22	----	60	SOVREMENNY TARANTUL II

NOTE: Data based upon Appendix B, "To Understanding Soviet Naval Developments," Office of the Chief of Naval Operations, Fifth Edition, April 1985.

UNITED STATES NAVY ANTI-SURFACE WARFARE FORCES

As Soviet naval warfare strategy began to move over-the-horizon, the United States Navy developed the concept of "Destruction-in-Depth" (both offensive and defensive) to counter these weapons. The concept involves striking Soviet naval forces beyond the launch range of their standoff weapons and providing sequential "layers" of kill opportunities for "leakage," (aircraft and missiles that succeed in penetrating the outermost engagements). The concept of layered defense was developed in the late 1950s, to handie the threats presented by air-to-surface missiles launched by the Soviet's long-range bomber force and the SSN-3 antiship cruise missile(ASCM).(10:64)

Today, destruction-in-depth is based on the ability of combined forces (both United States and Allied) to detect the enemy well before he can reach his standoff weapons release range, prevent closure to within launch range of the main elements of the naval task force, and maneuver additional elements of the task force to attack the threat. The same principles apply to all three fundamental naval warfare tasks: anti-air warfare (AAW), anti-submarine warfare (ASW), and anti-surface warfare (ASUW). Execution of the concept may involve the full breath of naval forces, from mining of enemy ports and geographic choke points, to discouraging or preventing his massing of forces, or denying him access to sea control areas:

Anti-surface warfare involves carriers, submarines, cruise missile-equipped ships,and land-based forces eliminating forward-deployed surface ships at the outset of the conflict. This requires appropriate rules of engagement at the brink of war to avoid losing the battle of the first salvo which is so important in Soviet doctrine. Our allies also have a critical role to play in anti-surface warfare. Germany, for example, will bear the brunt of the campaign in the Baltic, while the Turks will be key players in the Black Sea. As our forces move forward, antisurface warfare will continue, with a goal, the elimination of the Soviet fleets world wide.(11:12)

As previously pointed out, destruction-in-depth relies first upon detection-in-depth. Early detection of the enemy's surface forces is essential to distant engagement by the naval task force. Early detection from intelligence sources (including national and allied intelligence assets) and surveillance systems (United States Navy, sister services and allies) would be fed to the naval task force commander to provide him an over-the-horizon "picture" and assessment of the threat.(12:24)

The Navy Tactical Data System (NTDS) aboard the surface combatants and aircraft of the force can correlate the diverse data. Additionally, they have the capability to exchange tactical information among the units of the force and provide the task force commander with the type of "targeting-picture" he requires for employing forces to counter the enemy threat.

To "fight-in-depth" the task force would make engagements utilizing its layered offensive and defensive force.

the first layer could be provided by a combination of weapon platforms, consisting of cruise missile equipped attack submarines (SSNs), Tomahawk or Harpoon equipped surface combatants, and Harpoon equipped land-based and carrier-based aircraft. Attack submarines patrolling several hundred miles ahead of the task force could attack independently or in coordinated strikes with other units using Tomahawk or Harpoon antiship cruise missiles,

In addition to submarines, a vanguard naval surface force could be tasked, based on intelligence reports, to counter the enemy's anti-carrier warfare (ACW) surface ships. This Surface Action Group (SAG) would consist of a mixture of cruise missile equipped battle ships, cruisers, and destroyers. Long-range, land-based aircraft such as the P-3 and the B-52 are prime candidates to be used as Harpoon equipped platforms in the outer layer of defense.(13:101)

The next layer of engagement would likely be provided by a combination of carrier aircraft, P-3s, ships and submarines detached from the carrier battle group (CVBG). Early warning, surveillance, and targeting for these forces would be provided by the E-2C Hawkeye, while F-14 Tomcats provide fighter cover. Rounding out this layer's air arsenal would be the EA-6B Prowler. Designed to degrade enemy defenses by jamming their radar and communications, the Prowler would increase both the effectiveness of the attack and the survivability of the attackers.(11:14)

Should any enemy forces survive to close to their stand-off weapons range for launch of their missiles, they would be subjected to a second attack as mentioned above. The attack would take place beyond the range of the Kiev's, Slava's, or Kirov's cruise missiles. However to insure accuracy beyond their radar horizon (about 25 miles) these missiles require midcourse guidance from a targeting platform. This is usually provided by either the Hormone-B helicopter carried by these ships or the Bear-D land-based bomber.(7:33)(8:38) Thus, a preeminant part of this and earlier attacks would be air-to-air strikes on the targeting aircraft by F-14s and F/A-18s, and surface AAW surface-to-air missiles.(11:14)

Finally the defensive layers of the battle group would be brought to bear on any leakage of cruise missiles or aircraft. The first layer to engage would be the F-14s and F/A-18s followed by the surface-to-air missile platforms, and finally the point defenses, Sea Sparrows and Phalanx gatling guns.(11:14)(5:60)

B-52 AND HARPOON MISSILE COMBINATION

The present Anti-Surface Warfare capability of the B-52 "Stratofortress" evolved from the United States Navy's development of the HARPOON (AGM-84A) cruise missile in the 1970s. Admiral Elmo Zumwalt, then Chief of Naval Operations, had the missile's development expanded beyond its initially envisioned use against surfaced Soviet cruise missile submarines. This expansion of applications included its use as an anti-surface warfare weapon that could provide stand-off capability by ships, aircraft, or submarines.(14:36) Precedence for air-launched, antiship guided missiles on naval aircraft had been established earlier with the Bullpup antiship variant. However, because of its limited range and manual guidance, the Bullpup had become virtually ineffective as a standoff weapon against the Soviet's modern AAW defenses.

Meeting the challenge of the expanding Soviet capability to launch cruise missiles against United States and allied naval forces and to interdict our vital sea lines of communication (SLOCs) had become increasingly difficult. At a time when United States naval strength was declining, as previously outlined, the Soviets had achieved significant advances in all threat categories: air, surface, and subsurface. Similar declines in the naval forces of our NATO allies exacerbated the problem, and led our defense planners to investigate additional means to counter these threats:

> In 1975, Secretary of Defense, James R. Schlesinger, proposed to marry the Air Force B-52 with the Navy Harpoon antiship missile for use in the sea interdiction role.(15:30)

This proposal was given a "fair and cooperative" hearing by both the Air Force and the Navy; various options for providing a standoff antiship weapon for the Air Force were evaluated. Also, on 2 September 1975 a Memorandum of Agreement was signed by Chief of Naval Operations, Admiral J.L. Holloway III, and Air Force Chief of Staff, General David C. Jones to provide for "training Air Force resources in collateral maritime functions."(16:1)

An evaluation of three options was undertaken. The three potential antiship weapons evaluated for the B-52 were the Harpoon, the GBU-15 glide bomb, and a laser-guided glide bomb (MK-84). In 1976, the Air Force decided in favor of the GBU-15, an electro-optical guided weapon, which was an improved follow-on to the "smart bombs" used in Vietnam. While normally employed on the MK-84, 2000 pound bomb, the GBU-15 offered the advantage of being a modular unit that was compatible with various warheads. The GBU-15 could be locked onto a target prior to launch or flown into the target manually by the B-52 navigator.(17:34) This flexibility, which permitted the use of the GBU-15 against land and naval targets, probably accounted for its selection by the Air Force. Its short standoff range (approximately 7 miles) made its effectiveness and the survivability of the launching aircraft suspect in contrast to the range of SAM defenses aboard the newer Soviet warships. Then Air Force Chief of Staff, General Lew Allen reported to the Senate Armed Services Committee:

> ... that the Air Force had demonstrated the B-52s capability to kill ships with the GBU-15 guided bomb; however, he stated that this weapon's stand-off range "is really not quite good enough to get in close enough to well-defended combat ships of the Soviet Navy," although the GBU-15 could be effective against some vessels.(18:25)

In 1982, the idea of arming the B-52 with Harpoon missiles was again brought before the combined attention of the Air Force and the Navy. According to Richard Barnard, of Defense Week:

> In his defense guidance -- the "definitive framework" for strategic and tactical planning by the military services which was prepared last March -- Defense Secretary Casper Weinberger ordered the Air Force to equip its B-52 bombers "with suitable radar and stand off conventional weapons" to attack Soviet warships and naval ports.(19:1)

The Chief of Naval Operations, Admiral Watkins, and the Air Force Chief of Staff, General Gabriel, addressed the new guidance by issuing another joint memorandum of agreement (MOA). In their 9 September 1982 MOA, entitled "Joint USN/USAF Efforts To Enhance USAF Contribution to Maritime Operation", the two service chiefs stated:

> As reflected by the Defense Guidance, requisite maritime strength to keep all SLOC's open is an indispensable component of the US military posture. The broadening threat to this capability

is clearly recognized and sustained efforts are underway to regain maritime superiority. The combined assets of the Navy and Marine Corps are insufficient to meet the threat in all areas. To obtain the best deterrent value and fighting capability in wartime, a continued effort is needed to prepare for the optimal interaction of service forces. The Navy and the Air Force should therefore accelerate their joint efforts to exploit their capabilities to enhance maritime operations in defense of the SLOC's.(20:1)

It was further stated that while anti-air and counter-air operations were the two Air Force capabilities that would provide the most immediate gains, " ...the Air Force will also improve its antiship capability in support of the Anti-Surface Ship Warfare (ASUW) mission."(20:1)

Following the signing of the 1982, Watkins-Gabriel MOA, the Harpoon missile replaced the GBU-15 in the antishipping weapon test program, and the B-52G models became the candidate aircraft, replacing the older B-52Ds which had begun to be retired (the last B-52Ds were retired by October 1983). Meanwhile other B-52G and H model aircraft were being adapted for employment as a weapons platform for the AGM-86 air-launched, cruise missile (ALCM).(17:25) The B-52Gs not assigned as ALCM carriers became available for multi-mission conventional roles:

> USAF Strategic Air Command has earmarked 67 B-52Gs for use in a conventional reconnaissance/strike role for the 1980s, as the B-1B becomes operational. The fleet represents the balance of the B-52G force less the 99 aircraft being modified to carry cruise missiles, and they will be the first SAC aircraft to be expressly assigned to a non-nuclear mission. Currently the B-52 can strike precision targets from a low-level overhead

> run. With the proliferation of modern SAM systems such an attack is likely to be too costly to be contemplated. Under the conventional Stand-Off Capability (CSC) program, the 67 conventional strike B-52Gs are to be given the ability to attack precision targets from outside SAM range. (21:104)

Considering the complexity of typical airborne weapons systems, the integration of the Harpoon with the B-52Gs proceeded quite rapidly. By early 1983, the program had completed all major milestones:

> The Air Force in cooperation with the Navy completed a series of flight tests in March 1983, to demonstrate the capability to launch Harpoons from B-52s. The test culminated with three live firings against a Navy surface target. All three firings were successful. A pair of AWAC planes equipped with maritime surveillance radars and temporarily modified with Navy targeting systems provided surveillance and coordination during the tests, which were conducted on the Navy's Pacific Missile Test Range and coordinated by the Commander of the Third Fleet.(22:38)

Thus, the tests had not only proven that the B-52 and Harpoon combination could be successfully employed in anti-surface warfare roles, but that the E-3A AWACs could serve as an over-the-horizon surveillance and targeting platform for maritime forces. Moreover, it substantiated its worth for coordinating naval surface engagements thereby enhancing the total United States forces capability to conduct maritime operations.

Following these tests, the first operational B-52Gs were modified to carry and launch the Harpoon. The 69 Bombardment Squadron (69 BMS) stationed at Loring AFB, Maine became the first squadron to undergo aircraft Harpoon modification and aircrew training for the antiship cruise missiles employment. The squadron's transition, like the test and evaluation program, was relatively expeditious, with the 69 BMS achieving a limited operational capability in October 1983, and full operational status in December 1984.

In the intervening years since the 1982 Defense Guidance and the Watkins-Gabriel MOA neither the Soviet threat nor the resolve to counter that threat has deminished. In a more recent statement concerning his continued support for the United States Air Force and the B-52 in maritime roles, Secretary of Defense Weinberger stated in early 1985:

> During the past year ten long-range B-52G bombers were configured to fire the Harpoon, and we intend to modify 20 more by the middle of this year. This program, which enhances our capability to conduct antiship strikes world wide is an excellent example of how expanded cooperation among the military services can increase our overall defense capabilities.(23:162)

Today, there are two squadrons of B-52Gs equipped and trained to perform the ASLW mission. Together the 69 BMS at Loring AFB, Maine and the 60 BMS at Andersen AFB, Guam provide a total of 30 Maritime/CSC bomber aircraft, each capable of launching up to 12 AGM-84 Harpoon missiles per sortie.

THE B-52 IN THE ASUW ROLE

Arming the B-52 with the Harpoon antiship cruise missile has magnified and strengthened the Stratofortress' already exceptional qualities for maritime employment. The combination of the two has provided the United States Navy with a truly viable and important "joint partner" for anti-surface warfare.

The qualities that have made this true are largely the B-52's global operating radius, high dash speed compared to the Navy's P-3, high altitude performance, long endurance (coupled with an air-refueling capability), and large payload. Specifically, the important characteristics of the B-52 that compliment its maritime employment are: maximum level speed at high altitude of mach 0.84/390 knots indicated airspeed (IAS), a high altitude cruising speed of mach 0.77/442 knots true airspeed (TAS), and a penetration speed at low altitude of 350-390 knots IAS. Its outstanding range of 6500 nautical miles (over one and a half times that of the P-3 Orion) is extendable by inflight refueling. (24:402) In fact, the B-52 has twice flown around the world non-stop. The last occasion was in March 1980, and was completed with an elaspsed time aloft of over 42 hours.(25:38-42) More recently during the 1982 Bright Star exercise, a total of eight B-52s flew in formation over 7500 miles non-stop (from their base in North Dakota), made three inflight-refuelings, and dropped their bombs on exercise targets in

Egypt. Upon completing their attacks the aircraft rejoined and returned to their home bases on a mission that saw them airborne some 31 hours and over a distance of 13,000 miles.(26:41)

Its capability for delivering heavy weapons loads day or night, in all weather over long distances is also well documented. B-52Ds flown on Linebacker operations against North Vietnam each carried over 50,000 pounds of conventional bombs. Though operated on extended routes from bases in Guam and Thailand they proved deadly accurate. The B-52G has a pay load of 30,000 pounds external, 40,000 pounds internal and a bomb bay volume of 1,043 cubic feet. The aircraft is presently equipped to fire 12 externally mounted Harpoon missiles (six per side on hard point pylons). With so much payload capacity available internally, the Boeing Company has shown that another eight Harpoon missiles could be carried with minor bomb bay modifications.(27:6)

Unquestionably, these are great attributes for the National Command Authority's strategists and planners. Further, the task force commander can factor-in the B-52 as a "renewable asset." An onstation B-52, having fired all of its missiles, can be relieved by another fully loaded B-52. This allows the ships of the task force to conserve their own less easily replenished supply of antiship missiles. The B-52 can be tasked in a distant preemptive or offensive engagement instead of detaching several ships from the task force. This provides economy of force by allowing those ships that would otherwise be detached from the force to provide a more effective defensive umbrella around the task force. If needed to provide the improved probability of success, "cells" of two or more B-52s can be tasked based on the commander's assessment of the enemy's order of battle. In most engagements, coordinated strikes employing Harpoons, or a combination of Harpoon and Tomahawk cruise missiles, fired from several launch platforms along different axis will be required to counter a Soviet task force.

While the development of cruise missiles made a vast improvement in the standoff capability and survivability of ships, aircraft, and submarines, it did not make one-on-one ASCW engagements an overnight reality. The greater engagement range afforded by missiles such as the Tomahawk and Harpoon introduced more uncertainly in the targeting problem, which has a proportional effect on the number of weapons that need to be "put-on-target," to achieve desired kill probabilities. In a recent article, "Cruise Missile Warfare," Captain Myron Hura, USN, and Lieutenant Commander David Miller, USN, identified three major fleet limitations that exist in naval cruise missile employment:

> Only a finite number of cruise missiles are available at any given time for use by a navy battle force.

Nondiscriminating seeker systems, when confronted with multitarget formations mandate large salvo sizes.

Large salvo requirements, contrasted with finite magazine loadouts, early during a possible war at sea scenario.(28:97-102)

The B-52Gs with their existing salvo capability of 12 Harpoons, and their renewability by relief aircraft, or by sortie regeneration, can greatly assist in overcoming these limitations.

Many factors affect the necessity for large salvo sizes, some of which are known to a high degree, such as the specific performance estimates of our own-force weapons and systems. Other factors are much more difficult to estimate with precision. Such data includes the capabilities of the enemy's anti-missile defenses or his missile counter-measure effectiveness. The self-defense capabilities of the enemy force must be estimated to predict how many missiles must be fired to penetrate the enemy defenses to insure that the attack will achieve the desired results. In actuality the entering argument becomes, how many missile hits does it take to kill the desired target, based on the target's size and survivability features (e.g. waterline armor plating, watertight compartments, and damage control effectiveness).

In a study by the Brookings Institution, Michael MccGwire provided the following rule-of-thumb to estimate the number of missile hits required to achieve a "mission kill" of the target. First explaining that the number of missile salvoes is related to target size and construction, damage control capabilities, the impact point of the missile, and the amount of unburned fuel remaining in the missile which increases the explosive effects, he suggests, a rough estimate for missiles required can be made based on a ship's length. MccGwire states, "... as a very crude measure for Soviet ships one might allow one warhead for the first 300 feet of length, plus an additional warhead for each additional 100 feet."(29:235) Later commenting on the factors that require additional missiles to ensure getting the requisite number of "mission kill" missiles through to detonation, MccGwire states:

> ...successful penetration depends on overburdening the defenses' target handling capability. The latter is related to the speed of incoming missiles (which dictates available reaction time), the number of fire control channels (which determines the number of targets that can be handled simultaneously) and the rapidity with which missiles can be detected, designated, and weapon's systems retargeted. Again it is impossible to be precise about the number of missiles required to achieve saturation, as it will differ between ship classes and fleet formations, but some indication of this "price of admission" can be inferred from the types of antiair weapons and the number of separate fire control systems a ship carries.(29:236)

The following table, presents a selected portion of the results of MccGwire's study of the number of "mission-kill" and "price of admission" missiles required to attack Soviet naval combatants:

TABLE (2)

SHIP CLASS	YEAR IOC	LENGTH (feet)	MISSILES FOR MISSION KILL	MISSILES TO SATURATE	PRICE OF ADMISSION
KYNDA	1962	465	2-3	1	3-4
KRESTA I	1968	510	3	1	4
MOSKVA	1967	625	4	2	6
KRESTA II	1969	520	3	4	7
KRIVAK	1970	410	2	3	5
SVERDLOV	1972	690	5	3	8
KARA	1972	570	4	6	10
KIEV	1975	900	7	8	15
KIROV	1980	755	5-6	12	17-18

The effect of assigning a number of escort ships around a High Value Unit (HVU) is to provide a defensive umbrella in terms of protective and deceptive systems. A pair of naval researchers factored in the protection provided by escorts and their results are presented in the following two tables.(28:100) The first represents the missiles required to insure 80 percent confidence of successfully neutralizing the HVU in close company with three escort ships; the second table shows the same confidence level but with various numbers of escorts:

TABLE (3)

HVU	NO.ESCORTS	HVU's PRICE OF ADMISSION	TOTAL MISSILE SALVO REQUIRED
KYNDA	3	3	9
KRESTA I	3	4	12
MOSKVA	3	6	19
KRESTA II	3	7	23
KRIVAK	3	5	16
SVERDLOV	3	8	26
KARA	3	10	33
KIEV	3	15	51
KIROV	3	18	62

TABLE (4)

HVU	NO.ESCORTS	HVU's PRICE OF ADMISSION	TOTAL MISSILE SALVO REQUIRED
MOSKVA	3	6	19
MOSKVA	5	6	26
MOSKVA	7	6	32
KARA	3	10	33
KARA	5	10	46
KARA	7	10	57
KIEV	3	15	51
KIEV	5	15	71
KIEV	7	15	9[illegible]

Finally, since the preceding data assumed a missile without an identification and discrimination guidance system, which would permit it to preferentially reject the escorts and lock-on the HVU, the following table shows the reduction in salvo size when a smart missile is used that has the capability of target discrimination and has a 50 percent probability of HVU acquisition:(28:100)

TABLE (5)

HVU	NO.ESCORTS	HVU's PRICE OF ADMISSION	TOTAL SALVO RECOMMENDED
MOSKVA	3	6	12
KARA	3	10	19
KIEV	3	15	29

The point is obvious, the addition of Harpoon armed B-52s to an ASUW force of a naval task group may be far from a luxury in many naval warfare scenarios. In a preemptive strike against a large Soviet task force, with several HVUs and escorts, the added firepower carried by the B-52s could mean the difference in success or failure of the attack. In a fleet-on-fleet engagement, the employment of the B-52s might be an absolute necessity to gain the initiative and win the battle! Simply stated, mating an off-the-shelf missile, to a proven aircraft, flown by an established cadre of professionals, made the decision to make the B-52 Harpoon capable, both a low-risk and a cost-effective solution. Together they are providing a greatly increased ASUW capability in support of the nation's maritime strategy.

E-2C AND OVER-THE-HORIZON TARGETING

The basic tenet of antiship cruise missile (ASCM) warfare is to fire the missile "on course" with sufficient accuracy to insure the target will be within the detection envelope of the missile's terminal guidance system upon "seeker" activation. In the case of the Harpoon, the terminal guidance system is a frequency agile, jam resistant, active radar guidance package. However, unless the targeting and launch platforms are positioned accurately enough to put the seeker acquisition pattern "on-top" of the target, the most reliable and discriminating weapon will merely search aimlessly and not acquire the intended target. Therefore, the primary requirement of ASUW is to furnish precise over-the-horizon-targeting (OTH-T) information, to insure enough missiles saturate the target's defenses, and cause the maximum amount of damage or destruction.

The following quote will serve to highlight how tactical parameters and environmental factors cause important differences between land and naval combat:

> Problems encountered in maritime warfare present major differences to air and land campaigns. One aspect of the maritime mission not fully appreciated by those not expert in naval warfare is the significance of ship classification--ability to distinguish combatants from noncombatants and to determine the types within the combatant class. Consider the enormous volume of territory above, below, and on the surface of the ocean. Thus, the ocean, seldom, if ever, presents any "fronts" or "forward edges of the battle area." Its geographic sectors cannot be controlled in the same way as on land, and rear areas tend to be more vulnerable.

> In the opening phase of a conflict, the ships of opposing sides are likely to be mingled, rather than separated. Rather than being analogous to a football game with opponents lined up on both sides of the Forward Edge of Battle Area (FEBA), naval battle is more like a basketball game, with both sides interspersed; no recognizable FEBA exists.(30:11-45)

This facet of naval warfare produces additional difficulties, far beyond those the cruise missile's seeker faces in acquiring the targeted HVU once the missile is launched. The larger, more perplexing problem for the targeting and launch platform -- one with an even more crucial importance -- is determining the enemy's shipping (warships and cargo) from background shipping (neutral, allied, or own force). Raw radar returns confirm little other than contact with an object on the surface has been made. It would be extremely easy to attack the wrong ship, even if the contact happened to be exactly where earlier intelligence predicted the target to be.

To this dilemma add the mobility of naval forces (maximum speeds in excess of 30 knots) and the element of maneuver. The targeting problem becomes vastly more complicated in the OTH-T scenario. Naval forces are constantly moving from departure until arrival at their destination, a fact that presents difficulties for both friendly and hostile forces. Their direction of movement can not always be assumed to be in the general direction of the theater of operations. For instance, a carrier battle group will constantly alter its heading to achieve deception, to keep a hostile force from achieving a fire control solution, to take advantage of areas of concealment (fog, precipitation, or cloud cover), or to launch or recover aircraft.

The preceding examples all serve to illustrate that the sensor and fixing systems used to identify and target an enemy force must do so with a high degree of precision and certainty. They must provide sufficient position accuracy, image resolution, and timeliness to allow those who must decide to "pull the trigger," the assurance that they are not attacking friendly or neutral forces. Additionally, the combination of sensors that "fix" the target and the platform that launches the weapon must be able to maximize the standoff range of the weapon employed, while providing maximum survivability to the launch platform. Accurate identification and classification of detected surface contacts is an operational necessity, both to preclude firing on your own or neutral forces, and to avoid a "surprise attack" by a presumed friendly or an inadvertent disclosure by a surface "tattle-tale." Addressing the dilemma facing the "shooters" of over-the-horizon weapons, Captain Villar of the Royal Navy made these observations:

> Each method of locating a target brings its own problems; some may produce a positive and accurate position whilst others give no more than a rough bearing. In few is it possible to make a positive identification without actually sighting the target visually...that is the essential quandry of the fast attack craft -- that although it has over-the-

> horizon range missiles, it can only be regarded as an autonomous unit out to the very limited range at which it can actually identify its target positively.(31:31)

At least two authors have addressed the problem of imbalance between sensors and weapons regarding the B-52 in anti-surface warfare roles. The first article appeared in February 1983, one month before the successful completion of the B-52 Harpoon test firings. The author of this article entitled, "B-52 Roles in Sea Control," was the manager for strategic system concepts for the Boeing Military Airplane Company, and a former assistant to the Under Secretary of Defense for Research and Engineering. In the article, Mr. B. G. Nix states:

> A B-52 sea control mission requires long-range ship detection, long range selectivity ... long-range ship classification ... and close loop tracking of the missile and target to provide command update guidance to the missile ... (30:45-46)

Although "command update guidance" is not a requirement for the Harpoon, the author was envisioning the potential for launching follow-on, longer range missiles. Mr. Nix, while making it plain that such improvements to the B-52's sensor package would permit it to fully exploit antiship weapons, also explains that the technology required to do so (e.g. high-speed processors and synthetic aperture radar) was presently available. Later, the following year, in a National Defense University Monograph, Colonel Thomas A. Keaney, USAF, addressed the issue of the B-52's sensor system as follows:

> Even carrying the Harpoon, the B-52 has only the start of an antiship capability. While the missile has a 50-mile range the B-52 can not positively identify what the target is at 50 miles.(17:37)

While discussing the difficulties of warfare on the broad expanses of the ocean, Keaney further stated:

> Effective targeting in this environment requires a positive identification; for a B-52 this identification must be visual. In essence the standoff capability is largely negated.(17:37)

Colonel Keaney's premise should not be construed as the limiting values of either the missile or the radar. A separate study, based on the B-52 Busy Observer maritime surveillance program, reported that when flown on overwater missions the B-52 had demonstrated "observed radar ranges for surface ships as great as 65nm at 28,000 feet and 55nm at 3000 feet."(32:75) Similarly the Harpoon's manufacturer, McDonnell Douglas, advertises the improved Harpoon has a range of over "67 miles on any heading."(33:180)

Regardless of the maximum range of the radar or the missile, the basic limitation of "positive identification" reported by Keaney remains. This limitation, however, should not be considered as operationally crucial to the B-52's ability to perform as a standoff ASCM platform. That capability has been tested and exercised repeatedly. Instead, the imbalance between sensor and weapon merely restricts the B-52's present ability to fulfill the role as a totally autonomous OTH-targeter and shooter. In other words, it can not act as a hunter-killer out to the full range capability of the Harpoon missile.

If this virtue, the ability to perform as a hunter-killer were the sole determinant of viability as a standoff shooter for antiship cruise missiles, then there would be no need to install such systems on surface ships or submarines. Surface search radars on ships have distinctly limited range, when attempting to detect surface vessels, low flying aircraft, or cruise missiles. The range of these radars in such instances is determined by the height of the radar antenna, the height of the target, and the prevailing sea-state. Under ideal conditions, assuming a radar height of 75 feet on surface ships, the radar detection range is on the order of 20-23 nautical miles.(12:26) This hardly optimizes the standoff range available with the Harpoon, not to mention the much longer range of the Tomahawk antiship missile (TASM) version presently being fitted aboard United States Navy ships.

Among aircraft that carry the Harpoon, the B-52 is not alone in the targeting dilemma. While more capable in nominal detection ranges and the ability to provide 360-degree coverage, neither the AN/APS-115, nor the AN/APS-80 airborne search radars used by the United States Navy's P-3Cs and P-3Bs respectively, were designed with the capability to classify radar contacts. Although these aircraft to possess other passive sensors, none of the initial P-3s to receive Harpoon were any more capable than the B-52 at positively identifying a radar contact as friend or foe beyond visual ranges. Only now are the newest generation of ASW/ASUW aircraft, the P-3C update IV, and the S-3B, receiving the capability to perform such autonomous targeting at or beyond the maximum range of the Harpoon missile. This capability will be provided by the APS-137 inverse-synthetic aperture radar (ISAR), designed as an upgrade for the APS-116 radar on the S-3A Viking. This radar "provides a continuous imaging capability through the addition of ISAR processing, which generates true, two dimensional radar images of any selected target," in addition it features long-range navigation, improvements in periscope detection, high altitude surveillance, and multiple target tracking.(34:140) The APS-137 ISAR radar will be retrofitted to upgrade earlier P-3Cs and has also been proposed as a modification to the A-6E Intruder.

While the B-52 does not currently possess the sensors to provide maximum range targeting as a hunter-killer, its exceptional Harpoon firepower (twice that of a P-3 and three times that of an A-6) continues to make it an extremely potent asset in naval warfare. Instead of the total autonomy of a true hunter-killer, the B-52, like other platforms without an organic means of target identification, can still maximize the capability of its weapons as a member of a two-

[illegible] OTH-T team.

Two-party targeting, as the name implies, involves the coordination of two or more sensor/weapons platforms. The targeting partner of the pair may or may not carry standoff weapons, but in any case provides the detection, classification, position, and track information, necessary for the shooter to complete a fire control solution. This was the targeting situation used successfully during the initial B-52 Harpoon test firings where targeting instructions were relayed to the B-52 by a modified E-3A AWACS aircraft.

Operating with a naval task force, the B-52 can receive targeting information from a number of other platforms. The Navy's counterpart of the AWACS aircraft, the E-2C Hawkeye, could provide targeting using the same procedures used during the B-52's test shots. This procedure closely resembles a ground controlled intercept (GCI). The E-2C's radar would permit it to remain outside the lethal sphere of the targeted vessel while it painted both the B-52 and the target. Vectors from the E-2C's air controllers would direct the B-52 to its Harpoon launch point, enabling the bomber to close the target at low altitude -- under the target's radar horizon. While geographic coordinates of the target or launch point could be passed to the shooter, special care must be taken to preclude significant targeting errors. While the navigation accuracy of ships and aircraft is now remarkably accurate and reliable for practical purposes, no two navigation systems will be exactly congruent. Thus, when one unit tries to specify a latitude/longitude position to another unit, the difference in their respective navigation system positions will induce an error in the targeting solution. The error will be proportional to the difference between their assumed positions.

To overcome this difference the navigation systems must be married-up so that the magnitude of the error is insignificant to the accuracy required for targeting. The process to accomplish this is called "grid-lock." The easiest method to perform grid-lock, when the aircraft is being controlled by a surface ship, is to have the aircraft fly directly over the controlling ship. By marking-on-top the ship and receiving the ship's platform position at the time of the mark, the aircraft can note the difference in positions and compute a bias that will allow the aircraft to lock his navigational plot with that of the ship. While this is but one of many means to grid-lock, the goal of each method is to zero-out any geographic position differences and transform the targeting information into a highly accurate relative position.

In future exercises realistic training should be conducted to insure proficiency in the following areas: grid-locking procedures, covert shadowing of hostile forces, low altitude penetration, and exploitation of all means of obtaining over-the-horizion targeting information and fire control solutions. The skills acquired in these areas will preclude confuson and untimely delays in solving targeting and navigational problems in times of actual conflict.

B-52 VULNERABILITY IN STANDOFF ASUW.

Before a standoff weapon can be awarded any credibility, the launch platform that carries the weapon must be able to survive the run-in to its launch point. In the specific case of an air-launched cruise missile, the attacking aircraft must first successfully avoid or evade detection and counter-targeting by the enemy's air defense. Only after succeeding at safely reaching the launch point can the missile be launched to complete the attack on the enemy's vessels.

Presently all major Soviet surface combatants, most smaller combatants, patrol boats, and some amphibious ships are equipped with a surface-to-air missile (SAM) system. While the SAM-arming and development process began in the late 1950s, the maturity of the Soviet Navy's anti-air capability has only recently been realized with the latest classes of major combatants such as the Kiev class carriers, Kirov and Slava class cruisers, and the Udaloy and Sovremenny class destroyers. Many Soviet surface combatants have been built with more than one SAM system, in addition to large caliber AA (anti-aircraft) guns and 30mm Gatling guns to provide an overlap in defense against aircraft and cruise missiles. A summary of the Soviet Naval SAMs, and ships that carry each system is shown in the following table:

TABLE (6)

SOVIET NAVAL SURFACE-TO-AIR MISSILES AND PLATFORMS

Missile	NATO Name	Approximate Max Range	Approximate Speed(Mach)	Platforms
SAN-1	GOA	8-12nm	3+	KRESTA I, KYNDA, KANNIN KASHIN, KOTLIN
SAN-2	GUIDELINE	24-25nm	1+	SVERDLOV
SAN-3	GOBLET	16-22nm	3+	KIEV, MOSKVA KARA, KRESTA II
SAN-4	GECKO	6-6.5nm	2	KIEV, KARA, KIROV SLAVA, KONI, GRISHA KRIVAK, NANUCHKA SARANCHA, BEREZINA IVAN ROGOV
SAN-5	GRAIL	3-3.5nm	1.5	MOST PLATFORMS
SAN-6	GRUMBLE	40-75nm	3-6	KIEV, KIROV SLAVA, KARA
SAN-7	GADFLY	15-20nm	3	SOVREMENNY, KASHIN
SAN-8	----	?	3	UDALOY
SAN-9	----	?	?	FRUNZE

GUIDANCE SYSTEM	MISSILES
Radio command	SAN-1,2,3,4
Manual aiming and IR Homing	SAN-5
Command Semi-Active	SAN-6,7

Information compiled from: "UNDERSTANDING SOVIET NAVAL DEVELOPMENTS," Office of the Chief of Naval Operations, Fifth Edition, April 1985, Jane's Weapons Systems 1985-86, and Jane's Fighting-Ships 1986-87, both published by Jane's Publishing Company LTD. London, 1985 and 1986 respectively.

Examination of TABLE (6) Shows at least one SAM system that could pose a significant threat to antiship cruise missile shooters like the B-52. The SAN-6 area air-defense system is believed to be a naval version of the land-based SA-10 anti-aircraft missile. In its naval role the SAN-6 is mounted in a vertical launcher with a rapid-firing revolving magazine. The Kirov class cruiser has 12 of these vertical launchers; each believed to hold 8 missiles, for a total capacity of 96 missiles. Similarly, Slava class cruisers have 8 launchers for an assumed total of 64 missiles. Teamed with the long-range Top Dome radar for initial missile guidance, the SAN-6 system is reported to be capable of engaging multiple targets simultaneously.(8:106-107) Based on the figures shown, the SAN-6 could possess sufficient range and speed performance to engage targets at or beyond the advertised maximum launch ranges of the Harpoon missile. While the Soviet SAM missile threat is a primary concern to the survivability of ASCM launch aircraft, it is nevertheless one that can be mitigated by using appropriate tactics that exploit the weaknesses of the firing platform or the missile itself. The primary weakness of any surface ship is its limited vision, both optically and electronically. Shipboard radars, because of their antenna height, have a distinct physical limit in their ability to detect aircraft or missiles approaching at low altitude. This limit is the line-of-sight radar horizon, physically imposed by the curvature of the earth's surface. Beyond this limit, objects are in a shadow zone of the radar and can not be detected even though the radar's design might permit detections at much greater ranges.

Building on an earlier example, a ship's radar with a 75 foot antenna height could detect an aircraft or missile flying at 100 feet out to a range of about 23 nautical miles under ideal conditions. This same radar could detect targets flying at 300 feet altitude out to about 30 nautical miles, while those at 1,000 feet altitude could be spotted at over 50 nautical miles. These figures show that a distinct tactical advantage, the element of surprise, can be achieved by the attacking aircraft remaining covert during its attack run. Additionally, low altitude tactics enable the attacker to benefit from other physical phenomena:

> Shipboard radar acquisition at very low elevation angles is degraded by Lloyds Mirror multipath radar returns and visual observation at low altitude is difficult. There is no easy defense against the low fliers.(12:36)

Because of such limitations, and reality that emissions themselves permit passive counter detection and targeting, it is not uncommon for naval forces to restrict their use. Operating under conditions of partial or total Emissions Control (EMCON), a naval force may employ radar and radio silence until the tactical benefits clearly outweighed their risk of disclosure. By utilizing its Electronic Support

Measures (ESM) equipment to passively exploit the adversary's transmissions, the naval force may gain the tactical advantage. This also illustrates the kind of advantages that two party targeting can provide. If an attacking platform need not illuminate a target with an active sensor, then a degree of surprise can be achieved and its vulnerability decreased, while the illuminating partner causes the enemy to be distracted or decoyed.

In addition to the tactical benefits achievable through low altitude penetration, the B-52 can employ its numerous onboard passive and active systems. The presence of these systems alone make it more capable of proceeding in "harms way" than the Navy's P-3 aircraft. The B-52G currently incorporates a full complement of electronic warfare systems to enhance its survivability. This package includes threat warning receivers and electronic jammers to counter early warning and GCI radars, fire control radars for SAM systems, AAA batteries, and interceptor aircraft. The B-52 also incorporates chaff and flare dispensers as additional counters for SAM and air-interceptors.

These systems also decrease the B-52's vulnerability to the Soviet Navy's Yak-36, Forger, aircraft. The Forger is a Vertical/Short Takeoff and Landing (VSTOL) fighter with limited range and payload capability. It is deployed aboard the Kiev class (CVHG) carriers.

With a maximum armament capability of approximately

2,000 pounds, the Forger has been observed carrying AA-8 Aphid, short-range, air-to-air missiles, GSH-23 23mm gun pods and the AS-7 Kerry antiship missile. However, the Forger's ability as an autonomous Combat Air Patrol (CAP) fighter is extremely limited as a recent article points out:

> External examination of the "Forger" reveals no apparent long range sensor systems, active or passive. This conclusion is supported by the pointed nose which appears to have only a small white dielectric nose cap, probably housing a small range-only radar for the weapons delivery systems. In addition the Forger has no apparent apertures which might indicate Infrared (IR), Electro-Optical or laser sensors of any kind.(35:122)

Instead the Forger is apparently dependent upon shipboard air search radar for contact detection and GCI type engagements. No look-down/shoot-down capability appears to be incorporated. Here again, the limitations of shipboard radar systems tend to reduce vulnerability of low-flying aircraft. Additionally, simple visual attack tactics such as exploiting cloud cover, weather, and nightfall could help lessen the visual, day-only, threat of the Forger.

Although the Forger is reported to be able to achieve supersonic speeds in a clean configuration and with a light fuel load, its capabilities begin to be reduced rapidly as it is loaded with fuel and armaments.(35:123) Restricted to purely vertical takeoffs, all added weight creates additional penalities in terms of lift fuel consumed. Likewise, the Forger can mount external fuel tanks (adding both weight and drag) their addition does not greatly improve its range capabilities:

> The Forger has only a limited combat radius (100-200nm) and only a short loiter time on station, as well as a poor performance in an air-to-air combat maneuvering sense, a combat air patrol mission would appear to be impractical.(35:123)

In a separate study, a highly regarded defense analyst has shown that the Forger poses only a modest threat, even to the Navy's slower P-3 aircraft. Basing his calculations on the maximum speeds of the two aircraft, and assuming the P-3 might close to within 50 nautical miles of the Kiev to launch its Harpoon missiles, the author states:

> The limited range and speed of the Forger aircraft would not permit them to intercept the P-3 even in a full alert mode. The P-3, though a slow aircraft, would have an advantage of at least 50nm...which would permit it to get beyond Forger's dash speed radius before being overtaken.(36:239)

Under similar circumstances the B-52's chances of evading the Forger threat should be even better for a number of reasons. First, the B-52 can launch its attack from greater than 50nm using covert two-party OTH-T tactics as previously explained. Second, the B-52's higher dash speed would make overtaking it even less likely. Third, the extensive array of electronic countermeasure systems aboard the B-52G automatically afford it added survivability features (the P-3 does not incorporate any such system). Finally, in coordinated attacks against a Kiev class carrier's task force, carrier based aircraft would provide Airborne-Early-Warning

(AEW) and CAP aircraft to counter the Forger interceptors, and suppression of enemy air defenses (SEAD), using additional airborne jammers and anti-radiation missiles.

CONCLUSIONS

The threat to America's vital sea lines of communications from the Soviet Union is growing. Their fleets have matured into a bonafide blue water navy whose presence and influence on the world's oceans is expanding. America's unrivaled control of the high seas is rapidly diminishing. Our ability to defend the SLOCs is a crucial factor in the present and future national defense strategy. Although the Soviets placed their primary emphasis on a submarine strategy, they have emerged as a potential adversary in a three dimensional sense (air, surface, and subsurface). Defending the SLOCs requires a naval strategy able to counter Soviet intrusion in these areas. Our national budgetary restraints demand that we look at other means, to complement naval assets to provide a credible counter to this threat. The acknowledgment in Air Force Manual 1-1, that maritime operations is a legitimate Air Force mission is clearly warranted. Air Force contributions to naval fleet operations during times of hostilities can be significant and may well determine the outcome of the naval engagements. Operations in conjunction with Tactical Air Command AWACS aircraft, Strategic Air Command B-52s, and naval aviation and surface forces have been encouraging and mutually enlightening. The path to greater joint service cooperation in support of our national objectives is likewise promising.

The designation of two B-52 squadrons equipped with Harpoon missiles, to the maritime mission is a positive first step. In the anti-surface warfare role, the B-52 provides more lethality and sustainability than the P-3. At a rate of one B-52 replacing two P-3s (the B-52 carries twelve Harpoons to the P-3's six), the P-3 can be released to cover the antisubmarine warfare role. However, the B-52 can not be employed as a surface hunter-killer in a fully autonomous sense. Even when patrolling in a free-fire zone, it lacks the requisite avionics and communications inter-operability to capitalize on the full stand off capability of the Harpoon missile. In the two party (targeter-shooter) team concept, however, B-52 cells operating with Air Force or Navy airborne partners (such as AWACS, E-2Cs or P-3Cs), or with link capable surface combatants, can provide a potent force multiplier while conserving resources.

Challenges to the future effectiveness of this option resides not only with required aircraft modifications, but with its integration into naval operational procedures. First, incorporation of advanced radar technology such as the APS-137 or other state-of-the art inverse synthetic aperture radars should be pursued. Likewise, enhancements to the B-52's communications and navigation suite that will facilitate direct NTDS linking and increased position accuracy for rapid targeting should be jointly evaluated to provide the most effective interoperability. Second, tasking USAF assets for maritime operations is simply not enough. As the Navy employs its defense in depth against an enemy surface force, it must do so with its full complement of "joint partners." Success during the battle of the first salvo lies in realistic training conducted as part of fleet exercises. This training must integrate grid-locking procedures, covert shadowing of hostile forces, low altitude overwater penetrations and exploiting all means of over-the-horizon targeting.

In today's environment, innovative approaches to employing the assets of all our armed services has become the standard by which victory will be achieved. The B-52 Harpoon missile combination is one such approach that is ready today to complement our naval forces in providing deterrence of armed confrontations anywhere around the globe. Should deterrence fail, the B-52's contribution to anti-surface warfare can provide the flexibility and force necessary to ensure our nation controls the outcome. Joint planning and training provides the key to ensure our armed forces are able to unlock and unleash this capability.

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