The RAPID AIRBORNE MINE CLEARANCE SYSTEM (RAMICS) Approach to Entering Flight Test

Presented by
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TOPICS

• Overview of RAMICS program
• Outline acquisition challenges
• Approach taken
• Lessons learned
THE ORGANIC MCM CONCEPT

MH-60S

ALMDS

AN/AQS-20/X

RMS

LMRS

OASIS

RAMICS

AMNS

(Not to Scale)
SD&D TASKING

• Accelerated development program to seamlessly insert RAMICS capability into ongoing OAMCM initiative
ACQUISITION CHALLENGES

- Munition requirements
- Gun subsystem requirements
- System design
- Flight qualification
  - Subsequent DT/OT efforts
PERSONNEL

- Breadth across components
  - Experts used for each aspect
- Depth within IPT
  - “Borderless” team
APPROACH TAKEN

• Parallel Efforts to Keep Risk Low and Minimize Development Schedule
  – Gov’t Develop Gun/Munition
    • Begin qualification efforts
    • Collect firing data in flight to support targeting system development and cut risk
  – Contractor Develop Targeting
    • To include integration of entire weapon system
Munition drives gun
Gun drives munition
Trade study initiated on munition
- ATD Program used 20mm
- Munitions experiments results
- AoA Results
**TRADE STUDY RESULTS**

**NOTES:**
1. 25mm can sink a mine at the threshold neutralization depth. If sinking is an acceptable neutralization method, then it minimally meets the performance requirement.
2. 25mm cannot deflagrate a mine at the threshold neutralization depth. If a mine must deflagrate in order to be considered neutralized, then the 25mm does not meet the minimum performance requirement.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Weight Factor</th>
<th>25mm</th>
<th>30mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective (sink/deflagrate)</td>
<td>Critical</td>
<td>G!</td>
<td>LB</td>
</tr>
<tr>
<td>Integratable</td>
<td>Extremely Important</td>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>Executable</td>
<td>Considerably Important</td>
<td>G</td>
<td>G</td>
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<tr>
<td>Operationally Available</td>
<td>Considerably Important</td>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>Safe</td>
<td>Considerably Important</td>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>Supportable</td>
<td>Considerably Important</td>
<td>G</td>
<td>LB</td>
</tr>
</tbody>
</table>

**25mm Weight-Score = 152**  
**30mm Weight-Score = 168**  
**Difference = 10.3%**

A difference in weight-scores of at least 10% indicates that there is a meaningful distinction between candidates, according to the DSMC SE Management Guide.
RAMICS SYSTEM COMPONENTS

Targeting Sensor Subsystem (TBD) (ATD version shown)

Fire Control Subsystem (TBD) (ATD version shown)

Munition Subsystem – MK258 Mod 1 APFSDS-T with Supercavitating projectile

Gun Subsystem – Modified MK44 30mm Bushmaster II Cannon

MH-60S
Safe Standoff Distance
1500 ft

Gun (Navy Certified)
MK44 30mm Chain Gun
Bushmaster II

Mounted on Stbd Side of MH-60 via CSTRS

Ammunition (Navy Certified)
30mm Long Rod Penetrator

Targeting Sensor Subsystem
Blue-Green LIDAR

Field of Fire
45° - 60°
ASN RDA Acquisition Decision Memorandum 15 Mar 01 established the following C&TD Phase Exit Criteria:

1. Receive Safe Standoff certification from NAVAIR (Code 4.1).

2. Determine projectile mine neutralization capability beyond 40ft depth.

3. Develop a reduced-recoil gun/turret design that is acceptable for MH-60S integration (based upon airframe fatigue and deformation, dynamic component wear, cost, crash load constraints and other issues as required) and document PMA299/PMS210 concurrence.

Test and Evaluation

Exit criteria completed by testing:

- Safe standoff completed - Jul 02
- Projectile lethality completed - Oct 01
- Reduced recoil conducted - Apr 02
CRITERIA #1: SAFE STANDOFF

- Completed - NAVAIR 4.1 certification signed on 7 May 02
- Results: SSO Distances:
  - Shallow mines: 1500’
  - Deep mines: 700’

MEMORANDUM

From: AIR-4.1
To: PMA-279

Sub: RAMCS SAFE STANDOFF DISTANCES

Ref: (a) Acquisition Decision Memorandum for RAMCS, 11 March 2001
(b) Rapid Airborne Mine Clearance System Data Package for CTD Phase Exit Criteria 
   Safe Standoff, January 2001
(c) AIR-4.1-2.1 RAMCS Acquire Term Safe Escape Routes, draft
(d) NAVAIR-1 Rapid Airborne Mine Clearance System (RAMCS) Safe Standoff 
   Distance Certification, AIR-4.1-16 memorandum, 16 April 2002

1. The AN/AQS-7 of the RAMCS consists of a M944 Hummer with a 3.7mm gun and sensor subsystem, a fine targeting/mine clearance subsystem, and an oceanic camera integrated into the MH-60S helicopter weapon system. RAMCS is currently in the Concept and Technology Demonstration Phase (Phase 1) and is required by reference (b) to have the "Acquire Safe Standoff certification from Commander Naval Air System Command (COMNAVAIRCRAFT)" (Code 4.1). Personnel from AIR-4.1-6 and AIR-4.1-5 were assigned to review references (a) and (b) which document related work during the RAMCS Advanced Technology Demonstration phase conducted at Panam River, Kingdom of Saudi Arabia, and the Gulf Test Range near Panana City, Florida. These tests were in September, New Mexico, and marine performance testing in West Germany, Scotland. Additional data concerning items such as underwater performance predictions and relevance of targets issued the anticipated threat is also contained in reference (b).

2. Personnel from AIR-4.1-6 and AIR-4.1-10 have reviewed references (a) and (b). Based on these references and the analysis documented in reference (c), the recommended safe standoff distances are:

- Shallow mines: 1500’
- Deep mines: 700’

The safe standoff distance is defined as the horizontal distance measured radially from the center of the mine. The depth is defined as the ocean depth from the surface to the top of the mine casing. Training with tacticle equipment can be simulated at the distances noted above or greater.

3. The RAMCS IPT has been extremely conservative in their analysis regarding hazards to the aircraft and crew. While the current data contained in references (b) and (c) can only support the aforementioned distances, additional data would most likely support reductions in these ranges. When additional data and analysis becomes available to support a change in the safe standoff distances, AIR-4.1-6 and AIR-4.1-10 will make recommendations as to the optimal distances.

Copy to:
AIR-4.1-6
AIR-4.1-10

[Signature]

Date: May 6, 2002
CRITERIA #2: MINE NEUTRALIZATION CAPABILITY BEYOND 40 FT DEPTH

- Completed - Documented in CSS ltr dated 12 Mar 2002
- Results
  - 0 - 40ft Deflagration
  - 40 - 150ft Rapid sinking (less than 4 min.)
  - 150 - 200ft Slow sinking
CRITERIA #3: REDUCED RECOIL GUN/TURRET DESIGN

Completed – PMS-210/PMA-299 concurrence signed on 9 May 02

Results
Achieved recoil reduction below 4000lbs for armor piercing and Target Practice rounds
GUN SUBSYSTEM EVOLUTION

From Concept...

...to Mockup...

...to Modeling...

Prototype!
FIT CHECKS

RAMICS gun subsystem prototype installed on an MH-60S helicopter. Note the final design has the gun installed on the starboard side of the aircraft.
RAMICS SD&D DESIGN CONCEPT

Gun Camera, Boresight Laser Assy. Cradle Assembly
Standard Mk 44
Gun Turret Assembly
Gun Control Unit
Gun Power Supply
Turret Control Unit
Ammunition Can

LH CSTRS (ALMDS COMMON)
Sensor Pod
FLIGHT CRITERIA

- Crash Loading
- Structural Fatigue
- Dynamic Effects
- Recoil Effects
- Muzzle Flash
- Case/Link Disposal
- Ammunition Feed

- Electrical Power Requirements
- Exhaust Gas Toxicity
- Mock-Up
- Ground Clearance
- Resonant Freq.
- Software Cert.

- Initial Flight Tests - November 2003
LESSONS LEARNED

- The right team
- Environment of autonomy and empowerment
- Embrace acquisition reform
- Document everything
- Parallel risk-reduction testing
- Focus on exit criteria