



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

Presented by
Mr. Alan K. Jenkins
to the
2003 Gun, Ammunition, and Missiles
Symposiums & Exhibition
24-28 March 2003

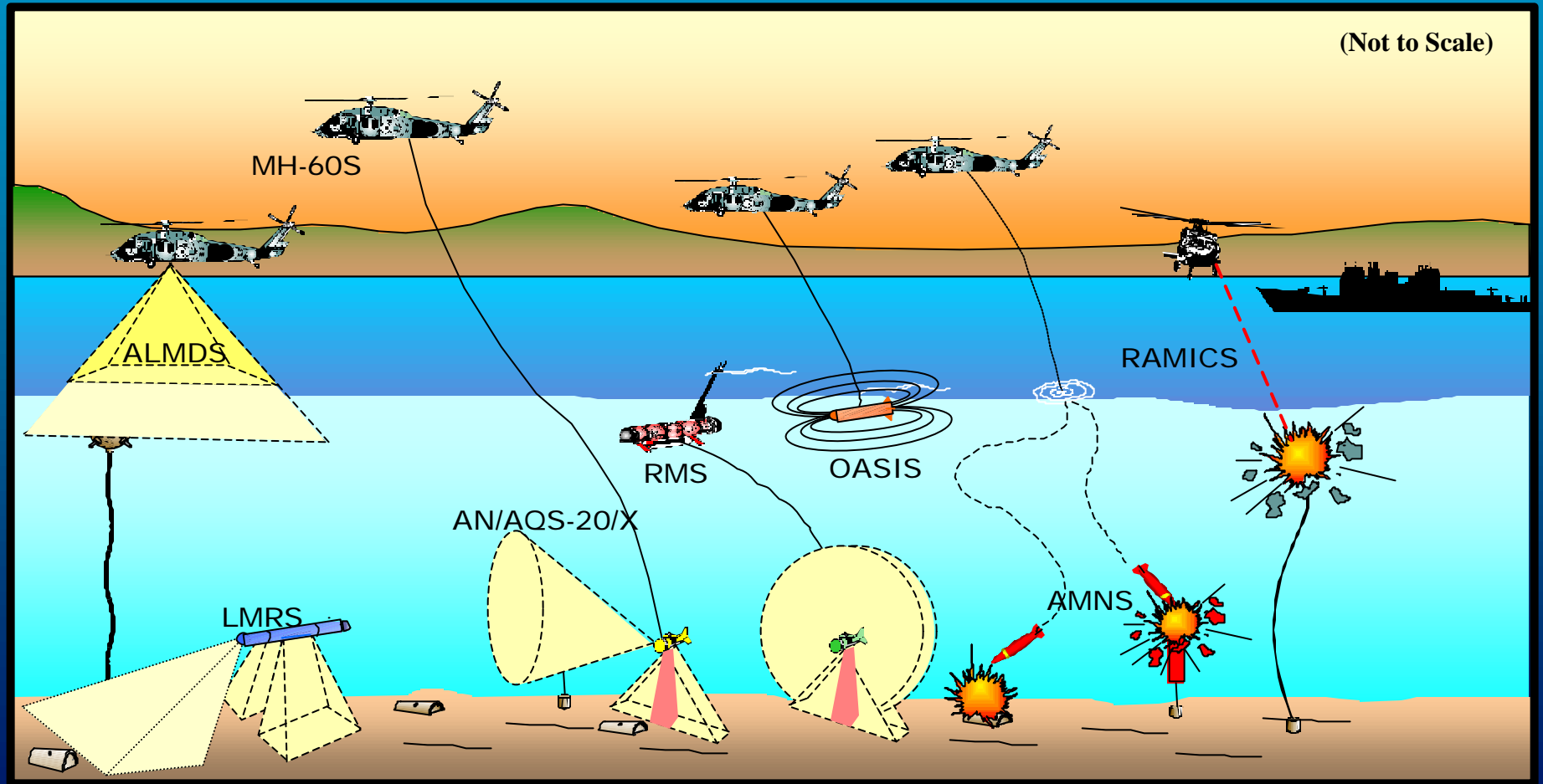
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Naval Air Warfare Center Aircraft Division
Patuxent River, MD 20670
301-342-1334



TOPICS

- Overview of RAMICS program
- Outline acquisition challenges
- Approach taken
- Lessons learned

THE ORGANIC MCM CONCEPT





ACQUISITION CHALLENGES

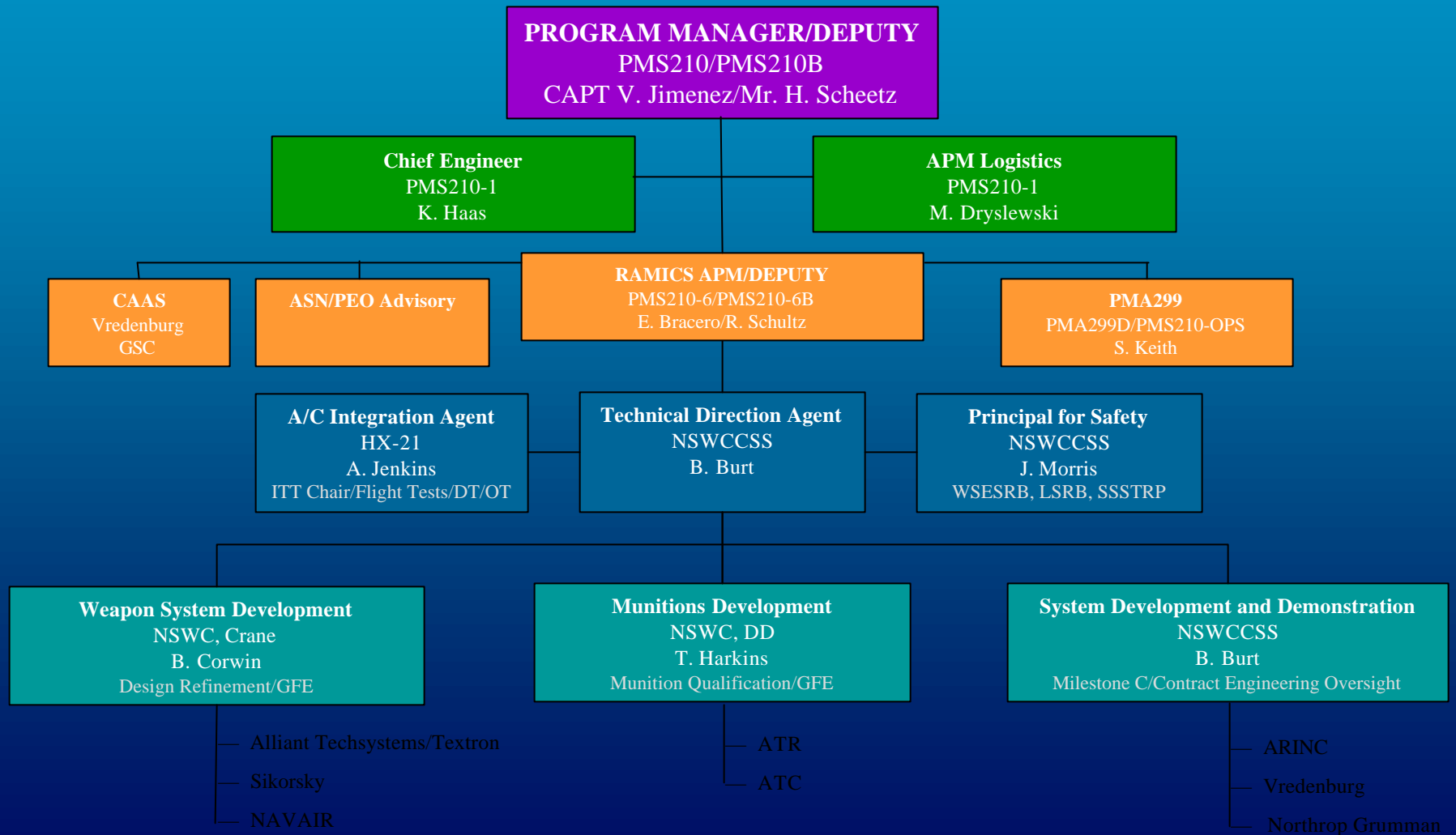
- Munition requirements
- Gun subsystem requirements
- System design
- Flight qualification
 - Subsequent DT/OT efforts



PERSONNEL

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

RAMICS INTEGRATED PRODUCT TEAM (IPT)





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



GUN/MUNITION SUBSYSTEMS

- Munition drives gun
- Gun drives munition
- Trade study initiated on munition
 - ATD Program used 20mm
 - Munitions experiments results
 - AoA Results

TRADE STUDY RESULTS

Parameter	Weight Factor	25mm	30mm
Effective (sink/deflagrate)	Critical	G ¹	LB
		R ²	
Integratable	Extremely Important	G	G
Executable	Considerably Important	G	G
Operationally Available	Considerably Important	G	G
Safe	Considerably Important	G	G
Supportable	Considerably Important	G	LB

25mm Weight-Score = 152

30mm Weight-Score = 168

Difference = 10.3%

NOTES:

¹25mm can sink a mine at the threshold neutralization depth. If sinking is an acceptable neutralization method, then it minimally meets the performance requirement.

²25mm 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.

LEGEND

- B** Exceeds the requirement
- LB** Somewhat exceeds the requirement (objective)
- G** Meets the requirement (threshold)
- O** Almost meets the requirement
- R** Does not meet the requirement

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)

MH-60S



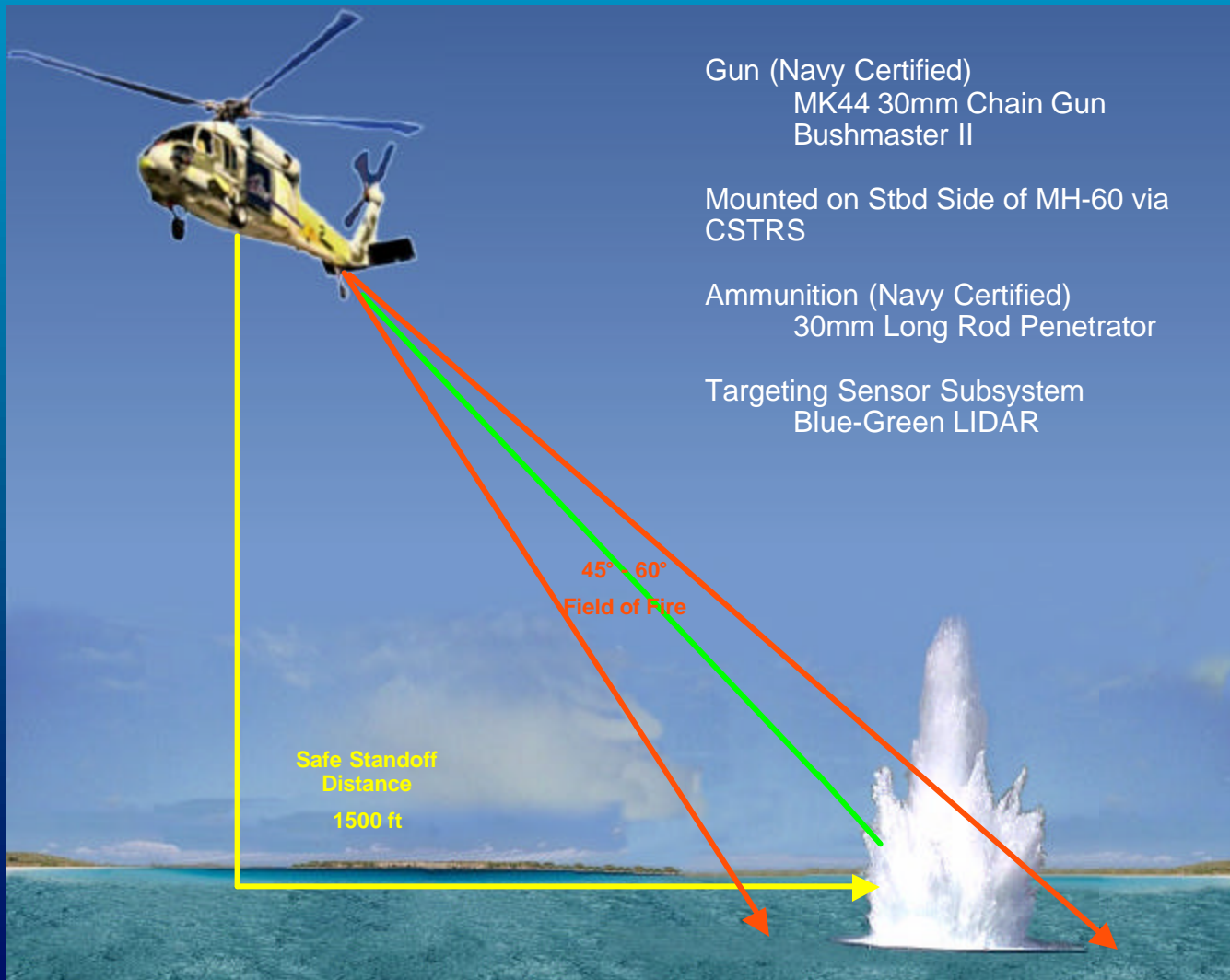
Munition Subsystem –
MK258 Mod 1
APFSDS-T with
Supercavitating
projectile



Gun Subsystem –
Modified MK44
30mm Bushmaster II
Cannon

AMMUNITION TYPES: 30mm GAU-8, 30mm Rarden, 40mm Super Forty

RAMICS SYSTEM DESCRIPTION



CTD PHASE EXIT CRITERIA



DEPARTMENT OF THE NAVY
OFFICE OF THE ASSISTANT SECRETARY
RESEARCH, DEVELOPMENT AND ACQUISITION
1000 NAVY PENTAGON
WASHINGTON, DC 20350-1000

MAR 15 2001

cos *[Signature]* 3/15

PMS210 _____

[Signature] MUW-T _____

MEMORANDUM FOR THE PROGRAM EXECUTIVE OFFICER (MINE AND UNDERSEA WARFARE)

Subj: ACQUISITION DECISION MEMORANDUM FOR THE RAPID AIRBORNE MINE CLEARANCE SYSTEM (RAMICS)

At the Program Review held on February 26, 2001, I reviewed the RAMICS program status and the Analysis of Alternatives Summary with recommendations. Additionally, I reviewed the ongoing Concept and Technology Development (CTD) efforts and proposed exit criteria.

The RAMICS program is approved to proceed to Milestone B as briefed. The CTD phase exit criteria are as follows:

- Receive Safe Standoff certification from NAVAIR (Code 4.1).
- Determine projectile mine neutralization capability beyond 40 foot depth.
- Develop a reduced-recoil gun/turret design that is acceptable for MH-60S integration (airframe fatigue and deformation, dynamic component wear, cost) and document PMA-299/PMS-210 concurrence.

[Signature]

Paul A. Schneider
Assistant Secretary of
the Navy (RD&A) (Acting)

ASN RDA Acquisition Decision
Memorandum 15 Mar 01 established the following C&TD Phase Exit Criteria :

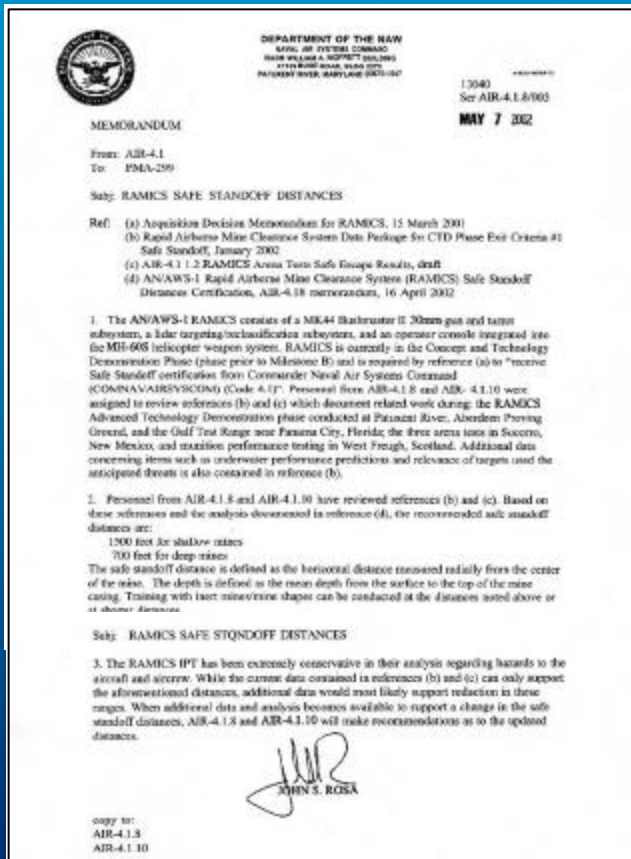
1. Receive Safe Standoff certification from NAVAIR (Code 4.1).
2. Determine projectile mine neutralization capability beyond 40ft depth.
3. Develop a reduced-recoil gun/turret design that is acceptable for MH-60S integration (based upon airframe fatigue and deformation, dynamic component wear, cost, 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'



T=0



0.5 msec



10msec



20msec




40msec



50msec

MINE DETONATION SEQUENCE

CRITERIA #2: MINE NEUTRALIZATION CAPABILITY BEYOND 40 FT DEPTH



DEPARTMENT OF THE NAVY
COASTAL SYSTEMS STATION DANLBERG DIVISION
NAVAL SURFACE WARFARE CENTER
8703 WEST HIGHWAY 90
PANAMA CITY FL 32407-0001

IN REPLY REFER TO:
1900
Sex A21/007
12 MAR 2002

From: Commanding Officer, Coastal Systems Station
To: Program Executive Officer, Mine and Undersea Warfare (DMS210)

Subj: PROJECTILE MINE NEUTRALIZATION CAPABILITY BEYOND 40 FOOT FOR THE AN/AWS-1 RAPID AIRBORNE MINE CLEARANCE SYSTEM (RAMICS)

Encl: (1) COASTSYSTA Doc Data Package for CTD Phase Exit Criteria #2 Neutralization Capability Beyond 40-Foot Depth of Mar 02
(2) COASTSYSTA CD Data Package for CTD Phase Exit Criteria #2 Neutralization Capability Beyond 40-Foot Depth of Mar 02

1. The Acquisition Decision Memorandum for the RAMICS, of 15 March 2001, established three exit criteria for the Concept and Technology Demonstration (CTD) phase. One exit criteria states, "Determine projectile mine neutralization capability beyond 40 foot depth." In order to fully comply with this exit criteria the RAMICS Program conducted a series of tests and analyses, documented in enclosure (1).

2. DoD 5000.2-R, June 2001, Paragraph AP3.2.6 defines lethality as "the ability of a munition or directed energy weapon to cause damage that will cause the loss or a degradation in the ability of a target system to complete its designated mission(s)." Consistent with that definition, RAMICS projectile Mine Neutralization capability is defined as "a detonation/deflagration of the explosive to achieve observable kill and sinking due to hoing of the mine buoyancy chamber." Based on test data and analysis, the following conclusions are made with respect to the neutralization capability of the RAMICS projectile:

(a) Neutralization of the mine due to deflagration can be achieved down to depths of 40 feet.

(b) Neutralization of the mine due to rapid sinking in less than four minutes can be achieved down to depths of 150 feet.

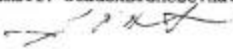
(c) Neutralization of the mine due to a slow sinking of the mine can be achieved down to depths of 200 feet.

3. System neutralization capability will be based on the projectile's capability, targeting, and fire control solution.

Subj: PROJECTILE MINE NEUTRALIZATION CAPABILITY BEYOND 40 FOOT FOR THE AN/AWS-1 RAPID AIRBORNE MINE CLEARANCE SYSTEM (RAMICS)

System capability will be greatly dependant upon the environmental conditions and should not be considered as typical for the entire RAMICS system.

4. The Coastal Systems Station point of contact for the RAMICS program is Mr. Bruce Dzadek (A21), commercial (850) 235-5380, DISN 436-5380, FAX (850) 236-7070, email: DzadekBr@nccsc.navy.mil



J. D. HORTON
By direction

- 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


PMA 299/PMS 210 MEMORANDUM OF CONCURRENCE
RAMICS REDUCED-RECOIL GUN/TURRET DESIGN
CONCEPT AND TECHNOLOGY DEMONSTRATION PHASE EXIT CRITERIA

1. Purpose: The purpose of this Memorandum of Concurrence (MOC) is to document PMA-299 and PMS-210 concurrence on the Rapid Airborne Mine Clearance System Exit Criteria #3.

2. Background: The Acquisition Decision Memorandum for the Rapid Airborne Mine Clearance System (RAMICS), dated 15 March 2001, establishes three Exit Criteria for the Concept and Technology Demonstration (CTD) phase. Exit Criteria #3 states, "Develop a reduced-recoil gun/turret design that is acceptable for MH-60S integration (airframe fatigue and deformation, dynamic component wear, cost) and documented PMA-299/PMS-210 concurrence".

3. During the CTD phase, a reduced recoil gun subsystem design has been completed that reduced gun recoil from 10,000 lbs to under 4,000 lbs. Based on the current test data at this phase of the RAMICS program, PMA-299, and PMS-210 concur that the reduced recoil design for the gun/turret sub-system is acceptable for MH-60S integration. Additional analysis and testing is required to determine other impacts on the aircraft in the DT-IIA configuration (flying qualities/handling, engines, electronic components, dynamic components, system safety, and human factors, as well as follow-on fatigue and crash load analysis) as part of the integration effort.


09 MAY 02
CDR W. J. Fulton (Date)
PMA-299 MH-60S IPT Lead


9 May 02
K. W. Haas (Date)
PMS-210 IPT Lead

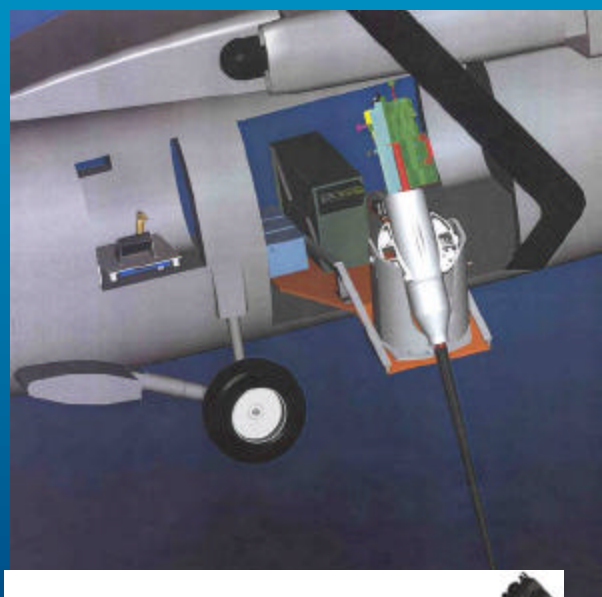
Completed – PMS-210/PMA-299
concurrence signed on 9 May 02
Results

Achieved recoil reduction below 4000lbs for
armor piercing and Target Practice rounds



GUN SUBSYSTEM EVOLUTION

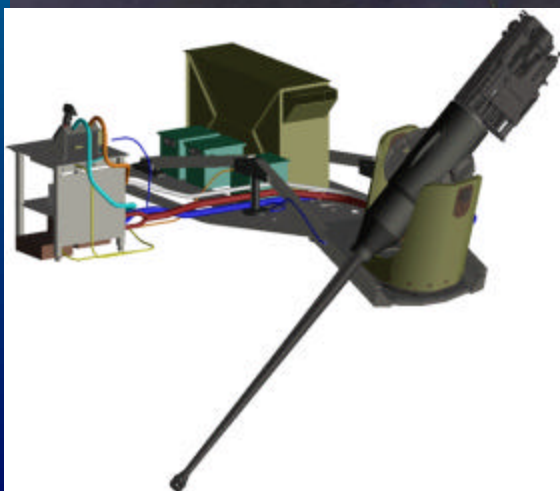
From
Concept...



...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





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