ANNEX B
Mine Warfare
Platforms, Programs and Systems

MH-53E Sea Dragon Airborne Mine Countermeasures Helicopter

MH-53E Sea Dragon AMCM Helicopter

Description: The MH-53E Sea Dragon helicopter is capable of minehunting and minesweeping operations in the deep to shallow water region. 25 of the total 29 airframes that are currently in the MH-53E fleet are configured for AMCM. Of these 25 aircraft, 6 are currently forward-deployed in two detachments, a 4-aircraft air detachment to Bahrain, and a 2-aircraft air detachment to Korea. As a result of developmental delays in critical organic technologies, and integration delays of the towed OAMCM systems on the MH-60S helicopter and unmanned systems from the LCS, the Navy has been required to extend the lives of its dedicated mine-warfare assets. Accordingly, an MH-53E Fatigue Life Extension program has been completed which allows the Navy to retain required AMCM capability through 2024.

Status: In FY 2011-13, the MH-53E AQS-24A sonar will be updated with a technology refresh integrating a synthetic aperture sonar to significantly improve performance and reduce operator workload. Two additional Mk-105 sweep sleds are notionally planned to be budgeted in FY 2012 to sustain minesweeping capacity requirements until future sweep systems are delivered to the Fleet. MH-53E inventory will start to drop in 2015. AMCM HM squadron manpower is aligned to meet the AMCM requirements through 2024.

Avenger-Class Mine Countermeasures Ship

USS Pioneer (MCM 9)

Description: The Avenger (MCM 1)-class SMCM ships are capable of the complete detect-to-engage sequence to include minehunting and minesweeping in deep to shallow water. A total of 14 Avenger-class ships were built and remain in active service. An SMCM modernization package and other major hull, mechanical and electrical (HM&E) alterations correct the most significant maintenance and obsolescence issues in order to maintain the ships through their full 30-year service lives. Developed in FY 2006, the MCM-1 modernization package includes:

- Upgrading the existing SQQ-32 sonar with high-frequency wideband capabilities
- Replacing the existing acoustic sweep system with the Advanced Acoustic Generator and the Infrasonic Advanced Acoustic Generator
- Replacement of the obsolete Mine Neutralization Vehicle with the smaller, more reliable, and user-friendly Expendable Mine Neutralization System (EMNS).
- Communications suite and navigation modernization including Electronic Charting and Display System
- Battle Space Profiler

Other major HM&E alterations included in Navy planning for the FY 2011 President's Budget are:

- Replacement of diesel generator analog voltage regulators with digital voltage regulators
- Static Frequency Converter upgrade
- Bow Thruster upgrades
- Replacement of aft deck hydraulic equipment with electric equipment.

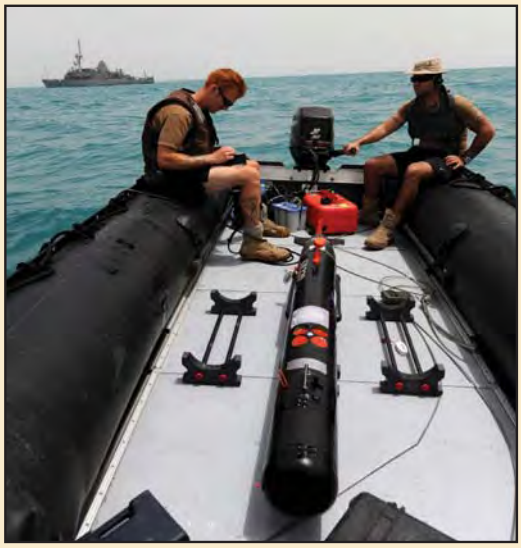
Status: The MCM 1 class modernization package commenced in FY 2004 and was originally scheduled for completion in 2010.

EMNS has been installed in USS Sentry (MCM 3) to support initial shipboard testing. Testing was intended to complete in 2011 but testing completion has been delayed due to an unintended, but correctable consequence of software programming discovered during testing which could result in the EMNS swimming underneath the MCM ship that launched the device. The EMNS program has a remedy for this behavior and a plan of action for implementation using FY 2011 budget funding.

MCM 1-class drawdown is scheduled to commence in 2017 with the final MCM 1-class ship decommissioning in 2025. The MCM 1-class drawdown will occur concurrently with the buildup in numbers of Littoral Combat Ships and MCM MPs.

Underwater Mine Countermeasures Unmanned Underwater Vehicles

Description: Current UUV operations are built upon Hydroid Remote Environmental Monitoring Unit System UUV bodies. The Mk 18 Mod 1 (Swordfish UUV) provides current operational capability. An enhancement to that system is the Mk 18 Mod 2, which provides a test bed for advanced sensors (e.g. dual frequency Small Synthetic Aperture Minehunter, LFBB), navigation, and processing.



Mk 18 Mod 1 Swordfish Unmanned Underwater Vehicle

The Mk 18 Mod 1 Swordfish UUV is capable of performing low-visible exploration and reconnaissance in support of amphibious landing; MCM operations (including search, classification and mapping; and reacquire and identification); and hydrographic mapping in the VSW zone (10 to 40 feet depth) and the seaward approaches. It is capable of navigating via acoustic transponders in long-baseline or ultra-short-baseline mode or via P-coded GPS. Upward- and downward looking acoustic digital velocity log improves dead-reckoning accuracy. Onboard sensors include water turbidity, water temperature and conductivity, side-scan sonar, and downward-looking camera.

Status: The Mk 18 Mod 1 Swordfish UUV achieved full operational capabilities (FOC) in 2008. Follow-on block upgrades will combine two separate UUV programs into the Mk 18 family of systems to deliver improved detection capability against buried mines in high clutter environments and are planned to deliver from FY 2014 through FY 2018.

Additionally, a program to deliver neutralization capability in the VSW region from a UUV is under consideration for start in FY 2012. Current efforts to prototype neutralization capability are being carried out under the Defense Conversion Assistance Program with the Archerfish system and Office of Naval Research (ONR) funding. Current neutralization programs are planning to initially experiment with a tethered neutralization system as an incremental approach to delivering autonomous neutralization capability.

Organic Mine Countermeasures Systems

MCM Mission Package

Description: Organic mine countermeasures systems (OMCM) will be assembled into the Littoral Combat Ship MCM mission package (MP). The MCM MP will include multiple systems contained within mission modules and provide surface, near surface, in volume, close-tethered and proud mine detection, classification, identification, neutralization and influence sweep capabilities in the deep to shallow water regions. Five of these systems will be carried by MH-60S Seahawk helicopters configured for AMCM missions. Additionally a VTUAV payload will provide an MCM SZ and beach reconnaissance capability. Ultimately, the baseline MCM MP will contain the following OMCM systems with the planned quantities of systems indicated:

- AN/AQS-20A Minehunting Sonar (3)
- AMNS (1)
- ALMDS (1)
- OASIS (1)
- RAMICS (1)
- COBRA (1)
- USV with US3 (1)
- RMS (2)
- Support equipment and computing environment

Status: The first MCM MP (Spiral Alpha MP) was delivered in September 2007. One MCM MP per year is planned for procurement in FY 2011-14 in order to align with LCS delivery, and a total inventory of 24 MCM MPs planned. MCM MP IOT&E is planned for FY 2011 in USS Independence (LCS 2). MCM Spiral Alpha MP is expected to IOC in FY 2013 when the first LCS with an MCM MP embarked is a deployable asset ready for assignment to an operational commander. The baseline MCM MP is expected to deliver in FY 2017.

The Navy is aligning MCM MP procurement with manpower to ensure availability of the MCM MP DET one year ahead of delivery of the MCM MP. The specific ratio of MCM DETs to MCM MPs is being reviewed.

AN/AQS-20A Minehunting Sonar

MH-60S Configured with AQS-20A Minehunting Sonar

Description: AQS-20A is a mine-detection sonar that also employs an electro-optical identification (EOID) sensor. AQS-20A is capable of detecting, localizing, and classifying bottom, close-tethered and moored sea mines. The EOID sensor also provides bottom mine identification capability. The AQS-20A mine-hunting system will be deployed, towed, and operated from the MH-60S Seahawk AMCM helicopter, and will also serve as the mine sensor towed by the RMS' remote multi-mission vehicle (RMMV). A procurement goal of 72 systems is planned.

Status: Milestone C and low rate initial production (LRIP) occurred in FY 2005. Improvements to Computer Aided Detection/Computer Aided Classification and Environmental Data Collection capabilities are being implemented via enhanced research and development efforts, and developmental testing is ongoing. Technical evaluation on MH-60S was completed in 2009, and IOT&E is planned in FY 2011. AQS-20A IOC is estimated in FY 2012.

AN/ASQ-235 Airborne Mine Neutralization System (AMNS)

Description: AMNS is an expendable, remotely operated mine-neutralization device that leverages non-developmental integration and commercial-off-the-shelf technologies. Deployed from MH-60S helicopters, AMNS reacquires and explosively neutralizes proud bottom and in-volume moored mines.

AMNS in MH-60S Seahawk

Status: Beginning in FY 2003, AMNS systems have been procured for the MH-53E to provide a near-term contingency airborne neutralization capability. Follow-on AMNS system integration work for the MH-60S began in FY 2003 and Milestone C and LRIP was achieved in 2008. IOC is estimated in FY 2012.

AN/ALQ-220 Organic Airborne and Surface Influence Sweep (OASIS)

Description:
The OASIS system will provide an organic, high-speed, magnetic/acoustic influence minesweeping capability in the deep to shallow water regions. The sweep is designed to be deployed from and towed by the MH-60S Seahawk AMCM helicopter. OASIS is subdivided into six major components: the Towed Body, the Magnetic Influence Subsystem, the Acoustic Influence Subsystem, the Control/Monitoring and Power Subsystem, the OASIS Software, and the Tow Cable/Helicopter Interface.

Graphic Illustration of OASIS Towed by MH-60S Seahawk

Status: The program was restructured in Program Objective Memorandum for FY 2010-2015 in order to test a redesigned sensor head. IOC is estimated in FY 2014.

AN/AES-1 Airborne Laser Mine Detection System (ALMDS)

ALMDS in MH-60S Seahawk

Description: ALMDS is an organic, laser-based high-area coverage system that uses streak tube imaging Light Detection and Ranging (LIDAR) to detect, classify, and localize floating surface and near-surface moored sea mines in the deep to shallow water regions. Deployed from the MH-60S Seahawk helicopter configured for AMCM, ALMDS will rapidly detect and classify mine-like contacts for subsequent prosecution.

Status: Milestone C and LRIP occurred in FY 2005. Through January 2010, a total of 5 ALMDS systems have been delivered under the LRIP Phase 1 and Phase 2 contracts. ALMDS recently completed a software upgrade focused on improving mine detection and classification performance, as well as to decrease false contacts. Pending successful flight testing which commenced in FY 2010, developmental testing and operational evaluation OPEVAL are planned in FY 2011. ALMDS IOC is anticipated in FY 2013.

AN/AWS-2 Rapid Airborne Mine Clearance System (RAMICS)

Graphic Illustration of RAMICS in MH-60S Seahawk

Description: RAMICS will be a non-towed system hosted on board the MH-60S Seahawk helicopter. It will be capable of reacquiring and neutralizing surface and near-surface moored mines. A rapid firing Mk 44 Bushmaster II chain gun is controlled by a LIDAR fire-control system coupled with targeting algorithms. The LIDAR reacquires and targets mines, providing aiming coordinates to the gun's fire control system. Firing a burst of Mk 258 Mod 1 30mm supercavitating tungsten projectile munitions specially designed for traveling tactical distances in air and water and through a casing, RAMICS will cause a low-order deflagration of the mine, causing immediate and positive mine neutralization. RAMICS is one of the systems in the LCS MCM Mission Package.

Status: The RAMICS program was restructured in FY 2008. Procurement of systems begins upon successful aircraft integration, scheduled for FY 2017. IOC is anticipated in FY 2017.

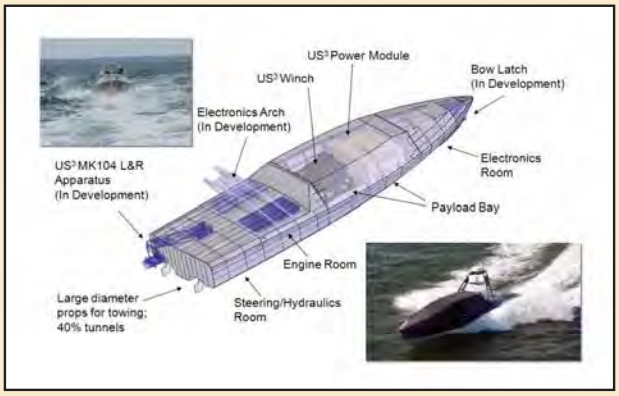
AN/WLD-1 Remote Minehunting System (RMS)

Remote Minehunting Vehicle with AN/AQS-20A Sonar Stowed

Description: RMS consists of a 23' long, 4' diameter, semi-submersible, unmanned RMMV weighing in excess of 7 tons designed to tow the AN/AQS-20A mine-hunting sonar. RMS is launched with a pre-programmed search pattern, and the system is capable of over-the-horizon minehunting. Once the mission is completed, RMS returns to the ship and data will be downloaded for post-mission analysis. RMS will be operated from the LCS.

Status: Milestone C occurred in FY 2005 and supported an LRIP decision that procured three systems. A second LRIP decision in FY 2006 acquired four more systems. RMS was tested on USS Bainbridge (DDG 96) and operated during deployment. RMS failed Operational Assessment due to RMV reliability on board Bainbridge and is currently undergoing an aggressive Reliability Growth Program to improve its capability. Following a Nunn-McCurdy breach reported in 2010 due to program issues associated with system reliability, but which do not reflect an inability to meet the critical warfighting thresholds assigned to the program, RMS Nunn-McCurdy certification was received from USD(AT&L) in May 2010. IOC is estimated in FY 2017. Procurement of 54 RMS systems is planned.

Unmanned Surface Sweep System (US3)



Unmanned Surface Sweep System

Description: US3 will provide a long endurance, wide area magnetic and acoustic influence sweep capability via an 11-meter USV. US3 is a magnetic/acoustic influence sweep deployed from an unmanned eleven meter surface craft. It is designed to sweep underwater influence mines and is composed of a control computer, power supply, winch, magnetic influence cable, and acoustic source. The cable and acoustic source can be deployed and operated under remote control and towed at high speed. The USV can operate at a significant range from the LCS or other host ship in both day and night operations.

Status: US3 IOC is planned in FY 2015.

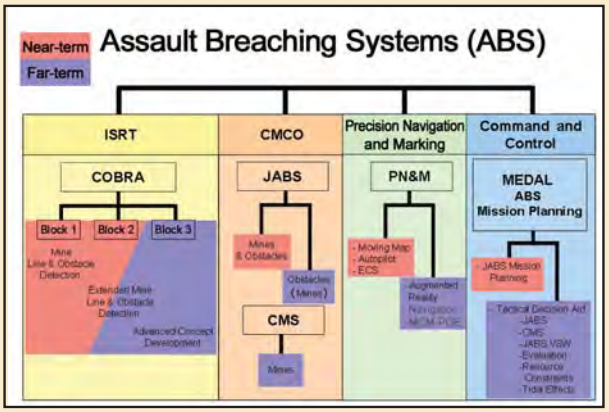
Surface Mine Countermeasures UUV with Low Frequency Broad Band Sonar (SMCM UUV with LFBB)

SMCM UUV Ready for Launch

Description: SMCM UUV with LFBB is a surface-launched MCM UUV that will employ a new low frequency broad band sonar from a large diameter, 19.5 inch heavyweight UUV. This system provides buried mine detection capability, the ability to hunt mines in high clutter environments, low false alarm rates, and single-pass detection and identification.

Status: The Navy is evaluating this capability for the MCM MP. IOC is planned in FY 2015.

Assault Breaching Systems (ABS)



The ABS program focuses on development of standoff weapons systems to counter mine and obstacle threats in the surf and beach zones. The program uses a "system-of-systems" approach that includes development and fielding of the COBRA mine/obstacle detection system as the ISRT component; JDAM Assault Breaching System (JABS) and Countermine System (CMS) as the CMCO component; and various technological developments providing a PN&M component; all of which are linked together through the Mine Warfare and Environmental Decision Aids Library (MEDAL) and the global information grid, the ABS C2 component. A near-term ABS capability using JABS was fielded in FY 2007.

Coastal Battlefield Reconnaissance and Analysis System

Description: COBRA is a payload for the Fire Scout VTUAV and will be capable of conducting standoff reconnaissance to detect minefields and obstacles in the SZ, on the beach, and through the beach exit. COBRA incremental development is planned to deliver the following capabilities:

Graphic Illustration of COBRA

- COBRA Block I
  - Daytime operations
  - Surface-laid mine-line and obstacle detection
  - Detection on the beach and limited capability in SZ
  - Offboard processing

- COBRA Block II
  - Day and night operations
  - Surface-laid mine-line and obstacle detection
  - Detection on the beach and in SZ
  - Offboard processing

- COBRA Block III
  - Day and night operations
  - Mine-line and obstacle detection
  - Detection on the beach and in SZ
  - Near real-time onboard processing
  - Proud and buried mines

Status: The COBRA Block I system achieved Milestone C in 2009. IOC is estimated in FY 2012. COBRA Block II, which will expand the capability to include the SZ and provide both a day and night detection capability, achieved Milestone B in FY 2010 transitioning the Block II technology to Naval Sea Systems Command (NAVSEA) Mine Warfare Program Office (PMS495). IOC is estimated in FY 2017. COBRA Block III, which will provide a buried detection capability in the SZ and on the beach with near real-time processing, is scheduled to commence acquisition in FY 2017 with IOC estimated in 2020.

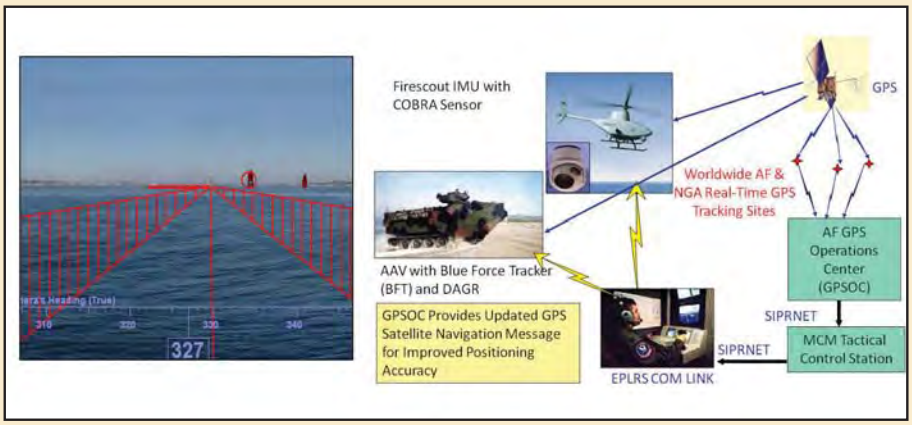
JDAM Assault Breaching System and Countermine System

Description: JABS uses existing MK-84 "dumb" bombs with JDAM tail kits to provide a near-term counter-mine and counter-obstacle capability in the SZ and on the beach. A validated Naval non-nuclear ordnance requirement to support JABS mission requirements in the beach and SZs has been derived from CCDRs and the Joint Staff. With accurate targeting information, JABS is the SZ and beach breaching capability of today. In the far-term, CMS will provide a more effective clearance capability against mines located in the SZ and on the beach. A single CMS all up round is planned to consist of over 5000 darts tightly packaged and designed to precisely dispense in a large pattern.

Countermine System Dart Dispense Testing

Status: Already fielded to support breaching requirements in the SZ and on the beach, testing of JABS in the very shallow water region has had promising results to date. CMS IOC is planned in FY 2017.

Precision Navigation and Marking



Potential Technological Solutions to Enhance Precision Navigation and Marking

Description: Enhancing the capabilities of landing craft and amphibious assault vehicles to more precisely navigate is the objective of the ABS PN&M component. Ultimately, with a narrower transit and/or assault lane requirement, breaching those lanes will require fewer munitions. Initiatives to enhance the navigation capabilities of LCAC, LCUs, and Amphibious Assault Vehicles (AAVs) are in progress.

Status: LCAC and LCUs continue to be upgraded with an autopilot capability and Voyage Management System, respectively. As a preliminary step to enhance AAV navigation, an upgrade providing a moving map capability to enhance situational awareness for the vehicle's driver has been developed. To further enhance AAV driver situational awareness, the Augmented Reality Visualization of the Common Operational Picture (ARVCOP) system depicted above will virtually mark assault lanes and obstacles. ARVCOP transitioned from ONR to PMS495 in FY 2010.

In FY 2010, ONR also continued its MCM Precision GPS Ephemeris (PGE) Data Distribution effort depicted above. The objective of this initiative is to provide updated GPS satellite navigation data at a much greater frequency than currently provided to improve the systems' positioning accuracy. Instead of twice per day, updates from the GPS Operations Center can be provided every 15 or 5 minutes. Following additional FY 2010 testing, the MCM PGE Data Distribution capability is planned to transition to PMS495 in late 2010.

Quickstrike Mine

Quickstrike Mines

Description: Quickstrike mines utilize a target detection device (TDD) Mk 57, a magnetic/seismic-sensing device designed specifically for Cold War targets such as large combatants and submarines on or near the surface. Mk 65 Quickstrike mines can also use the TDD Mk 58, which is a magnetic/seismic/pressure-sensing device.

Status: Developments in the Quickstrike mine family pertain to TDD upgrades and remote control implementation. Quickstrike mines are being upgraded with the TDD Mk71, a state-of-the-art firing mechanism that can sense magnetic, seismic, and pressure signatures, and can be programmed with sophisticated target-processing algorithms and counter-countermeasures. TDD Mk 71 is designed for use in all Quickstrike-series mines and will sense magnetic/seismic/pressure stimuli similar to the current TDD Mk 58. While the TDD Mk 58 uses hard wired algorithms with programmable sensitivities, the new TDD Mk 71 will be fully programmable for different algorithms and different sensitivities. Its improvements are centered around TDD development in target influence sensors; sensor signal processing and target logic; and timing and control logic. The TDD Mk 71 will enable Navy's miners to optimize performance against different target classes and to counter future threats. Engineering development efforts include advanced algorithms for ship detection, classification and localization against likely and emerging threats including quiet diesel-electric submarines, mini-submarines, fast patrol boats, high speed vessels, shallow water twin hull vessels, and air-cushioned vehicles.

A research and development effort designed to provide one-way remote control (RECO) of Quickstrike mine MK 65 is progressing. RECO commands will be Arm, Sterilize, and Self Destruct. RECO mines can be planted before a conflict begins and armed later, if required. Sterilize or self destruct commands will neutralize the minefield as soon as hostilities are over. Work includes development of transmitters to communicate with the mines.