REPORT

OF THE

AIR-TO-AIR MISSILE SYSTEM

CAPABILITY REVIEW (U)

JULY – NOVEMBER 1968

1 JANUARY 1969

NAVAL AIR SYSTEMS COMMAND

MASTER INDEX

MASTER INDEX (continued)

UNCLASSIFIED

SECTION I

REPORT

OF THE

AIR-TO-AIR MISSILE SYSTEM

CAPABILITY REVIEW (U)

JULY–NOVEMBER 1968

SECTION I

NAVAL AIR SYSTEMS COMMAND

UNCLASSIFIED

SECTION I - ABSTRACT

A. Almost 600 air-to-air missiles have been fired by Navy and Air Force pilots in about 360 hostile engagements in Southeast Asia between 17 June 1965 and 17 September 1968 (date of last hostile engagement). Performance in combat indicates a probability of achieving about one kill for every ten firing attempts in any engagement where air-to-air missiles are employed in an environment similar to that in Southeast Asia.

B. Pursuant to CNO message DTG 241506Z July 1968, during the period 8 August-8 November 1968, a five member review team, directed by Captain Frank W. Ault, USN, [redacted]/1310, NAVAIRSYSCOM, (AIR-001), conducted an in-depth review of the entire process by which the Navy's Air-to-Air Missile Systems are acquired and employed in order to identify those areas where improvements can and should be made.

C. Systems included:

1. F8 H/J
2. F4B/AERO-1A
3. F4J/AWG-10
4. AIM 7D/AIM 7E/AIM 7E-2/AIM 7F (SPARROW)
5. AIM 9B/AIM 9C/AIM 9D/AIM 9D(SEAM) (SIDEWINDER)

D. In assessing performance to date and exploring the ways and means of effecting future performance improvements, the review addressed air-to-air missile systems in each of five discrete stages of their life cycles, ranging from original design and manufacture through repair and rework. Review objectives were pursued by the address of five basic questions, each keyed to a specific area of inquiry:

1. Is industry delivering to the Navy a high quality product, designed and built to specifications?

2. Are Fleet support organizations delivering a high quality product to the CVA's and to the forward area sites ashore?

3. Do shipboard and squadron organizations (afloat and ashore) launch an optimally ready combat aircraft-missile system?

4. Does the combat aircrew fully understand and exploit the capabilities of the aircraft-missile system? (Corollary question: Is the aircraft-missile system properly designed and configured for the air-to-air mission?)

5. Is the air-to-air missile system (aircraft/fire control system/missile) repair and rework program returning a quality product to the Fleet?

E. The review indicates that numerous design, procedural, and organizational changes can and should be made. Some are immediately feasible and subject to early implementation. Others require time-phasing or require resolution of certain policy, economic, technical, and/or operational considerations. In all cases, vigorous follow-up and follow-through will be required if requisite improvements to current capabilities are to be realized.

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REPORT

OF THE

AIR-TO-AIR MISSILE SYSTEM

CAPABILITY REVIEW (U)

JULY–NOVEMBER 1968

SECTION II

NAVAL AIR SYSTEMS COMMAND

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SECTION II - IMPLEMENTING MESSAGE
NAVAL MESSAGE
OPNAV FORM 2110-28A (REV. 8-61)

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R 241506Z JUL 68

FM CNO
TO CINCLANTFLT
CINCPACFLT
CHNAVMAT

INFO CMC
COMNAVAIRLANT
COMNAVAIRPAC
COMSERVLANT
COMSERVPAC
COMFIRSTFLT
COMSECONDFLT
COMSIXTHFLT
COMSEVENTHFLT
COMOPTEVFOR
COMNAVAIRSYSCOM
COMNAVORDSYSCOM
COMFAIRNORFOLK
COMFAIRJAX
COMFAIRKEYWEST
COMFAIRMIRAMAR
COMFAIRALAMEDA
COMNAVMISCENPTMUGU
COMNAVWPNCENCHINALAKE
COMREADATKCARAIRWING 4
COMREADATKCARAIRWING 12
CGFMFPAC
CGFMFLANT

CONFIDENTIAL

Air-to-Air Missile Capability (U)

1. (C) Combat performance in Southeast Asia continues to indicate a need for an in-depth examination of the entire process by which Air-to-Air missile systems are acquired and employed.

2. (C) Captain Frank W. Ault [redacted]7/1310 U.S. Navy NAVAIRSYSCOM Code 001, has been directed to conduct such a review in order to identify any and all areas where improvements can and should be made. In addition to inputs from industry he will require support

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NAVAL MESSAGE

OPNAV FORM 2110-28A (REV. 3-81)

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by those Navy and Marine Corps commands and activities involved with Air-to-Air missile systems acquisition and/or employment.

3. (C) The majority of the review will be conducted through visits to cognizant commands and activities by Captain Ault and/or one to six key team members and by the assignment and execution of special tasks as mutually agreed and approved by appropriate authority. As an early step, a special, one-time Air-to-Air missile systems symposium is tentatively planned to be held at the NAVMISCEN Pt. Mugu 19-23 August 1968 during which a subcommittee approach will be employed to address review objectives as then defined and to identify other relevant areas for further inquiry. Additional information on this symposium will be promulgated prior to 1 August. A firm itinerary of team member visits will be promulgated earliest.

4. (C) Your cooperation and assistance in this review effort will aid in the orderly delineation of problem areas and the timely formulation of a plan to achieve a substantial improvement in combat capabilities of our air-to-air missile systems.

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REPORT

OF THE

AIR-TO-AIR MISSILE SYSTEM

CAPABILITY REVIEW (U)

JULY–NOVEMBER 1968

SECTION III

NAVAL AIR SYSTEMS COMMAND

SECTION III - APPROACH AND METHODOLOGY

A. Since the commencement of hostilities in Viet Nam in 1965, both the Navy and Air Force have conducted several evaluations of air-to-air missile performance in combat operations. Despite a plethora of recommendations directed to improvements in performance - a number of which consistently recur in consecutive reports - combat kills per numbers of missiles expended remain below expected or desired levels.

B. The scope of previous reviews/evaluations generally has been limited to examination of discrete areas of interest/activity such as:

1. Test and evaluation.

a. CONUS (e.g. Navy's ComOpTevFor Projects or USAF's "SPARROW SHOOT")

b. Forward Area (WestPac) (e.g. USAF's "COMBAT SAGE".)

2. Training (e.g. FMSAEG evaluations of Navy/Marine Corps training firings).

3. Combat performance of specific units over specific periods of time. (e.g. Navy's "Walker Report" of 3 July 1968 covering combat performance of the USS AMERICA (CVA66) and USS ENTERPRISE (CVAN-65) during May and June 1968).

4. Summary analyses of U.S. combat performance in Southeast Asia (e.g. WSEG's "RED BARON" Project).

5. Production evaluation (e.g. Production Monitoring Tests at NavMisCen Pt. Mugu or FMSAEG evaluations of missile rework programs at NARF Alameda and NARF Norfolk).

None of these addressed concurrently the aircraft-missile fire control-missile system across the complete spectrum of design, acquisition, operational, and logistic processes/procedures which determine its characteristics and/or influence its performance.

C. Accordingly, this review was undertaken with two basic premises firmly in the forefront:

1. There was a need to examine concurrently the complete spectrum of influences on weapon system characteristics and performance in order to identify those primarily reflected in combat results while assessing the need for, and practicability of, changes/modifications.

2. Improvement in the combat capabilities demonstrated to date manifestly could not be achieved merely by doing better those things now being

done. The need for new approaches and innovations appeared self-evident, considering the continuing inability to achieve desired results through the attempted implementation of recurring recommendations.

D. An initial step was the formulation of a review plan prescribing areas for review and factors to be considered in each. As can be seen in enclosure (1) to this Section, the plan encompassed five major areas of inquiry, each addressing those functions involved during the successive stages comprising the life cycle of the weapons system. Review objectives and scope were expressed in terms of five basic questions:

1. Is industry delivering to the Navy a high quality product, designed and built to specifications? (Functions/Factors: Design, Development, Production).

2. Are Fleet support organizations delivering a high quality product to the CVA's and to the forward area sites ashore? (Functions/Factors: Storage, Maintenance, Surveillance, Test, Repair, Transfer, Issue, Logistic Support).

3. Do shipboard and squadron organizations (afloat and ashore) launch an optimally ready aircraft-missile system? (Functions/Factors: Storage, Maintenance, Assembly, Test, Repair, Handling, Loading).

4. Does the combat aircrew fully understand and exploit the capabilities of the aircraft-missile system?

a. (corollary question) Is the aircraft-missile system properly designed and configured for the air-to-air mission?

(Functions/Factors: Training, Readiness, Doctrine, Tactics, Procedures, Human Engineering, Systems Performance).

5. Is the air-to-air missile systems repair and rework program returning a quality product to the Fleet? (Functions/Factors: Repair vs Rework, Engineering and Logistic Support, Funding, Quality Assurance).

E. The next step involved the selection of five Task Leaders to coordinate and direct the review effort in each of the major areas of enclosure (1). The following were selected on the basis of reputation as well as qualification in the particular areas as a result of professional training, experience, and duty assignments:

Area 1: Mr. B. W. Hays, NWC China Lake
Area 2: Mr. W. W. West, NWC Corona Lab
Area 3: Cdr. B. H. Gilpin, USN, NavMisCen Pt. Mugu
Area 4: Capt. M. H. Gorder, USN, OpNav (Op 561E)
Area 5: Mr. O. C. Robbins, NavAirSysComRepPac

These five Task Leaders, plus the Review Director, formed the Review Team. Task Teams were formed by Task Leaders to work in each area and were referred to by Task Team number (viz. Task Team One, Task Team Two, etc.)

F. The first meeting of the Review Team was held at the Naval Missile Center, Pt. Mugu on 8 August 1968. It had been determined previously that the aircraft-missile systems involved in the review were:

1. F8H/J
2. F4B/AERO1A
3. F4J/AWG10
4. AIM 7D/E/E2/F (SPARROW)
5. AIM9B/C/D/D(SEAM) (SIDEWINDER)

The review effort involved three basic phases to be addressed more or less concurrently: the collection of data, the collation of that data, and the evaluation of the data in order to generate conclusions and recommendations therefrom. It was agreed that, within the constraints of time and manpower available, conclusions and recommendations would be translated to proposals, plans, schedules, and funding wherever practicable. This latter step was deemed necessary in order to particularize terms of reference and to catalyze the impetus it was felt would be needed for early, aggressive action in some instances. Recognizing that the Review Team had no executive authority, it was agreed, at the outset, that ideas of special merit or timeliness would be relayed, as generated, to appropriate authority by the Review Director for consideration in advance of the Team's final report.

G. Methodology essayed involved the following:

1. Data Collection

   a. Briefings/Interviews
   b. Review of existing pertinent literature/reports.
   c. Field Visits
   d. Air-to-Air Missile System Symposium

2. Data Collation

   a. Identification of factor(s) or function(s) involved in each review area.

   b. Organization of Task Teams within each review area.

   c. Task Team development of cause and effect considerations as related to factors/functions involved.

3. Data Evaluation and Generation of Recommendations

   a. Task Team evaluation and recommendations

b. Review Team coordination and review
c. Review Director approval and consolidation

H. As stated previously, the foregoing efforts moved forward more or less concurrently. Since the Review Director had been a member of the team involved with the 28 June-3 July 1968 air-to-air missile review in the USS AMERICA and USS ENTERPRISE, the in-depth review commenced essentially at that point. Prior to the first meeting of the Review Team a field visit had already been made (by the Review Director and the Task Four Leader) to those CONUS Fleet Commands on both coasts concerned with air-to-air missile training. This visit set the pattern for other visits. (viz. a visit by the Review Director to each of the stations/commands/plants/etc. associated with air-to-air missilery, accompanied, in each case, by the Task Team Leader in the particular area involved (i.e., Task Team One Leader for Industry, Task Team Three and Four Leaders for CVA's, Task Team Two Leader for Weapon Stations, etc.)). Such visits were followed up, where appropriate or necessary, by Task Team Leaders whose Task Teams conducted in-depth, on-site reviews and analyses. A summation of the sites visited during the period 30 July-1 November appears in enclosure (2) to this Section. The opportunity to observe, interrogate, compare, discuss, and debate in the actual operating environment was an indispensible element of the data finding/collation process and provided, as well, the perspective essential to meaningful evaluation.

Briefings, interviews, and reviews of existing documentation/reports proceeded concurrently with other review efforts as the Review Team attacked the problem of evaluating past performance, program actions, and proposals while remaining abreast of current developments in an extremely dynamic environment.

An air-to-air missile system symposium at the Naval Missile Center, Pt. Mugu, during the period 19-23 August brought together over 200 attendees representing the complete spectrum of interest and/or direct participation in all phases of air-to-air missilery: Industry, Fleet, Shore Establishment, and Marine Corps. The primary objective of the symposium was to identify problems and reach concurrence on their definition. No real attempt was made to solve problems then identified, although recommendations for solutions frequently evolved as a natural consequence of symposium proceedings. Primarily, however, the symposium filled out the review matrices for the Task Leaders whose chore it then became to analyze and evaluate the slightly over 200 problems identified and to develop and refine problem solutions.

Shortly after the symposium, the three principal contractors - McDonnell, Westinghouse, and Raytheon - formed a coordinated management and engineering team to develop and refine industry's role in solutions to the problems involved and to advise and assist the Review Team, as required. This team - a notably dedicated and objective group - functioned most effectively throughout the review period. Other contractors involved, as

well, cooperated unreservedly so that required inputs from industry were readily available at all times.

Task teams worked individually - with occasional phone or personal contacts as required for coordination or consolidation of functions - until 8 October. At that point a meeting of the Review Team was held at the Naval Missile Center Pt. Mugu to check progress, to verify that all problem areas were being covered, and to check, finally, for duplication of effort or improper emphasis. Only minor adjustments were required and Task Teams proceeded on a schedule directed to review wrap-up in early November.

During the period 4-8 November the Review Team held its final sessions at the Naval Missile Center, Pt. Mugu for purposes of coordination and review of the findings of each of the five Task Teams. The industry team previously mentioned was available at Pt. Mugu throughout the week in a consultant capacity and provided a final up-date on some of the technical and fiscal data.

I. A very real problem for the Review Team throughout the period of its efforts was the difficulty in remaining abreast of the almost daily changes to programs during the course of the review. For this reason, an attempt was made to tailor conclusions and recommendations to fit basic problem solutions rather than to produce detailed, technical, engineering, and fiscal treatises.

J. As a final note, the Review Team could have had no greater incentive to press its efforts to conclusion than by observing that between the first meeting of the Team (on 8 August) and the last (on 8 November) the Navy fired an additional 12 SPARROWS (AIM7E's) and 12 SIDEWINDERS (AIM9D's) in combat with a net yield of 2 MIG kills: both to SIDEWINDER's.

Enclosure (1): Review Plan
Enclosure (2): Visits: 30 July - 1 November 1968

I. Question

1. Is industry delivering to the Navy a high quality product, designed and built to specifications?

A. Areas of Inquiry

1. Contracting - Production
   a. Philosophy of contracts
      (1) Performance
      (2) Specifications (Navy Design)
   b. Cost considerations
      (1) Fixed price vs. cost plus
         (a) Development
         (b) Prototype production
         (c) Production
         (d) Training
      (2) Contract Management
   c. Responsibility - Overall Program Management

2. Design and Development
   a. Requirements and Specifications
   b. Goals vs achievements
   c. Deviations
   d. Contractor - Navy interface

3. Production
   a. Performance
   b. Quality Assurance
   c. Factory Acceptance Tests (by Industry)
      (1) Criteria
      (2) Procedures
      (3) Validity
      (4) Specification responsibility
   d. Production Evaluation Tests (by Navy)
      (1) Criteria
      (2) Procedures
      (3) Validity
      (4) Specification responsibility
   e. Government monitoring

B. Corollary/Related Considerations

1. Systems Integration, Checkout, and Test
2. Facilities
3. Personnel: Availability, Training, and Experience
4. Documentation/Data Maintenance
5. Configuration Control
6. Impact of Modification Programs - Management Control
7. Feedback - Fleet; Weapon Facilities, etc.
8. Waivers, Deviations, and Material Review Board (MRB) Actions
9. Vendor Qualification

ENCLOSURE (1)

10. Schedules, Funding, and penalty provisions
11. Supervision and Management
12. DOD - Industry Interfaces
13. Procurement Regulations and Procedures
14. Reliability of Product

II. Question

1. Are Fleet support organizations delivering a high quality product to the CVA's and to the forward area sites ashore?

A. Areas of Inquiry

1. RFI Assembly
   a. Procedures
      (1) Where developed
      (2) Coordination and follow-up
   b. Standardization
   c. Quality Assurance
   d. Inspection/Acceptance
2. Logistic Pipeline
   a. Ashore
      (1) Transfer
      (2) Storage
      (3) Surveillance
      (4) Test, Maintenance, and Repair
      (5) Quality Assurance
      (6) Issue
   b. Afloat
      (1) Transfer
      (2) Storage
      (3) Surveillance
      (4) Test, Maintenance, and Repair
      (5) Quality Assurance
      (6) Issue

B. Corollary/Related Considerations

1. Systems Integration, Checkout, and Test
2. Training
3. Documentation
4. Safety
5. Impact of Modification Programs
6. Reliability
7. Lifetime and Cycle Specifics
8. Packing, Shipping, and Handling
9. Support
   a. Parts
   b. Test Equipment/Calibration
   c. Personnel
   d. Facilities
10. Standardization
11. Inspection and Evaluation
12. Supervision and Management

13. Policy direction
14. Stockpile to target sequence
15. TYCOM and NASC/NOSC/NAVSHIPS interfaces for logistics flow and maintenance management

III. Question
1. Do shipboard and squadron organizations (afloat and ashore) launch an optimally ready combat aircraft-missile system?

A. Areas of Inquiry (CVA and Naval/Marine Corps Air Station)
1. Strikedown and Storage
2. Maintenance, Test, and Repair
3. Assembly
4. Handling
5. Loading

B. Corollary/Related Considerations
1. Systems Integration, Checkout, and Test
2. Test Philosophy
3. Quality Assurance
4. Inspection and Evaluation
5. Lifetime and Cycle Specifics
6. Safety (HERO, etc.)
7. Training
   a. Formal (Schools, etc.)
   b. OJT
   c. Drills
8. Documentation
   a. Maintenance, Test, and Repair
   b. Training and Other
   c. Check-off Lists
   d. Records and reports
9. Support
   a. Parts
   b. Test Equipment/Calibration
   c. Handling and Loading Equipment
   d. Personnel (Tech. reps., etc.)
   e. Facilities
   f. Tools and Other Auxiliary Equipment
10. Standardization
11. Electromagnetic Compatibility
12. Impact of Modification Programs
13. Design Deficiencies
14. Supervision and Management
15. Stockpile to target sequence
16. Management of assets
   a. Material
   b. Personnel
17. Shipboard maintenance and supply systems

IV. Questions

1. Does the combat aircrew fully understand and exploit the capabilities of the aircraft-missile system?
2. Is the aircraft-missile system properly designed and configured for the air-to-air mission?

A. Areas of Inquiry

1. Training and Readiness
   a. Pilots/RIO's
      (1) Ground
      (2) Air
   b. Ground/Deck Crews
   c. Material Readiness
   d. Facilities and Services
2. Doctrine
   a. NATOPs
   b. Squadron
   c. Air Wing
   d. Rules of Engagement
3. Tactics and Procedures
   a. Pre-flight checks
   b. In-flight checks/procedures
   c. Firing envelopes
4. Human Engineering
   a. Switchology
   b. Cockpit configuration/instrumentation
5. System Performance
   a. Illumination Requirements
   b. Dead Time
   c. Maneuvering Restrictions
   d. Firing Envelopes
   e. Countermeasures
   f. Electromagnetic Compatibility
6. Training Target Systems/Aids
   a. Availability
   b. Adequacy
   c. Performance

B. Corollary Considerations

1. Systems Integration, Checkout, and Test
2. Inspection and Evaluation
3. Documentation
4. Safety
5. Impact of Modification Programs
6. Mission/Performance Records
7. Standardization/Cross Fertilization
8. Design Deficiencies
9. Syllabus Requisites vs. Time Available
10. Fighter-bomber vs. Fighter, only employment
11. Configuration
12. Leadership

13. Experience
14. Reliability and Operability
15. Assets Management
16. Stockpile to Target Sequence

V. Question
   1. Is the air-to-air missile system (missiles and aircraft) repair and rework program returning a quality product to the Fleet?

A. Areas of Inquiry
   1. Repair Program
      a. Criteria - component lifetime
      b. Procedures adequacy - Publication adequacy
      c. Support
         (1) Parts
         (2) Test Equipment/Calibration
         (3) Tools
         (4) Personnel
            a Availability
            b Skills and Training
         (5) Facilities
      d. Work Load (Include Air Force)
      e. Quality Assurance (Verification of product process and parts quality)
      f. System Integration, Checkout, and Test
      g. Issue
      h. Acceptance Tests
      i. Management
      j. Safety
   2. Rework Program
      a. Criteria
         (1) Component lifetime (replacement) specifics, parts quality
      b. Procedures
      c. Support
         (1) Parts
         (2) Tools
         (3) Test Equipment/Calibration
         (4) Personnel
            a Availability
            b Skills and Training
         (5) Facilities
      d. Work Load
      e. Quality Assurance
      f. Systems Integration, Checkout, and Test
      g. Issue
      h. Acceptance Tests
      i. Management
      j. Safety

B. Corollary Considerations

1. Training
2. Documentation
3. Safety
4. Impact of Modification Programs
5. Standardization
6. Design Deficiencies
7. Lifetime and Cycle Specifics
8. Schedules and Funding
9. Reliability of product - components and system
10. Stockpile to target sequence
11. Engineering support by other activities
12. Records and reports
13. Checkout of modification programs
14. Comparison of rework - military vs contractor

VISITS: 30 JULY - 1 NOVEMBER 1968

Type Commanders

ComNavAirLant
ComNavAirPac
ComServPac

ComFairs

Norfolk
Jacksonville
Key West
Caribbean
Alameda
Miramar

Ranges

PMR
AFWR

CVW's/RCVW's

All

Labs/Centers

China Lake
Corona
Pt. Mugu

MarCorps

Third MAW
MCAS El Toro
MCAS Yuma
Second MAW
MCAS Beaufort
MCAS Cherry Pt.

CVA's (all deployed)

FORRESTAL*
INDEPENDENCE*
HANCOCK
INTREPID
CORAL SEA
AMERICA
CONSTELLATION

NAVAIRSYSCOMREPS

Lant
Pac

Weapon Stas.

Concord
Seal Beach
Fallbrook
Yorktown
NAD Crane
Indian Head
NavMag Subic

Industry

Raytheon
Westinghouse
McDonnell-Douglas
Ling Temco Vought
Aerojet
Rocketdyne
Hughes

NAS's

Alameda
Miramar
Oceana

NAS's (Cont'd)

Cecil Field
Jacksonville
Key West
Cubi Pt.

NARF's

Alameda
North Island
Cherry Point
Norfolk

Other Flt Coms.

CincPacFlt
CTF 77
ComSixthFlt*
ComCarDiv 1
ComCarDiv 2
ComCarDiv 3
ComCarDiv 7

Tech. Tra. Comds.

CNATECHTRA
CONAMTRAGRU
CONTTCMemphis
CONTCC Jacksonville

OTHER

DepComFairWestPac
NWEF
6400 Test Sq. (USAF)
FMSAEG
VF101
VC5
VC8

*Visit to Sixth Fleet by Special NAVAIRSYSCOM/Industry/AirLant Team Reporting to Review Director.

ENCLOSURE (2)

UNCLASSIFIED

REPORT

OF THE

AIR-TO-AIR MISSILE SYSTEM

CAPABILITY REVIEW (U)

JULY–NOVEMBER 1968

SECTION IV

NAVAL AIR SYSTEMS COMMAND

UNCLASSIFIED

SECTION IV - SUMMARY REPORT

A. General Findings

There is always a hope, in undertaking a review of this nature, that there will be uncovered a few major discrepancies so crucial to systems performance that there is little question that corrective action will achieve, at once, a readily measurable, quantum improvement in performance and capabilities. Such was not to be the case, however, and as the review proceeded, it became clear that the road to improvement lay through a virtual jungle of problems: some readily and easily solvable; others requiring more funds, more time, greater effort and sustained perseverance and follow-through.

In sub-paragraph B, which follows, conclusions and recommendations are sub-divided into major functional categories. As a preface to that presentation, the following overview of the findings in each of the areas of review activity should provide a better appreciation of the magnitude and scope of the coordinated program which the Navy must prosecute if desired improvements in current combat capabilities of air-to-air missile systems are to be realized:

1. Industry

One of the basic tenets of present day contracting philosophy is that "fixed price" types of development contracts result in savings to the Government as compared to "cost plus" types. Despite bonus and penalty clauses, and other contractual provisions, history shows that a development program generally costs the Government whatever the costs actually are: if not in dollars (as is usually the case), then in time, or in the quality of the final product. Since analyses are seldom made of the additional fiscal outlay required of the Government to correct the maintainability and reliability problems created by a fixed price development effort, the fixed price contract retains its preferred status. Unquestionably, contracting philosophy is a prime factor in the present performance of the Navy's air-to-air missiles and their associated aircraft missile control systems.

While protection of his reputation is a prime motivation for a responsible contractor, his stock holders insist that he hew a line which provides an acceptable (but not an exceptional) design and, during the production process, holds expenditures on quality control/assurance to a nominal minimum required to 'sell' the product to the Government representative at the plant. Thus, the Government, in the interplay of profit incentives versus high integrity image, gets usually only what it is able to specify in detail and fund adequately. By and large, industry will produce as 'high' a "high quality product" as is requested and funded. The Navy must be more specific, however, in defining systems performance requirements and in stating quality requirements, not quality goals.

Better air-to-air missile systems can and should be produced by industry with added attention to the following areas which are addressed, in depth, in the Appendices to this report; notably, Appendix I:

a. Program Management
b. Quality Assurance/Control
c. Contractor/Government Representative Interfaces
d. Reliability Programs
e. Environmental Test Plans
f. Production Monitoring Tests
g. Second Source Considerations
h. Program Change Control Response and Actions

2. Fleet Support Organizations

Primary among those activities scrutinized in the Fleet support area were the Naval Weapons Stations which process and handle air-to-air missiles: NWS's Concord, Fallbrook, Yorktown, and the Naval Magazine, Subic Bay, R.P. The role of the ammunition ships (AE's and AOE's), while an important one, has very little (if any) influence on weapons system performance since the functions involved are almost exclusively passive in nature (i.e. transshipment, dead storage, and transfer). About 40 discrepancies were identified in the following major categories:

a. Management - The organization of the Navy Material Command with the consequent dissolution of the Bureau of Naval Weapons created several interface problems between the Naval Air Systems Command and the Naval Ordnance Systems Command - all of which have not yet been resolved. Air-to-air missiles are being handled and processed in the Naval Weapons Stations in accordance with a combination of NAVAIR and NAVORD directives which need to be reduced to a common baseline.

b. Maintenance - Air-to-air missiles are unique in the air-launched missile family in that they are subject to repetitive cycling through the carrier deck/forward area runway. There is a need to establish a three-level maintenance system for missiles quite similar to that employed for aircraft in order to reduce the size of the missile pipeline (now about 31% of the AIM-7 inventory), to improve on a "mean down time" (ranging from 270-296 days for an AIM-7 guidance and control unit returned to CONUS for repair), and to improve overall missile reliability.

c. Surveillance - A key element of any program to improve missile reliability is a surveillance program to maintain a current assessment of the missile inventory and to identify and isolate problem areas. A satisfactory program does not exist, ostensibly because of the lack of a justified urgency to date and a lack of funds.

d. General Logistic Support - Numerous problems exist with publications, test equipment, missile containers, personnel training, and other

support elements generally associated with missile logistics. These are addressed in detail in Appendix II.

3. Squadron/Shipboard Performance

This has been the most commonly examined element of air-to-air missile system performance in Navy reviews conducted since April 1965. Analyses of combat encounters in Southeast Asia clearly establish SPARROW performance as the primary problem. For that reason, this review devoted major energies to that system. Despite its superior combat performance, however, problems with SIDEWINDER do, of course, exist as exemplified by the current AIM-9D breakup problem. SIDEWINDER, therefore, received its fair share of attention.

The key functions involved in this area are: storage, test, maintenance, repair, assembly, handling and loading. Problems discussed in detail in Appendix III and elsewhere in this report cover the following eight major areas:

a. Manning and Training - The manning and performance of the Attack Carriers (CVA's) missile shops, and maintenance and loading crews suffer from the overall shortage of suitably qualified and rated enlisted personnel. While the experience level in air-to-air missilery is the highest it has ever been, formal missile system training is still largely a 'bootstrap' operation in many areas. The Review Team concludes that an overhaul of training policies and methodologies is required in order to distinguish between 'training' and 'education' and to exploit more fully the potential and utility of today's Recruit, who is the best in naval history.

b. Documentation - The complexity of current equipment, such as the AN/AWG-10 missile control system in the F4J, and the number and complexity of support equipments required to maintain them, present major (as yet unresolved) problems in the currency, adequacy, accuracy, presentation, and acceptability of technical information for maintenance and operations. Ingenuity and innovation must be the themes for urgent actions in this crucial area.

c. Inspections - Among the other actions considered, a more formalized inspection system for deploying CVA's and fighter squadrons, with a fully articulated plan for subsequent follow-up, is offered as one of the more important recommendations of the Review Team.

d. Test Philosophy - Lack of user confidence in overall system reliability dictates present shipboard test philosophy for the elements of the air-to-air missile system. Real relief will come only through better demonstrated reliability which, in turn, is dependent upon the quality control, maintenance, and surveillance programs recommended elsewhere herein.

e. Safety - Safety requirements are frequently in conflict with operational requirements, if not contradictory and confusing per se. The necessity for sound direction in this area fully justifies the conduct of a complete Air-to-Air Missile Safety Review along the lines of those heretofore confined mostly to nuclear weaponry.

f. Logistic Support - Numerous "horse shoe and nail" problems exist in this area and are discussed in depth later herein.

g. Support Equipment - The need for better planning and direction of the development, procurement, training, and maintenance effort for support equipment has long been admitted. As in numerous other areas, low funding priorities have impeded progress to date.

h. Policy - Among the key policy changes needed is one which emphasizes the maintainability and reliability of missile systems, possibly even at the occasional expense of 'nice to have' performance improvements. It is relevant to note that, despite continuing emphasis on performance improvements to the semi-active radar missile system over the years, overall system reliability has remained relatively constant at an unacceptably low level.

4. Airborne Performance

Analysis of airborne performance viewed the missile system at three principal stages along its logistics and operational flow. For the SPARROW system a typical presentation of performance data is as follows:

	New[1] Production	Fleet[2] CONUS	Combat[3]
I AMCS	.87	.57	Cannot distinguish missile failure from AMCS failure.
II Missile	.82	.65	
III (I X II) (Product)	.72	.37	.34
IV Misfire	.98	.87	.75
V Aircrew	.99	.96	.68
VI Fuzing	.81	.73	.74
Total	.57	.23	.13

[1] PMT data from NAVMISCEN
[2] SPARROW shoot data from FMSAEG
[3] "Red Baron" data augmented with last Navy firings.

Such analyses are important in a resource-limited world since they help in isolating those areas where the investment of funds and effort will most importantly influence performance improvements. From the above, three areas susceptible to early attack emerge at once:

a. Missile control system maintenance and reliability.
b. Aircrew performance in combat.
c. SPARROW motor fire.

As a corollary consideration, missile guidance and fuzing reliability improvements are indicated, provided they can be achieved by reliability improvements (in preference to design changes) in a missile out of production (AIM-7E) or approaching the end of production (AIM-7E2). This is not to say that missile guidance and fuzing improvements are not needed. It is submitted, however, that other actions may result in earlier and more significant performance gains.

With the foregoing in mind, the following avenues to performance, maintainability, and reliability improvements were explored:

a. Training and Readiness - A key issue in this area is the commitment of fighter squadrons to air-to-ground missions in Southeast Asia and the consequent dilution of air-to-air training and readiness. Of near equal importance is the availability of training facilities and training assets. Past major reliance on R&D ranges for missile training exercises has exacted its toll no less than the unavailability of missile training allowances and suitable airborne targets. Realization of improved aircrew performance should be possible through increased missile and target allowances, better range facilities, more realistic air combat maneuvering training, a concentrated effort on aircraft missile system qualification (as well as aircrew firing qualification), and improved tactics and doctrine. All are discussed in Appendix IV.

b. Missile Envelopes - Numerous missiles fired in combat have missed because they were fired out of envelope at low altitude against a relatively small maneuvering target by a U.S. fighter aircraft with a missile control system computer mechanized for a high altitude, non-maneuvering bomber. Considerable progress has been made in defining missile envelopes for the environment typical of a Southeast Asia fighter-vs.-fighter encounter. More needs to be done.

c. Human Engineering - By and large, U.S. fighter pilots have been required to fight a "heads-up" engagement in Southeast Asia with a "heads-down" system. This is, of course, particularly true for the F4. Cockpit rearrangement, coupled with added provisions for missile envelope identification at low altitude, are either under actual evaluation or are being considered.

d. Performance Evaluation - Accurate evaluation of missile firing results is crucial to training progress and systems performance improvement actions. Improvements in present data collection techniques is urgently required. Telemetry for all firings - training and combat - is, as yet, a largely unexploited tool in the Navy.

e. Design - Obviously, some balance must be struck between those design improvements essential to performance requirements and those affecting maintainability and reliability. Because of the critical import of configuration across-the-board, the Review Team feels that configuration freezes must be instituted as early as practicable. Appendix IV contains configuration freeze recommendations for the AERO 1A, AWG-10, AIM 7E/E2, and the AIM 9B/C/D. The specific primary goal is improved reliability at the expense, if necessary, of other than absolutely essential performance improvements. Obviously, such important corollary benefits as up-to-date documentation, better training, standardized maintenance and rework procedures, and stabilized tactical doctrine will accrue as natural by-products.

5. Rework Program

Naval Air Rework Facilities (NARF's) turn out a product (aircraft, missile control system, launcher, and missile) that compares favorably with the new product from industry. Both, however, require improvement. There is little question that the reworked product could be improved by the simple application of additional funds in this area. For example, items (e.g. electrical wiring) frequently found defective in Fleet aircraft after rework are often treated on an "inspect; repair as necessary" basis due mainly to lack of funds for a full rework program. Similarly, the 'rework' program for SPARROW and SIDEWINDER is not a true rework program (where configuration is fully updated and missile components are systematically replaced), but is largely a repair program. Until July 1968 the AERO 1A missile control system in the F4B was not being reworked at all; yet analysis has repeatedly identified the missile control system as the key performer in a SPARROW shoot. Every element of the missile system has been (or will go) through the rework process. The quality of that process is vitally important.

The review of the rework effort, reported in Appendix V, disclosed 23 specific areas where important improvements can be made, not only in the rework process, but in all aspects of developing, purchasing, employing, and maintaining the Navy's air-to-air missile systems. Action categories include:

a. Improved management and supervision.

b. Performance of the vitally important in-service engineering function by qualified field activities.

c. A formal rework cycle for all elements of the missile system, including special support equipment and ground support equipment.

d. Formal rework plans, validated by a joint Industry-Navy team, and followed-up by periodic audits of the rework process.

e. A product evaluation program to regularly and routinely measure quality of the reworked product.

6. Overview

In summary, it must be emphasized that the actions recommended in this report will improve the capabilities and performance of the Navy's present air-to-air missile systems. They will not, however, provide a true "dog fight" missile capability because of basic design limitations in the systems themselves. True "dog fight" capability will require a new missile development. In the interim, the Navy can more fully exploit the design capabilities of its present systems by upgrading their reliability, by better maintenance practices, and by improved training methods.

B. Major Conclusions and Recommendations

1. Policy

a. Conclusions

(1) Short turnaround times in CONUS and late acquisition of deployable assets by fighter squadrons have adversely affected the depth and quality of training and the material readiness of deploying units. The commitment of fighter squadrons to a dual, air-to-air and air-to-ground role further complicates the problem and dilutes air-to-air training and readiness.

(2) An aircraft availability philosophy for the F-4 similar to that normally found in the Fleet for the A-6 (viz., an "up" aircraft requires an "up" weapon control system) would effectuate an important gain in material readiness and combat capabilities.

(3) If the Stockpile-to-Target Sequence (STS) procedures (NAVY SWOP 50-20) were followed from the initial design through production of air-to-air missiles, many Fleet problems encountered in this review would not occur.

b. Recommendations

(1) CNO, Fleet, and Task Force Commanders reexamine the necessity for the continuing commitment of fighter squadrons to air-to-ground missions in Southeast Asia in the light of the growing inventory of A-6 and A-7 attack aircraft with their greater load-carrying capacities.

(2) Type, Fleet, and Task Force Commanders iterate a policy for F-4 aircraft that stipulates a fully "up" missile control system as a requisite in a fully "up" aircraft. This should be done whether or not relief from air-to-ground commitments is accorded.

(3) CNO and Chief of Naval Material direct that the concept of Navy SWOP 50-20 be incorporated in all future planning and contractual phases for air-to-air missiles.

2. Management

a. Conclusions

(1) Air-to-air guided missiles, as well as all other aeronautical material, should be maintained using the same management techniques. Air-to-Air missiles are unique in the air-launched weapons family because of the requirement of repetitive cycling through the carrier deck. There should be defined, for air-to-air missiles, a three level maintenance system similar to that for aircraft.

(2) There is a need for better program direction and coordination of several elements of the air-to-air missile system capability, specifically:

(a) Overall direction in the Office of the Chief of Naval Operations.

(b) Performance of the in-service engineering function. Many of the recommendations of this report are solely and crucially dependent on proper performance of in-service engineering tasks.

(c) Program management by NAVAIRSYSCOM.

(d) NAVAIR/NAVORD Interface.

b. Recommendations

(1) The Commander, Naval Air Systems Command review, revise, and reissue BUWEPSINST 08810.1 of 14 June 1963 and NAVAIRINST 4700.2 to provide for a three level maintenance system for air-to-air missiles. Consideration should be given to reissuance of NAVAIRINST 4700.2 as an OPNAVINST entitled "Aeronautical Material Maintenance Manual," considering the applicability to all users of the air-to-air weapons system, Navy and Marine Corps.

(2) The Deputy Chief of Naval Operations (Air) select and designate a senior officer of the rank of Captain to serve as the program coordinator, in the Office of the Chief of Naval Operations, for the further development and implementation of all approved recommendations of this report.

(3) CNO examine the internal organization in OPNAV and make that realignment necessary to provide clearer lines of authority and the close coordination required if air-to-air missile capabilities are to receive the priority attention requisite to the realization of necessary improvement.

(4) The Commander, Naval Air Systems Command, define and delegate to appropriate field activities the in-service engineering authority and responsibility for the SPARROW and SIDEWINDER missiles and the AERO 1A and AWG-10 missile control systems. Both cognizant and participating field activities should be designated and tasked.

(5) The Commander, Naval Air Systems Command take appropriate action to augment, as necessary, those elements of the headquarters organization associated with management of the SPARROW and SIDEWINDER systems and to effect those minor organizational changes needed to provide better lines of authority and communication between the Program Managers and the NAVAIRSYSCOM functional organization.

(6) The Commanders, Naval Air Systems Command and Naval Ordnance Systems Command, respectively, effect the coordination necessary to provide improved management direction to the Naval Weapons Stations/Naval Ammunition Depots, Naval Magazines in the areas of Test, Maintenance, Repair, Handling, Transfer, Storage and Surveillance of air-to-air missiles.

3. Production

a. Conclusions

(1) Government requirements for Quality Control are normally expressed contractually in the application of MIL-Q-9858A, "Quality Program Requirements." This document is subject to broad interpretation: by industry as well as by government plant representatives. Quality of the product is normally directly proportional to the extent of industry's self-motivation and the degree of Government monitoring.

(2) High failure rates of electronic components in the AIM-7 and the AWG-10 indicate a requirement for renewed emphasis on reliability programs at both RAYTHEON and WESTINGHOUSE. Reliability and design margin studies originally planned for both these programs were seriously curtailed by limited funding. A Mean Time Before Failure (MTBF) of five to ten hours for the AWG-10 and the AIM-7E reliability in the Fleet are clearly indicative of designs that require additional attention to component selection, parts and sub-system burn-in, and design margin studies.

(3) Detailed environmental test plans are required for both the SPARROW and SIDEWINDER production processes at Raytheon and at NARF's Norfolk and Alameda in order to evaluate adequately the response of the design and work process to vibration, temperature, altitude, and other environmental conditions normal to service use.

(4) Production monitoring tests are not doing the job required due to lack of standardization, concentration on the missile (vice inclusion of the entire missile system), and test techniques and methodology which do not adequately simulate the 'real world' in which the system must perform in combat.

(5) A second procurement source for the SPARROW would be desirable, both from the standpoints of quality of a product produced in a competitive environment, and the strategic implications of the present concentration of the nation's air-to-air missile production at a single site. The projected buy of SPARROW's indicates that the cost of initiating a second source could be amortized.

(6) The six to eight months now required for Navy approval of an Engineering Change Proposal (ECP) from industry is inordinately long and can and should be improved.

b. Recommendations (All for action by the Commander, Naval Air Systems Command).

(1) Specify quality requirements, vice quality goals to industry including them, if necessary, as an element of contracts, subject to negotiation. Follow-up by insisting that government representatives at the plant concerned understand these requirements, have inspection programs to ensure their fulfillment, and are properly manned for the task. As a matter of priority examine specific direction now being provided to, and performance by, the DCASO representative at the Raytheon Lowell plant.

(2) Cause to be conducted, at the earliest practicable date, a quality control survey of the SPARROW production operation at Raytheon similar to (if not in greater depth than) that conducted for SIDEWINDER during the summer of 1968.

(3) Formulate and fund total reliability programs at both Raytheon and Westinghouse directed to component selection, sub-systems and systems burn-in, environmental tests, and design margin studies for the AIM-7F and AWG-10.

(4) Review and approve new Production Monitoring Test plans now being prepared by the Commander, Naval Missile Center, Pt. Mugu.

(5) Examine the practicability of establishment of a second procurement source for the AIM-7. An initial step - urgently needed for other reasons as well (e.g. NARF missile rework) - is procurement of a complete data package from Raytheon.

(6) Revise change control action procedures within NAVAIRSYSCOM to provide for change control meetings of all interested parties (NAVAIRSYSCOMHQ, industry (representing all elements of the total system),

NARF's, cognizant field stations), to prepare a coordinated ECP plan for the NAVAIR Change Control Board in order to expedite coordination and to ensure protection of the vital aircraft-missile control system-missile interfaces.

4. Performance vs. Design

a. Conclusions

(1) A primary reason for less-than-desired combat performance of air-to-air missile systems in Southeast Asia is their design optimization for a high altitude engagement against a non-maneuvering, large (bomber) target. Consequently, they exhibit important limitations in a low-altitude fighter-to-fighter engagement. "Dogfight" modifications to the SPARROW (AIM-7E2) and SIDEWINDER (AIM-9D), and the improved "dogfight" capability of the AIM-7F, will overcome some, but not all, of these and a true "dogfight" missile will require a new development program.

(2) Because of the complexity of the basic missile design and its close dependence on proper functioning of the aircraft's missile control system, the probability of a successful SPARROW shoot is lower than that for SIDEWINDER. This has been validated in both CONUS and combat firings. The inherently greater capabilities of the AIM-7 (viz. all-weather, all-aspect, greater range, larger warhead kill-radius) - but a significantly poorer (than the AIM-9D) combat performance - merit the highest priority attention to deficiency correction.

(3) An analysis of performance trends in successive 'looks' at the F4/SPARROW system - from Production Monitoring Tests of newly produced missiles to combat firings in Southeast Asia - reveals that the major degradations occur in the following areas:

(a) Missile control system performance

(b) Aircrew performance (procedural or tactical errors, out of envelope, etc.)

(c) Missile motor fire.

While there is some degradation in missile guidance and fuzing functions, this is indicative more of reliability problems associated with repetitive captive flights than of functional design deficiencies.

(4) Maintainability and reliability of the various elements of the total system appear to be greater contributors to inferior combat performance than do design deficiencies. There is a need to freeze, at the earliest practicable date, the design configurations of the various elements of the system (viz. missile control system, missile, and launcher) in order to concentrate on reliability improvements and on maintenance practices and procedures.

(5) A number of performance and engineering changes are still required in both the AERO 1A (F-4B) and AWG-10 (F-4J) missile control systems. Primarily these involve pilot-lock-on-mode, AIM7-E2 compatibility, and SIDEWINDER Expanded Acquisition Mode (SEAM) changes in both, plus solution of the cooling problem and AIM-7F and APX76/ALQ-91 compatibility changes in the AWG-10. It does not appear cost-effective at this time to modify the APA-157 in the AERO-1A/F4B to accommodate the AIM-7F; however, CNO review and decision is needed.

(6) Full AIM-9D (SEAM) compatibility in both the F8 and F4 will materially improve "dogfight" capability and should be expedited.

(7) Electromagnetic compatibility questions exist and require further investigation and attention. The most important of these are:

(a) F4B/F4J/SHOEHORN electrical and mechanical interface compatibility and (b) mutual aircraft radar interference with AIM-7 guidance/fuzing functions by radar klystrons in different aircraft in the same flight. The latter was highlighted in the USAF's final report on 'SPARROW SHOOT' in 1967 and has been a continuing problem with the AWG-10.

(8) There is an urgent need for better missile launch zone indications in the F4 cockpit. The present analog computers in the AERO 1A and AWG-10 cannot be properly mechanized for this task.

(9) More data are required on maximum and minimum range envelopes for the AIM-7F/E2 and the AIM-9D, for both maneuvering and non-maneuvering targets, to present a complete spectrum of launch range parameters at launch altitudes from sea-level to 45,000 feet at 5000 foot intervals.

(10) Fighter pilots, particularly those flying the F4, have been forced to fight in Southeast Asia in a "heads-up" environment with "heads-down" cockpit displays. An attack is needed on human engineering problems in both the F4 and F8 fighter aircraft.

(11) Continuing effort is needed to reduce the 'commit' time for the SPARROW missile from its present value of about 5.2 seconds (3.8 seconds radar settling and missile control system/missile interface functions plus 1.4 seconds launch delay from trigger squeeze).

(12) The complexity and unreliability resulting from the adaptation of a rail-launched missile (AIM-7) to an ejection launcher is the primary contributor to the 25% misfire rate experienced in combat firings. A solution for the poor motor fire record of the SPARROW is urgently required.

(13) In addition (or pending solution) to the above, all AIM-7E's will be updated to the AIM-7E2 configuration by the Naval Air Rework

Facilities commencing in April 1969. Three or four additional minor modifications (of a maintainability/reliability nature) are required before the AIM-7E2 configuration can be frozen. The AIM-7E to AIM-7E2 kit procurement schedule should be augmented to permit an increase in the AIM-7E to AIM-7E2 conversion rate. Some savings might be realized by not converting to AIM-7E2's those AIM-7E's diverted to training firings.

(14) Progress with the AIM-7F in seven contractor development flights at the Naval Missile Center, Pt. Mugu, to date indicates several design deficiencies requiring correction before release to production. The AIM-7F represents, however, an important addition to the SPARROW inventory on the basis of performance, maintainability, and reliability. A delay in the production schedule will be required in order to ensure that the AIM-7F will meet required performance and other goals.

(15) The SIDEWINDER (AIM-9D) is experiencing breakup problems in the Fleet. Action now underway to solve this problem appears adequate and of a sufficiently high priority.

(16) The AIM-9D (SEAM) design should be frozen upon completion of the "SKAMP" fuze development and the addition of the Mk 12 alternate canards, both about mid-1969.

(17) The proposed next generation, solid state SIDEWINDER is needed in the Fleet inventory, primarily on the basis of increased reliability. Warhead growth potential is a secondary, albeit important, consideration.

(18) The AIM-9C (SARAH) is providing only marginal Fleet capability at present because of performance limitations at altitudes below 10,000 feet, lack of user confidence and interest, and deteriorating logistic support. A decision on the continuing need for the AIM-9C is required.

(19) The AIM-7C and AIM-7D are both inferior performers to their successors and are not desired for combat by either the Navy or the Air Force. Launch capabilities for the AIM-7C are disappearing since Fleet squadrons have been authorized to remove the wing firing circuit required for the AIM-7C. A decision on the disposition of the AIM-7C and AIM-7D is needed.

b. Recommendations

(1) CNO and the Naval Material Command assign priority to those programs and efforts which will exploit fully the following avenues to improvement in the present air-to-air missile system capabilities and performance:

(a) Missile control system performance

(b) Aircrew training

(c) AIM-7E/E2 motor fire

(d) Concentration on reliability/maintainability improvements (vice performance improvements) in the AIM-7 and AIM-9 missiles and the AERO 1A and AWG-10 missile control systems.

(2) CNO and COMNAVAIRSYSCOM determine the point at which the configuration/design for the AERO 1A and AWG-10 can be frozen and implement the corresponding program actions.

(3) COMNAVAIRSYSCOM and COMNAVAIRPAC support the completion of the F4B/F4J/SHOEHORN compatibility investigations at NAVMISCEN, Pt. Mugu.

(4) COMNAVAIRSYSCOM expedite the inclusion of AIM-9D (SEAM) provisions in both the F8 and F4.

(5) Fleet and Type Commanders verify current doctrine and procedures for assuring that fighter tactical formations do not include two or more aircraft with CW transmitters separated by less than one megacycle or otherwise within certain frequency increments which can cause premature AIM-7 fuzing or erroneous missile guidance signals.

(6) CNO, COMNAVAIRSYSCOM and COMOPTEVFOR press to early conclusion the "heads up" range meter evaluation in VX-4 and install such a meter, complemented, possibly, by an "in-envelope" indicator, in all F4 & F8 aircraft.

(7) COMNAVAIRSYSCOM fund the NAVMISCEN, Pt. Mugu, Raytheon, and NWC China Lake to produce complete performance envelopes for the AIM-7E and AIM-9D missiles.

(8) COMNAVAIRSYSCOM review the recommendations of the Review Team for "heads up" cockpit displays for the F4 and F8 and implement as early as practicable.

(9) COMNAVAIRSYSCOM, in concert with the three principal contractors involved, prosecute a vigorous program to reduce the 'commit' time for the AIM-7 and to provide for motor fire through the umbilical.

(10) CNO and COMNAVAIRSYSCOM review the projected AIM-7E-to-AIM-7E2 conversion schedule and adjust kit procurements and NARF plans as required.

(11) CNO, Chief NAVMAT, and COMNAVAIRSYSCOM delay the AIM-7F production until assured that AIM-7F performance is satisfactory. Make any contractual adjustments or take such other actions as required to complete the necessary R&D. Substitute a buy of AIM-7E2's on at least a one-for-one basis until the AIM-7F is ready.

(12) COMNAVAIRSYSCOM and NWC China Lake prosecute to early conclusion the investigation of the AIM-9D break-up problem.

(13) CNO strongly support the solid-state SIDEWINDER development.

(14) CNO reexamine the requirement for the AIM-9C and either provide necessary support or drop from the inventory.

(15) CNO make an early determination on the disposition of the AIM-7C's and AIM-7D's still in the inventory. Expenditure for training, only, is recommended.

(16) CNO and COMNAVAIRSYSCOM press forward with the development of a digital computer for the AWG-10 in order to provide better missile envelope indications in the F4J, facilitate training for dual mission commitments, and provide a wide range of technical and tactical flexibility impossible in the present analog systems.

(17) COMNAVAIRSYSCOM continue exploratory and advanced development programs directed to the evolution of a new design "dogfight" missile. The USAF's efforts in this area should be closely monitored.

5. Maintenance and Test

a. Conclusions

(1) Analysis of SPARROW system performance from CONUS to combat clearly shows that performance of the missile control system is one of the primary items to be upgraded if combat performance is to be improved. The earliest, most significant gains in missile control system performance - and, hence, in overall system performance - can be realized through intensive attention to missile control system maintenance policies, procedures, and practices.

(2) Although the AWG-10 is designed specifically to permit fault detection and isolation by Built-in-Tests (BIT), a study at NAS Miramar (home port for Pacific Fleet fighter squadrons) showed that only 20% of maintenance actions were initiated by BIT actions. Further, BIT was successful in isolating the fault to a removable assembly only 18% of the time. Experience in the USS AMERICA (CVA-66), the first carrier to deploy to Southeast Asia with the AWG-10, indicated good performance with the performance verification portion of the "N" profile 1.5 tape but unreliability in the fault isolation portion, resulting in use only about 10% of the time and troubleshooting by trial and error. Since about half of a squadron's active maintenance time on the missile control system is spent in fault verification and isolation, improvement in BIT performance obviously would result in both time and manpower efficiencies, as well as maintenance improvements.

(3) Publications for both organizational and intermediate level maintenance of the AWG-10 need a complete overhaul, both with respect to accuracy of content and style of presentation of maintenance data.

(4) The test equipment supplied to check missile functions at the umbilical of the F4J aircraft (AWM-22) is not satisfactory. An existing MSTS (Missile Station Test Set) has been satisfactorily used with the F4B; however, modification is required to effect compatibility with the AIM-7E2. A design of a prototype modified MSTS has been submitted by NAVMISCEN Pt. Mugu to NARF North Island. MSTS's for F4J's are urgently needed.

(5) Organizational maintenance level CW illumination test equipment is required for the AWG-10. A Radio Frequency Noise Analyzer (RFNA) is not presently being used for such tests since available equipment is too large for CVA use and calibration and operational procedures for RFNA tests are out of date. RFNA tests are important to missile control system performance.

(6) The F4/AERO 7A ejection launcher dynamic test (pit check) is not adequately supported by funding, manpower, or logistics. There are no publications containing complete operating and maintenance instructions. Existing installations are not adequate to support Fleet requirements. Pit checks are essential to verification of the F4/AIM 7 launch capability.

(7) Present policy for AIM 7 shipboard test requires download and test after 10 and 20 captive flights and return to a NAVWEPSTA for check after 30 captive flights. Missile testing does not increase missile free flight reliability but, rather, merely helps screen out missiles failing during operations. Problems with SPARROW system performance stem from two sources: 1) reliability of the basic design of the missile's guidance and control section and 2) a requisite interface with unreliable subsystems (e.g. AERO 1A/AWG-10 and missile motor fire). There is no clear evidence, in comparing USAF and Navy combat performance in Southeast Asia, that missile test philosophy materially affects combat performance.

(8) SIDEWINDER is tested on board ship with a relatively uncomplicated portable tester every 100 hours of activated time, or approximately every 50 captive flights. Once loaded on the aircraft, a preflight check is made by illuminating the seeker with a flashlight and verifying the presence of an audio signal. Verification of audio during preflight or in flight constitutes a limited missile-on-aircraft test (MOAT). SIDEWINDER's performance is superior to SPARROW's because of a less complex design, better inherent design reliability, and lesser impact of subsystems (e.g. missile control system) interfaces.

(9) Limited controlled shipboard experiments with a "no test" philosophy for the AIM-7E have been evaluated to date. Data are inconclusive and should be expanded in order to determine the validity of this

concept. This is crucial to the planned implementation of the "all-up-round" concept.

(10) Several anomolies occur in the day to day operation of the DPM-7 (depot) and DSM-32 and DPM-14 (shipboard) testers for the AIM-7 in that test results do not always correlate. A formal Tester Correlation Study is needed to validate the comparative performance of these three testers and to evaluate the relative reliability and dependability of the DSM-32 and DPM-14 as shipboard test tools. A final decision on SPARROW shipboard test philosophy and test equipment requirements should be based on the results of this study and an in-depth investigation of the 'no test' philosophy (above).

(11) Uniform calibration criteria and standards for SPARROW test equipment are required. Further, the frequency and responsibility for periodic calibration and maintenance of missile test equipment should be specified.

(12) A configuration control system for air-to-air missile test equipment is needed. Responsibility assignment should include that for change kit management to ensure continuing tester compatibility and standardization.

(13) To improve reliability, a 100% quality assurance inspection should be made of any element of an air-to-air guided missile system worked either at the Depot or Intermediate maintenance levels.

(14) Finally, not enough can be said about the critical impact of parts support for the missile control system, the missiles, and the several test equipments. Better supply support for the AWG-10 is crucial to the improvement of air-to-air missile system capabilities. Continued expansion of AWG-10 capabilities to an ever-increasing list of sites and operational units must be tempered with a realistic look at the support capability. This has not always been the case to date.

b. Recommendations

(1) COMNAVAIRLANT/COMNAVAIRPAC examine missile control system maintenance policies, procedures, and practices and request all authority and assistance necessary to improve daily readiness posture in this critical element of the air-to-air missile system.

(2) COMNAVAIRSYSCOM task the Naval Air Development Center, Naval Air Engineering Center, and/or the Naval Missile Center to provide a continuing review, updating, and improvement of BIT/FIT hardware and software for the AWG-10. This function could be implicit in the delegation of the in-service engineering task discussed elsewhere herein.

(3) COMNAVAIRSYSCOM initiate a priority program to update and overhaul the present system of presentation of technical information for maintenance of the AWG-10 system.

(4) COMNAVAIRSYSCOM provide, as early as practicable, a suitable Missile Station Test Set (MSTS) to Fleet F4J squadrons. COMNAVAIRSYSCOM determine the relative utility and validity of MSTS and AWM-22 checks for daily/pre-flight checks and periodic (calendar) checks and issue instructions accordingly.

(5) COMNAVAIRSYSCOM address, as a matter of priority, the development and procurement of a carrier-suitable Radio Frequency Noise Analyzer for the AWG-10.

(6) COMNAVAIRSYSCOM provide funds and program direction to support the existing instrumentation packages for F4 pit checks, to develop a data package for an advanced standard pit instrumentation package, and for appropriate documentation. COMNAVAIRSYSCOM and COMNAVAIRLANT/PAC should recognize pit checks as a formal requirement for assurance of F4 missile fire control readiness and document and support accordingly.

(7) Fleet continue shipboard testing of SIDEWINDER and SPARROW missiles as at present except where specific exceptions have been granted or directed (e.g. USS KENNEDY, USS SARATOGA).

(8) COMNAVAIRSYSCOM reexamine the requirement to return AIM-7's to a NAVWEPSTA after every 30 captive flights and, in the interest of logistics simplification/economies, revise the AIM-7 test philosophy to provide for shipboard test every 10 flights and return to a NARF after 60 captive flights, unless failed earlier.

(9) COMNAVAIRSYSCOM direct the NAVMISCEN Pt. Mugu to conduct an in-depth AIM-7 Tester Correlation Study, building on the tester coordination studies conducted in 1968 by NARF's Norfolk and Alameda.

(10) COMNAVAIRSYSCOM establish procedures and define responsibilities for missile tester calibration and for tester configuration control and standardization.

(11) COMNAVAIRSYSCOM and COMNAVAIRLANT/PAC direct a 100% QA inspection of all elements of air-to-air missile systems worked at the Depot or Intermediate maintenance levels.

(12) COMNAVAIRPAC/LANT, CTF 77, and COMFAIRWESTPAC investigate the need for a specialized maintenance team (Navy/Industry) at NAS Cubi Pt. to assist fighter squadrons in 'peaking' missile fire control systems on a systematic rotation basis from Yankee Station and during in-port periods.

(13) CNO and the Chief of Naval Material require that on future air-to-air missile systems, missile-on-aircraft (MOAT) provisions be included in order to validate total system readiness prior to launch and, to the extent possible, during flight.

(14) CNO, COMNAVAIRSYSCOM, and Fleet and Type Commanders re-examine AWG-10 outfitting plans and schedules to ensure their compatibility with the ability to support logistically this key element of the Navy's air-to-air missile capability.

6. Aircrew Training

a. Conclusions

(1) Despite a renewed emphasis on air combat maneuvering (ACM) training since the commencement of hostilities in Southeast Asia much of this effort has been wasted because it did not stress one of the key elements of the problem: missile envelope recognition/identification at low altitude. Since the missile control system computers are not properly mechanized for a low-altitude maneuvering target, firing envelope recognition is largely by "eyeball and intuition." ACM exercises conducted on an instrumented range at NavMisCen, Pt. Mugu by experienced fighter pilots in VX-4 revealed that about half of the simulated missile shots were being made 'out of envelope.' ACM practice on an instrumented range can materially improve performance. Both CinCLantFlt and CinCPacFlt strongly concur.

(2) Training missile allowances, both live and dummy, have heretofore been well below those required for pilot checkout, training, and proficiency maintenance. Actual missile firings, both in CONUS and while deployed, are required if adequate aircrew performance is to be attained and sustained.

(3) Of importance equal to aircrew qualification is fighter weapon system verification by actual missile firings. This has been proved conclusively by the USAF's 'Combat Sage' program in Southeast Asia. There have been repeated cases where Navy squadrons have deployed with aircraft on board that have not fired a missile.

(4) Since decommissioning of the Fleet Air Gunnery Unit (FAGU) in 1960 there has been a gradual loss of expertise and continuity in the field of fighter weaponery. This trend must be reversed by providing a means of consolidating, coordinating, and promulgating the doctrine, lore, tactics, and procedures for fighter employment. The present Replacement Carrier Air Wings (RCVW's) provide a logical base to reinstitute elements of the FAGU concept.

(5) Non-standardization in fighter training requirements exists between the Atlantic and Pacific Fleets. The need for standardization for Fleet units deploying concommitantly to Southeast Asia is evident.

(6) Numerous improvements are needed in target drone capabilities including: airborne launch aircraft, out-of-sight control and telemetry, visual augmentation, and drone recovery vehicles.

(7) Several possibilities exist to provide an in-flight simulator/evaluator/recorder for the F4 which would serve as an excellent forward area training aid as well as an effective shipboard maintenance tool. Such an equipment, in concert with a forward area missile firing program, would offer important training and readiness gains.

(8) Better training aids (movies, sound/slide programs etc.) are needed for aircrew basic training and refresher efforts.

b. Recommendations

(1) CNO, CHNAVMAT, COMNAVAIRSYSCOM, COMNAVAIRLANT/PAC, and other cognizant commands establish, on each coast, CONUS, an instrumented Air Combat Maneuvering Range (ACMR) within reasonable range of fighter bases and not as a part of any present R&D range complex. Technical plans and cost estimates for the ACMR are available in Applied Physics Laboratory/Johns Hopkins University Report MS-102 of 15 November 1968 prepared jointly by APL/JHU and ComOpTevFor.

(2) Type, Fleet, and Task Force Commanders prosecute missile firing programs at the Atlantic Weapons Range, Pacific Missile Range, Okinawa, Poro Pt. R.P., and in the USAF's Wheelus Complex.

(3) CNO prescribe standards for fighter weapon system qualification/verification. As a minimum, each F4/F8 should be fired once annually for system verification and anytime thereafter when systems maintenance indicates a need for re-verification. Preferably, each fighter system should be verified upon arrival in the Sixth and/or Seventh Fleets and once thereafter during the deployment. A forward-area missile fire control maintenance-assist team (mentioned in paragraph 5 (above)) would be pertinent to this program.

(4) Type, Fleet, and Task Force Commanders establish procedures to ensure the missile firing qualifications of aircraft as well as aircrews.

(5) FMSAEG and Type Commanders review procedures for CONUS training firing data collection and processing and performance evaluation in order to provide an analytical approach to training methods, isolate and evaluate sub-system performance, and to assist in aircrew/aircraft qualification records management.

(6) FMSAEG institute a special analytical program for forward area firings in order to provide specific assessments of progress with (and value of) this program.

(7) CNO revise the Non-Nuclear Ordnance Requirements (NNOR) Manual to provide F4 pilots with one each AIM-7 and AIM-9 per pilot during RCVW training and two each AIM-7 and AIM-9 per pilot per year in fleet squadrons thereafter. F8 pilots should receive one AIM-9 in the RCVW and two per year in fleet squadrons thereafter. This allowance should be exclusive of specific allowances for ORE's, ORI's and air demonstrations.

(8) To optimize the utilization of assets, priority should be given to the expenditure of AIM-9B's, AIM-7C's, and AIM-7D's for training. AIM-9D's and AIM-7E's should be expended only where clearly justified for training benefit (e.g. AIM-7E against a BQM-34 (IMK)). AIM-7E2's should not be expended in training until the assets position materially improves.

(9) Dummy warheads and telemetry packs should be provided on a one-for-one basis for each live training missile. (Warhead firings destroy drones. 'Eyeball' evaluations of other than direct hits are of dubious value for training performance analysis.)

(10) CNO approve and ComNavAirSysCom provide four inert AIM-9D's for each Fleet fighter squadron and 18 for each RCVW fighter squadron for captive missile flight training.

(11) CNO and ComNavAirPac establish, as early as possible, an Advanced Fighter Weapons School in RCVW-12 at NAS Miramar for both the F8 and the F4. Concept and plans for this school have already been formulated by ComRCVW 12 and ComFairMiramar. After operation through a suitable trial period, evaluate its worth and expand within RCVW-12 or extend to RCVW4 as indicated.

(12) ComNavAirLant/Pac standardize Training and Readiness Manuals for fighters.

(13) CNO, CHNAVMAT, COMNAVAIRSYSCOM take necessary action to improve target drone capabilities by:

(a) Prosecuting procurement of DC-130's to at least a total of five.

(b) Providing better visual augmentation for the BQM-34 to enhance the safety factors during a maneuvering target exercise.

(c) Procuring and deploying drone recovery vehicles with capabilities sufficiently improved over the marginally-capable H-34's normally used at present.

(14) COMNAVAIRSYSCOM direct and fund NAVMISCEN Pt. Mugu and NAVAIRDEVCEN Johnsville to conduct an evaluation of the AWM-19, ACEARTS, and MATE II simulator/evaluators/recorders now available and recommend a suitable equipment configuration/design for these purposes.

(15) CNO, COMNAVAIRSYSCOM, TYCOMS, and COMOPTEVFOR investigate the availability and adequacy of present visual-aids training aids for fighter aircrews and produce and procure movies and slide-tape series on the AIM-7 and AIM-9 systems. (As a result of this review considerable progress has already been made in this area.)

7. Personnel/Training (Other than Aircrews)

a. Conclusions

(1) Additional qualified enlisted personnel are required in CVA air-launched guided missile shops.

(2) An ordnance ground officer should be assigned to each fighter squadron to provide the important focus of attention to all of the squadron weapon functions and, in particular, the air-to-air missile capability.

(3) Existing schools for CVA guided missile officers and squadron ordnance officers are not adequate. A course is needed designed specifically to provide information on missile theory and operation, test equipment, handling and assembly, publications, and reporting requirements.

(4) Important deficiencies in training are created by the lack of suitably configured, up-to-date training equipments in the Naval Air Maintenance Training Detachments (NAMTRADETS) at the Naval Air Stations. The provision of up-to-date training equipment should be a first, vice a last, or next-to-last, priority item when any new equipment or modification to equipment is nearing Fleet introduction.

(5) The performance of shipboard missile assembly, handling, and loading crews suffers from lack of command emphasis on training as well as dilution of attention and lack of appreciation of the importance of proper missile assembly, loading and handling, caused by concurrent commitment to other ordnance operations. Missiles treated like bombs frequently perform like bombs. Also lacking is Type Commander direction on the numbers of enlisted personnel requiring specialized missile training and the type of training required.

(6) Up-to-date movies and slide-sound presentations are needed for enlisted training programs on the missiles and missile control systems. Because of the complexity of current systems and the trends toward hard-to-comprehend documentation, retrenchment along the lines of the old 'Dilbert' approach is indicated.

(7) There is a Navy-wide shortage of adequate numbers of rated enlisted personnel properly qualified in the several aspects of air-to-air missilery. Little relief is possible through further redistribution of the available rated personnel assets. The Navy can reasonably look to some

relief through its first term enlistment training program by overhauling that program to emphasize: training vice education, earlier exposure to 'hands on hardware' training, earlier contact with current Fleet equipment/ problems, and increased utility of the first term enlistee by limited closed loop detailing of those trained in air-to-air missilery. The Navy's air-to-air missile systems offer a sound and reasonable foundation for a test cell operation which later can be expanded to other aviation activities and the associated Group IX ratings.

b. Recommendations

(1) CNO and the NavPers establish the following enlisted personnel allowance for CVA Guided Missile shops:

1 - AQC or ATC (NEC-7916)
1 - AQ1 (NEC-7916)
1 - AQF2 (NEC 7916)
3 - AO1
5 - AO2
11 - AO3
20 - AOAN
42 - Total

NOTE: Where senior rated personnel are not available, maintain total at 42 by increase in designated striker personnel trained as indicated in subsequent recommendation in this section.

(2) CNO and ChNavPers increase the allowance of each VF squadron and assign one ordnance ground officer (commissioned or warrant) to each.

(3) ComNavAirSysCom/ComNavMisCen, Pt. Mugu or CNATECHTRA (as appropriate) establish a one-week course for squadron ordnance officers and a two week course for CVA G/M at the NAVMISCEN or at the NAMTRADETS at NAS Miramar and NAS Oceana, respectively. Course outlines are available in Appendix III to this report.

(4) ComNavAirSysCom and CNATECHTRA examine NAMTRADET requirements for air-to-air missile training equipment and procure. The results of a survey by the Review Team appears in Appendix III to this report.

(5) ComNavAirLant/Pac establish mandatory training requirements for CVA missile shop personnel and squadron loading team formation, training, qualification, procedures, and inspections and issue implementing instructions as required by OpNav Inst. 3571.3. Missile loading team courses should be established in the RCVW's; other courses in the NAMTRADET's. The Advanced Fighter Weapons School, assisted by VX-4 and NAVMISCEN, should ensure that missile handling and loading and unit inspection criteria are

complete, valid, and current. Each VF squadron should establish a 6-9 man loading crew with missile loading as a designated primary responsibility.

(6) CNO and COMNAVAIRSYSCOM investigate the adequacy and completeness of the 5F8 slide-sound program and update as necessary. Provide, also, an enlisted training film on the SPARROW and investigate the "Dilbert" approach to posters and other visual training aids. (As a result of the Review Team effort, considerable activity is already in evidence in these areas)

(7) CNO and CNATECHTRA investigate the feasibility and practicability of abbreviated "A" school training for AO's, AQ's, AE's, and AT's to be coordinated with follow-on, specialized training in the NAMTRADETS and RCVW's, to provide functionally qualified, first term enlisted personnel in the numbers required.

(8) CNO, ChNavPers, TYCOM's and C.O. EPDOPAC/LANT examine detailing procedures to provide that first term enlistees initially trained in air-to-air missilery are retained in that job capacity throughout their first enlistments.

8. Logistic Support

a. Conclusions

(1) The most serious logistic support problem at present is that of parts support for the AWG-10 discussed in sub-paragraph 5 (above). This is a critically inhibiting influence overall, but full impact has not yet been realized in Southeast Asia because only two ships (AMERICA and RANGER) and one Marine squadron have deployed to West Pac with the system. Forward area support problems will be successively aggravated, commencing with the deployment of ENTERPRISE (next scheduled) unless prompt, vigorous action is taken to improve the AWG-10 parts support situation.

(2) Due to lack of forward area support capability for the SPARROW missile, 270-296 days are required before a defective missile offloaded by a deployed CVA is again on hand in the RFI condition, in West Pac or in the Mediterranean. About 31% of the AIM 7E guidance and control units are in the pipeline at all times. The number of AIM 7E's in the pipeline can be reduced, overall missile availability increased, and certain economics realized by providing a forward area repair capability for the AIM 7E.

(3) Missile components such as wings, domes, fins, antennas, umbilical inserts, lower motor fire connectors, EPU chimneys, etc. are being successively degraded and surveyed due to handling damage or wear normal to the shipboard environment. Considerable improvement can be realized by better management and procurement practices for these "bits and

pieces" and periodic, compulsory inspection, cleaning, and/or repair by shore activities.

(4) Missile containers have long been a neglected item in the logistic support area. Poor environmental protection for missile components in transshipment results in a considerable number of unusable missile components in the forward area. A repair and refurbishment program for present containers is required as well as a new look at packaging and handling material and techniques.

(5) There is no adequate shipboard handling and loading equipment for the SPARROW missile. Missile ground handling equipment at Marine Corps and Naval Air Stations features many locally fabricated or modified equipments which subject missiles to damage and create safety hazards.

(6) Logistic support for the AIM 9C is steadily deteriorating. Deficiencies exist in: lack of formal maintenance or operational training in the NAMTRA DET's and RCVW's, shortages of trained enlisted personnel and aircrews, lack of current publications, and shortages of test equipment. Approximately $ 2 million would be required to overcome current logistic deficiencies. This should be provided in an orderly program to rejuvenate the logistic support for the F8/AIM 9C system or the weapon should be removed from the CVA's (27 C class) where it is now carried.

(7) Lack of adequate communications between Fleet users, CNO, and the Naval Material Command inhibits the timely identification and solution of logistic problems. There is no substitute for on-site surveys and periodic symposiums to effect the necessary information interchange. The semi-annual Fleet support symposium sponsored by NAVAIRSYSCOM (AIR-04) falls short of providing what is needed because of lack of attendance by decision-making management in the activities represented and lack of representation from OPNAV.

b. Recommendations

(1) CNO, COMNAVAIRSYSCOM, and COMNAVAIRLANT/PAC take an overall look at the AWG-10 system, ranging from emphasis to be accorded to the contractor reliability program (recommended elsewhere herein) to the specific details of bits and piece support. In the total scheme of future trends and needs, it appears that a re-evaluation of relative priorities of the constituents of future capabilities is required. Present plans for outfitting new operational units should be balanced against the realities of a solid maintenance, repair, rework, and logistic support capability. It could well be, for example, that an early, full rework capability at the NARF Cherry Pt. is essential to operational expansion beyond a certain point and that a priority adjustment to accommodate that end would materially improve readiness posture earlier than now anticipated.

(2) COMNAVAIRSYSCOM and COMNAVAIRPAC establish a repair capability at the Naval Magazine Subic Bay for the AIM 7E guidance and control section and rocket motor. Consideration should be given to reduction of the total inventory in order to provide the necessary parts/sub-system support for this repair effort. Concomitantly, COMNAVAIRSYSCOM should procure the additional AIM-7E2 and AIM 7F materials needed to sustain the forward area repair capability.

(3) COMNAVAIRLANT/PAC direct CVA/s when offloading, to include all missile components for return to shore activities for inspection, cleaning, and repair.

(4) COMNAVAIRSYSCOM institute a refurbishment and repair program for air-to-air guided missile 'miscellaneous components' (i.e. wings, fins, antennas, etc.) at the Naval Weapons Stations and at the NARF's. Such a program should include a realistic procurement program for replacement parts for present air-to-air missiles as well as for future missiles.

(5) COMNAVAIRSYSCOM institute a missile container repair and refurbishment program and issue appropriate directives to assure the availability of containers where/when needed.

(6) COMNAVAIRSYSCOM examine present air-to-air missile packaging procedures and provide interim fixes (e.g. 'barrier bags', etc.) as needed to improve environmental protection for missile components during trans-shipment.

(7) COMNAVAIRSYSCOM initiate a packaging and handling study to evaluate possible solutions to present container problems including "turn-around" vs. "throw away" containers.

(8) COMNAVAIRSYSCOM expedite the engineering evaluation of the AERO 21AX loading adapter and the AERO 67A loader proposed for shipboard loading of the SPARROW and the AERO 52B transporter/loader designed for shore based use.

(9) CNO and Fleet Commanders reexamine the requirements for the AIM-9C and, if required, request and/or provide full logistic support for the weapon system; otherwise, the AIM-9C should be removed from the inventory.

(10) CNO sponsor a periodic (at least semi-annual) Fleet support conference for air-to-air guided missiles. A first order of business could be an agenda exploring progress in implementing the recommendations of this report.

9. Documentation

a. Conclusions

(1) Procedures and format for the preparation and presentation of technical information for maintenance and operations have not changed appreciably over the years. The operational effectiveness of air-to-air missile systems is being adversely affected by relatively low manpower productivity, much of which is due to: inaccurate, incomplete, or out-of-date technical data; the difficulty in interpreting data in the format presented; or the difficulty in data identification and retrieval. Problems with documentation were encountered in every one of the five review areas. Although cited as a prime problem area in the "Russell Report" of October 1967, there has been little discernible progress.

(2) A particular problem exists in the Naval Weapons Stations which work with a combination of NAVAIR and NAVORD publications. NAVAIRSYSCOM could exercise better technical control over the work performed on air-to-air missiles by the NWS's by review and approval of certain publications now issued exclusively within the NAVORDSYSCOM; notably, the "Quality Assurance Provisions" (QAP's) and Standard Operating Procedures (SOP's) for air-launched weapons.

(3) A program to provide centralized, operational compatibility verification of stores/aircraft combinations, as well as a program for the preparation of weapons loading manuals and check lists has been established at the Naval Weapons Evaluation Facility (NWEF). NWEF, however, encounters real problems in acquiring accurate and timely source data, plus the necessary assets (aircraft, weapons, equipment, facilities, and personnel) generally available only from Fleet units. An additional problem is the time consumed in document production by non-automated processes.

b. Recommendations

(1) COMNAVAIRSYSCOM conduct an in-depth survey of modern techniques for the collection and collation of data and the preparation and presentation of technical information for maintenance and operations.

(2) Concurrently with the broad effort in (1) (above), COMNAVAIRSYSCOM, initiate, as a matter of priority, a program to improve the technical documentation for the organizational and intermediate maintenance operation for the AWG-10. This should be a coordinated effort with McDonnell-Douglas and Westinghouse and should include an assessment and early application of "WSMAC", "PIMO", "RAPID", "MIRACODE", or any other of the numerous techniques available to improve the quality and utility of technical information.

(3) COMNAVAIRSYSCOM and COMNAVORDSYSCOM review jointly the present system for providing technical documentation for the Naval Weapons

Stations and consolidate and coordinate present unilateral efforts in this area.

(4) COMNAVAIRSYSCOM implement, at an early date, the recommendations evolved in the SPARROW and SIDEWINDER publications review conferences held during September 1968.

(5) CNO, Type Commanders, and COMNAVAIRSYSCOM assist NWEF in obtaining the data packages, recommended procedures, Special Support Equipment, and other documentation/assets needed for a complete update of the F8/F4 air-to-air missile systems documentation in NWEF's area of cognizance.

(6) CNO AND CONMAVAIRSYSCOM include NWEF at the Board of Inspection and Survey (BIS) trials and Operational Evaluations at NAVMISCEN Pt. Mugu and NATC Patuxent River. COMNAVAIRSYSCOM provide follow-up administrative and technical support as required by NWEF to assure that accurate checklists are available upon the Fleet introduction of any new weapon system.

(7) CO NWEF and COMNAVAIRSYSCOM investigate the technical and economic feasibility of automation of the NWEF document production process.

10. Surveillance

a. Conclusions

(1) A prime area for exploitation, with direct feedback into reliability, is that of surveillance. Ostensibly, because of funding limitations, this important area has been largely neglected to date. Consequently, it is difficult to assess the true quality of an inventory containing a number of missiles several years old. Failure mode data from the NWS's and QEL's, Unsatisfactory Reports, and NARF data on parts replacement are typical of the sources which should be coordinated and consolidated to form the foundation for the missile system reliability improvements urgently needed at present.

(2) A key element of the surveillance function is the reporting system. Numerous reports have repeatedly indicated various corrective actions with little or no evidence of response. Many of these are non-standard of analytical or engineering type and frequently are mis-routed/directed. There are presently nine reports related to missile malfunctions. The action agency/office is frequently dependent on the type of report used by the originator.

b. Recommendations

(1) COMNAVAIRSYSCOM review, revise as necessary, and promulgate an instruction similar to NAVORDINST 4355.3 to establish a NAVAIRSYSCOM

program for quality surveillance of air-to-air missiles. As an adjunct to (or model for) this program, consideration of a "Deficiency Corrective Action Program" (DCAP), similar to that in force for surface missile systems, is recommended.

(2) COMNAVAIRSYSCOM assign overall management of the surveillance program to that field activity invested with the in-service engineering responsibility for the system concerned. FMSAEG should support the surveillance program for the data collection and processing phases and for such other tasks as assigned by the surveillance program manager.

(3) COMNAVAIRSYSCOM provide appropriate direction to Type Commanders and Marine Corps activities to provide for the monitoring and reporting of captive flight histories and their observed effects.

(4) CNO, COMNAVAIRSYSCOM, and COMNAVORDSYSCOM coordinate and consolidate the nine separate reports now available for reporting missile malfunctions.

(5) COMNAVAIRSYSCOM, under the aegis of the surveillance program, systemize and standardize the missile malfunction/performance reporting systems.

11. Inspection

a. Conclusions

(1) There is no substitute for follow-up, in the form of on-site inspection, to ensure that policies are understood and that directives are being carried out. The present tools for measuring air-to-air missile system readiness in the CVA's (primarily Operational Readiness Evaluations/Inspections and Pre-deployment Reviews) frequently fall short of providing a true measure of readiness, primarily due to lack-of-depth of inquiry. The record also shows that likely avenues for the improvement of conditions noted during inspections/reviews may remain largely unexploited due to the lack of follow-up. Finally, unsatisfactory or marginal conditions, once corrected, may not remain so due to the rapid turnover of personnel.

(2) Standardization in procedures, workmanship standards, processes, quality control, and similar characteristics between Naval Air Rework Facilities and Naval Weapons Stations is extremely difficult to achieve solely by reliance on stated policy and a system of directives, no matter how complete. Differences in plant layout, test equipment, tooling, and personnel qualification are examples of factors inciting non-standardization. Performance and standardization at the depot level affect performance, reliability, and maintainability in the Fleet. An inspection system offers an effective means to evaluate and improve, as necessary, these important influences on capabilities and readiness.

b. Recommendations

(1) CNO promulgate a directive requiring Type Commanders to institute an Air-Launched Missile Technical Proficiency Inspection (ALMTPI) system; along the lines of the present NTPI, for each deploying CVA and VF squadron. The ALMTPI should be followed-up by a team formed by the Type Commanders (with assistance from technical and other activities as required) to conduct an on-site review in each CVA 60-120 days following deployment to the Sixth or Seventh Fleets.

(2) NAVAIRSYSCOM direct NAVAIRSYSCOMREPLANT/PAC to issue, prior to 1 January 1969, a joint instruction initiating an air-to-air weapon system proficiency inspection of the NARF's to be conducted annually, or at such other intervals as may be deemed necessary, to insure quality products are being delivered to the Fleet. The instruction should be coordinated with NAVORDSYSCOM and a similar inspection should be initiated at appropriate Naval Weapons Stations (Air-Launched Missile Divisions) by NAVAIRSYSCOMREP Teams. Cognizant field activities (NAVMISCEN, NAVWEPCEN, QEL's, FMSAEG), and contractor personnel should be requested to assist.

12. Safety

a. Conclusions

(1) Operational requirements during combat operations in Southeast Asia have frequently been in conflict with safety requirements. A typical example is the problem of a fighter requiring movement to the hangar deck of a CVA for a number of reasons where retention or down load of the air-to-air missiles is at issue. Most of the direction now available to the Commanding Officer of a CVA is necessarily derived from 'a priori' safety considerations rather than deductive analyses based on hard fact.

(2) Although considerable progress has been made since issuance of the "Russell Report" in October 1967, there remain numerous 'loose ends' in the safety areas associated with air-to-air missiles. Among these are HERO considerations for the AIM-7D (HERO unsafe) and SIDEWINDER (HERO testing not complete) as well as numerous problems related to standardization of such features/functions as safe/arm devices, firing circuitry, safety interlocks, stray voltage tests, receptacles, umbilicals, etc.

b. Recommendation

(1) CNO activate, at the earliest practicable date, an Air-to-Air Missile Safety Study Group for a complete Safety Review of the F8 and F4 missile systems. This Review should be of the same scope and depth as those normally conducted for nuclear weapons and should be organized and conducted accordingly.

13. Rework

a. Conclusions

(1) A comprehensive Rework Plan is needed for each of the elements of the air-to-air missile system (AMCS, missiles, SSE, launchers, and aircraft) which specifies, in detail, the rework to be accomplished. Such a plan should provide an orderly means of achieving standard configurations in that all approved Class 1 and Class 2 changes could be conveniently installed and chronic failure parts replaced.

(2) The NARF's require validation of their respective operations by specifically constituted teams which would examine data packages; incoming inspection procedures; the rework plan; the availability and adequacy of parts, tools, and test equipment; quality assurance procedures; calibration; workmanship; and the availability of manpower, skills and resources. Validation should include a management survey and provide for periodic audits to ensure that required standards are maintained.

(3) The lack of a complete data package for the SPARROW missile requires considerable improvisation in the NARF's from time to time in order to respond to problems uncovered in the missile rework process. This, in turn, may be affecting the quality of the final product, although no conclusive evidence to that effect is available.

(4) Parts support is a genuine problem, both from the standpoints of availability of parts (in a fund-limited world) and the quality of parts. Frequent parts shortages are hampering production. The procurement of non-standard or unqualified parts from numerous vendors (qualified and unqualified) can result in a final product with performance quite unlike the original factory product. This latter can be true for a missile even though it can pass all established test requirements at a NARF only to have a sub-standard component fail on a subsequent test or a combat firing.

(5) The NARF product should be as nearly "good as new" as possible. To that end, environmental and other test criteria applied during the original factory production should be applied, to the extent practicable, during the NARF production operation. The Performance Evaluation Program (PEP) for reworked missiles should be expanded to provide a test program to evaluate the NARF product to a depth comparable to original Production Monitoring Tests, revised as recommended elsewhere herein.

(6) An effective NARF rework program is importantly dependent on three of the other actions recommended elsewhere herein:

(a) Definition of a three level maintenance system for all elements of the air-to-air missile systems (including definition of the NARF's role in the 3-M program).

(b) Effective performance of the in-service engineering function.

(c) Dynamic program management at all levels.

b. Recommendations

(1) COMNAVAIRSYSCOM direct an appropriate activity to develop standard, comprehensive rework plans for the several elements of current air-to-air missile systems. Initial emphasis should be on the AIM-7E2 and the AWG-10.

(2) COMNAVAIRSYSCOM form a "Validation Team" consisting of Navy/Industry representation to validate the AWG-10 operation at NARF Cherry Pt., followed by validation of the AIM-7E2 rework operations at NARF's Norfolk and Alameda. Westinghouse has submitted a proposal for an AWG-10 rework validation. A similar plan should be solicited from Raytheon for the AIM-7E2 and these plans reviewed, amended as necessary, and implemented.

(3) COMNAVAIRSYSCOM require Raytheon to produce and submit a complete data package for the SPARROW missile.

(4) COMNAVAIRSYSCOM, ASO, SPCC, the NARF's and other cognizant activities, as requested by COMNAVAIRSYSCOM, conduct a study of supply support for the AWG-10, AIM-9, and AIM-7 rework programs. Some of the recommendations of Appendix V to this report would provide effective interim actions.

(5) COMNAVAIRSYSCOM expand the PEP program to provide periodic, telemetry-supported, full scale firings of the NARF air-to-air missile products. Supplementary tests should be expanded to include full environmental testing (temperature and vibration cycling) at the QEL's. Specific procedures and responsibilities should be established for failure analyses, data feedback, and follow-up. The sampling rate should be not less than 20 missiles of each type per NARF per quarter.

14. Evaluation by FMSAEG

a. Conclusions

(1) FMSAEG's contribution to air-to-air missile training, and readiness has been less than its full potential to date and certainly less than its contribution to the surface missile program. This is due primarily to lack of high level direction and emphasis on FMSAEG's role as an air-to-air missile system support activity as well as lack of coordinated, funded activity in certain areas (e.g. deficiency/failure corrective action program) where FMSAEG's participation would be important.

(2) The value of FMSAEG's evaluation of missile firings is directly proportional to the quality of the data received. Standard firing reports are of dubious value for a meaningful analysis unless supplemented by telemetry data. Good telemetry, then, is an important element of the missile training firing program and would be an invaluable aid to combat firing analysis.

(3) In a resources-limited world it is important to identify the critical performance elements and isolate problems at every stage of the logistic and operational flow of the missile system in order to direct funds and effort to the potentially most fruitful areas for exploitation. FMSAEG can do this; given direction, support, and good data.

b. Recommendations

(1) Type and Fleet Commanders, CNO, and COMNAVAIRSYSCOM evaluate current FMSAEG programs (both formal and informal) for air-to-air missiles and COMNAVAIRSYSCOM coordinate findings and provide more specific direction to FMSAEG for future efforts.

(2) C.O. FMSAEG formulate and submit to COMNAVAIRSYSCOM for consideration a Deficiency/Failure Corrective Action Program (DCAP) for air-to-air missiles.

(3) CNO and Chief NAVMAT plan for and program sufficient telemetry packs to support the air-to-air missile training firing program.

(4) CNO, COMNAVAIRSYSCOM, and C.O. FMSAEG explore the technical, economic, and operational feasibility of a combat telemetry program for fighter aircraft in Southeast Asia.

(5) CNO, Chief NAVMAT, and COMNAVAIRSYSCOM plan and budget, on a continuing basis, to support the following programs at FMSAEG, as a minimum:

(a) Training missile firing analysis and other Fleet support tasks recommended by FMSAEG in its proposed five year budget plan, FY 1969 - FY 1973.

(b) A special forward area training missile firing analysis program.

(c) Analysis of Navy combat missile firings.

(d) A DCAP for air-to-air missiles.

C. Funding Estimates

1. An intensive effort was made to identify funding requirements associated with the numerous recommendations of this review. It should be noted that several important actions proposed can be accommodated within presently programmed fiscal assets and without major reorientations of the programs involved. The primary problem was with program recommendations where additional study and/or investigation is required in order to determine technical or operational feasibility. For that reason, there are a number of fiscal estimate adjustments still required.

2. Funding estimates, to the depth of detail possible, appear in the Appendices to this report. Gross estimates of the total amounts required (over and above current financial plans) are as follows:

Review Area	Costs (x 1000)	
	Initial	Recurring
I	5,000	1,000
II	1,000	800
III	8,101	582
IV	40,940	12,050
V	7,460	5,681
	62,501	20,113

D. Proposed Action Matrix

This section which will be issued with the Appendices, contains a proposed action matrix wherein proposed action assignments for commands and activities concerned are keyed to each of the specific recommendations appearing in Appendices I through VI.