

The Loss of USMC Man Portable Air Defense Capability

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EXECUTIVE SUMMARY

Title: The Loss of USMC Man Portable Air Defense Capability

Author: Major Stephen G. Conroy, United States Marine Corps

Thesis: The loss of Stinger missile capability in the USMC will leave a gap in the future concept known as Sea Shield. Without a sound Sea Shield the operational concepts of Operational Maneuver from the Sea (OMFTS) and Expeditionary Maneuver Warfare (EMW) will be unsupportable.

Discussion: The future vision of the USMC and Navy are embodied in the transformational concepts of Seabasing, Sea Shield, Sea Strike, Expeditionary Maneuver Warfare (EMW), Operational Maneuver from the Sea (OMFTS), and Ship to Objective Maneuver (STOM). In the quest to transform many have advocated the removal of Short Range Air Defense (SHORAD)¹ systems from the Marine Corps.

The future Marine Corps' operating concepts will be protected by the Navy's future concept of Sea Shield (see Fig 1). Sea Shield will protect the Sea Base and STOM forces ashore through a network of sensors and weapons platforms (see Fig 3). As STOM forces maneuver 110nm inland to seize objectives, Sea Shield will experience blind spots due to radar horizon, terrain shadowing, electronic warfare, and interference (see Fig 2). In these cases Sea Shield will not adequately defend against asymmetric, low, slow flying threats.

Calculations in Fig 2 show a 5,500 foot sensor gap from Sea Based assets. Airborne sensors only provide detection and surveillance cueing and not target quality data for guiding missiles to airborne threats. The last radar piece of Sea Shield is organic STOM force sensors. Radar horizon and terrain shadowing will also degrade these sensors because they are not designed to move with the maneuver forces. Consequently, maneuver forces will require an organic air defense capability for local protection from immediate, pop up, low-level air threats.

This organic air defense capability is the Stinger missile system. However, it will be removed from service by 2009 due to shelf life and obsolescence. This capability is a current and future requirement. The III MEF Commanding General, the operational environment, and Marine Corps/Navy concepts for operations all require a man portable, short range, air defense capability. Consequently, without action, the concept of Sea Shield will not be complete and STOM forces could be unsupported as they maneuver to long-range objectives.

Conclusion(s) or Recommendations: Stinger will go due to obsolescence but a replacement capability is required because EMW has arrived today. The ESG is the first form of Seabasing and STOM started when Marines were inserted into Camp Rhino, Afghanistan. In the short-

¹ SHORAD in the USMC is located in the Low Altitude Air Defense (LAAD) battalion. The LAAD battalion's main air defense weapon is the Stinger Missile.

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term, service life extension programs for current Stinger inventory should be fully funded to maintain a core capability. Next, MCCDC should conduct a study to determine air defense requirements for STOM maneuver forces. Lastly, Marine Cops Systems Command should investigate rapid acquisition possibilities for a replacement capability and develop a program for MCCDC derived requirements.

Figures and Calculations

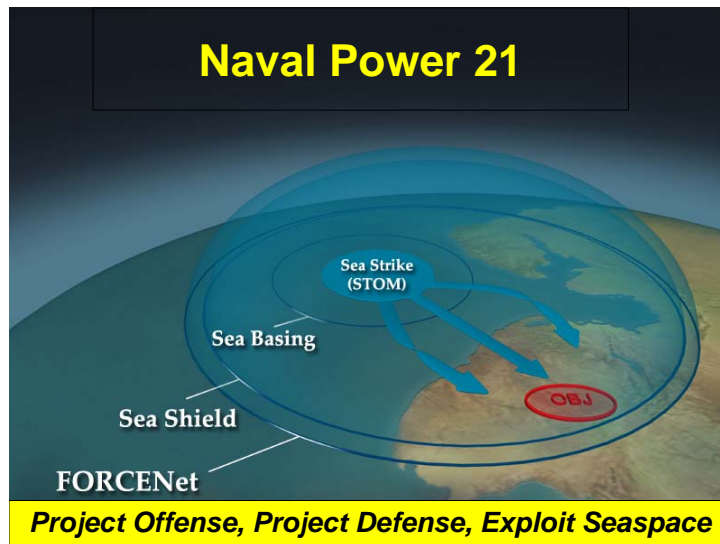


FIG 1²

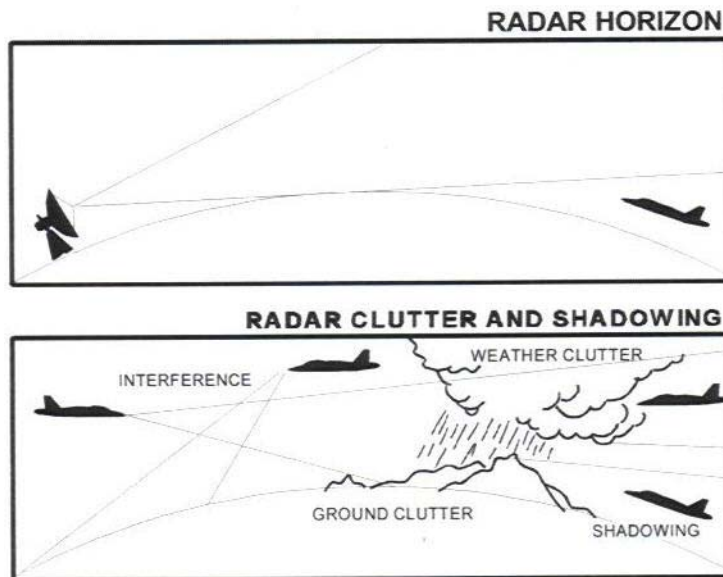


Fig 2³

$$\text{Distance(nm)} = 1.23(\text{SqrRt}(h) + \text{SqrRt}(H))\text{ }^4$$

$$110\text{nm} = 1.23(\text{SqrRt}(225) + \text{SqrRt}(H))$$

² Marine Corps Combat Development Command (MCCDC), *Future Concepts & Capabilities Transforming the Marine Corps*, Future Concepts Branch, N.d., Power Point Presentation, Slide #10

³ WP61, *Radar Horizon/Line of Sight*, Pt MUGU, 2000, 1

⁴ *ibids*, 1

$$110/1.23 = 15 + \text{SqrRt} (H)$$

$$(89.43 - 15)^2 = H$$

$$74.43^2 = H$$

$$5,539.89 \text{ ft} = H$$

225' high Sea Based sensors will not be able to detect targets below 5,539 feet at a range of 110nm.

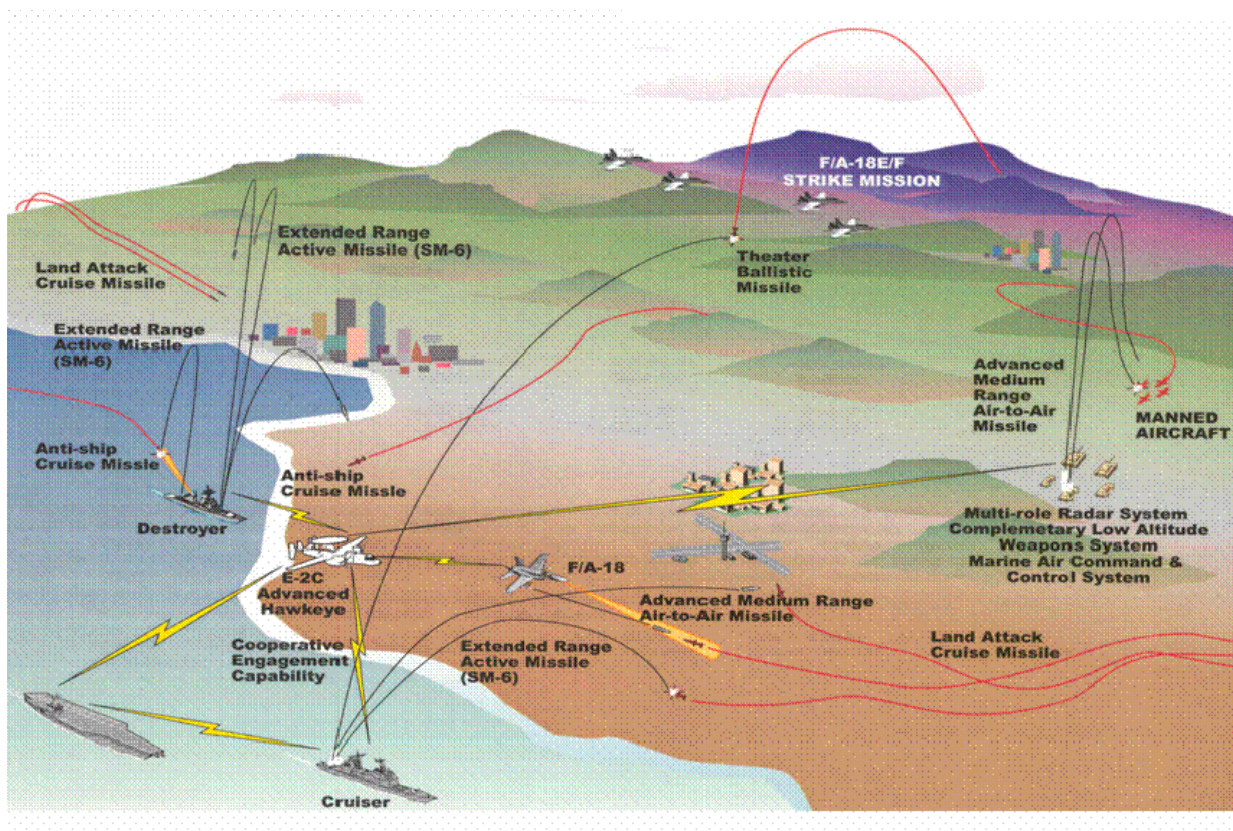


Fig 3: Naval Air and Missile Defense Concept of Operations⁵

⁵ Secretary of the Navy, *Naval Transformation Roadmap*, N.p., N.d., 13

A Seam in STOM

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A Seam in STOM

Is Man Portable Air Defense Relevant in the USMC?

Introduction

The future of the Marine Corps, as it always has been, is entwined with the Navy's future. Both services have embraced a visionary future embodied by Seabasing, Sea Shield, Sea Strike, Expeditionary Maneuver Warfare (EMW), Operational Maneuver from the Sea (OMFTS), and Ship to Objective Maneuver (STOM). In the quest to transform into the Joint force of the future, many have advocated the removal of Short Range Air Defense (SHORAD)¹ systems from the Marine Corps. The belief that USMC forces have never utilized Stinger² in anger against an enemy, that the US will always possess air supremacy, and that a network of sensors will allow the engagement of all targets in the battle space have led to a perception that man portable short range air defense is no longer required in the USMC.

These perceptions do not constitute an integrated concept for USMC air defense nor do they support the USMC/Navy vision of the twenty first century. In the future STOM forces will maneuver 110nm inland to seize objectives. A combination of sea, air, and organic ground systems will form an air defense shield for these forces. Yet, this Sea

¹ SHORAD in the USMC is located in the Low Altitude Air Defense (LAAD) battalion. The LAAD battalion's main air defense weapon is the Stinger Missile.

Shield will provide minimal air defense support from asymmetric, low, slow flying threats because of the limitations of radar guided missiles. The USMC's only organic air defense system designed to move with maneuver forces will be removed from service due to shelf life. However, the requirement for a short range, man portable air defense capability will not disappear.

USMC SHORAD is a current and future requirement. The warfighter, the operational environment, and Marine Corps/Navy concepts for operations all require a man portable, short range, air defense capability.

Navy/Marine Corps Vision

Uncertainty rules the operational environment (see fig 1) and has driven the marine corps and navy to develop a joint vision for future operations at sea, in the littorals, and ashore. These marine corps and navy concepts are captured in marine corps strategy 21 and seapower 21.³ these two documents are the genesis of the marine corp's capstone concept known as emw which frames operational concepts for

² Stinger is a man portable, surface-to-air, shoulder fired, supersonic missile designed to counter high-speed, low-level ground attack aircraft.

³ Headquarters, U.S. Marine Corps, *Naval Power 21 ... A Naval Vision*, N.p., 2002, 4



Fig 1: EMW Operating Environment⁴

the 21st century and beyond.⁵ EMW is based on the operational concepts of OMFTS, Sustained Operations Ashore (SOA), and Other Expeditionary Operations (OEO), which encompass STOM.⁶ These concepts provide the framework to

⁴ Headquarters, U.S. Marine Corps, *Marine Corps Strategy 21*, 4

⁵ Headquarters, U.S. Marine Corps, *Operational Maneuver from the Sea*, N.p., 2001, 3

⁶ LtCol Webster, U.S. Marine Corps, Future Concepts & Capabilities Officer, interview by author, 10 December 2003

transform the Marine Corps into a force that can strike almost anywhere via the littorals.

The Marine Corps vision for the future is directly tied to the Navy's concepts in *Naval Power 21*. The three overarching Navy concepts are Sea Basing, Sea Shield, and Sea Strike, all enabled by FORCENet (see fig 2).⁷ The names imply the capability associated with each concept. The sea base will allow forces to remain offshore while Sea Shield provides protection. Sea strike will attack enemy targets and FORCENet includes the command and control system connecting each concept to the other.

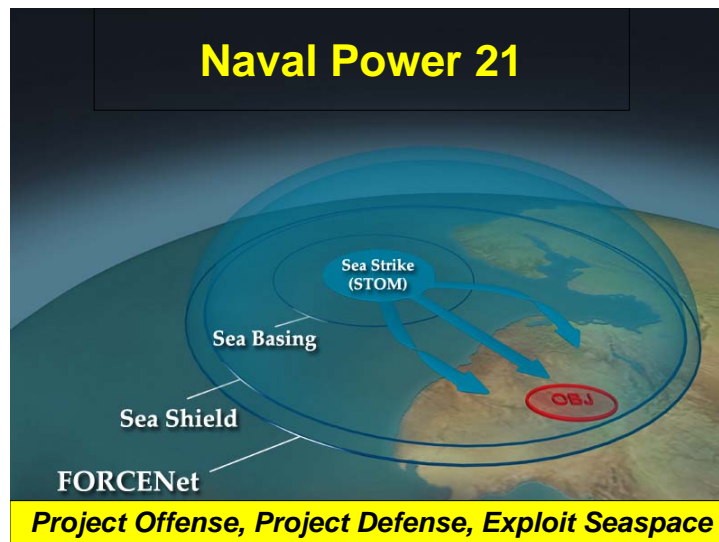


Fig 2: Conceptual depiction of future USMC/Navy operational concepts⁸

The Navy's concepts will facilitate EMW, OMFTS and STOM and allow Naval forces to conduct maritime Joint Forcible

⁷ *Naval Power 21*, 4

Entry Operations (JFEO), provide flexible and adaptable warfighting capabilities, provide staying power, and maintain self-sufficiency.⁹

An overview of these Navy and Marine Corps operational concepts will help define the current USMC air defense dilemma.

Seabasing

Projects the sovereignty of the United States globally while providing Joint Force Commanders with vital command and control, fire support, and logistics from the sea, thereby minimizing vulnerable assets ashore.¹⁰

The *Enhanced Networked Seabasing* document divides Sea Basing into dynamic and static *Seabasing*. *Static Seabasing* encompasses those operations that deal with force build up, logistics, and movement of people ashore in an administrative manner. *Dynamic Seabasing* is operational maneuver, and seeks to place the adversary in a dilemma through the conduct of distributed, dispersed operations.¹¹ *Dynamic Seabasing* is an enabler of and directly responsible for the success of OMFTS.

⁸ Marine Corps Combat Development Command (MCCDC), *Future Concepts & Capabilities Transforming the Marine Corps*, Future Concepts Branch, N.d., Power Point Presentation, Slide #10

⁹ Secretary of the Navy, *Naval Transformation Roadmap*, N.p., N.d., 10

¹⁰ *Naval Power 21*, 5

¹¹ MCCDC, *Enhanced Networked Seabasing*, N.p., N.d., 2 This concept is the enabler of the USMC OMFTS.

Sea Strike

Sea Strike operations will project increasingly decisive offensive power.¹²

Offensive combat power will not be limited to physical destruction. STOM and EW/IO are included in Sea Strike. The requirement is to deliver decisive, sustainable combat power.¹³

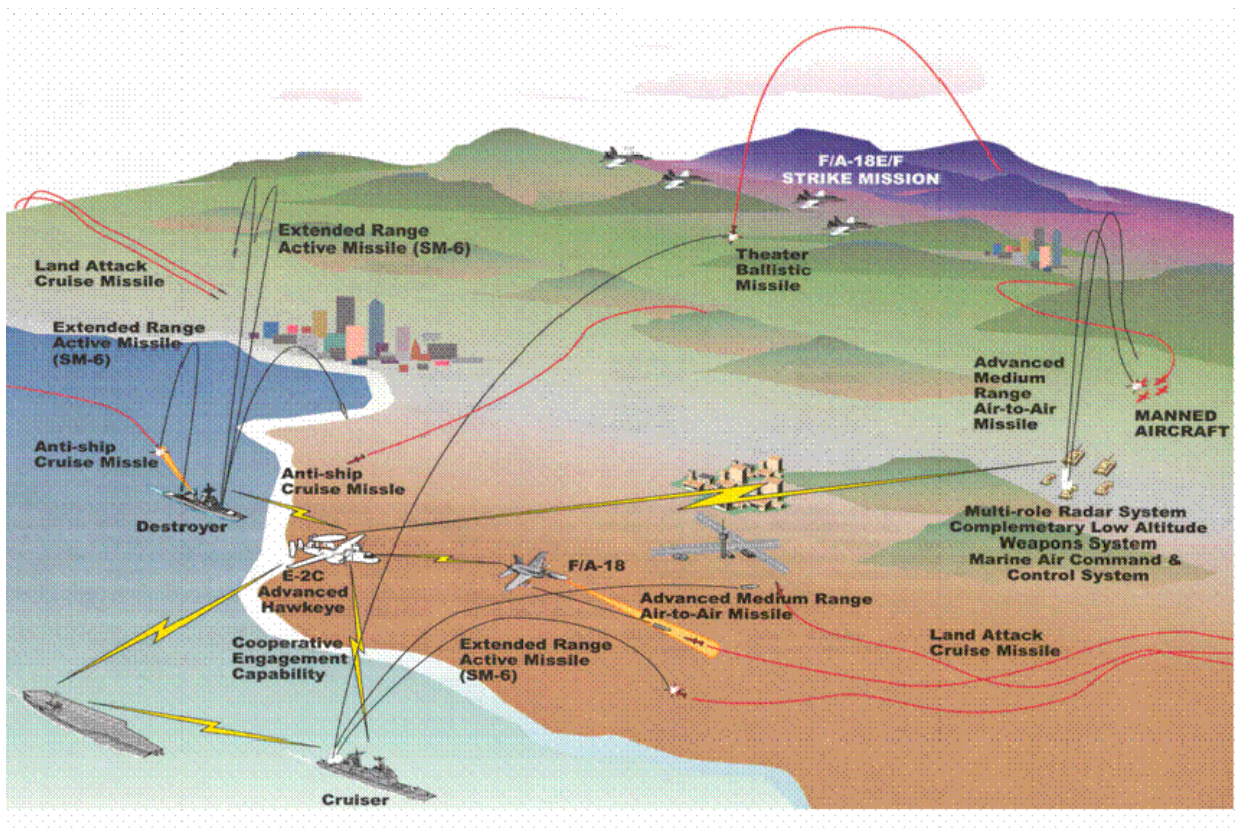


Fig 3: Naval Air and Missile Defense Concept of Operations¹⁴

¹² *ibid*, 14

¹³ Naval Operating Concept, 14

¹⁴ Transformation Roadmap, 13

Sea Shield

Sea Shield will provide integrated and layered global defensive power for the Joint force, enabled by networked intelligence and shared information provided through FORCEnet.¹⁵

Sea shield is the defensive arm of the future Navy. It encompasses anti-submarine, missile defense, anti-ship operations, maritime interdiction operations, ship defense, precision attack, and mine countermeasure ops.¹⁶ This capability will extend over the sea, littorals, and the land (see Fig 3). As Sea Shield grows in capability it will provide an integrated air, missile, and counter battery umbrella under which the MAGTF Commander operates.

Fire support for Sea Shield ashore is based on a triad of fires consisting of aviation fires, naval surface fires, and organic ground fires.¹⁷ The only current and future USMC organic ground air defense fire support for Sea Shield, (which directly supports maneuver forces), is the Stinger missile. Yet, the Stinger capability will be removed from service sooner than expected.

¹⁵ Chief of Naval Operations, Naval Operating Concept for Joint Operations, N.p., N.d., 15

¹⁶ *ibid*, 16

¹⁷ *ibid*, 48

The Marine Corps Vision

The Marine Corps vision of future warfare is derived from the Navy's Seabasing concept. The USMC will use Seabasing as the secure base to execute its operational concepts in a Joint environment. Some of those concepts are Expeditionary Maneuver Warfare, Operational Maneuver from the Sea, and Ship to Objective Maneuver.

Expeditionary Maneuver Warfare (EMW)

EMW is described as "the union of our (USMC) core competencies; maneuver warfare philosophy; expeditionary heritage; and the concepts by which we organize, deploy, and employ forces."¹⁸ EMW emphasizes the use of Seabasing to gain advantage of maneuver space in the sea. From these philosophies EMW derives the supporting operational concepts of OMFTS and STOM.

Operational Maneuver From The Sea (OMFTS)

Operational Maneuver from the Sea describes rapid maneuver by landing forces from their ships directly to objectives ashore, uninterrupted by topography or hydrography.¹⁹

¹⁸ Headquarters, U.S. Marine Corps, *Expeditionary Maneuver Warfare*, Marine Corps Capstone Concept, N.p., 2001, 2

¹⁹ MCCDC, *Ship-To-Objective Maneuver*, N.p., 1997, II-4

It is a subset of the navy's transformational pillar of seabasing. Omfts possesses the flexibility to utilize any part of the sea as the departure point for an attack,



Fig 4: Conceptual Depiction OMFTS, ENS & STOM²⁰

Operation, or campaign (see Fig 4). It provides the lateral movement of maneuver from the sea. Because forces can enter the enemy's area from any direction the sea allows, the enemy is forced to do one of two things: either spread his forces thin to protect everywhere or mass his forces in areas that allow rapid response to a forcible entry. In the first case, naval forces use the sea as maneuver space and pit strength against weakness²¹. In the second case, naval forces can maneuver through gaps between

²⁰ Marine Corps, *Future Concepts & Capabilities*, Slide #11, The Enhanced Networked Seabasing (ENS) document, describes how the Navy-Marine Corps team will enable the projection, protection, and sustainment of a multi-dimensional Naval-Power, 3

²¹ Operating Concept, 4

massed forces and arrive at the objective of their choosing (see fig 5).

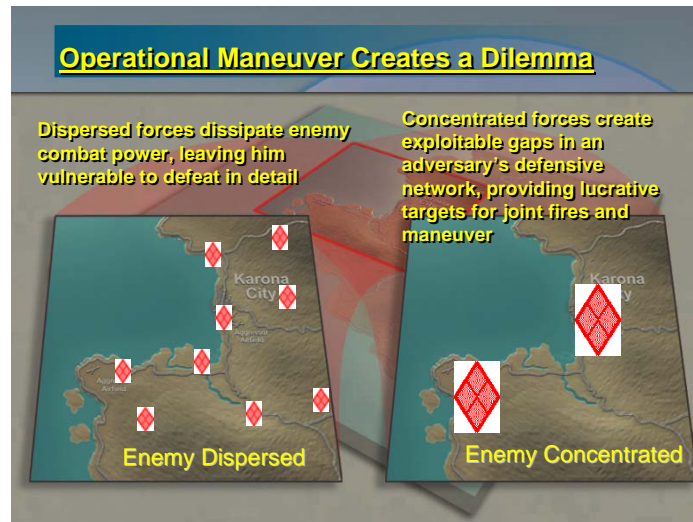


Fig 5: Visual Depiction Of The Enemy's Dilemma Created By OMFTS ²²

Ship to Objective Maneuver (STOM)

The projection of power ashore combined with maneuver warfare principles is called Ship to Objective Maneuver.²³ For the Marine Corps warfighter, STOM is the concept that allows forces to close with and destroy the enemy without vulnerable lines of communication (LOC). Sea based forces will "conduct expeditionary operations from extended ranges with highly versatile and survivable organic and supporting

²² Marine Corps, *Future Concepts & Capabilities*, Slide #12

²³ *Ship-To_Objective-Maneuver*, II-4,5

sea/air/land mobility assets.”²⁴ STOM forces will “simultaneously conduct complex sea control, strike, forcible entry, special operations”²⁵ and they must be capable of semi-independent operations.²⁶ Semi-independent operations suggest operating with a reduced command and control capability and therefore require weapon systems that do not depend on external command and control.

Air Defense Dilemma in STOM

Sea Shield will provide the air defense protection for Marine Corps and Navy future concepts. Conceptually air threats will primarily be engaged with radar guided missiles. Sensors utilized in Sea Shield to detect air threats and provide target data will be Sea Based surface/air, national or organic land force sensors. These sensors provide target data to Sea Based, airborne, or organic MAGTF radar guided missile systems to provide air defense for the Sea Base and STOM forces. The goal is a seamless, integrated air picture with any sensor providing target data to any shooter. Although possible, the concept will not be reality for the foreseeable future. Consequently protection from Sea Shield for STOM forces can

²⁴ *Enhanced Networked Seabasing*, 9

²⁵ *Naval Power* 21, 3

be incomplete due to radar horizons, latency issues, rules of engagement (ROE), and a lack of sensors capable of providing three dimensional target quality data.

Radar Horizon/Shadow and Clutter for Sea Based Surface Sensors

EMW forces projecting themselves 110 nm inland will find themselves without the complete protection of Sea Shield.²⁷ Available Sea Based sensors will not be effective at 110 nm because of a physical principal known as radar horizon. Due to the earth's curvature, ground or sea based sensors cannot detect targets below certain altitudes as distances increase (see Fig 6).²⁸

A sensor located 225 ft above the water will not be able to detect targets less than 5,539 ft in altitude at 110nm.²⁹ If the terrain is not flat the detection altitudes may increase. The second picture in Fig 6 depicts terrain shadowing and shows how it will increase the altitude not covered by Sea Based Sensors.

²⁶ Smith Jr, Edward A., *NETWORK-CENTRIC WARFARE What's the Point?*, 6

²⁷ MCCDC, *EMW-Capabilities List*, June 2003, Np, 21. The EMW-CL requires the capability to move a battalion reinforced element 110 Nm in one period of darkness beginning in 2010.

²⁸ Detection is dependent on a multitude of criteria. The most important of these are the height of the target and the height of the radar.

²⁹ See Appendix B for altitude calculations.

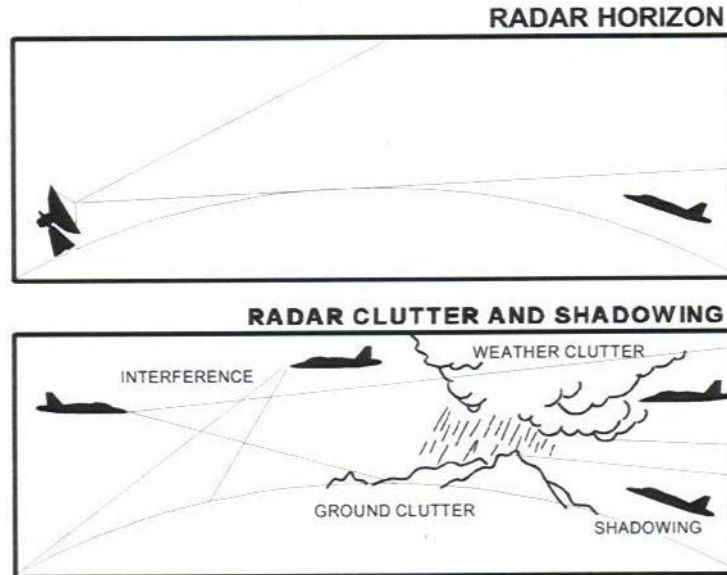


Fig 6: Radar Horizon, Terrain Shadowing, and Clutter³⁰

National and Naval Air Sensors

National sensor assets³¹ cannot be assumed available or dedicated for STOM operations due to their limited number. The Navy's Transformational Roadmap does not depict national assets as a given in Sea Shield or Sea Strike (see Fig 3). Consequently the assumption must be made that national assets would not be available in all situations to provide target fire control quality data to shooters in the STOM area.

The Navy's carrier based E-2C tactical battle management airborne command and control aircraft is a more likely platform to support Sea Shield and the MAGTF. The support

³⁰ WP61, *Radar Horizon/Line of Sight*, Pt MUGU, 2000, 1

³¹ The National Command Authority controls national sensor assets. Some of these sensors included satellites and the E-3Airborne Warning and Control System (AWACS) Aircraft.

provided by the E-2C consists of detection/surveillance but does not provide target quality data. This means it can only vector combat air patrol (CAP) aircraft to a potential target where it would engage the air threat.

Because target quality cueing is not available and radar coverage is lacking other issues become a concern. The CAP requires time to respond, the correct weapons load, and positive combat identification (CID) of the enemy target. Airborne assets must have an air-to-air weapon, they must fly to the engagement zone and if the target is unidentified they must visually identify the threat before engaging. All of these issues reduce the response to pop up immediate threat air targets. Additionally E2-C coverage is not twenty-four hours a day, seven days a week (24/7) coverage; and is normally focused primarily on defense of the Carrier Battle Group or Sea Base.

CID is the factor that will reduce combat air patrol (CAP) response time and put both the STOM forces and the aircraft assigned to attack the target at risk. Because of the April 14, 1994 shoot down of two US Army Black Hawk helicopters by Air Force F-15 Strike Eagles there is normally an engagement criteria for "fast movers" (i.e. jets) to visually identify slow moving targets like helicopters. Consequently the fly-by for visual

identification would bring friendly aircraft into the weapons engagement envelope of enemy small arms and man portable surface to air missiles.

Because air superiority is assumed, the requirement for fixed wing to visually identify their low slow targets is not expected to be relaxed. Consequently the time to engage a pop up immediate air threat to maneuver forces will be extended and will put our aircraft in a high-risk threat envelope. This is also expensive and resource-draining to rely on fixed wing CAP for 24/7 coverage when a man portable air defense weapon would be with the maneuver forces being attacked.

Organic MAGTF Radar and Shooter

The lack of a target quality cue from air born and sea based assets to protect a STOM force has led to the development of an organic ground based sensor. Currently the Ground Air Task Oriented Radar (GATOR) and the Complementary Low Altitude Weapon System (CLAWS) will are being developed to provide this capability to the MAGTF.

Like the Naval air borne platforms the Marine Corps does not currently have a radar capable of providing target quality data. The future target tracking radar for the Marine Corps is GATOR. The air variant, (with air defense

and air surveillance capability), is scheduled for IOC in fiscal year 2008.³² However, the technical risk in the development and the high cost of the program may see its fielding schedule slide to fiscal year 2009 or beyond.³³

GATOR consists of a HMMWV with a radar mounted in the rear. It is the material solution to the Multi Role Radar System (MRRS) and the Ground Weapons Locating Radar (GWLRL) requirements. Gator will provide target quality fire control for Advanced Medium Range Air to Air Missile (AMRAAM). GATOR will be V-22 transportable and could rapidly deploy with STOM forces via LCAC or external lift from a helicopter.³⁴

GATOR is not designed to move with the maneuver forces so echeloning radars would be required. Terrain shadowing and radar horizon will still be an issue with this concept of employment but it gets a sensor into the area which is unsupportable by Sea Based sensors and reduces undetected air space in Sea Shield. Because GATOR is not envisioned to move with maneuver forces it will leave low flying targets undetected and maneuver forces vulnerable. The gaps left by a combination of sea, air, and ground based

³² LtCol Steve Jones, USMC, MARCORSYSCOM, Deputy Program Manager for radars, Quantico, Va, interview by author, 10 Dec 2003

³³ CWO3 Tom Morris, USMC, MARCORSYSCOM, CLAWS Project Officer, Quantico, Va, interview by author, 10 Dec 20

³⁴ LtCol Jones, interview 10 Dec 2003

sensors can be exploited by our enemy in the close fight and requires a weapon system that moves with the maneuver forces.

CLAWS

The CLAWS is a radar guided missile system designed to complement the current Stinger missile system. The mixture of Stinger and CLAWS will bring a layered approach to air defense and provide the required protection for high value targets as well as maneuver forces.

The CLAWS system consists of a HMMWV mounted with AMRAAM. Due to its projected low density, CLAWS' mission is to protect high value targets³⁵. CLAWS can engage cruise missiles, fixed and rotary wing aircraft, and UAVs. Like GATOR, CLAWS is V-22 transportable yet, not currently designed to operate with the maneuver element or shoot on the move.³⁶ CLAWS requires target quality data from a sensor or other cueing system to engage targets because the missiles are radar guided. Because GATOR and CLAWS are not designed to move with the maneuver forces radar horizon and terrain shadowing could leave STOM forces unprotected from pop up immediate air threats.

³⁵ High Value Targets are designated by the Joint Force Commander. Some examples are airfields, fuel dumps and chlorine plants.

³⁶ CWO3 Morris interview, 10 Dec 2003

The Close Battle

maneuver forces must retain sufficient organic firepower to provide for their own force protection, adapt to unanticipated situations, or deal with asymmetrical threats which are less vulnerable to long-range, precision fires.³⁷

In the Single Battle Concept STOM forces will not be protected from Sea Shield in the close fight at low altitudes. Sea Shield assets should cover all other parts of the airspace. Yet, attacks at close range to maneuver forces allow threats to fly below the radar horizon and use terrain for concealment and surprise. The enemy will need to utilize asymmetric attacks to hit the STOM critical vulnerability of long range, maneuvering forces with no organic air defense assets.

The enemy will utilize terrain shadowing, weather, sporadic communications, high tempo operations, and small, low, slow airborne assets at close range to attack STOM forces. Unmanned Aerial Vehicles (UAV), ultra light aircraft, and helicopters can maneuver undetected by Sea Shield given the correct terrain, weather, and our large maneuver distances. These assets can launch from anywhere presenting themselves on the battlefield when STOM forces are in close contact. Like a prizefighter with a short reach the enemy will wait for his opponent to close and

then unveil his counter strike working inside the other fighter's extended reach.

Visual identification requirements of CAP assets will delay response times, CLAWS/GATOR will suffer from radar horizon and terrain shadowing, and Sea Based sensors will be ineffective at 110 Nm. Responses to the threat will need to be immediate. An air defense weapon will need to be between the attacker and the maneuver unit to be effective. STOM maneuver forces must possess a complementary capability to radar guided missiles that can deploy wherever a Marine can in order to defend against immediate air threats.

Complementary Capabilities

Maneuver warfare is based on placing the enemy on the horns of a dilemma. When the enemy is behind cover we utilize indirect fires to destroy him. If he removes himself from his defenses to escape the indirect fire he will be destroyed by direct fire. Ideally, these complementary capabilities are utilized throughout the military.

Air defense requires a complementary capability or in other terms a layered defense. Radar guided missiles are

³⁷ Headquarters, U.S. Marine Corps, *The MAGTF in Sustained Operations Ashore*, IV-16

normally all weather, medium to long range, centrally controlled, and engage/intercept targets beyond visual range (BVR).³⁸ The radar guided missile requires constant command and control until it reaches terminal flight, and a target quality cue from a radar with updates in flight to maintain a high probability of kill (P_k). Radar missile systems require robust communications and are thus vulnerable to electronic warfare, command and control warfare, and the physics of radar. Lastly the missiles are designed for BVR engagement requiring larger motors, more communications equipment, and more electronics. Thus radar missiles are much too heavy for man portable use and more expensive than man portable systems.

The complement to radar guided systems is a direct fire system. This system will have its own guidance system, integrated Identify Friend or Foe (IFF)³⁹, does not require data links or communication to operate, and is man portable. A threat using terrain shadowing to avoid radar will fly into the engagement envelope of the direct fire system. The gunner can determine if the target is actually

³⁸ CWO3 Morris interview, 10 Dec 2003. CID and authority to engage is usually located away from the launcher and requires robust communication links.

³⁹ IFF is a term used to describe an electronic system that allows shooters to determine if an air threat is a friend or foe. When the system is broken, (due to maintenance or battle damage), visual identification is normally required prior to firing at the target.

a threat based on ROE and visual identification and engage without a radar cue.

Air defense in the USMC must not be solely dependent on a target quality cue. Defenses must be layered and provide protection from various threats and tactics with complementary systems; otherwise the enemy will exploit our dependence on radar.

Stinger, the Gap Filler

Currently the Stinger weapon system is the only organic air defense system in the USMC.⁴⁰ Originally, predecessors to stinger were developed to defend gaps in the radar coverage of the Homing All the Way Killer (HAWK) missile system. Hawk could not reliably shoot in terrain shadow or other radar unfriendly situations so shoulder launched redevye were produced to fill those gaps.⁴¹ Stinger, a follow-on missile to redevye, was developed with a more robust capability.

HAWK was subsequently removed from the inventory leaving Stinger as the only USMC air defense asset to support ground forces. Now the more flexible radar guided CLAWS system is being developed to replace the lost HAWK

⁴⁰ See appendix C for more details on Stinger system capability

⁴¹ Maj Ray Placinte, USMC, MARCORSYSCOM LAAD project officer, interview 10 Dec 2003

capability. Although a better system than HAWK, CLAWS still depends on radar cueing which will have gaps in coverage, radar unfriendly environments, and degraded command and control at STOM maneuver ranges. As in the past, a Stinger like capability will be needed in the future to fill these gaps in radar and command and control coverage.

Stinger is a man portable, surface-to-air, shoulder fired, supersonic missile designed to counter high-speed, low-level ground attack aircraft. It is capable of all aspect engagement. The current BLOCK I version is capable of destroying fixed and rotary wing aircraft and unmanned aerial vehicles. Stinger missiles are five feet long and weigh thirty five pounds fully armed making them man portable.⁴²

Because of its small size a commander can build up capability very rapidly. Two V-22s are required to move one CLAWS and one GATOR giving the commander the capability to fire four missiles. If those same V-22s transported only MANPAD stinger teams the commander would possess 25 teams and 50 missiles that maneuver with the ground combat

⁴² FAS.org, *FIM-92A Stinger Weapon System: RMP & Basic*, 09 August 2000.
<<http://www.fas.org/man/dod-101/sys/land/stinger.htm>>

element and are ready for operation the moment they debark the aircraft.⁴³

Although generally seen exclusively as an air defense weapon, stinger can serve multi mission duties. It possesses the capability to strike surface targets as well as air targets. Marine Corps Systems Command in conjunction with the Army conducted a test at McGregor range near Ft. Bliss Texas during the summer of 2003.⁴⁴ Stinger's engagement of non-standard targets demonstrated its destructive capability against surface targets. A white box truck, a medium sized pickup truck, and an Amtrack were engaged and destroyed by a Stinger missile.⁴⁵ The Navy has also conducted a test against a surface target. Stinger destroyed a speedboat as it followed a high crossing angle profile.⁴⁶ These tests demonstrate Stinger's flexibility to engage a multitude of targets in different environments and though not an anti-armor weapon it can destroy lightly protected land and sea vehicles.

The portability and flexibility of man portable anti-air weapons have proven value on the battlefield. In Afghanistan, Stinger had significant influence on the Soviet war effort. Afghanistan fighters boasted a 75

⁴³Maj Placiente, interview 10 Dec 2003

⁴⁴ ibids

⁴⁵ ibids

percent kill ratio using the American supplied Stinger missile.⁴⁷ Recently, this past year in Iraq, 22 soldiers were killed and two military helicopters shot down by man portable surface to air missiles.⁴⁸ Since that time a civilian transport aircraft and a C-5 Galaxy have also been engaged by man portable surface to air missiles and the only defense is reactive after the missile has been fired. Flexibility, concealment and effectiveness make man portable surface to air missiles a valuable commodity on the battlefield.

Other Needs Beyond STOM

Besides STOM the United States Marine Corps requires man portable air defense for a multitude of other situations. One situation is Military Operations Other than War (MOOTW). Another is the marine expeditionary unit.

MOOTW

Imagine if you will, all is quiet in downtown Baghdad. A light civil aircraft takes off from the Baghdad airport. The pilot has recently received his private pilot license and begins to drift off course. Not wanting to get lost he

⁴⁶ Maj Placinte, interview 10 Dec 2003

⁴⁷ Yousaf, Mohammad & Mark Adkin, *THE BEAR TRAP*, Lahore, Pakistan: Jang Publishers, 1992, 186

⁴⁸ Benjamin, Daniel, *Flightmare*, 07 November 2003, <<http://slate.msn.com/id/2091002>>

lowers his altitude to see the streets below and get his bearings straight before climbing to the prescribed 5,000 ft. In the Tactical Air Operations Center the radar screen displays a small aircraft descending from 1000 feet to 500 ft and turning toward UN headquarters. Successful free elections have just been conducted and the UN has validated the election process. The UN headquarters has been designated a high value target and is to be protected. ROE states that an aircraft below 1000 feet is a target. There are no airborne fighters to vector to the area and the on-call aircraft will not be able to scramble in time to divert the plane. The coalition commander was heard in a previous conversation saying; "we don't want the UN to leave the country again because we can't protect them!" The watch officer has all the guidance he needs and commands claws to engage. The aircraft is destroyed. The pilot was the son of the newly elected president of Iraq.

Now lets change the scenario. The watch officer holds the fire command and the small aircraft passes over UN headquarters and then rolls his aircraft upside down and plunges 500 ft into the top of the building. Too late to react the load of explosives detonates and collapses every interior wall, burying every person inside to include the visiting UN secretary general.

In this scenario, the weapons controller is required to make a rapid decision, and it cannot be made from information on a radar screen. Furthermore the shooter will have to be between the threat and the target. This capability is utilized every time code orange is set in the United States. During code orange Stinger teams deploy around the capitol to protect high value government buildings from aircraft departing or arriving to Reagan National Airport. Flight routes into and out of Reagan are so close a radar-guided system does not possess the required reaction time to engage the threat.

Another benefit of stinger is its dual use capability to engage ground targets. Now unarmored vehicles speeding for the front gate of the UN can be stopped as easily as the light civil aircraft, ultra light, or UAV. Man portable systems are the perfect complement to the more robust radar guided systems that would be used to engage a cruise missile raid from Iran or Syria.

Marine Expeditionary Unit (MEU)

Another area requiring man portable air defense is the MEU. The MEU remains a MAGTF element of the future.⁴⁹

⁴⁹*Expeditionary Maneuver Warfare*, 7, The MEU's battalion reinforced meets STOM force size requirements for maneuvering 110 nm in one period of darkness.

These forces are now deploying inside an Expeditionary Strike Group (ESG).

The ESG is the first implementation of the Sea Shield/Strike concepts. An Aegis capable cruiser, destroyer and a submarine have been added to the normal MEU complement of amphibious shipping.⁵⁰ Although the Aegis brings a 250 nm air defense bubble it still has radar horizon and terrain shadowing issues. The E-2C is not normally close by as it is located with the big carrier in the Carrier Strike Group (CSG). Currently, CLAWS is not projected to be placed on MEU shipping and it has yet to be determined if GATOR will accompany the MEU.⁵¹ If the MEU needs to rapidly react to a situation and put boots on the ground the only air defense asset possessed by the MEU commander are man portable Stinger missiles and organic machine guns.

The lowest level of employment for CLAWS is the platoon consisting of four launchers, one command and control vehicle, and one GATOR. Even if CLAWS and GATOR were put on the MEU their quantity would be limited due to boat space. The MEU might take one GATOR and two CLAWS vehicles; which would provide a minimum of 45 minute set up

⁵⁰ MAWTS-1, TacAir Integration information brief, N.p., N.d., Power Point Presentation, Slide #15

⁵¹ CWO3 Morris, interview 10 Dec 2003

and eight missiles. Man portable weapons take up less room and provide the flexible forcible entry capability a MEU requires.

Stinger Will Go

Despite its value, the Stinger appears to be on its way out. Because the preponderance of Marine Corps Stinger missiles were procured in Fiscal Year (FY) 90-91 and the shelf life is estimated to be 16 years, 8100 USMC Stinger missiles will expire by 2009.⁵² 8100 missiles constitute 100 percent of the Marine Corps' Stinger missile stocks. Inventory will fall below the wartime requirement of 7200 missiles by FY05. In 2008 the United States Marine Corps will lose the ability to field a LAAD Battery with a single load of 330 Stingers (see Fig 7).⁵³ Consequently, division commanders will find themselves without an organic Ground Based Air Defense (GBAD) capability to support their maneuver forces.

⁵² APC, HQMC, Information Paper personal for the Deputy Commandant of Aviation, "*Stinger Surface to Air Missile Obsolescence*", N.p., Mar 2003, 1, See Appendix A for baseline stinger shelf life data.

⁵³ APC, HQMC, Information Paper, "*Stinger Surface to Air Missile Obsolescence*", 1

USMC Missile Inventory - FY 04 to 15

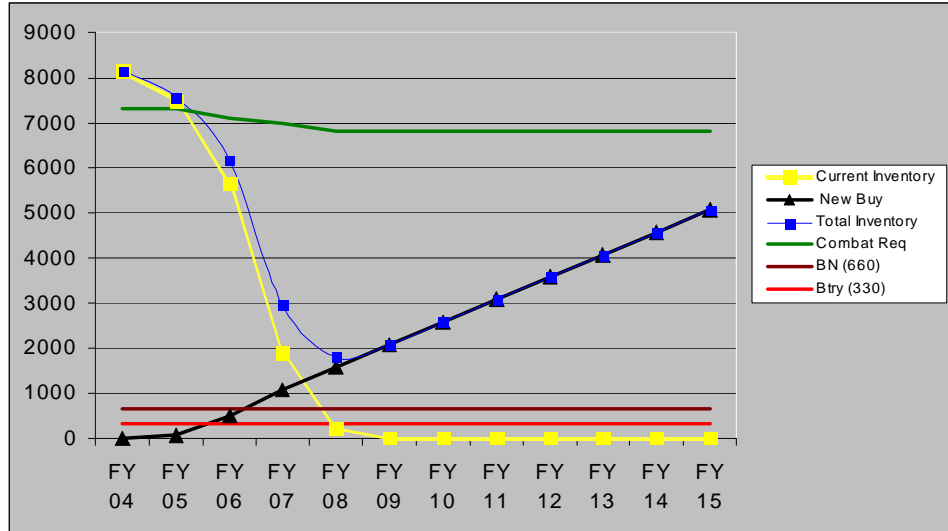


Fig 7: USMC Stinger Missile Shelf Life Graph⁵⁴

Who Cares?

The Marine Corps Combat Development Command (MCCDC) requirements division does not possess a written requirement or capabilities analysis for the Stinger missile system. MCCDC does have an Army requirement document but has yet to write a cover letter endorsing the Stinger system. Due to the lack of a validated requirement, many in leadership roles have advocated the removal of Stinger from the USMC inventory.

Even without a valid written requirement from MCCDC, implied requirements exist now and for future concepts.

⁵⁴ Mr. Rick Vangee, *Accelerated Aging Study*, Power Point Presentation, Slide #6 MARCORSSYSCOM Stinger Program Office. The new buy line is notional depicting inventories if SYSCOM could buy 500

The EMW Capabilities List shows Low Altitude Air Defense (LAAD) in its appendices as a future part of EMW.⁵⁵ The Naval Transformation Road Map lists Short Range Air Defense (SHORAD)/LAAD as key elements of the Air and Missile Defense (AMD) Transformation⁵⁶ and the Marine Corps Aviation Campaign Plan depicts the Avenger Weapon System as part of the Marine Corps' future.⁵⁷ Lastly, the Commanding General of III MEF expressed his desire to the Deputy Commandant for Aviation for retention of the Stinger missile capability as a viable weapon system for his forces.⁵⁸ The III MEF Commander's Marine Air Wing Commander expounded on the General's comments with the following citation:

Stinger Missile obsolescence would degrade 1st MAW'S organic ground based air defense capability and adversely affect the wing's ability to perform its expeditionary air defense mission. 1st MAW must be able to detect low altitude threats, which include highly maneuverable, low-observable cruise missiles and UAVS, share target information, and successfully engage and destroy those targets. POM 02, and subsequent budget decisions, strengthened Marine aviation's contributions to integrated joint theater air and missile defense through procurement of the Complementary Low Altitude Weapon System (CLAW), Multi-Role Radar System (MRRS), Composite Tracking Network (CTN), and the Common Aviation

missiles per year and Total Inventory is a summation of current inventory plus New Buy missiles minus expired missiles.

⁵⁵ *Expeditionary Maneuver Warfare Capabilities List*, 44,46

⁵⁶ *Transformation Roadmap*, 14, SHORAD and LAAD are listed separately to distinguish Stinger capability from CLAWS capability.

⁵⁷ Headquarters, U.S. *Marine Corps, Aviation Campaign Plan*, N.p., 2002, 30

⁵⁸ Commanding General III MEF, USMC, Personal for the General message concerning Stinger obsolescence, March 2003.

Command And Control System (CAC2S). Each of these program decisions were made to complement and enhance our current active ground based air defense capability. To permit stinger missile obsolescence would undermine these decisions and significantly affect 1st MAW'S support to III MEF remaining USPACOM'S "First In/First to Fight" force in each of its OPLANS and CONPLANS.⁵⁹

SHORAD is a requirement in the future concepts of the navy and Marine Corps and the current operations plans of the MEF Commander. Stinger's man portable, direct fire, self-guiding air defense capability is a required part of the overall defense of the MAGTF and Sea Shield. Stinger brings flexibility and mobility that is required on today's battlefield and for the future.

The Death of Stinger

Man portable short-range air defense is a requirement for the Marine Corps of today and the future. The Stinger system currently meets this requirement. However, the Stinger system will be removed from the inventory due to shelf life and programmatic issues.

Replacement of the missile components by procurement has become too expensive because of obsolescence. Electronics needed to build new missiles are no longer manufactured, so every new batch of missiles must have the electronics

⁵⁹ Commanding General 1st MAW, Response to Deputy Commandant for Aviation's personal request

reengineered and tested. The benefit of mass procurement is no longer available. The Army and Foreign Military Sales (FMS) will not procure any more units after 2005. Thus combining our procurement money with others cannot reduce unit cost. The cost of a new Stinger in 2001 was approximately \$80 thousand dollars. In 2003 the price was \$110 thousand dollars. Unit cost will continue to increase without major reengineering of the Stinger system. The Marine Corps cannot afford to support the procurement of legacy missiles without sharing the cost with other services or governments. After 2005 this will not be an option.

To Redesign or Replace?

The current Stinger system will not be as effective against the emerging threat. Stinger's main target was large, fast moving, ground attack aircraft. The emerging threat moves beyond high speed fixed wing aircraft and includes UAVs and other non-traditional threats with lower heat signatures.

UAVs have moved from large government produced science projects to small, high tech, private venture projects. They have electric engines with low heat signatures. They

are made of lightweight non-metallic material with a very low radar cross section. They can be equipped with GPS, laser range finders, and a variety of sensors. At the 2004 Paris Air Show no less than twelve mini to micro UAVs were marketed.

The new air threats are beyond the engagement parameters of the current Stinger system. Stinger's seeker requires new technology because it is not currently sensitive enough to detect small UAVs. Its fusing system requires modification to include a proximity fuse for near miss engagements. Rocket motors need to be adjusted to increase range. Lastly, a sighting system will be required to enhance the gunner's ability to detect and properly identify targets at longer ranges.

Together, these issues are too cumbersome to merit the procurement of Stinger missiles to replace the aging inventory. A new solution must be found to meet the future threat.

Requirements

The Navy and Marine Corps documents listed earlier outlined many of the requirements for a new system. Transformation of current systems requires an order of magnitude increase in capability to warrant investment of

resources.⁶⁰ A replacement for Stinger will need to shoot farther, detect more threats, have a higher P_k , and be capable of attacking air and lightly armored ground targets.

As part of the Sea Shield triad of fires, it will need to communicate with Sea Shield.⁶¹ It must be capable of Joint Combat Identification and independent operations.⁶² The new system will have to operate with the maneuver forces in the STOM model both mounted and dismounted and it must be man portable.

The primary target set for this system will be UAVs, fixed, and rotary wing aircraft.⁶³ It must also be able to engage nonstandard asymmetric threats. Threats like small planes, ultra lights, or suicide vehicles are difficult to spot or target until they have entered the terminal part of their attack. Placing man portable assets at high value targets will allow quick reaction to these asymmetric threats.

The new weapon system will require a seeker that can acquire targets with very low heat signatures made of non-metal materials and utilizing electric motors for stealth

⁶⁰ *Future Concepts & Capabilities*, Slide #5

⁶¹ Transformation Roadmap, 48

⁶² *ibids*, 35

⁶³ Headquarters, Department of the Army, *FM-44-100-2*, CH2, N.p., 2000, 1

and weight constraints.⁶⁴ New technologies like those in the AIM-9X show promise in extending detection capabilities by an order of magnitude or more.

The new system must be cost effective. Although Stinger has become more expensive, it is still relatively cheap. One F-18 (\$70 Million⁶⁵) buys almost two full LAAD Batterys (636) of Stinger missiles. One and a half LAAD Batterys of Stinger (454) could be purchased for the projected price of a new Joint Strike Fighter (JSF) (\$50 Million⁶⁶). In addition, these numbers do not include the ordnance to hang on the aircraft. The USMC cannot afford a million dollar man portable missile.

Lastly the system should be dual purpose. The history of USMC air defense is full of dual use systems. In Korea and Vietnam Anti Air Artillery from quad 50 caliber half-tracks was used against air and ground targets.⁶⁷ In OIF Third LAAD Battalion was employed as convoy escort bringing an air defense capability and the capability to engage ground targets.⁶⁸ The new replacement system should incorporate a dual use capability and it will require variable

⁶⁴ The USMC Dragon Eye UAV is man portable, made os Kevlar and utilizes two electric motors for propulsion. The Paris air show 14-22 June 2003 debuted multiple UAVs. Including 5 mini UAVs and 7 micro UAVs and a Small UAV helicopter with a 150 Kg payload.

⁶⁵ Maj Rich Bomhold, USMC, ASL F-18 cost analyst, telephone interview by author, 24 December 2003

⁶⁶ ibids

⁶⁷ Maj Jeff Davis, "*By the Right Flank, March!*", 2

⁶⁸ Maj Placiente, interview 10 Dec 2003

penetration and explosive characteristics for urban operations.⁶⁹ This dual use capability will make the system usable to more than just the air defense community. Therefore it will reduce logistics supportability and allow procurement of large numbers of ordnance and thus reducing cost.

Conclusion / Recommendations

For today and the foreseeable future man portable air defense will remain a requirement for the Marine Corps. Marine Cops Strategy 21, Naval Power 21, EMW-CL, USMC Campaign Plan, Naval Transformation Road Map, and the current Marine Expeditionary Force Commanding General all claim Stinger as a current and future requirement. Yet this capability is in jeopardy of being lost.

Despite the requirements Stinger missiles will be removed from USMC inventory by 2009 due to obsolescence. Procuring current version Stinger will be costly and insufficient to meet the emerging threat. Furthermore, senior leaders debate the validity of a man portable capability in a high tech environment when action is required.

Many suggest the loss of Stinger is an insignificant event. How can Marine Corps leaders be so certain? There

⁶⁹ MCCDC, *A Concept for Future Military Operations on Urbanized Terrain*, III-13

are no comprehensive studies analyzing the loss of Stinger's capability. There is no requirement defining the capability that will be lost or needs replacing. MCCDC has not written a requirement that encompasses Stinger capability in any other weapon system.

MCCDC and its Navy counterpart must do a thorough analysis to determine specific requirements that need to be replacement. How will the LAAD Battalions be restructured without proper analysis? How will bandwidth requirements be determined for an increased CLAWS requirement? Will there be an increased CLAWS requirement? A multitude of questions remain unanswered as the USMC contemplates the loss of Stinger. The Marine Corps cannot afford to have an overworked major in a dark cubicle in the Pentagon making air defense decisions without the proper empirical data and analysis. A Capstone Requirements Document is required to determine the future of air defense for Marine Corps Vision 21.

In the short-term, service life extension programs (SLEP) for the current Stinger inventory should be fully funded to maintain a core capability. Next, MCCDC should conduct a study to determine air defense requirements for STOM maneuver forces. Lastly, Systems Command should

investigate rapid acquisition possibilities for a replacement capability.

Acquisition endeavors require a long lead-time and Expeditionary Maneuver Warfare has arrived today. The beginning of Sea Basing comes in the form of the ESG and a hint of STOM was seen when Marines were inserted into Camp Rhino, Afghanistan. The Marine Corps/Navy Vision is occurring today and STOM forces require a man portable air defense capability to ensure their success.

The ability of current and future radar systems in Sea Shield will fail to provide required target quality data to radar guided missiles. The lack of coverage will leave STOM forces maneuvering 110 nm inland vulnerable to pop up immediate air threats without an organic air defense system. Furthermore, this system must be man portable in order to replace the loss of Stinger capability and support Marines wherever they maneuver. The USMC future concepts of EMW, OMFTS, and STOM cannot depend on a target quality cue when Marines will operate in electronically unfriendly environments and places where radar will be ineffective. The loss of Stinger is only a matter of time. A solution to replace the loss of Stinger capability is required or STOM will present the enemy with an air defense seam that can be exploited making EMW ineffective.

Appendix A

Stinger Shelf Life Raw Data

Stinger Service Life

PWR Missiles									
DODIC	Mfr Yr	Shelf life	Exp yr	Total Qty	CC A	CC B	CC C	CC N	Other CC
PL 94	1990	16	2006	674	294	379	0	0	1
PL 94	1991	16	2007	270	270	0	0	0	0
PL 94 Total				944	564	379	0	0	1
PL 95	1987	16	2003	0	0	0	0	0	0
PL 95	1988	16	2004	694	2	0	505	0	187
PL 95	1989	16	2005	610	149	384	0	0	77
PL 95	1990	16	2006	839	396	367	0	0	76
PL 95	1991	16	2007	40	16	21	0	3	0
PL 95	1992	16	2008	18	5	0	0	9	4
PL 95 Total				2201	568	772	505	12	344
PL 89	1990	16	2006	108	108	0	0	0	1
PL 89	1991	16	2007	1160	1159	0	0	0	0
PL 89 Total				1268	1267	0	0	0	1
PL 87	1990	16	2006	216	201	0	0	0	15
PL 87	1991	16	2007	2304	2185	0	0	0	78
PL 87	1992	16	2008	1640	1114	0	0	0	55
PL 87	1993	16	2009	217	22	0	0	0	195
PL 87	1994	16	2010	10	0	0	0	3	10
PL 87 Total				4387	3522	0	0	3	353
PL 41	1995	10	2005	43	43	0	0	0	0
PL 41 Total				43	43	0	0	0	0

DODIC Key	
DODIC	TYPE
PL 90, PL 93	Basic
PL 94, PL 95	RMP-C
PL 87, PL 89	RMP-D
PL 41	RMP Block 1

Component	Types	Age of Samples (yrs)	Sample Size	Current Shelf Life (yrs)	Recommended Shelf Life (yrs)
BCU	Ca/CaCr	3.40-19.75	176	18	23
	Lithium	7.17-8.17	17	11	23
Launch Motor		3.17-14.08	146	17	19
Flight Motor	Standard	3.17-11.25	36	15	16
	Alternate	5.83-11.17	47	13	16
Missile Battery	Ca/CaCr	3.42-14.50	110	18	23
	Lithium	7.17-10.00	57	11	23
Fuze		2.58-15.42	147	18	20

* Service Life based on RAM-Q and SRP process

Appendix B

Radar Horizon Calculations

To illustrate the significance of radar horizon the following calculation is submitted. In the equation below "h" is the height of a radar sensor and "H" is the height of a target. Because the sensors are ship based we will assume a sensor height of 225 feet and supported STOM forces to be located 110 nm away.

$$\text{Distance(nm)} = 1.23(\text{SqrRt}(h) + \text{SqrRt}(H))^{70}$$

$$110\text{nm} = 1.23(\text{SqrRt}(225) + \text{SqrRt}(H))$$

$$110/1.23 = 15 + \text{SqrRt}(H)$$

$$(89.43 - 15)^2 = H$$

$$74.43^2 = H$$

$$5,539.89 \text{ ft} = H$$

5,539 ft of altitude is not covered by Sea Based radars at 110 nm.

⁷⁰ WP61, *Radar Horizon/Line of Sight*, Pt MUGU, 2000, 1

APPENDIX C

STINGER MISSILE CAPABILITIES

Stinger is fired from the shoulder (see Fig 8) in man portable mode or from the Avenger Weapon System (Fig 9).⁷¹ The Avenger carries eight Stinger missiles, one M3P 50 caliber machine gun, one Forward Looking Infrared Receiver

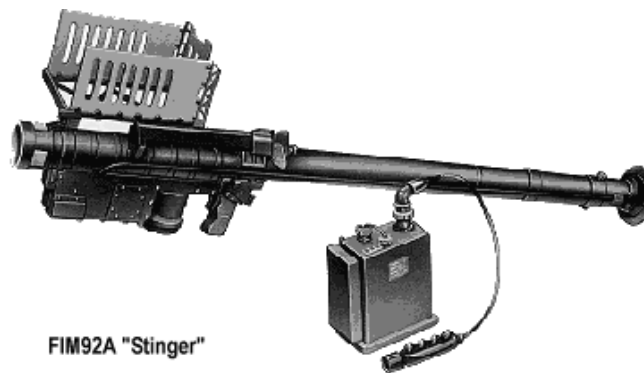


Fig 8: Stinger Gripstock for man portable operations⁷²

(FLIR), two SINCGARS radios, and a hardened laptop computer for data link and communication management.⁷³ It also carries two gripstocks for man portable operations if the Avenger is incapacitated. The man portable, or "MANPAD", vehicle consists of a HMMWV with a specialized rack system capable of carrying six missiles. It also has two SINCGARS radios and a hardened laptop computer for data link and communication management. Both MANPAD and Avenger have

⁷¹ *FIM-92A Stinger Weapon System*

⁷² Mr. Rick Vangee, MARCORSYSCOM Stinger Missile project officer, interview 10 Dec 2003 by this author

⁷³ *ibids*

Identify Friend or Foe (IFF) equipment to prevent fratricide. The hardened laptop computer and radios are also man portable; allowing communications and data link management anywhere a Marine can carry the radio and laptop.

The Stinger missile has a range of about six kilometers and reaches an altitude of ten thousand feet.⁷⁴ Stinger can dynamically move with maneuver units or remain static. It can use data links to receive target data or it can operate

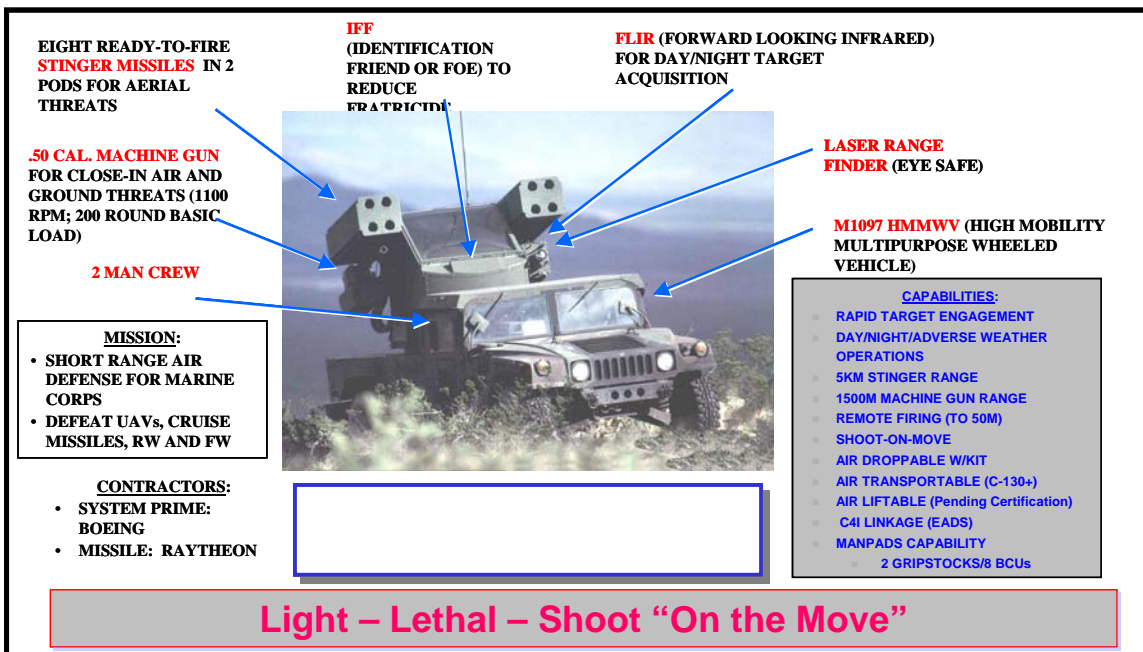


Fig 9: Avenger Weapon System⁷⁵

without communications from higher head quarters. Stinger teams can go anywhere a foot mobile Marine can go. Stinger is not limited to vehicle travel, and because the weapon is

⁷⁴ FIM-92A Stinger Weapon System

⁷⁵ MSgt (Ret) Jon Reznicek, MARCORSYSCOM Avenger Project Officer, interview 10 Dec 2003 by this author

fired by a human and does not depend on data links for guidance it is not degraded with a loss of communications. It can also operate with data links providing cueing for targets thus enhancing situational awareness, reducing engagement timelines, and increasing probability of kill by the gunner.

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¹ APC, HQMC, Information Paper, "Stinger Surface to Air Missile Obsolescence", 1

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