NDIA N-85 MCS STUDY

Final Report

Prepared for: Director, Expeditionary Warfare Division (N-85) [now N-75] Department of the Navy

By: Mine Warfare Subcommittee
Expeditionary Warfare Committee (EWC)
National Defense Industrial Association (NDIA)

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The views expressed herein are the responsibility of the study participants, and do not necessarily reflect those of the Department of the Navy or NDIA.

UNCLASSIFIED

EXECUTIVE SUMMARY

1. Purpose. This unfunded study was undertaken by the Expeditionary Warfare Committee of NDIA at the request of the Director, Expeditionary Warfare Division, (N-85), staff of the Chief of Naval Operations. The tasking was to determine whether there is an ongoing requirement for a Mine Countermeasures (MCM) Support Ship (MCS), and if the finding is in the affirmative, to address the various options that are available, or could be made available to fulfill the requirement. In making its determination, the study was directed to take into account the capabilities of Organic MCM systems which are currently under development, the forward looking vision in support of AForward...From the Sea@, and AOperational Maneuver from the Sea@.

2. Approach. The study first examined the roles, missions, and contribution of the MCS in light of current and future trends, and the National Security Strategy which emphasizes forward presence and maintaining worldwide access from the seas. Supporting material was also developed and is presented here for the mine threat, operational scenarios, and current and future MCM resources to present a thorough, unclassified discussion in a single volume.

3. Naval mines have historically provided an effective barrier against access from the sea, and they continue to proliferate globally. To meet this asymmetric threat, dedicated U.S. Navy Mine Countermeasures forces of today and for the near futuare are comprised of a ATriad of Capability@: MH-53 airborne MCM (AMCM) helicopters; MCM and MHC Class surface MCM (SMCM) ships, and Explosive Ordnance Disposal MCM (EODMCM) units. The linchpin or centerpiece which has resulted in the synergy when these forces operate together is USS INCHON (MCS-12), the MCM support ship which provides for command, integrated operations of AMCM, SMCM, and EODMCM, as well as the material and logistic support for these forces. Of note is that USS INCHON is programmed to reach end of service life in 2005.

4. The strength of today=s dedicated (to be redesignated Asupporting@) forces is their ability to conduct sustained MCM (minehunting/neutralizing and minesweeping) operations in large areas over extended periods of time. Their key limitation is the length of time it takes to reposition the surface part of the TRIAD from CONUS homeport to theater of operations in time of conflict. A small number of ships are forward deployed to mitigate this deficiency; however, the requirement remains for the Navy to have more robust capability available globally on short notice. To meet this requirement, the Navy has developed and funded a plan to provide forces which will be organic (to be designated Aassigned forces@) to carrier battle groups and amphibious ready groups. These new capabilities are planned to enter the force by 2005 and will consist of a suite of airborne MCM systems employed by the CH-60S helicopter and the Remote Minehunting System (RMS) operating from surface combatants, and potentially amphibious ships. These organic, or assigned forces are planned to include minehunting/neutralizing and minesweeping capabilities.

5. The U.S. Navy Mine Warfare Plan calls for the replacement of the current MH-53E with the CH-60S helicopter in the 2005-2010 period, and during the following decade(s) the possible replacement of existing surface (SMCM) by MCM(X) currently under study.

6. The MCM Force 21 Study was completed in 1999. It highlighted the value of an organic/assigned force in several BG/ARG MCM scenarios and recommended, with caveats, significant changes from the current MCM force. These included replacement of the MH-53E by CH60S helicopters; elimination of the MCS and a 50% reduction in SMCM ships. That study, however, did not fully examine the demands for sustained MCM operations.

7. The defining mine countermeasures situation requiring the support of an MCS is a sustained operation involving high levels of clearance in a large area over an extended period of time. A continuing, effective MCM capability must be maintained by the Navy through the transition to assigned MCM in forward deployed battle forces. In the end, a mix of dedicated/supporting and organic/assigned surface and airborne forces is envisioned to satisfy the required roles and missions over the wide spectrum of threats and scenarios in an uncertain future.

8. It is the opinion of this NDIA Study Group that prematurely implementing the above MCM Force 21 Study recommendations regarding dedicated/supporting forces would have a high degree of risk. The caveats in the study are in the majority associated with yet to be demonstrated capabilities, and the demands of sustained operations may require both MCS participation and substantial minesweeping efforts by surface ships and helicopters.

9. We conclude that there is a continuing need for an MCS now and for the foreseeable future. Service life for INCHON should be extended to at least 2010 and possibly beyond, pending evaluation of the performance of organic/assigned systems, and determination of their ultimate role. The foregoing will drive the evolving role of dedicated/supporting forces and better define the requirement for MCS(X) and MCM(X).

10. Multi-mission requirements for a future MCS have not been identified, but would be desirable. In this regard, the requirement to support the shallow/very shallow water/surf zone mine clearance mission by providing adequate capacity for equipment and explosives would extend capabilities beyond the present MCS and satisfy an existing deficiency.

11. Several design options for a follow on MCS were briefly examined, with a derivation from the LPD-17 Class appearing to be most promising from the points of view of operational compatibility and cost. However, before a decision or refined design can take place, the mix and relationship of future MCM forces needs to be evaluated and understood.

12. By extending INCHON service life, the navy will gain the time needed to examine evolving future requirements, evaluate the contribution of organic/assigned MCM and its relationship to dedicated/supporting forces, and consider various alternatives for future platforms.

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Our thanks to all of the following who have contributed to this study, rendering direct input or consultation, and to their organizations who have supported their efforts.

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I. INTRODUCTION AND BACKGROUND

Purpose of the Study

1.1 The Mine Countermeasures Support Ship U.S.S. INCHON (MCS-12) is the linchpin of the U.S. Navy Mine Force, providing several important command and support functions, as well as embarking mine countermeasures (MCM) elements. The ship, originally an Amphibious Assault Ship (LPH) was first launched in 1969 and converted in 1996, with its end of service life originally scheduled in 2005. Repairs are currently underway with the expectation that service life can be extended to 2010 and possibly beyond. At the request of the U.S. Navy Expeditionary Warfare Division, N-85, this study was undertaken by NDIA to determine whether there is an ongoing need for a mine countermeasures support ship as part of the Mine Force, and if so, what options might be available beyond INCHON.

1.2 The approach is first to provide a picture of mine warfare within the context of U.S. maritime strategies and objectives. The MCM climate and some possible scenarios are given, followed by a discussion of threats posed by naval mines and a review of some recent operations. The need for the MCS is reviewed in Section II, and roles and requirements for the ship are given in the third section, followed by a discussion of some options in Section IV. Results and conclusions of the study are summarized in Section V. Appendix A describes current operational MCM systems and Appendix B developmental systems. Current mission requirements are summarized in Appendix C and supporting analyses are presented in Appendix D.

MCM Climate

1.3 The end of the Cold War caused a wide ranging reevaluation of U.S. national priorities and interests in light of the departure of the bi-polar world of 35 years. The revised National Security Strategy calls for the military to meet aggression with a three-pronged approach of engagement, partnership and prevention. This strategy calls for significant forward presence, involving larger numbers of naval forces in crisis-prone areas. The *Navy=s Forward...From the Sea* underscores the need for naval forces to be prepared to control all elements of the battlespace. Many of these areas are in the world=s littorals, with a strong possibility that naval mines could be encountered, to deny access from the sea. This assertion is based on the worldwide proliferation of mines, with at least 49 countries now possessing an offensive mining capability.

1.4 The 1980s and 1990s experiences with Mine Warfare again underlined the need to focus on this key enabling aspect of Maritime Warfare, which time and again throughout history has been a AShow Stopper@, but has received a paucity of funding -- especially during the Cold War years. In the 80s there was the experience in the Persian Gulf (ERNEST WILL), and in the early 90s there was DESERT SHIELD / DESERT STORM. Inexpensive and often low technology mines thwarted U.S. ability to operate with impunity; caused extensive damage to ships, and eliminated a military option of unencumbered maneuver and operational flexibility, impacting our ability to exert military power and influence ashore.

1.5 There was much congressional interest and direction following DESERT STORM for the Navy to take immediate action to correct deficiencies -- this was in 1991 and followed in 1992. Congress edicted that the Mine Warfare area should get much greater focus in the Navy, directed that a Marine Corps Major General be assigned to OPNAV staff to oversee the requirements for all of Expeditionary Warfare, and required that SECNAV / SECDEF certify the Mine Warfare Plan each year to the Congress.

1.6 In the spring of 1995, the CNO, Admiral Boorda, USN, and the new N-85, MGEN Jones, USMC, placed a much greater emphasis on longer term planning. The CNO developed and released a AWhite Paper@ on Mine Warfare, raising the level of awareness with CJCS. MGEN Jones oversaw the development of the Mine Warfare Campaign Plan, with Near-, Mid-, and Far-term visions and programs. The notion of Organic Mine Warfare applied to major fleet elements was developed and programs to support this new set of capabilities were initiated for the mid- and far-terms. Meanwhile, the Navy and Marine Corps team was developing doctrine (e.g. OMFTS) which depended on unimpeded maneuver and rapid insertion of combat elements ashore to rapidly and dramatically influence the outcome.

1.7. In 1998, the Center for Naval Analysis (CNA) was tasked to perform a study of MCM Forces required for the 21st century with emphasis on organic capabilities. This study was completed and reported on in the Spring of 1999, with recommendations including eliminating the MCS, MH-53E AMCM helicopters and a significant reduction in surface MCM ships. However, these recommendations were caveated based on the realization of system performance.

1.8 One of the caveats in the CNA Force-21 study was Acan the CH-60S tow@ (as the replacement for the MH-53E AMCM platform). There is no doubt that the helicopter can tow; the question is effectiveness achieved in the mission. Congress added $12M in the FY99 budget for the Navy to perform H-60 tow tests, which are currently underway. Notwithstanding the results of these tests, helicopters will be a permanent facet of MCM for some time to come and flat decks will be required.

1.9 During 1999, as a result of both the AForce-21 study@ and Fleet and CH-60S Concept of Operations development, the terminology AOrganic@ and ADedicated@ were changed to be more reflective of their respective roles. AOrganic@ was changed to AASSIGNED@ and >Dedicated@ to ASUPPORTING=. These terms will be utilized in the remainder of the study. MCS-12 USS INCHON was scheduled to retire ca. 2005. The basis for this NDIA study, requested by OPNAV, N-85 is to determine whether there is a need for an MCS in the future. If so, what are alternatives to replace the MCS-12 and when should the transition occur?

MCM Scenarios

1.10 Types of scenarios involving MCM operations could fall into five general categories:

X Sea Lines of Communication (SLOC)

X Ports

X Fleet Operating Areas

X Independent Operations, and

X Follow-On / Sustainment.

Sea Lines of Communication

1.11 Naval and associated logistics forces must be able to transit the sea lanes to demonstrate forward presence and position themselves for power projection missions. The SLOCs are vulnerable to mining at straits, narrows and other choke points around the world. If mining of a SLOC is known or suspected, MCM forces must be able to open a safe lane through the mined waters to allow naval forces to transit as required. Examples of SLOCs that are vulnerable to mining are the Straits of Hormuz in the Persian Gulf, the Korea Strait and the Straits of Malacca.

1.12 The SLOC scenario requires opening a safe channel of about 1000 yards width that may run for over 100 nautical miles. The water depths may be combinations of deep and shallower areas. Because of the length of the safe channel, bottom types can also vary widely along the route. The mine threat is dependent on the water depth, with moored contact mines a threat in both deep and shallow water, and bottom influence mines a threat in shallower water depths (generally less than 200 to 300 feet for surface ships and 600 feet for submarines).

Ports

1.13 Port ingress or egress may be essential for naval forces or joint force support. For example, Maritime Prepositioning Squadrons (MPS) and/or Air Force or Army Afloat Prepositioning Force ships may be required to enter or leave ports vulnerable to mining to support joint land operations ashore. If a port is suspected of being mined, MCM forces must be able to clear an ingress / egress channel from the port out to unmined waters.

1.14 Port break-in or break-out requires that MCM forces open a safe channel of about 1000 yards width or more. The length of the safe channel will usually be shorter than that required in the SLOC scenario. However, the water depths close to the port will be shallower than in the SLOCs (for the most part), resulting in bottom influence mines posing a greater threat. Other special conditions in the shallow water, high traffic areas around ports that may make MCM operations more difficult or require different tactics include the possibility of mine burial in silty channels and a potential high level of clutter from discarded and sunken objects.

Fleet Operating Areas

1.15 Naval forces such as carrier battle groups or amphibious task forces, often have to operate within the confines of a fixed area that is in reasonable proximity of shore to carry out power projection missions or support joint operations ashore. These operating areas may be vulnerable to mining, depending on the area geography and the potential threat mine type. MCM forces must be capable of making these areas safe for naval ships to conduct required operations.

1.16 Fleet operating areas represent large scale areas as opposed to the narrow, long channels in SLOC and Port scenarios. Typical areas can be as large as 2500 square nautical miles (50 nmi. X 50 nmi.) for a carrier battle force and several hundred square nautical miles for the sea echelon area of an amphibious assault operation. Also ships operate in these areas for days, resulting in multiple ship passes through potentially mined areas, as opposed to a single pass for a ship transiting a SLOC or entering / leaving port. This considerably raises the risk of any single ship actuating a mine if present.

1.17 Carrier Battle Group (CVBG) or Battle Force operating areas may have flexible boundaries, so that if a segment within the oparea is found to be mined, the area could be redefined to exclude the mined area, within limits. This could eliminate MCM requirements to clear or neutralize mines provided that enough Asafe@ area exists nearby. The CVBG / F operating area may be in deep enough water to avoid the threat of bottom influence mines, except in certain shallow areas such as the Persian Gulf. However, a high value target such as a carrier may face sophisticated rising mines as well as moored influence and contact mines.

1.18 Amphibious forces may require a range of supporting MCM operations. The sea echelon area is a large operating area located over the horizon from the landmass under assault. There may also be smaller areas, closer to shore, where ships and landing craft rendezvous, as well as safe lanes between the inner and outer areas and assault lanes leading to the beach. All of these areas require MCM operations to assure safe operations for naval forces. The mine threat will vary with the water depth from the beach to the deeper water of the sea echelon area. In the shallowest water, close to the beach, large numbers of smaller anti-invasion type mines and obstacles designed to disable landing craft may be found. Farther from the shore, bottom influence mines are a danger to landing craft and ships alike. Moored contact mines may also be found over most of the amphibious assault areas, excluding only the shallowest areas close to the beach.

Independent Operations

1.19 Some missions for naval forces may require independent single ship or small group operations away from the main force. Examples of these missions are theater missile defense (TMD), naval fire support including land attack and Tomahawk missile strikes. These operations require independent transit to an area, underway operations in the area and return to rejoin the main force. Parts of the transit route and / or the operating area may be in mineable waters. There is no requirement to establish a safe lane for other ships to pass through, just a requirement for ship(s) performing the independent operations to reach their oparea in a timely manner and operate safely in the oparea once they have arrived.

1.20 The size of the oparea for independent operations will usually be smaller than for fleet operating areas, on the order of 100 to 200 square nautical miles. These missions may arise without much forewarning and rapid response may be required. An assigned MCM capability is needed that allows ships performing independent operations to respond in a timely manner.

Follow-on / Sustainment

1.21 The follow-on / sustainment scenario is distinguished from those already discussed, by the much larger area, high level of clearance, and scale of the required MCM operations, both in level of effort and time. The scenarios discussed above involve allowing naval and joint forces to reach their operating areas and commence operations. Follow-on / sustainment operations expand the MCM operations to enable build-up and sustained operations ashore. Examples of follow-on sustainment scenarios are post-amphibious assault follow-on clearance, port clearance (as opposed to break in / break out) and SLOC clearance.

1.22 Whereas the SLOC scenario and port break-in / break-out required opening a single, narrow safe channel, follow-on / sustainment operations would expand and clear multiple channels or large areas to allow large scale, follow-on forces and merchant shipping to transit SLOCs and to enter and leave ports. Follow-on operations in fleet operating areas would expand sea echelon areas and lanes to the beach to allow large-scale movement of sustaining troops and materials after the initial amphibious assault. In a CVBG oparea, follow-on operations would clear or neutralize mines that had initially been avoided by redefining the CVBG oparea boundaries.

MCM Scenario Summary

1.23 Table 1.1 summarizes the nominal characteristics of various MCM scenarios. The characteristics listed for each scenario are representative, not definitive. Real world situations can vary widely, but the table provides an overall view of the relative differences between scenarios in terms of the size of the area, water depths, likely mine threat, etc. Sea bottom clutter and mine burial are important considerations because they can limit the effectiveness of mine hunting operations and increase dependence on influence mine sweeping.

1.24 The mine threat is as much a function of the water depth and the adversary=s mine inventory and means for delivery as of the scenario. Sophisticated, expensive rising mines might be expected to be employed against high value targets. Moored contact mines are a threat in every scenario because of their widespread availability and ease of laying from small boats. Bottom influence mines are also widespread, but limited in applicability by water depth (generally limited to effective depths of 300 feet or less against surfce ships).

1.25 In examining the long term direction of the Navy to say 2030, and exploitation of the Sea Strike Concept[1], there is a continuing requirement to suppress area denial threats Ain the approaches to and establishment of the Sea Base@. This is manifest in supporting maneuver forces ashore and in

[1] CNO Strategic Studies Group XVIII, September 1999

the post conflict phase where the Navy transitions to perform the maritime component of a follow-on Joint Task Force. In thinking even further forward to 2030 to 2050, Naval Power Forward

Table 1.1 MCM Scenario Overview

PARAMETER	SCENARIO				
	SLOC	**Port**	**Fleet Op Area**	**Independent Operations**	**Follow-on / Sustainment**
MCM Requirement	Open a safe channel	Open a safe channel	Find a safe operating area, clear only if cannot move area	Find a safe transit lane and op area	Find and clear / neutralize **all mines**
Area Size	Small: 1000 yd X 100 NHI	Small: 1000 yd X 50 NHI	Large to Very Large: 400 to 2500 nmi^2	Moderate: 100 to 200 nmi^2	Large to Very Large: several 1000 nmi^2
Water Depths	Moderate to Deep: 100 to >200 ft	Shallow to Deep: 40 ft to >200 ft	Variable - Deep to Very Shallow: 10 ft to >200 ft	Variable - Deep to Shallow: 50 ft to >200 ft	Variable - Deep to Very Shallow: 10 ft to >200 ft
Sea Bottom Clutter	Moderate	High	Low to High	Low	High to Low
Probability of Encountering Buried Mines	Low to Moderate	High	Low to High	Low to High	Low to Very High
Mine Clearance / Neutralization Requirements	Moderate (mines in channel)	Moderate (mines in channel)	None (change areas) to Heavy (clear area)	Light to None (avoid wherever possible)	Very Heavy (clear / neutralize all mines)
Mine Threat:					
Moored Contact	XX	XX	XX	XX	XX
Moored Influence	X	X	X	X	X
Bottom Influence	X	XX	XX	XX	XX
Rising / Mobile Warhead			XX		XX
Obstacle / Anti-Invasion			X		XX

XX = Highly Likely

X	=	Likely

describes Ahow Naval forces will be established and sustained anywhere, including the contested littorals, to conduct and support the full range of maritime operations, including Sea Strike land attack in the 2030 - 2050 timeframe.@[2]

1.26 Four supporting concepts for Naval Power Forward all potentially encompass mine countermeasures to overcome adversary denial capabilities in each of the four key supporting concepts:

X Shape: Aneutralize or destroy -- denial capabilities.@

X Protect: Aattack and active defense operations -- (including) undersea warfare and mine countermeasures.@

X Survive: Afight through the entire spectrum of the adversary=s area denial capabilities.@

X Sustain: ATo conduct extended operations in the littorals, sustainment must be transparent and executed in stride.@

This most advanced thinking about the future Navy is built around the fundamentals of assured access and sustainment, in the face of asymmetric threats. Naval mines and therefore mine countermeasures are here to stay for the foreseeable future. Assigned MCM forces will provide heretofore nonexistent in-stride capabilities; supporting forces will provide core, sustainable capabilities, and the combination will assure the ability to satisfy the range of scenarios, contingencies and uncertainties that characterize mine warfare.

Minefield Threat

1.27 Naval mines exist in many forms, shapes, sizes and with many different actuation mechanisms and are found in the stockpiles of many nations. Principal types are: moored mines having a bottom anchor to which is tethered a buoyant mine case generally close to the surface, containing either a contact or influence, e.g., magnetic firing mechanism, and a few hundred pounds of explosive charge; bottom mines, most effective against surface targets in relatively shallow water, containing from a few

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[2] CNO Strategic Studies XIX, 16 December 1999

hundred pounds to almost a ton of explosive, and influence actuation mechanisms using magnetic, acoustic, or pressure sensors or combinations thereof that respond to ships signatures; and rising mines that are moored close to the bottom, but rise to the proximity of a ship target like a torpedo, based on a sensor actuation. Influence mines may be fitted with arming delays or shipcounters to thwart influence sweeps, or to prolong the useful life of the minefield.

1.28 In addition to the above which are generally found in water depths greater than 40 feet, shallower reaches could include a variety of anti-invasion mines, with beaches and surf zones also susceptible to mining. While the primary interest of conventional surface and airborne MCM operations lies in water depths of 40 feet or more, the MCS may also be required to support EOD and Special Warfare forces for shallow / very shallow water and surf zones clearance operations.

1.29 All mines pose a very serious threat to shipping, since underwater explosions can cause severe damage to hulls, machinery and personnel. The threat of naval mines to shipping is represented by the likelihood that a ship operating in or transiting a minefield will detonate a mine close enough aboard to cause damage or sinking. This threat, or risk, is expressed as a statistical probability percentage of the likelihood of damage for a given scenario. The risk depends on the number of mines or mine density in the field and their location; ship characteristics (signature, vulnerability and movement) and the mine types and settings. Reduction of risk is accomplished by avoiding mines once detected and if the operational situation allows; minimizing ship exposure and actively eliminating or neutralizing mines by sweeping, hunting or explosive means. Mine density and numbers are very significant variables; in Operations Desert Shield and Desert Storm coalition forces destroyed 1,300 mines of various types.

1.30 Planning Uncertainties. Factors affecting risk reduction, timing and effectiveness are a combination of environmental, dimensional, mine and mine countermeasure performance. While prior planning will utilize best estimates of MCM technical parameters based on available intelligence, the process is fraught with uncertainty. With minefields, one can=t be sure until arrival at the scene, MCM operations commence and feedback is analyzed before developing confidence in the probable outcome.

II. NEED FOR MCS

Concept of MCM Operations

2.1 The general concept presented in various CONOPS documents state that deployed BG / ARGs will rely upon both assigned and forward-based supporting MCM capabilities to initially assess and respond to a mine threat. As the potential for conflict rises or actual hostilities increase in scope and duration, the BG / ARG concentrates on effectively contributing to operations ashore. The initial mine threat is, in most cases, likely left behind and both forward-based and CONUS-based supporting MCM forces will assume the main theater MCM effort. Assigned BG / ARG MCM forces will focus solely on directly supporting BG / ARG maneuverability and mission accomplishment. Characteristics of the ships, aircraft and MCM equipment for both assigned and supporting forces are summarized in Appendix A.

2.2 The decision regarding when to phase supporting MCM forces into an operation will largely depend on the mine threat, the mission, the operating environment, the degree of force protection required, and what support or supporting platforms will be required. When a potential mine threat exists or when mines are actually detected, reconnaissance and possible clearance become the principal focus of MIW. BG / ARG with assigned MCM capabilities will conduct immediate reconnaissance operations. Forward-based supporting MCM forces may also be used to augment or expand these operations. Assigned MCM forces and other forward-based supporting minehunting / neutralization and minesweeping / clearance MCM systems can then be employed to establish safe passage routes and clear operating areas. As the level of conflict increases, other supporting MCM forces can augment assigned and forward-based MCM force efforts. If operational exigencies dictate that the BG / ARG re-deploy or reposition, then supporting MCM forces can continue residual reconnaissance and clearance operations.

2.3 There may be a continuing need for assigned and supporting forward-based or deployed Mine Countermeasures assets for potential extended MCM operations. Sustaining MCM operations in-theater requires extensive command, control and logistics that are currently only available from a MCS platform. This was demonstrated earlier when INCHON, before conversion to MCS, was deployed with an MCM group in NATO Exercise Blue Harrier 93 off the Danish Coast. In BG / ARG operations there will be strong competition for platforms to support assigned or supporting MCM forces. Past experience has shown that using a platform for MCM support can degrade that platform=s ability to perform its primary mission. If available, an MCS platform designed to support both assigned and supporting MCM forces could provide command, control and logistic support while freeing BG / ARG surface combatants for their primary missions. A future MCS, if undertaken, should be capable of deploying with the BG / ARG or separately with MCM assets, and with the departure of BG / ARG provide MCM support for logistics forces.

Gulf War Lessons Learned

2.4 The analysis of Operation Desert Storm showed the Navy=s lack of preparedness for supporting Mine Countermeasures forces. As the conflict progressed, Navy commanders discovered that the MCM Force was configured to rely on shore based support, and that MCM ops in the Gulf War would take place distant from shore bases, denying time critical logistics and shore-support facilities. An attempt was made to compensate by assigning USS TRIPOLI (LPH-10) as the Aplatform of opportunity@; however the ship suffered a mine strike and was out of action. The lessons learned also reflected that taking TRIPOLI away from the amphibious force was disruptive to U.S. Marine Corps amphibious lift requirements, and was a Apick up team@ approach to MCM warfighting. Therefore, the recommendation in the Gulf War lessons learned, Athat the MCM Force have dedicated sea-based support@ was adopted, and options developed to provide a dedicated Mine Countermeasures Support Ship (MCS). After months of staffing and review, the option to convert USS INCHON (LPH-12) to MCS-12 was chosen and Congressional Legislation obtained which provided the resources for the conversion. USS INCHON entered the Ingalls shipyard in 1995 and emerged to begin its new mission in the Fall of 1996.

MCS Performance

2.5 USS INCHON has completed three years performing its new mission, and by all accounts, the value of the ship has met or exceeded expectations. Operationally, MCM timelines have been reduced dramatically with the Triad (air, surface, and EOD forces operating in coordinated ops), demonstrating its ability to repeatedly detect, classify, and identify mines in less time and with greater accuracy than ever before in major Joint Task Force exercises. Contributing to the success was the command and control capability which has not only linked the ships of the mine force together and enabled the rapid exchange of data, but enabled the exchange of necessary data relative to the mine threat to senior commanders in the naval and joint warfighting chain of command. The fusion and full exploitation of environmental data and intelligence aboard the MCS platform added a new dimension to MCM ops, recognized as a major shortcoming in Gulf War lessons learned.

2.6 INCHON support of EOD MCM personnel considerably enhanced reacquisition and neutralization of sea mines, often at great distances from the MCS, allowing naval forces to operate in safe waters well outside mine danger areas. Additionally, in its role as the Intermediate Maintenance Support provider for both SMCM and AMCM, high readiness levels of ships and aircraft were maintained. Ships deployed readiness with INCHON are within the C2 or better category, and AMCM readiness rates are in the low 80s, based on data for calendar year 1998 and 1999 deployments.

2.7 Commencing in 1997, INCHON conducted operations in major Joint Task Force exercises, with integrated MCM Force operations and MCM Force operations integrated into Battle Group and Amphibious Group operations. The ship also made an extended deployment to Northern Europe in 1997 and Newfoundland in 1998, where successful combined MCM ops were conducted with NATO Allies. The ship in its C2 role in combined ops, handled low baud rate communications directly from Allied ships, fusing and providing information to the cognizant Commander. In 1999, INCHON=s planned MCM deployment to the Fifth Fleet was redirected to support Allied operations in Kosovo.

Future Force Planning

2.8 There are shortcomings in current capability which the Naval Service is attempting to address for the future. Specifically, the mine force of today is limited by being based in CONUS, and the preponderance of the surface MCM force, including the MCS, would require 30-60 days to arrive in potential threat theaters. Until their arrival, 4 SMCMs (2 each to Fifth and Seventh Fleets), and 4

MH-53E helicopters in Fifth Fleet, along with EOD MCM and additional MH-53E helos airlifted to the scene, would have to conduct operations either shore based, or utilizing the Aplatform of opportunity@ concept. With this shortfall in mind, in 1995 the Navy began to develop Aorganic (assigned) mine countermeasures@ capability for forward deployed Battle Groups and Amphibious Ready Groups. These systems would be installed in forward deployed forces poised to conduct rapid reconnaissance for sea mines, and if present, determine and mark their location sufficient for mine avoidance, or alternatively, perform limited neutralization, pending arrival of supporting forces. The current Navy Program calls for a Battle Group with assigned MCM capability in FY05. Since INCHON was scheduled to reach end of service life (ESL) in 2005, it was timely to review here the need and requirements for the MCS to determine its validity with the advent of this new assigned and supporting concept, and other changes envisioned in naval operational concepts over the next decade.

2.9 Given the significance of the year 2005 (ESL for INCHON and first deployment of an assigned MCM-equipped Battle Group), the following addresses the near term (2000-2005), the mid-term (2005-2010), and the far-term (beyond 2010) eras. The original Operational Requirements Document (ORD) for MCS, specified that this platform would embark the MCM commander and staff; provide integrated command and control; embark and operate a tailored AMCM squadron; embark EODMCM detachments; transport minehunting and minesweeping vehicles; embark and support Special Warfare Forces for shallow water / very shallow water / surf zone mine clearance ops, and provide general logistic support and organizational intermediate level maintenance support for embarked AMCM, EODMCM, and to assigned SMCM ships. With the exception of embarking Special Warfare Forces, these requirements have been met and built upon, and are valid today. The embarking of Special Warfare Forces has not been accomplished, due to their homebase location, the ability to satisfy training by other means and the desirability to operate from amphibious platforms when present; however, the flexibility inherent to the MCS ship would allow Special Forces embarkation when required by the specific mission with little prior notice or training.

2.10 With the evolving threat, both in terms of increased complexity from a technology standpoint, as well as availability, a continued full court press for at least the next decade is required if the U.S. Navy expects to pace the threat and remain relevant in joint warfighting in the Littorals, with the MCS in essence the center of current MCM capability. In the near term (i.e., until some time beyond 2005) the assigned capability envisioned for the Navy is not available to satisfy current requirements. The five years until the year 2005 provides the Navy the opportunity to execute its Fleet Engagement Strategy for Mine Warfare (the strategy for inculcating MIW into everyone=s thinking as a core capability throughout the operating forces, specifically all sea-going staffs, surface combatants, aircraft carriers, submarines, and amphibs). Assuming full acceptance of the Amainstream Mine Warfare culture@, MCM capabilities will redistribute between the supporting force and the Battle Groups and Amphibious Ready Groups of tomorrow.

2.11 It is almost a given that the requirement for the MCS remains valid at least through the year 2005. By then we should have shown that assigned systems demonstrate technical and operational effectiveness; assigned systems have achieved IOC dates and are scheduled to be procured in sufficient numbers; CH-60S helicopter buys are on schedule completing in 2008, and Mine Warfare Amainstreaming@ is achieved.

2.12 During the Mid Term (2005-2010) transition period the requirement for the dedicated MCS platform remains valid, for at least the beginning of this period to achieve a sufficient number of Battle Groups to be equipped and trained to deploy with the new systems. Meanwhile, the MCS should remain in commission to support sea basing the MH-53E at least until transition to the CH-60S helicopter takes place. But even after transition to the CH-60S, an AMCM support platform may still be required for extended or sustained AMCM operations (see the discussion of aircraft equivalents in Section III of this report).

2.13 The MCM Force-21 Study shows that today=s timelines can be improved upon with new developments, including the Remote Minehunting System (RMS) on two surface combatants in each Battle Group. Operating MCM assets off multi-mission, major combatant or amphibious ships, will be better understood when the first Battle Group is equipped and exercised in a multi-mission environment. A platform for seabasing the CH-60S in a supporting role if necessary will clarify when Concepts of Operations mature and new systems are fielded.

2.14 The support functions performed by INCHON for SMCM and EODMCM are important, providing some level of intermediate maintenance support, enhancing MHC-51 or MCM-1 Classes ability to conduct sustained operations remote from shore-based support. Diving lockers, recompression chambers for EOD; co-location with MCM Staff, and meteorology / oceanography capability in INCHON have demonstrated value. Technology should allow replication for basing such functions aboard surface combatants and amphibs; for example, the C4I capabilities of INCHON are available on most large deck ships.

2.15 The projected end of service life for the surface MCM force is beyond 2025, and this should weigh as a factor in the determination of a follow-on MCS. Surface MCM ships have both hunting and sweeping capability, and if the CH-60S replaces the MH-53E, sustained sweep capability will reside in the surface platforms. Given that sea mines are becoming more stealthy and sophisticated, the ability to sweep must be retained to pace the threat, and surface platforms may still be necessary. The Navy has begun to study a possible next surface MCM platform, entitled MCM(X). At this juncture it is not known whether MCM(X) is required or justified, or whether it is a ship or a Remotely Operated Vehicle (ROV). Some have suggested a well deck platform with a helo deck that can carry both helicopters and a number of smaller ROVs employing countermine systems. If MCM(X) turns out to be a ship, it might have MCS functions as well.

Wrap Up

2.16 Assigned forces will provide a much needed, long overdue organic MCM capacity to the CVBG and ARG; but there remains a requirement for supporting sustained MCM operations, for which assigned forces may not be available or capable. The burden will necessarily fall on supporting MCM assets, with attendant MCS support requirements possibly along the same lines listed in the original MCS ORD.

2.17 When we examine arguments relating to the MCS we find both positive and negative aspects to the present situation. If the ship stays at its Texas home port, it simply takes too long to get to where it might be needed. Forward deploying helps, but will it be in the right place? More than one ship would of course be better, but is this realistic in the light of present-day fiscal reality? Different concepts are discussed in Section IV of this report.

2.18 Given the long list of INCHON roles, missions, capacities, functions and ability to accomplish the wide requirements of Mine Warfare, the ship has done a superb job on site. In fact, INCHON with its embarked EOD, MH-53Es, and ability to support surface MCM is today and in the near future without parallel. Looking ahead, the wide spectrum of contingencies may still imply the need for such functions, recognizing the expected utilization of assigned and supporting forces shown below.

Assigned MCM Forces (BG / ARG)

X BG / ARG maneuver in support of operations ashore
X Immediate reconnaissance
X Safe passage

Supporting MCM Forces

X Residual reconnaissance
X Large scale clearance
X Extended MCM operations

III. MCS ROLES AND REQUIREMENTS

The Changing Mine Warfare Force

3.1 Former Chief of Naval Operations ADM Jay Johnson, USN has said Awe must have forces which are configured and trained for the mission of gaining access. Every potential enemy must know that the United States Navy and its coalition partners have access from over the blue water horizon to the beach and beyond -- there is no sanctuary for the enemy.@ But the Global 99 War Game conducted in September 1999 at the Naval War College Arevealed that there are many challenges that can delay access, such as mines, antisubmarine warfare, theater missile defense, space sensor protection and cyber attacks.@[3] To better meet the Navy=s need, an expansion to a more Aorganic@ (i.e., intrinsic) now assigned MCM force has been initiated to make MCM assets readily available to the battle groups.

Organic (Assigned) MCM Forces

3.2 Future MCM force requirements stress the need for improved operational timelines both tactically and strategically to support unencumbered maneuver of naval assets and provide timely SLOC / choke point reconnaissance; support BG operations such as punch through operations and oparea reconnaissance; support follow-on MCM clearance and sustained operations, and finally support Operational Maneuver from the Sea (OMFTS) and Ship to Objective Maneuver (STOM). Force commanders will expect low tolerance for risk from mines; therefore protection of platforms is paramount. There will be increased future reliance on autonomous MCM systems operating from supporting platforms or MCS to speed the MCM tactical timeline and eliminate the requirement for manned operations in minefields. To support MCM operations, a more robust, Network centric C4ISR capability will be employed to provide a common operational tactical picture, while future naval concepts will require a self-sufficient MCM capability to meet naval missions.

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[3] Spurred by Global >99, Navy Mulls Obstacles to AAssured Access@, Inside the Navy, December 27, 1999.

3.3 The current envisioned MCM force structure identifies assigned MCM assets that are resident in and deployed with battle groups / amphibious ready groups (BG / ARG). These assets provide an on-scene MCM capability and focus on self-protection, operating area reconnaissance and punch through missions. They may not be available for sustained MCM operations (e.g., residual clearance), since there are competing mission requirements (ASW, ASUW, AAW, CSAR, and VERTREP), and it is not envisioned that assigned MCM forces would replace all supporting MCM forces.

3.4 Assigned MCM assets which will be resident within the BG / ARG now and anticipated in the future include the following which are described in Appendix B:

X CH-60S helicopter with following AMCM systems:

-- AQS-20/X Mine Detecting Sonar

-- Airborne Laser Mine Detection System (ALMDS)

-- Airborne Mine Neutralization System (AMNS)

-- Rapid Airborne Mine Clearance Systems (RAMICS)

-- Organic Airborne Surface Influence Systems (OASIS)

X Remote Minehunting System (RMS) (AN/WLD-1(V))

X Long Term Mine Reconnaissance System (LMRS)

X Explosive Ordnance Disposal (EOD) Detachments

Dedicated (Supporting) MCM Forces

3.5 Complementary to assigned MCM forces are Asupporting@ MCM assets that are not assigned or deployed with a BG / ARG. Supporting forces can be based on CONUS or at forward locations and can operate independently or in direct support of BG / ARG. Supporting MCM assets possess a wide Range of MCM systems and capabilities and can perform sustained MCM operations. They can conduct port clearance operations, establish / maintain Q-Routes, and conduct rapid follow-on BG / ARG clearance operations. They are also available for large area, post-conflict clearance operations, route surveys and bottom mapping operations. These assets are dedicated to MCM and generally have no competing missions.

3.6 Supporting MCM assets not resident within the BG / ARG but available in theater now and anticipated in the near future include the following which are described in Appendix A:

- X MH-53E helicopter and combat systems
- X USS INCHON (MCS-12) Mine Countermeasures Support Ship and combat systems
- X AVENGER (MCM-1) Class Mine Countermeasures Ship and combat systems
- X OSPREY (MHC-51) Class Minehunter Ship and combat systems
- X EOD MCM and Very Shallow Water (VSW) detachments and combat systems.

3.7 New mine Warfare concepts incorporate new MIW relationships within the Composite Warfare Commander organization and establish a Mine Warfare Commander (MIWC) who will direct and coordinate MIW assets and operations. They articulate command responsibilities and authority within potential CWC organizational structures, principally BGs and ARGs, operating independently or as a task force, with or without supporting MIW forces.

MCS Operational Requirements

3.8 As a starting point, the Operational Requirements Document (ORD) for the Mine Countermeasures Support Ship (MCS) provided the following guidance and requirements. These would have to be reviewed and updated as necessary to accommodate new concepts of operations, as well as the role and utilization of assigned and supporting forces for a future MCS.

a. All scenarios involving Naval operations through choke points or near shore include the possibility of mine fields. To reduce the risk posed by mines, the Navy must provide adequate mine countermeasure (MCM) assets (ships, aircraft, EOD and systems) to counter the known and projected threat. Sustaining extended MCM operations at forward deployed locations requires extensive, dedicated command, control and logistics Navy assets.

b. Surface MCM (SMCM) assets are the most effective platforms for high probability mine clearance and posses unique capabilities for location and neutralization of mines in the water column. SMCM units have unique combat and propulsion systems and therefore require special logistics and deployment support to sustain mission readiness during extended operations. Shore-based support cannot be assumed to be available in proximity to the area of operations. However, manned SMCM assets are vulnerable to the risks of the minefield.

c. Air MCM (AMCM) assets are unique in their capability to deploy rapidly with a task group (aboard ship or by air transport) and provide rapid reconnaissance and precursor MCM operations. They are also safer and more capable than SMCM assets against the shallow water mine threat. Once on scene, AMCM assets require dedicated surface support to sustain extended operations. A Aplatform of opportunity@ or shore base cannot be assumed to be available to support extended air operations.

3.9 MCS ORD mission capabilities are summarized below and detailed in Appendix C.

a. Embark the MCM commander and staff;

b. Provide integrated command and control for all MCM forces, including communications and data interface with amphibious and battle force commanders. This capability includes Environmental Support consisting of in-situ sampling capability for essential oceanographic data. Maximum use will be made of standard products including Mine Warfare Pilots, charts, and specialized data bases provided by the Department of Defense and Commander Naval Meteorology and Oceanography Command;

c. Embark and operate a tailored AMCM squadron and a SAR / spotter aircraft detachment. The notional mix of the composite wing shall be a tailored AMCM squadron composed of eight MH-53 helicopters and a detachment of three H-46 spotter aircraft;

d. Embark EODMCM detachments assigned to the MCM operations;

e. Transport remote minehunting and minesweeping vehicles and associated support equipment;

f. Embark and support Special Warfare Forces for shallow water / very shallow water / surf zone mine clearance operations, and

g. Provide general logistic support and organizational and intermediate level maintenance support for embarked AMCM and EOD MCM detachments and to assigned SMCM ships; that is, establish a Mine Force Intermediate Maintenance Activity (MFIMA) function to serve aboard the MCS at sea, and be integrated with that of local and regional repair activities when the ship is in port.

3.10 Capabilities of the present MCS are a reasonable baseline for a future support ship. The Operational Requirements Document (ORD) for INCHON currently in effect defines functionalities and provides for each element of these functions. As far as is known, a new ORD is not under development, but could conceivably come about (1) as the organic concept matures; (2) from some of the observations of this study, and (3) from the ongoing MCM(X) Study. Regarding the latter, the Amother ship@, large MCM host ship option is much along the lines examined here for an MCS follow-on.

Airborne MCM Support

3.11 To support BG / ARG near- and mid-term Mine Warfare missions with either assigned or supporting AMCM helicopter assets, requires staging of these assets from ashore facilities close to the operating area or from ships capable of embarking helicopters. Because of their size, flight deck interoperability, and logistic support, helicopters generally stage and operate from ships equipped with large flight decks (CV / LHD / LHA / LPD / AOE, etc.). In the case of assigned AMCM CH-60S assets, cross decking or Alily-padding@ to smaller combatants in the BG is envisioned to position AMCM assets closer to the theater of operations. Positioning of AMCM assets, assigned or supporting, on these platforms requires re-staging / repositioning / displacement of other BG / ARG aircraft, equipment, and personnel. For the MH-53E, USMC ACE elements usually are required to be moved off the big decks to allow AMCM operations, as was highlighted in the Gulf War.

3.12 Looking ahead, a Mine Countermeasures Support Ship capable of embarking assigned and / or supporting AMCM helicopters and operating in-stride with the BG / ARG, would be desirable. Depending on size, the MCS should be capable of embarking and independently supporting a sufficient number of helicopters with full operational and logistic support. A large deck, capable of multi-helo operations would reduce the Mine Warfare timelines within the BG / ARG. Adequate on-board stowage, support of AMCM systems and equipment would reduce cross decking evolutions and eliminate the re-positioning or displacement of other BG / ARG air assets. The MCS should be capable of supporting both assigned and supporting AMCM assets, thus allowing for operational flexibility within the BG / ARG and subsequently, with any follow-on MCM operations.

3.13 MH-53E Sea Dragon Helicopter. Current platforms with AMCM support missions must be capable of embarking and supporting an MH-53E AMCM squadron or detachments and associated equipment. To equate to current INCHON capabilities the platform supporting the MH-53E AMCM force should be capable of:

- X embarking up to eight MH-53E helicopters,
- X providing accommodations for a large squadron population (up to 500),
- X providing multiple maintenance / office / work spaces,
- X providing stowage for a high volume (weight and cube) of AMCM systems, equipment, and support equipment,
- X providing organizational and intermediate maintenance facilities, and
- X providing high volume of supply support.

3.14 CH-60S Helicopters. The CH-60S is programmed to become the Navy=s primary assigned air MCM platform. It will incorporate all five developmental assigned air MCM systems in a common architecture that can be rapidly reconfigured to engage a given mine threat. The CH-60S will also be capable of conducting amphibious and combat search and rescue, vertical replenishment, and Airborne Mine Warfare. It will be deployed initially on aircraft carriers and large-deck amphibious platforms (for example, CV/N, LHA, and LPD), although cross-decking and Alily-padding@ to smaller combatants is envisioned. Deployment from small combatants would provide added flexibility in employing AMCM systems.

3.15 Platforms supporting the CH-60S AMCM force should be capable of:

- X embarking two or more CH-60S helicopters,
- X providing accommodations for a small detachment population (up to 30),
- X providing limited maintenance / office / work spaces,

- X providing stowage for a medium volume (weight and cube) of AMCM systems, equipment, and support equipment,
- X providing limited organizational and intermediate maintenance facilities, and
- X providing limited supply support (packup).

Aircraft Equivalents

3.16 The backbone of current airborne MCM is the MH-53E aircraft and its attendant gear. Transition to the CH-60S will impact on INCHON in the post-2005 period, as well as on a follow-on support ship. Appendix D examines and compares the performance of the two aircraft as derived from the MCM Force-21 Study, and updates provided by recent AMCM CONOPS. One factor is the decision to increase nominal standoff ranges of the support ship to 30 to 50 miles, instead of 10 to 30 miles as previously visualized.

3.17 The trend in mine countermeasure operations is to utilize minehunting / neutralization whenever possible, with much developmental effort and acquisition focused there. However, it is recognized that certain tactical conditions may not favor minehunting, including mine burial, severe clutter and a mine threat involving non-detectable or very difficult to detect weapons. Minesweeping is then the tactic of choice, with the means available including surface minesweepers; the MH-53E-towed Mk106 platform; the current Shallow Water Influence Minesweeping System (SWIMS), and the developmental Organic Airborne and Surface Influence Sweep (OASIS). Both SWIMS and OASIS can be deployed by CH-60S, but only the MH-53E can tow the Mk106 magnetic / acoustic system.

3.18 About two CH-60S helicopters are equivalent to the minehunting / neutralization capabilities of one MH-53E. For minesweeping with OASIS on the CH-60S the ratio is five to one in favor of the MH-53E using Mk-106. With SWIMS on the CH-60S the ratio is even higher.

3.19 For hunting / neutralization a force of sixteen CH-60S helicopters would be the equivalent of the eight MH-53E aboard INCHON, plus two additional CH-60S for SAR (CH-46 and CH-60 are assumed equivalent for that role). Eighteen CH-60S helicopters whether fully embarked or partially drawn from BG or ARG assets can be handled aboard INCHON, and would be a nominal design goal for a follow-on ship. However, minesweeping presents a formidable problem. Unless surface minesweepers could be made available (and with the attendant risk in the field), the sheer numbers of CH-60S helicopters needed to achieve equivalence with the eight MH-53E / Mk106 aboard an MCS is probably impractical.

Other Considerations

3.20 In discussions with PEO-MUW it is understood that repairs to INCHON, when completed, will extend the service life beyond 2005 to 2010 and possibly as far as 2015. Serious consideration and evaluation of options for a follow-on should begin in the near term, but there are opportunities to enhance INCHON over the remainder of her service life. Enhanced C4I capabilities fit with the role of the ship in integrating air, surface, EOD and other MCM elements. This will be a significant factor as organic elements operate with dedicated MCM forces and when joint U.S. and Allied MCM operations are undertaken. A detailed analysis of exact C4I suite content and upgrades is beyond the scope of this report.

3.21 The analyses presented in the MCM Force-21 Study showed the value of the Remote Minehunting System (RMS) which is scheduled for deployment as organic assets in Battle Groups. With extension of the service life of INCHON beyond 2005, it is believed that the addition of one and possibly two RMS units to the ship would be very beneficial in planning and executing MCM operations in the field.

3.22 The desire to minimize the exposure of personnel and resources to the threat of the minefield leads to consideration of longer standoff distances for the MCS, and to the extent practical, use of remote surface or underwater vehicles in the field itself. The latter is an important factor in the ongoing MCM(X) Study, and may argue for inclusion of a well deck in a follow-on support ship.

IV. OPTIONS

Strategic Considerations

4.1 The defining scenarios for the MCS and dedicated forces are considered to be sustained mine countermeasures (MCM) operations, involving high levels of clearance of large areas, extended over long time periods. These demand the presence and support of significant MCM assets (surface or airborne, or both), probably beyond the ability to commit organic units. This is precisely the kind of situation which led to creating INCHON, after the experience of the Gulf War.

4.2 A very serious criticism of the present-day, single MCS ship is the inability to deploy and respond in a timely fashion to far-flung areas of the world. Home ported in Ingleside, Texas with long transit cycles to either the MidEast or WestPac, seriously limits availability in crises. Conversely, organic forces will enable rapid on-the-scene MCM capabilities, providing some time for support ship deployment.

4.3 At present INCHON is laid up for major repairs in the Engineering Department, primarily the main condensers, so that no support ship is currently available. This underscores the value of more than one platform. Ideally, from the operational standpoint more than one ship would be needed to significantly reduce deployment times: one each forward-deployed for the East and West MRCs, and another home ported in Texas. Various ownership and manning schemes are possible to maintain a sufficient state of readiness and availability, at lowered cost, to mitigate the impact of this high end, three ship option. These are discussed later.

4.4 Given a continuing need for a mine countermeasures support ship for the foreseeable future, many configurations, ship types, ownership and manning options present themselves as possible choices. The following discussion starts with a summary of operational objectives underlying future choices; then some possibilities for ownership (e.g., MSC, Navy, etc.) and manning are presented, and finally some possible candidates are identified for future consideration.

Operational Objectives

4.5 Air Capability. The original decision to base the MCS on the LPH-12 was driven primarily by air mine countermeasures requirements, that is, a large deck and air support. The same is true for a follow-on version of a large MCM host ship. The success achieved by AMCM, the deployability of resources and decoupling from the minefield threat all argue for this direction.

4.6 As noted earlier, such a ship to be equivalent to the MCS-12 air group of eight MH-53E plus two SAR aircraft, should be capable of operating and supporting eighteen CH-60S helicopters. A ship of nominal INCHON size (20,000 tons) and configuration would be sufficient for that purpose. Growing that number of aircraft significantly (for example, to mount a large airborne minesweeping effort) and a concurrent increase in ship size (and cost) is not considered practical. Without MH-53E type aircraft and associated Mk-106 platforms, provision for the sweep system would not be necessary.

4.7 Command Capability. The command functions of the MCM Commander and Staff include planning, direction and integration of MCM operations; ongoing evaluation of results and modifying procedures as operations progress, and a host of other activities involving dedicated Mine Force units, future organic MCM resources, Navy and Marine interfaces and possible coordination with host country and Allies. These command functions imply a full set of C4I assets, including on-board equipment and linkages, as given in the MCS ORD and delineated in Appendix C, and updated to fit with modern network centric concepts.

4.8 Performance. Depending upon the deployment options discussed later, a full-up replacement for INCHON would have similar or enhanced performance, i.e., maximum speed 23 knots and range 10,000 miles at 20 knots. The ship should be capable of sustained operations on site, including ships= requirements and support for air attachments and surface MCM assets. Gear handling would be required for RMS or other remote vehicles if utilized. A well deck while useful is not considered critical, in view of the impact on ship size, cost and complexity, unless it was an essential feature of remote operated vehicles.

4.9 Multimission. While finding other uses for an MCS ship would be useful for spreading costs, it has been difficult to identify real compatibility without compromising the MCM support and perhaps another role, JCC(X), for example. However, there is an overlooked, but related mission which should be addressed, for shallow / very shallow water / surf zone mine clearance. The MCS-12 ORD shows a required mission capability to embark and support Special Warfare Forces for these operations. An earlier Department of the Navy Lift Study specified that some percentage of Lift in amphibious assault shipping would be reserved for MCM capability. The intent of this requirement was to provide capacity for equipment and explosives used in breaching operations.

4.10 In practice, to date those requirements have not been fulfilled either because of the configuration and operational employment of INCHON, or lack of available amphibious lift, perhaps pending the arrival of the LPD-17 Class ships. As 21st Century MCM concepts of operations and operational requirements develop and are refined, the potential contribution of a follow-on MCS to MCM breaching operations and obstacle clearance in the very shallow water / beach zone should be considered. If warranted, their space and handling provisions would be incorporated in the design.

Ownership and Manning

4.11 As alluded to earlier, ideally a future force would include three Mine Countermeasures Support ships. The problem with INCHON and a single host platform MCS (and staff) that is CONUS based, is that she is deployment-limited and 30 to 45 days away from theaters of employment. Consequently the ship and staff are viewed more as a mobilization asset, and not part of a forward deployed, engaged naval force that is routinely exercised or factored into a bi-lateral exercise program. With a more affordable, available and capable MCM host platform, these ships would be a more routine element of U.S. peacetime naval force presence.

4.12 USMC Commandant General Jones is working to reconstitute the MPF Marine Expeditionary Brigades as a force option for the Theater CINCs. Dedicated MCM forces could function as an equally compelling capability if they were more responsive and affordable. A useful concept is prepositioning, using contractor engineering and deck crews under MSC OPCON. (MSC has already studied operating INCHON with civilian mariners.) This is analogous to the existing USMC Prepositioning Force, and soon the U.S. Army Afloat Prepositioning Squadron.

4.13 Under the above concept a cadre of about 29 contract personnel crew the ship and keep her steaming, but a large (60+ for Army and 100+ for USMC) detachment of military personnel from CONUS embark during off-load exercises and operational tasking. The prepositioned ships are in Operational, not Reduced Operational Status. For the MSC case, some USN or USNR crew augmentation might be provided for damage control.

4.14 One possible concept to implement a three MCS ship option is as follows (all ships identical in configuration):

X One USN ship CONUS based.
X One MSC ship 5th Fleet.
X One MSC ship 7th Fleet.

The CONUS ship would be USN / USNR manned with the possible exception that civilians would man any billets that have been civilianized in other combatant ships. This ship would have a cadre of MCM operations specialists, which when required could be airlifted to operate from one of the forward deployed ships.

4.15 The two MSC ships would have one USN crew of operators and combat system maintainers between them. Except for these USN personnel, the MSC ships would be civilian operated and maintained, including engineering (main propulsion), ship control, food service and supply. The USN crew would be based in Bahrain or Sasebo so that a Aforward deployed perstempo@ would accrue when serving on the other forward deployed hull. Scheduling for training and fleet exercises would be coordinated between 5th and 7th Fleets to account for the single set of MCM personnel. However, if and when both forward ships are required for MCM operations concurrently, then the Aoperator / combat system maintainer@ crew from the CONUS based ship could be airlifted to the scene.

4.16 Two MCM staffs would have to be authorized and manned under the above concept. One would be based in CONUS and the other in the same forward deployed homeport as the MCM operations / maintenance staff described above. Unlike today, the crews on forward deployed ships would be primarily operators with minimal maintenance responsibilities. These would be performed by civilians to the greatest extent possible, allowing Navy personnel to focus on training and operations. Another approach would employ two forward deployed MPF ships outfitted with MCM equipment to function as an MCS in each theater. A CONUS-based MCS would perform training and peacetime exercise duties; while not as robust an approach, it is another alternative to achieving a 3 ship baseline by trading off capabilities, risks and costs.

Possible Platform Candidates

4.17 Several possibilities are available to meet the baseline requirements given in the MCS ORD, plus new enhancements as discussed above, for a future host platform to support the air, surface and underwater MCM Atriad@. These include pursuing an altogether new ship design and construction; modifying an existing or already planned Navy ship design; modifying an existing U.S. Navy platform, and procuring and / or modifying a commercial platform. Some characteristics of each of these options are discussed in turn. This cursory look is only intended to highlight possible strengths and weaknesses of each approach; an ultimate choice would evolve from more detailed design, cost and operational considerations.

4.18 New Design. While a new design would take advantage of building and operating economies in today=s modern naval ship designs, the front end cost for a full up, new design would be prohibitive, particularly spread over a small ship buy. This is considered an unlikely option for only 3 ships.

4.19 Modify an Existing Navy Design. Front end costs would be considerably reduced by utilizing an existing hull, engineering plant and many common spaces in an existing design, for example LPD-17. That ship as planned is about the right size (25,000 tons), has an efficient propulsion system, reduced crew size, is air capable and has an advanced C4I suite and a well deck. PEO-MUW has examined this possibility in two alternative concepts - a purpose-built, modified repeat design of LPD-

17, and an MCS rotatable pool concept. A purpose-build design would enlarge the flight deck and perhaps reduce or eliminate the well deck altogether. The rotatable pool ship undergoes minimal modifications and would utilize modularized MCS mission packages which could also be transferred to another LPD-17 Class ship at the time of scheduled extended yard availability. The disadvantage of the latter from the MCS view is the limited flight deck and air support and an oversized well deck in the present LPD-17 design. Purpose-built ships would be planned to be built in serial production with the other ships in the class. A PEO-MUW white paper concludes Athe existing LPD-17 design is the most desirable way to proceed to reduce time / cost in design development while providing the Fleet with another MCS ship quickly.@

4.20 Modify an Existing Navy Platform. Several air-capable candidates present themselves, including LHA-1, LPD-4, LSD-49 and LHD Ships.

a. LHA-1. The TARAWA Class ships provide the full range of capabilities required in an MCM host Platform: large flight deck; well deck (if needed); adequate C4I; sufficient accommodations and volume to support an embarked staff and to provide both AMCM and SMCM Intermediate Maintenance support and sustainability. However, these assets are basically committed through FY 2015, and at 40,000 tons, a steam plant and a large crew, the ship is probably oversized and overly expensive to the MCS task.

b. LPD-4. The LPDs are even older than the LPH Class ships, and were originally considered for conversion to MCS in 1992. However, INCHON was selected at about 60% of the conversion cost, among other factors. Positive factors include low operating cost and littoral capable, but this is offset by a relatively expensive conversion; no AI@ level facilities; significant C4I upgrade would be required, and a small flight deck.

c. LSD-49. The later ships of the Harpers Ferry Class are relatively new (commissioned 1985 or later), are littoral capable and exhibit low operating costs. Conversely, they would entail an expensive conversion with significant C4I upgrade required; have no AI@ level facilities; lack an aircraft hangar and have a small flight deck.

d. LHD. The ships of the WASP Class are much more than adequate to handle the MCS requirements; while newer, but like the LHA at 40,000 tons, a steam plant and a large crew, the ship is probably oversized and overly expensive for this application.

4.21 Commercial Platforms. Several possibilities were examined by the Navy previously:

a. New Construction Heavy Lift (MHLS) was found to be cost prohibitive, only buying lift capability, but no support facilities for AMCM or SMCM.

b. SEABEE Conversion was dropped from further consideration as being not available and cost prohibitive.

c. Heavy Lift Lease. While more such platforms could be available, they suffer the same problem as MHLS.

d. Ocean Going Barges were considered too slow to be useful.

e. Cruise Ship. Conversion of a cruise ship to this application was considered to be cost prohibitive.

Summary

4.22 From the above discussion, if the decision is indeed to provide for three ships to achieve timely deployments and adequate rotations, then a modified LPD-17 design would seem to be the most promising from an operational point of view, but the costs of designing and building a new ship is a major practical issue to be weighed against other priorities. While INCHON MCS-12 was a reasonable short-term (and now a mid-term) solution, the lack of deployability has surfaced as a major operational problem, for which numbers (and cost) may have to be faced.

V. SUMMARY AND CONCLUSIONS

5.1 Naval mines have historically, and will continue to provide a low cost, effective barrier to gaining access from the sea. This is particularly important to the United States, since the U.S. Navy and Marine Corps are committed to the National Strategy which emphasizes forward presence and gaining worldwide access from the sea.

5.2 Today=s Resources. Dedicated U.S. Navy mine countermeasures (MCM) forces of today and for the near future comprise MH-53E airborne MCM (AMCM) helicopters; MCM-1 and MHC-51 Class surface mine countermeasures (SMCM) ships, EODMCM units and USS INCHON (MCS-12) mine countermeasures support ship which provides command, integration and support functions for AMCM, SMCM and EOD forces. Of concern is the anticipated end of service life for INCHON in 2005, and in the face of embedding more MCM in forward deployed forces, whether and how should today=s MCS capabilities be transitioned to the future.

5.3 Future Resources. A new approach was initiated to provide an organic (assigned) MCM capability to battle groups. The assigned concept calls for a parallel approach with both airborne and surface systems. Based on the CH-60S helicopter as the assigned AMCM asset, new developments are underway to provide minesweeping, mine hunting, and neutralization capabilities suited to that aircraft. To provide intrinsic surface capability, the Remote Minehunting System (RMS) is under development for installation in certain classes of surface combatants and amphibious ships to enable them to detect, classify, and ultimately identify naval mines.

5.4 Timing. The emerging contribution of assigned MCM forces will not be manifest until 2005, and possibly not in significant numbers and in-place capabilities until 2008 and beyond. Much depends on the success achieved in development programs; committing and executing Mine Warfare mainstreaming throughout the U.S. Navy, and actually providing the resources necessary to achieve the ambitious goals which have been set forth. The timetable for implementation and situational applicability as currently envisioned is given in Table 5.1.

Table 5.1 MCM Forces Timetable

Era 9	Sustained MCM Operations		BG, ARG MCM Support
Function 6	**Hunt / Neutralize**	**Sweep**	**Hunt / Neutralize / Sweep**
2000	**Dedicated MCS, SMCM, MH-53E**	**Dedicated MCS, SMCM, MH-53E**	**N/A**
2005	**Dedicated MCS, SMCM, MH-53E**	**Dedicated MCS, SMCM, MH-53E**	**Organic IOC**
2010	**Dedicated MCS, SMCM, CH-60S**	**Dedicated MCS, SMCM**	**Organic**
Beyond	**Dedicated MCM-X, CH-60S**	**Dedicated MCM-X, SMCM**	**Organic**

5.5 Analysis. The 1998 MCM Force-21 Study was highly supportive to assigned forces, provided that several factors could be satisfied, but specified that before current dedicated (supporting) forces be changed, the transition must be successfully attained. Keys to the transition were caveats including: MCM mainstreaming is implemented throughout the Fleet; the CH-60S helicopter can tow (effectively); developmental systems perform successfully; SMCM ships remain forward based, and others.

5.6 With the above limitations in mind, that Study recommended deployment of CH-60S aboard CVs and LHA/Ds; provision of Remote Minehunting Systems (RMS) aboard DDG-51 and DD-21 Classes, and Long Term Mine Reconnaissance Systems (LMRS) aboard SSNs assigned to battle groups. At the same time, recommendations for today=s dedicated (supporting) forces were to: phase out the MH-53E and replace with CH-60S helicopters; provide no follow-on to INCHON (i.e., no MCSX); and reduce SMCM ships by about one-half, Aonly after transition wickets are attained.@

5.7 Risk. It is the opinion of this NDIA N-85 MCS Study Team that prematurely implementing the assigned / supporting MCM force recommendations cited above could be risky. Our reasoning is that the analysis properly cites many uncertainties; depends on the presumed success of the CH-60S and other developments underway, and does not fully examine demands for sustained or severely time constrained MCM operations. The latter is the defining mine countermeasures situation requiring the support of an MCS to achieve high levels of clearance in a large area over an extended period of time and under a variety of threats and environmental conditions.

5.8 A continuing, effective MCM capability must be maintained by the Navy as we transition to the embarked, assigned battle force MCM assets. In the end it will almost certainly require a mix of supporting and assigned surface and airborne forces to satisfy required roles and missions over the wide spectrum of threats and scenarios in an uncertain future. Principal roles and missions for assigned MCM forces are likely to include BG / ARG maneuver in support of operations ashore; immediate reconnaissance and ensuring safe passage. Continuing roles and missions for supporting MCM forces are likely to include residual reconnaissance; large scale clearance and extended MCM operations.

5.9 Need for MCS. For now and for the near term at least we have concluded that there is a continuing need for the MCS and its embarked capabilities in a central MCM role. MCS capability should be extended beyond expected service life of 2005 for USS INCHON, and preferably to at least 2010. PEO-MUW has indicated that service life can be extended from 2005 to 2010, and possibly longer. The ship, in addition to engineering repairs underway should have upgraded C4I capabilities, and when available, the Remote Minehunting System (RMS). A starting point for a future set of operational requirements for an MCS are given in the ORD for MCS-12, and in addition a future version must be compatible with, and complementary to the forthcoming organic (assigned) concept of mine countermeasure operations.

5.10 Aircraft Impact. AMCM is the major factor in MCS design and operation. INCHON currently embarks, operates and supports eight MH-53E helicopters, plus a few SAR CH-46D. As the MH-53E aircraft are phased out they are planned to be replaced by CH-60S, where approximately two of the latter are equivalent to a single MH-53E for minehunting / neutralization. For AMCM minesweeping, five or more CH-60S are needed to be equivalent to an MH-53E, probably resulting in an impractical loadout for a single ship.

5.11 Other Missions. Multimission capabilities for a future MCS have not been identified as a requirement, but would be desirable. However, there is an outstanding requirement to support the shallow / very shallow water / surf zone mine clearance mission. Providing adequate capacity for equipment and explosives would extend capabilities beyond the present MCS and satisfy an existing shortfall.

5.12 Deployability. A serious deficiency at present is the difficulty in timely deploying the single MCS. Ideally three ships would solve this deployment shortfall, and would also add a useful element of naval peacetime presence. One approach would be one USN ship CONUS-based, and one MSC ship each to Fifth and Seventh Fleets, using civilian manning to the maximum extent possible.

5.13 Options. Of the possible existing ship design options examined, a design derived from the LPD-17 Class appears to be most suitable from the points of view of operational compatibility and cost. Before such a decision and a refined design takes place, however, the impact of assigned/ supporting MCM missions needs to be accounted for.

5.14 Looking Ahead. With the extension of INCHON service life, the Navy has bought some time to examine platform, manning, ownership and employment options and tradeoffs. It is hoped that this study has provided a backdrop for the operational considerations and needs of the future MCM Force, and particularly the role of the MCS.

APPENDIX A

OPERATIONAL MCM SYSTEM DESCRIPTIONS

SURFACE SHIPS

A.1 AVENGER (MCM-1 Class). In the early 1980s, the U.S. Navy began development of a new mine countermeasures force, which included two new classes of ships and minesweeping helicopters. The vital importance of a state-of-the-art mine countermeasures force was strongly underscored in the Persian Gulf during the eight years of the Iran-Iraq war, and in Operations DESERT SHIELD and DESERT STORM in 1990 and 1991 when AVENGER (MCM 1) and GUARDIAN (MCM 5) ships conducted MCM operations. AVENGER class ships are designed as mine hunter-killers capable of finding, classifying and destroying moored and bottom mines. The last three MCM ships were purchased in 1990, bringing the total to 14 fully deployable, oceangoing AVENGER class ships. These ships use sonar and video systems, cable cutters and a mine-detonating device that can be released and detonated by remote control. They are also capable of conventional sweeping measures. The ships are of fiberglass sheathed, wooden hull construction. They are the first large mine countermeasures ships built in the United States in nearly 27 years.

A.2 General Characteristics, AVENGER Class

Builders: Peterson Shipbuilders, Sturgeon Bay, Wis., Marionette Marine, Marionette, Wis.
Power Plant: Four diesels (600 horsepower each), two shafts with controllable pitch propellers
Length: 224 feet
Beam: 39 feet
Displacement: 1,312 long tons full load
Speed: 14 knots
Ships: All 14 MCM 1 Class ships have been delivered and are based in Ingleside, Texas except for two ships permanently forward deployed to Sasebo, Japan and two ships forward deployed to the Arabian Gulf.

Crew: 8 officers, 76 enlisted

Armament: Mine neutralization system. Two .50 caliber machine guns

Date Deployed: 12 September 1987 (USS AVENGER)

A.3 OSPREY (MHC-51 Class). These ships are mine hunter-killers capable of finding, classifying and destroying moored and bottom mines. The MHC 51 has a 15-day endurance and depends on a support ship or shore based facilities for resupply. These ships use sonar and video systems, cable cutters and a mine-detonating device that can be released and detonated by remote control. The ships= hulls are made of glass-reinforced plastic (GRP) fiberglass.

A.4 General Characteristics, OSPREY Class.

Builders: MHC 51, 52, 55, 58, 59, 60 and 61 Intermarine USA, Savannah, GA; MHC 53, 54, 56, 57 Avondale Industries Inc., Gulfport, MS

Power Plant: Two diesels (800 hp each); two Voith-Schneider (cycloidal) propulsion systems

Length: 188 feet

Beam: 36 feet

Displacement: 893 long tons full load

Speed: 10 knots

Ships: All 12 MHC 51 Class ships have been delivered and are homeported in Ingleside, Texas

Crew: 5 officers, 46 enlisted

Armament: Two .50 caliber machine guns, Mine Neutralization System and other mine countermeasures systems

Date Deployed: 20 November 1993 (USS OSPREY)

A.5 Surface MCM Systems. The following systems are installed aboard MCM-1 and MHC-51 Class ships.

X AN/SQQ-32 Advanced Minehunting Sonar

X AN/SSQ-94-T1 Combat System Integrated Training Equipment

X AN/SLQ-48 Mine Neutralization System (MNS)

X AN/SSN-2(V)4 Precise Integrated Navigation System (PINS)

- X AN/SYQ-13 Navigation / Command and Control System

The following systems are only installed aboard MCM-1 class ships.

- X AN/SLQ-37 Magnetic / Acoustic Influence Sweeping System
- X AN/SLQ-38 Mechanical / Oropesa (Cable Cutting) Sweeps

SURFACE SYSTEMS

A.6 AN/SQQ-32 Advanced Minehunting Sonar is a new generation variable depth minehunting sonar, was developed to provide MCM 1 and MHC 51 Class ships a capability to detect, classify, and localize bottom and moored mines at safe stand-off distances. The system consists of search and classify sonars integrated into a towed body with electronic and display consoles on board the ship. The system became operational in 1990.

A.7 AN/SLQ-37 Magnetic / Acoustic Influence Minesweeping System is installed in the AVENGER (MCM 1) Class ships, and consists of a straight tail magnetic sweep combined with the earlier acoustic sweeps. The system can be configured in several says, including diverting the magnetic cable and / or the acoustic devices by using components from the AN/SLQ-38 mechanical gear.

A.8 AN/SLQ-38 Mechanical / Oropesa (Cable Cutting) Sweeps are of various types, all of which are designed to deal with moored buoyant mines relatively close to the surface. The newest design based on the Oropesa sweep is the AN/SLQ-38, which is standard equipment on the AVENGER Class minesweeper. The SLQ-38 utilizes the Oropesa Size 1 wire to provide a rugged, stable, and effective sweep that can be rigged to one or both sides of the hull and used with another ship in a catenary. The wire carries cable cutters that cut the moorings of buoyed mines. When streamed with 300-fathom wires at a maximum speed of about eight knots (sweep depth of 5-40 fathoms), the swept path for a double sweep is 500 yards wide, or 250 yards wide for a single sweep.

A.9 AN/SSQ-94-T1 Combat System Integrated Training Equipment. Developed for both the MCM 1 and MHC 51 classes, the SSQ-94 is a computer-driven, integrated combat system trainer that uses off-the-shelf technology. Capable of providing either individual or combat system team training, the SSQ-94 provides an organic training capability to improve and maintain mission readiness for individual ships. The SSQ-94 system provides MCM-1 and MHC-51 class ships with computer-driven, onboard combat systems training in navigation, command and control, mine detection, classification and neutralization, for individual operators, subteams, and full combat system teams. The system provides an organic training capability for MCM 1 and MHC 51 class ships, either in port or underway, in order to improve and maintain mission readiness of individual ships. A new start in fiscal year 1991, the system remains under development. Eventually 26 shipboard systems will be fielded. Individual system modules will enter service in stages with the AN/SLQ-48(V) module developed first, followed by the AN/SSN-2, the AN/SQQ-32, and the AN/SYQ-13 units, in this order.

A.10 AN/SLQ-48 Mine Neutralization System (MNS) is a remotely operated, unmanned minehunting submersible intended for both MCM 1 and MHC 51 class mine countermeasures ships. The vehicle takes its power and guidance commands from the launching ship through an umbilical cable and carries a small high-definition sonar and an acoustic transducer that enables the vehicle to be tracked by the shipboard sonar. There is also a low-light-level video for examining the target, with illumination provided by an onboard floodlight. Two consoles on board the ship monitor and control the vehicle=s operation. After the target is detected and classified by the ship=s sonar, the MNS is vectored to the target. The MNS presently carries two mission packages -- one to cut the mooring cable of moored mines, allowing them to rise to the surface for subsequent neutralization or recovery / exploitation, (MP-1) and one to destroy bottom mines by placing an explosive charge near the mine, (MP-2). A new mission package, MP-3, to destroy moored mines in-place recently successfully completed its Follow-On Operational Test and Evaluation (FOT&E).

A.11 AN/SSN-2(V)4 Precise Integrated Navigation System (PINS) is an integrated, GPS-based, computer navigation system that provides positional data to command and control displays. The system uses standard commercial peripherals, Navy computers, and proven MCM-dedicated tactical display consoles. The system also provides AVENGER Class ships with continuous precision tracking using an integrated acoustic tracker in support of SMCM operations.

A.12 AN/SYQ-13 Navigation / Command and Control System integrates the combat system and displays tactical information to assist the Commanding Officer and Tactical Action Officer in planning and execution of operations on MHC-51 Class ships. The system integrates data from navigation systems with the ship=s Doppler speed log and gyrocompass input to compute ownship position with the precision necessary for minehunting. It interfaces with the surface search radar and AN/SQQ-32 sonar providing real-time updates and display of contact data on two color tactical displays. Information is displayed in both alpha numeric and graphical fashion representing ownship position, speed, known sonar and radar contacts, as well s intended and achieved track and coverage data. The system is designed around five 68020 processors presenting data on two tactical displays, two remote monitors, and a 36" x 48" plotter. Data for post-mission analysis is collected on a hard disk drive and magnetic tape.

AIRCRAFT

<u>MH-53E</u>

A.13 The MH-53E (Sea Dragon) Airborne Mine Countermeasures helicopter is manufactured by United Technologies Corporation, Sikorsky Aircraft Division. The helicopter is equipped with a seven-blade main rotor and four blade canted tail rotor designed for land and ship-based operations, with an emergency water operating capability. Power is furnished by three T64-GE-419 engines capable of producing 4,750 shp each (contingency power capability of up to 5,000 shp for two minutes). The helicopter has a tow boom, tow coupler, precise navigation system (GPS) and provisions for mine hunting and mine sweeping. The maximum gross weight is limited to 69,750 pounds. The tow capability is steady state 25,000 pounds with surges to 30,000 pounds. The helicopter is designed for a standard day sea level AMCM mission with a 5-hour mission time plus 20 minute reserve. The primary mission of the helicopter is AMCM, which includes minesweeping, mine neutralization, mine hunting, floating mine destruction, channel marking, and surface towing such as towing of surface craft and ships. The secondary utility mission involves the movement of cargo and equipment and the transportation of passengers.

A.14 The immediate predecessor to the MH-53E was the twin engined RH-53D which was the primary AMCM platform for which the MK-103, 104 and 105 sweepgear were designed and are in service today. The H-53 saw service in sweeping Haiphong, Suez Canal, Port Said, Operation Earnest Will and the Gulf War, compiling thousands of hours of operational towing time. There are at present 44 MH-53E helicopters, of which 20 are assigned to the two Helicopter Mine Countermeasure Squadrons. At the same time there are 166 CH-53E and 47 CH-53D heavy lift helicopters which are likely to remain in the maritime inventory for some time.

In the AMCM role, the MH-53E can tow:

- X MK 103 mechanical minesweeping gear for moored mines
- X MK 104 acoustic influence sweep
- X MK 105/106 magnetic/magnetic-acoustic influence sweep
- X AN/SPU-1/W Magnetic Orange Pipe (MOP) influence sweep for shallow water mines
- X AN/AQS-14A side scan minehunting sonar
- X AN/ALQ-141 dual acoustic influence sweep
- X A/N 37U mechanical mine clearing set.

The MH-53E deploys on the MCS or large-deck amphibious platforms (LHD, LHA, and LPD) or is shore based in theater.

A.15 Inventories. The MH-53E inventory of 44 helicopters was calculated from the total helicopter requirement derived from the traditional airframe need categories of operational PAA, training, RDT&E, pipeline, and attrition. Presently there are two Helicopter Mine Countermeasures Squadrons (HM-14 & HM-15) with 10 aircraft each with the remaining aircraft used for VOD, training, pipeline and RDT&E.

A.16 The HM ROC and POE require that the two HM Squadrons each maintain an eight-aircraft rapid deployment capability. This requirement meets the two MRC contingencies and historically one HM Squadron / MCMRON is earmarked for East operations while the other HM / MCMRON is earmarked for West operations. The Squadron(s) would be required to conduct AMCM operations from fixed land bases, and aviation and amphibious aviation capable ships in theater. Each eight-aircraft component is also capable of providing up to two detachments of four aircraft each to support split site AMCM operations or organic Battle group / Amphibious Ready Group AMCM requirements. In the past, the HM Squadrons have deployed as a squadron to big deck ships (CV, LHA/LHD) and USS INCHON (MCS-12) and provided detachments on LPDs. HM-14 presently has a four aircraft detachment forward based ashore (with two MCM ships) in the Persian Gulf to meet in-theater supporting and assigned MCM requirements.

A.17 The MH-53E operational inventory of 20 aircraft appears sufficient to meet current supporting AMCM requirements and, when forward based in-theater as we are doing today, assigned AMCM requirements to the BG / ARG as well.

CH-60S

A.18 The CH-60S is manufactured by United Technologies Corporation, Sikorsky Aircraft Division. The CH-60S is derived from an Army UH-60L airframe modified with Navy H-60 components to include: folding rotor head and tail pylon, GE T-700 engines, and the SH-60R common cockpit. The helicopter is equipped with a single main rotor and a 20 degree canted tail rotor. Power is furnished by two T700-GE-401C engines capable of producing 1662 shp each (contingency power capability of up to 1940 shp for 2 2 minutes). The maximum gross weight is limited to 23,500 pounds. The tow capability is steady state 6,000 pounds with surges to 15,000 pounds. The CH-60S has a maximum speed of 170 knots, a 2.5-hour non-tow mission capability, plus fuel reserves, and is capable of all-weather day/night flying. The primary mission of the CH-60S is vertical replenishment; however, the aircraft will also be capable of conducting amphibious and combat search and rescue, and airborne Mine Warfare. The CH-60S is envisioned to become the Navy=s primary assigned air MCM platform. It is planned to accommodate each of the five developmental assigned air MCM systems in a common architecture that can be rapidly reconfigured to engage a given mine threat.

A.19 In the AMCM role, the CH-60S will be designed to employ the following which are described in Appendix B.

X Airborne Laser Mine Detection System (ALMDS)

- X AN/AQS-20X Sonar Mine Detecting Set
- X Airborne Mine Neutralization System (AMNS)
- X Rapid Airborne Mine Clearance System (RAMICS)
- X Organic Airborne Surface Influence Sweep (OASIS).

The CH-60S will be deployed initially on aircraft carriers and large-deck amphibious platforms (CV/N, LHD, LHA, and LPD, for example), although cross-decking and Alily-padding@ to smaller combatants is envisioned.

A.20 Inventories. The N88 Helicopter Master Plan (HMP) calls for approximately 218 CH-60S airframes. These aircraft will be used for VERTREP, CSAR, AMCM, Fleet Flag Ships, Station, Range and Fleet support. IOC for the CH-60S is FY02 and the HMP defines the numbers and distribution of the CH-60S to each of these roles. The CH-60S future force structure is not yet fully defined, awaiting the anticipated merging / marriage of the HC / HM missions. The CH-60S AMCM ORD addendum has not yet been finalized, nor has the attendant ROC / POE documentation been approved.

A.21 Currently, thirty-three CH-60S are notionally provided for the AMCM mission in the HMP. These 33 aircraft are identified in the present distribution plan as going to HM-14 & HM-15, with IOC for the AMCM CH-60S in FY05. These aircraft will be available for deployment performing assigned AMCM missions. N88 is examining a number of different CH-60S force structure options, with several studies underway to determine how many CH-60S could be configured for the AMCM mission.

A.22 MCM Force-21 utilized a number of CH-60S aircraft on the CV / LHA / LHD for assigned AMCM missions. There is concern whether the number of CH-60S aircraft available in the BG / ARG will be sufficient to meet operational timelines. The Concept of Operations for H-60 Anti-Mine Warfare Operations in the Battle Group identifies CH-60S allocation and availability in the BG / ARG, since the number of CH-60Ss assigned to the BG /ARG will have a significant impact in the MCM operational timeline. Further refinement of the CH-60S AMCM CONOPS will confirm the number of CH-60S available to perform the assigned AMCM mission in the BG / ARG.

A.23 Capabilities of the two helicopters are summarized in Table A.1.

Table A.1 Helicopter Comparison

Characteristic	MH-53E	CH-60S
Max Gross Weight	69,750 lbs	23,500 lbs
Engines	3 x T64-GE-419	2 x T700-GE-401C
Shaft Horsepower - each - total	4,750 shp 14,250 shp	1,662 shp 3,324 shp
Maximum Speed	170 kt	170 kt
Tow Tension	25,000 lbs. steady	6,000 lbs. steady[4]
Mission Time	5 hr + reserve (tow)	2.5 hr + reserve (non-tow)[5]
Length	99 ft .5 in	74 ft 10 in
Height	28 ft 4 in	16 ft
Rotor Diameter	79 ft	53 ft 10 in

AIRCRAFT SYSTEMS

A.24 AN/SQS-14 and AN/AQS-14A Sonar. The AN/AQS-14 is an active-controlled, helicopter-towed minehunting sonar currently used in MH-53E SEA DRAGON helicopters. It is a multi-beam, side-looking sonar with electronic beam forming, all-range focusing, and an adaptive processor. The system consists of three parts: a stabilized underwater vehicle, electro-mechanical tow cable, and airborne electronic console. The 10.7-foot long underwater vehicle can be maintained at a fixed depth above the sea floor or below the surface, and the thin, coaxial cable is armored and nonmagnetic. Sonar information is presented on two continuous waterfall displays. An upgrade to the AN/AQS-14 system, the AN/AQS-14A modifies the airborne electronics from an analog to a digital system and

[4] Tow tension limitation will be finalized following tow tests in FY00

[5] Tow mission time for the CH-60 is yet to be determined.

increases the size of the operator=s monitor. A Post Mission Analysis (PMA) station has been incorporated into the system for use with the contact tapes after the mission is complete to identify and classify mine-like contacts. The AN/AQS-14A completed successful fleet introduction in FY99.

A.25 SPU-1/W Magnetic Orange Pipe (MOP) is a magnetized pipe filled with styrofoam for buoyancy. The MOP is used to sweep waters too shallow for the MK 105 hydrofoil sleds. A helicopter can tow as many as three MOPs in tandem to increase sweep effectiveness. Total system weight is 1,000 pounds. It is 30 feet in length and 10 3/4 inches in diameter.

A.26 A MK 2(G) Acoustic Sweep called rattle bars, are used by both surface vessels and helicopters and consist of parallel pipes, or bars, towed broadside-on at speeds from four to ten knots. This produces a Bernoulli effect between the bars causing them to bang together and produce medium-to-high frequency acoustic energy.

A.27 MK 103 Mechanical Sweep is a helicopter-towed minesweeping system designed to counter moored mines. It consists of a tow wire, sweep wires (with explosive cutters), floats, a depressor, otters, and float pendants.

A.28 MK 104 Acoustic Sweep. The MK 104 is an airborne acoustic sweep system that consists of a cavitating disk within a venturi tube, driven by two self-rotating, cavitating disks. The MK 104 is towed behind a helicopter or is attached to the MK 105 sled to provide a combination magnetic / acoustic minesweeping system. Total system weight is 180 pounds, and towed body dimensions are 26 inches in width, 35 inches in height, and 49 inches in length.

A.29 MK 105 Magnetic Sweep is a helicopter-towed, minesweeping hydrofoil sled. It carries a gas turbine generator to power its magnetic sweep gear. The sled is typically towed at 20-25 knots, about 450 feet behind the helicopter, with the gas turbine providing power to the twin magnetic tails (conventional open-electrode magnetic sweeps are approximately 600 feet long). The sled becomes foil-borne at about 13 knots. Launch and recovery of the sled can be from a variety of surface ships (LHD, LHA, LPH, LPD, and CV), as well as from shore facilities and beaches. The system can be refueled from the helicopter during a mission. A combined magnetic and acoustic influence sweep may be achieved by adding the MK 104 acoustic system to the sweep array (see listing for the MK 106 sweep, below).

A.30 To enhance the MK 105 supportability and minesweeping capabilities, the system is being upgraded to the Mod 4 standard with a more supportable and effective power pack and structural changes to improve the hydrodynamic characteristics of the platform. Fleet introduction for the MK 105 Mod 4 is in FY00. Before introducing the MK 105 Mod 4, it was necessary to develop a new magnetic cable system that exploits all the capabilities of the enhanced power pack. The new magnetic cables will take full advantage of modern materials and manufacturing techniques to increase the electrode life during normal operation, as well as to increase the maximum current output. The improved magnetic cables are currently in production.

A.31 MK 106 Magnetic / Acoustic Sweep is a helicopter-towed acoustic / magnetic sweep, consisting of the MK 105 sled and the MK 104 attached to one of the magnetic tails.

A.32 A/N 37U Mechanical Sweep is a variable-depth, helicopter-towed mechanical sweeping system capable of sweeping moored mines in both deep and shallow water. During 1994, the Navy procured 11 systems and refurbished eight Engineering Development Models (EDMs). During 1996-97, the Navy procured an additional 15 systems and acquired three systems from Surface MCM Program Office assets.

A.33 AN/ALQ-141 Countermeasures System is a special purpose airborne mine countermeasures system designed to detect and counter specific mine types.

A.34 AMCM Stream and Recovery Module (ASRM) is a fixed, ground-based, computer-controlled training module used to train and qualify AMCM crewmembers in the stream and recovery of AMCM systems and equipment. The ASRM replicates the MH-53E cabin area and is designed to provide a safe, controlled environment to conduct AMCM aircrew training. The cabin houses the necessary mission interface equipment required to conduct Ahands-on@ training with actual AMCM equipment. The ASRM provides training for all AMCM systems in the fleet inventory. Utilizing pre-programmed mission scenarios, the ASRM will operate in an automatic mode to simulate conditions encountered during a typical mission. Instructors can intervene at any time to change the ongoing scenario or insert simulated emergencies. Video and audio recordings of each mission provide a complete debriefing package in which trainees can view their performance.

Acknowledgments

U.S. Navy Fact File Web Page; Surface Mine Warfare Systems Program Office (PM-407); Airborne Mine Countermeasures Program Office (PM-210); Navy Coastal Systems Station (NCSS), Panama City, FL.

APPENDIX B

DEVELOPMENTAL MCM SYSTEMS

REMOTE MINEHUNTING SYSTEM (RMS)

B.1 The Remote Minehunting System (RMS) is being developed to meet the Fleet=s critical need for organic mine countermeasures for surface ships. RMS will be an organic, off-board mine reconnaissance system. As part of the advanced forces, surface ships will employ RMS to meet the demand for over-the-horizon mine reconnaissance of anticipated operating areas in support of the ship=s individual mission and to prepare for the arrival of other naval forces. The RMS sensor suite will be used against bottom and moored mines for mine reconnaissance from deep water to the outer edge of the very shallow water (VSW) region.

B.2 The Remote Minehunting System is intended to provide battle groups and individual surface combatants with an organic means of detecting and avoiding mines. The remotely operated system, using computer aided detection and precise navigation systems, will detect and classify mines and record their locations for avoidance or subsequent removal. The system, with organic handling, control and logistic support, is designed to be air transportable to forces anywhere in the world. The Remote Minehunting System will provide a rapidly deployable mine countermeasures system to surface combatants in the absence of supporting mine countermeasures forces.

B.3 The AN/WLD-1(V)1 will be a high endurance, offboard system that can be operated and maintained from surface ships. The system will use acoustic and electro-optic sensors housed in a variable depth underwater body for the detection, classification, localization, and identification of mines and mine-like objects. The system will utilize a version of the AN/AQS-20 sensor to achieve commonality with other organic MIW systems. It will also be capable of OTH operations. Mission data is telemetered between the Remote Minehunting Vehicle (RMV) and the host ship via a radio frequency link. The offboard vehicle will have self-contained command / control, propulsion, power, and navigation systems, and will also be capable of automatic search and recording modes. The host platform will be equipped to provide data processing, display, recording, and mission analysis capabilities. AN/WLD-1(V)1 will be fully integrated into the AN/SEQ-89(V)15 Undersea Warfare Combat System. It will also interface / integrate with existing shipboard systems to communicate tactical mine reconnaissance data to other Naval forces. AN/WLD-1(V)1 will maximize the use of open architectures, using the ship=s existing hardware wherever feasible. The AN/WLD-1(V)1 will be designed for a high probability of survival in the minefield by minimizing its signature and providing obstacle avoidance.

B.4 Two primary MCM acoustic sensors will be used. The first is a side-looking sonar to detect and classify bottom and close-tethered mines. The second is a volume search sonar to detect and classify close-tethered and in-volume mines. Gap-filler and forward-looking sonars supplement the minehunting sonars for the AN/WLD-1(V)1. Additionally, an electro-optical sensor will be used for contact identification.

B.5 The AN/WLD-1(V)1 will be installed on DDG 91 Flight IIA and follow-on ships. Command, control, and communications will be integrated with the ship=s combat information center. The AN/WLD-1(V)1 will be designed so existing Navy logistic elements can assimilate the system with minimal modification to existing equipment configuration and logistics support.

EXPLOSIVE TECHNOLOGY

B.6 An initiative is underway to develop Distributed Explosive Technology (DET) for use in clearance of surf zone mines. The system is a 180-foot by 180-foot explosive net launched from a manned LCAC. The net consists of parallel lines of SX-2 detonating cord linked together with inert cross members. DET is being developed for use as a surf zone breaching tool. The net is deployed from a glass reinforced plastic and aluminum stowage container mounted atop a LCAC Interface Platform (LIP) by two, simultaneously initiated, MK 22 Mod 4 rocket motors. Parachutes are used on the trailing edge of the net array to maximize expansion in flight. A fire and forget fuse detonates the net once the net has reached a safe standoff from the LCAC and settles to the bottom of the surf zone. The DET system=s effectiveness to clear surf zone mines has been demonstrated during continuing developmental testing. Milestone II was completed during the 3rd quarter of fiscal year

1996. DET is expected to be fielded during FY08.

B.7 The Shallow Water Assault Breaching System (SABRE) is a single rocket-deployed linear demolition charge system launched from a manned LCAC. SABRE is being developed for use as a surf zone breaching tool. SABRE=s explosive train has been designed to maximize the explosive output in the surf zone environment. The system consists of 130 discrete charges, each containing ten pounds of PBXN-103 and separated by three feet of braided nylon harness, totaling approximately 400 feet. SABRE will be stowed in an aluminum container with an integral launch rail. A MK 22 Mod 4 rocket motor attaches to the rail and is used to deploy the system. SABRE incorporates a Afire and forget@ fuse that arms at a preset distance from the container. Detonation occurs automatically after a built-in delay internal to the fuse, allows the line charge to settle to the bottom. The system=s effectiveness in clearing surf zone mines and its potential to clear light to medium weight obstacles has been successfully demonstrated during continuing developmental testing. Milestone II was completed during the third quarter of fiscal year 1996. SABRE is expected to be fielded during FY03.

B.8 The Explosive Neutralization (EN) Program includes Pre-Planned Product Improvements (P3I) for the SABRE and DET programs, an LCAC Autopilot, a Fire Control System to replace the existing launch controller kit, and a Beach Zone Array (BZA) system using shaped-charge rocket motors and improved explosives. These developments will increase the stand-off range of the launch platform, reduce mission time, increase accuracy, and allow SABRE and DET deployment in up to Sea State 3. The Beach Zone Array, developed as a technology demonstration, is a 1/5th scale model of a proposed system that would be deployed from an unmanned glider. BZA will compete with other concepts in a future Analysis of Alternatives for far-term beach mine and obstacle clearance systems.

NEW APPROACHES TO AMCM

B.9 The goal of organic mine countermeasures operations is to provide deployed naval forces the capability to locate and clear mines without delay with the understanding that volume clearance or neutralization will be conducted with the arrival of supporting forces. For AMCM forces this means the integration of an airborne platform with the Battle Group. This can only be accomplished by Adownsizing@ the platform and the equipment it tows. Several smaller, lighter AMCM systems, capable of being deployed by a CH-60S helicopter, are now in various stages of development by the

U.S. Navy; including the AN/AQS-20/X Airborne Mine Hunting Sonar, the Airborne Mine Neutralization System (AMNS), the Organic Airborne and Surface Influence Sweep (OASIS), the Airborne Laser Mine Detection System (ALMDS), and the Rapid Airborne Mine Clearance System (RAMICS).

B.10 The AN/AQS-20 Airborne Mine Hunting Sonar is a helicopter towed system used for high speed reconnaissance and mine hunting to detect, classify, and localize unburied bottom, close tethered, and moored sea mines in shallow and deep water. It consists of an airborne operator station housing the signal processing and recording equipment, controls and displays, a towed vehicle housing the side looking, gap filling, forward looking, and volume search sonars, and a remote Mission Control and Display Subsystem (MC&DS) consisting of processing, playback, and display equipment for post mission analysis and mission planning. The AN/AQS-20 will determine if sonar contacts are mine like objects and will provide data needed for subsequent mine avoidance or follow up neutralization. Presently being designed for use from the MH-53E helicopter, the towed body is 125.5 inches long with a 60 inch wing span. It weighs 900 pounds in air but only 35 pounds in water.

B.11 The U.S. Navy=s acquisition strategy plans to evolve the MH-53E AN/AQS-20 into the assigned CH-60S AN/AQS-20/X. Starting in the summer of 1999, the AN/AQS-20 Engineering Development Models will be used as the baseline for the design, development, and integration of a laser based identification sensor. At the same time a CH-60S sized airborne operator station and Mission Interface Removables will be designed and developed. Hardware fabrication will take place in 2001 with test and evaluation in 2002. Production of the AN/AQS-20X will begin in 2003.

B.12 Airborne Mine Neutralization System (AMNS) is a remotely operated system, employed by helicopter to explosively neutralize unburied bottom and moored sea mines that are impractical or unsafe to counter using existing surface minesweeping techniques. The system will have both shallow and deep-water capabilities, and can be used day or night. Prior to the neutralization mission, a mine hunting sonar will have accomplished mine detection, classification, and localization. The AMNS will be maneuvered to the mine-like object location, where it will reacquire the target and, upon command, detonate its charge from a safe position to neutralize the threat. The current development schedule took advantage of already existing technology and the availability of non-developmental items (NDI) by awarding multiple contracts for technology demonstrations at the end of 1997. After the technology demonstration, a single contract was competitively awarded late in 1998 for an AMNS prototype and engineering efforts related to the integration of the console and expendable devices to the helicopter platform leading to test and evaluation in mid-2000. The contractor will also deliver an airborne operator station, expendable mine neutralizers, spare parts, support equipment, and technical documentation.

Beginning in 2001, the AMNS will be modified for use in a CH-60S helicopter with test and evaluation to follow in 2002. Following successful test and evaluation, production will begin in 2003 providing the U.S. Navy an organic airborne mine neutralization capability.

B.13 Organic Airborne and Surface Influence sweep (OASIS) is a high speed magnetic and acoustic influence minesweep system designed to support shallow water mine clearance operations. It consists of a towed magnetic and acoustic source, a tow / power delivery cable, a power conditioning and control subsystem, and an external or palletized power supply. It is highly maneuverable and capable of being towed at speeds up to 40 knots but may be limited by mine firing mechanism response. Its ability to fully de-magnetize allows the system to be transported in the helicopter allowing for fast transit to over the horizon operating areas. Programmable waveforms allow flexible performance.

B.14 The U.S. Navy initiated OASIS in 1999 with an Analysis of Alternatives that evaluated all magnetic and acoustic technologies to identify the most cost and operationally effective ideas to pursue during Engineering and Manufacturing Development (E&MD). The E&MD contract will be awarded late in 2000 to design, develop, and fabricate an assigned airborne influence sweep system that will also be compatible with surface platforms and remote control vehicles. Following a three and one half year development phase, test and evaluation will be conducted in 2003 with production to follow.

B.15 Airborne Laser Mine Detection System (ALMDS). For several years the U.S. Navy has been evaluating electro-optics as a method of locating sea mines. Lasers have become more powerful and compact, and their wavelengths more tunable. Lasers are operated much like radar, and when used for detection purposes, have acquired the LIDAR (Light Detection and Ranging) acronym. The use of a blue-green laser, which has frequency compatible with transmission in seawater, allows a LIDAR system to provide accurate information on the characteristics of targets at various water depths. This technology could provide the fleet self-protection when traveling through choke points and confined straits, and rapid reconnaissance of minefields in support of Amphibious Operations. During Operation Desert Shield / Storm, the U.S. Navy demonstrated a LIDAR mine hunting system on a very limited scale. During Program Definition and Risk Reduction (PDRR), this system was re-engineered / repackaged. The current system is based on a Straight Tube Image Laser (STIL). Three deployment contingency systems are currently assigned to a U.S. Naval Reserve Squadron.

B.16 The U.S. Navy has begun efforts to develop an assigned Airborne Laser Mine Detection System (ALMDS). The ALMDS, a non-towed offboard system, will provide rapid detection, classification, and localization of floating and near-surface moored sea mines. This electro-optic system will represent the first new AMCM technology delivered for U.S. Navy use since the introduction of sonar. The intent is to competitively award an Engineering and Manufacturing Development (E&MD) contract in 2000 to design, develop, and fabricate two ALMDS systems. Following successful test and evaluation in 2003, ALMDS production will begin in 2004.

B.17 Rapid Airborne Mine Clearance System (RAMICS). The RAMICS integrates LIDAR and Asupercavitating@ projectiles to safely and rapidly destroy near surface moored mines with positive verification of mission success. RAMICS is a helicopter borne system consisting of a special 20mm munition controlled by a blue-green LIDAR. At the heart of this system is the supercavitating 20mm projectile specially designed for traveling tactical distances in water and driving a chemical initiator through a casing into the mine explosive. The LIDAR locates and targets the mine as well as provides aiming coordinates to the gun=s fire control system. A burst of approximately twenty-five rounds is fired at the mine with a high probability of one or more projectiles penetrating the warhead, resulting in positive destruction of the mine. RAMICS is an Advanced Technology Demonstration (ATD) developmental program. In 1998 the gun and supercavitating munition demonstrated its lethality against naval mines. In addition, targeting design, gun installation design, and fire control design was initiated. In 1999 Static Platform Testing was successfully conducted. This ATower Test@ was a series of shots from the actual RAMICS gun under control of a brassboard targeting and fire control system. In 2000, Flight System Integration and Flight Tests will be conducted utilizing the Super Cobra as the airborne platform for the demonstration.

B.18 Upon successful completion of the RAMICS ATD, the U.S. Navy will transition the RAMICS technologies to the assigned AMCM platform, the CH-60S helicopter. To increase the supercavitating projectile mine neutralization capability, a 30mm chain gun is planned to be integrated into the CH-60S during EMD. The major developmental effort during the transition from ATD to the EMD phase will consist of qualifying a 30mm chain gun on the CH-60S along with the development of the 30mm munition. The RAMICS EMD phase will culminate with test and evaluation in 2004 and production contract in 2005.

Acknowledgments

U.S. Navy Fact File Web Page; Surface Mine Warfare Systems Program Office (PM-407); Airborne Mine Countermeasures Program Office (PM-210); Navy Coastal Systems Station (NCSS), Panama City, FL.

APPENDIX C

CURRENT MCS ORD MISSION REQUIREMENTS

C.1 Detailed requirements delineated in the Operational Requirements Document for the Mine Countermeasures Support Ship are summarized in the following tables.

Table	C.1	MCS ORD MCM Group Commander Support
Table	C.2	MCS ORD Surface MCM Support
Table	C.3	MCS ORD Air MCM Support
Table	C.4	MCS ORD EOD Support
Table	C.5	MCS ORD Miscellaneous Requirements

Table C.1 MCS ORD MCM Group Commander Support

Personnel: 12-O, 5-CPO, 8 Enlisted
Office / Work space: 1725 sq. ft.
C^4I Upgrades (NTCS-A, RCS, RADDS, SATCOM)

Table C.2 MCS ORD Surface MCM Support

MCM / MHC Alongside Mooring: 4 Port or Stbd
Hotel services (electric / fresh water / firemain):
  2 Port or Stbd
Crane for SMCM equipment lift
20-40 fifty-five gallon drums of lube oil
Emergent I-Level repair capability for MCMs / MHCs
(Waste removal) -- Pass through only in port

Table C.3 MCS ORD Air MCM Support

8 MH-53E Helicopters
3 H-3 Spotter / SAR Helicopters
AMCM Squadron and Spotter / SAR Detachment:
  44-O, 27-CPO, 429 Enlisted
Office / Work spaces: 1100 sq. ft.
O&I Level Maintenance spaces: 4120 sq. ft.
4 Simultaneous Land / Launch spots
1 MH-53E Hangar Maintenance spot
6 MK-105 Sleds
JP-5 Endurance: Minimum of 7 days
Stowage for AMCM Equipment and Helicopter O&I level spares
Crane for MK-105 Sled handling
MK-105 Sled Launch spots (ASpot Mike@): 1-2 spots

Table C.4 MCS ORD EOD Support

4 EOD detachments: 7 Os, 11 CPOs, 24 Enlisted
Fly-Away Recompression Chamber (FARC) Stowage: 900 sq. ft.
Transportable Recompression Chamber System (TRCS) Stowage
Stowage from EODMCM Support Equipment: 600 sq. ft.
Stowage for 3 Fly-Away Dive Lockers (FADLs)
Office and other Climate-Controlled EOD Support Spaces:
1270 sq. ft.
Magazine and Cargo Stowage
MOGAS Stowage: 2000 Gallons

Table C.5 MCS ORD Miscellaneous Requirements

Limited self-defense
Ship=s boats: 8-RIBs, 1-35 ft. workboat and 5-MK V Zodiacs
Accommodations for 90/ 10 male / female crew ratio
Modern Habitability Standards (New / Modified only)
Pollution Abatement Modifications
> Waste Disposal
> CFC reduction (A/C Plant)
> Hazardous / Medical Waste
> Oily Waste
> CHT (no change)
Tailored Logistics Support

APPENDIX D

ANALYSIS

D.1 This section summarizes the background and applicable portions of the 1999 MCM Force-21 Study, which is a planning factor in much of the current Mine Warfare Program. An important aspect is the introduction of the CH-60S helicopter as an AMCM platform, and its equivalence to the existing AMCM MH-53E aircraft, which is also discussed.

MCM Force-21 Study

D.2 Study Tasking and Goals. With the shift from the cold war to the types of naval operations envisioned in *Forward...From the Sea,* The U.S. Navy has initiated a plan to provide forward deployed naval forces with an assigned mine countermeasures (MCM) capability. The concept is intended to allow forward deployed forces to carry out missions in the face of a potential mine threat, without having to wait until supporting Mine Warfare assets can arrive on the scene. With more potential conflicts necessitating operations in littoral waters and the widespread availability and relative low cost of mines, a rapid response MCM capability is deemed highly important to the success of naval missins, particularly early in a conflict. The assigned MCM concept is intended to fulfill this requirement by providing MCM assets that are an integral part of the naval task groups (CVBGs and ARGs).

D.3 The MCM Force-21 study was initiated by the Director, Expeditionary Warfare (N85) to Aensure that programming plans and strategies for the evolving OMCM [organic MCM] systems are quantatively balanced against future warfighting requirements.@ N85 tasked the Center for Naval Analysis (CNA) to lead the MCM Force-21 study, with assistance from Johns Hopkins University Applied Physics Laboratory (JHU/APL), the Carderock Division of the Naval Surface Warfare Center (NSWC/CD) and the Coastal System Station of the Dahlgren Division of the Naval Surface Warfare Center (NSWC/DD/CSS). The stated goal of the MCM Force-21 Study was Ato determine the optimal organic / dedicated (assigned / supporting) MCM force mix, within fiscal realities, necessary to meet 21st century warfighting requirements.@

D.4 Study Structure. The study focused on the 2015 time frame. Potential operational scenarios were leveraged from previous studies such as the SC-21 cost and operational effectiveness analysis (COEA) and the CVX analysis of alternatives (AOA). A series of seminar exercises, including the Mine Warfare Community and also the broader fleet communities, was used to develop concepts of operations and tactics for both assigned and supporting MCM forces, operating independently and integrated. The study team then derived a set of options for assigned / supporting force mixes and analyzed the potential operational effectiveness and costs of these options. The mine countermeasures support ship (MCS) was not explicitly played in the operational effectiveness analysis, but its costs and the cost of a replacement ship were included in comparing force mix options.

D.5 The assigned MCM systems considered in the study included the surface combatant (DD/DDG/CG) based Remote Minehunting System (RMS), the submarine deployed Long Term Mine Reconnaissance System (LMRS) and five systems deployed from helicopters. The five airborne mine countermeasures (AMCM) systems include both systems that are towed in the water from the helicopter and systems contained within the helicopter (non-tow systems). Modified CH-60S helicopters based within a CVBG and ARG would utilize these systems to provide an assigned AMCM capability. Table D.1 lists the assigned AMCM systems.

Table D.1 MCM-21 Assigned AMCM Systems

Non-Tow Systems	ALMDS	Airborne Laser Mine Detection System
	RAMICS	Rapid Airborne Mine Clearance System
	AMNS	Airborne Mine Neutralization System
Tow Systems	AQS-20X	Airborne Minehunting Sonar
	SWIMS	Shallow Water Influence Minesweeping System

D.6 The final results of the study were reported out as an annotated briefing[1] accompanied by a separate volume of appendices[2] that contain more details of the study. The operational effectiveness

[1] CNA Annotated Briefing 99-37, MCM Force-21 Study Final Results (U), June 1999, SECRET

[2] CNA Research Memorandum 99-47, MCM Force-21 Study Appendices A through G (U), June 1999,

analysis was carried out by NSWC/DD/CSS and reported in Appendix B of the MCM Force-21 Study Report. Life cycle cost analysis and notional assigned systems acquisition plans were provided by NSWC/CD and reported in Appendix G of the Study Report. JHU / APL provided a discussion of twelve key issue areas in Appendix C of the Study Report that could not be adequately addressed by the quantitative analysis. These issue areas were identified as key factors and potential Ashow stoppers@ in future MCM developments.

MCM Force-21 Study Results

D.7 MCM System Effectiveness. The operational effectiveness analysis examined operational time savings achieved with various mixes of assigned and supporting MCM forces compared to a baseline (reference) case. A series of MCM scenarios were derived from the higher level major theater of war (MTW), lesser regional contingency (LRC) and operations other than war (OOTW) scenarios taken from the SC-21 COEA and CVX AOA. In the summary of effectiveness results of Appendix B of the Study Report, results are reported for up to six different MCM force combinations in nine MCM scenarios. The nine MCM scenarios include three Q-route clearances in SLOCS; three single channel clearances in a port break-in; one partial fleet operating area reconnaissance and clearance (CVBG); one Amphibious Sea Echelon Area, and one case involving clearance of amphibious assault lanes. A very large area, sustained MCM scenario was not examined. The results were summarized as per cent changes in the time required to complete the MCM mission relative to a reference case. The reference case is a force made up entirely of current supporting MCM forces in eight of the nine scenarios. In the OOTW port break-in scenario, the reference case is a mix of assigned and supporting forces.

D.8 The final effectiveness results are presented as aggregated operational time savings giving equal weight to all nine scenarios and averaged over the nine scenarios for assigned forces comprised of the CH-60S with the AMCM systems previously discussed; the RMS only, and a combination of the RMS and CH-60S. Six of the nine scenarios include MCM-1 Class ships operating with the assigned forces to perform mine sweeping and/or mine neutralization tasks that the assigned forces cannot perform. The number of MCM assets used varies from scenario to scenario for both the reference case and the assigned MCM cases. The reference case is comprised of MCM-1 class ships and MH-53E AMCM helicopters using current (1999) MCM systems in all scenarios except the OOTW port break-in, where the reference case is the CH-60S. The results show that the addition of RMS substantially reduces the average time and is a most significant factor.

D.9 Life Cycle Cost. The life cycle cost analysis in Appendix G of the Study Report presented estimated costs on a year-by-year and total basis from FY 1999 through FY 2020 for several force mix alternatives, including maintaining the full supporting MCM capability with minimal assigned MCM. The baseline assigned MCM cost case equips carrier battle groups with assigned AMCM capability by providing a detachment of two MCM capable CH-60S helicopters and the assigned AMCM systems that go with them. The baseline assigned case also includes the RMS system on 17 DDG-51 class ships, and six LMRS systems for SSN use. Table D.2 lists details of the baseline assigned cost case.

Table D.2 Assigned MCM Baseline Cost Case

SYSTEM	COST BASIS
MCM-Capable CH-60	- 1 HM/HC detachment (2 CH-60S) deployed with each BG - 2 each of AQS-20X, AMNS, RAMICS, ALMDS, SWIMS with each deployed detachment - 3 HM/HC detachments (2 CH-60S, 1 of each system) on each coast for Asurge@
RMS	- On DDG-51 Class hull numbers 91-107 (17 systems) - 2 trainer / pipeline systems
LMRS	- 6 systems

Above the baseline cost case, two other assigned cases of interest are: (1) adding RMS to the DD-21, and (2) adding an HM/HC detachment of 2 MCM capable CH-60S to each deployed ARG. The baseline case requires 26 sets of AMCM systems. Adding the MCM capable CH-60S to the ARG requires an additional 16 sets of AMCM systems, and adding RMS to the DD-21 class requires an additional 21 RMS systems.

D.10 The cost analysis looked at combining the assigned MCM cases with a reduced supporting MCM force consisting of only surface mine countermeasure (SMCM) ships (no MCS and no MH-53Es). Two variations were analyzed, retaining the entire supporting SMCM force and reducing the supporting SMCM force by 50%. Estimated costs over the twenty year period FY99 - FY2020 are summarized in Table D.3, as developed from the Study:

Table D.3 Estimated Costs for MCM Alternatives
(FY 99 to FY 2020, inclusive)

Option	$Billions
X Current Supporting, including MCS(X) and MH-53E SLEP	9.9
X Eliminating MH-53E, MCS and 50% SMCM	6.1
X Eliminating MH-53E and MCS only	7.0
X Incremental Cost of Adding Baseline Assigned	4.3
X Incremental Cost of Adding Baseline plus RMS on DD-21	4.9
X Adding Baseline plus RMS on DD-21 plus CH-60S in ARG	5.5

The above takes into account costs and the time line for adding or replacing assets; for example, the cost of procuring an LPD-17 variant as a replacement for MCS starting in 2006.

D-11 A number of weighting factors were applied and combined with the system effectiveness results mentioned above in a cost / benefit tradeoff. For the extreme spread of between $10B and $13B over 20 years, the results between the various options and averaging over the range of scenarios and weightings, results in useful operational time savings, with RMS appearing to be a very large contributor.

Study Conclusions and Recommendations

D.12 INCHON Follow-on Issue. The study addressed the MCS follow-on question as one of the Akey issues@ discussed in Appendix C of the Study Report. The study concludes that it is difficult to make a case for a follow-on to INCHON (i.e., another large deck MCS), based on the following reasoning, as quoted from the Study:

AINCHON is expensive to maintain for a single-mission focus and, home-ported in Ingleside, Texas, is not highly responsive in the event of a short warning contingency. It would get to the theater in time for later MCM operations in support of amphibious assaults or large area, follow-on clearance operations but would not be available for initial choke point/SLOC/port clearance operations unless it happened to be deployed at the time of crisis. In addition, most of these MCM functions performed by INCHON could be off-loaded to ashore/afloat assets, particularly in a future era featuring network-centric initiatives and organic MCM capabilities for CVBG/ARG forces. ***A notable exception would be support of SMCM units not normally staged in the region of operations. In this case, shore support and maintenance facilities would not be available and, without the MCS (capable of supporting 4 SMCM ships moored alongside) there would be no apparent afloat option to do so.@*** [bolding added]

D.13 Based on the cost / benefit tradeoff results, the Study recommended the following:

For Assigned MCM Forces:

X detachments of 2 MCM capable CH-60S be provided for all deployed CVBGs and ARGs

X RMS be installed on both DDG-51 class hull numbers 91-107 and the DD-21 Class

X LMRS be provided for SSNs with deployed battle groups.

For Supporting MCM Forces:

- X Phase out MH-53E
- X No MCS follow-on ship (MCSX)
- X Reduce SMCM by – 50% (preferably keep MCM-1s)
  - \- Retain some MCM ships + EOD (exploitation, MMS)
  - \- Replace MH-53E with CH-60S

D.14 There were caveats attached to the above supporting force recommendations. The following is quoted from the supporting recommendations page in the study annotated briefing[3].

ABefore any of the dedicated forces are phased-out or reduced, the transition process must be closely monitored and the transition wickets must be successfully attained. These wickets are, for the most part, contained in the caveats detailed on pages 30 and 31.@

The caveats referred to in the above quote are reproduced below.

- X Mainstreaming happens (C2 is key)
- X CH-60S can tow
- X AShowcase@ systems achieve at least threshold performance
  - \- AQS-20X and RMS perform in-stride ID
  - \- AMNS reacquires/neutralizes previously identified mines
  - \- SWIMS acoustic component added, magnetic improved
  - \- ALMDS false contact rates – 1 per sq. n. mi.
  - \- RAMICS BDA (and becomes a program)
  - \- RMS/CH-60S endurance
  - \- LMRS emphasizes search, manages clutter
- X MCM ships remain forward-based
- X Low vulnerability of MCM platform/systems.

[3] CNA Annotated Briefing 99-37, op. Cit.

D.15 The potential effect of additional multi-mission tasking by adding the MCM mission to surface combatants already tasked with ASW, AAW, ASUW, fire support and strikes is not examined, but needs to be addressed as we develop and prove assigned MCM concepts of operations. Surface combatants (DDG-51 and DD-21) are the host platforms for RMS and also provide the cross-decking or lily-pad support for the CH-60S. With the ASW community lamenting the loss of proficiency caused by lack of at-sea training due to the Amulti-mission penalty@, the addition of another highly complex mission to surface combatants has to be realistically assessed.

Observations

D.16 Following are our principal observations on the MCM Force-21 Study and its recommendations:

a. In view of the above caveats, premature reductions in supporting MCM force levels before the assigned concept is proven and achieved in practice, could be risky.

b. The recommended assigned / supporting force mix relies on the forward deployed MCM-1 Class ships for minesweeping. Although mine hunting is preferred to minesweeping whenever possible, there may be situations where mine hunting alone cannot achieve desired levels of confidence that the mine threat has been neutralized. These situations could include high clutter and bad bottom areas, areas where mine burial is a problem and the use of mines designed to hinder mine hunting operations (coatings, odd shapes, unique case materials, etc.).

c. The systems effectiveness analysis did not include a significant sustainment / follow-on type of scenario which would involve large area clearance operations and maximum, prolonged use of the supporting MCM force. This could be the critical factor in the continuing need for an MCS or equivalent for some time in the future.

MH-53 / CH-60S Equivalence

D.17 The MCM mission performance of the CH-60S and the MH-53E helicopter is compared in three generic, sustained mine countermeasures (MCM) missions and derives the ratio of the number of CH-60S helicopters required to achieve mission performance equal to asingle MH-53E. The three MCM missions used to cover a spectrum of MCM operations are:

1. Mine hunting and neutralization of bottom and deep moored mines,
2. Influence mine sweepig, and
3. Near surface moored mine clearance.

D.18 Mission performance is calculated in the form of a daily clearance or sweep rate for a single helicopter, then the performance of the MH-53E is divided by the CH-60S performance to obtain the ratio of CH-60Ss to MH-53Es for equivalent mission performance. A 95% clearance level is used in all three missions. When both search and neutralization are performed during the same aircraft sortie (as in influence mine sweeping), daily clearance rates can be derived and compared directly. When search and neutralization are performed during separate sorties (as in mine hunting and neutralization, the average clearance rate for a 100 square nautical mile (nmi^2) aea is derived and used to compare mission performance. Each helicopter is equipped with the same systems for each type of MCM mission, whenever it is within the capability of the aircraft. All MCM mission performance parameters for the MCM systems used and for the helicopters were taken from the MCM Force-21 Study[4], except as noted.

Helicopter Characteristics

D.19 The basic weights, dimensions and aircraft performance characteristics of the MH-53E and CH-60S are listed in Table D.4. The CH-60S uses the main fuselage and landing gear of the UH-60L and the tail cone and dynamic components of the SH-60 Seahawk. The UH-60L is the current production variant of the Black Hawk helicopter. The CH-60S parameters in Table D.4 are based on the UH-60L. The major differences of note between the two helicopters, from an MCM mission performance point of view, are the differences in payload capacity and range. The MH-53E is a much

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[4] Center for Naval Analysis Research Memorandum 99-47 (CRM 99-47), *MCM Force-21 Study Appendices A Through G (U)*, June 1999, SECRET

larger helicopter than the CH-60S and has a payload capacity three times larger and a range of over three and a half times that of the CH-60S. The size of the MH-53E however preesents it from operating off of cruiser and destroyer (CG/DD/DDG) size ships, as can the CH-60S.

Table D.4 Helicopter Comparison

PARAMETERS	MH-53E	CH-60S
DIMENSIONS		
Fuselage Length	73 ft. 3.9 in.	50 ft. 0.75 in.
Fuselage Width	18 ft. 6.0 in.	7 ft. 9 in.
Fuselage Height	17 ft. 2.0 in.	12 ft. 4 in.
Cabin Volume	1,460 cu. ft.	410 cu. ft.
WEIGHTS		
Empty	36,745 lbs.	11,156 lbs.
Max. Fuel	21,000 lbs.	-
Max. Takeoff	69.750 lbs.	24,500 lbs.
Payload	12,000 lbs.	4,000 lbs.
PERFORMANCE		
Max. Speed	170 kn.	194 kn.
Cruise Speed	150 kn.	159 kn.
Max. Endurance	6 hrs.	-
Max. Range	1,120 nmi.	315 nmi.*
Max. Climb Rate	2,500 fpm	1,550 fpm
Ceiling - Hover	9,500 ft.	10,400 ft.
Ceiling - Operational	18,500 ft.	19,150 ft.
Power	13,140 shp	3,400 shp
Number of Engines	3	2
Number of Crew	2-3	2-3

* with internal fuel

MCM Mission Performance

D.20 The MCM systems used in each of the three MCM missions are:

- X Mine Hunting and Neutralization: AN/AQS-20X mine hunting sonar for search and the Airborne Mine Neutralization System (AMNS) for neutralization,
- X Influence Mine Sweeping: Organic Airborne and Surface Influence Sweep (OASIS) for the CH-60S and the MK-106 influence sweep for the MH-53E, and
- X Near Surface Moored Mine Clearance: Airborne Laser Mine Detection System (ALMDS) for search and Rapid Airborne Mine Clearance System (RAMICS) for neutralization.

The daily search or sweep rate is calculated as the product of the average effective hourly search or sweep rate for the MCM system being used, the daily useful time in the field for the helicopter and the average operational availability for the helicopter. Neutralization rates are limited by the number of neutralization rounds carried by the helicopter rather than the time the helicopter can spend in the field. Therefore daily neutralization rates are the product of the maximum number of neutralization attempts per aircraft sorties, the number of sorties per day per aircraft and the operational availability of the aircraft. The average clearance rate for a 100 nmi^2 area is calculated to combine the search and neutralization rates. This is done by deriving the number of days to search the area, adding that to the number of days to neutralize the contacts in the area and dividing the total number of days into 100 to obtain the average daily clearance rate. The number of contacts in the area is obtained from the expected false contact rates for the search systems used and a nominal number of real mines. Helicopters are limited to a maximum of three sorties per day and MCM operations are conducted only during daylight hours. This differs from the MCM Force-21 study, where the CH-60S flew three sorties per day and the MH-53E flew two sorties per day.

D.21 Mine Hunting and Neutralization. The range (endurance) advantage of the MH-53E results in significantly more useful operating time in the minefield each day, compared to the CH-60S. This results in a search only ratio ranging between about two to three, depending on available hours of daylight and the standoff range between the minefield and the ship supporting helicopter operations.

D.22 Because of its payload advantage, the MH-53E is assumed to carry twice as many neutralization rounds per sortie as the CH-60S. This results in a neutralization ratio of about two. But because of the assumed in-stride mine identification capability of the AN/AQS-20X, required search times are generally far greater than required neutralization times. Therefore the overall clerance ratio of the CH-60S to the MH-53E is very close to the search only ratio. Table D.5 shows the overall clearance ratios for three standoff ranges and two values of available daylight.

Table D.5 Ratio of CH-60S to MH-53E for Equivalent Mission Performance in Mine Hunting and Neutralization

Available Hours of Daylight	Range from Support Ship to Minefield, nmi		
	10	30	50
12	2.2	2.4	2.8
14	2.4	2.7	3.2

D.23 Influence Mine Sweeping. Because of aerodynamic power limitations, theCH-60S cannot tow the MK-105 magnetic sweep hydrofoil sled (which with the MK-104 acoustic sweep towed in tandem becomes the MK-106 combined influence sweep). The smaller OASIS sweep is used instead by the CH-60S. The OASIS system is assumed to be of the same size as the Shallow Water Influence Sweep System (SWIMS), but with increased capability. (The MCM Force-21 Study used the SWIMS system on the CH-60S.) The OASIS performance used here is based on a ratio of OASIS to MK-105 performance provided by Coastal Systems Station, Panama City.

D.24 The MH-53E uses the MK-106 system for influence sweeping. It is assumed that the first aircraft sorties of the day tows the sled to the operating area and transfers it on-station to the relieving helicopter at the end of its mission time. The last sortie of the day tows the sled back to the support ship. This differs from the MCM Force-21 Study, where each MH-53E sorties towed the MK-106 out to and back from the operating area. Table D.6 shows the mission performance ratio for influence mine sweeping. Ratios are shown for the CH-60S using OASIS and, for comparison, for the CH-60S using SWIMS. Daylight hours are not shown as a parameter in this mission since both helicopters complete three sorties in less than twelve hours.

Table D.6 Ratio of CH-60S to MH-53E for Equivalent Mission Performance in Influence Mine Sweeping

CH-60S Sweep System	Range from Support Ship to Minefield, nmi		
	10	30	50
OASIS	5.0	4.9	4.8
SWIMS	10.8	10.6	10.3

D.25 The MH-53E=s advantage over the CH-60S decreases slightly with standoff range because the MK-106 system must be towed back and forth daily to the operating area while SWIMS or OASIS can be flown out and deployed to tow in the operating area. This is contrary to the mine hunting and neutralization mission, where the MH-53E endurance gives it an increasing time in field advantage with standoff range when both helicopters are using the same mission equipment.

D.26 Near Surface Moored Mine Clearance. At present, ALMDS and RAMICS are not integrated, with RAMICS having its own targeting laser. Because of its payload limitations, the CH-60S cannot carry both ALMDS and RAMICS at the same time. Therefore, the CH-60S must first search an area with the ALMDS and then come back in separate sorties with RAMICS to neutralize the contacts detected with ALMDS. With its large payload, it is assumed that the MH-53E can carry both systems at once and therefore perform in-stride neutralization of ALMDS contacts. This differs from the MCM Force-21 Study, where the MH-53E flew separate ALMDS search and RAMICS neutralization sorties, the same as the CH-60S. As with AMNS, the MH-53E is assumed to carry twice as many RAMICS rounds as the CH-60S. The CH-60S mission endurance issignificantly higher in this mission because no towing is involved, as opposed to the mine hunting and influence mine sweeping missions. MH-53E mission endurance also is increased but not as much as the CH-60S relative to the towing missions.

D.27 Because of the characteristics of the ALMDS search system, the performance ratio in this mission is sensitive to the ALMDS false contact rate. Two values of false contact rate are used: in Table D.7 the operational requirement specified value (low) is used, and in Table D.8 a higher value is used for comparison purposes. (The MCM Force-21 Study used the lower, operational requirement specified false contact rate.) Because neither helicopter is towing during near surface moored mine clearance operations, more sortie time is available. Therefore three full sorties cannot be flown in twelve hours of daylight. Table D.7 and D.8 show results for both 12 and 14 hours of available daylight. However, if the MH-53E also must fly separate search and neutralization sorties (i.e., it is unable to carry both ALMDS and RAMICS at the same time), then the ratios in Table D.7 would be about 1.3 for 12 hours of daylight and 1.4 for 14 hours of daylight, and the ratios in Table D.8 would be about 1.5 for 12 hours of daylight and 1.6 for 14 hours of daylight.

Table D.7 Ratio of CH-60S to MH-53E for Equivalent Mission Performance in Near Surface Moored Mine Clearance (Specified False Contact Rate)

Available Hours of Daylight	Range from Support Ship to Minefield, nmi		
	10	30	50
12	1.6	1.6	1.5
14	1.8	1.7	1.7

Table D.8 Ratio of CH-60S to MH-53E for Equivalent Mission Performance in Near Surface Moored Mine Clearance (Higher False Contact Rate)

Available Hours of Daylight	Range from Support Ship to Minefield, nmi		
	10	30	50
12	2.2	2.1	2.0

14	**2.5**	**2.3**	**2.2**

D.28 The performance ratios are not very sensitive to either the standoff range from the support ship to the minefield operating area or the available hours of daylight. These factors effect the Ch-60S and the MH-53E almost equally in this mission. However the ratios are more sensitive to the ALMDS false contact rate, emphasizing the importance of this variable.

D.29 Summary. Over the ranges of variables considered, it appears that a reasonable equivalence for minehunting / neutralization is two CH-60S to a single MH-53E. For minesweeping however, the equivalence is five or more Ch-60S to each MH-53E.