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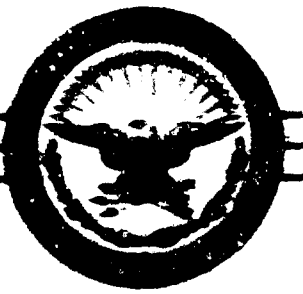

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(2) LEVEL II

A COMPARATIVE ANALYSIS OF USAF FIXED-WING AIRCRAFT LOSSES IN SOUTHEAST ASIA COMBAT (U)

Survivability/Vulnerability Branch (FES)
Vehicle Equipment Division (FE)

December 1977

TECHNICAL REPORT AFFDL-TR-77-115
Final Report for Period June 1974 - March 1975

AIR FORCE FLIGHT DYNAMICS LABORATORY
AIR FORCE WRIGHT AERONAUTICAL LABORATORIES
AIR FORCE SYSTEMS COMMAND
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45433

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This technical report has been reviewed and is approved for publication.

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18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Aircraft	Kill Severity	Vulnerability
Aircraft Loss Rates	Reason for Crash	
Combat Data	Southeast Asia	
Combat Loss	Survivability	
Crewmember Survival Rates	Threat Spectrum	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

(U) This report includes an analysis of all USAF fixed-wing aircraft combat losses in Southeast Asia from 1962 through 1973. Special attention is paid to aircraft loss rates, crewmember survival rates, threats encountered, and system(s) damaged. Specific comparisons are made among the F-4, F-105 and F-100 aircraft. The effect of one vs two engines upon aircraft survivability is addressed. An assessment of the effectiveness of fuel system vulnerability reduction modifications is made.

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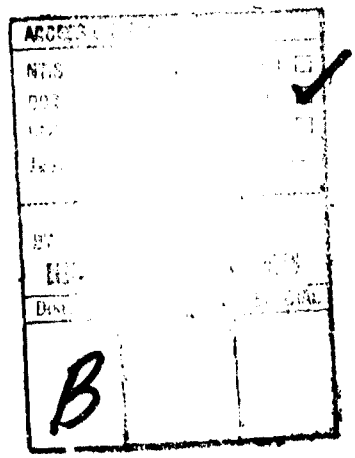
FOREWORD

The effort reported herein was conducted in-house by Capt Richard D. Gabbert and Mr Gary B. Streets of the Methodology & Analysis Group, Survivability/Vulnerability Branch (FES), Vehicle Equipment Division (FE), Air Force Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio.

This work is part of a larger effort to analyze combat data from Southeast Asia to identify aircraft vulnerability for use in survivability design. The effort was conducted under Project 4363, "Aerospace Vehicle Combat Survivability," Task 436303, "Aircraft Survivability Methodology."

This study was performed during the period June 1974 to March 1975. The report was released by the authors in April 1976.



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GLOSSARY

ANTIAIRCRAFT ARTILLERY - Ground or sea-based weapons that fire projectiles greater than 20mm in size and that are designed to operate against airborne targets. The projectiles fired by these weapons are of the high-explosive, armor-piercing and/or incendiary type.

COMBAT LOSS ("shot down") - An aircraft which is lost to the inventory as a result of the aircraft or crew being impacted by all or part of an enemy launched munition while engaged in a combat mission. This definition is applicable beginning with Section III.

CREWMEMBER SURVIVAL RATE - The percentage of downed crewmembers known to have survived being shot down. This includes both those rescued and those officially listed as prisoners.

CUMULATIVE LOSS RATE - The ratio of aircraft losses per a given number (usually 1000) of combat sorties flown calculated from the year the first sortie was flown to a given point in time. Cumulative rather than annual loss rates are used in order to allow proper weighting of the rates by high activity periods. For example, the effect on the cumulative rate for a year in which 20,000 sorties were flown would be greater than one in which 5,000 sorties were flown.

CUMULATIVE LOST - Total cumulative number of aircraft lost through a given year.

CUMULATIVE SORTIES - Total cumulative number of combat sorties flown through a given year.

KILL SEVERITY - An indicator of the rapidity of flight degradation in a damaged aircraft expressed in miles flown between munitions impact and crash location. The following categories are employed: "K" Aircraft flew less than 5 NM, "A" Aircraft flew 5-50 NM, "B" Aircraft flew more than 50 NM.

NOTE: The kill categories (K, A, & B) used here should not be confused with those commonly accepted and used in vulnerability assessments and listed in the proposed MIL-STD-XXX, Aircraft Nonnuclear Survivability/ Vulnerability Terms, where kill categories are shown as a function of time rather than distance.

LOSS RATE - The ratio of aircraft losses per a given number (usually 1,000) of combat sorties flown.

REASON FOR CRASH - The aircraft system(s) that is/are damaged or the damage mechanism(s) (fire, explosion, etc.) which results in the loss of the aircraft. The ones used in this report are: loss of control, crew/control, crew, loss of propulsion, engine fire, and fire/explosion.

GLOSSARY (Contd)

SMALL ARMS/AUTOMATIC WEAPONS - Weapons that fire projectiles up to and including 14.5mm. The projectiles fired by these weapons are either of the ball, armor-piercing, or armor-piercing-incendiary type.

THREAT - The enemy weapon causing damage which results in an aircraft loss. Where possible, the specific threat is noted, such as 7.62mm, 23mm, SA-7, or MIG missile. Where this resolution is not possible, a collective term may be used, such as small arms/automatic weapons, AAA, SAM, or MIG. Where differentiation between small arms/automatic weapons, and AAA is not possible, the collective term "unspecified ground fire" is employed.

UNSPECIFIED GROUND FIRE - Projectiles of unknown size fired from ground based guns as opposed to surface-to-air missiles or air-launched weapons.

LIST OF ABBREVIATIONS

"A"	Aircraft flew 5-50 nautical miles after being hit - used to designate kill severity
AAA	AntiAircraft Artillery
"B"	Aircraft flew more than 50 nautical miles after being hit - used to designate kill severity
"K"	Aircraft flew less than 5 nautical miles after being hit - used to designate kill severity
MIG	MIG aircraft
NFA	No flying activity during the period indicated in the country listed
SA/AW	Small Arms/Automatic Weapons
SAM	Surface-to-Air Missile
UGF	Unspecified Ground Fire

(U) SECTION I

INTRODUCTION

(U) The purpose of this report is to present an analysis of all USAF fixed-wing aircraft combat losses in Southeast Asia from 1962 through 1973. It is in part a follow-on to a previous Secret report titled "Analysis of USAF Fixed-Wing Aircraft Losses, Aircrew Casualties and F-105 Damages in SEASIA Combat (U)", (Ref. 1). Many of the results of that analysis are incorporated herein. Section II provides official total figures on aircraft losses, the cost of same and a composite look at the status of downed crewmembers. Section III is an update of the previous analysis and includes all those losses suffered after the period covered in the original report. The aircraft covered in Section III represent those which either experienced the most losses and/or held other special significance. Section IV includes basic comparisons of loss rates and crewmember survival rates for the aircraft considered. In Section V, specific comparisons are made among the F-4, F-105 and F-100 aircraft. In Section VI, evidence relating to the effectiveness of specific vulnerability reduction modifications is presented. Major conclusions from this and the referenced reports are in Section VII. A detailed listing of the combat data used in this report is contained in Appendix A.

(U) 1. OBJECTIVES

There are four major objectives in this analysis: (1) determining the loss experience of specific aircraft, (2) comparing this experience with other similar aircraft, (3) determining the effectiveness of selected vulnerability reduction modifications and (4) providing a central reference report for USAF fixed-wing aircraft combat losses in Southeast Asia and data related thereto.

(U) a. Specific Aircraft

Each loss for a given aircraft model was analyzed to determine the threat spectrum encountered, kill severity and reason

for crash. In addition, the total number lost, loss rates, crewmember survival rates plus any interrelationships that may exist among any of these parameters was determined.

(U) b. Comparing Experience

The loss experience of selected aircraft performing similar roles was compared in an attempt to determine their relative vulnerabilities. As much as was possible, parameters were equalized before comparisons were made.

(U) c. Vulnerability Reduction Modifications

Special attention was paid to the relative loss experience of those aircraft having fuel tank protection modifications compared to those in similar roles that did not have these modifications.

(U) d. Central Reference Report

Throughout this report, all contributing data sources are fully referenced. In this way, any analysis performed in this or referenced reports may be duplicated to assess the validity of all assumptions and the analytic processes used.

(U) 2. DATA SOURCES

All data and referenced documents contained herein are currently located at the Combat Data Information Center (CDIC), Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio 45433. CDIC retains all known data pertaining to a given combat incident in its Single Incident File (Ref. 2). This file contains such things as Battle Damage Assessment and Reporting Team (BDART) reports, loss and damage compilations, 7th AF Form 40, technical representative reports, OPREP messages, squadron records, and numerous other sources of data. Therefore, although all this data is now consolidated at a single source, the origin

of the data could be almost any reporting system. CDIC is the only location in which all of this data is contained and correlated.

The accuracy, completeness and usefulness of BDART data compared to combat data collected through other sources is reported in References 3 and 4.

(C) SECTION II

GENERAL USAF LOSS DATA

(C) 1. TOTAL USAF FIXED-WING AIRCRAFT LOSSES

(C) Over 1600 USAF fixed-wing aircraft are listed as combat losses in the Southeast Asia Conflict (Ref. 5), representing a dollar loss figure of over 2.3 billion dollars (Ref. 6). Three aircraft models, the F/RF-4, F-105 and F-100, accounted for over 59% of the USAF aircraft losses and over 74% of the total replacement cost. The addition of only four more models, the A-1, O-1, O-2, and OV-10A, will encompass over 83% of the aircraft lost. The remaining 17% (286) of the losses were distributed over 22 different models. The total number and approximate replacement cost of the USAF aircraft lost in Southeast Asia are shown in Table 1. This table includes all aircraft officially listed as a combat loss by the USAF Command Post (Ref. 5). Table 1 also includes the total number of combat sorties flown by each of the aircraft listed (Ref. 7). The word combat sortie is used here in order to delineate these sorties from noncombat type sorties such as administration and training flights. A detailed listing of losses by enemy threat class is provided in the Appendix, Table A-1.

(C) 2. STATUS OF DOWNED USAF CREWMEMBERS

(C) The immediate status of crewmembers resulting from the loss of their aircraft is shown in Table 2. From a survivability perspective, 50.5% of the aircrew members downed in the entire war were known to be alive (either rescued or captured). The highest survival rate is noted in North Vietnam (60.8%) and the lowest in South Vietnam (42.1%). This table reflects the official status of the crewmembers as listed by the USAF Command Post (Ref. 5).

(C) TABLE 1

USAF FIXED-WING AIRCRAFT COMBAT LOSSES IN SOUTHEAST ASIA BY COUNTRY WITH TOTAL NUMBER OF COMBAT SORTIES FLOWN AND TOTAL REPLACEMENT COST FOR EACH AIRCRAFT MODEL (U)

	L O S S E S					TOTAL COMBAT SORTIES *	TOTAL LOSSES**	TOTAL REPLACEMENT COST ($ thousands)***
	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	OTHER			
F-4	8	109	193	71	1	496,670	382	$ 725,620
RF-4C	2	22	38	14	0	100,050	76	177,460
F-105	0	51	282	1	0	159,795	334	700,732
F-100	6	29	16	147	0	360,665	198	157,410
A-1	0	89	18	43	0	91,855	150	53,700
O-1	1	9	2	110	0	485,452	122	3,172
O-2	4	18	3	57	0	281,000	82	7,216
OV-10A	6	18	0	22	0	123,572	46	23,276
B-57	0	12	5	23	0	43,772	40	52,190
C-130	0	2	2	32	0	227,807	36	91,476
RF-101	0	3	27	3	0	39,296	33	64,482

(C) TABLE 1 (CONTINUED)

	L O S S E S					TOTAL COMBAT SORTIES*	TOTAL LOSSES **	TOTAL REPLACEMENT COST ($ thousands)* **
	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	OTHER			
C-47	0	8	1	16	0	125,660	25	$ 2,375
C-123	0	3	0	18	0	186,339	21	12,705
B-52	0	0	17	0	0	118,758	17	111,061
T-28	0	3	1	13	0	12,829	17	2,414
A-37	5	0	0	11	0	68,471	16	6,544
A-26	0	10	0	0	0	9,734	10	5,770
B-26	0	0	0	9	0	5,242	9	2,187
F-111	0	3	3	0	2	8,845	8	91,464
F-104	0	2	4	2	0	7,107	8	13,504
C-7	0	0	0	8	0	239,567	8	6,392
F-102	0	0	1	6	0	21,186	7	8,288
F-5	0	0	0	7	0	9,502	7	5,264
AC-130	0	5	0	1	0	11,707	6	16,542
B-66	0	0	4	2	0	35,716	6	18,624

(C) TABLE 1 (CONCLUDED)

	L O S S E S					TOTAL COMBAT SORTIES*	TOTAL LOSSES **	TOTAL REPLACEMENT COST ($ thousands)* **
	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	OTHER			
A-7	2	2	0	0	0	12,550	4	$ 10,000
U-10	0	1	0	3	0	49,765	4	256
AC-119	0	0	0	1	1	15,612	2	968
U-3	0	0	0	1	0	1,526	1	53
HU-16	0	0	0	1	0	238	1	744
	34	399	617	622	4	3,350,288	1,676	$ 2,371,889

*Reference 7

**Reference 5, Table A-1

***Reference 6

(C) TABLE 2

IMMEDIATE STATUS OF DOWNED USAF AIRCREW MEMBERS BY COUNTRY (U)*

	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL	PERCENT
Rescued	20	331	336	393	1080	39.2
Captured	0	8	299	2	309	11.2
Missing	5	268	361	77	711	25.8
Killed	14	124	48	466	652	23.7
TOTAL	39	731	1044	938	2752	
PERCENT	1.4	26.6	37.9	34.1		

*Reference 5

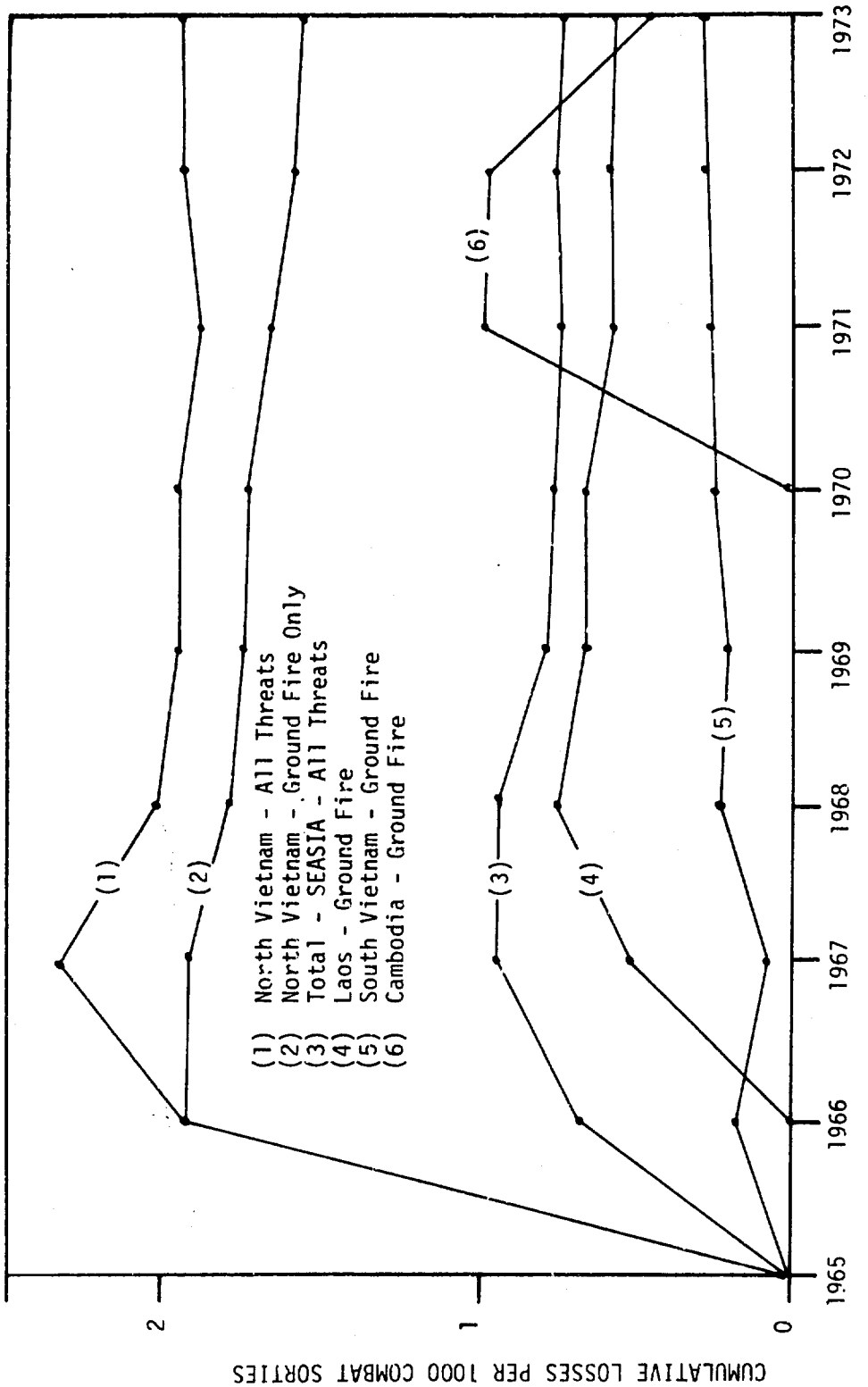
(S) SECTION III

LOSS EXPERIENCE OF SPECIFIC USAF AIRCRAFT

(U) In this section, special attention will be given to the seven aircraft models that accounted for 83% of the losses. Factors such as loss rates, crewmember status, threat spectrum encountered, kill severity, and reason for crash will be investigated. For purposes of this report, loss rates will be defined as the number of aircraft "shot down" per 1,000 combat sorties. The term "shot down" implies that the aircraft was lost due to physical damage to the airplane or crew resulting from the impact of enemy munitions. As a result of this definition, the numbers of aircraft losses reflected in this and subsequent portions of this report may not agree with the official losses listed in Section II, Table 1, or in the Appendix, Table A-1. The official figures also include aircraft destroyed on the ground, lost due to damage from secondary explosions of targets, self-inflicted damage from ordnance malfunctions or other situations where the aircraft was lost due to combat action but not downed by enemy munitions. The threat spectrum is initially divided into three classes; ground fire, surface-to-air missiles (SAM'S) and enemy aircraft (MIG'S). These three classes are used in the main body of the report. A breakdown of specific threats (when known) is included, in most cases, in Appendix A. In Appendix A, the ground fire threat class is broken into caliber of weapon when known or reported, and the MIG threat class is divided into cannon or air-to-air missile, if known or reported. The term "kill severity" implies the rapidity of deterioration of the flight capability of a damaged aircraft. For the purpose of this report, it is a measurement of the distance an aircraft flew after being hit by enemy munitions. The term "reason for crash" is applied to the aircraft system(s) that is/are damaged or the damage mechanism(s) which results in the loss of the aircraft. This may be considered as a crude measure of vulnerability.

(S) 1. RF-4C

(S) Seventy-two USAF RF-4C aircraft were "shot down" in Southeast Asia. A breakdown of these losses by year, country, and threat class is given in Table A-2. A tabulation of combat sorties flown is given in Table A-3. The RF-4C experienced an overall loss rate of 0.720 aircraft per 1,000 combat sorties flown. This varied from a high of 1.934 in North Vietnam to a low of 0.277 in South Vietnam (Figure 1 and Table A-4). The overall probability of crewmember survival in the RF-4C given a loss was 56.9%. This ranged from a high of 100% in Cambodia to a low of 35% in South Vietnam (Table 3). The probability of crewmember survival increased directly with the distance the aircraft could be flown after being hit. If the aircraft flew 5NM or less after being hit (Kill Severity "K"), the crewmember survival rate was 61.1%. When the aircraft could be flown from 5-50NM (Kill Severity "A"), the crewmember survival rate was 79.2% and when the aircraft could be flown more than 50NM (Kill Severity "B"), the crewmember survival rate was 83.3% (Table A-5). Although only seven RF-4C's were lost to SAM's, the crewmember survival rate under these circumstances is considerably higher (Table A-6). This will be discussed in greater detail in Section III-3. The crewmember survival rates shown here compare favorably with those generated in Reference 1. Where kill severity could be determined, 42.9% of the RF-4C losses were "K" kills (Table 4). The RF-4C is unusual in that the probability of "K" kills decreases with a corresponding increase in threat size. Approximately 64% of the RF-4C losses in the small arms/automatic weapons threat class were "K" kills, whereas only 37.5% of the losses in the AAA threat class were in this category. Against the SAM threat, only 28.6% were "K" kills. Where the reason for crash could be determined for the RF-4C in the 1971-1973 time frame, flight controls, propulsion systems, and fire/explosion accounted for 81.8% of the losses (Table A-8). The correlation of reason for crash versus threat class for the 1962-1973 time frame is integrated with the F-4 experience and discussed in Section III-3.



(C)Figure 1. RF-4C Cumulative Loss Rates per 1,000 Combat Sorties by Year and Country (U)*

*Reference Table A-4.

(C) TABLE 3

IMMEDIATE STATUS OF DOWNED RF-4C AIRCREW MEMBERS BY COUNTRY (U)*

	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL	PERCENT
Rescued	4	26	22	6	58	40.3
Captured	0	2	21	1	24	16.7
Missing	0	13	28	7	48	33.3
Killed	0	3	5	6	14	9.7
TOTAL	4	44	76	20	144	
PERCENT	2.8	30.5	52.8	13.9		

Reference 5

(S) TABLE 4

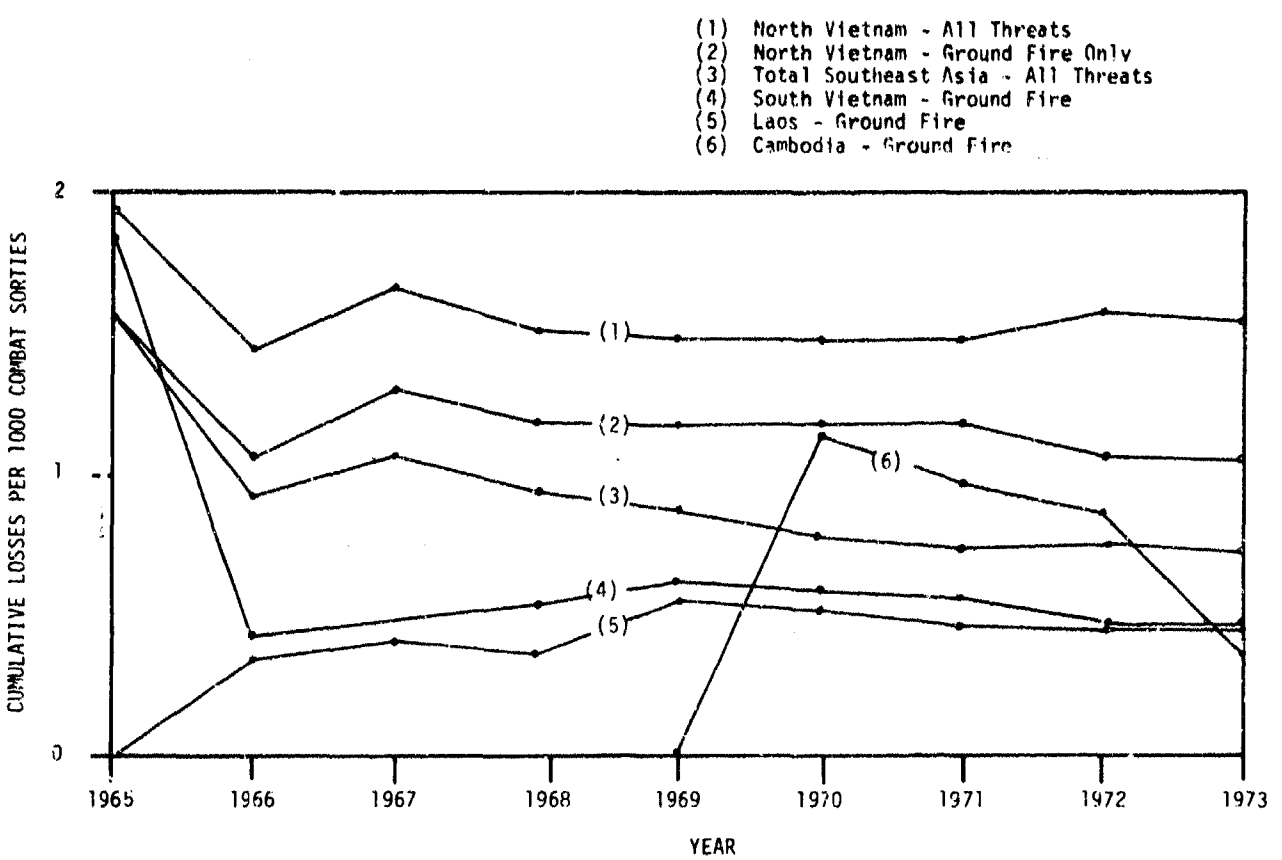
RF-4C, THREAT CLASS VERSUS KILL SEVERITY (U)*

	"K"	"A"	"B"	UNKNOWN	TOTAL	PERCENT
SA/AW	7	2	2	4	15	20.8
AAA	9	6	9	26	50	69.4
SAM	2	4	1	0	7	9.7
TOTAL	18	12	12	30	72	
PERCENT	25.0	16.7	16.7	41.6		

*Reference 1, 2, and Table A-7

(S) 2. F-4

(S) Three hundred and fifty-eight USAF F-4 aircraft were "shot down" in Southeast Asia. A breakdown of these losses by year, country, and threat class is given in Table A-9. A tabulation of combat sorties flown is given in Table A-10. The F-4 experienced an overall loss rate of 0.721 aircraft per 1,000 combat sorties flown. This varied from a high of 1.560 in North Vietnam to a low of 0.339 in Cambodia (Figure 2 and Table A-13). The overall probability of crewmember survival in the F-4 given a loss was 60.5%. This ranged from a high of 65.7% in North Vietnam to a low of 37.5% in Cambodia (Table 5). F-4 crewmember survivability as a function of kill severity for the 1971-1973 time frame was similar to that experienced in the RF-4C. Only 65.3% of the F-4 crewmembers survived a "K" kill. However, this survival rate increased to 94.2% for "A" kills and was 81.8% for "B" kills (Table A-11). Crewmember survival rates in "K" kills from SAM's and MIG's were considerably higher than those from ground fire. In this category, 80.8% of the crewmembers survived the SAM "K" kill and 91.2% survived the MIG "K" kill (Table A-12). This phenomenon is addressed in Section IV-2 of this report. Crewmember survival in the F-4 did vary considerably with the threat class causing the loss. Where the aircraft was downed by small arms/automatic weapons, only half (50.0%) of the crewmembers were known to have survived. Against the AAA threat class, this survival rate climbed to 57.5%. Crewmember survival rates in F-4 losses due to SAM's and MIG's were 80.4% and 86.1%, respectively (Table 6). Where kill severity could be determined, the small arms/automatic weapons threat class caused the highest percentage of "K" kills with 63.4%. For all other threat classes, approximately half were "K" kills (Table 7, Table A-14). Where the reason for crash could be determined for the F-4 in the 1971-1973 time frame, the results were similar to those generated in Reference 1. Flight controls, propulsion systems, and fire/explosion accounted for 79-83% of the losses from ground fire (Table 8).



(C) Figure 2. F-4 Cumulative Loss Rates per 1,000 Combat Sorties by Year and Country (U)*

*Reference Table A-13.

(C) TABLE 5

IMMEDIATE STATUS OF DOWNED F-4 AIRCREW MEMBERS BY COUNTRY (U)*

	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL	PERCENT
Rescued	6	105	117	74	302	42.2
Captured	0	5	126	0	131	18.3
Missing	6	78	119	7	210	29.3
Killed	4	20	8	41	73	10.2
TOTAL	16	208	370	122	716	
PERCENT	2.2	29.1	51.7	17.0		

*Reference 5

(S) TABLE 6

F-4, THREAT CLASS VERSUS IMMEDIATE CREWMEMBER STATUS (U)*

	RESCUED	CAPTURED	MISSING	KILLED	TOTAL	PERCENT
SA/AW	79	3	33	49	164	22.9
AAA	196	48	156	24	424	59.2
SAM	14	31	11	0	56	7.8
MIG	13	49	10	0	72	10.1
TOTAL	302	131	210	73	716	
PERCENT	42.2	18.3	29.3	10.2		

*Reference Table A-14

(S) TABLE 7

F-4, THREAT CLASS VERSUS KILL SEVERITY (U)*

	"K"	"A"	"B"	UNKNOWN	TOTAL	PERCENT
SA/AW	45	22	4	11	82	22.9
AAA	82	64	37	29	212	59.2
SAM	13	10	2	3	28	7.8
MIG	17	12	5	2	36	10.1
TOTAL	157	108	48	45	358	
PERCENT	43.9	30.2	13.4	12.5		

* Reference Table A-14

(S) TABLE 8

F-4, THREAT CLASS VERSUS REASON FOR CRASH, 1971-1973 (GROUND FIRE ONLY) (U)

	LOSS OF CONTROL	CREW/ CONTROL	CREW	LOSS OF PROPULSION	ENGINE FIRE	FIRE/ EXPLOSION	MISC.	INSUFFICIENT DATA	TOTAL	%
SA/AW	0	0	1	1	2	3	2	1	10	15.4
UGF	1	1	0	0	0	2	2	16	22	33.8
AAA	6	1	0	7	3	8	2	6	33	50.8
TOTAL	7	2	1	8	5	13	6	23	65	

Since more than one lethal event may occur in a single aircraft loss, the numbers shown in this table are not necessarily mutually exclusive.

(S) 3. F/RF-4 CONSOLIDATED EXPERIENCE

(S) The threat spectrum encountered in all areas of Southeast Asia changed considerably during the 1971-1973 time frame as compared with that of prior years (Ref. 1). In North Vietnam, SAM's and MIG's accounted for only 17.8% of the F/RF-4 losses in the earlier years but during the 1971-1973 time frame, 68.5% of the F/RF-4's lost were downed by SAM's and MIG's (Table 9). At the same time, small arms/automatic weapons activity decreased markedly and more emphasis was placed on a coordinated AAA-SAM-MIG defense. In South Vietnam, AAA activity increased in 1971-1973 (Table 9) and the introduction of the SA-7 accounted for 15.3% of the F/RF-4 losses in this time frame. There was no appreciable change in the defenses in Laos. In summary, the North Vietnam air war started as an AAA war with sporadic use of SAM's and MIG's and evolved into an integrated air defense, coordinating all phases for optimum effectiveness. In Laos, the threat spectrum remained fairly stable (mainly ground fire) with some emphasis on AAA weapons. In Cambodia, the defenses consisted almost exclusively of small arms/automatic weapons. Early in the war in South Vietnam, small arms/automatic weapons were the statistical threat, but during the 1971-1973 time frame, a significantly high number of aircraft were lost to 23-37mm AAA and SA-7 missiles (Table 9). Aircrew members survived in 59.9% of the F/RF-4 losses. The highest survival rate was noted in North Vietnam (64.1%), the lowest in Cambodia (50%) (Table 10). Where kill severity could be determined in F/RF-4 losses due to SAM's and MIG's, 87.9% of the aircraft flew 50NM or less. Over 48% were "K" kills and over 39% were "A" kills (Table 11). Under these conditions, crewmembers experienced an extremely high survival rate, 85.9% for "K" kills and 82.7% for "A" kills (Table 11). Where the reason for crash could be determined for F/RF-4's downed by ground fire, 38% were lost due to fire/explosion, 23.5% due to engine damage/fire and 13-14% due to flight control damage (Table 12). These results compare favorably with those generated in Reference 1.

(S) TABLE 9

F/RF-4, PERCENTAGE OF LOSSES BY TIME FRAME, COUNTRY, AND THREAT CLASS (U)*

	SA/AW	UGF	AAA	SAM	MIG
NORTH VIETNAM					
1965-1970	7.1%	29.8%	45.2%	9.5%	8.3%
1971-1973	1.8%	9.3%	20.4%	31.5%	37.0%
1965-1973**	5.8%	24.8%	39.2%	14.9%	15.3%
LAOS					
1965-1970	16.0%	41.5%	42.5%	0.0%	0.0%
1971-1973	7.1%	46.4%	42.9%	0.0%	3.6%
1965-1973**	13.9%	42.6%	42.6%	0.0%	0.8%
SOUTH VIETNAM					
1965-1970	46.6%	50.0%	3.4%	0.0%	0.0%
1971-1973	23.1%	23.1%	38.5%	15.3%	0.0%
1965-1973**	42.2%	45.3%	9.9%	2.8%	0.0%

*Reference Tables A-2 and A-9

**NOTE: Percentages cannot be averaged due to the different sample sizes in the two time frames, 1965-1970 and 1971-1973.

(C) TABLE 10

IMMEDIATE STATUS OF DOWNED F/RF-4 AIRCREW MEMBERS BY COUNTRY (U)*

	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL	PERCENT
Rescued	10	131	139	80	360	41.9
Captured	0	7	147	1	155	18.0
Missing	6	91	147	14	258	30.0
Killed	4	23	13	47	87	10.1
TOTAL	20	252	446	142	860	
PERCENT	2.3	29.3	51.9	16.5		

*Reference 5

(S) TABLE 11

F/RF-4, IMMEDIATE CREWMEMBER STATUS VERSUS KILL SEVERITY FOR SAM, MIG KILLS (U)*

	"K"	"A"	"B"	UNKNOWN	TOTAL	PERCENT
Rescued	6	10	12	2	30	21.1
Captured	49	33	2	5	89	62.7
Missing	9	9	2	3	23	16.2
Killed	0	0	0	0	0	0.0
TOTAL	64	52	16	10	142	
PERCENT	45.1	36.6	11.3	7.0		

*Reference Tables A-6 & A-12

(S) TABLE 12

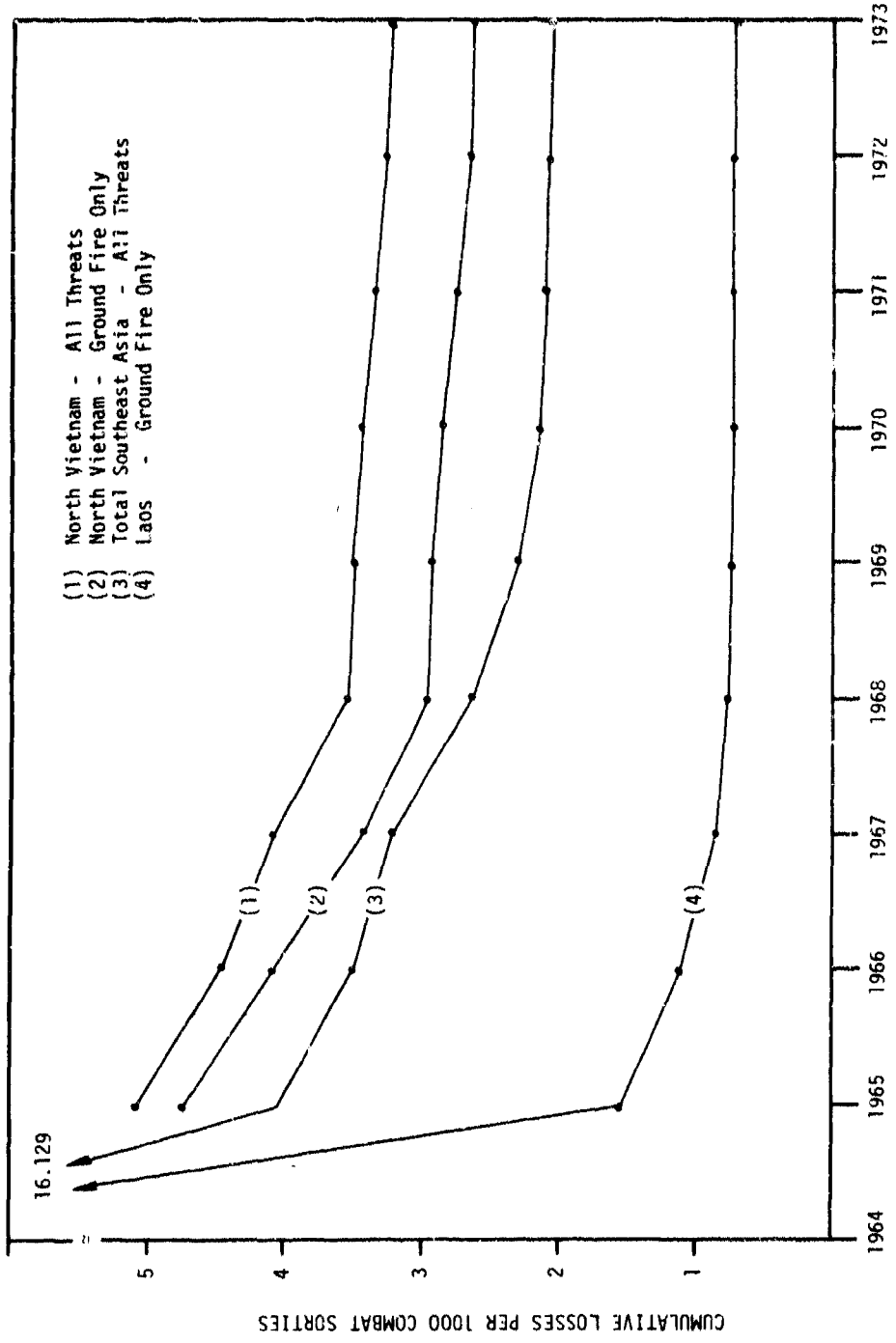
F/RF-4, THREAT CLASS VERSUS REASON FOR CRASH (GROUND FIRE ONLY) (U)

	LOSS OF CONTROL	CREW/ CONTROL	CREW	LOSS OF PROPULSION	ENGINE FIRE	FIRE/ EXPLOSION	MISC.	INSUFFICIENT DATA	TOTAL	%
SA/AW	3	0	3	4	6	18	10	22	66	17.9
UGF	10	1	2	7	8	22	11	86	147	39.8
AAA	16	1	1	14	13	44	27	40	156	42.3
TOTAL	29	2	6	25	27	84	48	148	369	

Since more than one lethal event may occur in a single aircraft loss, the numbers shown in this table are not necessarily mutually exclusive.

(S) 4. F-105

(S) Three hundred and thirty-two USAF F-105 aircraft were "shot down" in Southeast Asia. A breakdown of these losses by year, country and threat class is given in Table A-15. A tabulation of combat sorties flown is given in Table A-16. The F-105 experienced an overall loss rate of 2.078 aircraft per 1,000 combat sorties flown. This varied from a high of 3.281 in North Vietnam to a low of 0.330 in South Vietnam (Figure 3, Tables A-15, A-16 and A-17). The overall probability of crewmember survival in the F-105 given a loss was 65%. This ranged from a high of 100% in South Vietnam to a low of 56.9% in Laos (Table 13). The probability of crewmember survival increased directly with the distance the aircraft could be flown after being hit. For "K" kills, 52.9% of the crewmembers survived, for "A" kills 67.6% of the crewmembers survived, and for "B" kills, the crewmember survival rate was 94% (Table A-18). Contrary to the experience of the F/RF-4, no significant difference in crewmember survival was noted in F-105 losses due to SAM's and MIG's (Table 14). Crewmember survival rates did not appear to vary according to gun caliber in the ground fire threat class, but were higher (67.2%) than those noted for losses due to SAM's (51.2%) and MIG's (63.0%) (Tables 15, A-19 and A-20). Where kill severity could be determined, only 31.9% of the F-105 losses were "K" kills (Table 16). This may account for the numerous "war stories" about the amount of damage an F-105 could sustain and keep flying. The truth of the matter is although the F-105 may not "die" as rapidly as other aircraft when hit, it does "die" more frequently per combat sortie flown (Figure 3). In addition, documented instances of heavily damaged F-105's safely returning to base are rare. Roughly, one out of every four F-105's hit in combat will crash, and the remaining three usually sustain only minor damage (Ref. 1). It was, however, this capacity to "die slowly" that contributed to the high crewmember survival rate noted for the F-105. Where the reason for the crash could be determined for F-105's downed by ground fire, over 79% of the losses could be attributed to three causes, fire/explosion (44.2%), flight control damage (18.4%) and engine damage/fire (16.8%) (Table 17).



(C) Figure 3. F-105 Cumulative Loss Rates per 1,000 Combat Sorties by Year and Country (U)*

*Reference Table A-17.

(C) TABLE 13

IMMEDIATE STATUS OF DOWNED F-105 AIRCREW MEMBERS BY COUNTRY (U)*

	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL	PERCENT
Rescued	28	97	1	126	34.7
Captured	1	109	0	110	30.3
Missing	14	87	0	101	27.8
Killed	8	18	0	26	7.2
TOTAL	51	311	1	363	
PERCENT	14.0	85.7	0.3		

*Reference 5

(S) TABLE 14

F-105, IMMEDIATE CREWMEMBER STATUS VERSUS
KILL SEVERITY FOR SAM, MIG KILLS (U)

	"K"	"A"	"B"	UNKNOWN	TOTAL	PERCENT
Rescued	4	2	6	0	12	17.1
Captured	9	18	0	0	27	38.6
Missing	9	16	0	0	25	35.7
Killed	1	4	1	0	6	8.6
TOTAL	23	40	7	0	70	
PERCENT	32.9	57.1	10.0	0.0		

(S) TABLE 15

F-105, THREAT CLASS VERSUS IMMEDIATE CREWMEMBER STATUS (U)*

	RESCUED	CAPTURED	MISSING	KILLED	TOTAL	PERCENT
SA/AW	21	7	6	5	39	10.7
UGF	25	13	23	9	70	19.3
AAA	68	63	47	6	184	50.7
SAM	8	14	17	4	43	11.8
MIG	4	13	8	2	27	7.4
TOTAL	126	110	101	26	363	
PERCENT	34.7	30.3	27.8	7.2		

*Reference Tables A-19, A-20

(S) TABLE 16

F-105, THREAT CLASS VERSUS KILL SEVERITY (U)

	"K"	"A"	"B"	UNKNOWN	TOTAL	PERCENT
SA/AW	10	20	7	2	39	11.7
UGF	18	26	5	25	74	22.3
AAA	46	80	30	10	166	50.0
SAM	10	20	2	0	32	9.6
MIG	10	8	3	0	21	6.3
TOTAL	94	154	47	37	332	
PERCENT	28.3	46.4	14.2	11.1		

(S) TABLE 17

F-105, THREAT CLASS VERSUS REASON FOR CRASH (GROUND FIRE ONLY) (U)

	LOSS OF CONTROL	CREW/ CONTROL	CREW	LOSS OF PROPULSION	ENGINE FIRE	FIRE/ EXPLOSION	MISC.	INSUFFICIENT DATA	TOTAL	%
SA/AW	5	0	1	7	0	12	7	7	39	14.0
UGF	8	0	2	4	3	21	3	33	74	26.5
AAA	22	0	1	11	7	51	25	49	166	59.5
TOTAL	35	0	4	22	10	84	35	89	279	

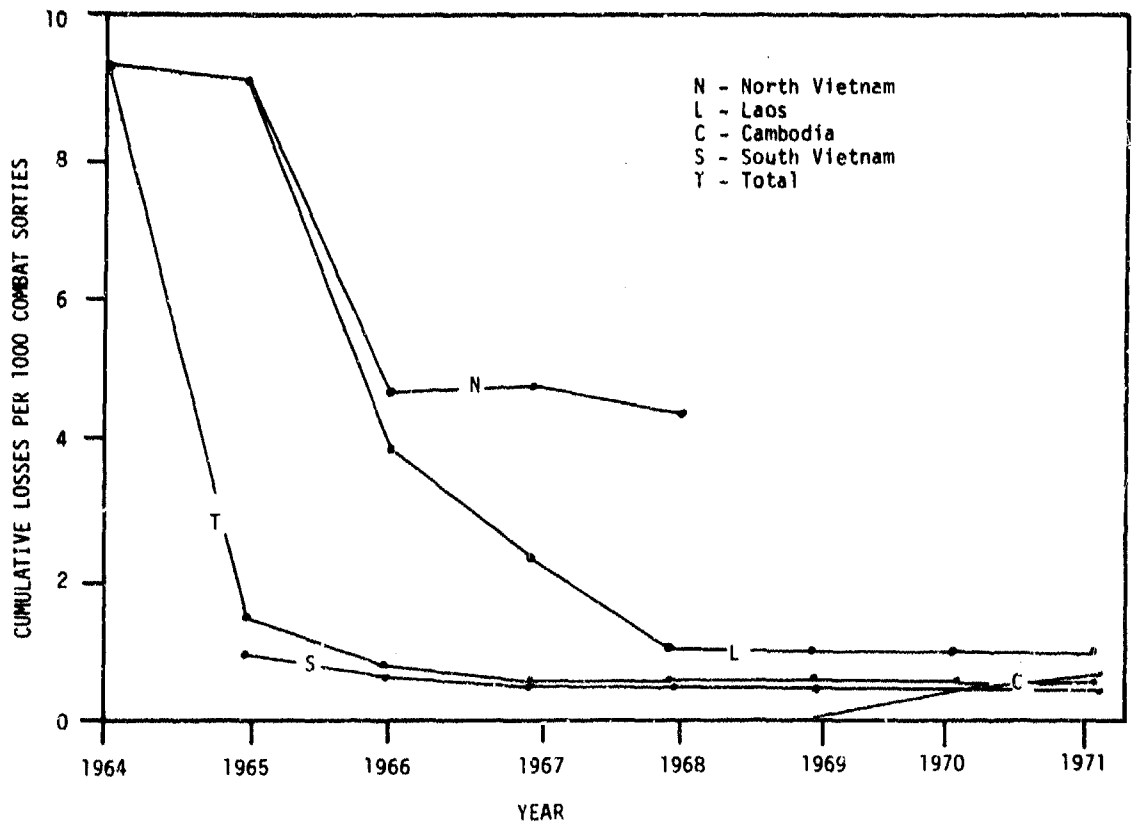
Since more than one lethal event may occur in a single aircraft loss, the numbers shown in this table are not necessarily mutually exclusive.

(S) 5. F-100

(S) One hundred and ninety-one USAF F-100 aircraft were "shot down" in Southeast Asia. A breakdown of these losses by year and country as well as a tabulation of combat sorties flown is given in Table A-21. No F-100's were lost to SAM's or MIG's. This is not surprising since only slightly over 1% of the F-100 sorties were flown in North Vietnam and none were flown there after 1968, which was prior to the coordinated air defense tactics noted in the 1971-1973 time frame. The F-100 experienced an overall loss rate of 0.530 aircraft per 1,000 combat sorties flown. This varied from a high of 4.344 in North Vietnam to a low of 0.447 in South Vietnam (Figure 4, Table A-22). The overall probability of crewmember survival in the F-100 given a loss was 63.1%. This ranged from a high of 66.7% in Cambodia to a low of 56.7% in Laos (Table 18). Due to the high percentage of unspecified caliber weapons, no conclusions could reasonably be drawn as to crewmember survival as a function of threat (Table A-23). Where kill severity could be determined, 57.9% of the F-100 losses were "K" kills, 29.6% were "A" kills and 12.5% were "B" kills (Tables 19, A-24). Where the reason for crash could be determined for F-100's, 30.3% were lost due to fire/explosion, 23.2% due to engine damage/fire and 10.3% due to flight control damage (Tables 20, A-25).

(S) 6. OV-10A

(S) Forty-five USAF OV-10A aircraft were "shot down" in Southeast Asia. A breakdown of these losses by year, country, and threat class, as well as a tabulation of combat sorties flown is given in Table A-26. The OV-10A experienced an overall loss rate of 0.364 aircraft per 1,000 combat sorties flown. This varied from a high of 0.494 in Laos to a low of 0.290 in South Vietnam. (Figure 5 and Table A-27 show loss rates due to ground fire only.) The overall probability of crewmember survival in the OV-10A given a loss was 42.6%. This ranged from a high of 63.6% in Laos to a low of 25% in South Vietnam (Table 21). Where the reason for crash could be determined for OV-10A's downed by ground fire, 24-40% were lost due to



(C) Figure 4. F-100 Cumulative Loss Rates per 1,000 Combat Sorties by Year and Country (U)*

*Reference Table A-22.

(C) TABLE 18

IMMEDIATE STATUS OF DOWNED F-100 AIRCREW MEMBERS BY COUNTRY (U)*

	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL	PERCENT
Rescued	4	17	7	91	119	60.1
Captured	0	0	5	1	6	3.0
Missing	1	7	5	3	16	8.1
Killed	1	6	3	47	57	28.8
TOTAL	6	30	20	142	198	
PERCENT	3.0	15.2	10.1	71.7		

*Reference 5

(S) TABLE 19

F-100, THREAT CLASS VERSUS KILL SEVERITY (U)*

	"K"	"A"	"B"	UNKNOWN	TOTAL	PERCENT
SA/AW	30	19	9	9	67	35.1
UGF	48	16	7	21	92	48.2
AAA	10	10	3	9	32	16.7
TOTAL	88	45	19	39	191	
PERCENT	46.1	23.6	9.9	20.4		

*Reference Table A-24

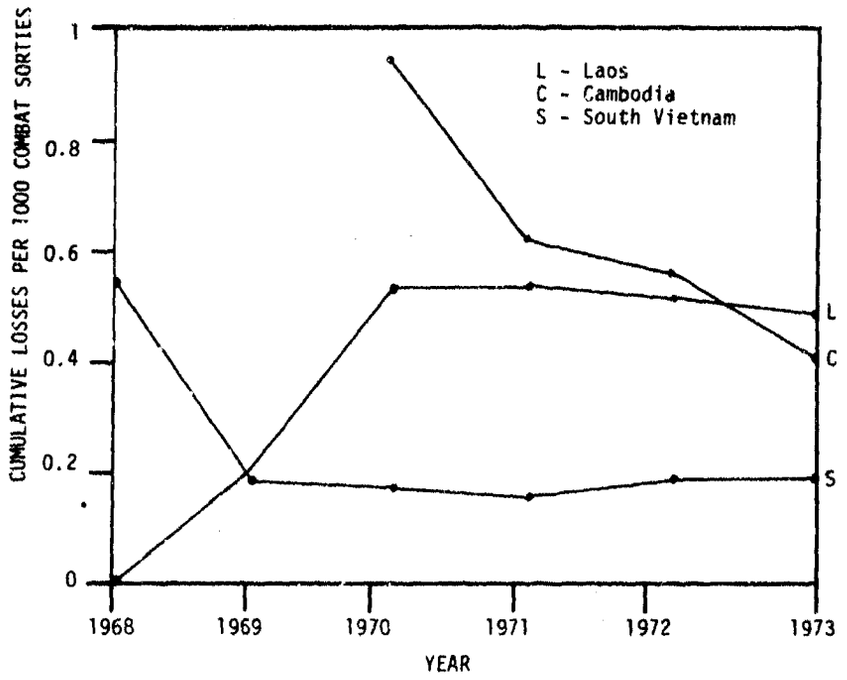
(S) TABLE 20

F-100, THREAT CLASS VERSUS REASON FOR CRASH (U)*

	LOSS OF CONTROL	CREW/ CONTROL	CREW	LOSS OF PROPULSION	ENGINE FIRE	FIRE/ EXPLOSION	MISC.	INSUFFICIENT DATA	TOTAL	%
SA/AW	6	0	4	10	8	12	21	6	67	35.1
UGF	7	0	4	11	3	25	20	22	92	48.2
AAA	3	0	1	2	2	10	6	8	32	16.7
TOTAL	16	0	9	23	13	47	47	36	191	

Since more than one lethal event may occur in a single aircraft loss, the numbers shown in this table are not necessarily mutually exclusive.

*Reference Table A-25



(C) Figure 5. OV-10A Cumulative Loss Rates per 1,000 Combat Sorties by Year and Country (Ground Fire Only) (U)*

*Reference Table A-27.

(C) TABLE 21

IMMEDIATE STATUS OF DOWNED OV-10A AIRCREW MEMBERS BY COUNTRY (U)*

	CAMBODIA	LAOS	SOUTH VIETNAM	TOTAL	PERCENT
Rescued	4	13	8	25	41.0
Captured	0	1	0	1	1.6
Missing	1	0	8	9	14.8
Killed	2	8	16	26	42.6
TOTAL	7	22	32	61	
PERCENT	11.5	36.1	52.4		

*Reference 5

flight control damage, 20% due to engine damage/fire, 12-28% due to crew incapacitation and 12% due to fire/explosion. The reason for varying percentages is found in those cases where the specific reason for crash could not be ascertained, but the aircraft behavior after being hit indicated either control system damage and/or crewmember incapacitation. These are shown in Table 22 as "crew/control". Therefore, if all "crew/control" losses were actually only flight control damage, the flight control figure would be 40%. If none were flight control damage and all were actually crewmember incapacitation, flight controls would reflect 24% and crew 28%. However, the percentages attributable to the causes shown do lie in the range indicated. It should be pointed out that the OV-10A was designed to survive in a 7.62mm environment. Approximately half of the known reasons for crash involved reported AAA threats, a severe mismatch between weapon and aircraft (Table A-28). Fully 66.7% of the flight control losses, all of the engine fire losses and 66.7% of the fire/explosion losses were due to the high explosive AAA threat. These figures reflect the loss experience of USAF OV-10A aircraft only. An analysis of Air Force, Navy, and Marine Corps OV-10A combat damages and losses from July 1968, when the aircraft was first deployed to Southeast Asia, through June 1971 is available in Reference 8.

(S) 7. A-1

(S) One hundred and forty-seven USAF A-1 aircraft were "shot down" in Southeast Asia. A breakdown of these losses by year, country, and threat class as well as a tabulation of combat sorties flown is given in Table A-29. The A-1 experienced an overall loss rate of 1.6 aircraft per 1,000 combat sorties flown. This varied from a high of 6.596 in North Vietnam to a low of 1.326 in South Vietnam. (Figure 6 and Table A-30 show loss rates due to ground fire only.) The overall probability of crewmember survival in the A-1 given a loss was 52.9%. This ranged from a high of 57.9% in North Vietnam to a low of 50% in South Vietnam (Table 23). All but five of the A-1 losses were caused by ground fire (Table 24). Where the reason for crash could be determined for A-1's downed by ground fire, 39.8% were lost due to engine damage/fire, 21.7% due to fire/explosion and 8.4% due to flight control damage (Table 24).

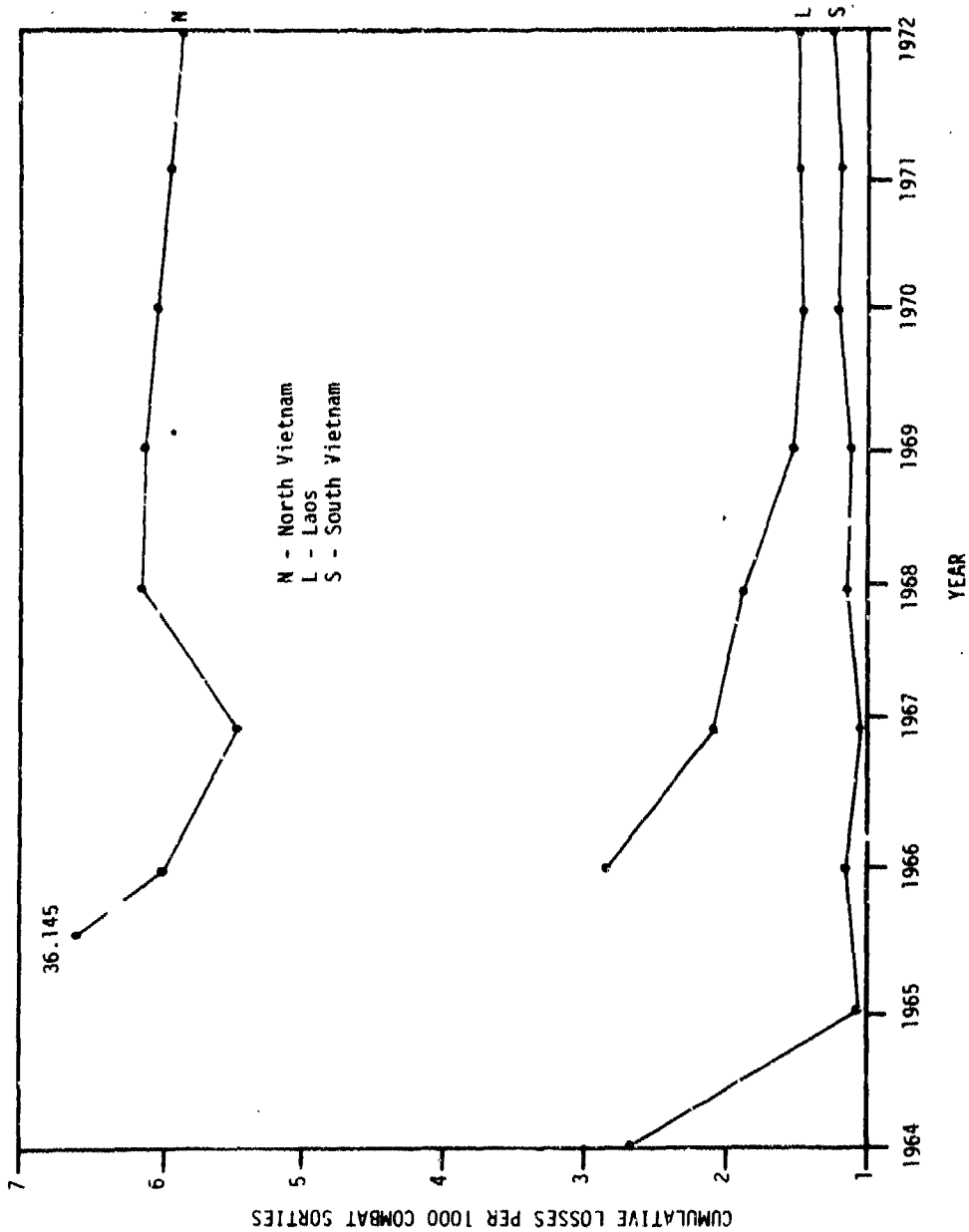
(S) TABLE 22

OV-10A, THREAT CLASS VERSUS REASON FOR CRASH (GROUND FIRE ONLY) (U)*

	LOSS OF CONTROL	CREW/ CONTROL	CREW	LOSS OF PROPULSION	ENGINE FIRE	FIRE/ EXPLOSION	MISC.	INSUFFICIENT DATA	TOTAL	%
SA/AW	2	4	1	3	0	1	1	5	17	41.5
UGF	0	0	1	0	0	0	0	8	9	21.9
AAA	4	0	1	0	2	2	3	3	15	36.6
TOTAL	6	4	3	3	2	3	4	16	41	

Since more than one lethal event may occur in a single aircraft loss, the numbers shown in this table are not necessarily mutually exclusive.

*Reference Table A-28



(C) Figure 6. A-1 Cumulative Loss Rates per 1,000 Combat Sorties by Year and Country (Ground Fire Only) (U)*

*Reference Table A-30.

(C) TABLE 23

IMMEDIATE STATUS OF DOWNED A-1 AIRCREW MEMBERS BY COUNTRY (U)*

	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL	PERCENT
Rescued	50	9	22	81	51.6
Captured	0	2	0	2	1.3
Missing	16	6	0	22	14.0
Killed	28	2	22	52	33.1
TOTAL	94	19	44	157	
PERCENT	59.9	12.1	28.0		

*Reference 5

(S) TABLE 24

A-1, THREAT CLASS VERSUS REASON FOR CRASH (U)

	LOSS OF CONTROL	CREW/ CONTROL	CREW	LOSS OF PROPULSION	ENGINE FIRE	FIRE/ EXPLOSION	MISC.	INSUFFICIENT DATA	TOTAL	%
SA/AW	4	0	2	14	1	13	4	15	53	36.0
UGF	1	0	4	7	1	5	7	33	58	39.5
AAA	2	0	0	3	7	0	8	11	31	21.1
SA-7	0	0	0	0	3	0	0	0	3	2.0
MIG	0	0	0	0	0	0	0	2	2	1.4
TOTAL	7	0	6	24	12	18	19	61	147	

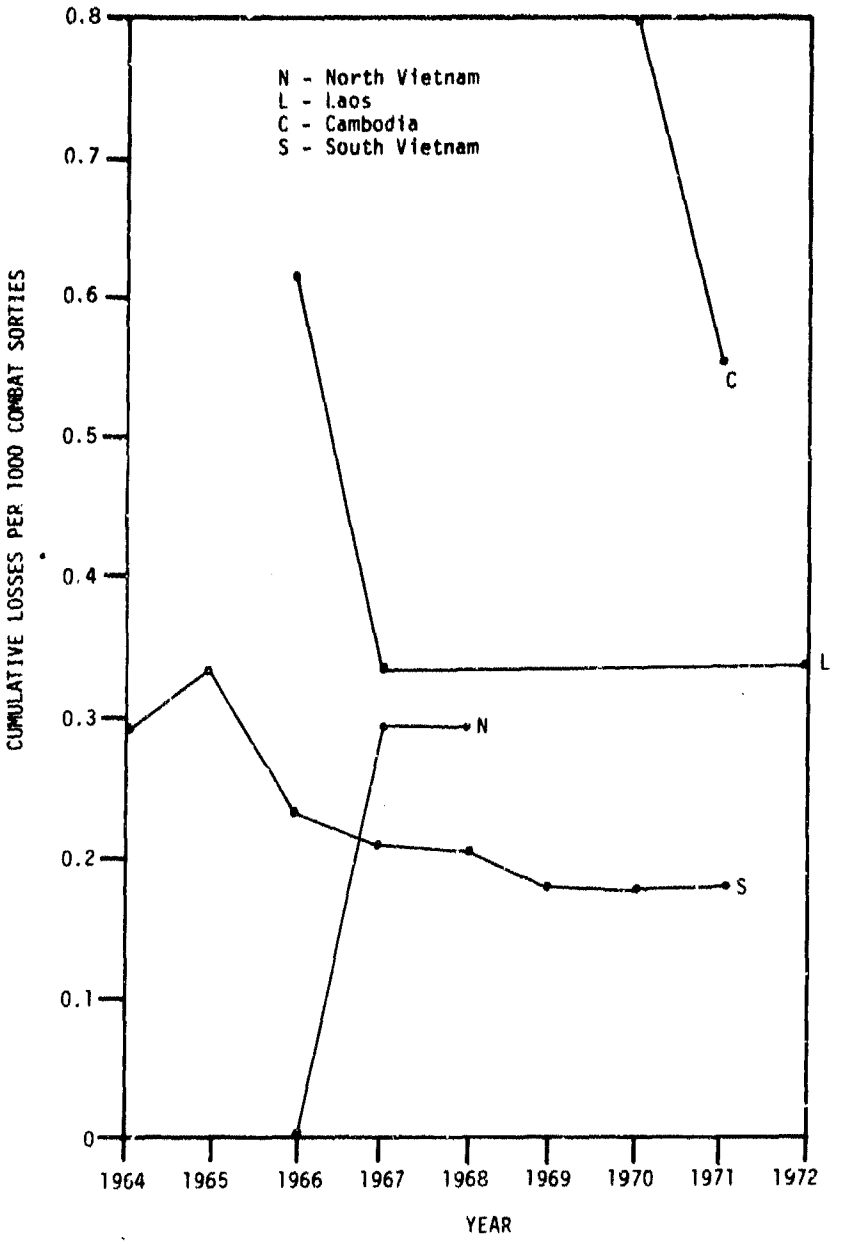
Since more than one lethal event may occur in a single aircraft loss, the numbers shown in this table are not necessarily mutually exclusive.

(S) 8. O-1

(S) Ninety-three USAF O-1 aircraft were "shot down" in Southeast Asia. A breakdown of these losses by year and country as well as a tabulation of combat sorties flown is given in Table A-31. The O-1 experienced an overall loss rate of 0.192 aircraft per 1,000 combat sorties flown. This varied from a high of 0.586 in North Vietnam to a low of 0.179 in South Vietnam. (Figure 7 and Table A-32 show loss rates due to ground fire only). All but 12 of the O-1's lost were downed in South Vietnam and all but one were downed by ground fire. The overall probability of crewmember survival in the O-1 given a loss was 47.3%. This ranged from a high of 100% in Cambodia to a low of 0% in North Vietnam (Table 25). Where the reason for crash could be determined for O-1's downed by ground fire, 54.9% were lost due to engine damage/fire, 11.8% due to crew incapacitation and 5.9% due to fire/explosion (Table 26).

(S) 9. O-2

(S) Seventy-two USAF O-2 aircraft were "shot down" in Southeast Asia. A breakdown of these losses by year, country, and threat class as well as a tabulation of combat sorties flown is given in Table A-33. The O-2 experienced an overall loss rate of 0.256 aircraft per 1,000 combat sorties flown. This varied from a high of 0.471 in North Vietnam to a low of 0.220 in South Vienam (Figure 8 and Table A-34 show loss rates due to ground fire only.) Over 94% of the O-2's were lost to ground fire and almost 64% were downed in South Vietnam, where the O-2 flew over 74% of its combat sorties. The overall probability of crewmember survival in the O-2 given a loss was 30.5%. This ranged from a high of 40% in Laos and North Vietnam to a low of 25.4% in South Vietnam (Table 27). Where the reason for crash could be determined for O-2's downed by ground fire, over 35% were lost due to crew incapacitation, 23.5% due to engine damage and 14.7% due to flight control damage (Table 28).



(C) Figure 7. O-1 Cumulative Loss Rates per 1,000 Combat Sorties by Year and Country (Ground Fire Only) (U)*

*Reference Table A-32.

(C) TABLE 25

IMMEDIATE STATUS OF DOWNED O-1 AIRCREW MEMBERS BY COUNTRY (U)*

	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL	PERCENT
Rescued	1	2	0	50	53	47.3
Captured	0	0	0	0	0	0.0
Missing	0	5	2	8	15	13.4
Killed	0	4	0	40	44	39.3
TOTAL	1	11	2	98	112	
PERCENT	0.9	9.8	1.8	87.5		

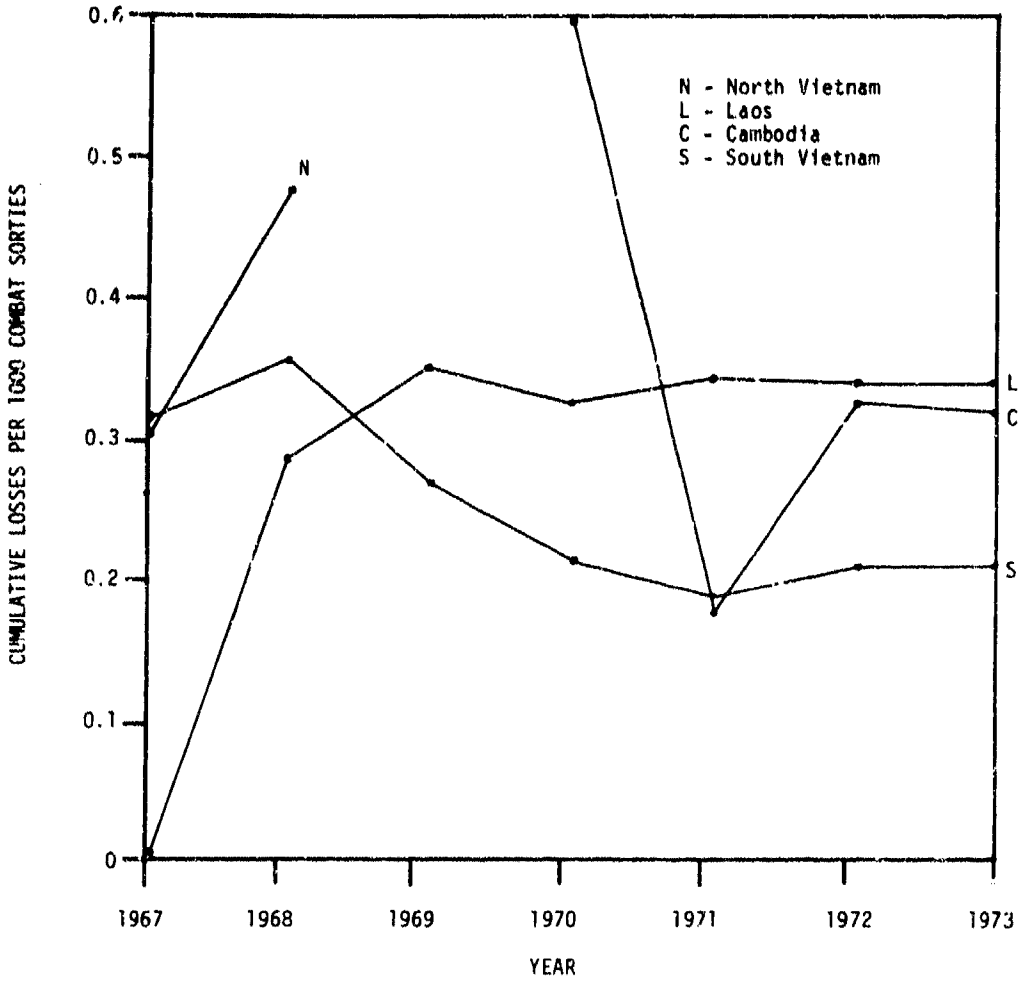
*Reference 5

(S) TABLE 26

0-1, THREAT CLASS VERSUS REASON FOR CRASH (U)

	LOSS OF CONTROL	CREW/ CONTROL	CREW	LOSS OF PROPULSION	ENGINE FIRE	FIRE/ EXPLOSION	MISC.	INSUFFICIENT DATA	TOTAL	%
SA/AW	0	0	2	11	2	0	6	9	30	31.9
UGF	1	0	4	14	1	3	5	33	61	64.9
AAA	0	0	0	0	0	0	2	0	2	2.1
SAM	0	0	0	0	0	0	1	0	1	1.1
TOTAL	1	0	6	25	3	3	14	42	94	

Since more than one lethal event may occur in a single aircraft loss, the numbers shown in this table are not necessarily mutually exclusive.



(C) Figure 8. O-2 Cumulative Loss Rates per 1,000 Combat Sorties by Year and Country (Ground Fire Only) (U)*

*Reference Table A-34.

(C) TABLE 27

IMMEDIATE STATUS OF DOWNED O-2 AIRCREW MEMBERS BY COUNTRY (U)*

	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL	PERCENT
Rescued	2	10	2	15	29	30.5
Captured	0	0	0	0	0	0.0
Missing	1	8	0	11	20	21.1
Killed	3	7	3	33	46	48.4
TOTAL	6	25	5	59	95	
PERCENT	6.3	26.3	5.3	62.1		

*Reference 5

(S) TABLE 28

0-2, THREAT CLASS VERSUS REASON FOR CRASH (U)

	LOSS OF CONTROL	CREW/ CONTROL	CREW	LOSS OF PROPULSION	ENGINE FIRE	FIRE/ EXPLOSION	MISC.	INSUFFICIENT DATA	TOTAL	%
SA/AW	0	0	3	4	0	1	2	5	15	20.8
UGF	4	0	9	4	0	1	2	25	45	62.5
AAA	1	0	0	0	0	1	2	4	8	11.1
SA-7	0	0	0	0	0	0	2	2	4	5.6
TOTAL	5	0	12	8	0	3	8	36	72	

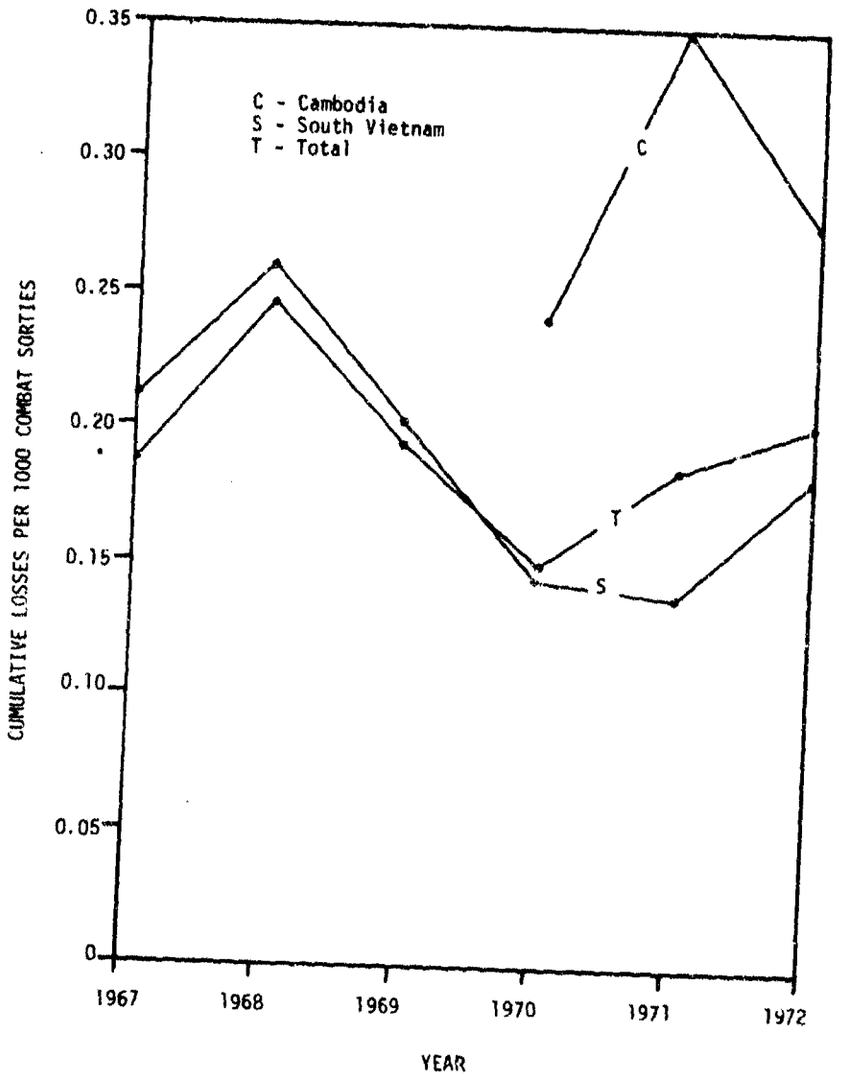
Since more than one lethal event may occur in a single aircraft loss, the numbers shown in this table are not necessarily mutually exclusive.

(S) 10. A-37

(S) Although only 14 USAF A-37 aircraft were "shot down" in Southeast Asia, it did fly over 68,000 combat sorties and was one of the few aircraft which incorporated fuel system protection as a vulnerability reduction feature. For these reasons, it is included in this report. A breakdown of A-37 losses by year and country as well as a tabulation of combat sorties flown is given in Table A-35. The A-37 experienced an overall loss rate of 0.204 aircraft per 1,000 combat sorties flown. The A-37 was used primarily in South Vietnam where only 0.184 aircraft were lost per 1,000 combat sorties. In Laos, the loss rate was 0.274 aircraft per 1,000 combat sorties (Figure 9 and Table A-36). All A-37's lost were downed by ground fire, primarily in the small arms/automatic weapons threat class (Table 29). The overall probability of crewmember survival in the A-37 given a loss was 21.4%. This ranged from a high of 22.2% in South Vietnam to a low of 20.0% in Cambodia (Table 30). Where the reason for crash could be determined for A-37's, 70% were lost due to either crew incapacitation and/or flight control damage (Table 29).

(U) 11. B-52

(U) A complete and detailed analysis of all B-52 combat damage and loss incidents is available in Reference 9. Only a table showing the reasons for crash is included in this report (Table 31). The numbers included in this table are not mutually exclusive. In many cases, more than one lethal event (reason for crash) was observed in a single B-52 loss. These lethal events, although possibly caused by the same SAM, were independent in their capability to destroy the aircraft. Since comparisons of the B-52 with other aircraft are unsound and unjustified due to differences in mission, operational parameters, threat encountered, and aircraft configuration, no other B-52 data are included herein.



(C) Figure 9. A-37 Cumulative Loss Rates per 1,000 Combat Sorties by Year and Country (U)*

*Reference Table A-36.

(S) TABLE 29

A-37, THREAT VERSUS REASON FOR CRASH (U)

	LOSS OF CONTROL	CREW/ CONTROL	CREW	LOSS OF PROPULSION	ENGINE FIRE	FIRE/ EXPLOSION	MISC.	INSUFFICIENT DATA	TOTAL	%
7.62mm	0	0	0	0	0	0	1	0	1	7.1
12.7mm	0	0	0	0	1	0	0	0	1	7.1
SA/AW	1	1	0	0	0	0	0	0	2	14.3
UGF	1	2	1	0	0	1	0	4	9	64.3
23mm	0	1	0	0	0	0	0	0	1	7.1
TOTAL	2	4	1	0	1	1	1	4	14	

Since more than one lethal event may occur in a single aircraft loss, the numbers shown in this table are not necessarily mutually exclusive.

(C) TABLE 30

IMMEDIATE STATUS OF DOWNED A-37 AIRCREW MEMBERS BY COUNTRY (U)*

	CAMBODIA	SOUTH VIETNAM	TOTAL	PERCENT
Rescued	1	2	3	21.4
Captured	0	0	0	0.0
Missing	0	2	2	14.3
Killed	4	5	9	64.3
TOTAL	5	9	14	
PERCENT	35.7	64.3		

*Reference 5

(S) TABLE 31

B-52, REASONS FOR CRASH (U)*

REASON FOR CRASH	NUMBER OF INCIDENTS
Fuel Fire	7
Flight Controls	5
Hydraulic Fire	3
Fuel Leak	2
Electric Power	2
Engine Failure	2
Pilot(s) Hit	1
Engine Fire	1
Electric Lines	1
Pneumatic Duct	1

*Reference 9

(S) 12. AC-130

(S) A detailed analysis of AC-130 combat damage and loss incidents through 1 April 1972 is available in Reference 10. This reference covers four of the six AC-130's that were lost in Southeast Asia combat. Only the reason for crash for these four aircraft plus the two that were lost after 1 April 1972 is included herein. There are many unique aspects of the mission and configuration of the AC-130 which discourage superficial comparisons with other aircraft. This brief overview of AC-130 losses is included only because of the vulnerability reduction features incorporated in this aircraft. Two of the AC-130's lost suffered massive catastrophic destruction from SAM detonations. One was lost due to a sustained fire when an on-board box of flares was ignited. One AC-130 was lost due to a statistically improbable combination of nonlethal damages. Hydraulic damage, coupled with some electrical system damage, resulted in the loss of the aircraft upon landing. Neither damage alone should have caused the loss, but the combination proved lethal. A fifth AC-130 was lost when a sustained fire in an avionics pod maintained combustion of fuel leaking from a damaged tank in close proximity to the pod. The sixth AC-130 was lost when it exploded ten minutes after being hit by AAA fire. This aircraft had a sustained fire in the wing/engine nacelle area.

(S) SECTION IV

GENERAL COMPARISONS OF USAF LOSS EXPERIENCE

(C) 1. COMPARATIVE AIRCRAFT LOSS RATES

(C) Loss rates for the first nine aircraft discussed in Section III are provided in Table 32. They are expressed in losses per 1,000 combat sorties, by country, and are in rank order. The overall loss rate for a given aircraft, and hence its relative ranking, does not necessarily correlate with the rate experienced in any given country, since the overall rate is weighted by the number of sorties flown in any given country. For example, the F-105 overall loss rate was the highest (2.078) of all the aircraft discussed, yet both the F-100 and A-1 reflected higher loss rates in North Vietnam, South Vietnam and Laos. Since the F-105 flew over 53% of its combat sorties in North Vietnam and over 44% in Laos (Table A-16), loss rates in these countries had a strong influence on the overall loss rate. The F-100, however, flew over 87% of its combat sorties in South Vietnam (Table A-21), resulting in an overall loss rate very similar to that experienced in South Vietnam. The A-1 flew over 64% of its combat sorties in Laos and over 32% in South Vietnam (Table A-29), resulting in an overall loss rate similar to that experienced in these countries. One could jump to the conclusion that relative loss rates in a given country could be a crude measure of the relative vulnerability of these aircraft with respect to the threat spectrum encountered, or come to even less justified conclusions about number of engines, crewmembers, etc. This would generally be misleading since numerous parameters come into play that could severely alter the conclusions that might be derived from this apparently sound statistical data base. For example, a F-105 on a bombing sortie over North Vietnam has a higher probability of being hit by ground fire than an F-4 on a MIGCAP sortie, due to the fact that the F-105 is more likely to be engaged by the ground defenses. To properly compare two aircraft from the perspective of relative vulnerability, many parameters must be equalized. An attempt to do this very thing is included in Section V. The numbers in Table 32 reflect relative loss rates and nothing more.

(C) TABLE 32

OVERALL AIRCRAFT LOSS RATES PER 1,000 COMBAT SORTIES BY COUNTRY (RANKED BY AIRCRAFT MODEL) (U)*

CAMBODIA		LAOS		NORTH VIETNAM		SOUTH VIETNAM		OVERALL	
MODEL	RATE	MODEL	RATE	MODEL	RATE	MODEL	RATE	MODEL	RATE
F-100	0.599	A-1	1.511	A-1	6.596	A-1	1.326	F-105	2.078
O-1	0.552	F-100	0.888	F-100	4.344	F-4	0.484	A-1	1.600
RF-4C	0.438	F-105	0.719	F-105	3.281	F-100	0.447	F-4	0.721
OV-10A	0.407	Average	.623	Average	2.261	F-105	0.330	RF-4C	0.720
Average	.370	PF-4C	0.553	RF-4C	1.934	Average	.317	Average	.611
F-4	0.339	OV-10A	0.494	F-4	1.560	OV-10A	0.290	F-100	0.530
O-2	0.319	F-4	0.455	O-1	0.586	RF-4C	0.277	OV-10A	0.364
A-37	0.274	O-2	0.358	O-2	0.471	O-2	0.220	O-2	0.256
		O-1	0.334			A-37	0.184	A-37	0.204
						O-1	0.179	O-1	0.192

*Zero (0) loss rates are not included due to little or no flying activity in some countries.

(S) 2. COMPARATIVE CREWMEMBER SURVIVAL RATES

(S) Crewmember survival rates, given a downed aircraft, for the first nine aircraft discussed in Section III are provided in Table 33. They are displayed by country and are in rank order, with the overall average of all USAF crewmembers included. It is stressed that the survival rate implies probability of crewmember survival given the loss of the aircraft. These figures can be assumed to be minimum values since they reflect the percentage of aircrew members known to be alive (rescued or captured) after the lethal event. It cannot be ascertained, at this time, how many of the crewmembers listed as missing survived the downing of the aircraft, hence the use of the term "minimum" survival rate. It can be seen that there is more consistency in the crewmember survival rates than was noted in the relative aircraft loss rates. The high crewmember survival rate in the F-105 can be attributed, at least in part, to the relative kill severity noted in F-105 losses (Table 16). The extremely low crewmember survival rates noted in the A-37 and OV-10A are due in no small way to the relative exposure of the aircrew due to aircraft configuration. In the case of the OV-10A, the relative presented area of the aircrew with respect to the anticipated hit direction is quite large. The number of hits on the aircrew compartment was proportional to its presented area (as anticipated in theory), thereby causing what appeared to be a much higher fatality rate for the OV-10A than other aircraft (Ref. 8). In actuality, given the design scenario for the OV-10A, the crewmember survival rate given an aircraft loss is consistent with the aircraft configuration. A word of caution is in order here. The crewmember survival rate is determined by three factors: (1) probability of surviving the initial munitions impact on the aircraft, (2) probability of successfully egressing from the aircraft and (3) probability of surviving the parachute descent. The rankings shown in Table 33 are a combination of these contributing factors. One aircraft, the F/RF-4, demonstrated a unique characteristic in crewmember survival. While other aircraft reflect similar or lower probabilities of crewmember survival for SAM and MIG kills, as compared to those from ground fire, the F/RF-4 experienced a 83.8% crewmember survival rate

(C) TABLE 33

OVERALL CREWMEMBER SURVIVAL RATES BY COUNTRY
(RANKED BY AIRCRAFT MODEL) (U)*

CAMBODIA		LAOS		NORTH VIETNAM		SOUTH VIETNAM		OVERALL	
AIRCRAFT MODEL	% SURVIVAL	AIRCRAFT MODEL	% SURVIVAL	AIRCRAFT MODEL	% SURVIVAL	AIRCRAFT MODEL	% SURVIVAL	AIRCRAFT MODEL	% SURVIVAL
RF-4C	100.0	RF-4C	63.6	F-105	66.2	F-105	100.0	F-105	65.0
O-1	100.0	OV-10A	63.6	F-4	65.7	F-100	64.8	F-100	63.1
F-100	66.7	F-105	56.9	AVERAGE	60.8	F-4	60.7	F-4	60.5
OV-10A	57.1	F-100	56.7	F-100	60.0	O-1	51.0	RF-4C	56.9
AVERAGE	51.3	A-1	52.2	A-1	57.9	A-1	50.0	A-1	52.9
F-4	37.5	F-4	52.9	RF-4C	56.6	AVERAGE	42.1	AVERAGE	50.5
O-2	33.3	AVERAGE	46.4	O-2	40.0	RF-4C	35.0	O-1	47.3
A-37	20.0	O-2	40.0	O-1	0.0	O-2	25.4	OV-10A	42.6
		O-1	18.2			OV-10A	25.0	O-2	30.5
						A-37	22.2	A-37	21.4

*Zero (0) crewmember survival rates are only included if an aircraft was lost in the country and none of the crewmembers survived.

when downed by SAM's or MIG's (Table 11). This is due primarily to aircraft configuration. In a "typical" SAM kill, the weapon usually detonates below the aircraft, the crew being shielded from the terminal effects of the missile fragments. In a "typical" MIG missile kill, the missile impacts in the engine exhaust area, once again remote from the shielded crew. In a "typical" MIG cannon kill, the projectiles usually impact the mid-fuselage or wing root areas, again no direct immediate threat to the crew. Coupled with a highly effective ejection system, a high percentage of crewmembers survived these "ideal" encounter conditions.

(C) 3. AIRCRAFT LOSS RATE VS CREWMEMBER SURVIVAL RATE

(C) The probability of a crewmember surviving a 100 combat mission tour is determined by two factors: (1) the probability of being shot down and (2) the probability of surviving if shot down. The probability of a crewmember surviving a 100 combat mission tour in Southeast Asia is presented in Table 34. The data in Table 34 are taken from Tables 32 and 33. It can be seen that the most favorable crewmember survival rate for a 100 combat mission tour in Southeast Asia was experienced in the O-1 in South Vietnam. It can also be seen that even though the F-105 showed the best overall crewmember survival rate given a loss, the higher aircraft loss rate made the F-105 one of the least desirable aircraft to fly from the crewmember survival perspective.

(C) TABLE 34

PROBABILITY OF USAF CREWMEMBER SURVIVAL GIVEN A 100 COMBAT MISSION TOUR IN SOUTHEAST ASIA BY COUNTRY (RANKED BY AIRCRAFT MODEL) (U)

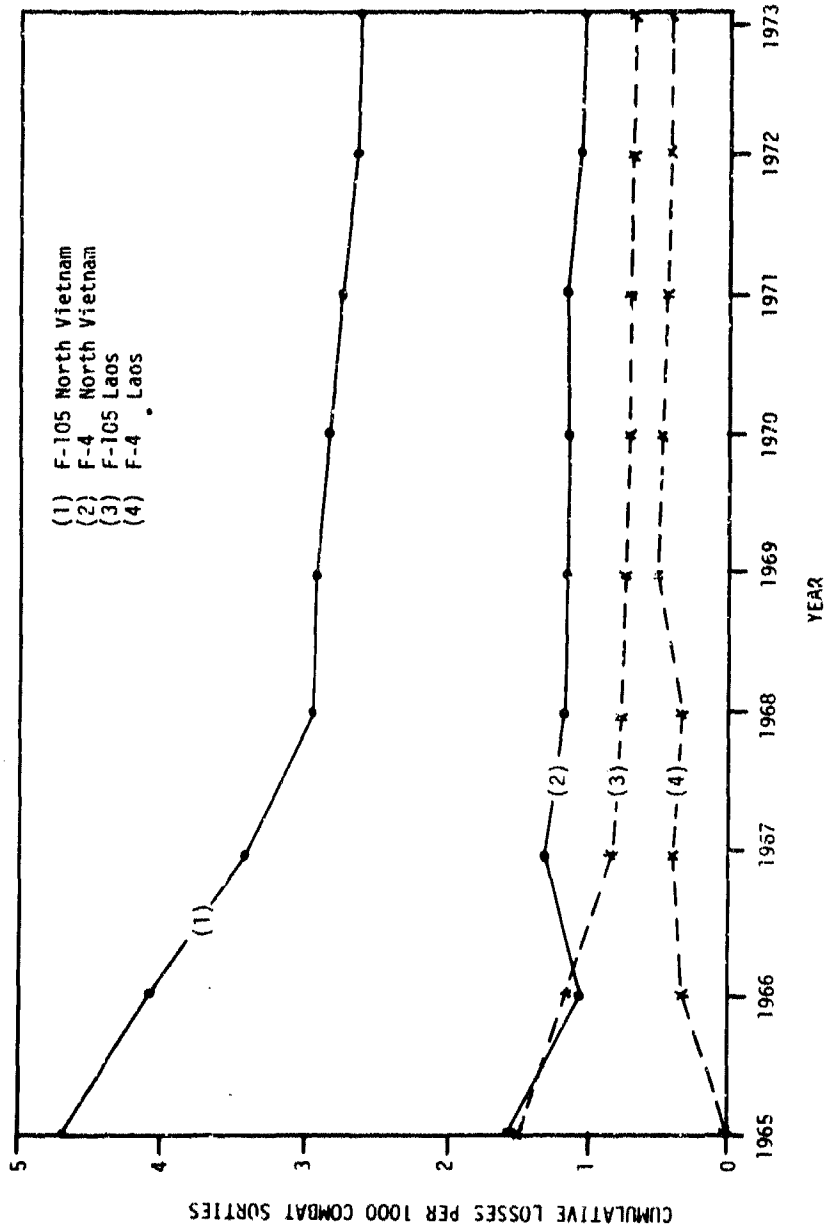
CAMBODIA		LAOS		NORTH VIETNAM		SOUTH VIETNAM		OVERALL	
AIRCRAFT MODEL	% SURVIVAL	AIRCRAFT MODEL	% SURVIVAL	AIRCRAFT MODEL	% SURVIVAL	AIRCRAFT MODEL	% SURVIVAL	AIRCRAFT MODEL	% SURVIVAL
O-1 -	100	OV-10A -	98.20	O-2 -	97.17	F-105 -	100	O-1 -	98.99
RF-4C -	100	RF-4C -	97.99	F-4 -	94.65	O-1 -	99.12	A-37 -	98.40
OV-10A -	98.25	F-4 -	97.86	RF-4C -	91.61	A-37 -	98.57	O-2 -	98.22
F-100 -	98.01	O-2 -	97.85	F-105 -	88.91	F-100 -	98.43	F-100 -	98.04
F-4 -	97.88	O-1	97.27	F-100 -	82.62	O-2 -	98.36	OV-10A -	97.91
O-2 -	97.87	F-105 -	96.90	A-1 -	72.23	RF-4C -	98.20	F-4 -	97.15
A-37 -	97.81	F-100 -	96.15	O-1 -	0	F-4 -	98.10	RF-4C -	96.90
		A-1 -	92.93			OV-10A -	97.83	F-105 -	92.73
						A-1 -	93.37	A-1 -	92.46

(S) SECTION V

SPECIFIC COMPARISONS OF USAF LOSS EXPERIENCE

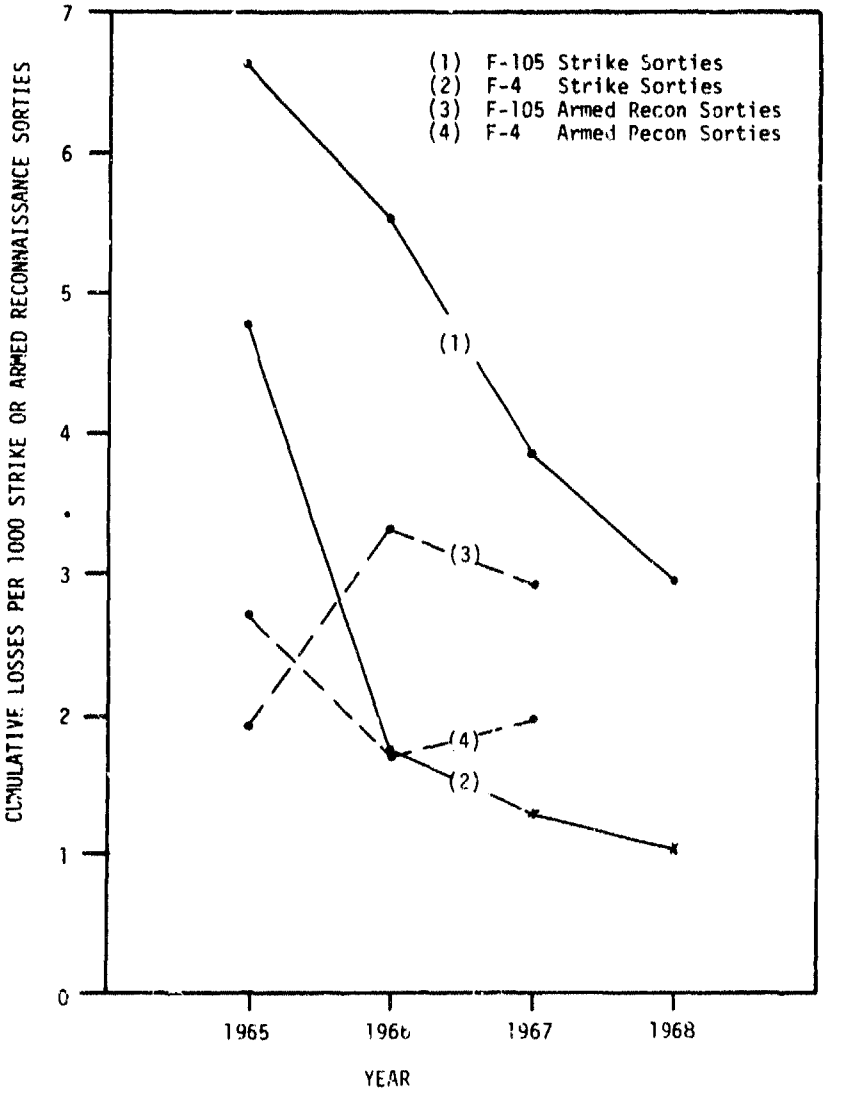
(C) 1. F-4 VS F-105

(C) In order to have a basis for comparing two aircraft, it is necessary to equalize as many parameters as possible. One way to equalize the threat spectrum is to compare two aircraft flying in the same target countries. Since the threat spectrum in some of the countries did vary in time, comparisons must also be made for the same time frame. Also, since the use of SAM's and MIG's was not consistent, the comparison should be made for losses due to ground fire only. In addition, both aircraft should have flown a sufficient number of sorties during the time frame to justify comparisons of statistical rates. Cumulative loss rates (per 1,000 combat sorties flown) due to ground fire is shown in Figure 10 for the F-4 and F-105 in both North Vietnam and Laos. There are still many differences to be equalized, since hit probabilities differ with the operational parameters of the missions flown. Even comparing loss rates to ground fire in North Vietnam for the same time period on Armed Recon Sorties only (Figure 11), does not demonstrate consistency since there are still differences which may vary the statistics. If we compare the F-4 and F-105 under all of the above constraints and in addition, look at strike sorties only and count only those aircraft lost on strike sorties, a relatively reasonable comparison may be made. Such factors as threat encountered, delivery altitude, delivery airspeed, and engagement conditions for fixed targets are now very similar. The comparative loss rates under these conditions for strike missions in North Vietnam is shown in Figure 11. Some may still argue that the F-105 was sent against more heavily defended fixed targets in North Vietnam than the F-4, resulting in the higher loss rates. To counter this argument without agreeing or disagreeing, the loss rates are compared on strike missions in both northern and southern Laos (Figure 12). We now have two aircraft in identical roles (similar engagement scenario), flying in the same country at the same time (highly similar threat spectrum encountered), implying similar



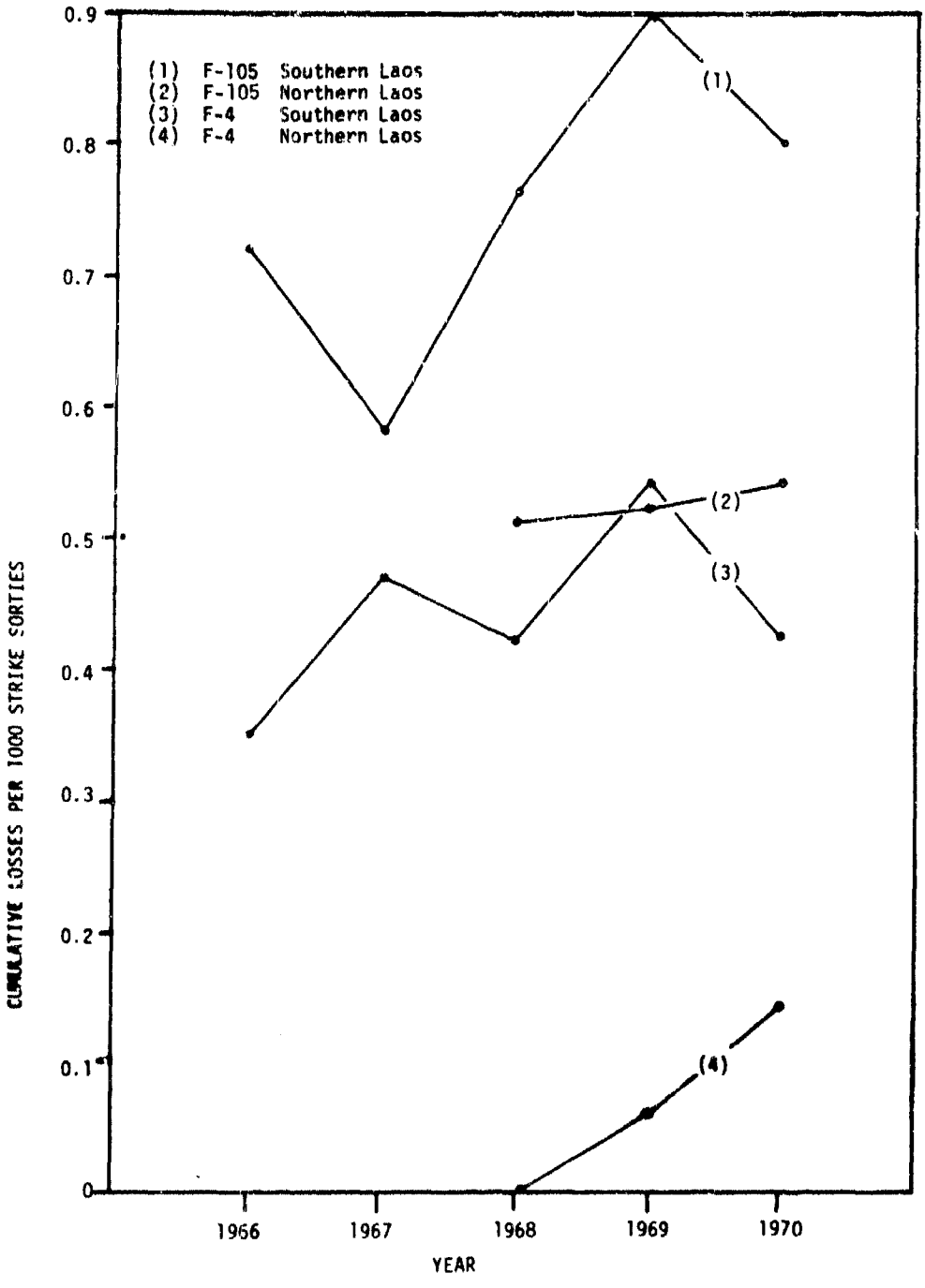
(C) Figure 10. F-4 vs F-105, Cumulative Loss Rates per 1,000 Combat Sorties in North Vietnam and Laos (Ground Fire Only) (U)*

*Reference Tables A-13 and A-17.



(C) Figure 11. F-4 vs F-105, Cumulative Loss Rates per 1,000 Strike or Armed Reconnaissance Sorties in North Vietnam (Ground Fire Only) (U)*

*Reference Tables A-37, A-38, A-39 and A-40



(C) Figure 12. F-4 vs F-105, Cumulative Loss Rates per 1,000 Strike Sorties in Laos (Ground Fire Only) (U)*

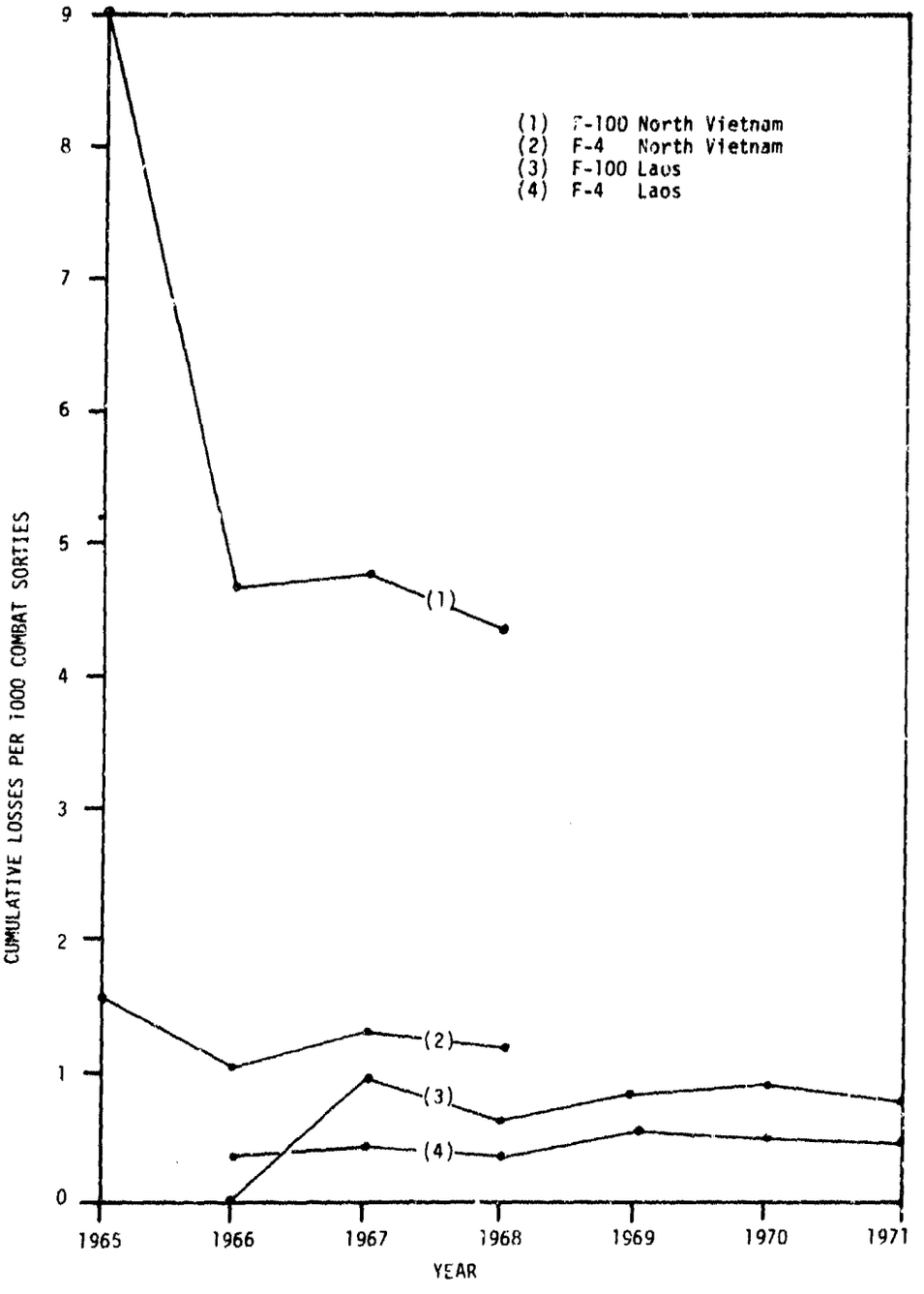
*Reference Tables A-41 and A-42.

probabilities of being hit per sortie, and flying a sufficient number of sorties to support a statistical comparison. The results indicate higher overall cumulative loss rates for the F-105 (Figure 12), as well as higher loss rates on a yearly basis for the F-105 (Table A-41) as compared with the F-4 (Table A-42). While different methods of comparison all reach the conclusion that the F-4 is the less vulnerable aircraft, the magnitude of the difference does change as the comparison is refined.

(C) 2. F-4 VS F-100

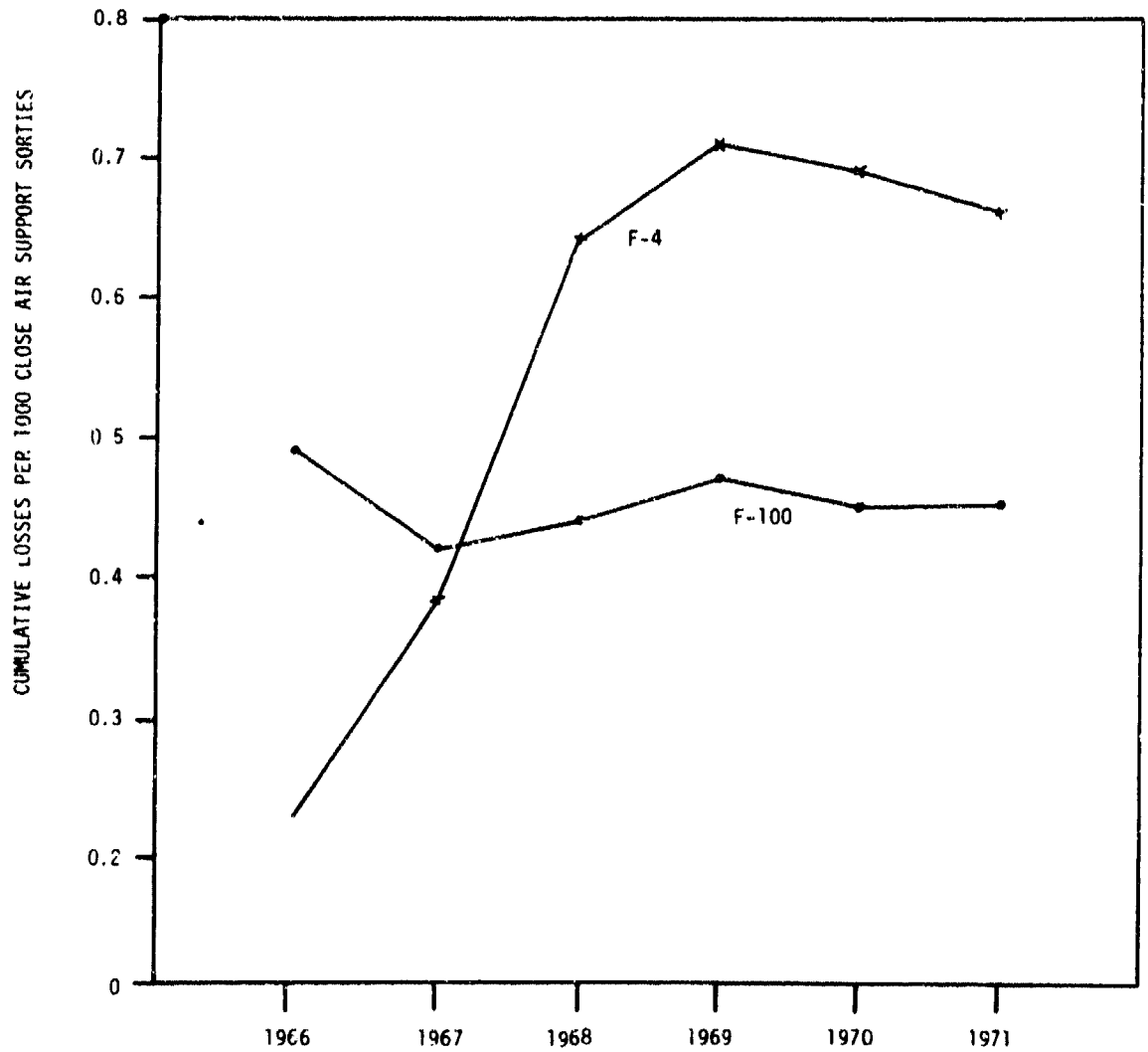
(C) If we follow the same line of reasoning used in the previous section, and compare the gross loss rates of the F-4 and F-100 due to ground fire in North Vietnam and Laos, it tends to label the F-100 as a much more vulnerable aircraft (Figure 13).* A strikingly different picture emerges when the two aircraft are compared in the close air support role in South Vietnam (Figure 14). Once again, other possible parameters enter the picture. The dissimilarity in the sizes of the two aircraft does have a bearing on the relative hit probabilities, the F-4 being a much larger aircraft. In the cases of both the F-4 and of the F-100, each aircraft reflected the lower loss rate in the capacity in which it was most often used. The F-100, used predominantly in a close air support scenario, fared much better in this area while the F-4 did better in a strike mission scenario.

*(Note: Since we are considering only those years in which both aircraft flew a sufficient number of sorties to warrant comparison, the relative experience in Laos was considered only for the 1966-1971 time frame. This data is not readily available in Tables A-13 and A-22 but it can be extracted from them.)



(C) Figure 13. F-4 vs F-100, Cumulative Loss Rates Per 1,000 Combat Sorties in North Vietnam and Laos (Ground Fire Only) (U)*

*Reference Tables A-13 and A-22.



(C) Figure 14. F-4 vs F-100, Cumulative Loss Rates per 1,000 Close Air Support Sorties in South Vietnam (Ground Fire Only) (U)*

*Reference Tables A-43 and A-44.

(S) 3. ONE VS TWO ENGINES

(S) Recently, a great deal of controversy has arisen about the advantage or disadvantage of one engine versus two engines in jet fighter aircraft. To address this question from the perspective of combat vulnerability only based on our combat data, the F-4, F-100 and F-105 were compared. In order to eliminate the effect of all parameters other than the number of engines, the aircraft were compared in similar circumstances, as in Sections V-1 and V-2, with the same ground rules as to number of sorties flown, etc. In this case, only losses due to known engine damage or engine fire are considered. The F-100 demonstrated the most consistency, reflecting an engine damage/fire loss rate of 0.09 aircraft per 1,000 close air support sorties in South Vietnam (23 known losses to engine damage/fire in 255,349 sorties) as well as an engine damage/fire loss rate of 0.09 aircraft per 1,000 strike sorties in Laos (2 losses in 21,832 sorties). The F-4 matched the F-100 in the close air support role in South Vietnam with an engine damage/fire loss rate of 0.09 aircraft per 1,000 close air support sorties (4 losses in 42,320 sorties). In Laos, both the F-4 and F-105 experienced a rate of 0.04 known losses to engine damage/fire per 1,000 sorties while flying similar roles. At first glance, it would appear that the number of engines has no effect on the loss rate due to engine damage/fire. All factors here thus far appear to be the same, including the reliability of the data sources. For example, since a significant number of losses were noted in which the reason for crash could not be determined, the error bands on the rates should be similar since the reporting sources were the same. Therefore, although the magnitude of the rates may be questionable, similar rates would tend to indicate similar experience. In North Vietnam, the F-105 experienced an engine damage/fire loss rate of 0.34 aircraft per 1,000 combat sorties (25 losses in 72,285 sorties), while the F-4's were lost at the rate of 0.12 aircraft per 1,000 combat sorties (8 per 68,455 sorties). It appears that the effect of one or two engines from a vulnerability perspective is configuration dependent, since the close proximity of the engines on the F-4 tends to make it respond in a manner similar to a single engine aircraft when hit, at least at the lower altitudes at which the hits occur in South Vietnam.

Even though the F-105 seems more vulnerable to engine damage than the F-4 in the AAA environment of North Vietnam, the apparent differences do not support the argument that twin-engine aircraft are less vulnerable. However, in the case of the F-4 the aircraft configuration has a large impact on this concept. The single versus twin-engine argument holds only when the engines are separated to the extent that one hit cannot damage both engines and the aircraft must be able to recover from the weapon delivery mode on one engine. This is because aircraft usually sustain hits in the delivery mode (Refs. 1, 8, and 10) and recovery would be critical usually only when delivering air-to-ground weapons.

(S) SECTION VI

EFFECTIVENESS OF VULNERABILITY REDUCTION MODIFICATIONS

(S) The four main reasons for crash observed in the nine aircraft covered in Section III are given in Table 35 as percentages of known reasons for crash. For the three aircraft having fuel system modifications (A-37, OV-10A, and certain F/RF-4's), losses due to fire/explosion are considerably less frequent than other JP- fueled aircraft. From a statistical perspective, it appears that explosion suppressive and fire retardant foam does reduce the vulnerability significantly. While this does not in itself constitute proof, there are virtually no documented cases of unmodified aircraft safely returning to base after sustaining a direct hit on a fuel tank other than drop tanks (Ref. 2). There are numerous cases, however, of OV-10A's (Ref. 8) and AC-130 gunships (Ref. 10) safely returning to base after sustaining direct hits on fuel tanks. Unfortunately, no definitive post-modification data on F-4 damages was collected. However, the evidence presented above should prove the effectiveness of fuel system vulnerability reduction technology.

(S) TABLE 35

SELECTED COMPARISONS OF REASON FOR CRASH (GROUND FIRE ONLY) (U)*

	KNOWN REASON FOR CRASH (%)			
	LOSS OF CONTROL**	LOSS OF PROPULSION	ENGINE FIRE	FIRE/ EXPLOSION
JET POWERED AIRCRAFT				
A-37	20.0-40.0	0.0	10.0	10.0
Modified F/RF-4***	20.0-30.0	30.0	10.0	10.0
OV-10	24.0-40.0	12.0	8.0	12.0
F-100	10.3	14.8	8.4	30.3
Unmodified F/RF-4	12.8-13.3	10.4	12.3	39.3
F-105	18.4	11.6	5.3	44.2
PISTON POWERED AIRCRAFT				
O-1	2.0	49.0	5.9	5.9
O-2	14.7	23.5	0.0	8.8
A-1	8.4	28.9	10.8	21.7

*NOTE: Figures given are percentages of known reasons for crash, for the aircraft indicated, attributable to the reasons given.

**NOTE: The second %-figure under "LOSS OF CONTROL" includes kills recorded as "Crew/Control."

***NOTE: Modified F/RF-4 aircraft contain fuel tank protection.

(S) SECTION VII

CONCLUSIONS

(U) The conclusions reached in this report are combined here with those found in previous analyses. For those conclusions which are supported by data in this report, the appropriate section will be referenced. For those conclusions reached completely or in part in other analyses, the appropriate report is referenced.

(C) In the entire Southeast Asia conflict, 1,676 fixed-wing USAF aircraft were lost due to combat action at a total replacement cost of over 2.3 billion dollars (Ref. Section II-1).

(U) The F/RF-4, F-105, and F-100 accounted for over 59% of the losses and over 74% of the total replacement cost (Ref. Section II-1).

(U) Of the 29 different models of aircraft lost, only 7 models (F/RF-4, F-105, F-100, A-1, O-1, O-2, and OV-10A) accounted for over 83% of the losses (Ref. Section II-1).

(U) Approximately 90% of the time an aircraft is hit by enemy ground fire, the aircraft is engaged with its target (Refs. 1, 8, 9, and 10).

(C) Statistically speaking, if an aircraft is hit, only one gun round or missile is involved (Refs. 8, 9, and 10).

(U) For the purpose of vulnerability assessment, the anticipated hit direction should be biased by the anticipated engagement scenario (Refs. 8 and 10).

(C) Of the 2,752 USAF aircrew members downed in Southeast Asia, 50.5% were known to have survived but only 39.2% were rescued (Ref. Section II-2).

(C) The crewmember survival rate given a downed aircraft was 60.8% in North Vietnam, 51.3% in Cambodia, 46.4% in Laos and 42.1% in South Vietnam (Ref. Section II-2).

(C) With few exceptions, crewmembers downed and known to be alive were rescued in Cambodia, Laos, and South Vietnam (Ref. Section II-2).

(C) Although 60.8% of the crewmembers downed in North Vietnam survived, only 52.9% of the survivors were rescued (Ref. Section II-2).

(S) Crewmember survival was highest in the F-105 (65%), F-100 (63.1%) and F-4 (60.5%), but lowest in the O-2 (30.5%) and A-37 (21.4%). One major exception was noted in the F/RF-4's downed by SAM's or MIG's, where almost 84% survived the encounter (Ref. Sections III-3 and IV-2).

(C) Loss rates appeared to vary with threat spectrum, the highest being in North Vietnam, next highest in Laos, and lowest in Cambodia and South Vietnam (Ref. Sections III and IV-1).

(C) The highest loss rates in North Vietnam and Laos were experienced by the A-1, F-100, and F-105 (Ref. Section IV-1).

(C) In South Vietnam, only the A-1 experienced a significantly higher loss rate than other aircraft (Ref. Section IV-1).

(C) The probability of an aircrew member surviving an encounter tended to increase with the distance the aircraft could fly after being hit. The only major exception was the F/RF-4, which showed extremely high crewmember survival rates for SAM and MIG encounters in which the aircraft was rapidly downed (Ref. 1 and Section III).

(C) In North Vietnam and Laos, the F-105 suffered almost twice the loss rate to ground fire as the F-4 (Ref. Section V-1).

(C) The probability of a crewmember surviving a 100 combat mission tour was highest in the O-1 and A-37, lowest in the F-105 and A-1 (Ref. Section IV-3).

(C) Considering strike missions only, the F-105 loss rate in North Vietnam to ground fire was almost three times as high as the F-4. In Southern Laos, it was twice as high and in Northern Laos almost four times as high (Ref. Section V-1).

(C) In Laos and North Vietnam, the F-100 loss rate to ground fire was two to four times as high as that of the F-4, although in South Vietnam the loss rates were almost equal (Ref. Sections III and V-2).

(C) In the close air support role in South Vietnam, F-4 losses to ground fire were almost 47% higher than those of the F-100 (Ref. Section V-2).

(U) There was no significant difference in the loss rates to ground fire due to engine damage or engine fire among the F-4, F-105, and F-100 (Ref. Section V-3).

(C) Fire/explosion, engine damage/fire and flight control system damage were the biggest contributors to aircraft losses (Ref. 1 and Section VI).

(C) Given a fuel system fire or explosion on an unmodified aircraft, the aircraft will most likely be lost (Refs. 1, 9, and Section VI).

(C) Aircraft with fuel system survivability modifications experience significantly fewer losses due to fire/explosion (Ref. Section VI).

(C) Aircraft with fuel system survivability modifications are frequently capable of sustaining direct hits on internal fuel tanks without fire resulting, and in the cases where a fire does result, it is often self-extinguished (Refs. 8, 10, and Section VI).

APPENDIX A

DETAILED LISTING OF COMBAT DATA

(C) TABLE A-1 (PART 1)

USAF FIXED-WING AIRCRAFT COMBAT LOSSES IN SOUTHEAST ASIA
BY COUNTRY AND THREAT CLASS (U)

	CAMBODIA		LAOS				NORTH VIETNAM			
	GROUND FIRE	OTHER	GROUND FIRE	SAM	AIR-TO AIR	OTHER	GROUND FIRE	SAM	AIR-TO AIR	OTHER
F-4	7	1	104	1	1	3	127	24	37	5
RF-4 C	2	0	22	0	0	0	31	7	0	0
F-105	0	0	51	0	0	0	228	30	22	2
F-100	6	0	29	0	0	0	16	0	0	0
A-1	0	0	88	0	0	1	16	0	2	0
O-1	1	0	9	0	0	0	1	1	0	0
O-2	4	0	17	1	0	0	3	0	0	0
OV-10A	6	0	18	0	0	0	0	0	0	0
B-57	0	0	12	0	0	0	5	0	0	0
C-130	0	0	2	0	0	0	2	0	0	0
RF-101	0	0	3	0	0	0	21	5	1	0
C-47	0	0	7	0	0	1	0	0	1	0

(C) TABLE A-1 (PART 1) (CONTINUED)

	CAMBODIA		LAOS				NORTH VIETNAM			
	GROUND FIRE	OTHER	GROUND FIRE	SAM	AIR-TO AIR	OTHER	GROUND FIRE	SAM	AIR-TO AIR	OTHER
C-123	0	0	3	0	0	0	0	0	0	0
B-52	0	0	0	0	0	0	0	17	0	0
T-28	0	0	3	0	0	0	1	0	0	0
A-37	5	0	0	0	0	0	0	0	0	0
A-26	0	0	9	0	0	1	0	0	0	0
B-26	0	0	0	0	0	0	0	0	0	0
F-111	0	0	3	0	0	0	3	0	0	0
F-104	0	0	2	0	0	0	2	2	0	0
C-7	0	0	0	0	0	0	0	0	0	0
F-102	0	0	0	0	0	0	0	0	1	0
F-5	0	0	0	0	0	0	0	0	0	0
AC-130	0	0	4	1	0	0	0	0	0	0
B-66	0	0	0	0	0	0	0	3	1	0

(C) TABLE A-1 (PART 1) (CONTINUED)

	CAMBODIA		LAOS				NORTH VIETNAM			
	GROUND FIRE	OTHER	GROUND FIRE	SAM	AIR-TO AIR	OTHER	GROUND FIRE	SAM	AIR-TO AIR	OTHER
A-7	2	0	2	0	0	0	0	0	0	0
U-10	0	0	0	0	0	1	0	0	0	0
AC-119	0	0	0	0	0	0	0	0	0	0
U-3	0	0	0	0	0	0	0	0	0	0
HU-16	0	0	0	0	0	0	0	0	0	0
TOTAL	33	1	388	3	1	7	456	89	65	7

(C) TABLE A-1 (PART 2) (CONTINUED)

	SOUTH VIETNAM			OTHER		TOTAL				
	GROUND FIRE	SAM	OTHER	GROUND FIRE	OTHER	GROUND FIRE	SAM	AIR-TO AIR	OTHER	TOTAL
F-4	59	2	10	1	0	298	27	38	19	382
RF-4C	10	0	4	0	0	65	7	0	4	76
F-105	1	0	0	0	0	280	30	22	2	334
F-100	140	0	7	0	0	191	0	0	7	198
A-1	38	3	2	0	0	142	3	2	3	150
O-1	81	0	29	0	0	92	1	0	29	122
O-2	44	3	10	0	0	68	4	0	10	82
OV-10A	16	5	1	0	0	40	5	0	1	46
B-57	18	0	5	0	0	35	0	0	5	40
C-130	18	0	14	0	0	22	0	0	14	36
RF-101	2	0	1	0	0	26	5	1	1	33
C-47	12	0	4	0	0	19	0	1	5	25

(C) TABLE A-1 (PART 2) (CONTINUED)

	SOUTH VIETNAM			OTHER		TOTAL				
	GROUND FIRE	SAM	OTHER	GROUND FIRE	OTHER	GROUND FIRE	SAM	AIR-TO AIR	OTHER	TOTAL
C-123	14	0	4	0	0	17	0	0	4	21
B-52	0	0	0	0	0	0	17	0	0	17
T-28	13	0	0	0	0	17	0	0	0	17
A-37	9	0	2	0	0	14	0	0	2	16
A-26	0	0	0	0	0	9	0	0	1	10
B-26	9	0	0	0	0	9	0	0	0	9
F-111	0	0	0	0	2	6	0	0	2	8
F-104	2	0	0	0	0	6	2	0	0	8
C-7	7	0	1	0	0	7	0	0	1	8
F-102	2	0	4	0	0	2	0	1	4	7
F-5	7	0	0	0	0	7	0	0	0	7
AC-130	0	1	0	0	0	4	2	0	0	6
B-66	1	1	0	0	0	1	4	1	0	6

(C) TABLE A-1 (CONCLUDED)

	SOUTH VIETNAM			OTHER		TOTAL				
	GROUND FIRE	SAM	OTHER	GROUND FIRE	OTHER	GROUND FIRE	SAM	AIR-TO AIR	OTHER	TOTAL
A-7	0	0	0	0	0	4	0	0	0	4
U-10	2	0	1	0	0	2	0	0	2	4
AC-119	1	0	0	0	1	1	0	0	1	2
U-3	0	0	1	0	0	0	0	0	1	1
HU-16	1	0	C	0	0	1	0	0	C	1
TOTAL	507	15	100	1	3	1385	107	66	118	1676

(C) TABLE A-2

RF-4C LOSSES BY YEAR, COUNTRY, AND THREAT CLASS (U)

	CAMBODIA	LAOS	NORTH VIETNAM		SOUTH VIETNAM	TOTAL		
	GROUND FIRE	GROUND FIRE	GROUND FIRE	SAM	GROUND FIRE	GROUND FIRE	SAM	TOTAL
1966	0	0	6	0	1	7	0	7
1967	0	3	13	4	0	16	4	20
1968	0	6	9	0	4	19	0	19
1969	0	6	1	0	1	8	0	8
1970	0	6	1	0	2	9	0	9
1971	2	0	0	0	1	3	0	3
1972	0	1	1	3	1	3	3	6
TOTAL	2	22	31	7	10	65	7	72

(C) TABLE A-3

RF-4C COMBAT SORTIES BY YEAR AND COUNTRY (U)

	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
1965	0	31	6	520	557
1966	0	2040	3099	4699	9838
1967	0	3890	6849	7985	18724
1968	21	6006	5620	8719	20366
1969	0	11087	1066	8101	20254
1970	1112	8572	773	3374	13831
1971	872	4335	716	1204	7127
1972	62	2015	1450	1370	4897
1973	2498	1775	73	110	4456
TOTAL	4565	39751	19652	36082	100050

(C) TABLE A-4

RF-4C CUMULATIVE LOSS RATES PER 1,000 COMBAT SORTIES BY YEAR, COUNTRY, AND THREAT CLASS (U)

		CAMBODIA	LAOS	NORTH VIETNAM		SOUTH VIETNAM	TOTAL
		GROUND FIRE	GROUND FIRE	ALL THREATS	GROUND FIRE ONLY	GROUND FIRE	ALL
1965	Lost	NFA	0	0	0	0	0
	Sorties		31	6	6	520	557
	Rate		0.000	0.000	0.000	0.000	0.000
1966	Rate	NFA	0.000	1.936	1.936	0.213	0.712
	Cumulative Lost		0.000	6	6	1	7
	Cumulative Sorties		2071	3105	3105	5219	10395
	Cumulative Rate		0.000	1.932	1.932	0.192	0.673
1967	Rate	NFA	0.771	2.482	1.898	0.000	1.068
	Cumulative Lost		3	23	19	1	27
	Cumulative Sorties		5961	9954	9954	13204	29119
	Cumulative Rate		0.503	2.311	1.909	0.076	0.927

(C) TABLE A-4 (CONTINUED)

		CAMBODIA	LAOS	NORTH VIETNAM		SOUTH VIETNAM	TOTAL
		GROUND FIRE	GROUND FIRE	ALL THREATS	GROUND FIRE ONLY	GROUND FIRE	ALL THREATS
1968	Pate	0.000	0.999	1.601	1.601	0.459	0.933
	Cumulative Lost	0	9	32	28	5	46
	Cumulative Sorties	21	11967	15574	15574	21923	49485
	Cumulative Rate	0.000	0.752	2.055	1.798	0.228	0.930
1969	Rate	0.000	0.541	0.938	0.938	0.123	0.395
	Cumulative Lost	0	15	33	29	6	54
	Cumulative Sorties	21	23054	16640	16640	30024	69739
	Cumulative Rate	0.000	0.651	1.938	1.743	0.200	0.774
1970	Rate	0.000	0.700	1.294	1.294	0.593	0.651
	Cumulative Lost	0	21	34	30	8	63
	Cumulative Sorties	1133	31626	17413	17413	33398	83570
	Cumulative Rate	0.000	0.664	1.953	1.723	0.240	0.754

(C) TABLE A-4 (CONCLUDED)

		CAMBODIA	LAOS	NORTH VIETNAM		SOUTH VIETNAM	TOTAL
		GROUND FIRE	GROUND FIRE	ALL THREATS	GROUND FIRE ONLY	GROUND FIRE	ALL THREATS
1971	Rate	2.294	0.000	0.000	0.000	0.831	0.421
	Cumulative Lost	2	21	34	30	9	66
	Cumulative Sorties	2005	35961	18129	18129	34602	90697
	Cumulative Rate	0.998	0.584	1.875	1.655	0.260	0.728
1972	Rate	0.000	0.496	2.759	0.690	0.730	1.225
	Cumulative Lost	2	22	38	31	10	72
	Cumulative Sorties	2067	37976	19579	19579	35972	95594
	Cumulative Rate	0.968	0.579	1.941	1.583	0.278	0.753
1973	Rate	0.000	0.000	0.000	0.000	0.000	0.000
	Cumulative Lost	2	22	38	31	10	72
	Cumulative Sorties	4565	39751	19652	19652	36082	100050
	Cumulative Rate	0.438	0.553	1.934	1.577	0.277	0.720

(S) TABLE A-5

RF-4C. IMMEDIATE CREWMEMBER STATUS vs KILL SEVERITY BY COUNTRY (U)

	"K"	"A"	"B"	UNKNOWN	TOTAL	PERCENT
NORTH VIETNAM						
Rescued	3	7	10	2	22	28.9
Captured	6	8	0	7	21	27.6
Missing	5	3	0	20	28	36.8
Killed	0	2	0	3	5	6.6
TOTAL	14	20	10	32	76	
PERCENT	18.4	26.3	13.2	42.1		
SOUTH VIETNAM						
Rescued	4	0	0	2	6	30.0
Captured	1	0	0	0	1	5.0
Missing	1	0	2	4	7	35.0
Killed	4	0	0	2	6	30.0
TOTAL	10	0	2	8	20	
PERCENT	50.0	0.0	10.0	40.0		

(S) TABLE A-5 (CONTINUED)

	"K"	"A"	"B"	UNKNOWN	TOTAL	PERCENT
LAOS						
Rescued	5	3	8	10	26	59.1
Captured	1	1	0	0	2	4.5
Missing	4	0	0	9	13	29.5
Killed	0	0	2	1	3	6.8
TOTAL	10	4	10	20	44	
PERCENT	22.7	9.1	22.7	45.5		
CAMBODIA						
Rescued	2	0	2	0	4	100.0
Captured	0	0	0	0	0	0.0
Missing	0	0	0	0	0	0.0
Killed	0	0	0	0	0	0.0
TOTAL	2	0	2	0	4	
PERCENT	50.0	0.0	50.0	0.0		

(S) TABLE A-5 (CONCLUDED)

	"K"	"A"	"B"	UNKNOWN	TOTAL	PERCENT
TOTAL						
Rescued	14	10	20	14	58	40.3
Captured	8	9	0	7	24	16.7
Missing	10	3	2	33	48	33.3
Killed	4	2	2	6	14	9.7
GRAND TOTAL	36	24	24	60	144	
PERCENT	25.0	16.7	16.7	41.7		

(S) TABLE A-6

RF-4C, IMMEDIATE CREWMEMBER STATUS vs KILL SEVERITY FOR SAM LOSSES (U)

	"K"	"A"	"B"	UNKNOWN	TOTAL	PERCENT
Rescued	0	1	2	0	3	21.4
Captured	3	6	0	0	9	64.3
Missing	1	1	0	0	2	14.3
Killed	0	0	0	0	0	0.0
TOTAL	4	8	2	0	14	
PERCENT	28.6	57.1	14.3	0.0		

(S) TABLE A-7

RF-4C, THREAT vs KILL SEVERITY BY COUNTRY (U)

	"K"	"A"	"B"	UNKNOWN	TOTAL	PERCENT
NORTH VIETNAM						
SA/AW	0	2	0	0	2	5.3
UGF	5	0	1	13	19	50.0
AAA	0	0	1	0	1	2.6
23mm	0	1	0	1	2	5.3
37mm	0	2	0	1	3	7.9
37/57mm	1	0	1	1	3	7.9
85mm	0	0	1	0	1	2.6
SAM	2	4	1	0	7	18.4
TOTAL	8	9	5	16	38	
PERCENT	21.0	23.7	13.2	42.1		
SOUTH VIETNAM						
12.7mm	1	0	0	0	1	10.0
UGF	4	0	1	4	9	90.0
TOTAL	5	0	1	4	10	
PERCENT	50.0	0.0	10.0	40.0		

(S) TABLE A-7 (CONCLUDED)

	"K"	"A"	"B"	UNKNOWN	TOTAL	PERCENT
LAOS						
SA/AW	1	0	0	0	1	4.5
UGF	2	3	0	5	10	45.5
AAA	1	0	0	2	3	13.5
23mm	0	0	2	1	3	13.5
23/37mm	0	0	1	1	2	9.1
37mm	0	0	2	1	3	13.5
TOTAL	4	3	5	10	22	
PERCENT	18.2	13.6	22.7	45.5		
CAMBODIA						
12.7mm	0	0	1	0	1	50.0
UGF	1	0	0	0	1	50.0
TOTAL	1	0	1	0	2	
PERCENT	50.0	0.0	50.0	0.0		

(S) TABLE A-8

RF-4C, THREAT vs REASON FOR CRASH, 1971-1973 (U)

	LOSS OF CONTROL	LOSS OF PROPULSION	FIRE/ EXPLOSION	MISC.	INSUFFICIENT DATA	TOTAL	%
12.7mm	0	0	1	1	0	2	16.7
UGF	3	0	0	0	0	3	25.0
23mm	0	1	0	0	0	1	8.3
37mm	1	1	0	0	0	2	16.7
SAM	0	0	2	1	1	4	33.3
TOTAL	4	2	3	2	1	12	

Since more than one lethal event may occur in a single aircraft loss, the numbers shown in this table are not necessarily mutually exclusive.

(C) TABLE A-9

F-4 LOSSES BY YEAR, COUNTRY, AND THREAT CLASS (U)

	CAMBODIA	LAOS		NORTH VIETNAM			SOUTH VIETNAM		TOTAL			
	GROUND FIRE	GROUND FIRE	AIR-TO AIR	GROUND FIRE	SAM	AIR-TO AIR	GROUND FIRE	SAM	GROUND FIRE	SAM	AIR-TO AIR	TOTAL
1965	0	0	0	8	2	0	2	0	10	2	0	12
1966	0	5	0	23	6	3	4	0	32	6	3	41
1967	0	6	0	47	3	9	9	0	62	3	9	74
1968	0	7	0	28	1	3	13	0	48	1	3	52
1969	0	39	0	0	0	0	18	0	57	0	0	57
1970	4	20	0	2	0	0	4	0	30	0	0	30
1971	1	18	1	1	1	0	2	0	22	1	1	24
1972	0	7	0	15	13	20	7	2	29	15	20	64
1973	3	1	0	0	0	0	0	0	4	0	0	4
TOTAL	8	103	1	124	26	35	59	2	294	28	36	358

(C) TABLE A-10

F-4 COMBAT SORTIES BY YEAR AND COUNTRY (II)

	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
1965	0	1457	5066	1067	7590
1966	0	13002	24138	12986	50126
1967	0	12736	31019	16355	60110
1968	0	21119	24812	23164	72695
1969	6	56422	547	21799	78774
1970	3494	49041	1685	10295	64515
1971	1623	49676	1203	8213	60715
1972	746	19143	25253	31067	76209
1973	17715	5777	1233	1211	25936
TOTAL	23584	228373	118556	126157	496670

(S) TABLE A-11

F-4, IMMEDIATE CREWMEMBER STATUS vs KILL SEVERITY, 1971-1973 (U)

	"K"	"A"	"B"	UNKNOWN	TOTAL	PERCENT
Rescued	13	40	16	3	72	39.1
Captured	34	9	2	7	52	28.3
Missing	20	3	2	25	50	27.2
Killed	5	0	2	3	10	5.4
TOTAL	72	52	22	38	184	
PERCENT	39.1	28.3	12.0	20.7		

(S) TABLE A-12

F-4, IMMEDIATE CREWMEMBER STATUS vs KILL SEVERITY FOR SAM, MIG KILLS (U)

	"K"	"A"	"B"	UNKNOWN	TOTAL	PERCENT
SAM						
Rescued	4	6	2	2	14	25.0
Captured	17	9	2	3	31	55.4
Missing	5	5	0	1	11	19.6
Killed	0	0	0	0	0	0.0
TOTAL	26	20	4	6	56	
PERCENT	46.4	35.7	7.1	10.1		
MIG						
Rescued	2	3	8	0	13	18.0
Captured	29	18	0	2	49	68.1
Missing	3	3	2	2	10	13.9
Killed	0	0	0	0	0	0.0
TOTAL	34	24	10	4	72	
PERCENT	47.2	33.3	13.9	5.6		

(C) TABLE A-13

F-4 CUMULATIVE LOSS RATES PER 1,000 COMBAT SORTIES BY YEAR, COUNTRY, AND THREAT CLASS (U)

		CAMBODIA	LAOS	NORTH VIETNAM		SOUTH VIETNAM	TOTAL
		GROUND FIRE	GROUND FIRE	ALL THREATS	GROUND FIRE ONLY	GROUND FIRE	ALL THREATS
1965	Lost	NFA	0	10	8	2	12
	Sorties		1457	5066	5066	1067	7590
	Rate		0.000	1.974	1.579	1.874	1.581
1966	Rate	NFA	0.385	1.326	0.953	0.308	0.818
	Cumulative Lost		5	42	31	6	53
	Cumulative Sorties		14459	29204	29204	14053	57716
	Cumulative Rate		0.346	1.438	1.061	0.427	0.918
1967	Rate	NFA	0.471	1.902	1.515	0.550	1.231
	Cumulative Lost		11	101	78	15	127
	Cumulative Sorties		27195	60223	60223	30408	117826
	Cumulative Rate		0.404	1.677	1.300	0.493	1.078

(C) TABLE A-13 (CONTINUED)

		CAMBODIA	LAOS	NORTH VIETNAM		SOUTH VIETNAM	TOTAL
		GROUND FIRE	GROUND FIRE	ALL THREATS	GROUND FIRE ONLY	GROUND FIRE	ALL THREATS
1968	Rate	NFA	0.331	1.126	1.021	0.561	0.715
	Cumulative Lost		18	133	106	28	179
	Cumulative Sorties		48314	88635	88635	53572	190521
	Cumulative Rate		0.373	1.501	1.196	0.523	0.940
1969	Rate	0.000	0.691	0.000	0.000	0.826	0.724
	Cumulative Lost	0	57	133	106	46	236
	Cumulative Sorties	6	104736	89182	89182	75371	269295
	Cumulative Rate	0.000	0.544	1.491	1.189	0.610	0.876
1970	Rate	1.145	0.408	1.187	1.187	0.389	0.465
	Cumulative Lost	4	77	135	108	50	266
	Cumulative Sorties	3500	153777	90867	90867	85666	333810
	Cumulative Rate	1.143	0.501	1.486	1.189	0.584	0.797

(C) TABLE A-13 (CONCLUDED)

		CAMBODIA	LAOS	NORTH VIETNAM		SOUTH VIETNAM	TOTAL
		GROUND FIRE	GROUND FIRE	ALL THREATS	GROUND FIRE ONLY	GROUND FIRE	ALL THREATS
1971	Rate	0.616	0.382	1.663	0.831	0.244	0.428
	Cumulative Lost	5	95	137	109	52	290
	Cumulative Sorties	5123	203453	92070	92070	93879	394525
	Cumulative Rate	0.976	0.467	1.488	1.184	0.554	0.735
1972	Rate	0.000	0.418	1.901	0.594	0.225	0.853
	Cumulative Lost	5	102	185	124	59	354
	Cumulative Sorties	5869	222596	117323	117323	124946	470734
	Cumulative Rate	0.852	0.458	1.577	1.057	0.472	0.752
1973	Rate	0.169	0.173	0.000	0.000	0.000	0.154
	Cumulative Lost	8	103	185	124	59	358
	Cumulative Sorties	23584	228373	118556	118556	126157	496670
	Cumulative Rate	0.339	0.451	1.560	1.046	0.468	0.721

(S) TABLE A-14

F-4, THREAT vs KILL SEVERITY AND IMMEDIATE CREWMEMBER STATUS BY COUNTRY (U)

	KILL SEVERITY				IMMEDIATE CREWMEMBER STATUS			
	"K"	"A"	"B"	UNKNOWN	RESCUED	CAPTURED	MISSING	KILLED
CAMBODIA								
12.7mm	1	1	0	0	2	0	0	2
SA/AW	0	1	0	0	2	0	0	0
UGF	2	0	0	2	0	0	6	2
23/37mm	0	0	1	0	2	0	0	0
TOTAL	3	2	1	2	6	0	6	4

(S) TABLE A-14 (CONTINUED)

	KILL SEVERITY				IMMEDIATE CREWMEMBER STATUS			
	"K"	"A"	"B"	UNKNOWN	RESCUED	CAPTURED	MISSING	KILLED
LAOS								
12.7mm	1	2	0	0	4	0	2	0
14.5mm	0	0	1	0	1	0	0	1
SA/AW	4	2	1	1	7	1	6	2
UGF	13	9	4	12	35	1	34	6
AAA	4	3	3	1	12	0	10	0
23mm	1	1	3	2	11	0	0	3
23/37mm	5	0	2	1	6	1	6	3
37mm	14	5	4	3	27	0	20	5
37/57mm	1	0	0	0	2	0	0	0
MIG	1	0	0	0	0	2	0	0
TOTAL	44	22	18	20	105	5	78	20

(S) TABLE A-14 (CONTINUED)

	KILL SEVERITY				IMMEDIATE CREWMEMBER STATUS			
	"K"	"A"	"B"	UNKNOWN	RESCUED	CAPTURED	MISSING	KILLED
SOUTH VIETNAM								
7.62mm	1	0	0	1	4	0	0	0
12.7mm	4	5	0	0	13	0	0	5
SA/AW	10	5	1	4	23	0	3	14
UGF	15	3	1	3	20	0	4	20
AAA	0	1	0	0	2	0	0	0
23mm	1	1	1	0	4	0	0	2
23/37mm	1	0	0	0	2	0	0	0
37mm	0	1	0	0	2	0	0	0
SA2	0	1	0	0	2	0	0	0
SA7	0	1	0	0	2	0	0	0
TOTAL	32	18	3	8	74	0	7	41

(S) TABLE A-14 (CONCLUDED)

	KILL SEVERITY				IMMEDIATE CREWMEMBER STATUS			
	"K"	"A"	"B"	UNKNOWN	RESCUED	CAPTURED	MISSING	KILLED
NORTH VIETNAM								
12.7mm	2	1	0	0	2	0	2	2
SA/AW	5	2	0	0	1	2	10	1
UGF	18	4	3	8	12	5	47	2
AAA	1	7	3	0	15	3	3	1
23/37mm	2	0	2	0	4	2	0	0
37mm	11	11	4	0	21	12	19	0
37/57mm	3	14	3	0	20	11	9	0
57mm	4	3	3	2	13	5	5	1
85mm	3	3	2	0	6	6	3	1
100mm	0	1	0	0	0	2	0	0
SA2	13	8	2	3	10	31	11	0
MIG- Gun	3	2	2	0	3	6	5	0
MIG- AAM	11	9	3	2	9	36	5	0
MIG- Unspec	2	1	0	0	1	5	0	0
TOTAL	78	66	26	15	117	126	119	8

(C) TABLE A-15

F-105 LOSSES BY YEAR, COUNTRY AND THREAT CLASS (U)

	LAOS	NORTH VIETNAM			SOUTH VIETNAM	TOTAL			
	GROUND FIRE	GROUND FIRE	SAM	MIG	GROUND FIRE	GROUND FIRE	SAM	MIG	TOTAL
1964	1	0	0	0	0	1	0	0	1
1965	6	49	3	2	0	55	3	2	60
1966	8	94	5	3	0	102	5	3	110
1967	4	65	17	11	0	69	17	11	97
1968	10	17	2	4	1	28	2	4	34
1969	16	0	0	0	0	16	0	0	16
1970	6	1	0	0	0	7	0	0	7
1971	0	0	1	0	0	0	1	0	1
1972	0	1	4	1	0	1	4	1	6
TOTAL	51	227	32	21	1	279	32	21	332

(C) TABLE A-16

F-105 COMBAT SORTIES BY YEAR AND COUNTRY (U)

	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
1964	0	62	0	0	62
1965	0	4491	10498	17	15006
1966	0	9129	24602	0	33731
1967	0	8769	25814	0	34583
1968	0	14231	15401	2043	31675
1969	0	21985	674	4	22663
1970	120	11345	1806	24	13295
1971	0	117	2970	4	3091
1972	0	666	3417	794	4877
1973	342	158	166	146	812
TOTAL	462	70953	85348	3032	159795

(C) TABLE A-17

F-105 CUMULATIVE LOSS RATES PER 1,000 COMBAT SORTIES BY YEAR, COUNTRY, AND THREAT CLASS (U)

		NORTH VIETNAM			LAOS	TOTAL*
		GROUND FIRE	MIG	SAM	GROUND FIRE	
1964	Lost	NFA	NFA	NFA	1	1
	Sorties				62	62
	Rate				16.129	16.129
1965	Rate	4.668	0.191	0.286	1.336	3.998
	Cumulative Lost	49	2	3	7	61
	Cumulative Sorties	10498	10498	10498	4553	15068
	Cumulative Rate	4.668	0.191	0.286	1.537	4.048
1966	Rate	3.821	0.122	0.203	0.876	3.261
	Cumulative Lost	143	5	8	15	171
	Cumulative Sorties	35100	35100	35100	13682	48799
	Cumulative Rate	4.074	0.142	0.228	1.096	3.504

(C) TABLE A-17 (CONTINUED)

		NORTH VIETNAM			LAOS	TOTAL*
		GROUND FIRE	MIG	SAM	GROUND FIRE	
1967	Rate	2.518	0.426	0.659	0.456	2.805
	Cumulative Lost	208	16	25	19	268
	Cumulative Sorties	60914	60914	60914	22451	83382
	Cumulative Rate	3.415	0.263	0.410	0.846	3.214
1968	Rate	1.104	0.260	0.130	0.703	1.073
	Cumulative Lost	225	20	27	29	302
	Cumulative Sorties	76315	76315	76315	36682	115057
	Cumulative Rate	2.948	0.262	0.354	0.791	2.625
1969	Rate	0.000	0.000	0.000	0.728	0.706
	Cumulative Lost	225	20	27	45	318
	Cumulative Sorties	76989	76989	76989	58667	137720
	Cumulative Rate	2.922	0.260	0.351	0.767	2.309

(C) TABLE A-17 (CONTINUED)

		NORTH VIETNAM			LAOS	TOTAL*
		GROUND FIRE	MIG	SAM	GROUND FIRE	
1970	Rate	0.554	0.000	0.000	0.529	0.527
	Cumulative Lost	226	20	27	51	325
	Cumulative Sorties	78795	78795	78795	70012	151015
	Cumulative Rate	2.868	0.254	0.343	0.728	2.152
1971	Rate	0.000	0.000	0.337	0.000	0.324
	Cumulative Lost	226	20	28	51	326
	Cumulative Sorties	81765	81765	81765	70129	154106
	Cumulative Rate	2.764	0.245	0.342	0.727	2.115
1972	Rate	0.878	0.293	1.171	0.000	1.230
	Cumulative Lost	227	21	32	51	332
	Cumulative Sorties	85182	85182	85182	70795	158983
	Cumulative Rate	2.665	0.247	0.376	0.720	2.088

(C) TABLE A-17 (CONCLUDED)

		NORTH VIETNAM			LAOS	TOTAL*
		GROUND FIRE	MIG	SAM	GROUND FIRE	
1973	Rate	0.000	0.000	0.000	0.000	0.000
	Cumulative Lost	227	21	32	51	332
	Cumulative Sorties	85348	85348	85348	70953	159795
	Cumulative Rate	2.660	0.246	0.375	0.719	2.078

*NOTE: TOTAL includes Cambodia, South Vietnam

(S) TABLE A-18

F-105, IMMEDIATE CREWMEMBER STATUS vs KILL SEVERITY BY COUNTRY (U)

	"K"	"A"	"B"	UNKNOWN	TOTAL	PERCENT
NORTH VIETNAM						
Rescued	11	40	37	9	97	31.2
Captured	39	60	4	6	109	35.0
Missing	33	38	0	16	87	28.0
Killed	3	11	1	3	18	5.8
TOTAL	86	149	42	34	311	
PERCENT	27.7	47.9	13.5	10.9		
LAOS AND SOUTH VIETNAM						
Rescued	4	15	6	4	29	55.8
Captured	0	0	0	1	1	1.9
Missing	8	4	0	2	14	26.9
Killed	4	2	2	0	8	15.4
TOTAL	16	21	8	7	52	
PERCENT	30.8	40.4	15.4	13.4		

(S) TABLE A-19

F-105, THREAT vs IMMEDIATE CREWMEMBER STATUS, NORTH VIETNAM (U)

	RESCUED	CAPTURED	MISSING	KILLED	TOTAL
14.5mm	1	0	0	0	1
SA/AW	14	7	3	1	25
UGF	15	12	21	8	56
AAA	4	2	6	0	12
37mm	22	15	11	1	49
37/57mm	17	19	9	0	45
57mm	5	10	5	1	21
85mm	7	17	6	1	31
100mm	0	0	1	0	1
SAM	8	14	17	4	43
MIG	4	13	8	2	27
TOTAL	97	109	87	18	311

(S) TABLE A-20

F-105, THREAT vs IMMEDIATE CREWMEMBER STATUS,
LAOS AND SOUTH VIETNAM (U)

	RESCUED	CAPTURED	MISSING	KILLED	TOTAL
12.7mm	1	0	0	0	1
14.5mm	1	0	0	0	1
SA/AW	4	0	3	4	11
UGF	10	1	2	1	14
AAA	1	0	0	0	1
23/37mm	1	0	1	0	2
37mm	9	0	5	2	16
37/57mm	1	0	3	1	5
57mm	1	0	0	0	1
TOTAL	29	1	14	8	52

(C) TABLE A-21

F-100 LOSSES AND COMBAT SORTIES BY YEAR AND COUNTRY (U)

	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
LOSSES					
1964	0	2	0	0	2
1965	0	2	5	14	21
1966	0	0	1	21	22
1967	0	2	4	26	32
1968	0	3	6	39	48
1969	0	12	0	29	41
1970	3	6	0	8	17
1971	3	1	0	4	8
TOTAL	6	28	16	141	191

(C) TABLE A-2: (CONCLUDED)

	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
COMBAT SORTIES					
1964	0	214	0	0	214
1965	0	226	550	15024	15800
1966	0	591	740	43033	44364
1967	0	1554	812	80374	82740
1968	0	6069	1581	88276	95926
1969	12	12965	0	59724	72701
1970	6702	4676	0	26118	37496
1971	3301	5237	0	2886	11424
TOTAL	10015	31532	3683	315435	360665

(C) TABLE A-22

F-100 CUMULATIVE LOSS RATES PER 1,000 COMBAT SORTIES BY YEAR AND COUNTRY (U)

		CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
1964	Lost	NFA	2	NFA	NFA	2
	Sorties		214			214
	Rate		9.346			9.346
1965	Rate	NFA	8.850	9.091	0.932	1.329
	Cumulative Lost		4	5	14	23
	Cumulative Sorties		440	550	15024	16014
	Cumulative Rate		9.091	9.091	0.932	1.436
1966	Rate	NFA	0.000	1.351	0.488	0.496
	Cumulative Lost		4	6	35	45
	Cumulative Sorties		1031	1290	58057	60378
	Cumulative Rate		3.880	4.651	0.603	0.745

(C) TABLE A-22 (CONTINUED)

		CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
1967	Rate	NFA	1.287	4.926	0.323	0.387
	Cumulative Lost		6	10	61	77
	Cumulative Sorties		2585	2102	138431	143118
	Cumulative Rate		2.321	4.757	0.441	0.538
1968	Rate	NFA	0.494	3.795	0.442	0.500
	Cumulative Lost		9	16	100	125
	Cumulative Sorties		8654	3683	226707	239044
	Cumulative Rate		1.040	4.344	0.441	0.523
1969	Rate	0.000	0.926	NFA	0.486	0.564
	Cumulative Lost	0	21		129	166
	Cumulative Sorties	12	21619		286431	311745
	Cumulative Rate	0.000	0.971		0.450	0.532

(C) TABLE A-22 (CONCLUDED)

		CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
1970	Rate	0.448	1.283	NFA	0.306	0.453
	Cumulative Lost	3	27		137	183
	Cumulative Sorties	6714	26295		312549	349241
	Cumulative Rate	0.447	1.027		0.438	0.524
1971	Rate	0.909	0.191	NFA	1.386	0.700
	Cumulative Lost	6	28		141	191
	Cumulative Sorties	10015	31532		315435	360665
	Cumulative Rate	0.599	0.888		0.447	0.530

(S) TABLE A-23

F-100, THREAT CLASS vs IMMEDIATE CREWMEMBER STATUS (U)

	RESCUED	CAPTURED	MISSING	KILLED	TOTAL	PERCENT
SA/AW	52	0	0	15	67	33.8
UGF	48	3	10	36	97	49.0
AAA	19	3	6	6	34	17.2
TOTAL	119	6	16	57	198	
PERCENT	60.1	3.0	8.1	28.8		

(S) TABLE A-24

F-100, THREAT vs KILL SEVERITY AND IMMEDIATE CREWMEMBER STATUS BY COUNTRY (U)

	KILL SEVERITY				IMMEDIATE CREWMEMBER STATUS			
	"K"	"A"	"B"	UNKNOWN	RESCUED	CAPTURED	MISSING	KILLED
CAMBODIA								
7.62mm	0	0	0	1	1	0	0	0
12.7mm	0	1	0	0	1	0	0	0
SA/AW	0	0	1	0	1	0	0	0
UGF	2	1	0	0	1	0	1	1
TOTAL	2	2	1	1	4	0	1	1

SECRET

(S) TABLE A-24 (CONTINUED)

	KILL SEVERITY				IMMEDIATE CREWMEMBER STATUS			
	"K"	"A"	"B"	UNKNOWN	RESCUED	CAPTURED	MISSING	KILLED
LAOS								
7.62mm	0	0	1	0	1	0	0	0
12.7mm	1	0	0	0	0	0	0	1
SA/AW	3	0	0	1	3	0	0	1
UGF	3	1	2	3	4	0	5	2
AAA	1	0	0	0	1	0	0	0
23mm	0	1	0	2	2	0	1	0
23/37mm	0	1	0	0	1	0	0	0
37mm	4	1	0	1	4	0	1	1
37/57mm	0	0	0	2	1	0	0	1
TOTAL	12	4	3	9	17	0	7	6

(S) TABLE A-24 (CONTINUED)

	KILL SEVERITY				IMMEDIATE CREWMEMBER STATUS			
	"K"	"A"	"B"	UNKNOWN	RESCUED	CAPTURED	MISSING	KILLED
SOUTH VIETNAM								
7.62mm	0	1	0	1	2	0	0	0
12.7mm	4	6	1	0	9	0	0	2
SA/AW	22	10	6	6	33	0	0	11
UGF	42	14	5	16	43	0	2	33
AAA	1	0	0	0	0	0	1	0
37mm	2	0	0	0	1	0	0	1
37/57mm	0	1	0	3	3	1	0	0
TOTAL	71	32	12	26	91	1	3	47

(S) TABLE A-24 (CONCLUDED)

	KILL SEVERITY				IMMEDIATE CREWMEMBER STATUS			
	"K"	"A"	"B"	UNKNOWN	RESCUED	CAPTURED	MISSING	KILLED
NORTH VIETNAM								
SA/AW	0	1	0	0	1	0	0	0
UGF	1	0	0	2	0	3	2	0
37mm	0	3	2	0	4	0	0	1
37/57mm	2	1	1	0	1	1	1	2
57mm	0	1	0	1	1	0	1	0
100mm	0	1	0	0	0	1	1	0
TOTAL	3	7	3	3	7	5	5	3

(S) TABLE A-25

F-100, THREAT vs REASON FOR CRASH (U)

	LOSS OF CONTROL	CREW/ CONTROL	CREW	LOSS OF PROPULSION	ENGINE FIRE	FIRE/ EXPLOSION	MISC.	INSUFFICIENT DATA	TOTAL	%
7.62mm	0	0	0	2	0	0	2	0	4	2.1
12.7mm	2	0	2	1	2	2	3	0	12	6.3
SA/AW	4	0	2	7	6	10	16	6	51	26.7
UGF	7	0	4	11	3	25	20	22	92	48.2
AAA	0	0	0	0	1	0	1	0	2	1.0
23mm	0	0	1	1	0	0	1	0	3	1.6
23/37mm	0	0	0	0	0	1	0	0	1	0.5
37mm	1	0	0	0	0	7	3	2	13	6.8
37/57mm	0	0	0	1	1	2	1	5	10	5.2
57mm	1	0	0	0	0	0	0	1	2	1.0
100mm	1	0	0	0	0	0	0	0	1	0.5
TOTAL	16	0	9	23	13	47	47	36	191	

Since more than one lethal event may occur in a single aircraft loss, the numbers shown in this table are not necessarily mutually exclusive.

(C) TABLE A-26

OV-10A LOSSES AND COMBAT SORTIES BY YEAR, COUNTRY, AND THREAT CLASS (U)

	CAMBODIA	LAOS	SOUTH VIETNAM		TOTAL
	GROUND FIRE	GROUND FIRE	GROUND FIRE	SAM	
LOSSES					
1968	0	0	1	0	1
1969	0	1	5	0	6
1970	3	8	3	0	14
1971	2	6	1	0	9
1972	0	3	4	6	13
1973	1	0	0	1	2
TOTAL	6	18	14	7	45

(C) TABLE A-26 (CONCLUDED)

	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
COMBAT SORTIES					
1968	0	275	0	1813	2088
1969	0	4656	0	30711	35367
1970	3169	11915	0	18559	33643
1971	3087	11204	0	11669	27960
1972	697	6933	9	9252	16891
1973	5787	1422	2	412	7623
TOTAL	14740	36405	11	72416	123572

(C) TABLE A-27

OV-10A CUMULATIVE LOSS RATES PER 1,000 COMBAT SORTIES BY YEAR AND COUNTRY (GROUND FIRE ONLY) (U)

		CAMBODIA	LAOS	SOUTH VIETNAM	TOTAL*
1968	Lost		0	1	1
	Sorties	NFA	275	1813	2088
	Rate		0.000	0.552	0.479
1969	Rate		0.215	0.163	0.170
	Cumulative Lost	NFA	1	6	7
	Cumulative Sorties		4931	32524	37455
	Cumulative Rate		0.203	0.184	0.187
1970	Rate	0.947	0.671	0.162	0.416
	Cumulative Lost	3	9	9	21
	Cumulative Sorties	3169	16846	51083	71098
	Cumulative Rate	0.947	0.534	0.176	0.295

(C) TABLE A-27 (CONCLUDED)

		CAMBODIA	LAOS	SOUTH VIETNAM	TOTAL*
1971	Rate	0.393	0.536	0.086	0.322
	Cumulative Lost	5	15	10	30
	Cumulative Sorties	8256	28050	62752	99058
	Cumulative Rate	0.606	0.535	0.159	0.303
1972	Rate	0.000	0.433	0.432	0.414
	Cumulative Lost	5	18	14	37
	Cumulative Sorties	8953	34983	72004	115949
	Cumulative Rate	0.558	0.515	0.194	0.319
1973	Rate	0.173	0.000	0.000	0.131
	Cumulative Lost	6	18	14	38
	Cumulative Sorties	14740	36405	72416	123572
	Cumulative Rate	0.407	0.494	0.193	0.308

*NOTE: TOTAL includes sorties in North Vietnam

(S) TABLE A-28

OV-10A, THREAT vs REASON FOR CRASH (GROUND FIRE ONLY) (U)

	LOSS OF CONTROL	CREW/ CONTROL	CREW	LOSS OF PROPULSION	ENGINE FIRE	FIRE/ EXPLOSION	MISC.	INSUFFICIENT DATA	TOTAL	%
7.62mm	1	1	0	0	0	0	0	0	2	4.9
12.7mm	1	1	1	2	0	1	1	3	10	24.4
SA/AW	0	2	0	1	0	0	0	2	5	12.2
UGF	0	0	1	0	0	0	0	8	9	22.0
AAA	0	0	0	0	1	1	1	0	3	7.3
23/37mm	0	0	0	0	1	0	0	0	1	2.4
37mm	3	0	1	0	0	1	2	1	8	19.5
37/57mm	1	0	0	0	0	0	0	1	2	4.9
57/85mm	0	0	0	0	0	0	0	1	1	2.4
TOTAL	6	4	3	3	2	3	4	16	41	

Since more than one lethal event may occur in a single aircraft loss, the numbers shown in this table are not necessarily mutually exclusive.

(C) TABLE A-29

A-1 LOSSES AND COMBAT SORTIES BY YEAR, COUNTRY, AND THREAT CLASS (U)

	LAOS	NORTH VIETNAM		SOUTH VIETNAM		TOTAL		
	GROUND FIRE	GROUND FIRE	MIG	GROUND FIRE	SAM	GROUND FIRE	SAM	MIG
LOSSES								
1964	0	0	0	7	0	7	0	0
1965	0	3	0	10	0	13	0	0
1966	17	8	1	8	0	33	0	1
1967	10	2	1	1	0	13	0	1
1968	21	3	0	6	0	30	0	0
1969	18	0	0	2	0	20	0	0
1970	15	0	0	2	0	17	0	0
1971	6	0	0	0	0	6	0	0
1972	2	0	0	1	3	3	3	0
TOTAL	89	16	2	37	3	142	3	2

(C) TABLE A-29 (CONCLUDED)

	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
COMBAT SORTIES					
1964	0	0	0	2597	2597
1965	0	8	83	13221	13312
1966	0	5945	1752	5465	13162
1967	0	6932	544	3000	10476
1968	0	12324	223	3172	15719
1969	0	17033	6	2225	19264
1970	40	11477	57	283	11857
1971	7	3449	34	40	3530
1972	40	1714	30	154	1938
TOTAL	87	58882	2729	30157	91855

(C) TABLE A-30

A-1 CUMULATIVE LOSS RATES PER 1,000 COMBAT SORTIES BY YEAR AND COUNTRY (GROUND FIRE ONLY) (U)

		LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
1964	Lost	NFA	NFA	7	7
	Sorties			2597	2597
	Rate			2.695	2.695
1965	Rate	NFA	36.145	0.756	0.977
	Cumulative Lost		3	17	20
	Cumulative Sorties		83	15818	15909
	Cumulative Rate		36.145	1.075	1.257
1966	Rate	2.866	4.566	1.464	2.507
	Cumulative Lost	17	11	25	53
	Cumulative Sorties	5953	1835	21283	29071
	Cumulative Rate	2.856	5.995	1.175	1.823

(C) TABLE A-30 (CONTINUED)

		LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
1967	Rate	1.443	3.676	0.333	1.241
	Cumulative Lost	27	13	26	66
	Cumulative Sorties	12885	2379	24283	39547
	Cumulative Rate	2.095	5.464	1.071	1.669
1968	Rate	1.704	13.453	1.892	1.909
	Cumulative Lost	48	16	32	96
	Cumulative Sorties	25209	2602	27455	55266
	Cumulative Rate	1.904	6.149	1.166	1.737
1969	Rate	1.057	0.000	0.899	1.038
	Cumulative Lost	66	16	34	116
	Cumulative Sorties	42242	2608	29680	74530
	Cumulative Rate	1.562	6.135	1.146	1.556

(C) TABLE A-30 (CONCLUDED)

		LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
1970	Rate	1.307	0.000	7.067	1.434
	Cumulative Lost	81	16	36	133
	Cumulative Sorties	53719	2665	29963	86387
	Cumulative Rate	1.508	6.004	1.201	1.540
1971	Rate	1.740	0.000	0.000	1.700
	Cumulative Lost	87	16	36	139
	Cumulative Sorties	57168	2699	30003	89917
	Cumulative Rate	1.522	5.928	1.200	1.546
1972	Rate	1.167	0.000	6.494	1.548
	Cumulative Lost	89	16	37	142
	Cumulative Sorties	58882	2729	30157	91855
	Cumulative Rate	1.511	5.863	1.227	1.546

(C) TABLE A-31

O-1 LOSSES AND COMBAT SORTIES BY YEAR AND COUNTRY (U)

	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
LOSSES					
1964	0	0	0	3	3
1965	0	0	0	13	13
1966	0	7	0	14	21
1967	0	2	2*	21	25
1968	0	0	0	20	20
1969	0	0	0	6	6
1970	1	0	0	3	4
1971	0	0	0	1	1
1972	0	0	0	0	0
TOTAL	1	9	2*	81	93

*Includes one loss to a SAM

(C) TABLE A-31 (CONCLUDED)

	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
SORTIES					
1964	0	0	0	10480	10480
1965	0	0	0	37325	37325
1966	0	11435	970	82024	94429
1967	0	15458	2437	115623	133518
1968	0	1	5	104084	104090
1969	0	0	0	79482	79482
1970	1252	0	0	23757	25009
1971	560	2	0	545	1107
1972	0	12	0	0	12
TOTAL	1812	26908	3412	453320	485452

(C) TABLE A-32

O-1 CUMULATIVE LOSS RATES PER 1,000 COMBAT SORTIES BY YEAR AND COUNTRY (GROUND FIRE ONLY) (U)

		CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
1964	Lost	NFA	NFA	NFA	3	3
	Sort				10480	10480
	Rate				0.286	0.286
1965	Rate	NFA	NFA	NFA	0.348	0.348
	Cumulative Lost				16	16
	Cumulative Sorties				47805	47805
	Cumulative Rate				0.335	0.335
1966	Rate	NFA	0.612	0.000	0.171	0.222
	Cumulative Lost		7	0	30	37
	Cumulative Sorties		11435	970	129829	142234
	Cumulative Rate		0.612	0.000	0.231	0.260

(C) TABLE A-32 (CONTINUED)

		CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
1967	Rate	NFA	0.129	0.410	0.192	0.180
	Cumulative Lost		9	1	51	61
	Cumulative Sorties		26893	3407	245452	275752
	Cumulative Rate		0.335	0.294	0.208	0.221
1968	Rate	NFA	0.000	0.000	0.192	0.192
	Cumulative Lost		9	1	71	81
	Cumulative Sorties		26894	3412	349536	379842
	Cumulative Rate		0.335	0.293	0.203	0.213
1969	Rate	NFA	NFA	NFA	0.075	0.075
	Cumulative Lost				77	87
	Cumulative Sorties				429018	459324
	Cumulative Rate				0.179	0.189

(C) TABLE A-32 (CONCLUDED)

		CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
1970	Rate	0.799	NFA	NFA	0.126	0.160
	Cumulative Lost	1			80	91
	Cumulative Sorties	1252			452775	484333
	Cumulative Rate	0.799			0.177	0.188
1971	Rate	0.000	0.000	NFA	1.835	0.903
	Cumulative Lost	1	9		81	92
	Cumulative Sorties	1812	26896		453320	485440
	Cumulative Rate	0.552	0.335		0.179	0.190
1972	Rate	NFA	0.000	NFA	NFA	0.000
	Cumulative Lost		9			92
	Cumulative Sorties		26908			485452
	Cumulative Rate		0.334			0.190

(C) TABLE A-33

O-2 LOSSES AND COMBAT SORTIES BY YEAR, COUNTRY, AND THREAT CLASS (U)

	CAMBODIA	LAOS		NORTH VIETNAM	SOUTH VIETNAM		TOTAL	
	GROUND FIRE	GROUND FIRE	SAM	GROUND FIRE	GROUND FIRE	SAM	GROUND FIRE	SAM
LOSSES								
1967	0	0	0	1	3	0	4	0
1968	0	6	0	2	14	0	22	0
1969	0	6	0	0	10	0	16	0
1970	2	2	0	0	7	0	11	0
1971	0	3	1	0	2	0	5	1
1972	3	0	0	0	7	3	10	3
1973	0	0	0	0	0	0	0	0
TOTAL	5	17	1	3	43	3	68	4

(C) TABLE A-33 (CONCLUDED)

	CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
COMBAT SORTIES					
1967	0	2807	3371	9648	15826
1968	0	18266	3003	38193	59462
1969	0	13360	0	54348	67708
1970	3357	8897	0	59404	71658
1971	8093	6692	0	32860	47645
1972	4020	291	0	13688	17999
1973	187	3	0	512	702
TOTAL	15657	50316	6374	208653	281000

(C) TABLE A-34

O-2 CUMULATIVE LOSS RATES PER 1,000 COMBAT SORTIES BY YEAR AND COUNTRY (GROUND FIRE ONLY) (U)

		CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
1967	Lost	NFA	0	1	3	4
	Sorties		2807	3371	9648	15826
	Rate		0.000	0.297	0.311	0.253
1968	Rate	NFA	0.328	0.666	0.367	0.370
	Cumulative Lost		6	3	17	26
	Cumulative Sorties		21073	6374	47841	75288
	Cumulative Rate		0.285	0.471	0.355	0.345
1969	Rate	NFA	0.449	NFA	0.184	0.236
	Cumulative Lost		12		27	42
	Cumulative Sorties		34433		102189	142996
	Cumulative Rate		0.349		0.264	0.294

(C) TABLE A-34 (CONTINUED)

		CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
1970	Rate	0.596	0.225	NFA	0.118	0.154
	Cumulative Lost	2	14		34	53
	Cumulative Sorties	3357	43330		161593	214654
	Cumulative Rate	0.596	0.323		0.210	0.247
1971	Rate	0.000	0.448	NFA	0.061	0.105
	Cumulative Lost	2	17		36	58
	Cumulative Sorties	11450	50022		194453	262299
	Cumulative Rate	0.175	0.340		0.185	0.221
1972	Rate	0.746	0.000	NFA	0.511	0.556
	Cumulative Lost	5	17		43	69
	Cumulative Sorties	15470	50313		208141	280298
	Cumulative Rate	0.323	0.338		0.207	0.243

(C) TABLE A-34 (CONCLUDED)

		CAMBODIA	LAOS	NORTH VIETNAM	SOUTH VIETNAM	TOTAL
1973	Rate	0.000	0.000		0.000	0.000
	Cumulative Lost	5	17		43	68
	Cumulative Sorties	15657	50316	NFA	208653	281000
	Cumulative Rate	0.319	0.338		0.206	0.242

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(C) TABLE A-35

A-37 LOSSES AND COMBAT SORTIES BY YEAR AND COUNTRY (U)

	CAMBODIA	LAOS	SOUTH VIETNAM	TOTAL
LOSSES				
1967	0	0	1	1
1968	0	0	4	4
1969	0	0	1	1
1970	1	0	0	1
1971	4	0	0	4
1972	0	0	3	3
TOTAL	5	0	9	14
COMBAT SORTIES				
1967	0	619	4772	5391
1968	0	368	14450	14818
1969	0	0	10736	10736
1970	4167	0	11867	16034
1971	10027	238	1444	11709
1972	4022	14	5747	9783
TOTAL	18216	1239	49016	68471

(C) TABLE A-36

A-37 CUMULATIVE LOSS RATES PER 1,000 COMBAT SORTIES BY YEAR AND COUNTRY (U)

YEAR		CAMBODIA	SOUTH VIETNAM	TOTAL*
1967	Lost	NFA	1	1
	Sorties		4772	5391
	Rate		0.210	0.185
1968	Rate	NFA	0.277	0.270
	Cumulative Lost		5	5
	Cumulative Sorties		19222	20209
	Cumulative Rate		0.260	0.247
1969	Rate	NFA	0.093	0.093
	Cumulative Lost		6	6
	Cumulative Sorties		29958	30945
	Cumulative Rate		0.200	0.194
1970	Rate	0.240	0.000	0.062
	Cumulative Lost	1	6	7
	Cumulative Sorties	4167	41825	46979
	Cumulative Rate	0.240	0.143	0.149

(C) TABLE A-36 (CONCLUDED)

YEAR		CAMBODIA	SOUTH VIETNAM	TOTAL*
1971	Rate	0.399	0.000	0.342
	Cumulative Lost	5	6	11
	Cumulative Sorties	14194	43269	58688
	Cumulative Rate	0.352	0.139	0.187
1972	Rate	0.000	0.522	0.307
	Cumulative Lost	5	9	14
	Cumulative Sorties	18216	49016	68471
	Cumulative Rate	0.274	0.184	0.204

*TOTAL includes sorties in Laos.

(C) TABLE A-37

F-105 LOSS RATES TO GROUND FIRE ON ARMED RECONNAISSANCE SORTIES OVER NORTH VIETNAM (U)

YEAR	ARMED RECONNAISSANCE SORTIES	LOSSES	RATE PER 1,000 SORTIES	CUMULATIVE		
				SORTIES	LOSSES	RATE
1965	2638	5	1.90	2638	5	1.90
1966	16362	58	3.54	19000	63	3.32
1967	6876	13	1.89	25876	76	2.94

(C) TABLE A-38

F-4 LOSS RATES TO GROUND FIRE ON ARMED RECONNAISSANCE SORTIES OVER NORTH VIETNAM (U)

YEAR	ARMED RECONNAISSANCE SORTIES	LOSSES	RATE PER 1,000 SORTIES	CUMULATIVE		
				SORTIES	LOSSES	RATE
1965	1102	3	2.72	1102	3	2.72
1966	11246	18	1.60	12348	21	1.70
1967	6219	15	2.41	18567	36	1.94

(C) TABLE A-39

F-105 LOSS RATES TO GROUND FIRE ON
STRIKE SORTIES OVER NORTH VIETNAM (U)

YEAR	STRIKE SORTIES	LOSSES	RATE PER 1,000 SORTIES	CUMULATIVE		
				SORTIES	LOSSES	RATE
1965	6176	41	6.64	6176	41	6.54
1966	7526	35	4.65	13702	76	5.55
1967	18007	46	2.55	31709	122	3.85
1968	14700	15	1.02	46409	137	2.95

(C) TABLE A-40

F-4 LOSS RATES TO GROUND FIRE ON
STRIKE SORTIES OVER NORTH VIETNAM (U)

YEAR	STRIKE SORTIES	LOSSES	RATE PER 1,000 SORTIES	CUMULATIVE		
				SORTIES	LOSSES	RATE
1965	1048	5	4.77	1048	5	4.77
1966	4790	5	1.04	5838	10	1.71
1967	20816	24	1.15	26654	34	1.28
1968	23234	17	0.73	49888	51	1.02

(C) TABLE A-41

F-105 LOSS RATES TO GROUND FIRE ON STRIKE SORTIES OVER LAOS (U)

YEAR	STRIKE SORTIES	LOSSES	RATE PER 1,000 SORTIES	CUMULATIVE		
				SORTIES	LOSSES	RATE
(NORTHERN LAOS)						
1968	3886	2	0.51	3886	2	0.51
1969	11514	6	0.52	15400	8	0.52
1970	6985	4	0.57	22385	12	0.54
(SOUTHERN LAOS)						
1966	2796	2	0.72	2796	2	0.72
1967	2391	1	0.42	5187	3	0.58
1968	9265	8	0.86	14452	11	0.76
1969	8927	10	1.12	23379	21	0.90
1970	4040	1	0.25	27419	22	0.80

(C) TABLE A-42

F-4 LOSS RATES TO GROUND FIRE ON STRIKE SORTIES OVER LAOS (U)

YEAR	STRIKE SORTIES	LOSSES	RATE PER 1,000 SORTIES	CUMULATIVE		
				SORTIES	LOSSES	RATE
(NORTHERN LAOS)						
1968	2423	0	0.00	2423	0	0.00
1969	13568	1	0.07	15991	1	0.06
1970	11911	3	0.25	27902	4	0.14
(SOUTHERN LAOS)						
1966	8637	3	0.35	8637	3	0.35
1967	10566	6	0.57	19203	9	0.47
1968	16438	6	0.37	35641	15	0.42
1969	33516	22	0.66	69157	37	0.54
1970	28484	4	0.14	97641	41	0.42

(C) TABLE A-43

F-4 LOSS RATES TO GROUND FIRE ON CLOSE AIR SUPPORT SORTIES IN SOUTH VIETNAM (U)

YEAR	SORTIES	LOSSES	RATE PER 1,000 SORTIES	CUMULATIVE		
				SORTIES	LOSSES	RATE
1966	12847	3	0.23	12847	3	0.23
1967	11146	6	0.54	23993	9	0.38
1968	7036	11	1.56	31029	20	0.64
1969	5470	6	1.10	36499	26	0.71
1970	2507	1	0.40	39006	27	0.69
1971	3314	1	0.30	42320	28	0.66

(C) TABLE A-44

F-100 LOSS RATES TO GROUND FIRE ON CLOSE AIR SUPPORT SORTIES IN SOUTH VIETNAM (U)

YEAR	SORTIES	LOSSES	RATE PER 1,000 SORTIES	CUMULATIVE		
				SORTIES	LOSSES	RATE
1966	42,553	21	0.49	42,558	21	0.49
1967	67,108	25	0.37	109,666	46	0.42
1968	72,393	35	0.48	182,059	81	0.44
1969	47,352	27	0.57	229,411	108	0.47
1970	23,315	5	0.21	252,726	113	0.45
1971	2,623	2	0.76	255,349	115	0.45

REFERENCES

1. P. C. Hewett, et al, Analysis of USAF Fixed-Wing Aircraft Losses, Aircrew Casualties and F-105 Damages in SEASIA Combat (U), AFFDL-TR-72-15, A. T. Kearney & Co., Inc., Caywood-Schiller Division, July 1971. (Secret)

2. Single Incident File, Combat Data Information Center (CDIC), Air Force Flight Dynamics Laboratory (AFFDL), Wright-Patterson AFB, Ohio 45433. (Secret)

3. W. R. Doane, L. E. Thomas and P. C. Hewett, An Assessment of USAF BDART-OV-10A (U), AFFDL-TR-73-22, A. T. Kearney & Co., Inc., Caywood-Schiller Division, April 1973. (Secret)

4. P. C. Hewett, An Assessment of USAF BDART Data for A-1 and F-4 Series Aircraft (U), AFFDL-TR-75-12, A. T. Kearney & Co., Inc., Caywood-Schiller Division, March 1975.

5. Computer Listing, Losses by Aircraft Type by Country (U), OPS/SYS Division, USAF Operations Center, Hq USAF/XOOCOAB, 5 July 1973. (Confidential)

6. T. O. 00-25-30, 30 June 1970.

7. Computer Listing, Sortie/Recap Data (U), OPS/SYS Division USAF Operations Center, Hq USAF/XOOCOAB, 5 July 1973. (Confidential)

8. J. J. Morrow and J. P. Stephens, OV-10A Combat Damage Analysis (U), AFFDL-TR-71-176, North American Rockwell Corporation, Columbus Division, January 1972. (Secret)

9. P. C. Hewett, L. E. Thomas & R. H. Rose, B-52 Combat Damage Analysis, (U), 61JTCG/ME-75-1, A. T. Kearney & Co., Inc., Caywood-Schiller Division, October 1974. (Secret)

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DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 88TH AIR BASE WING (AFMC)
WRIGHT-PATTERSON AIR FORCE BASE OHIO

MEMORANDUM FOR DTIC-RS

14 JUN 2002

ATTN: Kelly Akers
Defense Technology Information Center
8725 John J. Kingman Rd, Suite 0944
Ft Belvoir VA 22060-6218

FROM: 88 CG/SCCMF
4375 5th Street Rm 150
WPAFB OH 45433-7802

SUBJECT: Change of Classification and Distribution Statement for Document Number's AD-C016-682 and AD-385-882

1. The attached 16 April 2001 letter from W. Howard Plunkett requests classification review of subject technical reports and change of distribution requirements from "Limited Distribution" to "Approved for Public Release; Distribution Unlimited."

2. The requestor handcarried this request to the FOIA office, therefore it was treated as a FOIA request. Subsequently, it was reviewed by the Subject Matter Expert, Don Voyls, 46 OGM/OL-AC. His analysis states that the documents appear to be fully releasable. Capt Stephanie Masoni, his Security Manager, attached a memo indicating that she concurs to full release of the reports.

3. Please take the appropriate action to make subject technical reports available for public dissemination. The requester has been notified of this action. Point of contact at 88 CG/SCCMF is Lynn Kane at DSN 674-8189.

Sincerely,

Sheree M. Coon

SHEREE M. COON
Freedom of Information Act Manager
Management Services Branch
Information Management Division

Attachments:
1. AFMC Form 559, 6 June 2002
2. 46 OG/OGM/OL-AC Memo, 6 Jun 2002
3. Don Voyls Memo, 5 Jun 2002
4. Initial Request Letter, 16 Apr 2001
5. AD 385-882
6. AD C016 682
7. 88CG/SCCMF Ltr to Requestor, 14 Jun 02

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 88TH AIR BASE WING (AFMC)
WRIGHT-PATTERSON AIR FORCE BASE OHIO

88 CG/SCCMF
Building 676, Area B
2435 5th Street, Room 150
Wright-Patterson AFB OH 45433-7802

14 JUN 2002

LtCol W. Howard Plunkett (Ret.)
5042 Justin Drive NW
Albuquerque NM 87114

Dear LtCol Plunkett

This is in response to your attached 16 April 2001 request that AD 385 882L and AD C016 682L be approved for public release, distribution unlimited. Since you handcarried your request to the FOIA office, it was treated as a FOIA request. The FOIA control number for your request is 01042 LK.

Classification and limited distribution requirement review on the above two technical reports has been completed. The subject matter expert and security manager have both concurred that both documents are now fully releasable to the public. Your request and the appropriate documentation has been transferred to the address listed below so that the distribution requirements can be changed and made available to the public.

DTIC-RS
ATTN: Kelly Akers
Defense Technology Information Center
8725 John J. Kingman Rd, Suite 0944
Ft Belvoir VA 22060-6218
(703) 676-9194

Please contact Lynn Kane at (937) 904-8189 if you have any questions.

Sincerely

SHEREE M. COON
Freedom of Information Act Manager
Management Services Branch
Information Management Division

Attachment:
Your FOIA Request

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 46TH TEST WING (AFMC)
EGLIN AIR FORCE BASE, FLORIDA

6 June 2002

MEMORANDUM FOR 46 OG/OGM/OL-AC (Mr. Richard E. Colclough)

FROM: CAPT STEPHANIE MASONI (Unit Security Manager)

SUBJECT: Classification and Limited Distribution Requirement Review for Freedom of Information Act (FOIA) Case #010421LK, W. Howard Plunkett.

I have reviewed the two documents in support of the attached FOIA request, and concur with Mr. Donald Voyls(memo attached); both documents are fully releasable to the public.

Stephanie C Masoni

Stephanie C. Masoni, Capt, USAF
46 OG/OGM/OL-AC
Security Manager

Attachment
Memo dated 5 June 02 (Mr. Voyls)