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PROJECT CHECO SOUTHEAST ASIA REPORT

COMBAT SNAP
(AIM-9J Southeast Asia Introduction)

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14. ABSTRACT

Project CHECO was established in 1962 to document and analyze air operations in Southeast Asia. Over the years the meaning of the acronym changed several times to reflect the escalation of operations: Current Historical Evaluation of Counterinsurgency Operations, Contemporary Historical Evaluation of Combat Operations and Contemporary Historical Examination of Current Operations. Project CHECO and other U. S. Air Force Historical study programs provided the Air Force with timely and lasting corporate insights into operational, conceptual and doctrinal lessons from the war in SEA.

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PROJECT
Contemporary
Historical
Examination of
Current
Operations
REPORT

COMBAT SNAP
(AIM-9J Southeast Asia Introduction)

24 APR 74

HQ PACAF
Directorate of Operations Analysis
CHECO/CORONA HARVEST DIVISION

Prepared by:
Major John W. Siemann
Project CHECO 7th AF

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS PACIFIC AIR FORCES
APO SAN FRANCISCO 96553

PROJECT CHECO REPORTS

The counterinsurgency and unconventional warfare environment of Southeast Asia has resulted in USAF airpower being employed to meet a multitude of requirements. These varied applications have involved the full spectrum of USAF aerospace vehicles, support equipment, and manpower. As a result, operational data and experiences have accumulated which should be collected, documented, and analyzed for current and future impact upon USAF policies, concepts, and doctrine.

Fortunately, the value of collecting and documenting our SEA experiences was recognized at an early date. In 1962, Hq USAF directed CINCPACAF to establish an activity which would provide timely and analytical studies of USAF combat operations in SEA and would be primarily responsive to Air Staff requirements and direction.

Project CHECO, an acronym for Contemporary Historical Examination of Current Operations, was established to meet the Air Staff directive. Based on the policy guidance of the Office of Air Force History and managed by Hq PACAF, with elements in Southeast Asia, Project CHECO provides a scholarly "on-going" historical examination, documentation, and reporting on USAF policies, concepts, and doctrine in PACOM. This CHECO report is part of the overall documentation and examination which is being accomplished. It is an authentic source for an assessment of the effectiveness of USAF airpower in PACOM when used in proper context. The reader must view the study in relation to the events and circumstances at the time of its preparation--recognizing that it was prepared on a contemporary basis which restricted perspective and that the author's research was limited to records available within his local headquarters area.

Robert E. Hiller

ROBERT E. HILLER
Chief, Operations Analysis
DCS/Plans and Operations

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS PACIFIC AIR FORCES
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V. H. Gallacher

V. H. GALLACHER, Lt Colonel, USAF
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FOREWORD

(S) Combat Snap is the code name used to identify (1) a development phase and (2) the introduction into Southeast Asia (SEA) of the AIM-9J tactical air intercept missile (AIM). From the start of the air superiority contest in early 1965 to its conclusion in January 1973, it was apparent to both commanders and fighter pilots that a reliable, close range, dogfight-environment air intercept missile was needed. AIMs in the USAF inventory had been designed for the Air Defense mission against a non-maneuvering target.* In an attempt to resolve this deficiency, the Philco-Ford Corporation proposed, designed, and developed for Air Force acceptance the AIM-9J. The Air Force conducted preliminary testing of the AIM-9J under two programs: AIM-9J End Game II Development Program, August 1970, and Combat Snap (Phase I), April-July 1972.** The Chief of Staff, USAF (CSAF), authorized the introduction of the AIM-9J into SEA on 8 June 1972 under the code name COMBAT SNAP (Phase IIA).

(S) This report documents the need for, evolution of, and combat employment of the AIM-9J. Although this report is primarily concerned with the history of the AIMs' performance in SEA and the resulting attempts to improve the missiles, it must be recognized that the aircrew is a vital factor in the successful employment of missiles. Thus, the kill rate of the missiles is greatly influenced by the level of aircrew training in

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*(S) I.e., they had been designed for use in the intercept role against hostile bombers.

**Only limited coverage of these test programs is provided in this report, because not all test data and results were available in SEA during report preparation. Test programs conducted for other types of air-to-air missiles are beyond the scope of this report.

air-to-air employment of USAF fighter weapon systems against maneuvering MIG-sized targets. This training must include live missile firings against realistic targets.

(U) The author expresses his gratitude and appreciation to the members of the 432nd Tactical Reconnaissance Wing (TRW), Tactics and Operations Division, Udorn Royal Thai Air Force Base, Thailand, for their cooperation and assistance in the development of this report.

OVERVIEW

(S) Air-to-air engagements began during United States air operations over North Vietnam (NVN) on 3 April 1965 under the code name ROLLING THUNDER.[1] The American forces directed their air strikes primarily against selected logistics targets and lines of communication in an attempt to exert pressure on NVN and to halt supplies necessary to wage war in the south. It was during one of the more massive interdiction raids on the Thanh Hoa Bridge near Hanoi that America lost two F-105s to enemy MIG-17 cannon fire. These were the first U.S. tactical aircraft downed by MIGs in the Vietnam conflict.[2] As operations over the north continued, MIG encounters became more frequent. On 10 July 1965, two F-4Cs, assigned to the 45th Tactical Fighter Squadron, downed two MIG-17s using infrared (IR) heat-seeking missiles. The air intercept missiles used in this encounter were Sidewinders (AIM-9s)*--"the missile destined to be one of the Air Force's most reliable and destructive air-to-air weapons."[3]

(S) Early in the history of aerial combat over NVN, American pilots learned the enemy's tactics, friendly versus enemy aircraft performance capabilities, and most important to the fighter pilot, air-to-air weapon effectiveness, reliability, and limitations. An analysis of air encounters during ROLLING THUNDER, 3 April 1965-31 October 1968, showed that USAF tactical fighters downed 66 MIGs and Navy aircraft destroyed 30 MIGs.[4] In the loss column, the Air Force and Navy lost** 15 and 8 aircraft respectively. Air

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*In this instance, they were the heat-seeking "B" models.

**(S) The NSA SIGINT Report 2/0/VCK-E/R97-70, pp. II-A3-15 to II-A3-25 shows that the USAF lost some 35 aircraft and the Navy at least 7 during this period.

Force air-to-air ordnance during this period of intense MIG activity consisted of either heat-seeking AIM-4D (Falcon) and AIM-9B (Sidewinder) or radar controlled AIM-7E (Sparrow) missiles. Of the MIGs downed by USAF aircraft during ROLLING THUNDER, 30 kills (46 percent) resulted from either the AIM-4D or 9B; AIM-7E destroyed 25 MIGS (38 percent); and guns destroyed the remaining 11 MIGs (16 percent) at close range.[5] Although a commendable 4:1 kill ratio existed in the U.S. favor at the end of ROLLING THUNDER, aerial combat experience proved that the existing AIMs possessed limited capability when MIG engagements occurred in a close range maneuvering combat environment.

(S) From the beginning of the first extended bombing halt on 1 November 1968, air activity over NVN was inconsequential.[6] The cessation of air strikes provided both American and NVN Air Forces the needed time to analyze prior air-to-air engagements, modify tactics and strategy, and improve weapon systems, and both sides progressed in sophistication of weapon development.

(S) The next major phase of air operations over NVN occurred during 1972. In response to NVN's invasion of South Vietnam, bombing resumed over southern North Vietnam with the initiation of FREEDOM TRAIN operations on 30 March 1972. On 9 May 1972 the U.S. mined Haiphong Harbor, and the following day Operation LINEBACKER began as air strikes were resumed in the heartland of NVN.[7] MIGs were again encountered. The MIG Combat Air Patrol (MIGCAP) and escort aircraft flown by U.S. fighter pilots fluctuated between periods of aerial defeat and victory. The U.S.

suffered their greatest losses in late June and July. General John W. Vogt, Commander of 7th Air Force, expressed his sentiments about this phase of the air war as follows:[8]

> When LINEBACKER started, we did quite well for the first few months. In May and June we were doing better than one-to-one. In the latter part of June and the month of July, they really started getting to us. We were losing more airplanes than we were shooting down. In August we reversed this very dramatically, and we have sustained a four-to-one ratio ever since. This is the most effective show we've had during the entire war with the battle against the MIGs, over a sustained period. The answer was that we went into a much more sophisticated system for providing warning for the defending pilots--our guys.

(S) The development on 31 July 1972 of TEABALL* greatly enhanced the defensive posture of the F-4 fleet. From its inception, TEABALL provided the friendly fighter advanced MIG warnings and the necessary time to prepare for an accurate missile launch. As General Vogt stated, ". . . if you can show an American fighter pilot where the enemy is in sufficient time, he'll shoot him down."[9]

(S) In an earlier development which also had a significant impact on air-to-air engagements, the F-4E had been added to the F-4 fleet. This updated version of the F-4 possessed an internally mounted 20 millimeter (mm) gun and carried an advanced version of the radar guided AIM-7E-2 and the improved heat-seeking AIM-9E.[10]

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*(S) TEABALL--code name for a long range integrated ground control and warning system that provided friendly pilots with near real-time information on MIG activity.

(S) During the first four months of LINEBACKER I (10 May-10 September 1972), the Air Force lost 17 F-4s and one F-105 to MIG aircraft over NVN. Fifteen other F-4s and one other F-105 were lost over NVN: six F-4s to surface-to-air missiles (SAMs), five F-4s to anti-aircraft artillery (AAA) or gunfire, and four F-4s and one F-105 to unknown causes.[11] In comparison, NVN lost 40 MIGs to U.S. aircraft during the same period. Thus, during 1972 America once again achieved air superiority over NVN; however, several significant factors continued to greatly concern the fighter pilot. They included marginal air-to-air weaponry reliability, lack of close-in kill capability, and missile launch procedure complexity. The Rules of Engagement requirement for positive visual aircraft identification also imposed restrictions on AIM missile employment. On numerous occasions, attacking U.S. aircraft found that by the time visual identification of the MIG had been made, they were no longer in the prescribed missile launch or range envelopes. The engagement then became a short-range maneuvering encounter which further compounded the problem for an accurate missile launch. In the first seven months of 1972, 149 Sparrow missile firings by USAF aircraft resulted in 20* MIG kills, and 30 USAF Sidewinder firings resulted in 3 MIG kills.[12] Although a definite increase in MIG kills occurred, missile reliability still remained a significant Air Force problem. A survey of the missile problem stated:[13]

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*(S) The Air Defense Analysis Center (ADAC) at Hq PACAF shows 19 as the number of MIG kills by the Sparrow during this period.

> Regarding a dogfight missile, most aircrews . . . believe a short-range, high G, high angle-off missile is needed. However, they want it to have reliability and simplicity, which present-day missiles lack.

(S) The need for an improved AIM missile was clear from the aircrew viewpoint, and that need was supported by statistics derived from the various air encounters over NVN. Throughout the entire air war, new systems such as the AIM-9E and AIM-7E-2 were designed and introduced into the war at regular intervals. However, a true "air superiority" missile was not yet available.

CHAPTER I

AIR INTERCEPT MISSILE (AIM) EMPLOYMENT AND EFFECTIVENESS, SEA*

(S) The inventory of the USAF air-to-air weaponry used during ROLLING THUNDER consisted of radar controlled AIM-7D/7Es and infrared heat-seeking AIM-4D/9Bs. Air Force F-4C/Ds, flying either in a MIGCAP or escort role in support of air strikes over NVN, often carried four AIM-7s mounted in the fuselage, four AIM-4D/9Bs (two under each wing), and an externally mounted 20mm cannon. On numerous occasions, all three weapons failed to achieve a kill in short-range dogfights. One of the major problems associated with these AIMs was their lack of reliability and probability of kill in a maneuvering air encounter. Both categories of missiles, designed for use against non-maneuvering systems, proved ineffective against maneuvering MIG-17s and MIG-21s.[14]

AIM-4D

(S) The AIM-4D (Falcon) arrived with the F-4D in SEA in June 1969.[15] Designed as a passive, infrared-homing missile, and employed as a short range, low-aspect weapon, its use in combat was limited. Overall, its limitations included: warhead size, fuzing, IR discrimination, gimbal limits,** maneuverability, range, and cooling.[16] Unlike the AIMs-7 and 9,

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*For a more comprehensive explanation of the AIMs discussed in this chapter, see (S) Project Red Baron II, Vol II, Part 2: Ordnance Firing, January 1973.

**Maximum angular deflection of missile target seeker from the missile's longitudinal axis.

the AIM-4D had to score a direct hit on the target aircraft to destroy it due to the missile's small warhead size (7.5 pounds*) and impact fuzing restriction. Infrared discrimination also imposed limitations on the use of the missile. In a pursuit mode of engagement, as the angle-off the target tail increased from zero degrees,** the missile IR seeker tended to transfer its aiming point from the target aircraft to the target's exhaust plume, the area of greatest infrared energy radiation.[17] Thus, many near misses occurred that might have inflicted damage to enemy aircraft if the missile had the added benefit of a larger warhead and proximity fuze. Coupled with these and other design deficiencies, the AIM-4D launch activation procedures were extremely complex and time consuming. According to the RED BARON reports, which describe known air-to-air encounters, the FALCON was considered the most complex to fire of all air-to-air missiles in the USAF inventory. The minimum time required to prepare and launch the missile was approximately 4.2 seconds from cooling initiation to actual launch. (After preparation, early models of the AIM-4 had to be fired within two minutes due to a coolant limitation.) To a fighter pilot, flying at high Mach airspeeds during MIG engagements, 4.2 seconds was impractical.[18] Thus, many firing opportunities were lost.

(S) Due to its limitations, the combat utilization of the AIM-4D in SEA was low--only 48 firing attempts occurred during ROLLING THUNDER,

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*(S) The weight of the explosive warhead is 7.5 pounds and the weight of the total warhead is 16.6 pounds.

**I.e., as the target shifted from other than the straight-ahead, common course position.

resulting in five confirmed kills.[19] General William Momyer, Commander, Seventh Air Force, expressed his concern about employing the AIM-4D when he said in a personal message to General Ryan:[20]

> Tactical limitations of the AIM-4D render the weapon unsuitable for operation over NVN. We have experienced the majority of our MIG kills with the Sidewinder and are reluctant to give it up unless deficiencies of the AIM-4D are overcome.

Colonel Robin Olds, Commander of the 8th Tactical Fighter Wing (TFW), and his experienced pilots did not achieve success with the missile. During June through August 1967, the 8th TFW made 15 launch attempts. These resulted in 10 actual launches, none of which scored a hit.[21] A member of the Analysis Branch of the Tactical Air Warfare Center said in reference to the 8th TFW AIM-4D firing results:[22]

> We in the Falcon program were very disappointed in the results of the first nine AIM-4D firings. (I'm sure Robin and the troops were more than disappointed.) . . .

In September 1967 Headquarters Pacific Air Force (PACAF), long aware of missile problems, informed the Chief of Staff, USAF, that the command intended to employ the AIM-9 on the F-4D aircraft in preference to the AIM-4D.[23]

(S) The withdrawal of the AIM-4D, as used in a completely new aerial combat environment over NVN, appeared inevitable. Even before its arrival in SEA, plans were undertaken to improve its capabilities with a new version and to introduce that version into SEA in 1969.[24] The improved model was never produced because the AIM-4D engineering development program ended 14 May 1968.[25] Although engineering development was again resumed in 1970,

the Air Force on 22 August 1972 declared 776 AIM-4D missiles excess to SEA needs due to their limited air-to-air capability.[26]

AIM-7D/E

(S) The air-to-air Sparrow (AIM-7) missile program was begun in 1951. From that date the AIM-7 series of missiles underwent numerous modifications in USAF attempts to improve their operational capability. The AIM-7D, the first model carried by USAF aircraft in SEA, was only employed from April 1965 to April 1966. During its employment the USAF confirmed one MIG-17 kill by the F-4C/AIM-7D weapon system.[27] From April 1966 through August 1968, the Air Force used the improved AIM-7E as its primary air-to-air weapon and achieved greater MIG kill success.

(S) The AIM-7E, forerunner of the dogfight version, was heavily employed by both the Air Force and the Navy during ROLLING THUNDER. It was a semi-active radar controlled, all-weather missile possessing a large explosive warhead, proximity and contact fusing, and an all-aspect* attack capability.[28] During MIG engagements, the standard aerial combat tactics manual recommended that an attack begin with the AIM-7 launch due to its medium/long range capabilities. Because a single missile seldom downed an aircraft, the fighter fired the AIM-7 in ripples of two, three, or four.[29]

(S) In air activity over NVN during ROLLING THUNDER, USAF F-4C/D aircraft made 260 launch attempts which resulted in 21** confirmed MIG

*I.e., any attack approach angle being acceptable.

**The Air Defense Analysis Center file at Hq PACAF shows the figure to be 24.

kills.[30] In terms of missile success, the Sparrow appeared to work significantly better as a mid-range, non-maneuvering air-to-air weapon when fired under the conditions for which it was designed:[31]

> Of possible significance is the difference in AIM-7E performance on 2 and 6 January versus the performance subsequent to that time. On 2 and 6 January, all engagements were against MIG-21 aircraft above 10,000 feet with a 7,000 foot undercast. The only aircraft in the area were the F-4Cs and the MIGs. All F-4Cs were camouflaged and the MIG-21s were silver in color which eased the identification problem. This engagement was characterized, therefore, by relatively long range visual identification and, because of the medium altitude, the ability to use the APQ-100/Sparrow system in the manner for which it was designed; i.e., full system lock-on, little close-in maneuvering, with most of the shots occurring in the beam or front quarter. On these two days, a total of 22 AIM-7Es were launched and five MIGs destroyed for a .23PK.* Subsequent to 6 January, the majority of the engagements have been against MIG-17 aircraft at altitudes ranging from 500 to 5,000 feet and in hard maneuvering where full system lock-ons have been extremely difficult to achieve. During this period, four MIGs were destroyed with 40 AIM-7E missiles for an overall PK of .10. The difference between .23 PK and .10 PK is significant.

(S) As noted above, the effect of altitude during MIG engagements had a pronounced bearing on the success of the missile due to its dependence upon achieving full system radar lock-on prior to launch and throughout its flight. Thus, tactics against MIGs at low altitudes resulted in poor missile performance. During several MIG encounters over NVN, the 366th Tactical Fighter Wing fired 21 AIM-7Es below 8,000 feet without a single success. Although maneuvering conditions and

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*PK - Probability of Kill.

launch ranges were also factors, this lack of success was caused primarily by ground clutter. Either the radar operator could not distinguish the target aircraft from ground clutter, or, when the target was located, the missile would not lock on or would transfer radar lock-on to the ground.[32] The Rules of Engagement for aerial combat over NVN--which required positive visual identification of the target aircraft prior to attack--also restricted the missile's use. Therefore, the use of the AIM-7E as a weapon system in the long range interceptor environment (its design characteristic) was precluded as the aircraft closed its range on the MIG.[33]

(S) With surprise in favor of the U.S. fighter, however, the missile was an effective weapon against the MIGs in a non-maneuvering encounter at high altitude. Yet, only rarely were all conditions for effective employment satisfied at the same time; thus, the fourth generation Sparrow missile, the AIM-7E-2, was introduced into the SEA conflict.

AIM-7E-2

(S) The AIM-7E-2, aptly named the "Dogfight Sparrow," became operational in August 1968--two months prior to the end of ROLLING THUNDER.[34] The modified AIM-7E-2 was developed specifically to meet the requirements for launches at shorter minimum ranges and higher G loadings such as those experienced in the majority of the SEA MIG encounters.[35] The missile possessed two modes of operation: NORMAL and DOGFIGHT. In the NORMAL mode of operation, the missile capabilities and limitations were essentially the same as the AIM-7E with the exception of better fuzing and improved high altitude performance.[36] The DOGFIGHT mode was accomplished by installing a minimum

range plug in the side of the missile prior to uploading. This gave the AIM-7E-2 a better minimum range capability (1,500 feet under ideal conditions, as opposed to 3,300 feet for the AIM-7E) against a non-maneuvering target flying at the same speed. The DOGFIGHT mode also provided a better capability against a maneuvering target and better fuzing.[37] With the end of ROLLING THUNDER, however, the AIM-7E-2 combat employment was halted.

(S) In early 1970, MIGCAP flights began to increase. In order to provide the best air-to-air weapons capability, Seventh Air Force endorsed the AIM-7E-2 and recommended that it--and not its predecessor--be carried on all future fighter aircraft sorties.[38]

(S) After two years of only a few air-to-air encounters, the air war resumed in 1972 with a greater intensity than that experienced during any other phase of the conflict. During the MIG encounters that occurred in 1972 and the first days of 1973, U.S. aircraft launched 243 AIM-7E missiles, most of which were the AIM-7E-2 (dogfight model).[39] Table 1 summarizes the missile data for that period.

(S) Of the total missiles fired, almost two-thirds (65 percent) missed the target aircraft. The reasons for such an excessive miss rate lie in the combat conditions under which they were fired. When LINEBACKER I began, the war over NVN had evolved into the most technologically complex conflict in the history of aerial combat.[40] Frequently, AIMs were fired in ripples to turn a MIG into a second AIM, or into the lethal path of an accompanying wing man, or to divert the MIG from the strike force. Furthermore, the American pilot had to contend with the threat of SAMs

TABLE 1

COMBAT EFFECTIVENESS OF THE AIM-7E/E-2
JANUARY 1972 - JANUARY 1973*

	Jan - Jun		Jul		Aug		Sep		Oct		Nov-Dec		Jan		Total	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Firing Attempts	102		26		13		36		35		29		2		243	
Miss	62	60.8	15	57.7	6	46.2	27	75.0	28	80.0	19	65.5	1	50.0	158	65.0
Kill	13	12.7	4	15.4	4	30.8	1	2.8	2	5.7	2	6.9	1	50.0	27	11.1
Hit Without Kill	3	2.9	2	7.7	1	7.7					1	3.4			7	2.9
No Motor Fire (NMF)	8	7.8									1	3.4			9	3.7
No Launch	9	8.8	2	7.7			8	22.2	5	14.3	6	20.8			30	12.3
Outcome Unknown	7	6.8	3	11.5	2	15.3									12	5.0

*This data was extracted from the Combat Sage Semi-Annual Report and Monthly MIG Engagement Reports for the year 1972 and from the 432 Tactical Reconnaissance Wing MIG Engagement Weapon System Performance Reports.

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and AAA during many MIG encounters. Thus, the use of missiles was dictated by the tactical situation, and missiles were often fired outside prescribed launch parameters. Additionally, the missile, on numerous occasions, either failed to launch or detonated prematurely. Extensive operational use over NVN indicated the AIM-7E-2 was unreliable in the following areas: frequent no motor fire, erratic flight path, and early, late, or negative fuzing.[41] These operational factors and missile problems resulted in a relatively unsuccessful employment of the AIM-7E-2 in combat.*

AIM-9B/D

(S) The AIM-9B Sidewinder, used by the USAF during ROLLING THUNDER, was a supersonic, single-stage, solid-propellant missile featuring simplicity of operation.[42] Designed as a passive, infrared-homing weapon to be employed in a short/medium range environment, the missile was used to fill the gap between the long range AIM-7 and close-in gun kill capability. Much like the AIM-4D and AIM-7E, the AIM-9B was not designed to attack a maneuvering target. When the missile was employed in that role the main problems included IR discrimination, gimbal limit (25°), maneuverability, and range.[43] The inability of the missile to adequately distinguish the target aircraft from the aircraft's plume, the clouds, the ground, or the sun degraded its effectiveness. MIG pilots capitalized on this deficiency, and often both the MIG and missile disappeared into the clouds

*(S) In their pre-publication review of this report, Hq PACAF/XOOF noted that (1) the problem of "no motor fire" was solved by mid-1972 and (2) considering the low degree of aircrew training in air-to-air combat and the confusing situation during air battles over NVN in 1972, employment was reasonably successful even though only a marginal capability was demonstrated.

with an unknown outcome.[44] American pilots attempted to attack MIG formations from below in order to use the low-IR-emitting sky as the background. Against the sky, the target aircraft's IR return generally stood out more clearly and missile performance improved.[45] The kill capability of the AIM-9B was virtually nil if the MIG sustained five* or more Gs in an evasive maneuver. Also, the blunt head of the missile produced aerodynamic drag and limited its maximum range.[46] On the positive side, the AIM-9B was a less complicated missile to launch. Because it was not radar controlled, the AIM-9B could be fired in less than one second.[47]

(S) In addition to simplicity of operation, the AIM-9B was one of the more effective air-to-air weapons employed during ROLLING THUNDER. During the period April 1965 through September 1968, 175 USAF AIM-9B firing attempts resulted in 26 confirmed MIG kills.[48] Its counterpart, the AIM-9D, was used exclusively by the Navy and recorded 18 confirmed kills during the same period. Although the probability of kill for the Sidewinder was low at 0.15, the missile did provide a necessary middle range kill potential.

AIM-9E

(S) The AIM-9E (second generation missile from the AIM-9 series) began its combat employment in SEA after the conclusion of ROLLING THUNDER. The AIM-9E had a smaller field of view, wider gimbal limits,

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*(S) Hq PACAF/XOOF noted that the kill capability was nil at 3 Gs or even less.

and the ability to uncage the seeker head prior to launch.* The AIM-9E's gimbal limits were 40°, as compared to 25° for the AIM-9B.[49] The AIM-9E possessed a greater range capability and could be fired at a much greater aspect angle off the target aircraft. In addition, the AIM-9E had improved aerodynamic performance at low altitude.[50] Since there was virtually no air activity over the North after the bombing halt in November 1968, the effectiveness of the AIM-9E as an air-to-air weapon remained unknown until 1972.

(S) Air-to-air MIG engagements in 1972 resulted in 71 AIM-9E firing attempts. Table 2 summarizes their effectiveness. Factors contributing to the high miss rate were: aircrew training, launches out of the envelope, the tactical situation, marginal tone,** tone discrimination,*** the missile going ballistic,**** and other malfunctions. For those missiles which actually left the aircraft, the PK was 0.12.

(S) Interestingly, with the beginning of LINEBACKER there appeared to be greater emphasis placed upon using the AIM-7E-2 radar controlled missile in combat rather than the IR AIM-9E. While both missiles essentially possessed the same minimum launch range restriction, the AIM-7E-2 could be launched at a much higher G loading than the AIM-9E. Therefore, pilot

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*See p. 27, below.

**(S) While attempting to acquire the target, the selected missile emitted an audible tone, which varied depending upon the degree of acquisiton at any given moment.

***(S) The pilot often found himself subjected to other tones (up to 14 in the F-4E), so being able to hear and differentiate the missile tone was often a problem.

****I.e., losing guidance.

TABLE 2

COMBAT EFFECTIVENESS OF THE AIM-9E
JANUARY - OCTOBER 1972*

	Jan - Jun		Jul		Aug		Sep		Oct		Total	
	#	%	#	%	#	%	#	%	#	%	#	%
Attempts	25		22		0		15		9		71	
Miss	15	60.0	17	77.3			9	60.0	5	55.6	46	64.8
Kill	3	12.0	1	4.5			1	6.7	1	11.1	6	8.5
Hit							1	6.7			1	1.4
NMF			4	18.2							4	5.6
No Launch	5	20.0					3	20.0	3	33.3	11	15.5
Outcome Unknown	2	8.0					1	6.7			3	4.2

*This data was extracted from the Combat Sage Semi-Annual Report Jan-Jun 1972 and Monthly MIG Engagement Reports for the year 1972.

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choice and the tactical situation dictated the launch of the AIM-7E-2 in preference to the AIM-9E. This may explain why 243 AIM-7E-2 firings were attempted compared to 71 AIM-9E firing attempts.[51] (See Tables 1 and 2.)

Missile Reliability

(S) The air war over NVN in the first six months of 1972 focused command attention on the poor combat performance of the AIMs in the inventory. Although the U.S. had a favorable air-to-air combat kill/loss ratio, missile reliability was less than desired. A message dated 24 May 1972 indicated the severity of the problem:[52]

> The low reliability of our AIM missiles during combat engagements since 1 January 1972 has prompted much concern at all command levels. The number of missile firings vs the number of enemy acft kills is indeed discouraging.

In response to a request for assistance from 7AF, a missile assistance team, composed of expert technicians from Raytheon, Philco-Ford, and Hughes, arrived in the theater in May 1972.[53] The team planned to visit each SEA F-4 base "to improve the success of the current SEA missile system configuration with changes in employment and maintenance methods."[54] Three experienced fighter pilots from Nellis Air Force Base accompanied the team in order to brief and discuss operational tactics with the tactical aircrews. General Lucius D. Clay, Jr., Commander in Chief, Pacific Air Forces (CINCPACAF), also visited bases in SEA. Commenting to the members of the 432nd TRW, Udorn Royal Thai Air Force Base, he stated:[55]

> Detailed records must be maintained and each missile expenditure documented, unsuccessful missiles must be explained, i.e., tactical situation, target destroyed,

> no guide, fired out of parameters, early/late fuse, FSC [Fire Control System] malfunctions, switch error by aircrew, etc.

Meticulous documentation was specifically required if missile reliability was to improve. With the increase in MIG engagements and accompanying AIM firings that occurred in April 1972, personnel assigned to the PACAF Weapon System Evaluation Program (WSEP), 1st Test Squadron, Clark Air Base, were dispatched to SEA to aid in the analysis of missile failure problems.[56] A data collection center was established at the 432nd TRW in May 1972, and, for the first time during the SEA conflict, the center developed a timely, efficient, and objective means of data collection.

(S) The results of the team visit, command interest, and Combat Sage (PACAF-WSEP) involvement in trying to solve the missile reliability problem were not immediately evident. In August 1972, however, the first indication of missile improvement appeared in a Special Interest Item which summarized air-to-air activity for that month.[57] It reported:

> Thirteen AIM-7E-2 missiles were launched from aircraft. No failures of rocket motors were observed. Four MIGs were destroyed. Two missiles detonated approximately 100 feet from maneuvering targets.

In a hand written note to General Vogt, Brig General Holland commented, "Things are looking up."[58]

CHAPTER II

THE EVOLUTION OF THE AIM-9J

(S) Aerial combat experience in SEA from April 1965 to the introduction of the AIM-9J showed conclusively that the performance in short range dogfights of AIMs in the inventory was unsatisfactory.[59] The U.S. air defense AIMs were, in general, more effective against MIG aircraft when the MIGs were unaware that an attack was imminent. (This was also true of the MIG success against U.S. aircraft. The MIG-21, equipped with only IR Atoll missiles, destroyed many non-maneuvering friendly aircraft when it had the element of surprise.)[60] As the war continued, technologists on both sides introduced increasingly sophisticated weapon systems: advanced early aircraft warning devices, ground control intercept systems, and other improved air defense facilities. The air war was now being waged in a totally different environment from that in 1965 and in many cases both friendly and enemy aircraft knew the exact location of their adversaries prior to visual identification. The element of surprise now assumed a lesser role in air conflicts, and attacks against unsuspecting, non-maneuvering targets decreased in frequency, while attacks against maneuvering targets increased. It was in this combat arena that the existing AIMs proved relatively ineffective.

Preliminary Testing

(S) In November 1968, Warner Robins Air Materiel Area (WRAMA), Warner Robins AFB, Georgia, received authorization from CSAF to begin the initial testing program of the AIM-9E "Extended Performance" missile, subsequently

designated the AIM-9J.[61] The AIM-9J, an advanced version of the IR AIM-9E missile produced by the Philco-Ford Corporation, was designed specifically to provide the American fighter pilot with a reliable weapon at close range against a maneuvering enemy fighter. The initial testing phase of the missile began under the WRAMA project entitled "AIM-9 End Game II Development Program."

(S) The primary objectives of the program were to evaluate the AIM-9J's miss distance reduction, increase in aerodynamic stability, and increase in lateral G capability.[62] Fourteen missiles, configured with telemetry units, were fired against BQM-34A target drones equipped with bi-doppler scoring devices (BIDOPS) to determine immediate miss distance.[63] The success rate of the AIM-9J missiles fired was 92 percent (12 successful of 13 fired), with an average miss distance of 13.5 feet. With the addition of the double delta canards (stabilizing fins) and a torque feedback servo unit (a signal processing device), the AIM-9J demonstrated significantly improved G capability over the AIM-9B/E.[64] It was expected that this G capability improvement would in turn directly enhance the outer and inner G boundaries of the missile's launch envelope.

(S) While results obtained from these first AIM-9J tests were generally favorable, a reduction in miss distance was not evident. Although the 92 percent success rate indicated a marked improvement over the AIM-9B/E missile series, further experimental testing* was necessary prior to USAF acceptance.[65]

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*(S) Concurrently, extensive tests were also being conducted on an updated radar controlled missile, the AIM-7F, in an attempt to eliminate operational deficiencies identified in the combat use of the Sparrow missiles.[66]

(S) Following the initial test series, testing was suspended. In January 1971, the CSAF authorized the resumption of the AIM-9J test effort under the program entitled Combat Snap.[67] The qualification phase (the most significant portion of the test program)* commenced on 4 April 1972 at Holloman AFB, New Mexico, with seven valid launches programmed against a maneuvering BQM-34 drone. Nine additional AIM-9J firings against a QF-104 at Eglin AFB, Florida, concluded the test effort.[68] As stated in the contract proposal, missile acceptance depended upon 12 out of the 16 missiles launched guiding to within 20 feet of the target aircraft's IR source. This was two feet closer than the recently revised missile success kill criteria for USAF air-to-air weapons systems.[69] From the data obtained from the Holloman tests, all missiles guided satisfactorily and recorded an average miss distance (from the IR source) of approximately six feet.[70] Results obtained from the Eglin test revealed an average miss distance of nine feet for the four missiles that guided satisfactorily (out of nine fired). The miss distance of the five AIM-9Js that failed to meet contract specifications ranged from 25 feet to more than 100 feet.[71] (See Figure 1 for a photograph of an AIM-9J-configured F-4.)

(S) Table 3 outlines the major configuration and performance changes incorporated into the improved AIM-9J missile. The most significant changes consisted of the missile's improved "G" capability between sea level and 50,000 feet, a 4 degree per second increase in its maximum seeker tracking

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*If successful, this phase leads to acceptance of the system by the Government, in this case the USAF.

TABLE 3

AIM-9E VERSUS AIM-9J CONFIGURATION AND PERFORMANCE CHARACTERISTICS

Technical Specifications	AIM-9E	AIM-9J
Length	117.9 in	121.9 in
Diameter	5.0 in	5.0 in
Canard span	15.0 in	17.2 in
Wing span	22.0 in	22.0 in
Weight (launch)	168.5 lb	169.6 lb
Rocket total impulse	8,800.0 lb/sec	8,800.0 lb/sec
Rocket burn time	2.2 sec	2.2 sec
Rocket peak thrust	4,200.0 lb	4,200.0 lb
Axial acceleration, peak	28 G	28 G
Maximum seeker track rate	12 deg/sec	16 deg/sec
Seeker cage rate	10 deg/sec/deg	16 deg/sec/deg
Maximum servo torque	750 in-lb	1,050 in-lb
Torque feedback servo	No	Yes
Maximum guidance duration	20 sec	40 sec
Double-delta canards	No	Yes
Lengthened canard hinge line	No	Yes
Lateral G capability (mean sea level, 1 plane)	11	22
Lateral G capability (50,000 feet, 1 plane)	6	13

Source: TAC Project 72A-095T, TAWC Project 2093, Introduction Plan, Combat Snap SEA Introduction, Aug 1972, Appendix A, p. 12. (S)

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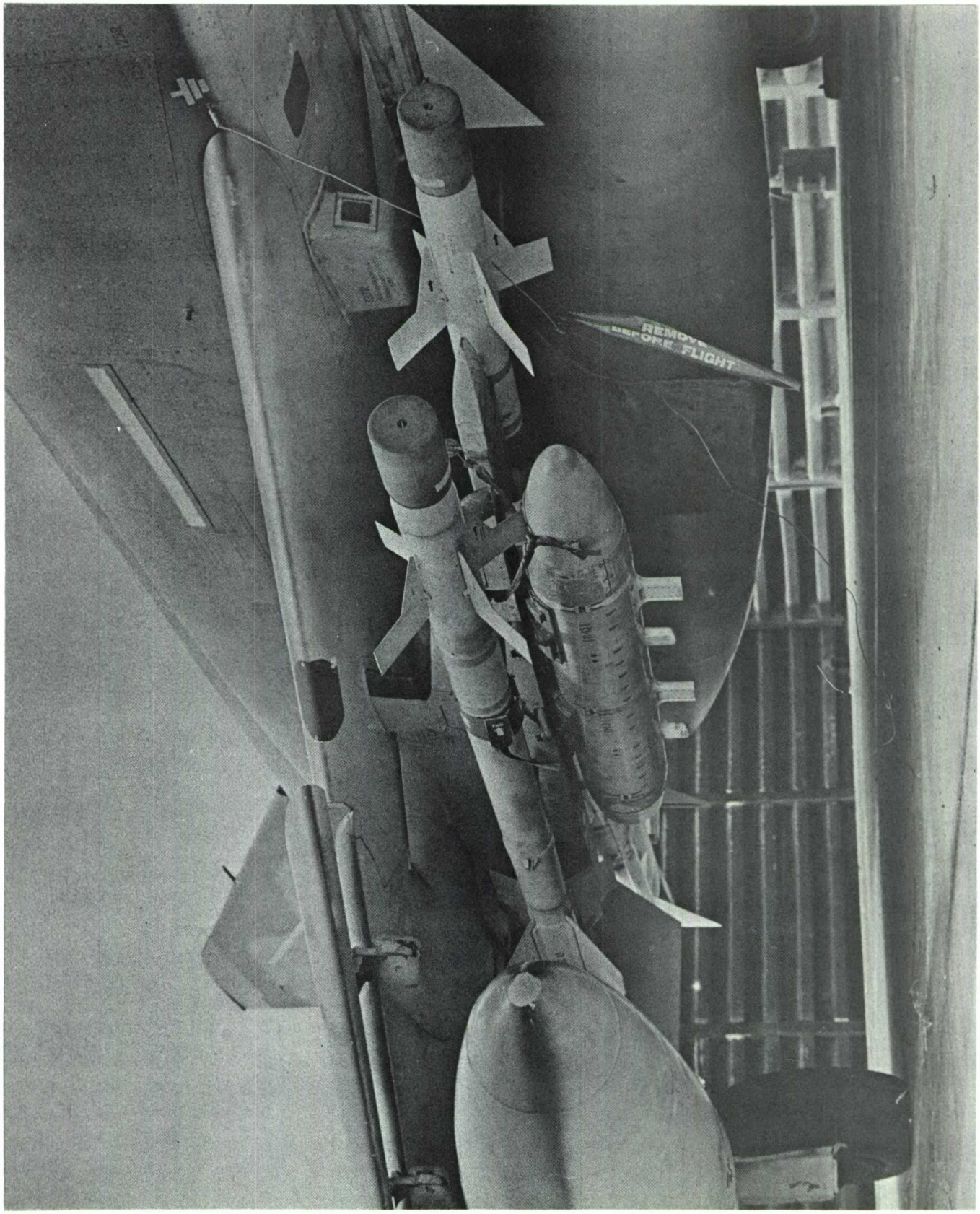

F-4E Configured with AIM-9Js

Figure 1

rate, a 100 percent increase in maximum guidance duration, the addition of double-delta canards, and a lengthened canard hinge line for increased missile launch maneuverability. Improved missile signal processing associated with a new torque feedback system to the missile servo control unit was incorporated to reduce miss distance, but results did not reflect the expected improvement.[72] Both the WRAMA and Combat Snap test results, however, demonstrated the missile's improved maneuverability. The missile's responsiveness at firing was much better than that of the AIM-9E.[73] Upon launch from the aircraft, the AIM-9Js turned immediately in the direction of target motion and, except for the low angle off case, appeared to have fewer guidance problems early in flight.

(S) In a dogfight, from sea level to 20,000 feet at Mach 0.70 to Mach 1.00, the AIM-9J was believed to be more effective in some respects than earlier models because of several developments. It was expected that the minimum launch range would be reduced to 1,000 feet when attacking a non-maneuvering target from the rear at aspect angles up to 15°, provided the target's speed was the same as the attacker's. The missile could be launched at larger aspect angles to the target because of increased missile maneuverability. In addition, the AIM-9J's range at higher altitudes was greater, and the launch aircraft could now fire the missile at load factors up to seven Gs.[74]

(S) Although the missile apparently performed relatively well in the rather sterile environment over New Mexico and Florida against the non-aggressive BQM 34R and QF-104 target drones (11 successes out of 16 launches),

its testing still revealed several important deficiencies. The AIM-9J missile tone, the positive indication given to the pilot of target acquisition, unchanged from the AIM-9B/E, was inadequate.[75] In an actual situation, additional cockpit noise (e.g., radio and interphone communication and Radar Homing Advanced Warning inputs) could severely handicap and interfere with an AIM-9J launch. The warhead/fuze combination demonstrated a deficiency in target kill capability when the warhead detonated at more than 16 feet from the target.[76]

SEA Introduction

(S) The preliminary testing ended on 3 July 1972 indicating that further in-depth testing and evaluation were necessary prior to replacing the AIM-9B/E.[77] Although the AIM-9J had yet to prove its value as a weapon, it was about to enter its most important test to date--its introduction into the hostile environment of SEA. It was to be the missile that would "hopefully carry us over until such a new development (USAF decision on a new air-to-air missile) could be completed."[78]

(S) On 8 June 1972, the CSAF authorized the introduction of the AIM-9J into SEA under Phase IIA of its evaluation program.[79] The 432nd Tactical Reconnaissance Wing, Udorn Royal Thai Air Force Base, Thailand, was selected as the host wing for the initial employment of the weapon. Wing anticipation was high in the latter part of June at the first prospect of the AIM-9J's arrival.[80] However, it was not until one month later that the first shipment of 47 AIM-9J Guidance and Control Units (GCUs) actually arrived at Udorn.[81] Accompanying the GCUs was a team of experts representing

Tactical Air Command (TAC), Tactical Air Warfare Center (TAWC), Philco-Ford, and WRAMA. Under the team's supervision, aircrews and maintenance personnel learned how to effectively use the weapon in the theater. On 30 July 1972, the training ended and aircrews awaited their first combat flight with the AIM-9Js. On 31 July 1972, CINCPACAF approval to employ the weapon in combat was received.

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(S) On 2 August 1972, the first combat flight of the AIM-9Js occurred. F-4D Combat Tree* and F-4E aircraft from the 555th TFS and 13th TFS assigned to a MIGCAP role in support of LINEBACKER I air strikes over NVN carried the first operational AIM-9Js. The MIGCAP aircraft, with four AIM-7Es mounted in the fuselage, generally also carried four wing-mounted AIM-9Js on each sortie over the North. Figure 1 shows the typical F-4E air defense aircraft configured with two AIM-9Js on the right inboard pylon.

(S) Although there were numerous MIG encounters throughout the month of August, no AIM-9J combat firings were made. As the missile's captive flight hours increased, missile problems arose and indications of its deficiencies became evident. For example, a Combat Snap Introduction Status Report dated 19 August 1972 noted that four AIM-9Js returned from combat flights with broken IR domes, and one AIM-9J had been inadvertently launched from an aircraft.[83] These problems would have to be resolved if the AIM-9J were to be an effective weapon in combat.

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*This equipment provided a friendly and enemy airborne Identification Friend or Foe interrogation capability.

CHAPTER III

COMBAT EMPLOYMENT

(S) On 9 September 1972, three AIM-9Js were fired in combat. Olds Flight, a flight of four F-4s from the Triple Nickle Squadron (the 555th TFS), were flying in a MIGCAP role in support of a LINEBACKER I strike over NVN. They engaged one MIG-21 and two MIG-19s in the vicinity of Phuc Yen airfield.[84] In the encounters, Olds 03 destroyed the MIG-21 with 20mm cannon fire. As Olds Flight was egressing the area, they were attacked by two MIG-19s. Olds Lead (Aircraft Commander Capt John A. Madden and Weapon System Officer Capt Charles B. DeBellevue), after acquiring the MIGs on radar, positioned themselves for a stern attack.[85] One MIG-19 dove just as the first two AIM-9Js launched. Their results were not observed by Olds Lead, but the crew in the number four aircraft stated that the first missile guided, missed the target aircraft, and detonated approximately 25 feet to the rear of the MIG.[86] The flight path of the second missile was unknown. Olds Lead then pursued the other MIG-19, now climbing in a hard left turn. After acquiring good missile tone, the pilot launched the third AIM-9J.[87] The third missile guided "just as advertised" to a kill.[88]

(S) The first combat firings of the improved AIM-9J proved to be most noteworthy in the SEA air war and in U.S. weaponry history. Using the AIM-9J, Capt Charles B. DeBellevue became the Air Force's second ace of the Vietnam conflict.[89]

(S) The parameters of the third AIM-9J launch, as estimated by the pilot, were as follows: aspect angle off the target, 50°; slant range, between 3,000 and 4,000 feet; launch aircraft, 5 Gs; target aircraft, estimated at 4-5 Gs; and target background, haze.[90] For its first exposure to combat, the AIM-9J performed exceedingly well, particularly under the conditions in which it was launched. Achieving a kill after being fired at a 50° aspect angle was noteworthy in itself.

(S) Subsequently, a 19 September 1972 follow-up report concerning the 9 September 1972 MIG engagement stated:[91]

> Additional intelligence information obtained concerning the first (3) AIM-9J missiles launched on 9 September 1972 has resulted in a confirmed kill for the first AIM-9J missile launched, three (3) aircrew members flying in two (2) other F-4 aircraft in the flight reported that the first AIM-9J missile guided to approximately 20-25 feet of the green MIG-19 target and the warhead detonated. The MIG-19 later landed with the aft section of the plane on fire and was destroyed.

It was also determined that the second AIM-9J to leave the aircraft was launched inadvertently.[92] Excluding the inadvertent launch, two AIM-9Js recorded two kills, and Capt Charles D. Debellevue became the Air Force's leading SEA ace, credited with six MIG kills.

(S) On 16 September 1972, Chevy Flight, consisting of four F-4s from the 555th TFS, departed Udorn in their familiar MIGCAP role. Approximately 70 nautical miles from Hanoi, a MIG-21 was sighted at low altitude.[93] Chevy Flight immediately descended and began pursuing the MIG down the Red River towards Hanoi.[94] From an altitude of approximately 700 feet above ground level (AGL), Chevy Lead fired four AIM-9Js, but all missed.

Two impacted the ground and the other two guided but disappeared into the haze.[95] Chevy 03 continued pursuit and likewise fired all four of his AIM-9Js. The first two missiles, launched with marginal tone indications, went ballistic. The third missile had good tone and guided, but failed to detonate. The fourth AIM-9J fired with positive target discrimination, guided straight for the MIG, and impacted into the tail. The MIG went out of control, and its pilot ejected just prior to the MIG hitting the ground.[96] This high speed encounter was a straight and level, low altitude tail chase with little maneuvering. The altitude varied between 50 and 500 feet AGL, and Gs on the aircraft never exceeded one.[97] Although the encounter resulted in the third confirmed AIM-9J kill, it revealed the missile's unreliable performance at low altitude. Seventh Air Force immediately notified TAC and requested an investigation of the AIM-9J's maximum launch range and its flight performance against low altitude, co-speed targets* (600-650 Knots True Air Speed). The ensuing investigation indicated the AIM-9J maximum range at low altitude was much less than had been expected.[98]

(S) The fourth and last confirmed AIM-9J kill during the very short period of use in SEA occurred on 15 October 1972. Chevy Flight departed Udorn at 0554Z in support of another LINEBACKER strike mission. Upon reaching their orbit point, the flight was informed by RED CROWN at 0710Z that two enemy aircraft had just taken off from Phuc Yen airfield.[99] At 0722Z, Chevy 01 saw the MIG-21, maneuvered into position, and fired three

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*I.e., both the pursuer and the target flying at the same speed.

AIM-7s, all of which missed. Chevy 01 then fired three AIM-9Js; the first two missed the MIG, but the third scored a direct hit.[100]

(S) Thus, from September 1972 until the end of operation LINEBACKER on 29 December, there were 31 attempted AIM-9J launches in combat.[101] (See Table 4.) Of the 31 firing attempts, 23 missed the target, 4 resulted in confirmed kills, and 4 failed to launch. During this same period, 100 AIM-7E-2 attempted launches resulted in 5 confirmed kills. The other 95 AIM-7E-2 missiles either missed, did not launch, did not fire, or were unobserved. The results of 24 attempted AIM-9E launches included 2 confirmed kills, 14 misses, and 1 hit without a kill. The remainder either failed to launch or their outcomes were unknown.[102]

(S) The cease-fire in Vietnam began on 24 January 1973.[103] The historic signing of the peace treaty ended the combat employment of the AIM-9J.

TABLE 4

AIM-9J MIG ENGAGEMENT PERFORMANCE SUMMARY (SEP - DEC 72)

Engagement Call Sign/Date	Number of Missiles Fired	Launch Mode	Outcome	Fault	Remarks
OLDS 01/9 Sep	3	Caged*	Kill	None	Confirmed later
		Caged	Miss	Unknown	Flight unobserved
		Caged	Kill	None	Impacted vertical stabilizer--no detonation
CHEVY 01/16 Sep	4	Caged	Miss	Unknown	Good tone--guided, lost in haze
		Caged	Miss	Unknown	Good tone--hit ground
		Caged	Miss	Unknown	Good tone--hit ground
		Caged	Miss	Unknown	Guided--lost in haze
CHEVY 03/16 Sep	4	Caged	Miss	Unknown	Ballistic--marginal tone
		Caged	Miss	Unknown	Ballistic--marginal tone
		Caged	Miss	Unknown	Good tone--guided, no detonation
		Caged	Kill	None	Aided by MIG maneuver
OLDS 01/30 Sep	4	Caged	Miss	Crew Factor	Ballistic--questionable tone
		Caged	Miss	Crew Factor	Ballistic--questionable tone
		Caged	Miss	Missile	Ballistic--headed toward the ground
		Uncaged**	Miss	Unknown	Missile and MIG disappeared in clouds
OLDS 03/30 Sep	2	Caged	Miss	Missile	Guided close and detonated
		Caged	Miss	Missile	Guided close and detonated. Debris was noticed after the first missile explosion. Kill not confirmed

*The missile seeker head was boresighted with the gunsight, i.e., locked in the dead-ahead position.
**The missile seeker head is free to track within its gimbal limits.

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TABLE 4 (Continued)

Engagement Call Sign/Date	Number of Missiles Fired	Launch Mode	Outcome	Fault	Remarks
CHEVY 01/15 Oct	3	Caged	Miss	Unknown	Missile flight unobserved
		Caged	Miss	Unknown	Missile flight unobserved
		Caged	Kill		
JAGUAR 01/15 Oct	2	Caged	Miss	Unknown	Missile flight unobserved
		Caged	Miss	Unknown	Missile flight unobserved
BARRACUDA 01/ 18 Dec	4	Caged	Miss	Unknown	Night engagement--visual range and overtake estimated--no detonation
		Caged	Miss	Unknown	Night engagement--visual range and overtake estimated--no detonation
		Caged	No launch	Missile	Gas grain generator expended*
TOGO 01/18 Dec	3	Caged	No launch	Unknown	Exhaustive maintenance checks failed to reveal problem--possibly master arm switch on
VEGA 01/27 Dec	1	Uncaged	Miss	Unknown	Fired in range
RACOON 01/29 Dec	1	Caged	Miss	Aircrew factor FCS	Fired without tone--out of range

*This generator provides electrical power for the guidance system. When the gas grain power source has been expended, the power generation ends.

Source: PACAF, Combat Sage Monthly MIG Engagement Reports, Sep-Dec 72. (S)

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CHAPTER IV

SUMMARY, CONCLUSION, AND EPILOGUE

(S) The AIM-9J, an advanced version of the AIM-9E, began its combat employment in the SEA theater just four months before the cease-fire. Its combat life and contribution to the air war effort were, therefore, minimal--only 31 combat firings were attempted. With such a small number of firings, an analysis of these data, and comparisons with other existing AIM missiles in order to draw definite conclusions as to the AIM-9J's effectiveness, would be premature. From an absolute standpoint, however, and considering the original intent of its development, the AIM-9J performance was relatively unimpressive in combat.* Nevertheless, compared to its competitors (the AIM-7E-2 and the AIM-9E), the AIM-9J did appear relatively successful. The AIM-9J kill rate per missile fired was 13 percent from September to December 1972, compared to 5 percent and 8 percent registered by the AIM-7E-2 and AIM-9E, respectively. When viewed on the basis of effectiveness per engagement, the AIM-9J fared better with 33 percent kills per

*(S) During follow-on testing and combat employment, the AIM-9J did not display the improved capability that was desired. Maximum range, which was to have increased, was in general only slightly improved; however, it was actually reduced for some launch conditions. Similarly, minimum launch ranges, although improved for high angle-off launches, were degraded for low angle-off launches. Overall, aerodynamic boundaries had changed depending on aspect angle, altitude, and launch speed, but these changes were neither decisively better nor worse than previous missile envelopes. Furthermore, low angle-off launches appeared to suffer from overcontrol as a result of the torque feedback mechanism. The overcontrol had two negative results: it created high G turns which reduced the range of the missile, and it resulted in the missile intercepting the target with a high crossing angle, a condition which results in a low probability of kill for the missile's fuzing/warhead system.

engagement, versus 11 percent and 15 percent for the AIM-7E-2 and AIM-9E, respectively.[104]

(S) In January 1973 PACAF reinstituted* its Weapon System Evaluation Program, known as Combat Sage, at Clark Air Base, Republic of the Philippines.[105] This program, designed to determine the operational effectiveness of the various air-to-air weapon systems in the PACAF inventory, contributed immensely to the overall Air Force air superiority effort over NVN throughout the entire SEA conflict. Although Combat Sage functioned in a rather controlled environment, the benefits derived, both professionally and psychologically, from actual pre-combat AIM firings have already proven invaluable.[106]

(S) The first Combat Sage F-4/AIM-9J missile firings and their evaluation began in February 1973 when a sufficient inventory of the weapon existed in SEA.[107] In an attempt to simulate realistic combat conditions, missiles were fired at a maneuverable BMQ-34A target drone. Immediately after the AIM launch, the drone controller maneuvers the drone into a 70-80 degree bank. By the time of actual missile intercept, a 3 G load exists on the drone. (This would approximate the situation where a MIG might not take evasive action until he receives an indication that an AIM missile had been fired at him.)[108] During the month of February, seven valid AIM-9J firings resulted in six successful missile guides,[109] while one AIM-9J malfunctioned after launch.[110] BIDOPS recorded an average miss distance of 4 feet, and two had direct hits. For the months of March, April, and May, the same trends were noted for the AIM-9J

*The program had been temporarily suspended during LINEBACKER.

launches at Combat Sage. During these 3 months, 32 valid launches yielded 27 successful guides.[111] Direct hits were again evident and miss distances ranged from 1 to 13 feet.[112] Even though these results are impressive, aircrew participation in the program revealed other important air-to-air weaponry data. Some missiles did malfunction, and in several cases aircrews lacked a knowledge of missile performance and firing parameters. In this environment these problems are easily resolved. Thus, Combat Sage provided a clinic to find, diagnose, and cure technical and aircrew problems.

(S) In May 1973, the Air Staff considered a temporary halt in the Combat Sage expenditure of the AIM-9J until each missile was configured with telemetry. The CINCPACAF response to this Air Staff proposal provided a clear indication of the level of acceptance which the AIM-9J had achieved during the 10 months since its introduction into SEA:[113]

> . . . the AIM-9J is one of our most important air-to-air weapons in a theater with a considerable air-to-air threat. We strongly believe continued AIM-9J expenditure is mandatory in the PACAF WSEP. Request your aggressive support in this regard.

FOOTNOTES

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2. (S) USAF Tactical Fighter Weapons Center, Interim Report #7, "U.S. and Enemy Air-to-Air Tactics in SEA," Jul 72, p. 1. (Hereafter cited as "U.S. and Enemy Tactics.")

3. (S) "Air-to-Air Encounters," p. 1.

4. (S) TAC, "SEA Air Engagements Study," 4 Aug 72, p. 15. Located on CHECO Microfilm Roll (CMR) S-768, 089. (Hereafter cited as "SEA Air Engagements Study.")

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6. Ibid., p. 2.

7. (TS) Secret Extract from Project CHECO Report, LINEBACKER: Overview of the First 120 Days, 27 Sep 73, p. 9. (Hereafter cited as "LINEBACKER.")

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9. (TS) LINEBACKER, p. 68. Material extracted is classified no higher than Secret.

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11. (S) 7AF Report, 7AF Air Operations Report 73/3, 30 Jun 73.

12. (S) USAF Fighter Weapons School Instructional Text, "All Aspect Aerial Attack Systems," p. 1. (Hereafter cited as "All Attack Systems.")

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13. (S) USAF Tactical Fighter Weapons Center, Interim Report #8, "Survey of Aircrew Comments," Jun 72, p. 5.

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22. (S) Ltr TAC to 8th TFW unsigned, 1 Aug 67, p. 1. CMR S-153, 099.

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24. (C) Msg, CSAF to CINCPACAF, Subj: AIM-4D Capability, 061727Z Mar 67. CMR S-86, 178.

25. (C) Hq USAF Cancellation of Development Directive for Growth AIM-4D, 14 May 68. CMR S-86, 113.

26. (C) 7AF Special Interest Item, unsigned, 22 Aug 72. CMR S-773, 068.

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28. (S) 7AFRP 136-2, No. 1, "Conventional Air Munitions Guide for USAF Air Liaison Officers and Forward Air Controllers, undtd. CMR TS-181, 118.

29. (S) All Attack Systems, p. 5-35.

30. (S) Red Baron Ordnance Firings, p. 18.

31. (S) 8th TFW EOT Report, p. 8.

32. (S) TAC Analysis Bulletin, 14 Aug 67, p. 56. CMR S-43, 010.

33. (S) All Attack Systems, p. 5-35.

34. (S) Msg, CSAF to AFSC, Subj: AIM-7E, System Management Directive, 242156Z May 68. CMR S-86, 119.

35. (S) Red Baron Ordnance Firings, p. 11.

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40. (S) USAF Tactical Fighter Weapons Center, "Project Red Baron, Vol. 1: Overview of Report, "Preface."

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46. (S) TAC Analysis Bulletin, Vol. 72-7, Jul 72, p. 38. (Hereafter cited as "TAC Analysis Bulletin.")

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50. (S) Combat Sage Study Folder, "AIM-9E Study Guide," undtd. CMR S-527, 089.

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GLOSSARY

AAA	Anti-aircraft Artillery
AFB	Air Force Base
AGL	Above Ground Level
AIM	Air Intercept Missile
AIM-4D/9E/9J	Passive, infrared-homing, air-to-air missile
AIM-7D/E/E-2	Semi-active radar-homing, all-weather air-to-air missile
BIDOPS	Bi-doppler scoring devices
CINCPACAF	Commander-in-Chief, Pacific Air Forces
CMR	CHECO Microfilm Reel
CSAF	Chief of Staff, USAF
FCS	Fire Control System
GCU	Guidance Control Units
IR	Infrared
MIGCAP	MIG Combat Air Patrol
mm	millimeter
NMF	No Motor Fire
NVN	North Vietnam
PACAF	Pacific Air Forces
PK	Probability of Kill
SAM	Surface-to-Air Missile
SEA	Southeast Asia
TAC	Tactical Air Command
TAWC	Tactical Air Warfare Center
TFW	Tactical Fighter Wing
TRW	Tactical Reconnaissance Wing
WRAMA	Warner Robins Air Materiel Area
WSEP	Weapon Systems Evaluation Program

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