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REPORT

OF THE

AIR-TO-AIR MISSILE SYSTEM

CAPABILITY REVIEW (U)

JULY—NOVEMBER 1968

APPENDIX IV

NAVAL AIR SYSTEMS COMMAND

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APPENDIX IV

REPORT OF TASK TEAM FOUR

Chairman: Captain M. H. Gorder, U.S. Navy
Office of the Chief of Naval Operations (Op 561E)

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

"Is the aircraft-missile system properly designed and configured for the air-to-air mission?"

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INTRODUCTION

A. The mission of Task Team Four was to determine if combat aircrews understand and exploit the capabilities of F4 and F8 aircraft-missile systems and if the aircraft-missile system is properly configured for the air-to-air mission. In addition to the problems discussed at the air-to-air symposium, Captain Ault and the task leader visited all U.S. Navy and Marine training and support bases in CONUS as well as NAS Roosevelt Roads, NAS Cubi Pt., USAF 6400 Test Squadron at Clark AFB, USS America (CVA 66), USS Coral Sea (CVA 43), USS Intepríd (CVS 11), USS Hancock (CVA 19) and USS Constellation (CVA 64). All associated personnel involved in the training and fleet fighter squadrons, homeported or embarked in these bases, were consulted concerning problems, conclusions or recommendations concerning aircraft missile system employment and configuration as well as aircrew performance.

B. The major portions of the report and the reported problem areas pertain to combat readiness, aircraft-missile system performance and aircrew performance.

C. In order to evaluate the relative importance of the problem areas and to determine the point in the operational cycle that the problems occur, the following data was used to describe the SPARROW system reliability.

	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.

D. Similar information was used to evaluate the SIDEWINDER system reliability.

E. All associated areas such as training and readiness procedures, predicted missile envelopes, training aids, human engineering, cockpit displays, and aircraft-missile system designs were studied in order not only to do better what we are doing, but to do it differently if the sensitivity analysis showed that a new approach or procedure would increase aircraft-missile system and aircrew reliability.

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I. TRAINING AND READINESS

A. Availability of Assets During CONUS Turnaround

Conclusions

1. At present F4/F8 squadrons have insufficient aircraft and personnel to train fully in the air-to-air missile environment. Assignments of deployment aircraft come late in the turn-around cycle, without sufficient time to conduct aircraft/system check-out and missile firings. Training commitments for the air-to-ground mission for VF squadrons further complicate the problem.

2. Increased air-to-air/ACM/Missile training is required during turn-around cycles for aircrews and enlisted personnel.

3. By October 1968, the F4 rework/MOD program had improved sufficiently to permit assignments of all aircraft to ENTERPRISE F4 fighter squadrons (VF92/96). All subsequently deploying F4 squadrons (e.g., those in Kitty Hawk/JFK/Saratoga) will have all assigned aircraft in sufficient time to conduct adequate aircrew training. The F8 MOD/rework program will not have improved sufficiently to permit F8 fighter squadrons to have all assigned aircraft until after January 1969. COMSEVENTHFLT has indicated a desire to reduce the air-to-ground commitments for VF squadrons.

Recommendation

CNO and Fleet and Task Force Commanders re-examine the necessity for continuing commitment of VF squadrons to air-to-ground missions in Southeast Asia and re-emphasize the fighter mission for fighters. The bombing pause in SEA, coupled with the increased ordnance carrying capabilities of the A7 and A6 squadrons, could make possible the reduction of VF ground attack mission commitments as VA aircraft become available in sufficient numbers and thereby permit primary emphasis by VF squadrons, on the air-to-air mission.

B. Forward Area Operational Training

Discussion

As a result of the Navy's air-to-air missile system performance in combat in SEA, CTF-77 has issued a directive re-emphasizing the requirement for conducting air-to-air missile training in the forward area in order to achieve improved readiness through strict adherence to prescribed maintenance procedures, aircrew continuing review of weapons systems capabilities and limitations, air combat maneuvering training, and periodic missile firings while deployed. The Commander SIXTH Fleet is presently exploiting the USAF Wheelus complex in an effort to exercise all VF squadrons while deployed in the Mediterranean.

Review of Fleet firings indicates that there are frequent cases where only a limited number of aircraft assigned to a squadron are utilized during missile training exercises. It appears that the primary emphasis is placed on qualifying aircrews and expending missile allowances rather than on qualifying all squadron aircraft.

Conclusions

1. Air-to-air combat readiness in the forward areas must be sustained to at least CONUS levels and enhanced, if possible.

2. No program is in existence to ensure that all squadron aircraft have been fully certified as able to launch and guide missiles.

Recommendations

1. Conduct firing programs at the Atlantic Fleet Weapon Range, Wheelus, the Pacific Missile Range, at Okinawa and at the USAF Poro Point, R.P., firing range. Place sufficient support equipment and personnel at Wheelus, Naval Air Station Cubi Point, and Naha to monitor and provide technical assistance. FMSAEG assist with telemetry and analysis as required.

2. Certify an aircraft as qualified only when it has successfully launched missiles which intercept the target within the lethal radius of the missile warhead. Require all aircraft to continue launching missiles until this is accomplished.

3. USN: Qualify each squadron aircraft and aircrew upon arrival at WESTPAC and once subsequently during WESTPAC deployment.

USMC: Qualify aircraft upon arrival into SEA (Southeast Asia) and at least once a year thereafter.

4. COMSIXTHFLT conduct similar qualification firings at range facilities available in the Mediterranean.

5. CTF 77 and COMFAIRWESTPAC investigate the need for a maintenance team to assist squadron personnel in "peaking" aircraft for firing upon arrival at Cubi Point. This team could be comprised as follows:

1 NAVISCEN Representative
1 Raytheon Representative
1 McDonnell-Douglas Representative
1 Westinghouse Representative
3 Navy AQ Ratings
2 Navy AO Ratings

6. Type, Fleet, and Task Force Commanders establish procedures to ensure the missile qualifications of all assigned fighter weapon systems as well as aircrews.

7. FMSEAG institute a special analytical program to evaluate forward area training firings in order to:

(a) Provide meaningful data on training results for Fleet use.

(b) Assist in monitoring progress with aircrew/aircraft missile qualification.

(c) Provide data on training/qualification results needed for justification of the forward area training program to OSD and elsewhere.

C. <u>Live Missile Training Allowances</u>

<u>Conclusions</u>

Presently the Non-Nuclear Ordnance Requirements (NNOR) Manual provides each operational pilot with two missiles per year of each type carried. This is not a sufficient missile allowance to meet the expenditures realistically needed for training. F4 aircrews should be provided with one Sparrow (AIM-7D/E) and one Sidewinder (AIM-9B/D) in the Carrier Replacement Wing (RCVW). The training allowance should also provide two Sparrows (AIM-7D/E) and two Sidewinders (AIM-9B/D) per year per pilot in fleet squadrons. F8 pilots should be provided with one Sidewinder (AIM-9B) in the RCVW and two Sidewinders (AIM-9B/D) per year in fleet squadrons. These should be exclusive of ORI, ORE, air demonstrations and other requirements.

<u>Recommendations</u>

1. CNO revise the NNOR based on the above requirements and adjust current missile allocation on an individual basis in order to meet all CINCPACFLT and CINCLANTFLT requirements. Squadrons should give higher priority to missile firing in order to insure total system reliability. It must be recognized that in order to provide total system reliability, a concentrated effort must be applied in the firing area.

2. To optimize the utilization of assets, priority should be given to the expenditure, in training, of the older missile in the inventory (i.e., AIM-9B and AIM-7D). AIM-9D's and AIM-7E's should be expended only where clearly justified by reason of training benefit to be derived (e.g., AIM-7E against BQM-34(IMK)). AIM-7E-2's should not be expended in training until considerable improvement in the current asset situation is realized.

3. Dummy warheads and telemetry packs should be programmed on a one-for-one basis for each live training missile programmed.

D. Inert Training Missile Allowances

Conclusion

There are presently insufficient Sidewinder (AIM-9D) inert captive missiles available in the fleet to meet squadron and RCVW training requirements.

Recommendation

Each VF squadron's inert captive missile training allowance should be four AIM-9D's and each VF RCVW squadron's inert captive missile training allowance should be eighteen AIM-9D's. This air-to-air missile training deficiency should be resolved at the earliest possible date.

E. Post Graduate Fighter Weapons School

Conclusion

Since the Fleet Air Gunnery Unit (FAGU) was decommissioned in 1960, there has been a great loss of expertise and continuity in the air-to-air weapons systems capability within Navy fighter squadrons. There is a need to establish a fighter weapons school to reverse this trend and to eliminate aircrew and ground personnel error in weapons system and air-to-air missile performance. TAB A expands on this concept.

Recommendations

Establish a fighter weapons school in the RCVW at NAS Miramar to train Weapons Training Officers and supervisory personnel of all fighter squadrons. This training should be conducted during the squadron turnaround training cycle.

F. Air Combat Maneuvering Range (ACMR)

Conclusion

Close-in aerial engagements in Southeast Asia (SEA) have imposed upon aircrews (F4 and F8) the requirement to visually estimate "in range" firing parameters for air-to-air missiles in "heads-up" engagements below 10,000 feet against highly maneuvering targets (MIG 17/21). Rule of thumb missile firing envelopes based on a high state aircrew interpretation of target crossing angles (TCA), differential range (DR), altitude (A), and target closing velocity (V_c) are required to employ the Sidewinder and Sparrow III missiles as well as 20MM guns. A large number of missiles have been fired in SEA using visual range and target aspects estimations with marginal success. Firing out of range or outside the missile envelope are common aircrew errors in SEA engagements. During September and October 1968 COMOPTEVFOR and APL/JHU conducted a study directed to system definition, requirements, and estimated costs for a facility, to provide air combat maneuvering training on an instrumented range.

Recommendations

Establish instrumented ACM ranges, East and West Coast, to provide "realtime" readout and flight path recording to aircrews during simulated missile firings while engaging in air combat maneuvering flights. TAB B provides details on the ACMR.

G. Fleet Readiness/Training Manuals

Conclusions

Presently there are differences in the training requirements of the two air Type Commanders. These manuals should reflect the best methods and procedures for both.

Recommendations

COMNAVAIRLANT and COMNAVAIRPAC revise and standardize Readiness and Training Manuals.

II. MISSILE ENVELOPES

A. Maximum and Minimum Range Envelopes for AIM-7E/E-2

Conclusion

Maximum and minimum range envelopes for AIM-7E/E-2 for both maneuvering and non-maneuvering targets are required to present the entire spectrum of launch range parameters to aircrews. Present launch zone information needs to be up-dated, printed, and distributed to operational units.

Launch envelopes for 5K-15K and 25K with target G's from 0 to 4.5 have been produced and will be incorporated in the F4 tactical manual presently being revised. Additional envelopes are required to complete sensitivity studies on heading error, launch speeds, target speeds and track crossing angles.

Funding for this additional effort is estimated at 150K.

Recommendation

The launch envelopes should include altitudes from sea-level to 45,000 feet, at 5,000 foot intervals, target speeds from sub-sonic to super-sonic, launch speeds to vary from speed disadvantage, to co-speed, to speed advantages. Additionally, P_k values, both theoretical and combat by general aspect should be provided on the launch envelopes. Relative P_k indications by quadrant would be adequate. This program is presently underway at Raytheon Company and a proposal for funding will be submitted in November 1968. Representative envelopes for 5,000 and 25,000 feet, respectively, appear in TAB C.

B. SIDEWINDER (AIM-9D) Envelope Studies

Conclusion

The present Naval Weapons Center (NWC) kinematic maximum range envelopes for the Sidewinder AIM-9D are inadequate and not up-to-date. A computer study similar to the Raytheon Sparrow AIM-7E maximum range study is required so that reliable missile envelopes can be distributed to fleet units. An elaborate study proposal consisting of more data than is necessary has been submitted by NWC to NAVAIRSYSCOM for approval.

Recommendation

NAVAIRSYSCOM, employing the criteria set for AIM-7E/E-2 envelope studies, direct the NWC China Lake to produce similar parametric data for the AIM-9D and fund this effort to the extent required.

III. TRAINING TARGET SYSTEMS/AIDS

A. Improved Target Drone Capability

Conclusion

Present visual augmentation (smoke) of the BQM-34(IMK) during maneuvering target exercises does not provide required safety throughout all parameters of a simulated close-in aerial engagement. There is a requirement to improve the visual augmentation of the BQM-34(IMK) in order to provide training for close-in aerial engagements with adequate safety protection throughout all exercises.

Recommendations

Composite Squadron THREE Detachment at NMC, Pt. Mugu is presently experimenting with "strobe light" augmentation to the BQM-34(IMK) drone. NAVAIRSYSCOM should examine this proposal as well as follow-on drone visual augmentation requirements.

B. Target Drone Launch Vehicles

Conclusion

The DP-2E's are old and unreliable for drone carriage and require replacement. Valuable training time is being lost because about fifty percent of all DP-2E launches are aborted due to aircraft systems failures. DC-130 launch vehicles, with double the drone carrying capacity and out-of-sight control capability, are required to replace the obsolete DP-2E's presently being used as drone launch vehicles. Further, shore-based drone launch facilities (Poro Pt, R.P.) impose line-of-sight and other constraints on drone control and telemetry support which can largely be obviated by the employment of airborne launch and control facilities.

Recommendation

A program change request (PCR) has been submitted by CNO for seven DC-130 aircraft to replace all DP-2E's currently in the fleet. OSD has tentatively approved two DC-130s for delivery in FY69 with subsequent approval of the remaining aircraft based on utilization data of the initial two aircraft. Greater priority is required to expedite the acquisition of adequate numbers of improved target drone (BQM-34(IMK)) launch vehicles (DC-130) for the fleet.

C. Drone Recovery Vehicles

Conclusion

Training operations (both CONUS and forward areas) are inhibited by the availability of suitable recovery vehicles for the BQM-34. The H-34 helicopter normally used is limited in range and lift capabilities and must be replaced. Surface craft are usually not suitable for BQM-34 recovery.

Recommendation

CNO examine the Navy's BQM-34 recovery capabilities, world-wide, justify to OSD the need for drone recovery vehicles, and direct the Chief of Naval Material to initiate any necessary procurement action.

D. AIM-7E-2 SPARROW Aircrew Training Film

Conclusion

The updating of the Sparrow Aircrew (Pilot and RIO) training film must be accomplished to include the AIM-7E2 and the weapons system presently in use in the F4J aircraft. This training film will provide basic indoctrination for the aircrew, and be presented prior to the formal training on the Sparrow Missile and the AWG-10 Weapons System.

Recommendation

The AIM-7E-2/AWG-10 Weapons System Training Film for Pilot and RIO will be produced by Raytheon Company at no cost to the Navy. This training film will be mission-oriented and will include Aircraft/Missile pre-flight, pre-start checks, pre-take-off checks, including switch actions. The intercept phase will pre-launch maneuvering, missile firing, post-launch procedures, and finally, the post-flight procedures. This film will be reviewed by Westinghouse, McDonnell, NAVAIRSYSCOM and the Naval Missile Center prior to release. This training film should be completed as soon as possible and distribution controlled by the Chief of Naval Operations (OP-563).

E. AIM-7E2 Envelope Training Film

Conclusion

As an aid to aircrew training in the Air Combat Maneuvering (ACM) environment, a presentation of missile envelopes, combining the distortion that occurs against a maneuvering target, is required. While a general understanding of maneuvering target envelopes exists, a detailed presentation of fighter to target relationships with track crossing angles, overtake, and ranges, correlated with envelopes in the same time frame will provide aircrews with a better appreciation of the ACM problems.

Recommendation

A proposal from Raytheon Company to produce a training film with maneuvering target envelopes will be submitted in November 1968. This film should be in full animation to best present the fighter to target relationships and to depict, in the same time frame, the distortion of the Sparrow firing envelopes. This presentation should include both minimum and maximum firing envelopes, and should include, if possible, actual photography of MIG 17's and MIG 21's.

F. In Flight Simulator/Evaluator/Recorder for F4 Weapons System

Conclusion

There is presently no simulator, evaluator and recording device in the Navy capable of testing the F4 weapons system or missile stations as well as aircrew performance while in flight. Mate II, ACEARTS and AWM-19 are presently industry proposals that have merit and should be examined at the earliest possible date. Such a device would be a genuine asset in the forward area as a tool for sustaining combat readiness through realistic airborne training as well as an efficient shipboard maintenance aid.

Recommendation

NAVMISCEN and NAVAIRDEVCEN evaluate these proposals and report results.

IV. HUMAN ENGINEERING

A. F8H/J Aircraft Fire Control Switch and Advisory Lights

Conclusion

The SEAM lock button and the fire control advisory lights in the F8H/J airplane are presently located in undesirable positions. The pilot must take his hand off the flight control stick or throttle to initiate a SEAM lock. He must look down low into the cockpit, and around the flight control stick pedestal to determine if he has a SEAM lock and to see what weapon he has selected. The radar lock and the in envelope advisory lights are not in his peripheral view. The range meter is poorly located and obscures a portion of the forward wind screen.

VX-4 is presently mechanizing an AFCS advisory light heads-up display in the pilot's field of view that does not obscure any of the wind screen. An in-flight evaluation of this display and a Parker Instrument E-45 range meter is underway at this time. The results of these flight tests will be reported to CNO and NAVAIRSYSCOM.

In-flight tests of a new position for the SEAM button is in progress at VX-4. The results of these tests will be reported to CNO and NAVAIRSYSCOM.

Recommendation

Reposition the SEAM lock button so that the pilot does not have to remove his hand from the throttle or flight control stick to initiate a SEAM lock in the ACM environment. The SEAM lock button could be placed where the present auto-pilot engage/disengage button is now positioned. In this arrangement, when the auto-pilot power switch is off and the SEAM mode switch is off, the auto-pilot engage/disengage switch would function as an auto-pilot switch. The F8H/J fire control system advisory lights should be positioned in a heads-up display above the front wind screen frame brace. The ID-1485 Sidewinder firing indicator should be removed from the cockpit and replaced with a small flat range meter similar to the Parker Instrument Company's Model E-45.

B. F4 Cockpit Range Meter/"In-Envelope" Indicator

Conclusion

Firing out of range or outside the missile envelope are common F4 air-crew errors, in SEA engagement. A direct readout range meter, complemented, if possible, by an "in-envelope" indicator, is required as soon as possible. These would provide a semi "heads-up" display and "shoot-no shoot" indication to the pilot during a "heads-up" engagement. Although any "in-envelope" indicator at low altitude would necessarily be mechanized to a limited portion of the total envelope available, its use in connection with a range meter should reduce the number of out-of-envelope firings in combat.

Recommendation

VX-4, with Westinghouse assistance has been assigned a project to evaluate a range/in-envelope meter for all F4 aircraft. This meter will be available for testing by VX-4 by January 1969 and, subject to favorable results, the range/in-envelope meter will be submitted to NAVAIRSYSCOM., for approval, retrofit, and follow-on installation in all F4B/J aircraft.

C. F4 Cockpit Display

Conclusion

The F4 cockpit display is designed for a "heads-down" engagement against a high level bomber in an all weather environment. F4 aircrews in SEA are required to fight the enemy in a "heads-up" environment with a "heads-down" cockpit display. A fully "heads-up" display is needed in all follow-on F4J aircraft.

Recommendations

McDonnell Aircraft Company conduct a controlled display review of the present F4B/J cockpits in December 1968 at St. Louis with appropriate NAVAIRSYSCOM and Type Commander representation. This display review will make recommendations concerning changes in the present F4B/J cockpit display and changes for future cockpit display for F4J follow-on aircraft.

V. COMBAT EVALUATION

A. Combat Telemetry

Discussion

Examination of "RED BARON" and other combat evaluation reports reveals that processes for combat performance data collection depend mostly on aircrew debrief and interrogation and similar inherently inexact sources. This, in turn, is reflected in the quality of the analyses derived from such data. In a resources limited world it is important to identify the critical performance elements of the air-to-air missile system in combat in order to direct funds and effort to the potentially most fruitful areas for exploitation. It is important, for instance, that analysis segregate the respective contributions of the missile, the air crew, and the missile fire control system with respect to the failure of a missile to guide and fuze as required for a MIG kill. It is unlikely that this will ever be done well enough by "eyeball" reports and adjective descriptions.

Conclusions

1. Combat telemetry would be an extremely useful tool for the combat analyst and offers important improvements over present data collection techniques.

2. From a cost effectiveness standpoint combat telemetry could probably be justified by a demonstrably more efficient application of funds and effort to specific deficiency areas which could be delineated by better analyses of total systems performance in combat.

Recommendation

NAVAIR and FMSAEG explore the technical, economic, and operational feasibility of a combat telemetry program in Southeast Asia.

VI. DESIGN

A. Aircraft/AMCS Design

The aircraft/AMCS problems contained in this section have been encountered during CVA operations in Southeast Asia.

1. F4B/AERO 1A

a. AN/APQ-72 Antenna Polarization Switch Failure (U)

Discussion

(1) The AN/APQ-72 antenna incorporates a quarter-wave plate and magnetic switching mechanism for changing the polarization of the radiated signal. This switching mechanism has proven to be unreliable and is mechanized in such a way that the position of the quarter-wave plate and the resultant polarization cannot be determined in the event of failure. Failure, in some cases, can preclude proper operation of the SPARROW missile. To prevent this type of failure, Fleet aircraft presently have the switching mechanism completely disabled.

(2) Westinghouse ECP 165, which improves the reliability of the switching mechanism, was approved on 26 September 1966; however, the retrofit kits (Avionics Change 514) have not yet been installed.

(3) Westinghouse has also recently submitted an ECP to the Air Force which would provide for antenna and radar set improvements to the AN/APQ-100. This change would, among other desirable improvements, provide a polarization sensor and a positive indication to the flight crew of the polarization. Change kits for the AN/APQ-72 would be identical to those for the AN/APQ-100; thus non-recurring engineering costs could be shared by the Air Force and the Navy.

Conclusion

The AN/APQ-72 polarization switching mechanism is unreliable and has been disabled in Fleet configured aircraft. Engineering changes are required to improve the reliability and to give aircrews a positive indication of polarization.

Recommendations

(1) Expedite incorporation of WEC-ECP-165.

(2) NAVAIRSYSCOMHQ solicit Westinghouse Company for an ECP for the Navy similar to WEC-ECP-WXAA-72-204 submitted to the USAF.

b. Hydraulic Fluid Contamination in AN/APQ-72 Antenna System

Discussion

(1) Contaminated hydraulic fluid from the F-4B aircraft utility hydraulic system is degrading aircraft radar system angle track response and accelerating antenna component failure.

(2) It has been proposed that a self-contained hydraulic source be installed in each F-4B aircraft. The system as proposed is isolated from the aircraft utility hydraulic system, thus preventing contamination from being introduced into the radar servo loop; however, a separate system of this type would have the following disadvantages:

a. High initial cost
b. Additional weight
c. Added spares/logistic costs
d. Aircraft modification required
e. Requires system/aircraft compatibility testing for vibration, temperature, and electromagnetic interference.
f. Requires changes in maintenance procedures

(3) Another solution to AN/APQ-72 hydraulic system contamination problems involves the use of servo valves and hydraulic actuators which are considerably less susceptible to hydraulic system contaminants. Such servo valves and actuators have been developed for the Air Force, for use on the AN/APQ-109 antenna, and are readily adaptable to the AN/APQ-72 antenna at less cost and with few of the disadvantages offered by the self contained hydraulic system.

Conclusion

The APQ-72 antenna hydraulic system was not designed to operate with the hydraulic oil contaminant level experienced in the aircraft utility system.

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Recommendation

NAVAIRSYSCOMHQ investigate the feasibility of an alternate servo valve/filtration system such as is presently used in the AN/APQ-109, AN/APQ-120, and AN/AWG-10 systems. Cost, time, and operational life of the system are constraints in considering implementation of this change.

2. F4J/AWG-10

a. AN/AWG-10 Cooling

Discussion

(1) The cooling provided for the AN/AWG-10 is inadequate, forcing deployed squadrons to refrain from turning their radars on until after catapult. Because of this, AN/AWG-10 and missile status cannot be determined until 5-1/2 minutes after launch. In addition, maintenance is severely hampered by a lack of sufficient air conditioners for organizational level use, and by a lack of clear definition of cooling limitations in appropriate handbooks.

(2) Interim Avionics Change (IAVC) 973, Westinghouse ECP-69, and McDonnell-Douglas ECP-927 have all been proposed to alleviate this problem. IAVC-973 provides for incorporation of an interim "B+ off" switch which will permit operation of the system for maintenance with B+ power turned off. This change is currently being incorporated into Fleet aircraft. ECP-69, submitted by Westinghouse in June 1968, would provide the ability to turn the transmitter off during test. ECP-927 has been approved and provides more cooling air to the pulse transmitter.

(3) The lack of air conditioners for organizational use can be eliminated by procuring more NR2B cooling carts and their associated equipment and by investigating the feasibility of developing an F-4J oriented air conditioner.

Conclusion

The cooling provided for the AN/AWG-10 is inadequate, thus hampering maintenance and precluding preflight checks of AWG-10 and missile status.

Recommendations

(1) Incorporate "B+ off" IAVC-973 as soon as possible.

(2) Expedite consideration of Westinghouse Corporation ECP-69.

(3) Procure more NR2B cooling carts and associated equipment for CVA's.

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(4) Develop an F-4J-oriented conditioner.

(5) Address the cooling problem early in the design phase of future fighter systems.

(6) Define cooling limitations in Maintenance Instruction Manuals.

b. AN/AWG-10 Built-in-Test Improvements

Discussion

(1) The AN/AWG-10 is a new Missile Control System which has recently been introduced into the Fleet. As is common with a newly introduced system of this complexity, the time and manpower required to properly maintain the system is inordinately long. This is due to several factors, including lack of experience in this particular system; lack of sufficient spares; lack of, and inaccuracies in, handbooks; numerous configuration changes required to eliminate design deficiencies or incorporate improvements; and an inadequate BIT (Built-in-Test). While most of these factors can be expected to improve with time and experience, improvement of the BIT requires special emphasis. During a study conducted by the NAVMISCEN at Naval Air Station Miramar, it was found that, while BIT is intended to be the primary means of fault detection and isolation, only 20% of maintenance actions were initiated by BIT indications, and that BIT was successful in isolating the fault to a removable assembly only 18% of the time. Since 46% of active maintenance time was taken up by verifying and isolating a fault, an improvement in the efficiency of BIT could result in a considerable saving in maintenance time and manpower, with an attendant improvement in the over-all maintenance of the weapon system. It is anticipated that the 1.5 series BIT tape, presently available, will provide considerable improvement in this area.

(2) In an effort to improve the maintainability, the contractor (Westinghouse) is attempting to further improve the effectiveness of BIT.

(3) An appropriate Naval engineering activity (e.g., the Naval Air Development Center, the Naval Air Engineering Center, or the NAVMISCEN) should be tasked to provide a continuing review, updating, and improvement of BIT hardware and programming for AN/AWG-10 and future systems (such as AN/AWG-9) which incorporate a BIT.

Conclusion

The AN/AWG-10 Built-in-Test (BIT) has not performed satisfactorily. A new BIT tape, now available, and further contractor improvement should considerably improve BIT effectiveness; however, there is a need for continuing review, updating and improvement of BIT for AN/AWG-10 and for future systems.

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Recommendation

NAVAIRSYSCOMHQ task an appropriate Naval engineering activity to provide for a continuing review, update and improvement in BIT hardware and programming.

3. F4B/F4J

a. F-4 Firing Circuit Changes

Discussion

The F-4 weapons control system firing circuits require changes to accommodate the AIM-7E2 missile, to provide for more meaningful SELECT light, and to eliminate the need for the pseudo signal. Several ECP's (Engineering Change Proposals) have been submitted to NAVAIRSYSCOM to provide these changes; however, these ECP's conflict in some areas and require coordination in others. A conference was held at NAVAIRSYSCOM on 17 September 1968 for the purpose of resolving conflicts and determining which ECP's should be incorporated. The decision made at the conference regarding these ECP's and the present status are given in Table 1.

Conclusion

The F-4 weapons control system firing circuits require changes to accommodate the AIM-7E-2 missile to provide for meaningful SELECT lights and to eliminate the need for pseudo signals.

Recommendation

NAVAIRSYSCOMHQ expedite action contained in Table 1.

b. Inadequate CW Illumination in ACM Environment

Discussion

It is extremely difficult to keep a target illuminated in the boresight mode due to the narrow beam width of the radar antenna when in an ACM engagement. This problem can be minimized by radiating CW energy through a flood antenna when in the ACM mode.

Conclusion

More adequate CW illumination of the target in the ACM environment may be accomplished by incorporation of the flood antenna into the F-4 weapons system.

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Table 1. F-4 Firing Circuit Changes Required

CHANGE	STATUS	ACTION REQUIRED
For F-4B		
1. (a) RAY-ECP-28 (Phase I) (b) IAFC-421	Approved. 100 kits produced.	Update to Change No.2 or No.3
2. (a) RAY-ECP-28 (Phase II) (b) AFC-421	Submitted. Not approved.	Approval of either Change No.2 or No.3. Change No.3 is preferable if it can be accomplished in timely manner.
3. (a) RAY-ECP-28 (Phase II) (b) MDC-ECP-912	Submitted. Not Approved.	Approval of either Change No.2 or No.3. Change No.3 is preferable if it can be accomplished in timely manner.
For F-4J		
4. (a) MDC-ECP-912	Approved for production beginning w/block No. 36.	Approval/funding for retrofit.
(b) ECP-RAY-0A6822/AWG-10-2 (c) WEC-ECP-99	Submitted. Not approved.	Approval/funding for both production and retrofit.

Recommendation

NAVAIRSYSCOM review and evaluate U.S. Air Force and Raytheon flight test of flood antenna to determine acceptability for ACM use.

c. Commit Time on AIM-7 Missile

Discussion

The 2 second radar settling time and the 1.8 second missile commit time and the 1.4 second launch delay add up to 5.2 seconds of total commit time. This time delay may cause missed opportunity to fire a missile. These times should be reduced if possible.

Conclusion

Investigation should be undertaken to reduce the Commit time for the AIM-7 missile.

Recommendations

(1) NAVAIRSYSCOMHQ expedite consideration of the following ECP's to reduce Commit time:

For F-4B

MDC 912-S2 (delays application of the sweep select signal to 0.5 seconds after trigger pull)

For F-4J

MDC 912-S2 (same as F-4B above)

WEC M-99 (accomplishes circuit changes to reduce AN/AWG-10 system Commit time)

(2) Raytheon investigate APA-157 computer settling time, etc., to determine if reduction is possible.

d. Air Crew Launch Zone Indication

Discussion and Conclusion

There are no indications to the aircrew for the launch zones of the minimum range SPARROW missile. Several of these missiles have been combat fired well out of range.

Recommendations

(1) Near term - Provide aircrews with rules of thumb for AIM-7E2 launch zones. (This is currently being accomplished by Raytheon team visits to Fleet activities.) Investigate the feasibility of providing a simple "heads-up" range meter and/or "in envelope" indication for the F-4.

(2) Mid-term - Evaluate changes to the existing analog computer to provide an in-range indication for the AIM-7E2 at low, intermediate, and high altitudes.

(3) Long term - Provide the AWG-10 with a digital computer for AIM-7E2 and AIM-7F employment. Provide for a heads-up display.

e. F-4B, F-4J/SHOEHORN Compatibility

Discussion

F-4B/F-4J/SHOEHORN electrical and mechanical interface compatibility has not been completely investigated.

Conclusion

F-4B/F-4J compatibility with SHOEHORN requires investigation.

Recommendation

Expedite completion of the present maximum level AIRTASK at NAVMISCEN (Naval Missile Center). NAVAIRSYSCOM provide required SHOEHORN equipment to accomplish the F-4B/SHOEHORN compatibility evaluation.

4. Configuration Control (F-4)

a. F4B-AERO-1A

Discussion

(1) Changes have been introduced into Fleet operating airborne weapon systems without adequate test and evaluation, and without adequate spares, publications and training.

(2) Repeated configuration changes in the AERO-1A AMCS have complicated Navy support on the areas of spares, publications, training, etc.

Conclusion

Support of the AERO-1A AMCS has been hampered by repeated configuration changes to the extent that Configuration Control and freezing of the design are necessary.

Recommendation

(1) Vest Configuration Control responsibilities in NAVAIRSYSCOM HQ, Air 05.

(2) Prefaced on a compatible, cost-effective interface between the F4/AERO-1A AMCS rework program and the F4B service life and inventory, the following immediate configuration freeze is recommended:

DESCRIPTION	AIRCRAFT	APQ-72	APA-157	GSE
PLM (Pilot Lock-on Mode)	ECP-911 IAFC-424	ECP-200 IAVC-862	NA	ECP-185-6
AIM-7E-2 Compatibility	ECP-912 IAFC-421	NA	ECP-28 IAVC-860	SEC-1267 SEC-1268 SEC-1270
Solid State Tuning Drive	NA	NA	ECP-30	NA
Select "G"'s *No Manual Switch	NA	ECP-169*	NA	ECP-185-11
Antenna Polarization		ECP-204	NA	Not requested

(3) As a second block configuration change, recommend investigate the following for incorporation in a Final Configuration Freeze:

ACEARTS/MATE II/AWM-19
CW Flood Antenna (dogfight)
Steering Equations (Ray-ECP-157-20)
AIM-7F Compatibility (Ray-ECP-157-26) (MDC-ECP-850)
APQ-72 Antenna Hydraulic System Improvement
APA-157 Computer Simulated Doppler Settling Time
SIDEWINDER Expanded Acquisition Mode (SEAM)

(4) Investigation reveals that many different configurations of the AERO-1A AMCS are employed throughout the fleet. While items (2) and (3) above define what changes should be considered in the recommended freeze, the problem of standardization beyond those changes described above requires a more thorough study than can be accomplished in this committee. It is, therefore, recommended that NAVAIRSYSCOM schedule a meeting immediately, of the appropriate contractor and Navy personnel to define and prescribe necessary action to standardize the AERO-1A AMCS, related systems, and support equipment.

(5) The institution of AERO-1A rework during PAR in July 1968 provides an excellent means of standardization. Recommend that NARFS develop the AERO-1A rework plan based on the Standard Configuration.

b. AN/AWG-10

Discussion

(1) Changes have been introduced into Fleet operational airborne weapon systems without adequate test and evaluation and without adequate spares, publications, built-in-test, and training.

(2) Because of repeated configuration block changes in the AN/AWG-10 spares, publications, built-in-test, training, etc. AN/AWG-10 assets, people, spares, test equipment, and facilities are tied up by a succession of modification team efforts further detracting from Fleet support of operational aircraft.

Conclusion

Support of the AN/AWG-10 system has been hampered by repeated configuration changes to the extent that Configuration Control and freezing of the design are necessary.

Recommendations

(1) Vest Configuration Control responsibilities in NAVAIRSYSCOMHQ Code 05.

(2) Freeze the configuration of the AN/AWG-10 to the 1472 block configuration defined as the 1207 block configuration with the additions of the following compatibility and improvement ECP's:

DESCRIPTION	AN/AWG-10	AIRCRAFT	RAYTHEON TUNER	GSE
APX-76/ALQ-91 Compatibility	ECP-46	ECP-840 ECP-758	NA	ECP-SM-46
Antenna feedhorn nutations in Range I & visident	ECP-50/ IAVC-834	NA	NA	NA

DESCRIPTION	AN/AWG-10	AIRCRAFT	RAYTHEON TUNER	GSE
Increase antenna slew rate & remove range rate circle delay	ECP-64/ IAVC-833	NA	NA	NA
Independent bezel lighting	ECP-79	ECP-822	NA	ECP-SM-79
Bit RF generator, M.D.S. in short pulse & chirp	ECP-75	NA	NA	NA
Low Voltage power supply start-up current	ECP-87	NA	NA	NA
Auto acquisition from wide scan search	ECP-101	NA	NA	NA
Improved shock mounts	ECP-100	NA	NA	NA
TR tube connectors	ECP-113/ IAVC-874	NA	NA	NA
Antenna servo high temp.	ECP-111	NA	NA	NA
*Independent navigation computer operation	ECP-21	Not requested	NA	ECP-SM-21
*Cooling, B plus off transmitter warning light etc	ECP-69	ECP-834 ECP-927	NA	NA
*PLM (Pilot Lock-on Mode)	ECP-83	ECP-911 ALT No. 1 VX-4 ALT No. 2 MDC	NA	ECP-SMA-83 SMB-83 SMC-83

DESCRIPTION	AN/AWG-10	AIRCRAFT	RAYTHEON TUNER	GSE
*AIM-7E-2 Compatibility	ECP-99	ECP-912	ECP-0A6822 /AWG-10-2	ECP-SMA-99 SMB-99 SMC-99
*Full lock-on from boresight	ECP-106	NA	NA	NA
*Solid state tuner	NA	NA	ECP-30	NA

* Not currently defined by NAVAIRSYSCOM as included in 1472, but recommended.

Note (1): Some form of an in-range indication device is desired in the same time frame.
Note (2): SEAM provisions required and should be expedited.

This configuration should remain fixed to allow all equipments, spares, training, publications, and BIT to catch up and stabilize. The next generation configuration should make provisions for a digital computer and new performance and reliability ECP's.

The companion and/or applicable McDonnell Douglas Corporation ECP's will be required upon approval of this recommended AN/AWG-10 configuration freeze.

(3) Allocate the first kits produced or systems delivered to NAVAIRTESTCEN, NAVMISCEN, AIRDEVRON FOUR, NAMTRADETS, Training Squadrons (in that order) so as to insure an adequate evaluation and training on the configuration prior to the outfitting of operational squadrons.

5. (F8H/J)

A. BAT Altitude Line Elimination

Conclusion

The BAT system does not inhibit altitude line lock-on and requires the pilot to analyze his radar scope presentation to determine if the radar has locked-on the target or the altitude line. At a meeting at NAVAIRSYSCOM on 24 October 1968, two solutions to this problem were discussed and it was disclosed that λ2,000,000 has been requested in FY 1970 to fund an altitude line elimination for F8H/J radars. VX-4 is presently evaluating and will report findings to NAVAIRSYSCOM and CNO.

Recommendation

A system to inhibit altitude line lock-on when the BAT mode of operation is employed be developed. The methods to accomplish this are: (1) varying gain and STC (Sensitivity Time Constant) to reduce the ground radar return to a level low enough to preclude lock-on, and (2) by installing a separate radar receiver antenna in the airplane to receive the radar ground return and then send this information to the radar to gate out the ground return being received by the radar. This method is referred to as ALE (Altitude Line Eraser).

B. Missile Design

The missile design problems contained in this section have been encountered during CVA operations and are mainly caused by the requirement for repetitive captive flight cycling in the Southeast Asia combat environment.

1. AIM 7E (SPARROW)

a. Missile Head Droop

Discussion

The SPARROW missile antenna (head) will droop following repetitive captive flights causing failure of the missile to auto-tune when, in fact, the aircraft and missile are in the GO status. IALMC-37 provides for a styrofoam ring to hold the head in a boresight position, as an interim fix, until pseudo is removed in proposed changes. The styrofoam ring provides a less than optimum solution. Raytheon Company is investigating an interim solution for the F-4B consisting of a change in the modulator which involves replacing one resistor.

Conclusion

The loss of the aircraft select light due to the drooping of the SPARROW antenna has been alleviated by the introduction of Interim ALMC-37. An interim solution that does not place a maintenance burden on the operating activities is desirable. A permanent solution is required.

Recommendations

(1) NAVAIRSYSCOM (Code AIR-5333B2) request Raytheon/NAVMISCEN verify that changing resistor 3A8R2 from 620K to 270K does not degrade system performance (F-4B only).

(2) Upon verification take appropriate action to expedite incorporation.

(3) Expedite removal of pseudo for all F-4 aircraft.

(a) F-4B - Raytheon ECP 157-28 (II)
MDC 912 or IAFC 421 (NAVAIRSYSCOM decision required)

(b) F-4J - Raytheon OA6822/AWG-10-2
MDC 912 and M-99

b. Time Delay in Firing

Discussion

There is an excessive time delay (1.4 seconds) from trigger squeeze to missile away in the F-4/SPARROW Weapon System. This delay is caused, in part, by the missile EPU (electrical power unit) settling time; however, investigation indicates that the EPU settling time is not the governing constraint.

Conclusion

The time delay from trigger squeeze to missile away of 1.4 seconds is excessive. Reduction in time delay will not affect the missile reliability but will increase the firing opportunity to the pilot. The time delay should be decreased to a minimum.

Recommendation

Raytheon Company review the other constraints and submit recommendations to NAVAIRSYSCOM (Code AIR-5108) to reduce missile away time to a minimum. NAVAIRSYSCOM (AIR-5108C) evaluate and expedite incorporation of required changes.

c. Difficulty in Wing Removal

Discussion

The SPARROW wing locking mechanism is difficult to unlock for wing removal; consequently, wings are frequently damaged by the missile handling crews by using improper tools, i.e., screwdrivers, hammers, and aircraft chocks, during removal.

Conclusion

The difficulty encountered in removing the wings from the SPARROW III missile during unloading and shipboard handling has contributed to an excessive number of damaged components. This damage does not significantly affect missile flight reliability but, rather, is a logistics problem due to the requirement for new components.

Recommendations

(1) NAVAIRSYSCOM (AIR-4107) expedite procurement and distribution of adequate wing lock pliers as recommended by NAVMISCEN letter serial 353 of 14 February 1968.

(2) Provide improved wing lock mechanisms for future missiles to expediate field assembly and disassembly. (Raytheon is presently investigating a design that will not require special tools and that will be compatible with existing AIM-7 missiles.)

d. Non-standard Missile Section Screws

Discussion

Non-standardization of section screws and joints between the air launched missiles and between sections on the same missile has created problem areas. The SPARROW missile is held together by special purpose screws with a NYLOC locking feature which deteriorates with repeated use, yet the screws must be removed for repeated missile test and assembly. Deviation in production quality has required investigation and correction of Fleet problems in both the SPARROW and SIDEWINDER during the past two years. One SPARROW missile in-flight breakup has been attributed to improper section screws.

Conclusion

There is no standardization of missile joints or section screws. The special purpose screws are expensive and not of standard quality. The section screws and the missile joints should be standardized to decrease training requirements, decrease assembly errors, reduce costs, and prevent missile breakup in flight.

Recommendations

(1) Immediate

NAVAIRSYSCOM (AIR-4107) issue amendment to ALMC-16 specifying one time use of section screws for SPARROW missile. SPCC (Ships Parts Control Center) assure adequate spares in stock for a significant increase in usage rate.

(2) Long Term

Standardize missile joints and section screws between all future air launched missiles.

e. Safe/Arm Switch on MK 265-0 Igniter

Discussion

(1) The Safe/Arm Switch on the MK 265-0 igniter is frequently broken during handling operations. While it is recognized that the prime reason for this occurrence is due to repetitive handling, it is felt that the affected part could be made stronger or possibly replaced with a, different handle.

(2) An improved S&A (Safe/Arm) device will be incorporated in follow-on production of SPARROW motors. The improved design provides a recessed S & A switch activated by an Allen wrench that is removed after activation. There are no projections of the switch beyond the missile skin. The MK 174 igniter on the MK 52 motor and the proposed MK 38-4 motor both incorporate this design. While an improvement over the present design, however, the new S & A device is still less than ideal and ready availability of the Allen wrench when needed, will create some problems.

Conclusion

The S&A switch on the MK265-0 igniter is frequently broken during missile handling. The switch has been redesigned and will be incorporated in future production. The new switch requires further improvement, however.

Recommendations

(1) That NAVAIRSYSCOM investigate the feasibility of incorporating the improved S&A device during periodic rework on Mk38-2 motors.

(2) That work be started now on further redesign of the new S&A device.

f. Moisture Intrusion

Discussion

During extensive captive flight operations in SEA, SPARROW missile failures are caused by moisture intrusion of the electronic circuitry. The problem is caused by free moisture from rain and clouds entering the missile through unsealed areas. Proposals from NAVMISCEN and Raytheon have been in review for three years. ALMC 17, requiring the squadron to tape the tunnel covers, has eliminated a major portion of the failures; however, this is an unnecessary maintenance burden to place on the operating activities.

Conclusion

Moisture intrusion degrades missile reliability by shorting out electronic components. An interim solution is required for existing missiles.

Recommendation

Expedite approval and installation of Raytheon ECP 47.

g. Failures of Side Receiver System (SRS) Crystals

Discussion

(1) Both NARF, Alameda, and NARF, Norfolk have observed a high rate of failed SRS crystals in Fleet returned SPARROW missiles. There is no test of this system except at the NARF's. It is suspected that RF radiation is damaging these crystals.

(2) NAVMISCEN and Raytheon are investigating to determine the cause, and recommend solutions.

Conclusion

An investigation of the SRS crystal failure rate is required, and the SRS should be evaluated for the need of more or improved tests to be made at NARF or field levels.

Recommendation

Raytheon and NAVMISCEN expedite completion of SRS crystal failure investigation.

h. SPARROW Desiccant Containers

Discussion

SPARROW G&C Section desiccant containers place an unnecessary maintenance burden on shipboard maintenance. Recent studies indicate that the requirement for continued use of these desiccant containers does not exist.

Recommendation

NAVAIRSYSCOM (AIR-5108C) expedite review of NAVMISCEN recommendations and approve the ALMB to delete the desiccant containers.

i. Missile Handling Damage

(1) Exterior portions of the missile are sensitive to damage during normal shipboard handling.

(2) Air-to-air missiles are presently designed and produced to the same general specifications as are air-to-surface missiles, yet the inherent requirement for a defensive weapon requires repetitive loadings

and captive flights while an attack weapon is primarily a one-shot device. External components or appendages on air-to-air weapons are not designed to withstand shipboard handling. On the SPARROW, the EPU chimney, tunnel covers and radomes are frequently damaged resulting in a no-go missile. The rollerons on the SIDEWINDER missile are extremely sensitive not only to damage but to salt air corrosion.

Conclusion

Because of the requirement for repeated captive flights for air-to-air missiles, the exterior components and appendages are subjected to extensive physical damage during shipboard handling. The difference between air-to-air and air-to-surface missiles must be considered during the missile design.

Recommendations

(1) Raytheon investigate design of an EPU chimney for the AIM-7E missile, less susceptible to damage.

(2) Review and modify AIM-7F specifications to reduce susceptibility to handling damage.

(3) Establish minimum design criteria for future systems.

j. SPARROW Missile Reliability

Discussion

All areas of shipboard operations were examined for possible degradation of missile reliability. It was concluded that the missile free flight guidance and fuzing reliability is not significantly degraded by shipboard operations, excluding captive flights, but is initially low when received and is further degraded during required captive flight cycling. There are no outstanding ECP's that will increase the missile reliability and the performance ECP's that have been incorporated, due to the increased complexity of the missile, have tended to lower the reliability. Substantial reliability improvements are required before definitive design information can be derived and the missile configuration can be standardized.

Conclusion

SPARROW missile free flight guidance and fuzing reliability is not significantly degraded during shipboard operations. It is low when received. A reliability improvement program is required prior to standardization of the missile.

Recommendations

(1) NAVAIRSYSCOM direct Raytheon to conduct a priority reliability improvement program that can be incorporated during periodic rework.

(2) Following qualification at NAVMISCEN, incorporate reliability improvements in all AIM-7E missiles at the NARF during periodic rework.

(3) NAVAIRSYSCOM institute and fund a continuing SPARROW reliability improvement program.

2. AIM 7F (SPARROW)

Discussion

The AIM-7F, like its predecessors, will be a semi-active, radar-homing, air-to-air missile, retaining essentially the same external configuration. However, advanced packaging techniques have resulted in a substantial reduction in the volume of missile electronics, permitting a significant increase in the size of the motor and warhead. Numerous improvements are being designed into the AIM-7F missile; the most notable of which are:

a. Reduced minimum launch range providing an effective dog-fight mode
b. Increased maximum range
c. Improved ECCM capability
d. Improved capability against multiple targets
e. Operation with either CW or PD illumination
f. Snap start
g. No field test required
h. Improved reliability
i. Increased P_{ssk}
j. Relative range mechanization to increase number of engagements per pass

Fleet introduction of the AIM-7F missile is estimated for mid 1970 or early 1971. Table I is a summarization of comparative AIM-7E/AIM-7F performance capabilities.

Included is a comparison of the AIM-7F performance capabilities available when utilized with an aircraft weapon system modified or not modified for complete AIM-7F compatibility.

	[1] AIM-7E-2	AIM-7F		
		[1] F-4B/J Unmodified	[2] F-4B Modified	[3] F-4J Modified
Rmin (Low Alt) Rmax (tail)	[4] 2,000 ft 11,000 ft	[4] 1,000 ft 26,000 ft	1,000 ft 26,000 ft	1,000 ft 26,000 ft
[7] Rmax (HO)	13.5 nm	13,5 nm/22.0 nm	22.0 nm	[6] 22.0 nm/27.0 nm
Maneuverability	25 g's	25 g's	25 g's	25 g's
Commit. Time	1.4 secs	1.4 secs	[9] 0.6 secs/1.7 secs	[9] 0.6 secs/1.7 secs
Sub Clutter Vis.	40 db	50 db	50 db	50 db
Lethality Fuzing Warhead	AIM-7E improved 65 lbs/30 ft	New fuze 90 lbs/40 ft	New fuze 90 lbs/40 ft	New fuze 90 lbs/40 ft
ECM	HOJ/FOJ	Improved	Improved	Improved
ASE	15°	15°	25°	25°
[8] Reliability	30 captive flights	75 captive flights	200 captive flights	200 captive flights
Aero Range (Hi Alt)	27 nm	53 nm	53 nm	53 nm
Differential alt	40 K ft	40 K ft	50 K ft	50 K ft
Mult target		Improved	Improved	Improved
Motor	Single Igniter	Dual Igniter	Dual Igniter	Dual Igniter
Contact Sensor		Improved	Improved	Improved
Altitude switching	Yes	Yes	Optimized	Optimized

Notes:

(1) Assumes AIM-7E-2 Dogfight changes have been made to aircraft.

(2) F-4B modification consists of AIM-7F changes and improved low altitude mechanization of non-maneuvering targets for AIM-7E-2.

(3) F-4J modification consists of digital AWG-10 with mechanization for maneuvering targets with Head-Up Display.

(4) Non mechanized - interlocks out.

(5) Interlocks in/Interlock out.

(6) Mechanized for both PD/CW.

(7) Seeker range for $2M^2$ target, 200 W CW, 440 W PD.

(8) AIM-7F on unmodified aircraft have the gyros running. Missile operates completely snap start on modified aircraft except in dogfight mode where the gyros are running.

(9) Dogfight mode/Normal mode.

[redacted] UNCLASSIFIED

Contractor development flight tests at NMC PT. Mugu to date have revealed several design deficiencies requiring correction before release to production. These are being addressed by NAVAIRSYSCOM, NAVMISCEN, and Raytheon.

Conclusions

a. The AIM 7F is a necessary and important addition to the Sparrow inventory from the standpoint of maintainability, reliability, and performance.

b. The AIM 7F is not yet ready for production and correction of design deficiencies now known may require additional research and development extending into mid or late calendar year 1969.

c. F4B/AIM 7F compatibility, while not yet fully explored, appears difficult to achieve and may not be reasonable from a cost-effectiveness standpoint.

d. F-4J modification, including a digital computer for the AWG-10 mechanized for maneuvering targets at all altitudes in a heads up display, is required to realize the full capabilities of the AIM 7F.

Recommendations

a. Delay AIM 7F production, substituting a continuing buy of AIM 7E2's on at least a one-for-one basis, until assured that the design is satisfactory and that missile performance is as originally predicted and expected.

b. Examine the cost effectiveness of modification of the F4B for full AIM 7F capability versus acceptance of limited AIM 7F capability on F4B aircraft configured for the AIM 7E 2.

c. Proceed with the orderly implementation of a plan to fully modify the F4J for AIM 7F carriage and delivery, such modification to include a digital computer for the AWG 10 and mechanization for maneuvering targets at all altitudes in a heads up display.

3. AIM-9 (SIDEWINDER)

A. Missile Breakup

Discussion

The primary problem currently being encountered with SIDEWINDER is that of AIM-9D breakup. Possibilities for failure are all under examination - such as - joints at all sections; clamp rings, depth of joint groove, launcher lugs, locks, and latches, and loading and handling procedures. Current status of work tasks is as follows:

[redacted] UNCLASSIFIED

(1) Revised launcher inspection criteria were distributed on 11 October 1968.

(2) A new coupling ring design was selected in October; torquing and assembly techniques were finalized.

(3) An improved warhead is now in production and should reach the Fleet in late November.

(4) Tests of a five-point launch improvement program are in progress.

(5) Environmental flight tests, somewhat delayed by F8 availability, are about 90% complete.

(6) An on-site quality review has been conducted at the site of the launcher manufacturer (VARO).

(7) Engineering and technical personnel are trouble shooting aboard the CVA's.

Conclusion

The AIM-9 breakup problem is a serious one, is not yet solved, but all possible steps toward solution are being essayed.

Recommendation

Press to earliest conclusion those actions now in process to solve the AIM-9 breakup problem.

B. AIM-9D Improvements

Discussion

The following improvements to the AIM-9D are scheduled:

(1) SKAMP - Improved fuze will provide increased kill probability against a fighter target. Scheduled for Fleet introduction July 1969.

(2) Large Canards - will provide increased missile maneuverability in a dogfight. Fleet introduction scheduled for July 1969.

(3) SEAM (Sidewinder Expanded Acquisition Mode) Slaves missile seeker head to aircraft radar. Increased look angle over standard AIM-9D. In Fleet now but programmer for F8's are slow in arriving. Test and evaluation program not yet completed at NMC, Pt. Mugu, and logistic support items (test equipment, publications, etc) lagging the hardware. Very little progress on F4 compatibility investigation.

Conclusion

The above improvement programs for the AIM-9D are all well in hand with the exception of SEAM Fleet introduction.

Recommendation

Expedite all aspects of a full Fleet operational capability for the AIM-9D (SEAM) to include both the F8 and the F4.

C. Solid State Electronics for AIM-9D

Discussion

NAVAIRS FY70 budget submission would provide about 185 units to the Fleet commencing in Sept 1970. Should improve off-axis tracking rate from 12°/sec to 20°/sec. Most important gains would be: improved producibility, 80% reduction in labor costs in rework, and 150% increase in reliability. As a longer term gain, space saved in the GCG (Guidance Control Group) as a result of transistorization could be exploited by providing a larger (about 50%) warhead.

Conclusion

The solid state Sidewinder is needed in the Fleet inventory, primarily on the basis of increased reliability, the most consistently missing quality in the current family of missiles.

Recommendation

CNO support the solid state Sidewinder program.

D. AIM-9C

Discussion

The AIM-9C is tied exclusively to the F8 radar and fire control system and is deployed only in the 27C class CVA. Low altitude performance is inhibited by the altitude line and performance below 10,000 feet is marginal. No further procurement is planned. A filter modification program (to provide high altitude capability up to 60,000 feet) in units being reworked is the only planned modification program. Fleet confidence in the AIM-9C is spotty. Logistics support is deteriorating.

Conclusion

Due to lack of need and emphasis the AIM-9C capability is slowly deteriorating and is a questionable commodity.

Recommendation

CNO reexamine the requirement for the AIM-9C and either remove it from the inventory or rejuvenate the support needed to render it a more effective weapon.

E. Non-Propulsive Attachment (NPA) for AIM-9B

Discussion

Ref: (a) COMNWC Ltr Ser 1928 of 17 May 1967

a. The Sidewinder AIM-9A missile was placed in Fleet use in 1956. A non-propulsive attachment (NPA) for the MK 15 motor was provided on the assumption that the assembled missile would be less hazardous to personnel and material, if the rocket motor were inadvertently ignited. The same NPA was used in the AIM-9B version of Sidewinder. This NPA has always been a source of confusion and argument.

b. The Sidewinder Weapons System Safety Manual requires installation of the NPA on the AIM-9B during assembly of the missile and authorizes removal of the NPA just prior to missile being loaded on the aircraft launcher. This rule requires that the NPA be brought to the flight deck on the missile, and removed and handled on the flight deck. The NPA thus becomes a FOD hazard. When missiles are downloaded the NPA is again installed. In some Fleet units, the NPA is installed at any time the missile is loaded on an aircraft and the aircraft is on the deck, and is removed just prior to flight. There have been several instances where the NPA's were left on missiles and in-flight firings were attempted, resulting in the loss of, or extensive fire damage to the aircraft. In one instance it resulted in the loss of a pilot.

c. The requirement for the NPA is inconsistent with requirements of AIM-9C and AIM-9D Sidewinder missiles which do not use NPA's. The use of the NPA is also inconsistent with all other air-launched missiles in Fleet inventory. The NWC (Naval Weapons Center) China Lake recommended removal of the NPA from Fleet inventory by reference (a); however, there was no action taken on the recommendation.

Conclusion

The utilization of a non-propulsive attachment (NPA) on the AIM-9B missile has created safety of flight problems and is inconsistent with the AIM-9C and -9D missiles.

Recommendation

Remove AIM-9B non-propulsive attachment from Fleet inventory and delete requirement from existing publications.

4. Design Evaluation

a. Surveillance Program

Discussion

ECP 50 has been proposed to incorporate elapsed time meters in the seeker and control sections of the AIM-7E missile. Because of the incompleteness of the missile logbooks, the elapsed time meters are essential for a component reliability monitoring program to relate operating time to component failure. However, such a program does not presently exist and is essential prior to any reliability improvement programs. Components cannot be improved or replaced until a failure rate can be established that is a function of operating time. AIM-9 surveillance efforts are better than those for AIM-7, but are not closely spelled out or supervised by NAVAIRSYSCOM.

Recommendations

(1) NAVAIRSYSCOM approve ECP 50 for retrofit in all AIM-7E missiles.

(2) NAVAIRSYSCOM direct the NARF's to immediately establish a reporting system that relates AIM-7 G&C serial number and recorded operating time (from the logbook until ECP 50 is incorporated) with major components replaced during rework.

(3) NAVAIRSYSCOM institute a failure investigation program for both AIM-7 and AIM-9. All failed components from the NARF Fleet Field Stations, etc., will be identified by missile serial number and sent to a QEL for failure mode investigations.

b. Evaluation of Ordnance Components

Discussion

Ordnance components of the Air-Launched Missiles are produced and delivered to the Fleet with inadequate engineering evaluation. Missiles are subjected to an extensive Navy Technical Evaluation following development including the motor, ignitor and safe and arm device. Subsequent developments, however, have been released for production with little or no evaluation. Approximately 2,000 MK-52 motors have recently been delivered to the Naval Weapons Stations. Following production, NAVMISCEN was requested to flight test several motors; however, neither the safe and arm device nor the ignitor have been evaluated.

Conclusion

Ordnance components introduced into the system subsequent to the Navy Technical Evaluation are not evaluated prior to Fleet use.

Recommendations

(1) NAVAIRSYSCOM direct NAVMISCEN to conduct an engineering evaluation of the MK-52 motor and associated components.

(2) NAVAIRSYSCOM initiate a NAVAIRINST defining the scope of the Navy Technical Evaluation that is required as a mandatory checkpoint prior to Fleet introduction of missile systems and subsystems.

5. Configuration Control

a. AIM-7E (Sparrow)

Conclusion

The AIM-7E configuration cannot be frozen at this time because several problems require solution prior to configuration freeze.

Recommendations

(1) Vest configuration control in NAVAIRSYSCOM (Air 05)

(2) Incorporate in all AIM-7E's:

(a) ECP-54 AIM-7E2 Modification
(b) ECP-47 Moisture Intrusion Fix
(c) ECP-50 Elapsed Time Meters

(3) Request ECP's from contractor and incorporate to provide:

(a) Decrease time from Trigger Squeeze to Launch (EPU Settling Time)
(b) Improved EPU Chimney
(c) Correction to SRS Crystal Failure
(d) Incorporate Internal Motor Fire

(4) Eliminate all AIM-7C Missiles from inventory, publications and training.

(5) Restrict all AIM-7D Missiles to training operations only.

B. AIM-7F (Sparrow)

Conclusion

The AIM-7F design cannot be frozen at this time due to design problems uncovered and still unresolved in contractor flight demonstrations.

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Recommendations

(1) Prosecute to satisfactory conclusion those design changes/ modifications required to achieve predicted and desired AIM-7F performance.

(2) Delay production of the AIM-7F until present problems are resolved and design can be frozen.

C. AIM-9 (SIDEWINDER)

(1) AIM-9B

Discussion

Out of production. Design is frozen. Reworked missiles are at a standard configuration.

Recommendation

Retain present configuration.

(2) AIM-9C

Discussion

Out of production. Missile should either be fully supported or eliminated from the inventory. Any change in configuration is contingent on plans for future operational deployment.

Recommendation

CNO re-evaluate requirements for current and future employment of the AIM-9C. In interim, maintain present configuration.

(3) AIM-9D

Discussion

Present improvement program is sensible, orderly, and necessary.

Recommendation

Recommended configuration is:

MK18	Mod 2	GCG
MK15	Mod 4	Skamp
MK12	Alternate canards.	

Maintain this design configuration until solid state produceability and reliability improvements can be made.

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C. Launchers

The Launcher problems can be attributed both to design as well as to repetitive captive flight cycling during extensive combat operations. Only 3 current launcher design problems are reported; however, their importance should be emphasized in that a launcher failure not only degrades system performance, but negates it, resulting in a fail to launch or no motor fire.

1. <u>Sparrow Motor Fire</u>

<u>Discussion</u>

The misfire rate of the Sparrow missile increases from 2% during controlled firings at NAVMISCEN to approximately 25% during combat firings. Extensive redesign of the launching system has failed to eliminate or decrease the high misfire rate. The other ejection launched missiles in operation maintain a motor fire reliability of 97-98% with the primary difference being in the method of applying motor fire. The Sparrow misfire problems are attributed to the reel and connectors providing the motor fire pulse to the rocket motor during ejection. All other ejection launched missiles provide motor fire from internal missile power and avoid this complexity.

<u>Conclusion</u>

The Sparrow motor fire is unreliable due to the complexity of the motor fire connection between the missile and launcher.

<u>Recommendations</u>

a. NAVAIRSYSCOM issue an urgent IALMB again re-emphasizing importance of launcher maintenance to system operation.

b. NAVAIRSYSCOM expedite procurement of improved lower motor fire connector (MDC P/N 32-94758-17).

c. NAVAIRSYSCOM institute priority redesign of missile and launcher providing initiation of motor fire through the umbilical.

2. <u>Sparrow Umbilical Plug Disconnect and Shorting Problems</u>

<u>Discussion</u>

Recent Fleet reports indicate problems of the umbilical plug disengaging in flight and pins shorting to the launcher after missile launch.

Recommendation

NAVAIRSYSCOM (AIR-5102F) expedite approval and incorporation of McDonnell-Douglas Corporation ECP-929.

3. LAU-7 Sidewinder Launcher Effects on Missile Vibration During Captive Flight

Discussion

Extensive Sidewinder missile breakups occurring in SEA have been attributed, in part, to improper snubbing of the missile on the Varo-produced LAU-7 launcher.

Recommendation

NAVWEPCEN China Lake expedite the investigation and resolution of the current LAU-7 problems.

4. AERO-7A Ejector Foot Pads

Discussion

Existing procedures require installation of a rubber pad between the ejector foot and the AIM-7 missile during loading. The pad is frequently omitted. Permanent bonding to the foot does not seem desirable because of deterioration of the rubber over extended periods.

Conclusion

A rubber pad or similar device that can be easily fastened and removed from the ejector foot is required.

Recommendation

NAVAIRSYSCOM request an ECP from MDC for shock mitigating attachment to the AERO-7A ejection foot that can be readily replaced by deploying activities.

POST GRADUATE FIGHTER WEAPONS SCHOOL

Detailed conclusions and recommendations

A Post Graduate Fighter Weapons School (FWS) is required to train selected pilots and supervisory personnel of all fighter squadrons. The Fighter Weapons School requirement would be to train 20 aircrews in the F4 per year and 10 pilots in the F8 per year. The aircrew syllabus should consist of 25 hours per pilot/aircrew in the F8 or F4 aircraft, 75 hours of classroom and a course duration of four weeks. Based on current F4/F8 aircraft utilization, the total aircraft necessary to support this advanced FWS syllabus, and train 30 pilots/aircrews at NAS MIRAMAR is 3 F4s and 2 F8s aircraft per year. The instructor/detachment officer requirement is as follows:

1 Officer-in-charge (F4 or F8 pilot)
3 F4 pilot instructors
3 F4 RIO instructors
3 F8 pilot instructors
1 Aviation Ordnance Officer

Enlisted instructor requirements will be based on the number of supervisory enlisted personnel to be trained.

Status

The FWS at NAS MIRAMAR will train the first class of F8 Weapons Training Officers commencing 2 December 1968. Aircraft for this FWS class will be supported by the individual's squadron assets. F4 FWS will be operational in January 1969. VF-121 should be augmented by 3 F8 aircraft to support annual FWS requirements. Organization of FWS and billet requirements will be submitted to CNO for approval by 1 January 1969.

In addition to the training of aircrews in weapons employment, the Fighter Weapons School will provide the vehicle to accomplish some additional functions. These will include, but are not limited to, the following:

BRIEFING TEAMS

Because of the expert weapons employment/system knowledge, the Fighter Weapons School would provide a briefing team to visit shorebased and deployed squadrons thereby keeping them updated on the latest weapons systems information. In connection with visits to deployed squadrons it is highly desirable to have the FWS representatives fly with the squadron. This would provide the latest techniques and allow the FWS to be updated to new operational requirements.

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FWS NEWSLETTER

New developments in weapons or in tactics should be made available to all operational units as soon as possible. This could be accomplished through a newsletter type of publication. In addition, the distribution of AEN's, and other newsletter publications should be controlled through the Fighter Weapons School.

AIRCREW MISSILE EXAM

Presently there is no system in effect to determine the level of weapons system knowledge of the aircrews. A ground weapons system proficiency and flight is required. The FWS should have the responsibility to prepare the examination and spot checks aircrews within squadrons.

TECHNICAL CLEARING HOUSE

There are a great number of technical publications produced by various agencies on the same weapons system. These technical publications need to be reviewed by the FWS to insure that they are correct and indeed are required. The FWS should have this responsibility.

TACTICS DEVELOPMENT

The FWS should have the responsibility to verify current fighter tactics and develope new air-to-air and air-to-ground tactics for the fighter tactical manuals.

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AIR COMBAT MANEUVERING RANGE

Detailed Conclusions and Recommendations

Air Combat Maneuvering Ranges (ACMR) are required to train aircrews in the employment of Sparrow (AIM 7D/E), Sidewinder (AIM 9B/D) and 20 MM guns in close-in air-to-air combat where visual recognition of firing parameters is required. Air Combat Maneuvering Ranges are required in the Virginia Capes and the Yuma/El Centro areas. The facilities consist primarily of two ground based tracking radars and a digital computer. The computer uses the radar tracking data and stored data describing permissible missile firing envelopes to score missile launches. A conventional aircraft communications channel provides the computer with missile launch time and, within two seconds of simulated launch (pickle push), the pilot is informed as to the accuracy of his visual interpretation of the missile firing envelope. The ACMR is not designed to eliminate the requirements of periodic missile firings by flight crews but to provide significantly more training without the expenditure of additional missiles.

a. ACMR Requirements

(1) Air Space Requirements - For the simultaneous conduct of two distinct and separate air engagements by exisitng and future supersonic aircraft, and unrestricted air space of approximately 80 nm by 80 nm by 30,000 ft is required.

(2) Aircraft Tracking Requirements - The range must be capable of handling up to two aircraft each capable of 6G maneuvers.

(3) Data Accuracy Requirements - The following maximum tolerances on the ACMR output Data:

TCA	within 5° rms
R	within ± 10%
V_c	within ± 10%
Fighter/Target climb or Dive Angle	within ± 10° from 0 to ± 60°

(4) Computation Requirements - The computation of the required parameters and their comparison to the missile firing envelope boundaries must be accomplished within two seconds of receipt of "fox" signal.

(5) Range Development Completion Date - The ranges should be completed by November 1969.

b. The Air Combat Maneuvering Range (ACMR) Technical Development Plan prepared by Johns Hopkins University - Applied Physics Laboratory provided a detailed analysis of ACMR requirements.

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SPARROW AIM-7E/E2 MISSILE ENVELOPES

1. The fire control mechanization for the F4/SPARROW Weapons System was optimized for the Fleet Air Defense environment. The equations were determined and mechanized for a medium altitude engagement against a non-maneuvering target. This mechanization compensates for altitude and closing velocity, to provide acceptable firing parameters throughout the entire altitude regime. The mechanization cannot depict the firing parameters for a maneuvering target because of the changing size and shape of the maneuvering target envelope.

2. The attached AIM-7E/E2 SPARROW envelopes depict the missile performance capabilities computed for "PIPPER ON" (0° Lead Angle) and "TRIGGER SQUEEZE" for maximum and minimum ranges at 5K feet and 25K feet altitudes. Target maneuvers of 0 lateral "G" (non-maneuvering), 3"G" and 4.5 "G" are depicted.

3. In addition to the envelopes printed, an overprint of the APA-157 computer mechanization has been provided to show the relationships to the missile capability. The outside mechanization line labeled "APA-157 RMAX" is shown to the aircrew as an "in range" light. The center mechanization line labeled "MAX ASE" is presented to the aircrew as the maximum dilation of the allowable steering error (ASE) circle. The inside mechanization line labeled "RMIN" is presented to the aircrew as a "BREAK-AWAY X".

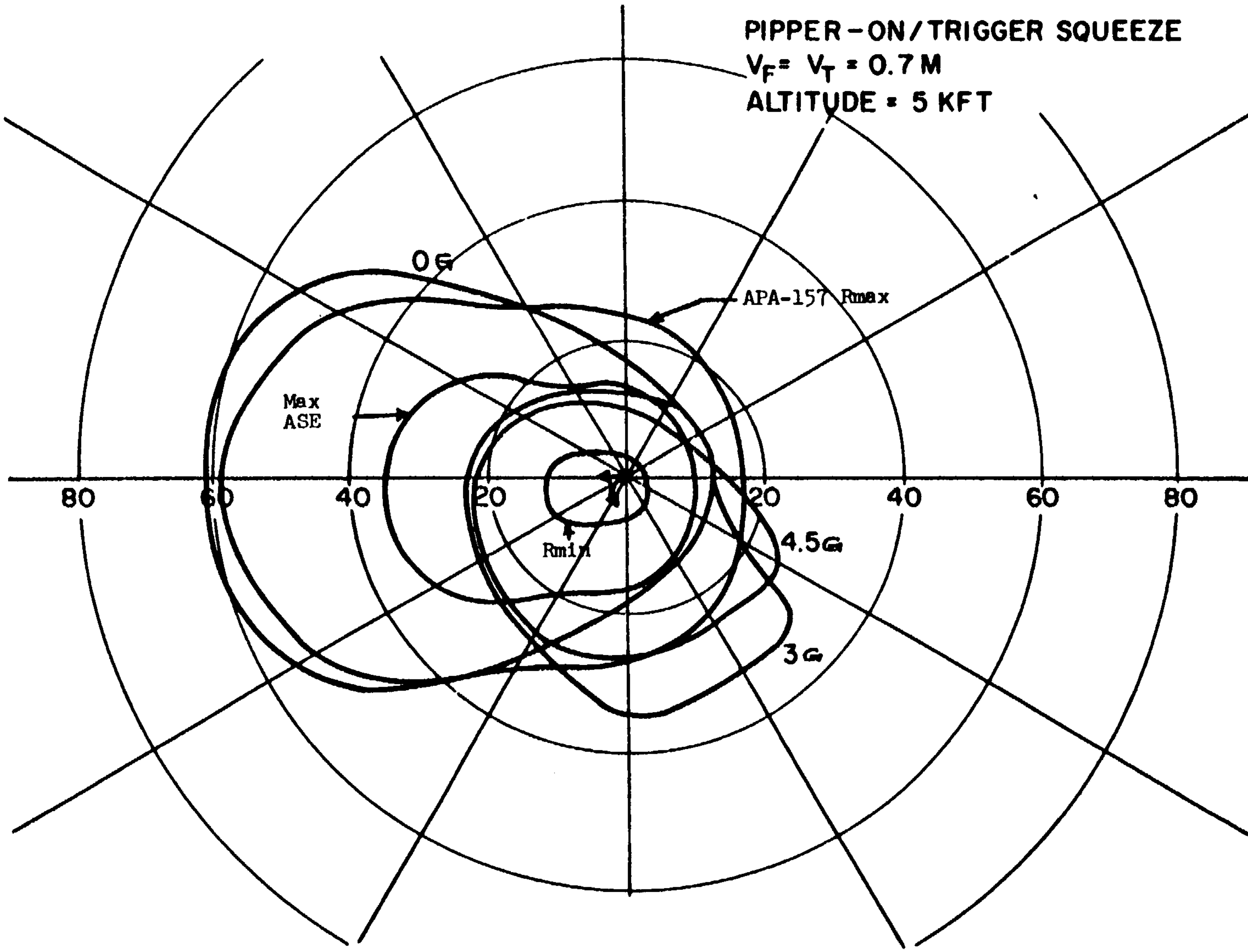
4. A brief review of the 5K feet maximum range envelopes reveals that the RMAX "in range" indication to the aircrew is valid for a non-maneuvering target and within the missile performance capability from the head-on position to approximately 60° either side of the head-on position. Beyond that, the "in range" light will come on, but the missile does not have the capability to intercept the target. The best way for the aircrew to determine RMAX for the remainder of the envelope is to use the maximum dilation of the ASE circle.

When the target maneuvers at 3 or 4.5 "G", the envelopes change both size and shape. The APA-157 mechanization must be understood in order to give the aircrew some indication of position in the missile performance envelopes.

5. A maximum range, maneuvering target study recommended that the maximum range of the SPARROW missile against maneuvering targets was .4 of the maximum aerodynamic range (R_A). This point occurs at one half of the range between maximum dilation of the ASE circle and the Break X. This insures that the missile has the capability of completing the intercept against a maneuvering target, and also points out that a maximum range "Rule of Thumb" exists: 2 miles on the tail, 3 miles on the beam, and 4 miles head-on.

6. In the minimum range envelopes against a maneuvering target, a similar guide exists to enable the aircrew to position itself in the envelope. The Break X (RMIN) was mechanized in the APA-157 for the AIM-7E against non-maneuvering targets. The AIM-7E2, with its reduced minimum range capability, now has the ability to intercept the maneuvering target when fired at the mechanized RMIN. This Break X also happens to occur at approximately the minimum range "Rule of Thumb": 1/2 miles on the tail, 1 mile on the beam, and 2 miles head-on.

7. These envelopes are a preliminary look at the missile/weapons sensitivities and mechanization. Additional study of the SPARROW envelopes has been proposed.



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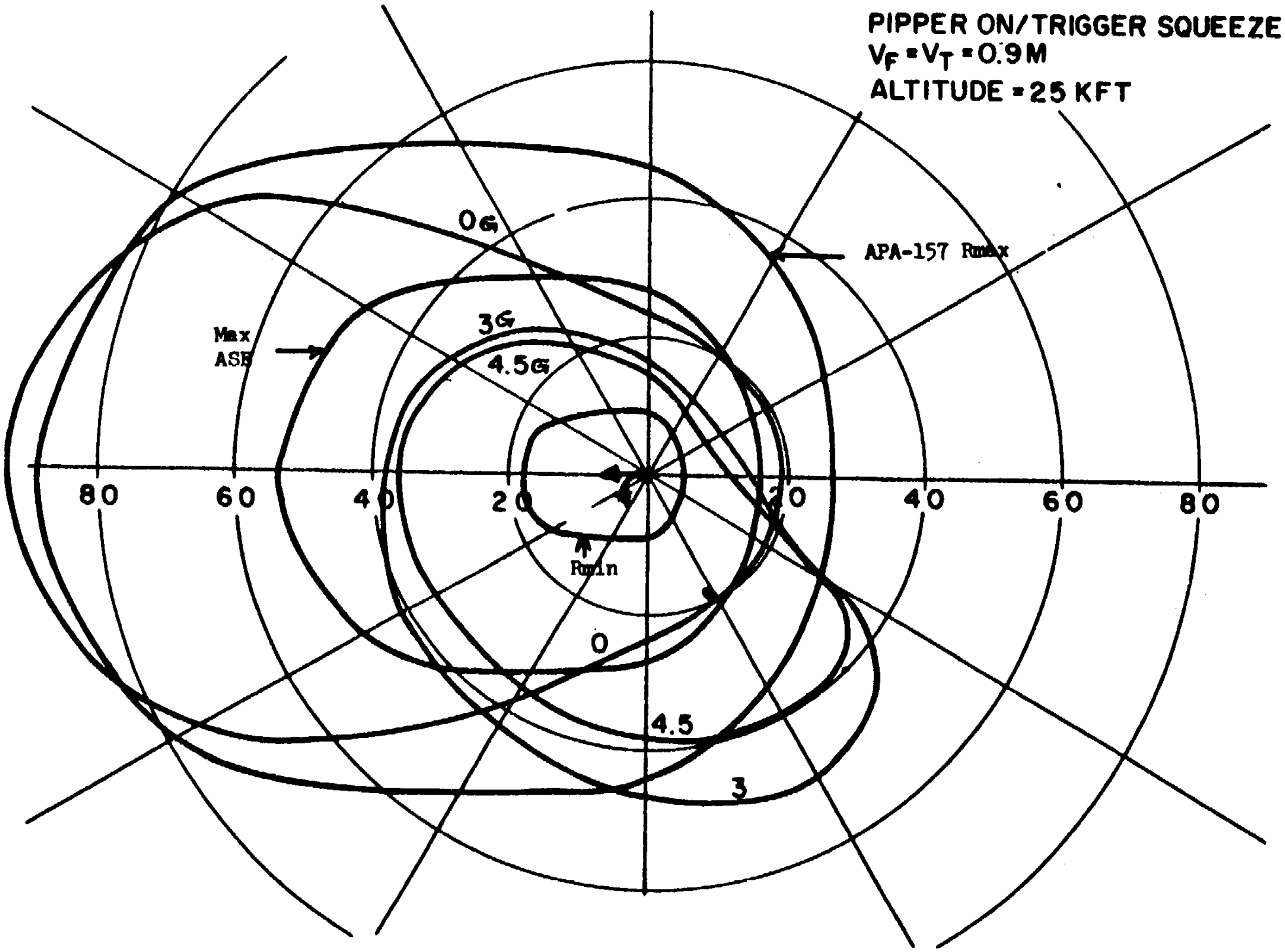

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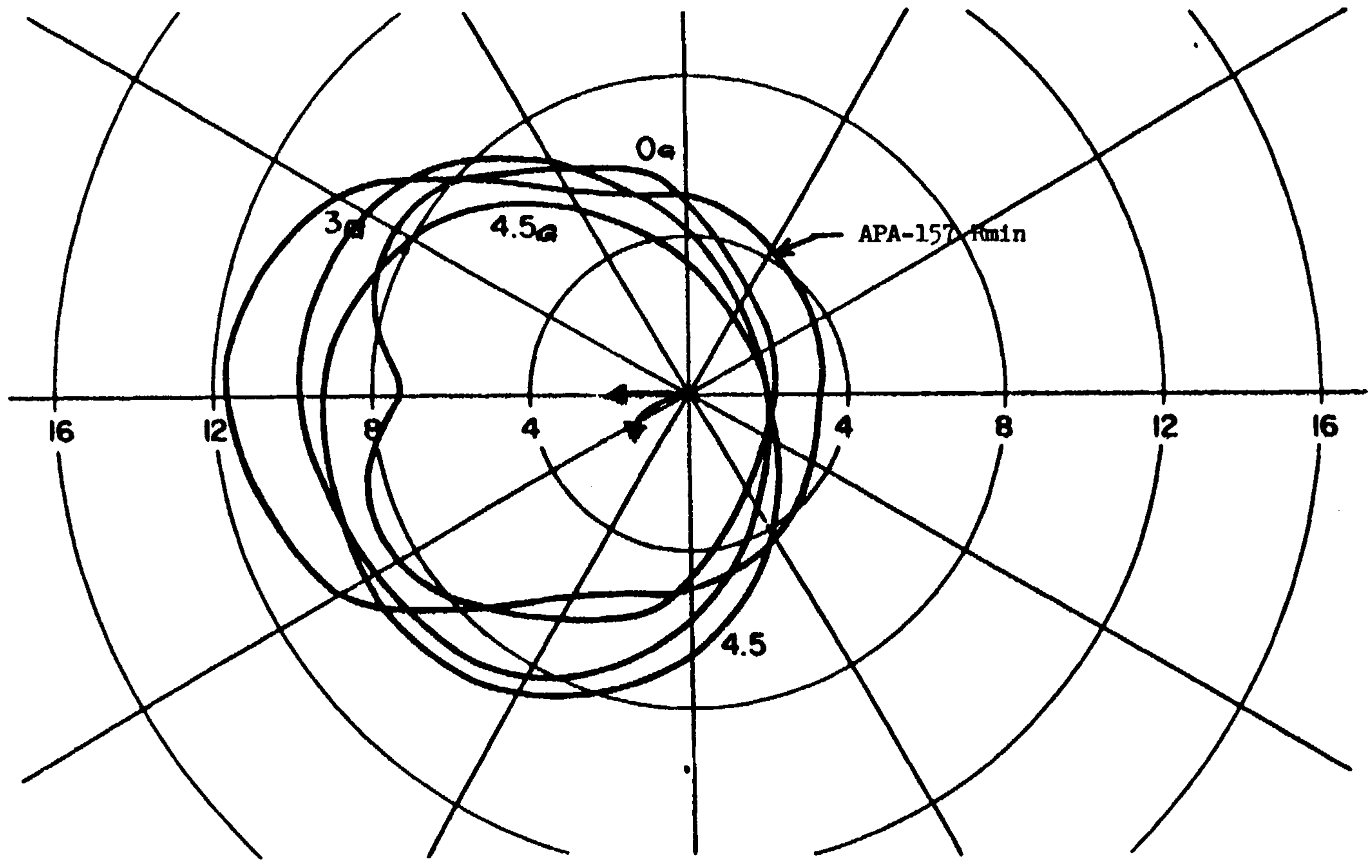
PIPPER ON/TRIGGER SQUEEZE
$V_F = V_T = 0.7$ M
ALTITUDE = 5 KFT



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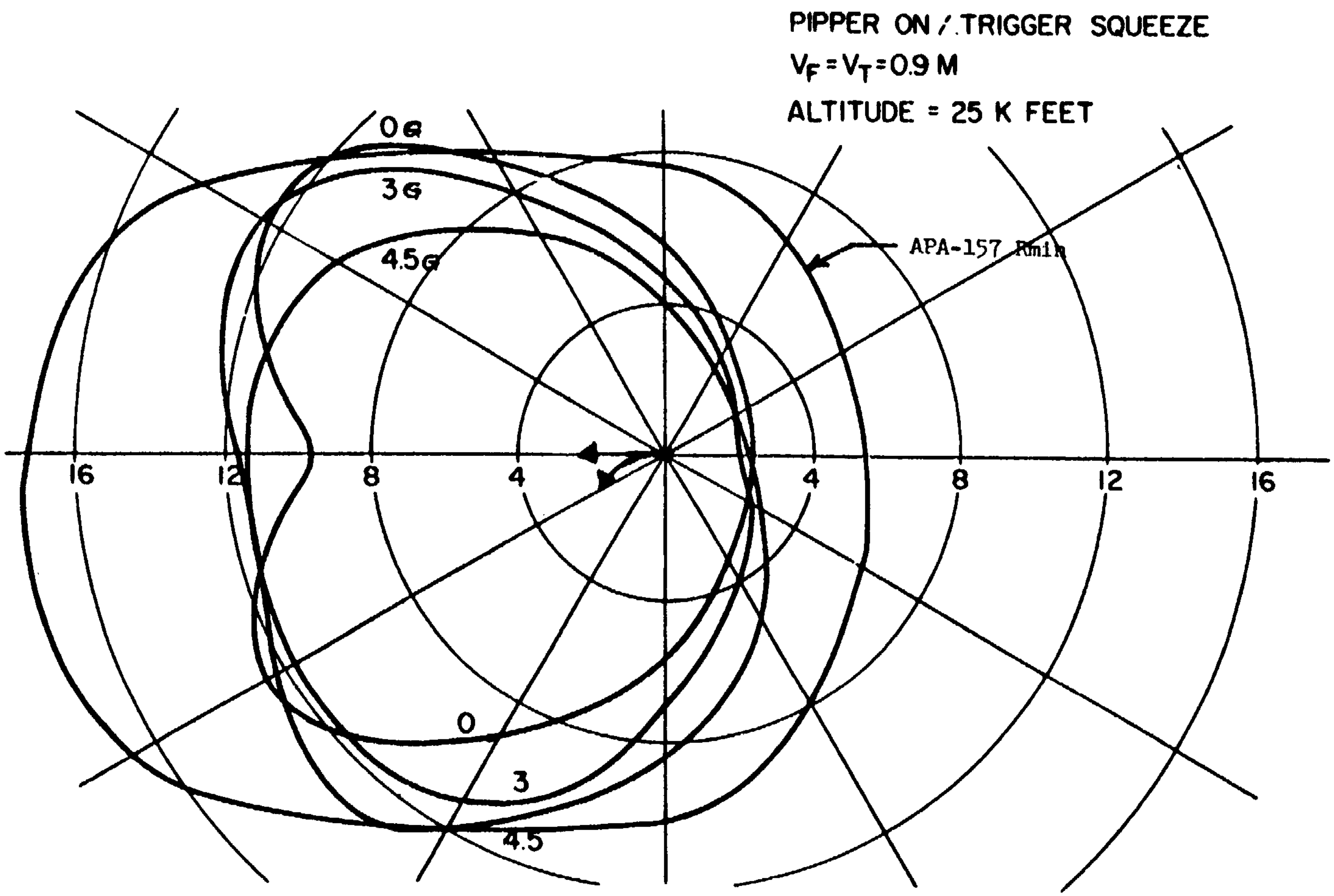

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Funding Estimates

1. All of the recommendations of Task Team Four are considered covered within fiscal planning for current programs, except for the following:

a. Items for which funding estimates are possible:

Paragraph	Subject	Costs (x 1000) Initial	Recurring
I. B.	Forward Area Firing Program	6,000	6,000
I. D.	Inert Training Missile Allowances	250	50
I. F.	Air Combat Maneuvering Ranges*	7,950	2,000
II. A.	AIM-7 Envelope Studies	150	--
II. B.	AIM-9 Envelope Studies	75	--
III. B.	DC-130's	3,500	--
III. E.	AIM 7 Training Film	40	--
III. F.	In-flight Simulator	100	4,000**
VI. A.4	F4B Configuration	3,476	--
VI. A.4	F4J Configuration	9,378	--
VI. B.1	AIM-7 Head Droop	565	--
VI. B.5	AIM-7/9 Configuration	8,469	--
VI. C.1	SPARROW Motor Fire	900	--
VI. C.2	SPARROW Umbilical	67	--
	TOTALS	40,940	12,050

* Will provide one range for each coast.

** Based on amortizing development costs and production buy of 40-50 per year for five years.

b. Items for which further investigation is required:

I. E.	Post Graduate Fighter Weapons School
III. C.	Drone Recovery Vehicles
IV. A.	F8H/J Cockpit Advisory Lights
IV. B.	F4 Range Meter
IV. C.	F4 Cockpit Display
V. A.	Combat Telemetry
VI. C.3.	LAU-7 SIDEWINDER Launcher
VI. C.4.	AERO 7A Ejector Foot Pads