WIRING VIETNAM

THE ELECTRONIC WALL

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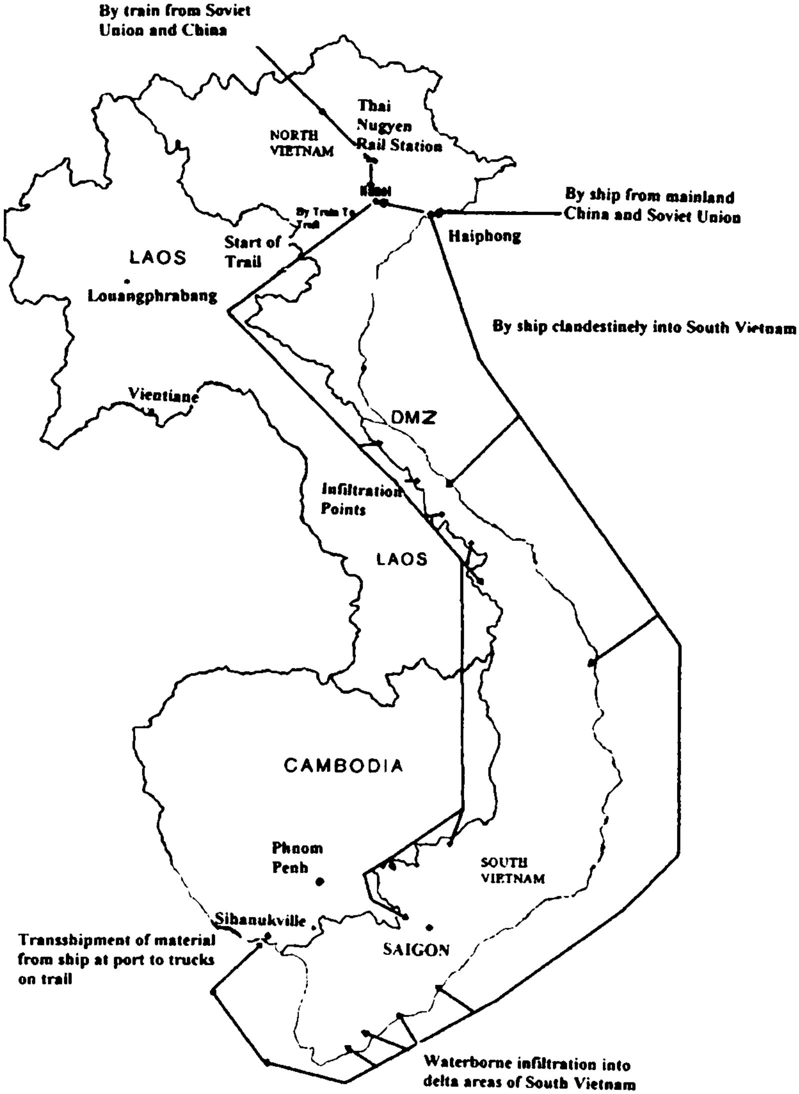

Infiltration Routes

Preface

THE HO CHI MINH Trail, known to the North Vietnamese as the Troung Son Strategic Supply Route, was not the image typically depicted by the media—an unsophisticated, haphazard series of small dirt roads built with the help of patriotically dedicated men and women. North Vietnamese conscripts built and maintained the trail, assisted by conscripts from Laos and Cambodia. Military service was mandatory in North Vietnam, and there was no such thing as antiwar demonstrations or activities. The Ho Chi Minh Trail was estimated by U.S. intelligence to be 3,500 miles in length, stretching from southern North Vietnam into Laos, Cambodia, and finally the delta area south of Saigon, the capital of what was South Vietnam. After the war, the North Vietnamese would admit that the trail was actually 8,100 miles long. In Laos alone, it encompassed an estimated 1,700 miles and included a sophisticated logistics network made up of major routes, roads, trails, vehicle parks, petroleum pipelines, and storage and bivouac areas. The North Vietnamese and their allies built this sophisticated system, in flagrant violation of international treaties and with complete disregard for international borders, in 1959. In 1965, U.S. intelligence estimated that 3,000 North Vietnamese per month were using the trail to infiltrate Laos. In 1961, at a conference in Geneva, Switzerland, the United States and North Vietnam (among other countries) signed an agreement guaranteeing the neutrality of Laos. North Vietnam had no intention of keeping this promise, however, and continued using the trail to send men and materiel into Laos as well as Cambodia and South Vietnam.[1] Intelligence estimates placed close to 100,000 North Vietnamese in Laos and Cambodia for network maintenance and protection. Also suspected of being stationed in Laos were an estimated 14,000 to 15,000 Communist Chinese. From

3,000 to 5,000 of these troops were specifically dedicated to antiaircraft weaponry operations and maintenance and the rest to road construction and maintenance.[2, 3, 4, 5]

China not only provided materiel and human resources to the North Vietnamese, Cambodian, and Laotian Communists, but also allowed its armed Communist brethren to transit Chinese soil on their trek to and from North Vietnam, Laos, and Cambodia via the Ho Chi Minh Trail. From Hanoi, troops boarded trains that transported them to the North Vietnamese town of Lao Cai, a small town at the Chinese border. From Lao Cai, the train continued to the Chinese village of Bang-Khe in Yunnan Province. Here the troops rested for the night and the next day continued by truck to the town of Men-La, only 2 kilometers from the Lao–Chinese border. At Men-La, Chinese intelligence units provided the Vietnamese, Laotian, and Cambodian troops with situation reports on the enemy's status and what they might encounter along the way to their destinations. After the briefing, the troops crossed the border between China and Laos at Muong Sing, a small village in the Nam Ta region of Laos.[6]

In discussing the Vietnam War, many people tend to forget that Laos and Cambodia were, for much of the war, established as internationally neutral countries. The Geneva Conference on Laos, convened from May to June 1961 and leading to the Zurich Agreements in June 1961, required the North Vietnamese and the United States to vacate Laos. The Zurich Agreements also guaranteed the neutrality of Cambodia.[1] The United States largely lived up to its agreement to recognize Laos and Cambodia as neutral, but the North Vietnamese saw the Zurich Agreement as a means to an end. By the end of the first Indochina War (against France), the North Vietnamese Army (NVA) had infiltrated into large sections of Laos and Cambodia. Indeed, a classified Military Assistance Command, Vietnam (MAC-V) report dated 15 August 1968 listed the NVA as having 110,325 personnel stationed in Laos.[3]

In the fall of 1969, Cambodian Prince Sihanouk stated that about 40,000 Vietnamese Communist soldiers (North Vietnamese and Viet Cong) were located in Cambodia's eastern border provinces.[7] The North Vietnamese and Viet Cong had been using Cambodia as a base of operations, launching attacks into South Vietnam, confident that the United States would not violate Cambodian neutrality to pursue the attackers into Cambodia. Protest by the Cambodian government to the National Liberation Front (the Viet Cong) and the Democratic Republic of Vietnam (North Vietnam) diplomatic missions in Phnom Penh produced the same predictable results—a pledge to respect Cambodian neutrality.[8] In mid-1970, the NVA gained control of vast areas of the Cambodian countryside, thereby obtaining even more area to logistically support their war in South Vietnam.[9]

The North Vietnamese had built up a vast logistics network, and they were not about to give it up because of a neutrality issue. The NVA had established six major logistics bases along the Ho Chi Minh Trail in Laos alone. U.S. military intelligence assigned these bases the following numbers:[9]

- Base Area 604 was near the Laotian village of Tchepone, at the junction of the North Vietnamese, Laos, and South Vietnamese borders. This was the main NVA logistics base for the vast Ho Chi Minh Trail network. As such, it was the focal point for distribution of men and materiel throughout Laos, Cambodia, and South Vietnam.
- Base Area 611 was located east of the Laotian village of Muong Nong. This base area supported the Pathet Lao in eastern Laos and supplied NVA and Viet Cong units in the central portions of South Vietnam. From North Vietnam, petroleum (POL) pipelines brought fuel and oil that was stored at the base. The POL was then transferred from the storage site to various base areas along the way as needed. Base Area 611 was also the main fueling point for trucks traveling along the trail.
- Base Area 612 was between the Laotian villages of Sarvane and Ban Bac. The base supported operations in South Vietnam's central highlands.
- Base Area 614 was located between the Laotian village of Chavane and the South Vietnamese town of Kam Duc. This base supported operations in the South Vietnamese lowlands.
- Base Area 609 was in eastern Laos near the South Vietnamese central highlands town of Dak To. This was the second most important base along the trail. In 1974, workers finished a POL pipeline connecting Base Area 609 with the main pipeline at Base Area 604. The base supported military operations well into central and southern South Vietnam.
- Base Area 613 supported NVA activity in southern Laos and Cambodia and was near the Laotian town of Attopeu. The base area was in south central Laos some distance from the main section of the Ho Chi Minh Trail and was just south of the Laotian area known as the Bolovens Plateau.

The introduction to *White Book on the Violations of the Geneva Accords of 1962 by the Government of North Vietnam*, by the Minister of Foreign Affairs of Laos (1968), summarizes the Lao government's frustration concerning the occupation of Laos by the North Vietnamese:

> Today more than ever, in spite of its commitment to respect and guarantee the sovereignty, neutrality, and territorial integrity of the Kingdom of Laos, made during the signature of the Geneva Accords of 1962, North Vietnam has escalated the war in Laos. Our previous White Books denounced the presence of North Vietnamese troops and their use of our territory. Reports from the International Commission for Surveillance and Control (ICC) published in the 1966 edition of the White Book, after 3 North Vietnamese military operations at Dong Hene (March 1965), at Thakhek (November 1965), and in the provinces of Sam Neua and Xieng Khouang. The interrogations by the ICC of North Vietnamese prisoners and defectors, the inspection of captured weapons, ammunition and captured documents were so much more and sufficient proof that North Vietnam, violating the Accords which it solemnly signed at Geneva, is continuing its aggression in Laos. The events which have taken place during these last 2 years and particularly since the autumn of 1967 have furnished fresh proof of this. The North Vietnamese attacks at Nam Bac (13–14 January 1968), at Sarvane (20 February 1968), at Lao Ngam (24 February 1968), at Attopeu (23 February 1968), at Phalane (25 February 1968), at Tha Thom and Muong Yut (12 January 1968)—during which two Antonov-2 aircraft flown by North Vietnamese were shot down—were further proof of the determination of North Vietnam to make Laos the permanent theater of their expansionist activity, assisted in this by the Pathet Lao, whose allegiance to Hanoi is not longer in doubt.

In Cambodia the NVA had established the Sihanouk Trail, which was a southern extension of the Ho Chi Minh Trail from Laos. The Sihanouk Trail started at the Bolovens Plateau near the village of Muong May and continued onto the port of Sihanoukville, a deepwater port near the Gulf of Thailand. This trail was started in 1965 without the knowledge or approval of the Cambodian government. During construction of the trail in Attopeu Province, the local Royal Cambodian regional commander, Colonel Khong Vongnarath, knowing full well that his meager military unit in the area could not successfully expel the NVA from his area of responsibility, had an unwritten understanding with the NVA that he would not attack the invaders if they did not shell the towns within his province.[9]

In 1970 the government of Cambodia was overthrown by its military. Cambodian Army General Lon Nol, fed up with the occupation of his country by the NVA and Viet Cong, decided to rid the country of these foreign invaders and hopefully restore peace for the Cambodian population. The new government shifted its political ties from accommodating the Communists to establishing more binding ties with the South Vietnamese, the Royal government, and the United States. The Lon Nol government closed all Cambodian ports to North Vietnamese ships and worked with the South Vietnamese in attempting to oust the NVA and Viet Cong from their illegal sanctuaries along the border areas. These actions, if left unchecked by the Communists, would have drastically affected North Vietnamese war operations in the South. Because the NVA could not tolerate losing its illegal Cambodian bases, it launched a series of major offenses to secure the Sihanouk Trail. These offenses drove the ill-prepared Cambodian defenders out of the border areas of their own country.[9] Respecting Laotian and Cambodian neutrality and territory would have meant giving up the vast logistics network supporting the North Vietnamese war against the South. It would have meant losing the war. The South Vietnamese government would then have been allowed to mature and become an economic threat to North Vietnam, similar to the situation in North and South Korea. The North Vietnamese were not about to let a treaty stand in the way of their taking over South Vietnam and hopefully turning Laos and Cambodia into vassal states.

To fully understand the extent of the North Vietnamese occupation of Laos and Cambodia and its complete disregard for the neutrality of those two countries, *RLG Military Operations and Activities in the Laotian Panhandle*, by former Laotian Brigadier General Soutchay Vongsavanh, is recommended reading. Brig. Gen. Vongsavanh was the commanding general of Laotian Military Region 4 from July 1971 through June 1975. Military Region 4 in Laos was at the southernmost end of the country. This area bordered northern Cambodia and central South Vietnam. Also, on the extent of North Vietnamese violations of the Geneva Accords, a must-read is *White Book on the Violations of the Geneva Accords of 1962 by the Government of North Vietnam*.

The United States was hamstrung over keeping its promise of Laotian and Cambodian neutrality while at the same time assisting its South

Vietnamese allies in maintaining the South's fledgling democratic government. Not wanting to invade Laos as well as Cambodia, the U.S. government came up with a plan to electronically monitor the Ho Chi Minh Trail and, at least initially, clandestinely attack any detected enemy activity on it.

Stories abound of pilots returning from strike missions over South Vietnam, Laos, southern North Vietnam, and Cambodia and complaining of bombing nothing but jungle. Movies have depicted the frustration of pilots who dropped bombs on jungle foliage to no apparent effect. *Tree killing* was the term used for these missions. Unknown to most aircrew members, however, was a program called Igloo White—better known either as the electronic wall or the McNamara Line. What these pilots were most likely responding to were sensory inputs indicating enemy troop and/or vehicle movement. This was truly the start of the high-tech sensor warfare that continues to this day.

For years, the popular press and military pundits have misunderstood and ridiculed the electronic wall. Neither its sophistication nor the number of allied and civilian lives it saved during the Vietnam War are well known. The story can now be told of how military and civilian technicians, sitting in darkened rooms in a faraway country, monitored one of the most sophisticated electronic sensing systems invented. Working with electronic signals generated hundreds of miles from their computer screens, these technicians tracked the progress of enemy vehicle and troop movements flowing from North Vietnam, through Laos and Cambodia, and to destinations as distant as southern South Vietnam.

Deployed in earnest in the late 1960s, this electronic wall consisted of a surprisingly wide range of sensors, delivery vehicles, monitoring devices, skilled technicians, and sophisticated processing equipment. On-ground sensors relayed a wide variety of sensory inputs to orbiting aircraft. These aircraft relayed the data several hundreds of miles, and in some instances past several international borders, to receiving stations that processed the data using the newest computer technology. Technicians monitoring computer screens plotted the progress of enemy troops and vehicles moving from North Vietnam into Laos and Cambodia. They called in airstrikes and/or artillery barrages to disrupt and destroy their adversary's logistics flow.

The electronic wall was called by many other names, most notably Igloo White, Dutch Windmill, Muscle Shoals, and Task Force Alpha. Each actually referred to a specific program or activity within the general term of *electronic wall*. Airborne assets such as the EC-121, F-4D, OP-2E, and various helicopters and other specialized platforms were used to establish the wall and monitor its activity. At times, Special Forces teams deep in enemy territory clandestinely placed sensors by hand.

Information gleaned from the Igloo White program has been put to use in today's marketplace. Cell phone technology is just one application resulting from work on this system. The military is currently using improved forms of this technology to protect sensitive locations where Top Secret work is being carried out. Stories abound of the sophisticated electronic wall surrounding the supersecret Groom Lake Air Base and the infamous Area 51 in the desert outside of Las Vegas, Nevada. The U.S. Border Patrol and the Central Intelligence Agency (CIA) also use systems that had their origin in the Vietnamese program.

The story of the electronic wall in Vietnam, Cambodia, and Laos is one of advanced electronics, high-tech equipment, skilled and dedicated technicians, hazardous flying, and above all, gallantry. For too long has the real story behind this program gone unreported. For too long have those without knowledge of the program or the benefit of discussions with those directly involved in the program ridiculed its concept and implementation.

The information contained in this book has come from congressional hearings, squadron histories, and firsthand knowledge. Also consulted was the U.S. Air Force Historical Archives Division at Maxwell Air Force Base, Alabama. The staffs at Maxwell have always been exemplary, going out of their way to assist those in need of information.

My personal experience with the Igloo White program in Southeast Asia is part of this book. I was assigned to the 25th Tactical Fighter Squadron when it was reactivated at Elgin Air Force Base, Florida, in 1967. The squadron was assigned the task of dropping electronic sensors along the Ho Chi Minh Trail. Chapter 10 deals with the squadron's operations in Thailand.

Notes

1. The Geneva Conference on Laos, convened from May to June 1961, led to the Zurich Agreements in June 1961 and required the North Vietnamese and the United States to vacate Laos. International Controls Commission (ICC) checkpoints were established as a result of the Zurich Agreements to monitor the departure of United States and North Vietnamese personnel. A total of 666 U.S. military personnel were recorded as departing through ICC checkpoints, and only

40 North Vietnamese passed these checkpoints. Large numbers, estimated at several thousand, remained in place in Laos. This data is based on a RAND study—Indochina in North Vietnamese Strategy—completed in March 1971.

2. The reference for China's involvement in the Ho Chi Minh Trail is taken from Project CHECO report, "Igloo White Program July 1968–December 1969: A Contemporary Historical Examination of Current Operations. Truck Parks and Storage Areas—Enemy Resources, 66." The Project CHECO reports were classified as Secret, and as required, remained so for 30 years after the war's end.

3. There is a note on page 3 of "Current Summary of Enemy Order of Battle in Laos," dated August 15, 1968, from Headquarters U.S. Military Assistance Command, Vietnam—Office of Assistant Chief of Staff J-2 and originally classified as Confidential. This note lists engineering strengths in Laos during that time frame at 13,450 and states that the figure "Includes command, tactical support and service personnel who are predominately Pathet Lao but who include foreign advisors." All other references in the publication list NVA, not "foreign advisors."

4. USAF Major (retired) Earl H. Tilford Jr., "Three Perspectives on a Secret War," *Air University Review* (January–February 1981). This document states: "The Chinese Communists had several thousand workers and troops constructing a road from their border through western Laos to a point just north of the Thai border. Additionally, they had a 'cultural' center in Xieng Province."

5. Christopher Robbins, *AIR AMERICA from World War II to Vietnam: The Explosive True Story of the CIA's Secret Airline* (Asia Books, 2003).

6. Paul F. Langer and Joseph J. Zasloff, *The North Vietnamese Military Adviser in Laos: A First Hand Account* (Compiled by the RAND Corporation for the U.S. Government in July 1968; Memorandum RM-5688-ARPA).

7. Prince Sihanouk himself made this statement on October 18, 1969, in an official Phnom Penh radio broadcast.

8. Cambodian Lieutenant General Tioulong, commander in chief of the Royal Cambodian Army in his report, *Neak Cheat Niyum*, dated March 1969.

9. Laotian Brigadier General Soutchay Vongsavanh, *RLG Military Operations and Activities in the Laotian Panhandle*. (Washington, DC: U.S. Army Center of Military History, 1981).

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I RECOGNIZE that some words, model names, and designations mentioned in this book are the property of the trademark holder and have used them as identification only. This is not an official publication. I am grateful to each of the following organizations for their contributions of time and information that made this book possible: In the Department of the Air Force, the Archives Branch of the Air Force Historical Research Agency, Maxwell Air Force Base, Alabama. In the U.S. Air Force Museum, the USAFM/MU Historical Center, 1100 Spaatz Street, Wright-Patterson Air Force Base, Ohio; the Naval Aviation History Branch, 805 Kidder Breese SE, Washington, D.C.; and Texas Tech University, The Vietnam Project, Lubbock, Texas.

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Acronyms and Abbreviations

AAA	antiaircraft artillery
ABCCC	airborne battlefield command and control center
Acoubouy	acoustical buoy
ACOUSID	acoustic seismic intrusion detector
ADSID	air-delivered seismic intrusion detector
AGL	above ground level
ARVN	Army of the Republic of Vietnam
ATUG	armed tactical unattended ground
AWACS	airborne warning and control system
BASS	Battlefield Area Surveillance System
BLU	bomb live unit
BuNo	bureau number
CAS	controlled American sources
CBU	cluster bomb unit
CDTC	Combat Development and Test Center
CHECO	contemporary historical examination of current operation
CIA	Central Intelligence Agency
CIB	China–India–Burma
COLOSSYS	coordinated LORAN sensor strike system
Commike	commandable microphone
COMNAVFORV	Commander Naval Forces, Vietnam
COMUSMACV	Commander United States Forces, Military Assistance Command, Vietnam
DARPA	Defense Advanced Research Projects Agency
DART	deployable automatic relay terminal

DCPG	Defense Communications Planning Group
DMPI	desired mean point of impact
DMZ	demilitarized zone
DSN	Distributed Sensor Network
ECM	electronics countermeasure
ECP	Engineering Change Proposal
EDIT	engine detection sensor
FAC	forward air controller
FADSID	fighter air-delivered seismic intrusion detector
FLIR	forward-looking infrared
GPS	global positioning system
HANDSID	hand-delivered seismic intrusion detector
HELIOSID	helicopter-delivered seismic intrusion detector
ICC	International Controls Commission
ISC	infiltration surveillance center
JCS	Joint Chiefs of Staff
JGS	Joint General Staff
JWG	Joint Working Group
LOC	lines of communications
LORAN	long-range air navigation
LZ	landing zone
MAC-V	Military Assistance Command, Vietnam
MAGID	magnetic anomaly detector
MASSTER	mobile army sensor systems test (Project MASSTER)
MER	multiple ejector rack
MICROSID	micro seismic intrusion detector
MINISID	miniaturized seismic intrusion detector
MIUGS	micro-internetted unattended ground sensor
MR-I	Military Region I
MTI	moving target indicator
NCO	noncommissioned officer
NKP	Nakhon Phanom
NOD	night observation device
NVA	North Vietnamese Army
PACAF	Pacific Air Forces
PAR	palletized airborne relay
PERSID	personnel seismic intrusion detector
PSID	patrol seismic intrusion detector

RABET	radar beacon transponder
RF	radio frequency
RON	rest overnight
RPB	river patrol boat
RVNAF	Republic of Vietnam Armed Forces
SEAL	Sea, Air, Land
SEALORDS	South East Asia lake ocean river delta strategy
SGU	special guerrilla unit
SID	seismic intrusion device
SRP	sensor reporting post
STANO	surveillance, target acquisition, and night observation
TACAN	tactical air navigation
TER	triple ejector rack
TFS	tactical fighter squadron
TFW	tactical fighter wing
USAF	United States Air Force
VC	Viet Cong or Vietnamese Communist
VHF	very high frequency
VNAF	Vietnam Air Force
WAAPM	wide-area antipersonnel mine

CHAPTER 1

Establishing the Electronic Wall

Infiltration of Men and Materiel into South Vietnam

Until making a startling discovery in early 1965, U.S. military intelligence services were unsure about how North Vietnam was infiltrating and logistically supporting its Communist brethren in South Vietnam. The flow of men and materiel was assumed to take place through the demilitarized zone (DMZ) separating North and South Vietnam. At the time it seemed a logical assumption since the area in northern South Vietnam and southern North Vietnam is rugged and sparsely populated. But in the opening months of 1965, off the coast of southern South Vietnam, this thinking changed when the South Vietnamese navy stopped and boarded what outwardly appeared to be a fishing trawler. What they found would, in the end, profoundly affect the prosecution of the war. The trawler was loaded with supplies and ammunition destined for the Viet Cong in the Mekong Delta area in the southern portion of South Vietnam. Through mid-1965 a total of 23 trawlers were stopped and boarded, and the same type of cargo was discovered. All the trawlers had departed ports in North Vietnam and sailed down the Vietnamese coast in an attempt to clandestinely offload their cargo near the Mekong Delta. After the trawler shipments were discovered, the Military Assistance Command, Vietnam (MAC-V) estimated that 70 percent of all enemy supplies sent into South Vietnam arrived by sea.[1, 2]

Securing the delta area of South Vietnam by allied forces was critical to the prosecution of the war. The delta was not only the fertile heartland of the country but also the home of approximately 40 percent of the South

Vietnamese population. The Mekong River ended its flow into the South China Sea via the delta. Waterways in and around Saigon, the capital of the South, emptied into the Mekong. The enemy was strongly entrenched in the delta area, and routing them out had to start with interdicting this logistics pipeline.

In mid- to late 1965, the U.S. Navy initiated a campaign to interdict the flow of men and materiel via the sea into the south. This campaign was called Task Force 115, code-named Operation Market Time. An offshore barrier, consisting of a wide variety of Vietnamese and U.S. naval vessels and patrol aircraft, was erected in the waters off the coast of South Vietnam. By late 1965 Operation Market Time had effectively stopped the flow from the sea. In December of 1965 a campaign to retake the delta's waterways was initiated with Task Force 116, code-named Operation Game Warden. This task force would later be involved with the Igloo White program, charged with establishing the electronic wall in and around South Vietnam.

The loss of the seaborne logistics pipeline forced North Vietnam into increasing the use of overland routes. Assisted by their Pathet Lao and Khmer Rouge allies, the North Vietnamese expanded on infiltrating men and materiel into South Vietnam via Laos and Cambodia down the Ho Chi Minh Trail. Although Laos was considered a neutral country, its government was immersed in a civil war of its own. The Royal Lao government, then the country's legal government, was battling the Communist Pathet Lao for control of the countryside. North Vietnam had been logistically supporting both the Lao and Cambodian Communists via land routes since the French Indochina War. With the loss of the sea-based logistics pipeline, expansion of this land route was needed to sustain the infiltration of men and materiel into South Vietnam. The expansion would require keeping the Pathet Lao and Khmer Rouge in line while simultaneously increasing protection to the route system, which meant stationing additional numbers of North Vietnamese troops in those countries as "advisers." This intervention had, of course, not been approved by the legal governments of Laos and Cambodia.[3]

With this change in the enemy's logistics flow from a primarily sea-based route to a land-based one, the United States and its allies became increasingly aware of the need for an interdiction campaign. The details of the electronic wall were formulated in the latter months of 1965, and by 1966 a plan to stem the seaborne flow of logistics was submitted for review at the Pentagon.

Planning and Development

In the mid-1960s the U.S. government was stymied regarding the best approach to stemming the flow of men and materiel into Laos, Cambodia, and South Vietnam. Since North Vietnam received all its war-making goods from outside the country, the most logical approach for the United States was to mine the harbors around the major port city of Haiphong and bomb the rail links between China and North Vietnam, over which tons of supplies flowed daily into the north. Concerned that this approach would cause serious international repercussions, the U.S. government turned to its universities and scientific think tanks for answers.

In January 1966, Harvard Law School professor Roger Fisher developed and submitted a plan to John McNaughton, one of Secretary of Defense Robert McNamara's assistants. The plan called for the creation of a land barrier along Route 9 in South Vietnam. The North Vietnamese considered Route 9 one of the main infiltration routes used for funneling men and equipment into the south. Fisher's plan as presented would only superficially resemble the electronic wall implemented later, but it was the genesis of an effort to monitor enemy activity from afar. Fisher's plan called for sowing minefields; erecting bunkers, ditches, and lines of barbed wire; and spraying defoliant on the jungle. As proposed, this wall would extend from the northern coastal areas of South Vietnam, just south of the DMZ, across the waist of South Vietnam and into Laos near the town of Tchepone. Once the wall was in place, the border would be monitored for activity and attacked as required. Fisher felt that blocking logistics flow from the north would effectively weaken the military effectiveness of North Vietnamese Army (NVA) and Viet Cong units in the south. He reasoned that with the plan in place, the United States could avoid bombing North Vietnam and thereby placing aircrew members in harm's way as well as potentially bringing death and destruction upon the civilian population. Defense Secretary McNamara's staff reviewed the plan and took it under advisement.

In August 1966, a scientific advisory group known as the JASON Committee approached Secretary McNamara with a modified Fisher plan, calling for the establishment of a barrier system to slow and/or stop the flow of enemy troops and equipment into South Vietnam. The JASON Committee (named for Jason and the Argonauts from Greek mythology) is a semiofficial, secret governmental think tank—comprised of top university scientists, Nobel laureates, computer experts, military strategists, and electronic technical experts—that the American government sometimes uses. Its members are more or less self-selected to maintain some independence from government and military influence. The committee was founded after World War II. (In 1967 the JASON group expanded and began operating under the auspices of the Defense Communications and Planning Group.)

As proposed, the JASON Committee's plan would use not only a series of strong points and obstacles to impede logistics flow but also strings of electronic sensors to remotely detect troop and vehicle movement. The electronic sensors would be a new addition to the plan and would make the barrier system relatively independent of on-site direct human observation. A conventional munitions barrier, consisting of both troop and vehicle mines, would also be sown at strategic locations to complement the electronic barrier. If enemy troop movements were detected, ground or airborne forces would be dispatched for reconnaissance, and an attack would be mounted on the enemy if required.

The plan described an electronic system that would be extensive, costly, and highly technical. It called for a completely new sensor system as well as new methods of sensor delivery. Relay aircraft for transmitting sensor signals would be needed. Signal-processing equipment had to be developed, and an equipment-processing site had to be located. Not only did the complete technical system have to be integrated, but developing the logistics system would be another huge hurdle: Sensors would have to be replaced. Aircraft damaged or destroyed in combat would need to be repaired or replaced. The technicians responsible for sensors, aircraft maintenance, ordnance, processing equipment, and so forth would have to be thoroughly trained. One thing was certain: the American government could not continue sustaining the losses of aircraft and pilots over North Vietnam. U.S. records indicated that clandestine bombing of the trail system in Laos and Cambodia was costing American taxpayers dearly—300 bombs were dropped for every one enemy killed. In mid-1960s dollars, this equated to $140,000 per enemy.[2]

Research into the development of electronic sensors for detecting enemy troop and vehicle movements had continued since the mid- to late 1950s. Testing of what was then called the seismic intrusion device (SID) took place in Southeast Asia in the early 1960s. The U.S. military maintained a Combat Development and Test Center (CDTC) in Thailand. A requirement of the test center was to develop and test equipment to assist in the counterinsurgency mission in Thailand. Near the end of 1962, the

CDTC was tasked with testing hand-delivered SID sensors in Thailand. The Southeast Asian climate was unique and hard to duplicate in any part of the United States. The sensors themselves were simple devices, approximately the size of a soup can with a detection antenna, resembling a knife blade, sticking out of the bottom. The sensor was powered by one D-cell battery. To operate the device, a soldier turned the unit on and then stuck the knife-blade antenna into the ground. The sensor then began picking up seismic vibrations and transmitting an audible tone to an operator wearing earphones.

Testing of the SID sensors continued through 1963, and they were found to be extremely useful for counterinsurgency missions. After the testing ended, SID units were shipped to South Korea to assist American and South Korean forces in the ongoing problem of detecting enemy infiltrators crossing the demilitarized zone into South Korea.

The JASON Committee conducted research to determine the sensor suite and delivery method best suited for the system. The committee soon turned to the U.S. Navy's Jezebel antisubmarine warfare program. This program used air-dropped sensors, called Acoubouys, designed to pick up acoustics from surface ships and submarines. However, some aquatic mammals as well as large schools of fish also generated acoustic signals. The various types of signals picked up by the sensors were placed into a spectrum analyzer, thus establishing a vast, continually updated database. The sensors were air-dropped primarily from the Lockheed P2V Neptune, a twin-engine, propeller-driven patrol aircraft developed shortly after World War II. The Neptune had a very long range, making it ideal for the extended patrol missions required not only for detecting submarines but also for recognizing and tracking surface ships across the earth's vast oceans. The sensor system, database, and delivery method all appeared to be optimum for the electronic wall application.

Selection of the P2V was also rooted in some clandestine missions carried out in the early 1950s. Early in 1952, U.S. Navy P2V-3W Neptune aircraft equipped with AN/APS-20 search radar, as well as other electronic gear, secretly overflew the Soviet Union. The Neptunes carried electronics gear that could detect and locate communications and radar signals emitted by the Soviets at several of their secret locations in the easternmost part of the country. These flights penetrated some 20 miles into the Soviet Union's coastal areas.

Initial plans called for modifying the Acoubouys from the acoustic to a land-based role by replacing the hydrophone underwater listening system with microphones and seismic detection sensors. The primary source for this conversion was the Los Alamos Laboratories in New Mexico. A major hurdle was that the Acoubouy was dropped from the P-2 aircraft and floated to the water with a parachute; the new seismic sensors would fall to earth without a parachute, and they required extensive modifications to prevent them from breaking on contact with the ground. Once perfected, the seismic sensors could withstand an impact of up to 2,000 g's—no small feat for early 1960s technology.

Two types of Phase I sensors were initially developed, the acoustic sensor and the seismic sensor. When its carrier aircraft released the acoustic sensor, a small parachute was deployed to slow its fall to earth. The sensor was dropped into forested or heavily foliated areas, so that the parachute would become entangled in branches or foliage. The acoustic sensor was designed to relay sounds that its sensitive microphone picked up. The seismic sensor was dropped without a parachute, so it landed with sufficient impact force for its body to penetrate into the earth. From this position, the seismic sensors could pick up vibrations caused by troop and vehicle movement.[2]

The aircraft identified to carry out sensor delivery was a highly modified U.S. Navy P2V-5 Neptune patrol aircraft, designated as the SP-2E. This special operations aircraft was then being used as a special electronics detection platform; as such, it was identified as the original Igloo White airborne delivery aircraft. The SP-2E required further modification for the airborne sensor delivery system and was subsequently reidentified as the OP-2E. Not long after OP-2Es began dropping sensors in Southeast Asia, however, their slowness and vulnerabilities to enemy ground fire indicated the need for a replacement. In 1967 the Department of Defense conducted a study, *Aircraft Attrition Estimates for Certain Proposed Operations*. The results clearly indicated that the OP-2E's loss rate would be at least three times the normal for theater operations. A review of potential replacement aircraft identified the McDonnell F-4D Phantom II as the ideal replacement, and an aircraft squadron was specially modified for the sensor drop mission.[2, 4]

The Lockheed C-121 was selected as the sensor relay platform. The original version entered service late in World War II, and by the 1960s the aircraft was being used extensively in the military for troop transport, electronics data gathering, weather research, and so on. Being initially developed as a long-range civilian transport for use after WWII, the aircraft was ideal for the extended loiter times necessary for flying long-duration sensor relay orbits. Both the U.S. Air Force and the U.S. Navy were operating the C-121 at the time. After being modified for sensor duty, its designation was changed to EC-121R. Other sensor relay platforms would follow. The Y/QU-22A and QU-22B eventually would supplement the EC-121R, flying relay orbits over Laos. Later, a C-130B would be tested as a replacement for both aircraft.[2, 5]

On 15 September 1966, the secretary of defense established the Defense Communications Planning Group (DCPG). One of the group's tasks was to provide military commanders with operationally effective hardware needed to implement the electronic barrier. The DCPG's first mission was to implement the anti-infiltration system conceived by the JASON Committee. Initially, the sensor implementation program was called Practice Nine. In June 1967 the name was changed to Illinois City. The program name changed again, in July 1967, to Dye Marker. On 8 September 1967, the name changed once more, this time to Muscle Shoals. This latest change was to indicate the sensor implementation program in eastern and central Laos. In June 1968 the program name changed again, this time to the now familiar Igloo White. The new name encompassed all of the various subsystems in the electronic wall under one program.[6, 7]

Implementing the sensor program was a huge challenge. As stated, a wide variety of sensors had to be developed, they had to be very rugged to sustain ground impact from high altitude, and they had to be extremely reliable. They also had to be available in quantities large enough to sustain the operation. A full complement of classified EC-121R data relay aircraft needed to be deployed to Korat Royal Thai Air Base, the mission to be kept a secret. Special operations OP-2E, the original sensor drop aircraft, had to be ferried into Nakhon Phanom (NKP), Thailand, and the infiltration surveillance center (ISC) had to be constructed in secret at NKP. Technicians to man and operate the vast network needed training. Each of the sensor airdrop missions in Laos required approval from the U.S. ambassador. Indeed, even airstrikes against the enemy in Laos required approval from the ambassador. One prime example of this was the February 1968 assault on a TACAN (tactical air navigation) site code-named Lima Site 85, situated on a mountaintop in northwestern Laos. The site, which was the main navigational aid for airstrikes from Thailand, was extremely important to the United States. In February 1968 the site came under attack by both Pathet Lao forces and an estimated three battalions of NVA units. Airstrikes were the only way of assisting in the defense of the base, but approval was required from the U.S. representative to Laos, Ambassador

Sullivan. Despite all of these uncertainties, logistics, and hardware requirements, the program started only one month behind schedule.

By late 1966 a rudimentary barrier system consisting of seismic and acoustic sensors, defoliation, detection, and response was in operation. In April 1968 the DCPG's mission expanded to include a wider range of sensors, designed to increase the information gathering process and provide better target detection and tracking. The DCPG director reported directly to the secretary of defense through the director of Defense Research and Engineering. This expanded mission allowed the DCPG not only to supply the needed sensors but also to design, develop, test, procure, and distribute them.

To logistically support the theater commander's sensor requirements, commanders fed requirements directly to the DCPG. Each theater commander's input was analyzed to determine the total production goals for the particular time frame covered. Data analyzed by the DCPG included sensor quantities, required sensor field life, production capability of suppliers, costs, and spares requirements. Clearly, the DCPG was responsible for a wide range of functions.

The DCPG's anti-infiltration barrier would ultimately consist of a complete sensor surveillance system. The system consisted of a wide variety of detection sensors, an air/land sensor delivery system, a sensor communications system incorporating a radio relay system, and signal-processing systems. Total cost of the complete system from 1967 through 1971 was estimated at nearly $1.9 billion, and annual cost of the system averaged $336 million; but compared to the cost of the bombing campaign over North Vietnam, these $336 million annual average costs were minuscule.[2] Stopping the flow of men and materials into the south from North Vietnam via the electronic wall would not only save millions of dollars annually but also frustrate North Vietnam's military machine. And it would keep American aviators out of the missile, fighter, and antiaircraft-infested skies of North Vietnam. The Department of Defense hoped that the wall would stop the hemorrhage of money, materiel, and lives being lost in all of Vietnam.

The plan for building the electronic wall was straightforward. The sensors could be delivered to specifically designated regions by aircraft or ground forces. The devices implanted by ground forces were small and lightweight; they could be carried in a soldier's ammunition pouch. These devices were placed at strategic locations, as determined by intelligence activities. Several types of hand-delivered sensors, designed to pick up seismic or magnetic signals, could be placed around the perimeter of a camp as a security measure to alert the defenders of potential intruders; or they could be carried by reconnaissance teams and planted at sites where enemy activity was suspected. A portable receiver called a Portatale allowed personnel in the camp to monitor the sensors for intruder activity. Ground forces also implanted a larger series of devices designed to transmit sensor information to orbiting aircraft for relay to a remote ground station.

Air delivery of sensors was conducted by a wide variety of fixed- and rotary-wing aircraft. Subsonic patrol aircraft included the Navy-operated OP-2E Neptune and the Army-operated EP-2E (also a modified version of the Neptune); both were initially used to drop sensors over Laos. Their slow speed made these aircraft vulnerable to enemy ground fire. Although LORAN-C navigation sets were installed in the aircraft, sensor delivery accuracy was sometimes a problem. These inaccuracies led to irregular sensor fields being sown, resulting in poor grid coordinates for attacking aircraft. This was not the fault of the aircrew but of the aircraft type selected for the mission and the reliability of the LORAN system at the time. Sensor delivery sometimes required the aircraft to fly through valleys with sheer cliffs on each side. This type of flying is hazardous and requires great skill, which the exceptionally talented pilots of U.S. Navy Observation Squadron VO-67 had. However, the aircraft's huge, straight wings and slow speed were negatives in such environments, where the aircraft was subjected to numerous updrafts, downdrafts, and crosswinds during sensor delivery flights.

The program also tried using the supersonic F-4D Phantom II fighter-bombers as delivery vehicles for the sensors. F-4 aircraft stationed at Ubon, Thailand, were assigned the task; the 8th Tactical Fighter Wing's 497th Tactical Fighter Squadron was assigned the mission. Although more survivable than the Neptune, the F-4D fighter-bombers also lacked the accuracy required for sensor delivery and subsequent location plotting. A specially equipped squadron of F-4Ds with LORAN (long-range air navigation) units took over the task of planting the devices in Laos, Cambodia, and southern North Vietnam as well as in South Vietnam. Helicopters and propeller-driven, fixed-wing aircraft delivered sensors in South Vietnam, primarily in areas that bordered neighboring countries, but also at times in Laos. Air-delivered sensors detected seismic, magnetic, electromagnetic, and acoustic signals. At times, the area surrounding the sensor field was saturated with antipersonnel and vehicle mines.

Starting in March 1967, Air America (the CIA-operated air asset in Southeast Asia) was briefly involved in relaying signals from the Ho Chi Minh Trail. Due to the extent of enemy traffic all along the trail in the mid- to late 1960s, and to the problems associated with providing sufficient aircraft for the orbits required, Air America was tasked to fly some sensor orbits. Air America Volpar Turbo Beech 18 aircraft based in Savannakhet, Laos, were modified with the required electronic equipment and operated as relay aircraft over the southern portion of the trail. The Volpar was a small twin-engine aircraft manufactured by the Beechcraft Corporation. The orbits usually took 12 hours or more and were flown at night. Air America orbits were terminated in late 1968.

The Volpar Turbo's success in the Air America project led to the development of the QU-22, a single-engine aircraft that was used in conjunction with the EC-121 for sensor signal relays. In those operations, sensors beamed detection signals to an orbiting relay aircraft. Equipment aboard the relay aircraft processed and amplified the signals and then relayed them to a receiving ground station at NKP in Thailand. The ground station further processed the signals, using an IBM 360 computer (then the latest in computer technology). Signal processing provided technicians with each sensor's specific code number, location, type of activity, and time of activation. Based on a coded signal, technicians watching computer screens could determine which sensor or series of sensors had been activated. The technicians next determined the type of intrusion—whether by troops or vehicles—and could plot and time the intrusion progress through the sensor field because sensors in the field were activated in sequence as the intrusion progressed through the field. When determined feasible, an air or land attack was mounted to destroy the intruders.[8, 9]

Before the sensor system was in place, locating the enemy in the jungles of the border areas and along the Ho Chi Minh Trail was at best sporadic and dangerous. Armed reconnaissance missions were flown by all types of aircraft, day and night, in hopes of catching the enemy in the open as he traveled south on the Ho Chi Minh Trail. One armed reconnaissance mission that stumbled upon the enemy before the sensor system's implementation was a 21 May 1968 night flight by two 497th Fighter Squadron F-4D aircraft from Ubon, Thailand. The two-aircraft flight, call sign Catsup, was conducting a night-armed reconnaissance over Route 137 in Laos when it discovered a 15-truck convoy in a valley near a well-known assembly area at the Kuan Son Ferry in western Laos. Because the rules of engagement required positive identification, the lead aircraft dropped down and flew through the valley to confirm that the convoy was indeed the enemy. This effort seemed pointless to the pilots since no known friendly forces were operating a truck convoy down the Ho Chi Minh Trail. With 5,300-foot cliffs on each side of the valley, flying in was dangerous, especially since there was no moon that night. The lead aircraft dropped illumination flares to identify the trucks, their location, and quantity. That information was quickly relayed to the second aircraft in the flight, which commenced the attack. Both aircraft came under intense antiaircraft fire from 37-mm and 57-mm weapons and small arms fire. The aircraft weathered the rain of steel, successfully destroyed at least six trucks, and completely silenced the antiaircraft weapons.

By late 1966, the "McNamara Line" was in place across the northern portion of South Vietnam just south of the DMZ. The line, officially known as the conventional barrier system, consisted of an anti-infiltration field of sensors and obstacles strategically placed to channel troop and vehicle movements through specific areas within the barrier system. Fortified fire support bases and rapid-response team bases responded to intrusion alerts. The barrier system just south of the DMZ was the first portion to be implemented. It would eventually stretch from the east coast of South Vietnam through Laos and down into Cambodia.

The sensors initially experienced a wide variety of problems. Reliability was extremely low, partially because the Phase I sensors were modified Navy Sonobouys. What's more, their battery life was short and did not meet specifications. These problems were rectified by the Phase II sensors, specifically designed for use in Southeast Asia. Another problem was the loss of data within the radio relay system. Radio equipment interference—such as very high frequency (VHF) emissions on board the EC-121R as well as equipment problems on the relay aircraft—coupled with an overloading of equipment at the ISC ground station caused data loss initially estimated to be 40 to 60 percent, an extremely high rate for such a sensitive system. However, through overall system improvements, the data loss was reduced to approximately 17 percent by early 1969.

Once airborne sensor delivery began in Laos, a method of confirming sensor location relative to local terrain was required. Without matching terrain to the sensor location, airstrikes on suspected enemy movements would be difficult for aircraft not equipped with LORAN sets or some form of extremely accurate navigation system. A plan was hastily established to employ forward air controllers (FACs) for this confirmation. Once the ISC ground station detected movement, the airborne relay aircraft would vector an FAC over the suspected area to confirm the sensor activation. This plan worked well, and it became evident that the sensors were providing valid information on troop and vehicle movement in Laos.

Truck Park Working Group/Commando Hunt Program

On 8 April 1968 the DCPG formed a Truck Park Working Group to review sensor activity and plot the locations of suspected daytime truck-parking areas, designated Zulu Truck Parks. Those locations were passed on to Seventh Air Force for airstrike assignments. A wide variety of aircraft flew in support of these missions, most notably the Arc Light bombing missions flown by USAF B-52s. Arc Light strikes, in response to Igloo White, used an electronic bomb release method. Called Combat Skyspot, the method directed aircraft to release their bomb loads based on an electrical signal generated at the ISC ground station.[1, 10]

An unusual and infrequent event occurred from mid-1966 through mid-1967 concerning the sensor fields in Laos. At times the fields mysteriously became inactive. The inactivity was determined to stem from EB-66 electronic countermeasures missions being flown in conjunction with and in support of B-52 Arc Light bombings. The EB-66 was an early 1950s era twin-engine, medium-range jet bomber that had been converted into an electronics countermeasure platform. Electronic jamming missions affecting the Igloo White sensors were flown over northern Laos from June 1966 through July 1967. The EB-66s also flew jamming missions on a northwest/southeast course near the 20th parallel over the western border of Laos. The times of sensor inactivity were not detrimental to the overall Igloo White program, so no action was taken to remedy the sensor signal loss from the EB-66 emissions.

April 1968 was a significant month for the Igloo White program. Besides establishing the Truck Park Working Group, the DCPG initiated what was called the Commando Hunt program, which was an increased interdiction effort in Laos. Task Force Alpha, located at NKP, was tasked to exercise control over airstrikes in Laos in support of Commando Hunt. In July 1968 the monsoon season started—and so did the Commando Hunt program, with the objective of reducing the enemy's logistics flow into South Vietnam. To accomplish this, the program's primary task was to destroy enemy trucks and storage depots in Laos. USAF Igloo White F-4D aircraft dropped sensor strings, containing 3 to 6 sensors per string, along known or suspected truck routes in Laos. Attack aircraft were loaded with special munitions and assigned specific areas of operations for airstrikes each day, based on ISC ground station information. Some of these attack missions were part of what was called Pathfinder Operations. During these operations, USAF EB-66B electronic warfare aircraft accompanied a flight of fighter-bombers (F-4 or F-105 aircraft) on bombing missions over Laos. The EB-66s used the K-5 bombing-navigation system, a leftover from the original B-66 bomber concept. The K-5 gave the fighter-bombers a specific location and time, sent by a tone signal from the Igloo White ISC station in Thailand, to drop their bomb loads (in principle, this worked almost like Combat Skyspot). When required, the EB-66 electronic warfare suite also provided the Pathfinder strike force with threat warning information and tactical jamming. This warning/jamming kept the strike force relatively safe from radar-directed antiaircraft fire from, for example, the deadly rapid-fire 37-mm AAA guns and surface-to-air missiles that protected the Ho Chi Minh Trail. The Pathfinder missions were particularly effective during the monsoon season, when visual bombing of targets was almost impossible to accomplish.[11] Concurrent with the Truck Park Working Group program, the ISC computers at NKP underwent an extensive upgrade to increase their data processing and storage capabilities.[2]

From the first week of April to 13 September 1968, Igloo White aircraft dropped 633 Acoubouys, 1,068 Spikebouys, and 1,696 ADSID sensors in Laos. During that period, the ISC ground station determined the most promising areas of sensor activity for air attack; those areas were designated as spotlights, and airstrikes were initiated against them. Program managers were confident about stemming the logistics flow significantly along the trail during this intensified effort. The results of Commando Hunt operations validated the program. Of the targets attacked during Commando Hunt I, 39 percent were Igloo White validated targets. Additionally, 25 percent of the truck kills during this time frame were Igloo White validated targets that forward air controllers (FACs) had visually confirmed as destroyed.

The 1968 cessation of bombing north of the 19th parallel provided impetus to further expand the electronic wall in an effort to stem the flow of men and materiel south. A plan was developed and approved by the U.S. Joint Chiefs of Staff to greatly expand the sensor field to encompass significantly more areas in Laos and Cambodia. This plan, which also fell under the Commando Hunt program, was executed on 15 November 1968. Due to the mountainous terrain in Laos, the flow south was channeled into known "choke points," primarily at the Mu Gia Pass in northern Laos and the area near the city of Tchepone to the south. Both areas lay just south and west of the DMZ separating North and South Vietnam. The Mu Gia Pass is an area in the Truong Son mountains bordering North Vietnam and Laos. It was an ideal entry point for the logistics flow from North Vietnam into Laos because it is just over 75 miles from the border of South Vietnam and 80 miles from the strategic Laotian town of Tchepone. Tchepone had an unimproved 4,000-foot runway, making the pass and the town ideal for transporting materiel from North Vietnam to points south. The pass is narrow, with peaks on either side reaching some 6,000 feet. The gap cuts through a range of mountains averaging 4,000 to 4,500 feet in height. High-speed Air Force F-4D aircraft from the 25th Tactical Fighter Squadron laid a variety of sensor fields in specific grid patterns in these areas. Sensor data from the fields were relayed via EC-121R aircraft to the data collection point at NKP in Thailand.

In late October 1968, Igloo White was extended to North Vietnam. Twelve sensor strings, totaling 69 sensors, were air-dropped into the area known as Route Package I in southern North Vietnam. On 3 November an EC-121R aircraft was assigned relay duties for these sensor strings. The orbit, flown over the Gulf of Tonkin, was identified as Pink Orbit. On 10 November, 10 more sensors were air-dropped into the same region. The last flight of Pink Orbit was flown on 26 November 1968. The sensor fields planted in North Vietnam did not produce the results desired; consequently, the orbit was canceled when the sensors became inactive.

Continued program successes and improvements in sensor processing, command, control, and communications brought an expansion of operations in Laos during the following year. On 13 April 1969, operational control of aircraft in the Commando Hunt program was transferred from Task Force Alpha to an Airborne Battlefield Command and Control Center. The command and control functions of Task Force Alpha effectively ended on 26 April 1969. In the summer of 1969, the sensor buildup facility was moved from its location at NKP to Ubon Royal Thai Air Base, Thailand. This allowed the sensors to be built up and delivered directly to the recently arrived 25th Tactical Fighter Squadron (TFS) aircraft. Transshipment from one location to another was thus eliminated, significantly reducing the logistics pipeline. Phase II sensor delivery also began at about the same time. The most significant Phase II sensors were the fighter air-delivered seismic intrusion detector, or FADSID, and the Acoubouy II. Both were improvements over the original Phase I sensors that had originated in the Navy's submarine detection program.

In late August 1969, the sensor fields in Laos were expanded still further. Intelligence had suspected the enemy was moving equipment through the Plain of Jars in central Laos. Aircraft of the 25th TFS planted sensor fields at specific locations on the plain, and an EC-121R orbit, code-named Rose, was established. Unfortunately, the sensor field proved unproductive; Rose Orbit was canceled in mid-September. However, on-site human intelligence continued to detect vehicle and troop movements in the Plain of Jars, this time narrowing the suspected area significantly. With this new information, Rose Orbit was reestablished. The 25th TFS was tasked to sow sensors at specific locations as directed by the ISC. The new information brought positive results, and an interdiction effort was established in the Plain of Jars.

It had been estimated that at any given time during 1969, there were approximately 1,300 enemy truck movements through Laos. Of these, approximately 275 trucks were on the road at any one time. To avoid airborne detection, truck and personnel movements took place primarily at night. The effectiveness of the continued air campaign took its toll on the enemy's logistics lines. In December 1968, a total of 27 trucks were observed destroyed. In April 1969 the total daily trucks observed destroyed was reported as 44, which was a significant increase in truck kills.[12]

Floating Oil Drums

By late 1968, the interdiction campaign was starting to significantly affect the North's logistics flow. Consequently, the North Vietnamese attempted a new method of sending materiel south. This new method used the waterways of Laos that flowed into South Vietnam. Fifty-five-gallon oil drums were filled with materiel and floated down waterways through Laos. In some cases, enemy troops built artificial waterways in an attempt to circumvent areas where air attack was possible. This method of movement initially proved unsuccessful because the drums became entangled on foliage in and around the waterways. Once entangled, the drums were easily spotted from the air. The North Vietnamese suspended this method, pending a detailed review of the operation and its effectiveness as compared to other means of transport.[13]

Due to the large loss of vehicles, materiel, and personnel to air interdiction, the North Vietnamese later revived the floating oil drum method as a viable alternative to overland transport. By mid-1969 the oil drums were being fitted with a floating anchor device that made them float near the middle of the waterway. Another improvement in the new method was to load the drums so that their tops were just barely visible at the water's surface. This made them difficult to see from high-speed aircraft. Personnel were also set up at stations along the way to monitor the progress of the shipments. The Nam Ou and Xe Bang Hiang waterways flowing from North Vietnam through the DMZ to Tchepone in Laos were selected as the best routes. All types of antiaircraft weaponry heavily defended these waterways. To retrieve the floating drums, personnel used nets and ropes and sometimes waded into the river to stop the drums. This new method of shipment was especially well suited for use in inclement weather and at night, when airborne detection and attack would be most difficult. Water shipment was also undetectable by the electronic sensors that monitored the Ho Chi Minh Trail.

During September 1970, a Defense Intelligence Agency report estimated that approximately 30 drums per day were being floated down the various waterways. Forward air controllers estimated the figure at approximately 3,000 drums. In one day, a Nail FAC reported seeing between 400 and 500 drums floating in just one stretch of the Xe Kong River in Laos. About the same time, a Wolf FAC (a high-speed F-4 Phantom) reported seeing approximately 200 drums on one pass over the waterway.

Aircrews attacking the floating drums became adept in their technique. Although the shipments were heavily defended, the results were positive. The 7th/13th Air Force Director of Operations, Col. G. H. Scott, stated:

> Most of the strikes made by the Ubon F-4s wound up as a result of scrambles in the late afternoon. They were usually called out as a result of sightings by Wolf Fast Mover FACs of drums floating in the river. The F-4s got into the areas and if they found a large concentration of barrels they hit it hard with bombs and CBU-24s. . . .
>
> The CBU worked especially well when river width was sufficient to allow for the entire pattern to hit the water surface. When the river narrowed, and bank side foliage hung over the water, part of the bomblet pattern would explode ineffectively in the trees.
>
> Initially, the scrambled birds were hung with all iron bombs, but the effectiveness of the CBU prompted the 8th TFW to split the load half and half.

As this statement indicates, aircrews adapted to the enemy and continued to successfully attack his logistics supply lines. A wide variety of fighter and attack aircraft were used during this interdiction campaign. However, the F-4 flew the most interdiction missions—approximately 2,000 interdiction sorties from 1 January through 31 August 1970.

As also can be seen, the success of the sensor system had forced the North Vietnamese to devise this rather extreme method of shipment. Floating drums loaded with supplies down a river is very time-consuming, and it led to considerable loss of supplies. Clearly, the North Vietnamese needed a more practical way to ship goods—especially fuel and oil—south. Without a constant supply of fuel and oil, traffic along the Ho Chi Minh Trail would slow significantly. Something new was needed.

North Vietnamese Fuel/Oil Pipeline Discovered

Because of the increased interdiction campaign over Laos as well as the bombing halt north of the 19th parallel in April 1968, the NVA clearly needed a new method for shipping valuable fuel and oil south. A fuel/oil pipeline from North Vietnam through Laos and ultimately into South Vietnam would serve the need well. Once established, it would be difficult to attack from the air, and the sensor system would be virtually useless against it. The pipeline started in North Vietnam at Hanoi, Haiphong, and Vinh and ran southeast to the Mu Gia Pass in Laos. The port of Vinh was ideal for transshipments; it was well south of the major port of Haiphong and had docking berths for large ships. The pipeline was discovered in Laos in January 1969 when an FAC flying low over the countryside reported what appeared to be a pipeline at the bottom of a trench. To confirm the report, a special operations ground team was dispatched to determine specifically what the pilot had seen. The team clandestinely cut out a section of the pipeline and returned it for analysis. The results of this analysis were impressive. The pipeline was 4 inches in diameter, and its walls were 1/8-inch thick. More significantly, the pipe had Russian markings on it. Analysis also indicated that the pipeline was capable of carrying either gasoline or kerosene under high pressure. This meant that the pipeline could move large quantities of fluid relatively quickly.[14, 15]

In November 1968 an air campaign was implemented to attack the Laotian section of the pipeline. The airstrikes caused the NVA to shift the pipeline location from the southeasterly direction of its originating point at Vinh to a more southerly direction, going into the DMZ in the Ban Raving area and then westward into Laos. This shift actually made the operation more efficient for the NVA, although it had not been planned that way.

Near the end of 1969, the pipeline in Laos was approximately 31 miles long and was servicing approximately eight known major staging areas. The staging areas were actually sophisticated operations. They normally consisted of partially buried fuel/oil tanks capable of holding from 2,500 to 5,000 gallons of petroleum. The tanks were located in dense jungle or in other areas with low susceptibility to discovery and air attack.

The air interdiction campaign against the pipeline proved ineffective. The high-speed fighters and attack aircraft used against the pipeline were not effective at locating and attacking an object as small as a 4-inch-diameter pipe lying half buried in thick jungle. The air interdiction was suspended in favor of commando raids. Special guerrilla units (SGU) and controlled American sources (CAS), basically third-country nationals, were used to attack specific sections of the pipeline in an effort to disrupt the fuel/oil flow. In October 1970, B-52 Arc Light sorties and LORAN-equipped F-4 aircraft attempted to destroy the pipeline. Unfortunately, as with the previous air campaign, the target proved too small and well hidden to hit from the air.[14]

By late 1970, construction of the pipeline had progressed to the area southeast of Tchepone in Laos and was leading into the A Shau Valley of South Vietnam. Again, this was in violation of international treaties that North Vietnam agreed to. Several special operations teams sent into Laos to collect intelligence on the pipeline reported and photographed some of the equipment being used, which turned out to be of Soviet origin. Once in operation, the pipeline released a significant amount of trucks for the transport of munitions into South Vietnam. These trucks would previously have been tasked to carry fuel, oil, kerosene, and so on.[14]

During Operation Lam Son 719, a South Vietnamese incursion into the Cambodia border areas in early 1971, an extension of the petroleum pipeline was discovered just west of the Cambodian town of Aloui. The South Vietnamese Army destroyed several sections of the pipeline during the operation, but it was later repaired and extended many miles south into South Vietnam's Military Region III.[16]

The pipeline ultimately survived and was instrumental in the fall of South Vietnam. The only way the pipeline could have been damaged beyond repair was by a significant incursion into Laos and Cambodia. This was, of course, politically impossible. In fact, the small SGU and CAS teams previously referred to were non-American units sent into Laos and Cambodia to gather on-site, real-time intelligence, since American ground units were not allowed to enter these countries.[14]

Commando Bolt Interdiction Campaign

In November 1969, the DCPG initiated a new interdiction campaign. Called Commando Bolt, it better integrated sensor activity with FACs and strike aircraft in an effort to attack truck and troop movements at predetermined locations and specific times. Technicians at the ISC plotted the flow of enemy troops and vehicles through sensor fields and targeted specific areas where attacking aircraft could inflict the most damage. By plotting the flow through the sensor field, they could determine not only a specific area down the route but also the enemy's arrival time. With this information, an effective attack could be mounted.

Special sensor strings consisting of between 3 and 6 sensors per string were sown specifically for the Commando Bolt campaign. The sensors were placed at intervals approximately 200 meters apart. Near the South Vietnamese town of An Loc, just north of Saigon, sensor strings were implanted where enemy vehicle activity was suspected. The sensors confirmed heavy vehicle movement along a stretch of roadway near the village, and attacks subsequently called in stopped the movement. At times as many as four sensor strings were implanted along routes known to be used by the enemy, thus forming what was called a Commando Bolt Strike Module. LORAN-equipped fighter-bombers of the 25th Tactical Fighter Squadron were called in when needed and, using LORAN coordinates provided by the ISC, could navigate directly to the attack site.

Sensor System Data

As previously stated, each sensor carried its own identification code and was placed at specifically known locations. A grid of the sensor field would be plotted on a map of the area around the field. When troop movement or vehicle traffic activated a sensor, it transmitted its identification code to a receiving station. Because the sensor was placed at a known location, the technician operating the receiving equipment knew the exact sensor location, and in turn, knew exactly where the intruder was located within the sensor field. Troop and vehicle movement through the sensor field could be accurately plotted, even down to estimating the speed of intruder movement. Based on the time between sensor activations, a technician receiving an intruder alert could also roughly determine the number of troops on the move. The sensors were battery powered, and their transmissions lasted anywhere from 30 to 90 days. Each sensor had a self-destruction device built into it. When initiated, an explosive squib destroyed the transmission crystal, thus rendering the sensor inoperative. This usually occurred if the sensor was moved slightly from its original orientation.

The ground station was responsible for tracking the life of the sensors. Should sensor batteries reach their design service life, or if the sensor was deactivated for unknown reasons, the ground station transmitted an air-tasking order for replenishment. As previously stated, the major factor in sensor life was the battery. The sensor's usable life was determined by how often it transmitted a signal, so the more transmissions, the shorter the battery life.[17]

Correct interpretation of sensor signals was one important aspect of training for troops manning a portable receiving station, commonly called the Portatale receiver. Early in its initial deployment to the war zone, there had been problems interpreting the various signals received; for example, heavy rain could be interpreted as footsteps. However, with proper training and on-the-job experience, troops could differentiate between rain or troop movement, motorcycle or jeep, and small or large truck.

In December 1969, the secretary of defense directed the DCPG to relinquish its authority over the sensor program and transfer this authority to the military services, with a completion date of no later than 26 September 1970. The Army, Navy, and Air Force assumed roles of responsibility for the sensor system. Delegating the responsibility to the military allowed theater and division commanders to eventually relieve the equivalent of about three Army companies from security details.

Sensor costs decreased significantly over their years of use in Southeast Asia. The basic unit cost of the air-delivered seismic intrusion detector (ADSID) in 1967 was $2,145. By 1970, sensor unit cost was $975. Sensor reliability also significantly improved, to the point that battery life was the limiting factor in sensor operation.

Successes of the Sensor System

It would take volumes to describe the many sensor successes during the Vietnam War. The following is just a sampling of various successes attributed to the sensor system.

It is not well known that sensor fields significantly affected the defense of the Khe Sahn combat base. As it turns out, the battle for Khe Sahn was a proving ground that validated the concept of remote sensing of enemy movements. After the battle, remote sensing became an operational battlefield surveillance system. In January 1968, North Vietnamese Army (NVA) forces began massing for an attack on Khe Sahn. General William Westmoreland, commander of U.S. forces in Vietnam, directed the implementation of a sensor field to assist in defending the base. Initially the plan called for the installation of hand-delivered sensors, better known as personnel subsystems or hand-delivered seismic intrusion detectors (HANDSIDs). However, out of concern for the safety of personnel tasked with placing the sensors near suspected NVA locations, this plan was never implemented. After reconsidering, Gen. Westmoreland decided that a better approach would be to air-deliver the sensors to areas suspected of massive enemy activity. Navy OP-2E Neptune aircraft from Navy Special Operations Squadron VO-67, based in Thailand, air-dropped the sensors. The sensors were dropped near NVA forces and the network of roads and trails leading toward and ringing Khe Sahn. Air-dropping the sensors around the combat base was extremely hazardous: The slow-moving twin-engine, propeller-driven aircraft flew from Thailand to central South Vietnam; nearing the combat base, they dropped down to treetop level. When closing in on the sensor drop location, the aircraft popped up to a drop altitude of 500 feet and then went back down to treetop level to escape the withering ground fire. Information relayed by these sensors, coupled with aerial photography, was instrumental in effectively defending Khe Sahn against a large onslaught of NVA forces. Signals from the sensors were relayed to the ISC, but the combat base also had portable monitoring gear that allowed the defenders access to sensor signals.

Air attacks in the Khe Sahn area, so well documented and photographed, were primarily the result of the electronic sensory input. The enemy's intent to overrun the base was apparent by the huge amount of activated sensors as reported at the ISC ground station. This is one aspect of Khe Sahn's successful defense that has never been fully reported or described in detail. Aircrews from VO-67 that participated in the Khe Sahn operations were awarded the Navy Commendation Medal with a Combat "V" device. The award read in part: "Despite poor weather, rugged terrain and enemy defenses which included surface to air missiles and anti-aircraft guns."[5, 18, 19] It was estimated that approximately 40 percent of the raw intelligence data concerning enemy movements and concentrations around the Khe Sahn combat base came directly from sensor data via the ISC station at NKP in Thailand.[10]

With the continuing success of the sensor system, allied units in the field were deploying hand-delivered sensors in greater numbers. After the spring of 1968, ground units were using the sensors not only for camp protection but also for tracking NVA movements through their areas of responsibility. One great asset of the sensor system was that it gave allied ground forces the ability to attack the enemy in any type of weather. With each perceived success, confidence in the system grew. In March 1969, the South Vietnamese began training on the implementation and operation of a unique Vietnamese-only sensor system. By August 1969, special trainer teams in each Vietnamese army division had implemented a plan for training personnel to use the sensor system. Each army division was to have its own centralized sensor training school. By the end of 1969, the Vietnamese army had assumed responsibility for almost 47 percent of the sensors in the ground tactical system (hand-delivered sensors) within South Vietnam. Australian army units, under the command of Major General C. A. E. Fraser, also used the ground tactical system.

Another early example of the successful implementation of the sensor system was the defense of Fire Base Mahone. This fire base was located near the French Michelin rubber plantation at Dau Tieng. Just before sunrise early one morning in 1968, sensors placed along the base perimeter detected an enemy force in the bamboo thickets some several hundred yards from the base. In the predawn light, allied artillery and mortars opened fire on the area. At daylight a patrol was dispatched to investigate. The patrol found 21 enemy dead and 4 wounded. Also discovered were 129 rounds of heavy weapons ammunition, 3 rocket-propelled grenade launchers, a mortar, and a flamethrower. Without the sensors, Fire Base Mahone likely would have sustained significant damage and many allied deaths. The base could have been overrun, possibly resulting in the capture of its remaining defenders. It would have been a major psychological blow to the war effort, reminiscent of the French defeat at Dien Bien Phu. Stories like this one abounded throughout the war. Air bases, naval installations, army bases, and fire bases all had similar success in detecting enemy troop movements when the sensor system was implemented. The electronic wall saved the lives of countless numbers of allied troops and Vietnamese civilians.[20]

The defense of Fire Base Crook was perhaps the most successful use of the electronic sensor detection system, while at the same time the most costly for the enemy in the border areas of South Vietnam and Cambodia. Fire Base Crook was established northwest of Tay Ninh City and very near the Cambodian border. On 5 June 1969 at approximately 8 p.m., sensors placed near the fire base detected activity east and northwest of the base. Ground-based search radar at the installation detected troop movement near the base perimeter. Artillery at the base directed fire at the locations where the sensor field and radar had detected suspicious activity. Sensor activations and allied artillery fire continued sporadically throughout the night until 3 a.m., when enemy fire was directed into the base as a precursor to an assault. Sustained return fire from the base lasted until sunrise, when air support took over. The battle ended with the fire base still in allied hands. A search of the area surrounding the base revealed that 76 enemy soldiers—all members of the NVA's 9th Division, 272nd Regiment—had perished in the attempted assault. On the next night, 6 June, there was similar activity. That night the enemy was met not only by return fire but also by Night Hawk helicopters armed with xenon searchlights and mini-guns. Fixed-wing air support was also called in. A total of 450 enemy troops were killed during these two nights. Total allied losses were 1 U.S. soldier killed and 3 slightly wounded. Once again, sensor fields proved their worth in protecting allied lives.[21]

The Army of the Republic of Vietnam (ARVN) also had success with the sensors. In March 1970, the 54th ARVN Regiment at Fire Base Anzio (located south of the city of Phu Bai in War Zone D in southern South Vietnam) had strung a sensor line around the fire base. Shortly after midnight, movement activated the sensors. The ARVN monitored the enemy activity for several hours, carefully calculating the location and movement of enemy troops toward the fire base. This advance warning of an impending attack allowed the defenders to ready themselves for combat. Near morning, the ARVN commenced firing on the enemy. After sunrise an ARVN scouting party located 75 enemy bodies in the location where the sensors had detected movement. No defenders were killed or wounded. That same month, sensors around ARVN Fire Base Nancy north of the old imperial capital city of Hue in northern South Vietnam detected enemy movement. A similar drama played out, and this time 45 enemy bodies were discovered outside the base perimeter, Again, not a single defender was killed or wounded.[16]

The sensors aided not only in the direct defense of allied installations but also in locating and destroying hidden caches of enemy weapons. A prime example of this success occurred at a fire base near hill 558 in northern South Vietnam. Sensor strings placed around the hill were detecting movement in a specific sensor field, continuing for 15 to 20 minutes at irregular intervals. Based on the sensor activations, it was deduced that an enemy munitions cache was being filled. The defenders laid down a barrage of artillery fire on the area, resulting in a series of large secondary explosions that confirmed the ammunitions cache theory. Besides potentially saving many allied lives, the sensors enabled the defenders to destroy the enemy's logistics pipeline and his ability to attack the area.

During operation Lam Son 719 Northeast Monsoon, which occurred in early 1971, U.S. Marine OV-10 aircraft dropped 41 sensor strings along Route 9 near the tri-border area of South Vietnam, Laos, and Cambodia. The sensor strings, in support of the South Vietnamese Army's border operation into the neighboring countries, were directed at the heart of the Ho Chi Minh Trail system near the Laotian town of Tchepone. U.S. Air Force F-4D aircraft dropped an additional 12 sensor strings during the army's withdrawal from the border areas. These sensors detected 5,232 targets, of which 694 were fired on and hit by South Vietnamese artillery. Fourteen more were hit by mortar fire.[15, 22]

Sensors placed by Navy Riverine teams in the delta area of southern South Vietnam recorded a significant conversation during the early 1970s. Naval sensor-monitoring teams picked up enemy troop movements along a stretch of waterway. Airstrikes were called in, and ordnance was delivered on target. After the airstrikes, Acoubouy microphones picked up Viet Cong (VC) conversations centering on the hard life the VC had, the possibility of more airstrikes on their position, and instructions they had received to return to their base. In this case, as in so many others, sensors provided the ability not only to detect movement but also to listen in on conversations and thus gain some insight into the morale of enemy troops.

Sensor Security Breached

Unfortunately, over the course of the war NVA and VC units discovered both air-delivered and hand-delivered sensors. Acoustic sensors provided vivid accounts of discovery by enemy forces. In one case, an acoustic sensor relayed the voices of its discoverers. Excited voices can be heard as a small group of NVA soldiers first discover and then inspect the sensor. The next sound is of sustained chopping; apparently, the air-delivered sensor's parachute was entangled in tree limbs, in plain view of anyone who happened to wander by. The final part of the recording indicates the tree may have fallen on those who had cut it down.

Apparently, any sensors that were discovered were visible to the discoverers. No NVA or VC missions seem to have been established specifically to locate and retrieve sensors. Some air-dropped sensors landed on roadways in plain sight of passing enemy traffic. There were unconfirmed reports that sensors discovered by the enemy were sent to China and Russia for analysis. It is unlikely that the sensors provided these countries with any useful technology; they were merely magnetic and acoustic detection devices. The real secret to the electronic wall was the processing of sensory information. The enemy apparently never tried to jam the radio frequencies assigned to the sensors. This tactic probably would not have worked even if it had been attempted. In any event, the enemy would have found it difficult to extract useful information from captured sensors because the electronics were probably destroyed by the destruction charges each sensor carried.

Many sensors abruptly stopped working; ISC technicians suspected enemy troops might have tampered with them. As a result, sensor strings were seeded from the air along with munitions such as antipersonnel mines. This made tampering with the devices, or even entering into a sensor field, extremely hazardous for the enemy.

Interrogation of captured enemy troops revealed that they were very aware of the sensors but unsure about how they operated. North Vietnamese troops and convoys received briefings on the sensors from other troops stationed in Laos. These briefings explained what the sensors looked like and described where they were most likely to be found. Also covered were methods of rendering the sensors inoperative and warnings about the dangers they posed. One captured NVA soldier described a seismic intrusion device in great detail, apparently from firsthand observation. Most captured enemy troops thought that U.S. reconnaissance aircraft dropped the sensors, although one man reported that he had seen a South Vietnamese soldier place a sensor into the ground. Enemy troops were instructed to walk slowly and not speak when moving through a sensor field. It was well known that movement of some type would bring on an attack. Before setting up camp, the troops thoroughly searched the area for sensors.

Captured troops reported that after discovering a sensor, they tried to deactivate it by burning, hitting, or turning it upside down so that the antenna was in the ground. The North Vietnamese could be ingenious when it came to attempting to defeat electronic sensors. They were known to hang bags of water buffalo urine in areas suspected or known to have ammonia-sensing "people sniffer" sensors. This would cause a significant airborne assault in an area that enemy troops had left long ago. Sometimes the troops simply urinated on any device they discovered, hoping to corrode it. Apparently they were unaware that simply tilting the sensors would deactivate them. Everyone thought the sensors were listening devices; none realized they could also pick up seismic signals. All agreed that the sensors significantly affected the overall morale of troops moving down the Ho Chi Minh Trail.[23]

Notes

1. U.S. Government Report, Institute for Defense Analysis. *A Study of Data Related to Viet Cong and North Vietnamese Army Logistics and Manpower: Part One—Enemy Logistics in Support of Operations in South Vietnam; Chapter V—The Problem of Sea Infiltration* (August 26, 1966). This entire report was originally classified as Top Secret; however, it was declassified after 30 years.

2. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee of the Preparedness Investigating Subcommittee of the Committee on Armed Services* (November 18–20, 1970). U.S. Government Printing Office, Washington, DC.

3. The Geneva Conference on Laos, convened May 1961 through June 1961 and leading to the Zurich Agreements in June 1961, required the North Vietnamese and the United States to vacate Laos. International Controls Commission (ICC) checkpoints were established to monitor the departure of United States and North Vietnamese personnel. A total of 666 U.S. military personnel were recorded as departing through ICC checkpoints, but only 40 North Vietnamese passed these checkpoints. Large numbers, estimated at several thousand, remained in place in Laos. This information is based on a RAND study by Melvin Gurtov—*Indochina in North Vietnamese Strategy*, March 1971. The RAND Corporation, Santa Monica, CA. Publication Number P-4605.

4. The History of U.S. Naval Observation Squadron Sixty-Seven—February 1967 through December 1967. Naval Aviation History Office Publications, Dictionary of Naval Aviation Squadrons.

5. Bernard C. Nalty, "Chapter VIII: Beyond the Next Hill," in *Air Power and the Fight for Khe Sanh* (Washington, DC: Air Force History and Museums Program, USAF, 1968 ISBN 0-919299-20-X).

6. *Project CHECO (Southeast Asia Report) Igloo White Program: July 1969–December 1969, A Contemporary Historical Examination of Current Operations*.

7. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 24, 1970), 147–150. U.S. Government Printing Office, Washington, DC.

8. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 19, 1970), 122–126. 150. U.S. Government Printing Office, Washington, DC.

9. *Project CHECO Report, Igloo White Program: July 1968–December 1969, A Contemporary Historical Examination of Current Operations*. Report number 0239388 from the Directorate of Operations Analysis Office.

10. "Air Operations in Northern Laos—1 April through 1 November 1970," HQ PACAF. Directorate of Operations Analysis, Project CHECO 7th AF, DOAC (January 15, 1971).

11. The Douglas EB-66 Destroyer was an early 1950s era nuclear-capable bomber, converted into an electronic reconnaissance (EB-66C) and electronic jamming (EB-66B/E) platform. The EB-66 was the USAF Tactical Air Command's only dedicated tactical electronics reconnaissance and jamming aircraft. Two squadrons of EB-66s conducted operations in Southeast Asia during the entire Vietnam War.

12. *Project CHECO Report, Igloo White Program: July 1968–December 1969, A Contemporary Historical Examination of Current Operations. Operations*. Report number 0239388 from the Directorate of Operations Analysis Office.

13. *Project CHECO Report, Igloo White Program: July 1968–December 1969, A Contemporary Historical Examination of Current Operations—The Waterways. Operations*. Report number 0239388 from the Directorate of Operations Analysis Office.

14. *Project CHECO Report, Igloo White Program: July 1968–December 1969, A Contemporary Historical Examination of Current Operations—The Pipeline. Operations*. Report number 0239388 from the Directorate of Operations Analysis Office.

15. Laotian Brigadier General Soutchay Vongsavanh, "Logistics Base Areas," in *RLG Military Operations and Activities in the Laotian Panhandle* (Washington, DC: U.S. Army Center of Military History, 1981). ISBN 0-923135-05-7.

16. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 18, 1970), 74. 150. U.S. Government Printing Office, Washington, DC.

17. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 18, 1970), 117–120. 150. U.S. Government Printing Office, Washington, DC.

18. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 18, 1970), 10–13, 86–95. 150. U.S. Government Printing Office, Washington, DC.

19. *Project CHECO Report, Igloo White Program: July 1968–December 1969, A Contemporary Historical Examination of Current Operations. Operations.* Report number 0239388 from the Directorate of Operations Analysis Office.

20. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 18–20, 1970), 39, 40. 150. U.S. Government Printing Office, Washington, DC.

21. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 18, 1970), 57–64. 150. U.S. Government Printing Office, Washington, DC.

22. *Project CHECO Report, Igloo White Program: July 1968–December 1969, A Contemporary Historical Examination of Current Operations. Operations.* Report number 0239388 from the Directorate of Operations Analysis Office. Operation Lam Son was named after a Vietnamese fifteenth century victory when all of Vietnam was united under one ruler.

23. *Project CHECO Report, Igloo White Program: July 1968–December 1969, A Contemporary Historical Examination of Current Operations—Enemy Attempts to Neutralize Igloo White Sensors. Operations.* Report number 0239388 from the Directorate of Operations Analysis Office.

CHAPTER 2

Air-Delivered Devices

DETECTING THE infiltration of men and materiel through Laos required a sophisticated remote monitoring system. On-site human intelligence was difficult to obtain due to logistics, security, and diplomatic concerns. Airborne reconnaissance of the Ho Chi Minh Trail in Laos was nearly impossible because of the dense foliage, especially in the eastern portion of the country near the border with South Vietnam, where the jungle tree canopy can reach heights of 200 feet. As a result it was almost impossible in the mid- to late 1960s to detect troop movements in such an environment.

A top-secret letter from the U.S. ambassador in Laos to the U.S. State Department in June of 1965 described the problem well. In his letter the ambassador noted that General Ma, the Lao Air Force commander, had stated that the Royal Lao Army had discovered and taken a portion of a vast trail network in the easternmost part of the country. He reported that the dense jungle foliage made it impossible to see the trail from the air. The ambassador flew to the area with Gen. Ma and was surprised to find that the section of trail being flown over was completely hidden from view, even from a helicopter at relatively low altitude. Because of this inability to visually detect troop and vehicle movements, airborne delivery of sensors was really the only viable option. This chapter lists the airborne sensors that were air-dropped over Laos, Cambodia, and North and South Vietnam.[1]

Two basic types of air-delivered sensors were used in Southeast Asia during the early to mid- to late 1960s. These initial prototype sensors were U.S. Navy Sonobouys modified for use in Southeast Asia. They were hastily modified to meet the 1 December 1967 Igloo White activation date, and they were identified as Phase I sensors. Phase I indicated the first in a planned series of sensors. The Sonobouy was originally equipped with a parachute, which slowed its fall into the ocean after being dropped from a naval patrol aircraft. Two types of navy sensors were used, seismic and acoustic. Both were successful in their roles in detecting undersea activity, and the sensor concept was determined ideal for use in Southeast Asia.[2]

The original Phase I sensors transmitted on 31 channels in 27 different tone codes. They were normally air-dropped into what were called sensor fields—specific areas where numerous sensors, usually 6 to 8, were dropped. When combined, these sensors ultimately transmitted a maximum of 837 signals per sensor field. This maximum was never achieved during Phase I operations. One drawback of the Phase I sensors was that they were not commandable, meaning they could not be remotely switched on and off.[3]

With operational use, Phase I sensors improved over time. Sensor component reliability was improved and battery life increased, extending the useful life of the entire sensor. Eventually, other types of sensors were fielded. At first only seismic and acoustic sensors were shipped to Southeast Asia under the Phase I program. Later versions included electromagnetic detection sensors and greatly improved seismic and acoustic sensors. The following is a brief description of the variants used during the Vietnam War.

Phase I Sensors

Acoubouy—abbreviation for acoustical buoy (diameter, 4.75 inches; length, 36 inches; weight, 26 pounds). The heaviest internal component in the sensor was the sealed lead acid battery. The Acoubouy was a derivative of the U.S. Navy's Sonobouy sensor that was used for years as an underwater submarine acoustic detection device. Sonobouy is still in use today, though it has been significantly improved over the years. For use in the Igloo White program, the Sonobouy hydrophone (used to detect sound underwater) was replaced with a microphone. Like their Navy counterparts, Acoubouy sensors were dropped by aircraft or helicopter and floated to earth via parachute. The parachute not only decelerated the sensor so it fell slowly to earth but also allowed it to become entangled in the branches of trees. Suspended from above, it was hidden from ground view. The parachutes were colored light green, and the sensors painted in standard Southeast Asia tan and green camouflage. The microphones used in the Acoubouy produced surprisingly high-quality sound. Hanging among the tree limbs, the sensors picked up the sounds of enemy conversations, vehicle motors, attacking aircraft, and exploding ordnance. Acoubouys were dropped primarily in the border areas between South Vietnam, Laos, and Cambodia, where traffic along the Ho Chi Minh Trail was heaviest.[4]

ADSID—acronym for air-delivered seismic intrusion detector (body diameter at its slimmest point, 3 inches; combined diameter for the body plus tail fins, 10 inches; length, 31 inches; weight, 25 pounds). The ADSID was designed to be dropped from either high- or low-speed aircraft. Upon impact, its high rate of speed from the fall drove the body into the ground, effectively leaving only the baseplate and antenna visible aboveground. Fins kept the assembly stable during its descent; the baseplate stopped the sensor body at ground level. Once embedded, the sensor picked up seismic vibrations transmitted through the soil and into the sensor casing. A transmitting antenna was cleverly concealed, wrapped in plastic resembling a small tree sapling. The sensor was activated upon impact. Soil transmission qualities affected the sensor pickup range. For detecting vehicle movement along the Ho Chi Minh Trail in Laos and Cambodia, the ADSID was considered the sensor of choice. Its ability to be dropped from high-speed aircraft, such as the F-4 Phantom, gave the delivery aircraft significant survivability over hostile territory.[3, 5]

ACOUSID—abbreviation for acoustic seismic intrusion detector; (diameter at the body's base, 3 inches; diameter of the body plus tail fins, 4.6 inches; length, 48 inches; weight, 37 pounds). The ACOUSID was also known as the thumbtack because of its strong resemblance to those common household items. This sensor combined acoustic and seismic sensors in a single unit, making it a significant improvement over either the acoustic or seismic sensor. If the ACOUSID's seismic sensor detected movement, a small microphone at the antenna's base could be turned on from a remote location to determine specifically what caused the sensor to activate and send out a signal. The ADSID and ACOUSID sensors were the most frequently used during the Vietnam War, accounting for a large percentage of the electronic sensors deployed in Laos.[3, 5]

Spikebouy—one of the first electronic sensors developed (overall dimensions were about the same as those of its Sonobouy cousin). Essentially, it was a Navy Sonobouy modified for seismic sensing at Sandia National Laboratories in New Mexico. Aircraft dropped the sensor, which free-fell to earth; on impact, the sensor was implanted in the ground by the energy built up during the fall. These sensors, dropped primarily by OP-2E aircraft, were some of the first devices to be air-dropped in support of Igloo White operations.[6]

HELIOSID—abbreviation for helicopter-delivered seismic intrusion detector (generally the same overall dimensions as the Spikebouy). This sensor was specifically designed to be dropped from helicopters. The Air Force CH-3 turbine-powered helicopter was preferred, although the sensor could be dropped from the open door of any helicopter. The HELIOSID operated exactly like the Spikebouy. Initially the CH-3 helicopters were outfitted with special launchers that fired the sensor from directly under the helicopter. The thrust produced by the launch was supposed to have been sufficient to implant the device into the ground. Once the sensor was implanted, the helicopter pilot radioed its coordinates to the infiltration surveillance center (ISC) at Nakhon Phanom to ensure the sensor was operating and that NKP knew of its exact location. Unfortunately, the thrust developed by the launcher was too great; most of the sensors did not operate after hitting the ground with such force. The launcher was eventually discontinued, and the aircrew simply tossed the sensor out an open door.[7]

Phase II Sensors

Phase II sensors differed significantly from the originally fielded Phase I sensors. First, the Phase II sensors could be remotely commanded by orbiting relay aircraft or by the ISC through the orbiting aircraft. This gave technicians monitoring the sensors the advantage of extending sensor battery life by switching the sensors off when not needed. It also enabled technicians to switch on microphones whenever the sensor detected seismic activity. Except for the thumbtack, Phase I sensors were not commandable; they were triggered on when specific parameters were met (i.e., audio or seismic threshold levels). Phase II sensors also had several modes that could be commanded on either individually or simultaneously, thus simultaneously transmitting audio and seismic signals to relay aircraft in real time. Moreover, these improved sensors could store detected signals and transmit the information at a later date. The first Phase II sensor used in Southeast Asia was dropped into Laos on 22 October 1968.[3, 5]

Four basic Phase II sensors were fielded—Acoubouy, Spikebouy, FADSID, and ACOUSID. The Phase II Acoubouy and Spikebouy were basically the same as the Phase I sensors, but they now had a commandable on/off function. The fighter air-delivered seismic intrusion detector (FADSID) replaced the Phase I ADSID and was designed to be carried on high-speed F-4D delivery aircraft. These new sensors were more robust and streamlined for high-speed carriage. The most versatile Phase II sensor was the ACOUSID, which was both an audio and a seismic sensor. If the sensor detected seismic signals, the relay aircraft or the ISC could switch the audio sensors on and try to determine what was creating the seismic activity.[3, 5]

Phase III Sensors

As good as the Phase II sensors were compared to Phase I versions, they still needed further refinement. The Phase III sensor improvement program began in early 1970. Improvements included additional transmission channels, which greatly expanded the sensor fields. A modular design was also incorporated, standardizing the internal components of sensor types. These improvements provided greater flexibility in signal transmission and response. ADSID, ACOUSID, and Acoubouy sensor platforms were modified into a standardized baseline Phase III sensor. The Phase I, II, and III sensors were used in conjunction with each other until the logistics pipeline for the older sensors was exhausted. Their functions were not terminated in the field, because they provided valuable sensory information until their batteries went dead.[3, 5]

In the late 1970s the U.S. military conducted a series of tests at Fort Huachuca, Arizona, on the Phase II seismic sensors. The goal was to better understand seismic signatures of occurrences near the sensors. Researchers conducted tests in wet and dry areas and in a wide variety of soil conditions on the Fort Huachuca military reservation. Seismic activity monitored during the testing went from the mundane, such as troops walking near the sensors or dropping a tool, to the more exotic, such as driving an M151 wheeled vehicle and an M577 tracked vehicle near the sensors. The test results were evaluated and improvements incorporated into the Phase III sensors.[7]

Three sensor types made up the improved Phase III sensor program—the ADSID III, ACOUSID/Commike III, and engine detection (EDIT) sensor. The ACOUSID/Commike III sensor was an improved ACOUSID that enabled ISC technicians to remotely command the acoustic microphone on or off, hence the abbreviation Commike (commandable microphone).

The EDIT sensor was designed to pick up electronic pulses emanating from the electrical ignition system of gasoline-powered vehicles. Enemy vehicles of the era were not normally equipped with shielded ignition systems. As a result, radio frequency radiation emitted by the ignition system (the engine ignition coil, spark-plug wires, spark plugs, radios, etc.) emitted "static." This static is the very same noise that can be heard in car radios when there is a shielding problem or intermittent ground. The EDIT sensor could pick up these emissions.[5]

Before being deployed in Southeast Asia, the ADSID III sensor was field-tested at Fort Hood, Texas. The testing, conducted under the code name Project MASSTER (acronym for mobile army sensor systems test), was designed to see how well the sensors performed in three types of field tests—materiel adaptation and evaluation, functional and organizational experiments, and field exercise tests. Materiel adaptation and evaluation testing consisted of confirming the sensors' military potential. Functional and organizational experiments tested the sensors' integration into the functional military units that would operate them; it was primarily a user test. The field exercise test allowed for a small-scale troop test in the field. Fort Hood was chosen for this test because of its soil mix. The area had sections with good seismic qualities and large areas where seismic sensors were suspected of being ineffective. The testing included determining the air delivery depth of penetration and angle of impact, both critical factors for high-speed air delivery operations. Testing was completed in 1969, and the results were deemed positive. Later that year, the sensor was fielded to Southeast Asia.[7, 8]

In the early 1970s the ADSID's electronic circuitry underwent a technical review to determine if it would be practical to upgrade the electronics. As a result of this review, a two-class seismic classifier was incorporated into the Phase III ADSID. This improvement allowed for a reduction in the data handling and processing facility needed for target discrimination. After improvements defined during the technical review were incorporated, the new units were more reliable than the older versions; information sent to the processing facility was much more current, or real time, than that of the old units.[9]

One important improvement greatly expanded sensor use and data transmission; sensor identifier channels were increased from 27 in the Phase I and II sensors to 64 in the Phase III versions. This was accomplished by using digital codes in the Phase III sensors, as opposed to the analog tone codes used in earlier phases. In turn, this reduced the number of transmission bands and dramatically increased the number of channels—from 32 to an astounding 640. Incorporating these modifications and improvements into the Phase III sensors increased the maximum sensor field coverage from the Phase II maximum of 837 to a Phase III maximum of 20,480.[3]

Also improved upon was sensor effectiveness range. The following table summarizes the Phase III sensor ranges:[3]

Sensor Type	**Vehicles**	**Troops**
ADSID III	328–492 feet	98–164 feet
ACOUSID/Commike III	984–4,920 feet	98–328 feet
Seismic/ACOUSID III	328–984 feet	98–164 feet
Ignition/EDIT III	328–656 feet	Not applicable

A new sensor type was implemented during the Phase III upgrade program. The EDIT III detected pulsed radio frequency energy from unshielded gasoline-powered engine ignition systems. The new sensor used a standard Commike III housing and a parachute to slow its decent. The sensors were dropped in dense foliage so that the parachute canopy became entangled in tree limbs leaving the sensor suspended in the tree to detect passing vehicles. The EDIT sensors were effective, but lightning discharges sometimes activated the sensor transmitter, sending a false signal to the ISC in Thailand. Unfortunately, there was no way to discriminate between a passing truck and a lightning burst, short of getting an updated weather report from the local area.

With the greatly expanded capabilities of the Phase III sensors, an upgrade modification program was initiated to modify the ability of airborne relay aircraft to accept the increase in sensor data flow. The USAF initiated a program wherein 18 EC-121Rs received the necessary upgrades to process the increased Phase III sensor data flow. All QU-22 Pave Eagle aircraft were also upgraded and designated as strictly Phase III relay aircraft.

By February 1971, all Phase I and II sensor fields had become inactive. Their batteries were allowed to expire, and the areas were not reseeded with the old-style Phase I sensors. All sensors deployed after February 1971 were of the Phase III type. This allowed for a standardized sensor system and greatly streamlined logistics support. As an added benefit, the standardization program significantly reduced the overall cost of the sensors.

An ongoing sensor improvement program allowed for developmental improvement of the ADSID III. In 1975 the ADSID III electronics processor portion was improved, significantly reducing false alarm rates. A two-class seismic classifier module was installed, greatly reducing the need for large, sophisticated data handling and processing centers used for target discrimination. The sensor was also improved by increasing its resistance to temperature variations; it could operate in almost any environment on the planet, while withstanding the high shock impacts of air delivery.

Although many different sensor types were successfully used during the war in Southeast Asia, there was one glaring example of failure. The radar beacon transponder (RABET) was an attempt to provide attacking aircraft with a signal to home in on. The sensor consisted of a 400-watt X band radar beacon in an ACOUSID II casing. It was to be dropped from the 25th Fighter Squadron's LORAN-equipped aircraft. The RABET test program operated from July through October 1970 and accomplished six sensor test drops. Of the six sensors dropped, only one worked after reaching the ground. The project was canceled in December of 1970. It was a good idea, but the technology required to make it work had not reached the point of fielding a reliable unit.[4, 8]

Notes

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2. Bernard C. Nalty, "Chapter VIII: Beyond the Next Hill," in *Air Power and the Fight for Khe Sanh* (Washington, DC: Air Force History and Museums Program, USAF, 1968). ISBN 0-919299-20-X.

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CHAPTER 3

Hand Emplacement Devices

ACTIVATION OF the electronic wall started in the mid-1960s with delivery of hand-delivered seismic intrusion detectors (HANDSIDs) to the U.S. Army Command, Vietnam. However, military units at the platoon and company levels had little understanding of sensor use, nor were they briefed on the big picture of sensor integration into the war effort. In April 1968 the U.S. Army instituted a training program called Duffel Bag. This program was designed to train combat units and commanders to operate and use the various sensors. By mid-1969 the training program had succeeded in its plan; most allied units were somewhat familiar with sensors and their capabilities. U.S. incursions into Cambodia, ostensibly to capture enemy munitions and food, also allowed U.S. and South Vietnamese Army units to place sensors in and around captured caches as well as trails and roadways near enemy base camps.

South Vietnamese special operations forces and U.S.-financed special operations groups carried out cross-border operations into Laos and Cambodia, placing sensors at strategic locations along infiltration routes. These small teams were known as Spike Teams—a reference to the spike-like anchor used to secure hand emplacement sensors in the ground. Some sensors also used this spike as the seismic pickup detector.

Hand emplacement sensors were accepted and routinely used by the U.S. Army in conjunction with so-called ambush nets. To create an ambush net, allied daytime patrols placed sensors along known or suspected enemy trails. At night, ambush teams waited for sensor activity and attacked the sites where specific sensors detected movement or activity. In the early 1970s, each ambush site was costing the enemy an average of 10 to 30 deaths per night. The U.S. Army's 11th Armored Cavalry used sensors at ambush sites to great effect in Binh Long Province, South Vietnam.[1]

The 1980s hit TV series *Tour of Duty* contained several episodes depicting the use of sensors by army patrols in Vietnam. In one episode, a squad of army personnel is dispatched to reactivate an abandoned base camp. The squad leader is issued HANDSIDs to be planted in the ground at specific locations near the base camp. The technical adviser to this series is to be commended for the accuracy of information provided in this scene. In it, the squad leader not only explains the sensor's operation but also shows exactly how to place it in the ground. Viewers can see the HANDSID, fitting neatly in the squad leader's open hand. A small wire antenna protrudes from one end of the sensor, a spike from the other. The squad leader instructs his personnel to push each sensor, spike down, into the ground. The spike provides a firm base for the sensor and acts as a seismic antenna, picking up ground vibrations. Lastly, the squad leader directs the troops to cover the sensor with earth to completely hide it from view, with only the antenna showing.

Four types of HANDSIDs were fielded during the Vietnam War: the MAGID, MICROSID, MINISID, and PSID. Each transmitted a signal to a Portatale, a portable receiving station designed to acquire signals from hand emplacement sensors and process the signals accordingly. Troops placed sensors in specific patterns around camps or villages so that the receiving station could determine the enemy's location and direction of movement. These devices were invaluable in protecting allied soldiers and Vietnamese civilians not only during patrols but also whenever base camps, air bases, and naval facilities were threatened. Devices that were not hardwired directly into a receiving station, such as a Portatale, transmitted via line of sight on specific radio frequencies. The following sections briefly describe each sensor type.

MICROSID

The micro seismic intrusion detector (MICROSID) was a small, lightweight seismic detector. Its compact design allowed infantry soldiers to carry several at a time in their ammunition pouches. The sensors were hardwired and used electricity provided by the Portatale receiver, which had its own power source (usually a battery). MICROSIDs were perfect for their intended purpose; they were ruggedly built and very reliable given the abuse they took when carried around the countryside by ground troops. MICROSIDs were used for perimeter protection around camps when troops were deployed in the field, away from their base camps. This was one of the first hand-delivered sensors used in Southeast Asia.[2]

MINISID

An improved version of the MICROSID, the miniaturized seismic intrusion detector (MINISID) was somewhat larger and had a greater detection range. It was lightweight, rugged, and designed so that an infantryman could easily carry several. As its name implies, this sensor detected seismic activity. The MINISID could be attached to any of the other hand emplacement devices, such as the MAGID, and used with that device to provide maximum multispectral sensor detection. Like MICROSID sensors, MINISIDs were electrically connected (hardwired) to a Portatale receiver, which provided their operating power. The sensors, perfectly suited to their purpose, were ruggedly built and reliable during field use.[2]

In early 1971 the MINISID underwent field testing at the U.S. Army Engineer Waterways Experiment Station in Vicksburg, Mississippi. Researchers wanted to see how well the sensors held up in both wet and dry environments under various climatic conditions. The tests collected data on sensor response to vehicle movement, such as the M151 wheeled vehicle and M577 tracked vehicle; to troops moving past the sensor; and to items being dropped near the sensor, such as tools, weapons, and so on. When researchers concluded that MINISIDs were suitable for field use by military personnel, the devices were shipped to Southeast Asia.[3]

MAGID

The magnetic anomaly detector (MAGID) was, as its name implies, a sensor designed to detect metallic objects such as rifles, ammunition, or other items carried by enemy troops passing close by. The sensor worked something like an airport security detector. When the MAGID detected a specific amount or concentration of metal, it sent a signal to an orbiting aircraft for relay to the information surveillance center (ISC).[2]

PSID

The patrol seismic intrusion detector (PSID)—also called personnel seismic intrusion detector (PERSID)—had two primary components, a detector and an annunciator. The detector, or in military terms the AN/GSQ-151, was a seismic sensor that was hand placed in the ground at a specific location. The annunciator, or ID-1762/GSQ, was the PSID component that indicated seismic activity picked up by the sensor. The entire device consisted of four sensors, a receiver, and the annunciator. It was small enough to be carried by one infantryman. Very reliable and able to withstand considerable abuse, each device cost approximately $280 (in late 1960s dollars).[4] When a platoon on patrol took a rest stop in the jungle, the troops placed sensors anywhere from 80 to 165 feet around the rest area. This was considered enough distance to give ample warning of enemy activity within that area. PSIDs were connected by wire to a receiver that could be placed some 1,640 feet away from the device. Each detector had a battery life of approximately 30 days. Battery life actually depended on the length of time the sensors and receiver remained on and the conditions under which they operated. Each sensor transmitted its own unique signal code, giving the listener at the receiver a specific location of an intrusion. Before the device was authorized for use in Southeast Asia, the U.S. Army tested it in Texas. Recommendations were made to improve its overall reliability and utility, and by early 1968, the PSID was being used in Vietnam.[2, 5, 6, 7]

HANDSID

The hand-delivered seismic intrusion detector (HANDSID) was also small enough to be carried by troops in the field. It was placed in the earth with only the transmitting antenna visible aboveground. HANDSIDs had multiple uses, including any combination of seismic, magnetic intrusion, or passive infrared detection modes. They were carried into the field with the transmitting antenna removed. The sensor assembly had a built-in destructive charge as well as an arming system. After placing a sensor into the ground, the infantryman set a destruct circuit by inserting an arming key into an arming lock and turning it 90 degrees. Once the system was armed, if the sensor were turned more than 15 degrees from the vertical, the destruction device destroyed the sensor's internal components.

In the late 1970s the military conducted a series of tests at Fort Huachuca, Arizona, on the Phase II seismic sensors. Army researchers wanted to better understand the seismic signatures of occurrences near the sensors. They conducted testing in wet and dry areas and in a wide variety of soil conditions of the Fort Huachuca military reservation. Seismic activity monitored during the testing ranged from the mundane, such as troops walking near the sensors or a tool being dropped, to more exotic testing such as having an M151 wheeled vehicle and an M577 tracked vehicle drive near the sensors. Test results were evaluated and improvements incorporated into HANDSID sensors.[8]

Marine Force Recce Sensor Emplacement, circa 1968

While conducting research for this book, I had the opportunity to discuss the HANDSIDs with Mr. Johnny Herman, a U.S. Marine Corps combat veteran of the Vietnam War. From 1968 through 1969 Mr. Herman was assigned to U.S. Marine Corps Reconnaissance, 1st Force Recce Company, code-named Team Hunt Club, in South Vietnam. The mission of Marine Corps 1st Force Reconnaissance is twofold: (1) conduct reconnaissance deep within enemy territory, and (2) take direct action against the enemy. Entering the Force Reconnaissance Company is mentally and physically challenging, exhausting, and demanding; not many make it. The 1st Force Recce emblem illustrates it all: a scuba diver superimposed on parachute jump wings. Team members are highly trained in amphibious, airborne, and ground reconnaissance. During the five years that the 1st Force was in combat in Vietnam, it conducted more than 2,200 recon patrols and sustained 44 men killed or missing in action. One of its tasks was sensor emplacement deep in enemy territory.[9]

As we sat discussing the Vietnam War, the electronic wall in general, and HANDSIDs in particular, Mr. Herman related to me a combat mission that stood out in his mind. As the sun broke over the horizon on a hot, humid Vietnamese central highlands morning, a reconnaissance team squad (usually five men) received orders to recon a suspected enemy infiltration route along the border area between Laos and the northwesternmost part of South Vietnam. The squad was briefed on the mission, suspected areas of infiltration, enemy activity in the area, and requirements after arriving at the site. They were then flown by an armed Marine Corps CH-46 helicopter to a drop-off point near the border. The squad disembarked and surreptitiously made its way to the area where intelligence indicated the enemy might have been active and on the move. On missions like this, the distance between the helicopter landing zone (LZ) and the targeted site was usually several miles, due to the clandestine nature of the patrol. Landing too close to the site would tip off the enemy that the American military was in the immediate area. Once on the ground, and behind enemy lines, the team was isolated. If they ran into trouble, they would be unable to call in artillery strikes or request additional men to assist them in battle. The best they could hope for was to make it back to the helicopter pickup point in time and with no casualties.

Once at the LZ and out of the helicopter, the squad made its way to the suspected area near the Laotian border, moving quietly but deliberately. They were to monitor a location near an abandoned U.S. Army fire base. Intelligence suspected that the North Vietnamese Army (NVA) had moved into the area and was using it as an infiltration point. After several hours of jungle navigation, the squad could see the abandoned fire base in the distance; they stopped short of the base to reconnoiter the area. Although there appeared to be no activity, the squad moved slowly and carefully, looking for trip wires and booby traps. Since all five of the squad members had previously been in combat, they knew what to look for—an overturned leaf, a broken tree limb, a concealed trip wire, or anything out of the ordinary. Like most abandoned fire bases, this one was littered with trash from the U.S. Army's use. Empty shell casings, wooden planks and pallets, gun barrels past their useful life, and rations of all sorts littered the area. The NVA and Viet Cong (VC) were known to infiltrate areas like this, scavenging for anything that could be of material or intelligence use.

Once assured that the area was clear of anything that would cause harm, the squad moved on to a location a short distance just outside the fire base. They had been instructed to place sensors in the nearby area. The HANDSIDs they carried were slightly disassembled standard-issue seismic sensors; the antennas were removed, and the systems were not armed. Although familiar with the sensors, the squad had nonetheless been instructed on proper sensor emplacement just before the mission. As usual with these emplacements, the men were directed to return a handful of soil from the site. The sensor community analyzed the soil samples to determine their seismic properties. This assisted the processing center in Thailand—or deployable automatic relay terminal (DART) facilities in South Vietnam—in correctly interpreting sensor signals.

The squad carefully located each sensor site, ensuring that the HANDSIDs were well concealed and yet performed properly. At each site they dug a small hole, placed the sensor in it, and filled in the hole up to the antenna's base. Then they attached the antenna, which resembled a small tree sapling, and inspected the sensor with a leveling device to ensure it was not tilted. If the sensor was tilted more than 15 degrees, it selfdestructed as soon as it was armed. Next came the arming procedure. A squad member carried the arming key. This key fit into a lock on the top of the sensor body; when turned 90 degrees, the key activated the sensor electronics as well as the destruct circuit. After arming the sensor and removing the key, the team finished covering the sensor with soil to completely hide it from view. Once in place, the antenna blended in with the surrounding foliage, and the squad was adept at smoothing out the soil to make it match the surrounding soil texture. The casual passerby would have difficulty detecting it.

The squad then moved back to the abandoned fire base, where they encountered something they were not prepared for. On a ridge running parallel to the base, a line of 17 NVA soldiers and one Caucasian were walking nonchalantly along, oblivious to the recce squad. As luck would have it, one of the recce squad members had erected a small lean-to from half of his field tent. The squad members ducked behind the lean-to and watched the NVA walk past—not more than 50 yards away. The Marines were in a precarious situation. They were outnumbered, with only a thin sheet of fabric between them and the enemy. Worse yet, their defensive position was weak; if a firefight broke out, they would be firing up toward the ridgeline.

As a few tense minutes passed, the team leader, using binoculars, guessed that the Caucasian was French. Every now and then, the team caught portions of conversations in French. This was a bit of a surprise to the team, which expected any Caucasian associated with the NVA to be from the Soviet Union. Mr. Herman described the man as looking like U.S. President Abraham Lincoln. He was tall and lanky, his face gaunt and bearded. But however significant this Lincoln look-alike may have been, the immediate concern was the recon squad's well-being. Hearts raced, and squad members trained their rifles on the line of enemy troops that continued casually walking past. Eventually the troops disappeared from view, and the squad members breathed a simultaneous sigh of relief. There was one curious point about this particular recon; it was against regulations for a recce squad to leave anything in the area, so they never found out why one member had set up a lean-to and left it in place. But the entire team was glad that he had; there was no other cover, and the enemy would surely have sighted them.

The rest of the mission was uneventful. The CH-46 returned on time to extract the squad. The mission was considered successful because they had implanted the sensors without being detected. Upon debrief, the intelligence community was able to match the sensor locations and activations with the NVA movement past them. This greatly assisted in calibrating the sensor system. The squad never did find out from the intelligence community who "Lincoln" was, but at every Marine Corps reunion they attend, the conversation eventually turns to that recon mission.

Notes

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8. STINET Report no. ADB005327, *Effects of Terrain on the Propagation of Micro-seismic Waves and Implantation Characteristics of Air-Delivered Sensors at Fort Huachuca, Arizona, Wet and Dry Season Conditions* (Fort Belvoir, VA: Defense Technical Information Center, June 1, 1973).

9. This section is based on personal conversations with Mr. Johnny Herman. Mr. Herman was a Marine lance corporal with the Marine 1st Force Recce Company, Team Hunt Club. He was actually on this patrol and described the events to me.

CHAPTER 4

Airborne Sensor Delivery Systems

A WIDE RANGE of airborne vehicles were used to deliver sensors to the battlefields of Southeast Asia. Threat environment dictated the method of delivery; slow-moving aircraft delivered sensors to low-threat areas, high-speed aircraft to high-threat areas. In low-threat areas, sensors were thrown out open doors of helicopters, such as the CH-3, or released from the propeller-driven Korean War era A-1 Skyraider attack aircraft. In high-threat areas, the sensors were dropped from the high-speed F-4D fighter-bomber.

Sensor delivery was fraught with danger. Aircrews operating over Laos, Cambodia, and southern North Vietnam were subjected to a wide variety of antiaircraft fire. Weapons such as 20-, 30-, 57-, and 87-mm antiaircraft artillery as well as rapid-firing ZPU radar-directed cannon fire were a constant threat to aircrews. Although fire from these weapons was visible during the day, night flights brought home the significance of flying in such a high-threat environment. At night the constant spray of yellow light from the fire of ZPUs and glowing balls of light from high-caliber antiaircraft rounds could fill the air near the aircraft. Later in the war the Soviet Strella, a man-portable, shoulder-fired infrared guided missile, became a significant threat. To make matters worse, the cluster bomb units (CBUs) carried by the F-4s occasionally exploded just under the wing after being released from the aircraft. The F-4 stored fuel in its wings, so any damage to the wings potentially led to catastrophic results. At least three F-4s were known to have been lost during the war due to this self-inflicted damage, and several returned to base with countless holes in the aircraft from exploding cluster bombs. On top of all this, sensors released from the aircraft contained batteries with an average life of 30 days. This meant that the sensor or sensor strings required reseeding approximately once a month, again subjecting aircrew to antiaircraft fire. The following sections summarize the air vehicles used for sensor drops and their assigned units.

OP-2E Neptune: U.S. Navy Observation Squadron 67 (VO-67), Nakhon Phanom (NKP) Royal Thai Air Base, Thailand

In October 1966 the Defense Communications Planning Group (DCPG) directed the U.S. Navy to modify 68 SP-2E aircraft (an already modified version of the original 1950s era Naval P2V-5F patrol bomber) to have the capability to deliver sensors for the Igloo White program. The original quantity of 68 aircraft was later reduced to 15. This reduction in aircraft requirements was based on a 1967 DCPG decision to turn over sensor air delivery operations to the U.S. Air Force. After its modification, the SP-2E was redesignated the OP-2E. Twelve of these specially modified aircraft were assigned to fixed-wing Naval Observation Squadron VO-67, and three were relegated to a test and evaluation program. The squadron deployed to Southeast Asia with all 12 aircraft in November 1967 and was placed under the command of the USAF's Seventh Air Force.

The Martin Aircraft Company facility near Baltimore, Maryland, received the SP-2E from the Navy and reconfigured it as the OP-2E. Martin added armor plating, required for operations over hostile ground forces in Laos and Cambodia, and special surveillance radar. Perhaps most important, they installed the original P2V Sonobouy delivery system to accommodate the Igloo White Acoubouy and air-delivered seismic intrusion detector (ADSID) sensors. The original R3350 piston engines were replaced with new, more powerful R3350-WA32 versions. The metallic propellers of the SP-2E were replaced with propellers constructed of fiberglass. This change alone made the aircraft less visible to enemy radar. Because they were much lighter than the original metal propellers, the fiberglass propellers also reduced overall weight of the aircraft. Other changes were incorporated and are detailed in Appendix 1. The P2V was selected for this mission and other special operations missions because of its long history of successfully deploying antisubmarine detection devices, primarily the magnetic anomaly detector. The aircraft had long range, loiter time, and could be operated out of relatively short, unimproved airfields.

VO-67 was commissioned on 15 February 1967 at the Alameda Naval Air Station, California, specifically for delivering sensors in South Vietnam and Laos. On 1 May 1967 the one and only aircraft available with support personnel was sent to Eglin AFB, Florida, to participate in a test program called Dune Moon. This program was designed to integrate airborne sensor subsystems with aircraft and ground support stations in an effort to evaluate what was then called the Muscle Shoals Program (the electronic wall). After nearly six months at Eglin, testing was deemed successful and the aircraft returned to its operating location at Alameda. Shortly thereafter, the squadron was deployed to Thailand to commence combat operations.

During the squadron's deployment to Southeast Asia, the OP-2Es were further modified to improve overall accuracy of sensor delivery and aircraft survivability. In December 1967, squadron aircraft were rotated to NAS Sangley Point in the Philippines, where Martin Aircraft Corporation personnel installed the APQ-131 terrain avoidance radar; APN-153 Doppler navigation system; more armor plating; and a World War II era Norden bombsight, to be used for pinpoint delivery of the sensors. The original submarine-hunting P2V had no a bombsight. Dropping sensors into the ocean in search of submarines did not require pinpoint accuracy, so the sub-hunting sensors were usually dropped visually, or the drop was timed based on known or suspected target locations. It was no small job getting hold of the Norden bombsights; they had long ago become the stuff of history. The original P2V was outfitted with an MK-8 reflex sight, which was nothing more than a non-computing gun sight, and it was not accurate enough for Igloo White operations. A set of 7.62-mm mini-guns was mounted under each wing of the aircraft, and gun mounts were fixed at the left and right rear windows in the aft fuselage.

At first, sensor drops from the OP-2Es were accomplished at 500 feet above ground level (AGL). The aircraft carried ADSID and Spikebouy sensors on four underwing pylons just outboard of each wing-mounted jet assist pod. With a special modified pylon adapter, up to 24 sensors could be carried on the wing stations. Additional sensors were carried on special racks in the internal fuselage bomb bay.

On 11 January 1968, the first in a series of OP-2E losses occurred. Apparently due to inclement weather, aircraft serial number 131436 flew into a 4,583-foot mountain during a sensor drop mission in Laos. The aircraft's right wing clipped the face of Phou Louang Mountain, causing it to cartwheel into the side of the mountain karst. All nine crewmembers aboard were killed in the crash; no bodies were recovered due to the hazardous location of the wreckage.

February 1968 was even more devastating for the squadron. On 17 February, aircraft serial number 131486 was hit by enemy ground fire while flying at 2,000 feet AGL over Laos. The aircraft crashed, killing all nine crewmembers. The pilot's last transmission was, "We're beat up pretty bad." The remains of all nine crewmembers were recovered from the crash site in 1993. On 27 February a third squadron aircraft, call sign SOPHOMORE 50 (serial number 131484), was lost when hit by enemy ground fire over Laos. The aircraft was flying just south of the Ban Karai Pass and near the Ban Laboy Ford during a sensor drop mission. In this instance, the USAF's 37th Air Rescue Recovery Squadron, based in Thailand, rescued 7 of the 9 crewmembers who had bailed out of the crippled aircraft over Laos. The remains of one missing crewmember were recovered at the crash site in 1994. The remaining crewmember, the pilot, is still listed as missing in action. Four more aircraft were hit by ground fire but managed to return to base. Due to the losses and damaged aircraft, the altitude for sensor delivery was raised from 500 to 5,000 feet AGL.

From fall 1967 through spring 1968, the squadron operated out of NKP. As stated, several of the squadron's aircraft were shot down over Laos and many lives were lost. The propeller-driven aircraft were extremely slow, with a maximum speed of around 200 miles per hour. The rate of climb was also very slow and may have contributed to the aircraft crash at Phou Louang Mountain. Each aircraft carried a crew of nine, making operational losses that much harder to recover from.

One example of just how dangerous these missions were is a 25 April 1968 mission over Laos. During this sensor drop mission, two U.S. Air Force F-4D fighters were escorting an OP-2E (operating as call sign Caroline 07) when the flight came under intensive antiaircraft fire. Although the OP-2E was not hit, 57-mm antiaircraft rounds struck one of the F-4s. That aircraft, serial number 66-7758 from the 497th Tactical Fighter Squadron at Ubon, Thailand, had a 57-mm round blow an 18-inch hole in the left wing. The pilot, being closer to South Vietnam than his home base in Thailand, diverted into Da Nang Air Base in northern South Vietnam. Due to excessive operational losses, it was decided that the VO-67 would cease operations in Southeast Asia. The squadron's mission of delivering sensors was taken over by F-4Ds of the USAF's 25th Tactical Fighter Squadron. The final Igloo White combat mission flown by the OP-2Es of VO-67 occurred on 25 June 1968.

VO-67 was awarded a Navy Unit Commendation for its part in establishing the electronic wall. The commendation, signed by Secretary of the Navy John H. Chafee, reads in part:

> For exceptionally meritorious service from 15 November 1967 to 2 July 1968 during special operations in Southeast Asia. Although sustaining extensive operating damage and losses, and despite harsh climatic conditions at a remote operating base, the flight crews and ground support personnel of Observation Squadron Sixty-Seven consistently carried out their highly important and most sensitive missions with outstanding skill and dedication. The successful initiation of this new operation provided a significant and vital contribution to the art of warfare. By their courage, perseverance, and unfailing devotion to duty throughout this period, the officers and men of Observation Squadron Sixty-Seven upheld the highest traditions of the United States Naval Service.

In 1968 the squadron started terminating operations in Southeast Asia; by July, operations were completely terminated. VO-67 returned to the United States in August 1968. The remaining 10 aircraft were stripped of all usable equipment. Some of this equipment was turned over to the USAF; the rest was returned to supply inventory as serviceable equipment for use in other aircraft. The airframes were placed in storage at Davis-Monthan AFB near Tucson, Arizona, and eventually scrapped.

The VO-67s flew sensor missions for about 8 months. During that time, the squadron lost 20 aircrew members and 3 aircraft in combat. Although the attrition rate was less than predicted, it was still considered high. If not for the valor of VO-67 aircrews, the combat base at Khe Sahn, South Vietnam, would surely have fallen. This loss would have been devastating to the morale of Americans not only in the military but also at home in the United States.[1, 2]

F-4D Phantom II: U.S. Air Force 25th Tactical Fighter Squadron, 8th Tactical Fighter Wing, Ubon Royal Thai Air Base, Thailand

Before the specially modified F-4D aircraft of the 25th Fighter Squadron arrived in Vietnam, some of the Ubon unmodified F-4s assigned to the 8th Tactical Fighter Wing tried to deliver sensors. The results were dismal; the accuracy of delivered sensors was so poor that the sensor information they provided was useless. These unmodified F-4s dropped fewer than 100 sensors; the drops were a stopgap measure in an effort to stand down the OP-2E squadron, which was then sustaining unacceptable combat losses.

The 25th Fighter Squadron had been deactivated shortly after the Korean War during a period of military downsizing; it was reactivated in 1967 specifically for the Igloo White program. Reactivation took place at Eglin Air Force Base, Florida. The squadron was provided with factory-fresh F-4D fighter-bombers directly from the McDonnell Aircraft assembly plant in St. Louis, Missouri. This F-4D version was unique; the aircraft were equipped from the factory with an ITT/LSI AN/ARM-92 long-range air navigation (LORAN) system. Each aircraft was processed through two modification programs, Engineering Change Proposal 70.0 (ECP 70.0) and ECP 70.7. Both ECPs incorporated into the aircraft all the required hardware for Igloo White operations. One other program modification incorporated was the capability to carry a wide-angle (180-degree) camera pod in the left forward AIM-7 missile bay. The camera was required to record sensor drops so that photo-interpreter technicians could match the LORAN coordinates to the actual terrain where the sensor was delivered, thus providing a highly accurate record of sensor location. This camera capability—that is, the wiring for the camera—would become standard equipment on later F-4 versions.[3]

Twenty-one of these modified aircraft, all new 1966 models, were initially delivered to the squadron. These early aircraft were easily identifiable by the yellow squadron markings on the tail fin, around the equipment ram air intakes, and just under the canopy. The canopy rails, also painted yellow, bore the pilot and weapons systems officers' names. Early versions arriving at Ubon carried a colorful yellow dragon on the vertical fin, a reminder of the squadron's roots from World War II—they were then called the Assam Dragons, operating out of the Assam Valley in India. (The dragon was later moved from the fin to the fuselage, near the engine inlets.) Squadron pilots practiced airborne sensor delivery techniques over the restricted zones off the coast of Florida and in the neighboring special warfare center area at Hurlburt Field, bordering Eglin AFB.

In May 1968, the squadron deployed to Ubon Royal Thai Air Base in northeastern Thailand. The LORAN equipment initially proved to have very low reliability. Only 2 of the 20 aircraft arriving at Ubon had operational LORAN sets. They would break lock during maneuvers, weather, or near air-refueling tankers. However, a series of rushed modifications improved LORAN reliability.[3, 4]

The 25th Tactical Fighter Squadron (TFS) aircrews were initially tasked to deliver sensors at specific locations along the Ho Chi Minh Trail in Laos and Route Package I in southern North Vietnam. Sensor delivery flights consisted of two aircraft; the lead aircraft was loaded with sensors, cluster bomb units (CBUs), and a wingman carrying flak suppression ordnance. Both aircraft worked with an airborne forward air controller (FAC), called a Nail FAC, usually operating out of Ubon or NKP. If flak suppression ordnance was not required during sensor deployment, the aircrew worked with the FAC to deliver ordnance on targets of opportunity. All F-4 LORAN sensor drops were accomplished via straight and level flight at 500 to 2000 feet AGL and at 550 knots indicated airspeed. For accurate sensor delivery, the aircrew needed to maintain this flight profile for at least 30 seconds before releasing a sensor. When the sensor was ejected, the KB-18 wide-angle camera recorded the release and topography of the area into which the sensor fell. Photo interpreters at the ISC then reviewed this photo information as a cross-check to the LORAN coordinates and used it for potential strike coordinates if required.

The LORAN equipment also allowed for specific positioning of sensor fields. Delivery aircraft normally flew at a very low level; at least twice in 1969, squadron aircraft flew directly into 200-foot-tall trees while delivering sensors. Amazingly, the pilots were able to fly the aircraft back to Ubon. One aircraft, serial number 66-8789, returned from a mission over Laos with wood jammed down both engines, the left wing leading-edge flap extensively damaged, the radome completely destroyed, and significant structural damage to the underside of the aircraft. This aircraft was configured to carry 3 FADSIDs on each wing inboard station (for a total of 6) and 6 on the centerline station, for a total of 12 sensors. The extensive damage was deemed beyond the repair capabilities of the base. Both aircraft were shipped to the Philippines for heavy-duty depot-level repair.

Flying over Laos was always hazardous. In 1969 a two-aircraft F-4D flight from Ubon came under intensive antiaircraft fire. One ship was a sensor-dropping 25th TFS aircraft; the other was a flak suppression F-4D, serial number 67-8719, from the 433rd TFS, a sister squadron. Aircraft 67-8719 was hit in the nose by ground fire that destroyed its radome and radar package. As the aircraft became uncontrollable, the pilot called out to the backseater to eject. The pilot was then able to regain control and—amazingly—flew the damaged aircraft back to Ubon. Arriving there, he was unable to get the landing gear down and performed a gear-up landing on the runway. Luckily, the pilot walked away from the crash; three days later, a rescue team picked up the backseater in Laos.

As mentioned earlier, the F-4 was chosen to deliver sensors because of its speed, range, and two-man crew. Speed was essential because the trail that wound through Laos and Cambodia was heavily defended by the Khmer Rouge in Cambodia, the Pathet Lao in Laos, and the North Vietnamese Army in both countries. As pilots like to say, speed is life. Speed allows pilots to outfly adversaries, be they planes or missiles. The F-4 with its Mach 2 speed advantage was an ideally suited high-speed delivery aircraft. The F-4 also had the advantage of having a greater range than other types of high-speed airplanes. With its large internal fuel loading, capability to carry external fuel tanks, and in-flight refueling system, the aircraft had very long range, limited primarily to crew fatigue and mechanical reliability. With a two-man crew, the pilot could concentrate on flying the aircraft at high speed and low altitude while the weapons systems officer operated the LORAN and sensor delivery system. The LORAN system of the time was the only navigation system capable of delivering the sensor with the degree of accuracy required. Using LORAN, the sensors were usually dropped within an area of probability of 61 feet in range and 18 feet in azimuth of their intended location. For an aircraft moving as fast as the F-4, this was unheard-of accuracy at the time.

For several reasons, the USAF chose Ubon Royal Thai Air Base as the location for Igloo White F-4 operations. The base was relatively close to the Laotian and Cambodian borders; this not only decreased flying time to airdrop locations but also resulted in less fuel consumed and less time over hostile territory. Besides that, Ubon was almost exclusively an F-4 base. The 8th Tactical Fighter Wing was composed of the 497th, 433rd, and 417th Fighter Squadrons, and they all operated the F-4. Maintenance and logistics at Ubon were geared strictly to that aircraft, resulting in a better aircraft utilization rate.

Even under the best conditions, airborne delivery of sensors was difficult. Aircrews of the 25th Fighter Squadron were required to deliver the sensors within 262 feet of deflection error and 268 feet of range error. The pilots normally far exceeded that requirement, which was difficult enough for any aircrew and even more challenging at the high speeds reached by the F-4s. Couple this with low altitude, rough terrain, and the high drag associated with sensor carriage, and then consider that the F-4s were also being shot at. Initial problems with sensor drops from the F-4D were the result of outdated, poor-quality topographic maps. The maps were to be used along with LORAN data to ensure accurate sensor drop locations. The 180-degree camera installed on the underside of the aircraft helped considerably in determining specific sensor drop locations.[3, 5, 6]

During 1970, seventy-two more USAF F-4Ds were modified with LORAN systems under Modification Project 2038D at Clark Air Base, the Philippines. These newly modified aircraft carried a different antenna array on the dorsal deck. The original antenna, located in the vertical fin cap, was replaced with a new three-blade tandem antenna array. All the newly modified aircraft also had the wiring and provisions for carrying the KB-18 wide-angle camera in the forward left-hand missile bay. This camera was capable of 180-degree, horizon-to-horizon daytime photo coverage.[7]

EP-2E: U.S. Army 1st Radio Research (RR) Company, Cam Rahn Bay Air Base, South Vietnam

The 1st Radio Research Company is one of the lesser-known units to conduct airborne operations during the Vietnam War. It was a U.S. Army unit that operated the EP-2E, a highly modified version of the SP-2H Special Operations aircraft. The company was nicknamed Crazy Cats, also known as CEFLIEN LION. Its primary task was electronic signals gathering, although occasionally it was responsible for relaying sensor information to NKP. This task made the 1st RR Company and its aircraft ideal candidates for duty on the electronic wall. As with the OP-2Es of the U.S. Navy's VO-67 squadron, EP-2E involvement with the Igloo White program was relatively short. The unit arrived in South Vietnam in 1967 and operated part-time as a relay platform until early 1969. After 1969, the unit reverted to its original full-time mission of gathering signals intelligence from the battlefield. The Crazy Cats operated a total of six EP-2Es. Although the aircraft were assigned to U.S. Army aviation, they were originally delivered to U.S. Navy, so they retained their original Navy bureau numbers (BuNo's) after being transferred to the Army.

Some confusion existed over the model designation of the aircraft; some experts identified it as an AP-2H. The correct designation according to official records is EP-2E. The confusion surfaced years ago, when the U.S. Army assumed operations for some of the highly modified SP-2Hs. Army maintenance and operations personnel associated with the program gave the newly acquired aircraft the AP designation, which they likened to Attack/Patrol and Army/Patrol. However, the mission was always electronic data gathering, so the designator EP (Electronic Patrol) was used as the official designation.

CH-3E: USAF 21st Special Operations Squadron (SOS), Nakhon Phanom (NKP) Royal Thai Air Base, Thailand

The 21st SOS, known as the Dust Devils, was selected as the prime helicopter squadron to deliver sensors along the Ho Chi Minh Trail. The squadron's roots went back to 22 December 1939, when it was constituted as the 21st Pursuit Squadron (Interceptor); it entered World War II as the 35th Pursuit Group. In September 1965 the unit was consolidated as the 21st Helicopter Squadron, and in August 1968 it was redesignated as the 21st Special Operations Squadron, operating CH-3E helicopters. In November 1967 the squadron was sent to NKP; by January 1968 the squadron was in action, dropping sensors. The Dust Devils were instrumental (along with VO-67) in defending the Khe Sahn combat base. Squadron helicopters dropped electronic sensors around the besieged combat base, aiding in the defeat of the enemy and survival of the combat base.

The 21st SOS used area maps, area photos, and sometimes information from FACs to locate specific areas where sensors would provide the most effective information on troop and/or vehicle movement. Once over the area, the pilot or copilot signaled the flight engineer to drop the sensor out of the open helicopter cargo door. It's easy to imagine how hazardous this was in a hostile area.

The CH-3E helicopter was the USAF version of the U.S. Navy S-61. It was manufactured by Sikorsky as an amphibious transport. USAF versions had self-sealing fuel tanks; sponsons accommodating external fuel tanks, which increased range; externally mounted 7.62 mini-guns; in-flight refueling, which extended the helicopter's range; a permanently mounted rescue hoist, new to the CH-3 in Southeast Asia; titanium armor for self-protection, and foreign object damage/ice shields at the power plant's jet intakes. The CH-3E was later redesignated as HH-3E and nicknamed the Jolly Green Giant because of its size (as compared to other USAF helicopters of the time) and its green jungle Southeast Asia paint scheme. The CH-3E had a normal crew complement of three—a pilot, copilot, and flight engineer. It was powered by two General Electric T-58-GE-5 turboshaft jet engines that developed 1,500 horsepower each, and when fully loaded it weighed 22,050 pounds.

Using the helicopter, especially the CH-3, for sensor drops was logical at the time. The helicopter provided a stable platform. Additionally, based on maps, photos, and so forth, the crew could determine the exact location to drop the sensors. This information proved valuable to technicians at the ISC site at NKP. However, a hovering helicopter makes an ideal target for the enemy.

Operations with the Igloo White program in Southeast Asia lasted from January 1968 through February 1969. During that time the squadron lost two CH-3E helicopters while flying sensor drop missions. The two missions are summarized in the following paragraphs.

Helicopter serial number 66-13295 was lost while on a mission to drop sensors around the Khe Sahn combat base. The helicopter was one of three CH-3Es that departed NKP at 0654 on 23 May 1968. The three helicopters were escorted by two USAF A-1E propeller-driven, fixed-wing attack aircraft. The 66-13295 crew consisted of the pilot, Major James P. McCollum; copilot William H. Taylor; flight engineers John L. Coon and John E. Albanese; and crew chief Robert A. Fink.

When the helicopters and their escorts reached the target area, overcast covered the terrain; to visually acquire the target, they had to drop below the overcast. However, because of a low cloud cover, rugged mountains, and dense jungle, the target could not be visually acquired; the mission was aborted. The three helicopters and two fixed-wing aircraft climbed back through the cloud cover, all the while maintaining radio contact. Two of the helicopters reached the cloud tops and were followed by the two attack aircraft. Shortly thereafter, an explosion was observed under the clouds. The lead helicopter could not be reached by radio, and it was apparent after a time that it had crashed. The cause of the loss was listed as unknown. The wreckage was eventually located on a slope that was 500 feet below the peak of a 5,700-foot mountain. There were no survivors.

Helicopter serial number 64-14237, a CH-3E, was lost on 26 February 1969. Although the helicopter was shot down over Laos, there were no casualties; all crewmembers were recovered by friendly forces and returned to NKP.

The 21st SOS stood down from the Igloo White mission in early 1969. The 25th Tactical Fighter Squadron based at Ubon Royal Thai Air Base, Thailand, then assumed the sensor drop missions with their LORAN-equipped F-4D aircraft. After completion of the Igloo White mission, the 21st SOS continued with its primary special operations group missions.

During its operational life in Southeast Asia, the 21st Special Operations Squadron was awarded the Distinguished Unit Citation; the Outstanding Unit Award with a Combat "V" device; and the Republic of Vietnam Cross of Gallantry with Palm.[8, 9]

Douglas A-1E/A-1H Skyraider: USAF 22nd Air Commando Squadron, 56th Air Commando/Special Operations Wing, Nakhon Phanom (NKP) Royal Thai Air Base, Thailand

Although sensor drops were not the primary mission of the Air Commandos, the squadron did assist in the Igloo White program by dropping primarily ADSID sensors in Laos during the mid-1960s. Sensors were loaded into XM-41 dispensers, on the aircraft wing stations, with the sensor nose pointing aft and the sensor antenna pointing forward. A sensor antenna retaining ring held the antennae tightly together, so they easily passed out of the dispenser tube while falling aft of the aircraft flight path. Sensor drops from the Skyraiders were as accurate as those dropped by the U.S. Navy OP-2E aircraft or VO-67. The Skyraider operated slow and low—an advantage in planting the sensors, but a tremendous disadvantage to the aircrews because the low altitude and slow airspeeds made them perfect targets for the enemy. Because of this, aircrew members of the 56th Wing were deemed among the bravest of the brave. In some cases, 56th Wing members were flying and maintaining aircraft that had first been used during the Korean War.

An A-1E of the 22nd Air Commando Squadron is on display at the Royal Thai Air Force Museum in Bangkok, Thailand. Other Skyraiders, both A-1E and A-1H, have been returned to flying condition by private collectors and are touring on the air-show circuit.

During its operational life in Southeast Asia, the 22nd Special Operations Squadron was awarded the Presidential Unit Citation (multiple); Vietnam Advisory; Vietnam Defensive; Vietnam Air Offensive, Phase I, II, and III; Vietnam Air/Ground Offensive, Phase IV; TET 69 Counteroffensive; Vietnam Summer–Fall, 1969 Offensive; Vietnam Winter–Spring, 1970 Offensive; Sanctuary Counteroffensive; Southwest Monsoon Offensive; Commando Hunt V, VI, and VII Offensive; Republic of Vietnam Gallantry Cross with Palm; and Air Force Outstanding Unit Awards (multiple) with Combat V.

Notes

1. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee of Preparedness Investigating Subcommittee of the Committee on Armed Services* (November 18–20, 1970), 97–98. 105. U.S. Government Printing Office, Washington, DC.

2. *The History of U.S. Naval Observation Squadron Sixty-Seven*—February 1967 through December 1967. Naval Aviation History Office Publications, *Dictionary of Naval Aviation Squadrons*.

3. My own experiences with the 25th Tactical Fighter Squadron at Ubon, Thailand, 1968–1969.

4. *Project CHECO (Southeast Asia Report), Corona Harvest*, Interview no. 200 (June 12, 1969, 2–6). Directorate of Operations Analysis Office. This interview was conducted with a 25th TFS weapons systems officer.

5. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 18–20, 1970), 118–119. 105. U.S. Government Printing Office, Washington, DC.

6. *Project CHECO Report, Igloo White Program: July 1968–December 1969, A Contemporary Historical Examination of Current Operations—Oral Histories of 25th TFS Pilots*. Directorate of Operations Analysis Office.

7. "The LORAN D Retrofit Program at Clark AB," *MDC Product Support Digest* (2nd Quarter, 1971), 15, 34.

8. *A History of the 21st Special Operations Squadron, 1967–1975* (Maxwell AFB, AL: Air Force Historical Research Division, Organizational History Branch) at www.maxwell.af.mil/au/afhra/wwwrot/rso/squadrons_flights_pages/0021sos.html (accessed January 11, 2007).

9. Jim (Dusty) Henthorn, member 21st SOS, November 1967–May 1969. Personal correspondence.

CHAPTER 5

Naval Sea Patrol and Delivery

THE MEKONG DELTA area of southern South Vietnam held 40 percent of the population and is crisscrossed with more than 3,000 miles of waterways. The delta is considered the most fertile area in all of Vietnam. The many thousands of miles of waterways provided excellent coverage for the enemy to resupply its forces. In late 1964 the U.S. Navy formed a Vietnam Delta Infiltration Study Group, tasked with studying enemy infiltration of men and materiel into the Mekong Delta area. Near the end of 1964 the study group published the Bucklew Report, detailing its findings that infiltration into the delta was a significant and mounting problem that needed to be stopped as soon as possible. In early 1965 the U.S. military discovered that arms were being supplied to the Viet Cong via sea routes stretching from the port cities of Haiphong and Vinh in North Vietnam to the Mekong Delta area, well south of Saigon in South Vietnam. Trawlers were intercepted in South Vietnamese waters and discovered to be loaded with ammunition and materiel destined for the Viet Cong. It was estimated that in 1965, about 70 percent of the military supplies sent to the Viet Cong entered southern South Vietnam by sea routes. To stem the flow of men and materiel entering the delta area from the sea, the U.S. Navy implemented a river patrol program that would eventually assist in the implementation of the electronic wall concept.[1]

COMNAVFORV (Commander Naval Forces—Vietnam) developed a mission plan to interdict this logistics flow. The plan was dubbed SEALORDS, which stood for "South East Asia lake ocean river delta strategy." Sensor deployment via the SEALORDS strategy was confined strictly to the delta.

Task Force 115, the Coastal Surveillance Force; Task Force 116, the River Patrol Force; and Task Force 117, the Riverine Assault Force were all linked in some way to the Igloo White program. Sea, Air, Land (SEAL) teams deployed with these task forces would assist in placing sensors along waterways in the delta. Sometimes a Portatale was used to monitor sensor activity; at other times a fixed site on land monitored the activity. If a sensor was activated, river patrol boats were sent to investigate.

Initial monitoring of water-borne incursions started in August 1968. These preliminary operations lasted through October 1968. During that time frame, the SEALORDS developed tactics and conducted an initial operational evaluation of the practicality of sensor deployment and operations in delta waterways. The first Navy monitoring site for the SEALORDS project was established in August 1968, with surveillance monitoring of water-borne traffic in and around the Saigon River. When preliminary operations ended in October, COMNAVFORV deemed the program worthy of future use. In August 1969, three equipment vans—two sensor-monitoring vans and one maintenance van—were sent to Vietnam for expanded SEALORDS operations.

The primary method of interdiction for the Riverine force was the river patrol boat, or RPB. These fast vessels were based on a commercially available, fiberglass-hull boat manufactured in the United States. Structurally modified for combat with more powerful engines, the boats carried a crew of four. RPBs were outfitted with a wide variety of weapons—twin 50-caliber machine guns (one mounted forward and one aft), grenade launchers, and flamethrowers, just to mention a few.

In the early 1970s, Riverine patrols and sensor delivery operations were turned over to the South Vietnamese Navy. Although Admiral Chon, the South Vietnamese Chief of Naval Operations, was enthusiastic about assuming control over the program, the South Vietnamese did not vigorously pursue efforts at Riverine interdiction.

The military coup of the Cambodian government by General Lon Nol in 1970 significantly affected the interdiction of supplies arriving by ship in southern South Vietnam. The Lon Nol government closed all ports to North Vietnamese ships, effectively cutting off the resupply of NVA and Viet Cong forces in the Mekong Delta area of South Vietnam. The port closures—coupled with the ongoing Riverine patrols, Market Time operations, and deployment of sensors into the delta waterways—drove the North Vietnamese into expanding their operations on the Ho Chi Minh Trail.[2]

In August 1971 the Defense Special Projects Group (DSPG) determined that motorized sampan and water-borne craft in the Mekong Delta waterways was again on the increase. This may have been due, in no small part, to the extensive air interdiction program in Laos. The Commando Bolt and Commando Hunt programs of interdicting the enemy's logistics flow down the trail network in Laos and Cambodia were apparently paying off. The DSPG recommended the use of the EDIT sensor in support of water-borne interdiction. This new Phase III sensor detected pulsed radio frequency energy from unshielded engine ignition systems. The DSPG recommended the EDIT sensors be used initially along the Se Kong River, south of the provincial town of Attopeu in the delta area of southern South Vietnam, where activity was suspected. The program and sensors, emplaced by Riverine and SEAL forces, were effective in reducing enemy water-borne resupply during the rest of the war.[3]

Notes

1. U.S. Government Report, Institute for Defense Analysis, *A Study of Data Related to Viet Cong and North Vietnamese Army Logistics and Manpower: Part One—Enemy Logistics in Support of Operations in South Vietnam; Chapter V—The Problem of Sea Infiltration* (August 26, 1966). This entire report was originally classified as Top Secret; however, it was declassified after 30 years.

2. Laotian Brigadier General Soutchay Vongsavanh, *RLG Military Operations and Activities in the Laotian Panhandle* (Washington, DC: U.S. Army Center of Military History, 1981). Indochina Monographs, ISBN 0-923135-05-7.

3. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee of Preparedness Investigating Subcommittee of the Committee on Armed Services* (November 18–20, 1970), 98–105. U.S. Government Printing Office, Washington, DC.

CHAPTER 6

Data Relay Aircraft

KEY TO THE implementation and effectiveness of the electronic wall in Southeast Asia were the data relay aircraft. Their task was to orbit over specific areas and collect transmissions sent from sensor fields, process the information, and relay the data to fixed ground stations. Without the capabilities these aircraft provided, the electronic wall could not have functioned as part of the overall battlefield intelligence system then in use. Sensors in Laos and Cambodia could not have functioned autonomously without an airborne data relay system.

EC-121R Lockheed Constellation (Bat Cat)

Lockheed Aircraft Corporation originally developed this aircraft in the 1940s as the L-49. The U.S. Navy and U.S. Air Force used a derivative of this early version, designated as the C-121 transport/cargo/special mission aircraft. The Constellation—or Connie, as it was affectionately called—was extensively modified with all the electronics gear necessary for the sensor relay mission. In addition to the electronic modifications, its performance was enhanced with a high-altitude engine oil kit and an engine nacelle skin refurbishment kit.

The Connie was the primary airborne relay platform for Igloo White during the program's entire operational life in Southeast Asia. The EC-121Rs were assigned to the 553rd Reconnaissance Wing and based at Korat Royal Thai Air Base, Thailand. The U.S. Navy originally operated these aircraft as EC-121Ks, but transferred them to the USAF specifically for the Igloo White program. The EC-121K was selected for Igloo White because the Navy was then operating it as an electronics data gathering aircraft. As such, its passenger compartment was already outfitted with enough stations to seat the many electronics intercept technicians required for the mission. Converting EC-121Ks into Igloo White relay aircraft required less cost and manpower than converting any other available aircraft then in operation. The aircraft were equipped with the ARR-52 airborne monitoring system for Igloo White sensor reception, integration, and transmission of information to Nakhon Phanom (NKP). The 553rd Wing was activated at Otis Air Force Base in Massachusetts, the home base of the EC-121R before its deployment to Southeast Asia.

On 25 November 1967, the EC-121R detachment flew its first combat sortie out of Korat. By 6 December 1967 the detachment had 24 aircraft, flying 4 relay orbits during each 24-hour period; 2 aircraft flew day orbits and 2 flew night orbits. Mission requirements dictated that the detachment fly 24 hours a day, 7 days a week. Time on station (orbiting) usually averaged 10 hours at 16,000 to 18,000 feet. At that altitude, the aircraft accurately picked up sensor signals from a distance of approximately 43 miles. It was also the most efficient altitude for operating the piston engines; any higher, and the engines began losing performance and efficiency.

Eighteen crewmembers—the normal crew complement, as well as sensor technicians, sensor supervisors, and relief crews—flew in each aircraft. The EC-121Rs were assigned orbits over specific ranges within Southeast Asia. These orbits were identified by color: Rose Orbit flew over the southern section of North Vietnam; Green Orbit over the northwestern section of Laos; Blue Orbit over the tri-border area at the junction of Laos, North Vietnam, and South Vietnam; Orange Orbit over the Gulf of Tonkin; and so on.

As noted earlier, there were quite a few good reasons for using the C-121 in this mission. Other reasons included its long range, extended loiter times, availability in quantities, and spacious cabin. The electronic suite also allowed the aircrew to produce target information, via secured data link, to an airborne controller or strike aircraft.

In the early 1970s the EC-121Rs were inducted into an avionics upgrade program to make the on-board equipment compatible with the new Phase III sensors. The upgrades converted the aircraft to, in effect, an alternate airborne infiltration surveillance center (ISC). Later in the war, this capability would greatly assist the U.S. Army with interpreting sensor data. One of the upgrades was called an X-T plotter. This device allowed airborne technicians to plot, almost in real time, the progress of troop and vehicle movements down the trail in Laos. Also added to 10 of the aircraft, as part of the upgrade program, was an electronics countermeasure (ECM) system. This ECM system, also used by a wide variety of aircraft in Southeast Asia, was installed to warn the crew of potential radar-controlled antiaircraft and missile sites that could pose a threat to the aircraft. Enemy fire directed at the aircraft was becoming a real and growing threat over Laos by this time.

Amazingly, but unfortunately, only two EC-121Rs were lost during Igloo White operations in Southeast Asia. The losses were due not to enemy fire, but to inclement weather in the landing area. The first occurred on 25 April 1969 when aircraft 67-21493 crashed near its Korat Royal Thai Air Base, killing all 18 crewmembers on board. The second also occurred near the base, on 9 June 1969, when aircraft 67-21495 crashed after returning from a 12-hour flight over the combat zone. Of the 18 crewmembers on board, 4 were killed, 6 sustained major injuries, and the rest sustained minor injuries.

YQU-22A/QU-22B Beechcraft Pave Eagle (Vampire)

By early 1968, it was clear that the EC-121R was extremely vulnerable to antiaircraft and missile fire; a replacement aircraft was needed. The Model A36 Bonanza, a relatively inexpensive aircraft manufactured by Beechcraft Airplane Company in Kansas, was selected as this replacement aircraft. The A36 Bonanza was a single-engine, low-winged, general aviation aircraft that seated up to five passengers. The USAF modified the Bonanza by installing a larger, more powerful engine incorporating a turbocharger; this upgrade considerably increased the aircraft's service ceiling (operating altitude). The wingspan was increased to incorporate extra space for wing fuel tanks, thus extending the aircraft's range and altitude. Also added was the necessary electronic equipment to support the Igloo White program.

The modified aircraft, called Pave Eagle, was unusual in that it was designed to be flown by either a pilot or remotely as a drone. When piloted, the aircraft could remain airborne for up to 6 hours. In the drone configuration, it could remain airborne for 12 hours at more than 20,000 feet. The Univac Division of the Sperry Rand Corporation initially modified six Bonanzas into the prototype Pave Eagle configuration, designated as YQU-22A. Modifications included replacing the original Continental IO-520B six-cylinder, 285-horsepower, gasoline-powered engine with a more powerful Continental GTSIO-520 six-cylinder, 375-horsepower (displacement of 520 cubic inches) gasoline engine. The original two-blade A36 propeller was replaced with a quieter three-blade, slow-turning propeller. The electrical system was upgraded for the increased electronics load required to operate the Igloo White equipment. Externally, the YQU-22 differed from the A36 in many ways. The YQU-22 incorporated a set of wingtip fuel tanks, it had an extended wingspan, and the aft cabin windows of the A36 had been deleted. Eight externally mounted Igloo White program antennas were added to the YQU-22.

Although they could be flown as drones, all operational Pave Eagle flights from NKP were manned. There were several reasons for this decision. First was the fear of losing a command signal or experiencing signal interference, which could have resulted in the loss of the drone. Second, was the concern that radio frequency (RF) interference between the drone's electronics and sensor transmissions could cause problems when the aircraft was flown in the drone configuration. Apparently, electronic systems integration was an issue, because electromagnetic interference could have created a condition causing loss of the drone.

By early 1969 the Pave Eagle program had lost two aircraft to engine-related problems. Both losses involved piloted aircraft and, unfortunately, one pilot was lost. On 4 September 1969 flights were suspended due to low operational effectiveness. The remaining aircraft were returned to the United States, where a Pave Eagle improvement program was initiated. These improvements increased the aircraft's effectiveness; the original YQU-22A aircraft, along with a greater number of second-generation Pave Eagle II QU-22Bs, were returned to NKP to resume flight operations.

The sole purpose of the Y/QU-22 was data relay; it did not have the expanded capabilities of the EC-121R. However, strictly as a data relay aircraft, the Y/QU-22 had several advantages over the EC-121R. One was crew size exposed to hostile fire. The Constellation carried 18 crewmembers, as opposed to the Y/QU-22 crew size of 1 (or none, if flown as a drone). By March 1969, five Pave Eagle aircraft were being flown out of NKP. By the early 1970s, the USAF was operating a mixed fleet of EC-121R and Y/QU-22 aircraft. When compared to using a pure EC-121R fleet, the mixed fleet saved the military some $5 million and approximately 1,000 personnel (aircrew and support personnel). Clearly, the Connie was expensive to operate.

In 1971 a modification program called Compass Flag upgraded the Pave Eagle electronics to improve the performance of the electronic suite in the Y/QU-22B. These improvements were driven primarily by the new Phase III sensors being deployed to Southeast Asia during that time. After being modified, these aircraft were used primarily as Phase III sensor relay platforms. The USAF fielded 33 Pave Eagle aircraft (6 YQU-22As and 27 QU-22Bs). Of these, 24 were operated in Southeast Asia.

The USAF contemplated implementing a follow-on to the Pave Eagle II improvement program. It was intended to improve the performance of the Pave Eagle aircraft and to completely replace the vulnerable EC-121R. Proposed modifications included a cabin pressurization system, better deicing gear, and a turboprop engine to replace the piston engine. As the follow-on proposal progressed, costs became the driving factor. The turboprop engine was eliminated from the proposal in favor of a larger, more powerful, reciprocating engine. Unfortunately, due to the withdrawal of U.S. military personnel from the area and the subsequent end of the Igloo White program, the improved aircraft was not deployed into Southeast Asia.

A QU-22B Pave Eagle II aircraft was planned to be the premiere airborne relay platform for the proposed Vietnamese Sensor Program, codenamed Tight Jaw. This program, discussed in chapter 11, would have used the piloted Pave Eagle II aircraft along with in-country, ground-based deployable automatic relay terminal (DART) I and II processing facilities. The South Vietnamese would have operated the program on their own, without American military involvement. USAF Pave Eagle pilots were the vanguard of this program; they paved the way with valiant efforts over the hostile skies of Laos, proving the concept and providing valuable sensor data in support of the war effort. Unfortunately, the Vietnamese sensor program never made it out of the planning stages; but the heroism and dedication of American Pave Eagle pilots proved that a small, unarmed aircraft could perform as a relay platform in the hostile and deadly skies of a combat environment. The dedicated Pave Eagle team was at the forefront of the unmanned combat air vehicles and unmanned reconnaissance vehicles that would perform so admirably during future conflicts.

In October 1984 a civilian-owned QU-22A aircraft, USAF serial number 68-10534 and registered as N83475, crashed into mountainous terrain near Fancy Gap, Virginia. Investigators at the crash site discovered that the pilot had died in the crash and that the aircraft was loaded with approximately 1,000 pounds of marijuana. This was an inappropriate end for an aircraft that should have been exhibited in some air museum as an example of its type or, perhaps more appropriately, restored to its original military configuration by a museum or collector.[1]

C-130B/EC-130E ABCCC (Comfy Gator or Trump)

A few of the C-130 ABCCCs (airborne battlefield command and control centers) were modified to incorporate the Igloo White reception and relay electronics, making them capable of performing in the sensor signal processing and relay role. Some of these modified aircraft were temporarily based at NKP; others were at selected bases in South Vietnam. Although the ABCCC was used primarily for battlefield management, it did fly some test orbits as a sensor relay aircraft from late 1969 through late 1971. Sensor signal receiving, processing, and transmitting equipment was removed from an NKP-based QU-22 and temporarily installed in the ABCCC. The C-130 had several advantages over the EC-121R and QU-22B aircraft. First was its range and loiter time. The C-130 not only matched, but bettered the range and loiter time of the EC-121R and QU-22B. Second was logistics. Due to its age and operating cost, the EC-121R was being phased out of military service in favor of the C-130 and C-141 aircraft. This phaseout created logistics problems in supporting the EC-121R fleet; when an aircraft is phased out of operation, the logistics pipeline tends to dry up over time. The QU-22B fleet was both unique and small, thus creating a logistics problem difficult to deal with at the time. With the EC-121R and QU-22B assets already in place, and the war ending for the United States, a decision was made not to pursue a C-130 relay version when the test orbit program ended. The C-130 would have been an excellent replacement for the EC-121R. The C-130 cabin was wider and roomier than that of the EC-121. The C-130 turboprop engines were more fuel efficient than were the gas-guzzling, turbocompound piston engines of the EC-121. Logistically, because the C-130 was the mainstay medium-range transport for the U.S. military (as well as numerous foreign governments), its logistics and maintenance support would have been less costly.

Relay Orbits Flown

The various USAF aircraft were assigned relay orbits, identified by color, over specific ranges within Southeast Asia. Following are the orbits and the aircraft used in flying them:

Amber. Flown exclusively by the EC-121R on an as-required basis. The orbit was flown in support of the DART I program over central and southern South Vietnam.

Black. Flown exclusively by the EC-121R. Time on station averaged 18 hours. This orbit was flown over Cambodia from December 1970 through February 1971.

Blue. Flown by the EC-121R and QU-22B (C-130 was flown as a test orbit only). Time on station averaged 18 hours. The orbit was flown in support of both the Igloo White and DART I programs. This orbit was flown daily over the borders of Laos and South Vietnam, just south of the North/South Vietnamese demilitarized zone.

Green. Flown by the EC-121R and QU-22B (C-130 was flown as a test orbit only) in support of the Igloo White program. Average mission time was 21 hours. Orbit was flown daily over west central Laos.

Lavender. Flown by the EC-121R and QU-22B in support of the Igloo White program. The Lavender Orbit was flown only as a test orbit from late 1970 through early 1971. Average time on station for the EC-121R was approximately 10 hours, flown over southeastern Laos.

Orange. Flown by the EC-121R and QU-22B nightly in support of the DART II program. This orbit was flown from September 1969 through September 1970 over central South Vietnam near the Cambodian border.

Pink. Flown exclusively by the EC-121R on an as-required basis for sensors in southern North Vietnam. The orbit was flown from 3 November through 26 November 1968 off the coast of North Vietnam just north of the demilitarized zone.

Purple. Flown exclusively by the EC-121R (C-130 was flown as a test orbit only) nightly in support of the Igloo White program. Average time on station was approximately 18 hours. The orbit was flown over southern Laos, near the border with South Vietnam.

Red. Flown by the C-130 as a test orbit for data readout. The test orbit was flown from August 1969 through January 1970. Average time on station was approximately 10 hours. The orbit was flown over southeastern Laos near the border with South Vietnam.

Rose. Flown exclusively by the EC-121R from August 1969 through January 1970 in support of the Igloo White program. This orbit monitored the sensors placed on Route 7 in Laos. Average time on station was approximately 10 hours.

White. Flown by the C-130 for a short period of time. This orbit, used to monitor the Purple Orbit, was positioned over central southern Laos at a higher altitude to provide data relay to ISC for readout of information. Average time on station was 10.5 hours.

Yellow. Flown by the QU-22B and C-130 as a test orbit for the compass flag program. Missions were flown as a tract and not an orbit, over central Laos. Average time on station was approximately 10 to 12 hours.[2, 3]

Notes

1. National Transportation Safety Board (NTSB), Aviation Accident Number ATL85FA011, at http://www.ntsb.gov/ntsb/Response2.asp (accessed January 17, 2007).

2. Transcripts of U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee of Preparedness Investigating Subcommittee of the Committee on Armed Services* (November 18– 20, 1970). U.S. Government Printing Office, Washington, DC.

3. *Project CHECO Report, Igloo White Program: July 1968–December 1969, A Contemporary Historical Examination of Current Operations—Concepts Policies and Doctrines*.

CHAPTER 7

Data Processing

Infiltration Surveillance Center (ISC), Nakhon Phanom (NKP) Royal Thai Air Base, Thailand

The ISC was the nerve center of the Igloo White Program. It was sometimes called the Dutch Mill because the large receiving antenna on the ISC facility resembled a Dutch windmill. There were five antennas in all: three Conaga Model TTS-5A antennas, each with a diameter of 12 feet; one 30-foot-diameter Scientific Atlantic Model J469 antenna (the windmill); and one 10-foot-diameter Scientific Atlantic Model K214 antenna.

At the core of ISC operations was the IBM 360 computer. Initially the facility used two IBM 360 computers. Due to the size and complexity of the sensor fields sown throughout Southeast Asia, vast computational power was required to integrate all of the sensory inputs and ensure proper data readout. The sensor data, relayed via orbiting aircraft to the ISC, was first routed to an assessment processor. After a monitoring technician processed the data, a spectrum analyst sent it to either of the computers. The computer then graphically displayed the sensor information on a large electronic screen that was automatically updated each minute. The information was also printed out in a data stream, to providing a complete picture of sensor activations using their individual identification numbers, pattern activation within a specific grid area, and the time of activation. This information data set, called a CONFIRM, was updated and generated every 5 minutes. Based on the processed information, intelligence technicians passed the data on to the 7th Air Force—or later in the war, to the airborne battlefield command and control center (ABCCC), which then allocated air assets for attack if and when required.

The computers were routinely upgraded. The initial IBM 360-40 computers were upgraded in 1968 to IBM 360-65 versions, significantly increasing the ISC's computational power. In summer 1970, the ISC computer system was again upgraded with a new computer program. This action, coupled with a revised preventive maintenance plan, allowed for the removal of one IBM computer and a significant reduction in personnel manning at the NKP site. At the beginning of 1969, the NKP site had 385 personnel working to support the mission. Due to the stated improvements, the site reduced its manpower requirements to 225—at a cost savings of approximately $4.5 million.[1]

All Igloo White command and control operations, code-named Task Force Alpha, were located at NKP and were under the control of the USAF 13th Air Force. Task Force Alpha was commanded at least by a general officer; in 1967, the Task Force was commanded by Major General William P. McBride. Airborne attack in response to sensor activation was controlled by the USAF 7th Air Force, located at Tan Son Nhut Air Base on the outskirts of Saigon, South Vietnam. At NKP, a sensor planning committee assigned to Task Force Alpha was responsible for sensor string and field placements. The planning committee took into consideration suspected enemy movements, topography, designating and planning of choke points, and airborne photography and data passed on to the ISC via forward air controllers (FACs). Recommendations for establishing sensor fields were passed on to the 7th Air Force in Saigon. The tasking order ultimately flowed to the 25th Tactical Fighter Squadron at Ubon, Thailand.[2]

Sensor data were also used for historical purposes. In monitoring and recording enemy troop and vehicle movement over time, patterns would develop indicating locations of munitions storage areas, truck parks, rest areas, and so on. These data were eventually used for strike-planning purposes. The progress of enemy activity thus could be plotted over time; the success of allied airstrikes also could be determined by monitoring activity in and around the strike area.[2]

In November 1969 the ISC was tasked with implementing a program called Commando Bolt, designed specifically to track and attack vehicle convoys in Laos. The program was unique; it called for the ISC to track enemy movements and then plot times and locations for airstrikes. A three-man team at the ISC monitored and reviewed sensor data specifically for vehicle movements down the Ho Chi Minh Trail in northern Laos. This team included a fighter pilot of field grade rank, usually from the 25th Tactical Fighter Squadron (TFS) at Ubon Air Base, Thailand. The other two team members were technicians, usually F-4D weapons systems officers who operated the LORAN and Igloo White equipment; one of them was a sensor interpreter, the other an FAC with experience over Laos. Each technician used a workstation consisting of an IBM 2250 display monitor tied into the IBM 360 computer's output. The displays provided the technicians with real-time sensor information that was updated every minute. The technicians cross-checked seismic sensor data with audio data, when available, to confirm that vehicles were causing the seismic activations. After interpreting the signals, the analysts plotted the movements on topographic maps that matched the locations where the sensor strings had been activated. The IBM 2250 display presentations at each of these three locations graphically depicted the sensor strings being activated by sensor number and location as related to the topographic map. Most intriguing was the representation of a computer-generated icon that looked something like an inchworm slowly working its way through the sensor field. The rate of worm movement through the field matched, in scale, the movement of the objects (trucks, troops, etc.) through the sensor field. Technicians then plotted the time and location for airstrikes as well as the type of ordnance required for the target.[2, 3]

During the Commando Bolt campaign, the ISC used computer-driven sensor data to provide what were called Commando Bolt strike module targets. The computers presented to the intelligence technicians a display that identified a desired mean point of impact (DMPI) along a sensor string. This DMPI presentation gave the technician a computer-generated time line for projecting when enemy activity would reach a specific location along a sensor string corresponding to a specific location on the topographic map. Since the sensors were delivered by LORAN-equipped aircraft, the specific location of the sensor—and subsequently, the DMPI generated—was fairly accurate. The computer used the sensor's LORAN location and speed of vehicle movement through the sensor string to compute the DMPI. Once the DMPI was established, the information was passed to the coordinated LORAN sensor strike system (COLOSSYS). The COLOSSYS then coordinated an attack, passing all required information on to a LORAN-equipped aircraft to press the attack at the desired time and location. The pilot of the attacking aircraft adjusted his flight profile to ensure arrival at the DMPI at the required time. COLOSSYS was really nothing more than a LORAN strike coordinator for the Commando Bolt program. If no LORAN-equipped aircraft were available for the strike, non-LORAN aircraft were called in and vectored to the strike area by the ISC team, ensuring they arrived at the correct location at the proper time. There were two Commando Bolt airborne strike teams, one called Flasher and the other Panther. They were the assets that COLOSSYS normally tasked to attack DMPI targets.[1, 3]

Commando Bolt airstrikes typically encompassed a flight of two aircraft. The lead aircraft, usually a 25th TFS aircraft, flew to the LORAN checkpoint designated by the Sparky FAC. The lead and wingman (not necessarily a LORAN aircraft) carried the necessary ordnance to eliminate the target. Strike ordnance varied; the lead aircraft in a flight could carry anywhere from 6 to 12 cluster bomb units (CBUs), and the wingman could carry from 6 to 12 500-pound bombs. For maximum CBU dispersal, the aircraft flew at a predetermined speed and altitude so that the small cluster bombs covered an area 3,000 feet long by 1,000 feet wide within the sensor field.[4]

In late January 1971, an X-T plotter was installed at the ISC. A similar plotter had been installed well over a year previously in the EC-121R relay aircraft. Just one of these devices could plot data from up to 99 sensors in near real time. The X-T plotters were used in conjunction with other processed data at the ISC to plot and track the movement of troops and vehicles as they progressed through sensor fields along the route system in Laos. Moreover, the plotters were used not only to train technicians in sensor system surveillance but also as a backup to the IBM 360 computers and the DART facilities in South Vietnam.[3, 5]

Deployable Automatic Relay Terminal (DART)

Variations of the ISC were developed over time. The Igloo White program's success during the siege of the Khe Sahn combat base was instrumental in a decision made in mid-1968: The commander of the United States Forces, Military Assistance Command, Vietnam (COMUSMACV), directed the DCPG to develop a plan for expanding the sensor system in South Vietnam. This plan, called Duffel Bag, fielded a mobile ISC for the U.S. Army in South Vietnam. The facility was to supplement the ISC in Thailand. The original ISC concept—a huge, fixed ground station—eventually gave way to the deployable automatic relay terminal (DART) and the sensor reporting post (SRP). Although they did not have the ISC's computer processing capabilities, the DART and SRP systems were mobile. They could be deployed to various locations throughout the world when needed. The ISC provided significant capabilities in tracking, storing, and analyzing sensor data, but the deployable systems cost less and required far less manpower to operate. The trade-off was clear; the trend would be away from fixed sites in the future.[3, 6]

DART I

The prime contractor on the DART program was Radiation, Inc. The company tested a DART I prototype at Eglin AFB, Florida, in late 1967. On 1 March 1968, the DART concept was field-tested in Southeast Asia. The DART program in South Vietnam was called Commando Shackle; it was implemented at Bien Hoa Air Base, 30 miles from Saigon. The system consisted of an acquisition and assessment ground station, a mobile power system, a communications system, and an S-band antenna mounted on a 60-foot tower. The U.S. Army's 25th Infantry Division, 1st Infantry Division, and the 1st Air Calvary Division were tasked with placing hand-delivered sensors at strategic locations within South Vietnam and the areas bordering Laos and Cambodia. The primary sensor placed was the HANDSID, which could be used in any combination of seismic, magnetic intrusion, or passive infrared detection roles.

The DART testing period lasted the entire month of March 1968. Due to variables such as topography and distance from the sensors, an EC-121R flying the Amber Orbit was assigned the task of relaying sensor data to the DART station. On 1 May 1969 the EC-121R was no longer needed for sensor relay; a fixed relay antenna was installed atop the 3,235-foot-high Nui Ba De Mountain, located in the Bien Hoa area. Artillery fire and AC-47 gunships responded to sensor alerts when required. The DART I Command Shackle program was deemed a success, leading the subsequent expansion of the DART concept.

By the end of 1969 a new system, the Battlefield Area Surveillance System (BASS), was in operation. It was simpler than the DART I, and it was entirely under U.S. Army control. BASS is described in more detail below.[2, 3]

DART II

DART II, built as a backup system for the DART I program and the ISC, was established at Pleiku, South Vietnam. The site became operational on 28 September 1969. DART II had the capability to monitor and process data from Phase I and Phase II sensors. Due to the rough terrain around

Pleiku, which is located in the northeastern mountains of South Vietnam, using HANDSIDs was deemed impractical. The U.S. Army and Vietnamese Air Force consequently used helicopters to airdrop ADSIDs, HELIOSIDs, and Acoubouys. The agency responsible for determining where the sensors would be dropped was Military Assistance Command, Vietnam (MAC-V).[2, 3]

BASS

The Battlefield Area Surveillance System (BASS) was a U.S. Army program that used strategically placed HANDSIDs to monitor the approaches to villages or fire support bases. BASS was widely used during the later stages of American involvement in the war. The primary sensors placed were seismic, detecting movement through ground vibrations. A sensor picked up the vibrations through its housing. Once activated, the sensor transmitted a coded tone identifying itself and its location to the receiving station. Depending on the quantity of sensors placed, movement through a sensor field could be monitored if required.[2, 3]

Portatale

The Portatale was a man-portable receiving device designed to acquire signals from hand emplacement sensors and process the information accordingly. Sensors were laid out in specific patterns around camps and villages. The patterns allowed the Portatale operator to determine the location and movement of enemy troops passing through the sensor field. These devices would prove invaluable not only in protecting allied soldiers during patrols but also in alerting base camps, air bases, naval facilities, and villages when they were under threat. The Portatale was a lightweight device about the size of a laptop computer; it could be carried in the field by one soldier. The Portatale had earphones, which operators wore to monitor tone transmissions from the sensors.[2, 7]

U.S. Marine Corps aircrews devised a method for carrying a Portatale onboard a Marine OV-10 two-man observation aircraft. The pilot sitting in the forward cockpit flew the aircraft while an aircrew member in the rear cockpit monitored the Portatale, which rested on his lap. U.S. Marines flying out of Da Nang Air Base reported that the airborne Portatale was reliable, simple to operate, and compact. The Marine 3rd Air Wing at Da Nang, using three USAF OV-10s assigned to the Tactical Air

Support Squadron, assisted the USAF in conducting a 10-day evaluation (22–31 January 1970) of the airborne Portatale. The OV-10s operated along with USAF A-1 Skyraider attack aircraft. The evaluation was subsequently deemed a success. However, with the end of American involvement in the war, nothing came of this program in Southeast Asia.[2]

Notes

1. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee of Preparedness Investigating Subcommittee of the Committee on Armed Services* (November 19, 1970), 123–125. U.S. Government Printing Office, Washington, DC.

2. *Project CHECO (Southeast Asia Report) Igloo White: July 1969–December 1969, A Contemporary Historical Examination of Current Operations*.

3. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 18–20, 1970). U.S. Government Printing Office, Washington, DC.

4. *Project CHECO (Southeast Asia Report), Corona Harvest*, Directorate of Operations Analysis Office. Interview no. 200 (June 12, 1969). This interview was conducted with a 25th TFS weapons systems officer.

5. *Project CHECO report, Igloo White Program: July 1968–December 1969, A Contemporary Historical Examination of Current Operations—Concepts Policies and Doctrines*. Directorate of Operations Analysis Office.

6. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 19, 1970), 123–125. U.S. Government Printing Office, Washington, DC.

7. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 18, 1970), 64–67. U.S. Government Printing Office, Washington, DC.

CHAPTER 8

Surveillance, Target Acquisition, and Night Observation (STANO) Program

THE STANO program was not well known, and it was typically not considered a part of the electronic wall. Even so, this program complemented air- and hand-delivered sensors and was integrated into the overall electronic wall concept.

Since World War II, detecting and tracking the enemy in jungle environments like those in Southeast Asia had been a major intelligence obstacle for military planners. In 1965 the U.S. Army, working in conjunction with the scientific community, was determined to develop advanced technology to circumvent this problem. The team considered a wide variety of options: infrared sensors, night vision systems using starlight, radar and optical detection devices, and unattended sensors. The scientists then developed and implemented several innovative devices, which they sent to Fort Hood, Texas, for operational testing and evaluation. If proven successful and useful, the devices would be sent to Southeast Asia for use in combat.

Night Vision Systems

Night vision systems were developed by the U.S. Army's Research and Photometric Section starting in early 1954. In the early to mid-1960s, night vision systems (called starlight scopes) were first used in Vietnam. Ground forces put starlight scopes to very good use; the devices could be operated in complete darkness because their electronics processed and amplified the weak light of the stars at night. Of course, for the scopes to be effective, the night sky had to be relatively cloudless so that enough starlight reached the area being watched. Starlight scopes thus were hindered by weather; overcast night skies made them nearly useless. This was especially true during the monsoon season, when cloud cover lasted for days at a time. A thick overhead jungle canopy also reduced the effectiveness of these devices because the dense foliage blocked out the light of the stars.

Two types of starlight scopes were most commonly used during the Vietnam War. The AN/PVS-4 Individual Weapons Night Sight was a short-range, 5-pound scope mounted on a combat soldier's M-16 rifle. Under ideal conditions, this scope detected objects at a maximum distance of approximately 1,000 feet. A larger scope, the AN/TAS-2 NODLR, was a 34-pound, medium-range, tripod-mounted night observation device. It also used amplified starlight in order to see in the dark; but due to its size (approximately 3 feet long by 1 foot in diameter at the main barrel), it was relegated to use at the company level and higher. This device had a maximum range of approximately 4,000 feet.

Also in use in Southeast Asia during the 1970s was the SU-50 Electronic Binocular and AN/PAS-8 Aiming Light. These night vision systems came to the combat theater too late in the war, and in too small quantities, to make much of a difference. In 1980 the U.S. Army's Fort Hood, Texas, facility again tested a night vision system, this time associated with the antitank TOW missile (a missile optically guided to its target via a thin communications wire connected to the missile and the firing tube).[1, 2, 3]

Night vision systems similar to those used in Vietnam have become commonplace today. Anyone can purchase a night vision system at the local mall or through the mail for less than $200—and in many cases a lot less, depending on the system capabilities. Continued refinement through military use has not only improved these systems but also considerably reduced their overall price and made them very reliable. The Vietnam era systems provided a grainy, poorly defined, green image to the viewer. Today's military systems have been improved to the point that viewers using them at night can see with great clarity.[1]

Infrared Systems

Several infrared systems were introduced into Vietnam during the mid- to late 1960s. Except for the AN/PAS-7 Hand Held Thermal Viewer, most were large and cumbersome and could not be carried into the field.

Consequently, those devices were restricted to use at fire bases and other fixed locations. Some of these infrared systems were eventually mounted on aircraft and became the vanguard of modern airborne infrared systems. The advantage of an infrared or thermal system over a night vision or starlight system is that since the thermal system detects objects by their heat, it can operate in overcast skies and during inclement weather. In the early 1970s the U.S. Army equipped a squadron of OV-1 fixed-wing aircraft and UH-1 helicopters with both infrared and side-looking radar systems to ferret out enemy troops and equipment in the jungles of South Vietnam. The infrared devices mounted on these aircraft had a range of up to 11,000 yards under ideal conditions. The systems were somewhat successful, and they were sometimes used in conjunction with unattended ground sensors.[4, 5]

Infrared searchlights were also used in Vietnam. The searchlights were mounted on U.S. and South Vietnamese M-48 tanks and M551 Sheridans. Tank-mounted infrared searchlights were first used in the Vietnam War during an armored battle that took place at Ben Het, South Vietnam, in March 1969. Using the infrared searchlights, the South Vietnamese were able to locate and defeat North Vietnamese tanks at night.[6]

As with night vision systems, infrared systems based on those used in Vietnam are now commonplace. Mail order catalogs sell reliable, cost-effective infrared systems to anyone for a few hundred dollars—often much less. The airborne forward-looking infrared (FLIR) systems used on current military aircraft originated in these Vietnam era systems.

Radar

Historically, a major problem with radar was that it was often heavy, cumbersome, and maintenance intensive. In the late 1960s the U.S. Army developed the lightweight AN/PPS-5 radar. This device, designed to be operated at the company and battalion level, was used for early detection of enemy activity. It was also integrated into the Igloo White program by providing company and battalion commanders with additional information on enemy movements detected by unattended ground sensors. The AN/PPS-5 could detect enemy movements out to approximately 16,000 feet and was used primarily at fixed bases.

In the early 1970s a newer radar device, the PPS-14, was introduced in Vietnam. The PPS-14 weighed just 18 pounds, was extremely compact, and could be used by an outpost or an infantry patrol.

Another device used with limited success was the TPS-25 radar. This typical 1950s era "portable" radar unit used vacuum tube technology and took several hours to set up. Because of the vacuum tubes, TPS-25 reliability was poor; the unit also required many man-hours for maintenance. The real benefit of the TPS-25 was that its maximum range was approximately 60,000 feet. It was ideal for detecting enemy rockets, artillery, and mortars in flight, thus warning friendly troops of incoming enemy fire. The data provided could be used to calculate a launch point, so that a combat team could be sent out to investigate the site. A follow-on version, the TPS-58, replaced some of the vacuum tubes with transistors; because it was fielded near the end of U.S. involvement in the war, it had limited but effective use in Vietnam.[7, 8] (*Note:* In my experience with this system, the TPS-58 siren warning of an impending rocket or mortar in flight did not sound until after the munitions hit the ground.)

XM3 Chemical Detector

The XM3 Chemical Detector was developed for use in Southeast Asia in 1969. The so-called people sniffer was officially titled Detector, Concealed Personnel, Aircraft Mounted (XM3). One of the most unusual devices used during the war, the XM3 was designed to locate the enemy by detecting aromatic chemicals released by the human body. The detectors were initially mounted on U.S. Army UH-1 and OH-6A helicopters. However, because these helicopters were extremely noisy, the enemy could hear them coming long before the XM3s detected their presence.

Consequently, the Lockheed Aircraft Corporation was awarded a contract to develop what later became the YO-3A Quiet Star—a quiet, sailplane-derived reconnaissance aircraft. A 220-horsepower piston engine, driving a four-blade constant speed propeller, powered the aircraft. The engine exhaust was heavily muffled, making the airplane very quiet in flight. The small plane had an operational gross weight of only 3,000 pounds. At 400 feet, the sound of a passing YO-3A was comparable to the rustling of leaves in the wind. However, even when mounted in this aircraft, the chemical detectors were not very useful; they were designed to detect the presence of ammonia, but they could not distinguish between human and animal. The XM3 program had a short operational life during the Vietnam War and contributed very little to the overall Igloo White effort.[9, 10, 11]

Xenon Searchlight

One of the more mundane devices used was the xenon searchlight, more appropriately titled the airborne searchlight. The searchlight was originally designed to replace or supplement aircraft flares as an area illuminator at night. Like most STANO systems, the airborne searchlight was tested at the U.S. Army facility in Fort Hood, Texas. This device was usually mounted in conjunction with a FLIR pod and/or in a people-sniffer-equipped helicopter during night operations, many in support of the Igloo White program. The searchlight illuminated a good-sized area with an intense beam. Mini-guns on the helicopters zeroed in and destroyed the illuminated target if required. Although useful, the searchlight had the distinct drawback of being a perfect target for the enemy to shoot back at; as a result, the device quickly fell out of favor with aircrews.[12, 13]

Airborne searchlights have been used in combat at least as early as 1942, when they were installed in U.S. Army Air Force C-47 transports. During World War II, the U.S. Army installed a 60-inch General Electric Model 1942 searchlight in the open cargo door of a C-47 transport. Testing took place at Fort Belvoir, Virginia. During testing, the searchlight was installed first in the large rear cargo door and then in the smaller forward cargo door, just ahead of the wings. If successful, searchlight-equipped aircraft were to be operated in various missions including search and rescue, airborne troop resupply, and so on. It is not known whether these tests led to any actual operational missions.[14]

Several types of xenon searchlights were used during the Vietnam War. A 30-inch searchlight, known in the military as the AN/TVS-3, was usually mounted on a two-wheeled trailer. In operation, the searchlight became very hot and required either an air or liquid cooling system; without a cooling system, the lamp had a short life. The searchlight was unique in that it had a two-beam option—a horizontal spread beam and an adjustable beam. It used an external power source and required an AC generator (400 cycle, 3 phase, 120/208 volts, 15 kilowatts). The AN/TVS-3 was used briefly in Vietnam, starting in late 1969, but was considered impractical because of its size, power requirements, and cooling system.[15]

The Spectrolab FX-150 was a helicopter-mounted, 9- to 20-kilowatt searchlight developed by the Textron Corporation for use in Vietnam. Two U.S. Army aviation units started using the searchlight in July 1969. It was found to be lightweight as well as easy to operate and maintain. It also provided good light intensity from relatively safe altitudes, away from hostile ground fire. The Spectrolab FX-150 was very useful during night helicopter combat operations, and a similar version is still in use.[16]

A unique application of the xenon searchlight was on ground combat vehicles. The AN/VSS-4 searchlight was mounted on the armor tube of a tank gun mount for use during night operations. Though effective, the system was rarely used because tank operations were of limited use in the jungles and highlands of Vietnam.[17]

In 1970, six tank squadrons from the South Vietnamese Army's 20th Tank Regiment were outfitted with xenon searchlights at a total cost of $300,000. The searchlights, used for night operations near the Lao border area, proved to be both useful and practical.[18]

Xenon searchlights flowed quite easily into civilian applications. They were incorporated into police helicopters, civilian news helicopters, and Coast Guard and civilian rescue aircraft, to give a few examples. A version of the xenon searchlight was used in 1966 for research over the Chesapeake Bay in the eastern United States. The searchlight was used to calculate slant ranges over which light signals were detectable at an underwater receiver as part of a communications experiment conducted by the U.S. Navy.[19]

Today's xenon lights, although smaller and more powerful, are basically the same as those used during the Vietnam War. Xenon lights are becoming a standard fixture in automobile headlights and interior lights. Some household flashlights and desk lamps also use xenon-style lights. Because of their small size, powerful illumination, and greater lifetime, xenon lights are often preferred to the older style filament lights.

In 1975 the U.S. Army developed the Battalion Integrated Sensor System, a direct outgrowth of the STANO program used in Vietnam. The intent of this system was to integrate the various surveillance systems by using combinations of radar and night vision devices. The integrated system consisted of one AN/PPS-5A ground surveillance radar operator, one night observation device operator, a team chief, and a radio-telephone operator. This was one of many steps that led to integrating various systems and devices into a future electronic battlefield.[1]

Notes

1. STANO program; described in detail in U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee of Preparedness Investigating Subcommittee*

of the Committee on Armed Services (November 18–20, 1970), “Night Vision Systems” section, 176–177.

2. Scientific and Technical Information Network (STINET) Report no. ADA128086, *Human Factors Evaluation of Selected STANO (Surveillance, Target Acquisition, and Night Observation) Devices Employed in a Mechanized Infantry Platoon* (Fort Belvoir, VA: Defense Technical Information Center, 1980).

3. STINET Report no. ADD702422, *SU-50—AN/PAS-8 Evaluation* (Fort Belvoir, VA: Defense Technical Information Center, 1970).

4. STANO program; described in detail in U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 18–20, 1970), “Thermal Imaging Systems” section, 177–178.

5. John Pimlott, *Vietnam: The History and the Tactics* (Avenel, NJ: Crescent Books, 1984), 82.

6. General Donn A. Starry, *Mounted Combat in Vietnam* (Washington, DC: Department of the Army, Vietnam Studies, 1978), 157. Stock number 008-020-00747-1.

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8. STINET Report no. ADA025811, *Elements of a Battalion Integrated Sensor System: Operator and Team Performance* (Fort Belvoir, VA: Defense Technical Information Center, 1975).

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11. STINET Report no. ADD702237, *Utilization and Employment of the Detector, Concealed Personnel, Aircraft Mounted, XM3* (Fort Belvoir, VA: Defense Technical Information Center, 1970).

12. STANO program; described in detail in U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 18–20, 1970), “NOD Xenon Searchlight Mini-Gun Systems” section, 185–186.

13. STINET Report no. ADD702410, *Airborne Searchlight Test Report, Volume III* (Fort Belvoir, VA: Defense Technical Information Center, 1970).

14. STINET Report no. ADA955120, *Air Transport of Standard 60-Inch Searchlight* (Fort Belvoir, VA: Defense Technical Information Center, 1944).

15. STINET Report no. ADD702148, *30 Inch Xenon Searchlight AN/TVS-3* (Fort Belvoir, VA: Defense Technical Information Center, 1969).

16. STINET Report no. ADD702144, *Spectrolab FX-150, 9 to 20 KW, Helicopter-Mounted Searchlight* (Fort Belvoir, VA: Defense Technical Information Center, 1969).

17. STINET Report no. ADA040485, *Searchlight Sets AN/VSS-4 (XE-4)* (Fort Belvoir, VA: Defense Technical Information Center, 1977).

18. Starry, *Mounted Combat in Vietnam*, 203.

19. STINET Report no. AD370248, *Airborne Searchlight Signals Measured Underwater in the Chesapeake Bay* (Fort Belvoir, VA: Defense Technical Information Center, 1966).

CHAPTER 9

Airborne Attack

AIRBORNE ATTACK in response to sensor activity was on the one hand straightforward and on the other, complicated. An orbiting EC-121R or QU-22 aircraft picked up sensor signals indicating troop or vehicle movements. These signals were then transmitted to the infiltration surveillance center (ISC) facility at Nakhon Phanom (NKP). At the ISC facility, Task Force Alpha intelligence teams relayed sensor information to an orbiting airborne battlefield command and control center (ABCCC) aircraft. These aircraft were identified with call signs such as Cricket or Hillsboro during the day and Alleycat or Moon Beam at night, and they selected target locations accordingly. On the routes where sensor activations were detected, these teams picked selected points at specific locations and times for attack. Exact sensor coordinates were known because the sensors had been deposited via LORAN-equipped aircraft. These coordinates were then passed on to LORAN-equipped attack aircraft. Task Force Alpha sensor specialists briefed the specific sensor designators, called identifiers, to EC-121R and F-4D aircrews.

At times, F-4 fighter-bombers were constantly airborne, orbiting near a KC-135 refueling tanker while awaiting a strike call and LORAN information. For sensor response, the ISC contacted the EC-121R aircraft, which then relayed strike coordinates to the orbiting strike aircraft loaded with munitions. Attacking aircraft flew at 5,000 feet down the infiltration route; when the LORAN sets determined the aircraft were at a specific location, they released the munitions. Release could take place manually or automatically via a LORAN link. Night attacks with LORAN-equipped aircraft had very good results. Near sunset, squadron aircraft took off and orbited over a specific area near the Thai/Lao border, awaiting ISC notification that sensor fields had been activated by the enemy. Then, using the LORAN coordinates, the aircraft pressed the attack using cluster bomb units (CBUs) and 500-pound bombs.

In early 1969, “choke points” were established in Laos near the Mu Gia Pass, Tchepone, Ban Tanak, and Ban La Boi. The choke-point concept was an old military tactic, used again in this high-tech war. Airborne attack created a situation in which traffic flow was funneled to specific locations—usually near mountain passes or across rivers, where the enemy was backed up during transit. Such locations were ideal for attacking the bottled-up traffic. Once the choke points were established and traffic was flowing through them, they were attacked from the air with a wide variety of munitions, such as gravel and Dragontooth, FMU-72 delayed fused 500-pound bombs, and so on. This barrage closed the road and choke point for quite some time, and it usually required the enemy to construct temporary detours until the main road could be reopened or another safer route constructed.

In November 1969 the Commando Bolt/Commando Hunt programs were established. They were envisioned to be integrated combat operations using sensor fields, forward air controllers (FACs), and strike aircraft to intercept enemy convoys at predetermined locations during the infamous monsoon season. The term *Sparky FAC* (call sign Copperhead) arose during the Commando Bolt/Hunt campaigns. Sparky FAC was a three-man team assigned to the ISC to monitor sensor fields for convoy movements. When the Sparky FAC team detected convoy movements, they tracked them and determined when the convoy would arrive at a specified location. After identifying the time and location, Sparky FAC assigned specially designated air attack teams to strike. The attack teams were divided into low-speed and high-speed aircraft. Low-speed attack teams, called Panther Teams, usually consisted of two Douglas A-1 Skyraider attack aircraft. These were propeller-driven, Korean War–vintage aircraft that could carry a wide variety of ordnance. Accompanying the strike force was an FAC flying either a single-engine, propeller-driven Cessna 0-2 aircraft or a twin-engine turboprop OV-10. Panther teams were in operation from late December 1969 through early January 1970, after which operations were discontinued due to a significant increase in threat from antiaircraft artillery. High-speed attack aircraft were called Flasher Teams. These normally consisted of 25th Tactical Fighter Squadron (TFS) LORAN-equipped F-4s or Marine A-6 attack aircraft equipped with moving target indicator (MTI) radar. USAF

Flasher teams usually consisted of one LORAN F-4 leading two non-LORAN F-4 aircraft. Marine Flasher teams usually consisted of one MTI-equipped A-6 leading two Navy or Marine A-7 attack jets. Based on the large number of trucks damaged and/or destroyed, the Commando Bolt/Hunt program was deemed a success.

The success of Commando Bolt/Hunt resulted in the implementation of Commando Bolt II. During this operation, nonvisual bombing of targets during inclement weather took place. USAF LORAN-equipped 25th TFS aircraft attacked convoys in Laos using information processed through the ISC. Panther teams, operating with 0-2 and OV-10 forward air controllers equipped with night observation devices, directed A-1 Skyraider airstrikes on vehicles and troops. Flasher teams, with A-6 aircraft leading F-4 strike forces, conducted nonvisual airstrikes using locations provided by the ISC or Combat Skyspot radar releases. These nonvisual F-4 strikes were called Pave Phantom—a term reflecting the common name of the F-4, the Phantom II, and the fact that the strikes were nonvisual.

Commando Bolt II was followed by III, IV, and V. All three operations lasted from April 1970 through April 1971. Commando Hunt III resulted in destruction of or damage to 1,052 vehicles, with 2,540 secondary explosions. Twenty-six antiaircraft artillery sites were attacked and destroyed, with 131 secondary explosions. Commando Hunt IV shifted operations into the southwestern section of Laos, near the Ban Karai Pass area. Commando Hunt V expanded the sensor fields in the Ban Raving area. During this operation, it was determined that the enemy was monitoring U.S. strike frequencies and passing airstrike information on to the field commanders responsible for vehicle convoys. The information was used to hide convoys along the route network in Laos. Sensor information revealed that vehicle movements would decrease just before an airstrike and then pick up shortly thereafter. After it was discovered that the enemy was monitoring airstrike frequencies, U.S. aircraft communicated on a secure voice network. The B-57G aircraft was employed for the first time over Laos during Commando Bolt V. This was followed by VI, which was a planned reduction in the maximum number of active sensor strings. After implementation of this program, sensor strings were reduced from a maximum of 128 to approximately 50. Sensor string sites were allowed to become inactive (not resown after the sensor batteries went dead) because the airstrikes had been so successful that the enemy had to reroute the roads and trails away from Commando Bolt attack sites. These inactive sites were simply abandoned; no new sensors were delivered to the area.

From late 1970 through early 1971, a new concept in sensor emplacement was established. The new emplacement was called the sensor band string, which provided wider area coverage. This was necessary because the enemy was building bypasses around roads and routes that had been heavily damaged during the Commando Bolt/Hunt operations. In this concept, bands of sensors, as opposed to sensor strings, would be sown in areas suspected of being the location of bypasses. When movement was detected within the sensor band string, specific sensor(s) would be identified and a location determined. The information was plotted and filed as pending historical data. When taken as a whole, movement through sensor bands assisted the ISC technician in determining the specifics of the bypass route, thus giving ISC technicians a broad intelligence picture of the ever-changing road network.

Airborne attack in response to sensor activation was accomplished by a wide variety of Air Force, Marine, Navy, and/or Vietnamese aircraft. However, a few aircraft specifically dedicated to precision attack are worthy of mention. All were incorporated into the Commando Hunt and Bolt programs in one way or another. These aircraft provided real-time, all-weather strike operations that allowed sensor monitors to call in airstrikes any time of the day or night, in almost any type of weather.[1, 2, 3]

Commando Hunt/Bolt Aircraft

A-6 Intruder

Built by the Grumman Aircraft Corporation in the late 1950s, the A-6 Intruder was a subsonic, twin-engine, all-weather attack aircraft that carried a two-man crew and was operated by the U.S. Navy and Marine Corps. The Intruder had the capability of precision bombing in any weather. The benefit of using the A-6 for munitions delivery on targets identified by sensor systems was twofold. First, the all-weather capability allowed it to operate not only in poor weather but also at night, when the enemy was usually on the move. Second, the A-6 carried a very sophisticated radar system. One feature of this system was the moving target indicator, which allowed the radar systems operator to view objects moving on the ground in almost any weather condition. This, coupled with sensory information and the aircraft's precision bombing system, created unseen havoc on the enemy. The A-6 was a formidable attack aircraft capable of carrying a wide variety of air-to-ground ordnance in large quantity. For example, it could carry the following:

- Ten 2.75-inch folding fin rocket pods
- Ten 5-inch Zuni rockets
- Twenty-eight MK-81 general-purpose 200-pound bombs
- Twenty-eight MK-82 general-purpose 500-pound bombs
- Twenty MK-17 general-purpose 750-pound bombs
- Thirteen MK-83 general-purpose 1,000-pound bombs
- Twenty-eight cluster bomb units (CBUs)
- Five MK-84 general-purpose 2,000-pound bombs
- Any combination of the above

The first flight of the Intruder took place in 1963. It was capable of flying at 648 miles per hour and had a ceiling of 40,600 feet.[4]

F-4D Phantom II

The supersonic McDonnell F-4D Phantom II, assigned to the 25th Tactical Fighter Squadron (TFS), was unique among F-4 aircraft of the time. These two-place, twin-engine aircraft were delivered to the squadron with long-range airborne navigation (LORAN) systems installed. As stated in a previous chapter, the aircraft were used as high-speed sensor delivery platforms over North Vietnam, Laos, and Cambodia. However, because of the highly accurate navigational aids, they were also used extensively for pinpoint delivery of munitions on sensor-detected targets. The 25th Squadron aircraft also flew night attack operations, guided to their targets by information from the infiltration surveillance center at NKP. The F-4 was a formidable weapons platform capable in both the air-to-air and air-to-ground roles. For example, it could carry the following:

- Fifteen cluster bomb units (CBUs)
- Twelve MK-20 general-purpose 750-pound bombs
- Twenty-four MK-82 general-purpose 500-pound bombs, four AIM-7 Sparrow radar-guided long-range air-to-air missiles, and four AIM-9 Sidewinder infrared heat-seeking missiles
- Any combination of the above with additional air-to-ground weapons as required

B-57G Night Intruder

In late 1966, the USAF decided that to conduct nighttime operations in Southeast Asia, specialized aircraft with high-tech night equipment was needed. Project Shed Light was launched to such an end. The project was designed to conduct a review of technical equipment available, or in the development process, that might be used for night observation and attack in Southeast Asia. The B-57G Night Intruder was an outgrowth of Project Shed Light.

Development of the Night Intruder began in 1968 in a program called Tropic Moon. Tropic Moon I, initiated in 1967, had involved a modified Douglas A-1 Skyraider with a low-light television installed to view enemy location and movements at night. The follow-on, Tropic Moon II, involved three modified B-57s equipped with improved low-light television and other electronic equipment. The three modified B-57s were assigned to Phan Rang Air Base, South Vietnam. Tropic Moon III was a B-57G that served in Vietnam from October 1970 through March 1971. The subsonic Martin B-57G Night Intruder carried a crew of two and was modified with sophisticated radar similar to that in the A-6.

During the Tropic Moon modification program, Martin Aircraft Company and General Dynamics Corporation modified sixteen B-57B Canberras that had been operating as day bombers in Vietnam into the B-57G version. Although effective in this role, these aircraft were withdrawn due to a wide variety of problems. The B-57G was specifically dedicated to night operations. Painted entirely black, it sported a large multifunctional radar located in a bulbous nose, which set it off distinctly from the B-57B. The "G" was also modified to carry a low-light television camera, which peered through an optically pure window on the right-hand side of the aircraft just aft of the radome. A range-finding laser system, as well as an infrared detector, peered through an optically pure window on the left side of the aircraft just aft of the radome. Munitions carried included unguided and/or laser-guided bombs (laser-guided bombs were later called smart bombs, and unguided bombs were called dumb bombs). Also added was a rapid-fire cannon, located on the belly of the aircraft so that it could fire downward in a 180-degree arc.

Eleven B-57Gs were assigned to the 13th Bomb Squadron. They deployed to Ubon Royal Thai Air Base in Thailand in September 1970. Only one B-57G was lost in Southeast Asia during the Vietnam War. On the night of 12 December 1970, aircraft 53-3931 collided with a USAF

O-2A forward air controller. Both aircraft crashed near the Laotian town of Tchepone. The B-57G aircrew ejected and was subsequently rescued. Of course, B-57s were not immune to antiaircraft fire. In one instance, aircraft tail code PQ282 was hit in the right-hand horizontal tail by antiaircraft fire over Laos. The hit took out almost the entire right-hand horizontal tail surface, leaving only a small section attached to the base of the vertical tail. The pilot was able to retain control of the aircraft and flew it all the way back to Ubon. The effectiveness of the B-57G was summed up in a February 1971 message from the 8th Tactical Fighter Wing at Ubon, Thailand, stating in part: "B-57Gs of this wing destroyed 35 trucks, which set a record for trucks destroyed during one night's operation."

The 13th Bomb Squadron was deactivated in April 1972 and the remaining B-57Gs were returned to the United States and transferred to the Kansas Air National Guard. They were withdrawn from service and placed in storage at Davis-Monthan Air Base near Tucson, Arizona, in 1974. They were subsequently stripped of all useful equipment and scrapped.

Commando Bolt Munitions

Although munitions were used during airstrikes for a wide variety of purposes, the Commando Bolt munitions were used in support of Igloo White operations. These munitions were funded primarily by the Defense Communications Planning Group (DCPG). They were also used for the interdiction of enemy troops and equipment (not related directly to the Igloo White program) on an as-required basis.

Integrated use of sensor data and munitions greatly enhanced the overall effectiveness of the Igloo White program. Roadways used by vehicles and troops on the Ho Chi Minh Trail were cut off by bombing, creating a traffic bottleneck. U.S. troops then seeded with antipersonnel and vehicle land mines, effectively eliminating vehicles and troops entering the area.

Wide-Area Antipersonnel Mine (WAAPM) Gravel Submunition

Approximately 80 WAAPM submunitions could be carried in a single CBU-24 or CBU-42 dispenser. During an operational combat mission, the F-4 usually carried from 6 to 12 CBU dispensers. Upon reaching the target area, the aircraft released the dispensers. When the dispensers reached a predetermined altitude, a pressure-sensing fuse fired, splitting the canister open, releasing the submunition mines and allowing them to free-fall to earth. As the submunitions fell, airflow caused them to spin. This spinning action not only dispersed the mines but also, after a predetermined amount of spins, armed them. The arming was done by a centrifugal mechanism, used as a safety device to prevent the mines from exploding within the dispensers. A delay circuit was also built into the mines; this allowed them to come to rest on the ground before being fully armed, and it prevented them from exploding upon contact with the ground.

Because the mines were usually dispensed over an area that had been sown with sensors, their effects were multifold: When a mine was stepped on, the explosion activated the sensor field, sending signals to the ISC that the site was active. The munitions also protected the sensor field from the enemy, allowing the sensors to operate without being removed or tampered with. Moreover—once on the ground and fully armed—the mines exploded in response to any contact or disturbance, inflicting damage upon enemy troops and light vehicles.

Unlike earlier antipersonnel and anti-vehicle mines, these munitions were automatically deactivated at a specific time. This approach was in stark contrast to Soviet and Chinese mines used by the North Vietnamese; those mines were armed almost indefinitely, causing much pain and suffering in later years to unsuspecting civilians who happened upon them. One drawback early in the program was that mines exposed to the heat and humidity of the Southeast Asian environment sometimes failed to explode.[5, 6]

M-36 Incendiary Cluster Bombs

Although developed during World War II, incendiary cluster bombs were also ideal for destroying enemy fortifications and vehicles in Southeast Asia. The M-36 was a cluster of 182 magnesium incendiary bombs enclosed in a dispenser and weighing 800 pounds. Once ignited, the magnesium burned with a fury and was almost impossible to extinguish. Throwing water on burning magnesium only made the problem worse. Because of their size, weight, and design, early versions were carried externally on slow-moving aircraft such as the propeller-driven A-1 Skyraider or internally in the subsonic B-57 bomber. However, late in the war, the M-36 was redesigned to be carried on the F-4 and used for attacks on the Ho Chi Minh Trail in Laos. Although the F-4 could carry up to four M-36 dispensers, the normal complement for a combat mission was two.[7]

BLU-31 Land Mine

The BLU-31, or Bomb Live Unit-31, was a 750-pound blunt-nosed weapon designed to be buried slightly under the ground after impact. Unlike bombs that were armed before contacting the ground, BLU-31s were not fully armed until they had settled in the ground and all movement stopped. Their fusing mechanism could be set to explode in response to magnetic anomalies or seismic vibrations of specific magnitudes. This munition was ideal for attacks against the trail system in Laos and Cambodia because it could be dropped at desired mean point of impact (DMPI) sites where a convoy or troop movement was predicted to arrive. The munition would then be sitting in the ground ready to explode when the enemy passed nearby. A side benefit of a delayed explosion was that the carrier aircraft would be long gone and, at least hopefully, not subjected to enemy ground fire.[8]

Pave Pat I and II Fuel/Air Explosive

Fifty-two Pave Pat I explosives were developed. Some were tested in the United States, and the remaining explosives were used in Southeast Asia in the latter part of 1968. The weapon was basically a propane tank, airborne carriage unit, fusing mechanism, and parachute. Pave Pat I was not very successful. When the 52 Pave Pat I explosives were expended, the program was reevaluated. The new munitions, designated Pave Pat II, were improved for carriage on the F-4.

However, due to the final pullout of U.S. military personnel from Vietnam, Pave Pat II had very limited use during the war. The program continued, making improvements over the years; a greatly improved version was successfully used in Operation Desert Storm. The concept was to drop a canister containing a highly flammable substance that could spread out in the environment when the canister was opened. A fusing mechanism then ignited the flammable substance, causing a tremendous explosion in the air—or in some cases, in caves and underground tunnels.[9]

Dragontooth Submunition

Like the WAAPM, the Dragontooth was an antipersonnel submunition. It was carried in a CBU-24 container, which held several hundred Dragontooths. The Dragontooth was shaped like a large, blunt arrow; when dispensed it was designed to spin on its way to the ground. Like the WAAPM previously described, the Dragontooth was armed by the spinning. This feature prevented it from exploding while in the container or if accidentally dropped. When stepped on, the munition exploded, causing extensive damage to a soldier's foot and lower portion of the leg. The explosive charge was not large enough to damage vehicles—each Dragontooth was only about 3 inches long.[10]

XM41E1 Button Bomb/Micro-Gravel Submunition

These submunitions were carried in a standard CBU-41 dispenser; several hundred of them could be dispensed at a time. Like the Dragontooth, the XM41E1 was designed to explode when stepped upon. Also like the Dragontooth, the XM41E1 did not carry sufficient explosive power to damage vehicles, because these submunitions were small in diameter. The advantage of the XM41E1 submunition over other types was its small size—more of them could be carried and dispersed over a wider area, making them ideal for use on the Ho Chi Minh Trail.[11]

CBU-33 Anti-Vehicle Land Mine

The anti-vehicle land mine was developed in September 1953 as a tank destroyer; several of these 20-pound mines could be carried in a CBU-33 dispenser. The mine had a shaped charge at its rear, designed to penetrate the thick metal of tanks and other tracked vehicles. Once dispensed from passing aircraft, the mines fell to the ground and were fully armed after ground contact. They stayed in a passive mode until a vehicle passed over or close to them. Only 600 of these land mines were deployed to Southeast Asia, but terrain and expense did not warrant their continued use. Production was terminated in the early 1970s, although the weapon would have been ideal for DMPI use.[12]

BLU-52 Chemical Bomb

The Bomb Unit Live-52 (BLU-52) was filled with 270 pounds of CS-1—or if available, CS-2—riot control gas. CS-1 gas lingered and was effective for 3 to 5 days; CS-2 lingered for 30 to 45 days. For both gases, the length of effectiveness depended upon weather conditions. Contact (inhalation) with the gas caused troops to become ill, but the gas was not lethal. The bomb was not very effective in the war, so it was not often used. Its advantage for the Igloo White program was that it could be used in attacking troop convoys and bivouac areas.[13]

BLU-66 Bomblet

The Bomb Live Unit-66, or BLU-66, was an antipersonnel fragmentation bomb. The small bomblet, only 3 inches in diameter, packed the explosive power of a fragmentation grenade. The weapon was phased out of the Igloo White program in the early 1970s as the program concentrated on destroying trucks. The bomblet had insufficient explosive power to significantly damage trucks; but, like a hand grenade, it could be devastating to personnel.[14]

Special Air Assets Used in the Igloo White Program

AC-47 Gunship

Spooky—or Puff the Magic Dragon, as the aircraft came to be known—was a modified Douglas C-47, the military version of the commercial DC-3 airliner. It entered commercial service in the 1930s. First employed as a gunship in Southeast Asia in 1964, the AC-47's firepower came from three 7.62-mm rapid-fire Gatling-type guns mounted on the left-hand side of the fuselage. At each of the three gun locations, the passenger windows were removed so that the gun could fire through the opening. The pilot used a simple non-computing gun sight to point the guns at the target. The aircraft was flown with the left wing down for gun firing. A gun loader in the aircraft was responsible for keeping the guns in operation. Nighttime operations were conducted by dropping magnesium flares to illuminate the landscape. The aircraft was dispatched in support of the Igloo White program when sensors detected enemy movement near allied locations. All of the AC-47s in Vietnam were turned over to the South Vietnamese Air Force (VNAF) in 1969. The AC-47 is no longer in operational service in any country.

AC-119G/K Gunship

Called Stinger, this propeller-driven aircraft (which also carried a pod-mounted jet engine under each wing for additional thrust) was developed during the Korean War. It was converted into a gunship by the addition of four 7.62-mm Gatling guns and four 20-mm cannons; a pod-mounted, forward-looking infrared sensor (FLIR); and a night observation device (NOD). The NOD used a charged coupling tube, an electronic device that amplified the starlight reflected by objects to "see in the dark."

Stinger gunships were used in conjunction with Igloo White in the tank and truck destroyer role. They were to have taken the place of the AC-47 once that aircraft was phased out of service. However, like the AC-47, the Stinger was vulnerable to ground fire; it too was phased out of the U.S. inventory. All of the Stingers in Vietnam were turned over to the VNAF in the early 1970s. The AC-119 is no longer in operational service in any country.

AC-130A/E Gunship

The Spectre, as it was called, was stationed in both South Vietnam and at Ubon, Thailand. The original AC-130A gunship carried much the same munitions and electronic gear as the AC-119. However, in December 1969, a modification program called Surprise Package was instituted to replace the older C-130A airframe with that of the new C-130E. The new gunship platform received an improved fire control computer and updated sensor systems, and the aircraft designation was changed to AC-130E. This was to become the ultimate gunship; and it was the premiere gunship of the Vietnam War, especially in the interdiction role. The AC-130 continues to do a yeoman's job in military operations. It was used in numerous low- and high-intensity wars, such as Desert Storm and Operation Iraqi Freedom.

OV-10D Mohawk/Pave Nail

The two-man, twin turboprop Grumman OV-10 Mohawk was used in Southeast Asia as an attack aircraft, as a light observation aircraft, and as a forward air controller platform. At Varo Inc., the original OV-10 attack version was modified into the Pave Nail variant by installing an integrated night observation device, a laser target designator, a FLIR, and the capability to interface directly with Igloo White sensors. A squadron of the modified aircraft was dispatched to Vietnam in support of the Igloo White program. Aircraft equipped with Pave Nail used lasers to designate targets for attack by other aircraft that carried laser-guided bombs. Although civilian OV-10s are still flying, the U.S. military retired the Mohawk in the late 1970s because it was considered obsolete for its purposes.

UH-1 Iroquois/AN/ASQ-132 INFANT

The acronym INFANT stood for Iroquois Night Fighter and Night Tracker. The INFANT program modified the Bell Aircraft Corporation UH-1 transport helicopter, used by the U.S. Army, into a night attack platform. Installing a low-light television system, thermal imaging, and a system known as the AN/ASQ-132 night tracker on the UH-1B transport helicopter transformed the UH-1B into a formidable system for interdiction and night attack. Also added were pylons for installing unguided 2.75-inch folding fin rockets and machine guns in the doorways. The UH-1 and INFANT combination was the genesis of helicopter gunships that followed, and current versions of helicopter gunships can trace their origins to this program.

UH-1 Iroquois/NightHawk

Like the INFANT program, the NightHawk program modified and equipped a Bell UH-1B transport helicopter for night attack. In this case, the NightHawk was equipped with a powerful xenon spotlight and a 7.62-mm Gatling gun. Both devices were mounted in the left-hand aft doorway. This was the first aircraft deployed to Vietnam that could both find and attack the enemy at night. The UH-1/NightHawk, like the UH-1/INFANT, is considered the grandfather of today's helicopter gunships.

YO-3A Quiet Star (Initially called the Quiet Thruster)

In the late 1960s, the Defense Advanced Research Projects Agency (DARPA) awarded Lockheed Aircraft a $100,000 contract to modify two Schweizer SGS 2-32 sailplanes (gliders) into propeller-driven observation aircraft. The two prototypes were to be proof-of-concept aircraft for potential production versions to be used in the war in Southeast Asia.

The prototypes were equipped with Continental O-200 engines rated at 100 horsepower, mounted atop the fuselage and behind the cockpit. The prototypes had an 8-foot diameter, four-blade, fixed-pitch wooden propeller. The propeller was powered by a long driveshaft that ran from the front of the engine, went over the top of the canopy, and ended at a pulley and belts arrangement. The driveshaft, pulley, and belts were mounted on a pylon at the nose of the aircraft. The engine exhaust was quieted with an automobile muffler. The pilot was positioned in the front cockpit and the observer in the rear.

The two prototypes were actually experimental aircraft, but they were designated QT-2 (Quiet Thruster—2 place). After both aircraft flew test missions in California, any problems that developed were resolved. A simple sensor package consisting of an off-the-shelf starlight scope was installed. Improvements were made to the general configuration of the airframe/power-plant interface, self-sealing fuel tanks, and some off-the-shelf military avionics. The aircraft, newly designated as QT-2PC, were ready for combat.

In late 1967, the QT-2PCs were disassembled and flown to South Vietnam. They operated from Soc Trang, in the Mekong Delta area in the southern part of the country. The military was impressed with the ability of these aircraft to fly so quietly over the South Vietnamese countryside. Of course, all flights were conducted at night; behind the pilot, the observer was able to see enemy watercraft carrying supplies along the delta waterways and enemy truck convoys carrying supplies south. The two prototypes proved the concept, and the military requested an advanced version.

With the go-ahead to produce a better aircraft, Lockheed replaced the original power plant with a 6-cylinder, 220-horsepower Continental engine mounted in the nose of the aircraft. The long driveshaft, pylon, and pulley system on the QT-2 was gone. The four-blade, fixed-pitch wooden propeller used on the original version was replaced with a six-blade, constant-speed wooden propeller turning at 800 rpm. The refined aircraft carried the designation YO-3 (the "Y" is a military designation indicating a prototype). The YO-3 was a bit heavier and slightly louder than the prototype, so it had to be flown at a slightly higher altitude than the prototypes had been. The project was then transferred to the Department of Defense under what was called the Project Prize program. A sensor package was incorporated, including infrared sensors, an infrared illuminator, a laser target designator, and chemical detectors. Both the infrared sensor and the chemical detector were used to detect the presence of troops by body heat and odor. Because of the chemical detectors, the aircraft was dubbed the "people sniffer."

A total of 11 YO-3A aircraft were built, 9 of which were sent to South Vietnam in early 1970 and based at Hue Phu Bai and Long Thanh. Both the U.S. Army and the U.S. Marines flew the aircraft. The YO-3As performed admirably; but unfortunately, the chemical detectors proved ineffective—they could not distinguish between human and animal. None of the nine aircraft were shot down during their operational lifetimes in Vietnam. Improvements to the aircraft continued while in Vietnam; for example, a new four-blade, controllable-pitch propeller was installed. The U.S. Army discontinued the program in August 1971 due to funding and the foreseeable end of the war for the American military.

The QT-2 prototypes had no serial numbers; they were simply listed as number 1 and 2. All YO-3A aircraft were given serial numbers, from 69-18000 through 69-18010. As this book goes to press, seven YO-3As have survived; they are described in the following section. Of the two QT-2 prototypes, one survives; the other was reconfigured as the original SGS-2-32 sailplane.

The two QT-2 prototypes were given to the Navy's Test Pilot School, located at the Patuxent Naval Air Base in southern Maryland. They were placed in the experimental category and designated as X-26B, and the school used them well for training test pilots in low-speed flight and the phenomenon known as roll coupling.

Schweizer Aircraft would later build on the YO-3 concept and develop the SA2-37B, a silent aircraft that was in U.S. government service for several years before being replaced by a newer version, the RU-33B. The RU-33B, the company's president says, will be undetectable above 2,000 feet. The aircraft is powered by twin turboprops, mounted in tandem, operating propellers that can turn as slowly as 1,000 rpm in flight. The propeller on the aft engine can be shut down in flight to further reduce noise and conserve fuel. To reduce the aircraft's infrared signature, the engine exhaust is routed over the wings, thus dispersing hot engine exhaust heat.

The Diamond Aircraft Company is also building high-tech surveillance aircraft. The company is offering the DA42, a twin-engine turboprop aircraft in both manned and unmanned versions. The aircraft will provide customers with a sensor suite that includes electro-optical and infrared sensors and synthetic aperture radar. Most interesting, though, is that the aircraft's infrared signature has been greatly reduced; engine and propeller noise are also greatly reduced. Overall, the aircraft will have significant stealth characteristics—which had their origins during the Vietnam War.

Disposition of YO-3A Aircraft

As this book goes to press, seven YO-3A Quiet Stars have survived:

- **69-18000.** This aircraft was not sent to Vietnam. It remained in the United States and was used in conducting flight test improvements to be potentially incorporated into the aircraft in combat. This aircraft is currently at the U.S. Army Aviation Museum at Fort Rucker, Alabama; however, the aircraft is not on display. The museum is located just off U.S. highways 84 and 251 in Alabama. The museum web site is at http://www.armyavnmuseum.org.
- **69-18001.** This aircraft served in Vietnam. It is currently at Hiller Aviation Museum, 601 Skyway Road, San Carlos, California 94070. The museum web site is at http://www.hiller.org.
- **69-18002.** This aircraft crashed and was destroyed during landing at Long Thanh. Both crewmembers survived.
- **69-18003.** This aircraft served in Vietnam and is now privately owned.
- **69-18004.** Unfortunately, this aircraft crashed during combat operations in Vietnam. Both crewmembers were killed.
- **69-18005.** This aircraft served in Vietnam and is now privately owned.
- **69-18006.** This aircraft served in Vietnam. It is currently at the Pima Air and Space Museum, 6000 East Valencia Road, Tucson, Arizona 85706. The museum web site is at http://www.pimaair.org.
- **69-18007.** This aircraft served in Vietnam. It is currently at the Cable Museum. The museum is located at the Cable Airport, 1749 West 13th Street, Upland, California 91786-2100. The museum web site is at http://www.cableairport.com.
- **69-18008.** This aircraft was destroyed in a crash during combat operations in Vietnam. Both crewmembers survived.
- **69-18009.** This aircraft crashed in California. Both pilot and passenger survived the crash.
- **69-18010.** This aircraft is currently operated by NASA, serving as an airborne science research aircraft. It is operating out of NASA Dryden Ames Research Center at Moffett Field, California. The field is located just off U.S. Highway 101 near San Carlos, California. It is just a short distance from the Hiller Museum.

Notes

1. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee of Preparedness Investigating Subcommittee of the Committee on*

Armed Services (November 18–20, 1970). U.S. Government Printing Office, Washington, DC.

2. *Project CHECO (Southeast Asia Report) on Igloo White Operations: July 1968–December 1969, A Contemporary Historical Examination of Current Operations, Concepts, Policies and Doctrines.*

3. *Project CHECO Report, Igloo White Program: July 1968–December 1969, A Contemporary Historical Examination of Current Operations—Oral Histories of 25th TFS Pilots.*

4. Commando Bolt munitions are covered in some detail in U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee of Preparedness Investigating Subcommittee of the Committee on Armed Services* (November 18–20, 1970).

5. Bernard C. Nalty, "Chapter VIII: Beyond the Next Hill," in *Air Power and the Fight for Khe Sanh* (Washington, DC: Air Force History and Museums Program, USAF, 1968). ISBN 0-919299-20-X.

6. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 19, 1970), 129–131. U.S. Government Printing Office, Washington, DC.

7. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 19, 1970), 133–134. U.S. Government Printing Office, Washington, DC.

8. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 19, 1970), 134–135. U.S. Government Printing Office, Washington, DC.

9. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 19, 1970), 135–136. U.S. Government Printing Office, Washington, DC.

10. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 19, 1970), 137–138. U.S. Government Printing Office, Washington, DC.

11. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 19, 1970), 140–142. U.S. Government Printing Office, Washington, DC.

12. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 19, 1970), 143–144. U.S. Government Printing Office, Washington, DC.

13. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 19, 1970), 145–146. U.S. Government Printing Office, Washington, DC.

14. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee* (November 19, 1970), 147. U.S. Government Printing Office, Washington, DC.

CHAPTER 10

The 25th Tactical Fighter Squadron at Ubon

IN WRITING this book, I have drawn on personal experience with the Igloo White program in Southeast Asia. I was assigned to the 25th Tactical Fighter Squadron (25th TFS) when it was reactivated at Eglin Air Force Base, Florida, in 1967. Its mission was dropping various electronic sensors on the Ho Chi Minh Trail, primarily in Laos. The squadron was named the Assam Dragons, which dates back to its initial activation during World War II. Flying North American P-51 fighters, the squadron was assigned to the China–India–Burma (CIB) theater, operating from Assam, India. During the Korean War the squadron flew combat operations from 1950 through 1953. It was deactivated in 1960. When the need arose for more fighter-bomber units during the Vietnam War, the 25th was reactivated. It was assigned the role of airborne sensor delivery—initially the responsibility of the U.S. Navy's VO-67 squadron, operating the aging and vulnerable propeller-driven OP-2E aircraft. Not surprisingly, 25th Squadron personnel took some fairly hard ribbing over the name Assam Dragons.[1, 2]

Activating the 25th Tactical Fighter Squadron

At Eglin Air Force Base, the 25th TFS received new F-4D Phantom II aircraft directly from the McDonnell Aircraft factory in St. Louis, Missouri. These were specially modified aircraft incorporating, among other things, a then state-of-the-art long-range air navigation (LORAN) system that was vital for accurately determining the specific location of each sensor dropped. As the Phantoms arrived at Eglin, aircrews and crew chiefs were assigned to each of the new aircraft.

There were a few surprises during the transition/training period. One instance almost cost the lives of a two-man aircrew. Shortly after takeoff on a training flight, the pilot reported that the control stick was stuck. Superior piloting skill got the aircraft safely back to base, where the cockpit and flight control system were torn apart in an effort to determine the cause of the malfunction. After several weeks of intensive investigation, it was discovered that the torque tube connecting the forward and aft cockpit control sticks was cracked. As pressure was applied to the control stick column, the crack widened, causing the binding condition. In another instance, an F-4 crew accidentally dropped a load of special munitions near a public beach in South Carolina, causing much dismay not only in the military but also among the civilian population in the area. An explosive ordnance disposal team was sent to pick up the munitions.

After months of training, the squadron was ready for transfer to Southeast Asia. Forward-deployed ground crews and pilots were sent to various locations en route, where the aircraft would land and crews were scheduled to stop and rest overnight—or, as they were called, RONs. When ready, the F-4s departed Eglin for the long trip. RONs included Travis Air Force Base near Sacramento, California; Hickham Air Force Base in Hawaii; Anderson Air Force Base, Guam; and then the final destination at Ubon Royal Thai Air Base, Thailand. At each overnight stop, cold beer awaited the aircrew as they taxied in. Served by the crew chiefs, the liquid refreshments were a welcome sight to the sweat-drenched, bone-tired pilots.

Numerous in-flight refuelings were accomplished en route, and all aircraft arrived at Ubon in good shape. However, the LORAN sets proved to be very unreliable; only two aircraft arrived with operational systems. The reliability of the LORAN was a sore subject, one that was quickly remedied after a modification program was instituted to improve the reliability.

Shortly after arriving at Ubon, the aircraft were painted in squadron colors. This was standard practice and actually helped to readily identify the aircraft organization. For the 25th the colors were yellow and black. The canopy frames were painted yellow with a black border, and the pilot and weapons systems officer's names were in black on the left-hand side of the frame within the yellow area. The crew chief and assistant crew chief's names were painted in black on the right-hand canopy frame. The left and right ram air inlet scoops (on the underside of the aircraft, forward and slightly below the engine air intakes) were also painted yellow, and black was used for nose art.

Some very colorful art was painted on these ram air scoops (at least initially).[3] One aircraft in particular had a woman's breasts painted on the inlet scoops, with the logo "Judy's Front 40" in black on the yellow background.[4] As typical of Tactical Air Command aircraft, the tip of the vertical fin was painted in the squadron's color. Also painted on the vertical tail was the squadron's call sign—*FA*, in large but subdued white lettering. Just below the call sign were the last three numbers of the aircraft's serial number, also in subdued white. After a few months, the idea was floated that a dragon should be painted on the vertical tail to illustrate the dragon portion of the Assam Dragon squadron name. Unfortunately, the artwork for the dragon was nothing short of abysmal—the yellow dragon looked more like a crawdad. Again the squadron took some good-natured ribbing. Compared to the other squadron names on base, such as the 433rd's Satan's Angels—which by the way was then credited with 10 MiG kills—the 25th's name did seem lighthearted.

The 8th Tactical Fighter Wing at Ubon required all newly arrived aircrews to undergo a three-day ground school before being allowed to fly in combat. The ground school, jokingly called the Charm School, covered flight operations from the base as well as combat requirements.

One of the main topics covered in ground school dealt with the combat rules of engagement. Air Force upper echelon took the rules of engagement very seriously. Ubon had assigned to it an 8th Tactical Fighter Wing (TFW) rules of engagement officer, and each squadron on base was assigned a squadron rules of engagement officer. The wing officer was responsible for continually updating the rules as required and passing the information on to the squadron rules officers. They in turn conveyed the information to the aircrews. The rules were relatively straightforward but extensive. They covered topics such as where and when an enemy aircraft could be fired on; how close aircrews were allowed to drop ordinance near friendly troops; how close to a road you could drop ordinance in Laos with and without a forward air controller (FAC); what route segment in Laos ordinance could be dropped without an FAC; and so on. In general, the rules covered everything that could possibly be encountered in combat.[5]

Because the rules of engagement were extensive and varied from area to area within Southeast Asia, most pilots relied on the FACs they worked with to know the rules for the area being worked. After all, FACs generally worked one specific area their entire tour of duty and were therefore completely familiar with the rules as they applied to their assigned area.

After completing ground school, the aircrews went through a 15-mission checkout phase before being certified for combat. The training was designed to save lives in combat, and it appears to have been effective. After all, most of the squadron pilots had never been in combat before, and there was plenty of combat experience at Ubon to rely on. For example, when the 25th arrived at Ubon, the three existing squadrons had been at the base for approximately three years. In that time they had racked up an impressive amount of combat time and experience over all of Southeast Asia, including many missions over Laos and North Vietnam.

Before the 25th arrived, other F-4 squadrons at Ubon attempted to fly sensor missions with non-LORAN aircraft. It was not long before these missions proved ineffective, because the aircraft could not accurately determine the specific location of the sensor drops. These non-LORAN sensor missions consisted of perhaps fewer than 100 sensor drops. Aircrews from the units offered comments and recommendations to 25th TFS aircrew members, but the information was not operationally useful to the squadron's mission.[6]

Assignment at Ubon Royal Thai Air Base, Thailand

Thailand's climate is temperate, relatively cool during the "winter" with temperatures dropping to perhaps the low 60s at Ubon and rising to the mid 90s during the summer months. However, the humidity remains very high most of the year. The combination of warm to hot temperatures coupled with high humidity tended to take its toll on the maintenance technicians in the form of fatigue and irritability. To top this off, during the monsoon season high winds and drenching rain passed over the base, creating havoc with aircraft parked in open revetments. Crew chiefs scurried about, lowering canopies and closing open maintenance doors to ensure that water did not enter the open compartments or electrical equipment. If a drenching rain occurred in the afternoon and the sun reappeared, the relative humidity became almost unbelievably high—often reaching 90 percent or more.

Ubon Air Base is located in northeastern Thailand. From the mid-1960s through the mid-1970s, the U.S. Air Force used Ubon extensively for combat operations in Laos, Cambodia, and North and South Vietnam. During the 25th TFS's stay, the base was home to the 8th Tactical Fighter

Wing, comprised of four tactical fighter squadrons—the 25th, 417th, 435th, and 497th. The base also housed a small detachment of AC-130 gunships. The Royal Thai Air Force contingent assigned was a squadron of North American F-86F fighter-bombers, with a few North American T-28 propeller-driven attack aircraft. The Australian Air Force deployed a squadron of F-86F fighters at Ubon for air defense; however, the unit departed Ubon not long after the 25th arrived.[7]

The commander of the 25th TFS at Eglin, and early on at Ubon, was Lieutenant Colonel Lloyd Ulrich. He was, as they say, a pilot's pilot—and a great believer in keeping the maintenance folks happy. One instance in particular stands out as proof of the great relationship the "boss" had with his maintenance troops. According to Air Force regulations, a "commander's call" was required once a month. Stateside, a commander's call was nothing more than a review of military regulations and a commentary by the commander on how the squadron was doing (usually not good enough; improvement was needed). At 6:00 one hot and humid morning in Thailand, the second shift—which had just put in 12 hours—got off work. The weary men were scheduled to be at commander's call 2 hours later. They showed up, but the commander was late. Nine o'clock rolled around, and then 9:30. At 10:00, Lt. Col. Ulrich entered the assembly room with his F-4 backseater. Both men were wearing their sweat-soaked flight suits, harnesses still connected, guns strapped on, helmets in hand. Lt. Col. Ulrich apologized to his sleepy troops for being so late, explaining that he had just returned from a mission over Laos. Not only had the airplane been shot up, but he had lost his radios and was unable to communicate with the base. His wingman acted as his escort, coordinating the landing with the tower. He had come directly to see his troops to explain why he was late, before going to debriefing. After explaining and apologizing, he dismissed everyone. This is just one example of why many in the squadron considered him one of the best commanders ever.

The base was host to a wide variety of special weapons. Besides the Igloo White sensors, aircraft from Ubon flew some of the first "smart bomb" combat missions. These were the laser-guided bombs that have become so familiar to civilians today. TV-guided Maverick air-to-ground missiles were also flown from the base, and they were effective against ground targets. However, it was not widely known that these weapons being perfected during the Vietnam War were flown by aircraft based at Ubon.

In the late 1960s, maintenance technicians at Ubon worked 12-hour shifts, 6 days a week. During intensive combat operations the technicians stayed on the flight ramp, eating World War II era C or K rations while working on the aircraft. Amazingly few aircraft remained out of commission for maintenance or parts. This was unusual considering not only the tempo of operations but also that F-4 maintenance was very manpower intensive. Once every 3 months or so, a rotating group of technicians were issued 3-day passes. The 3 days came in handy because Thai Airways had very few scheduled flights into Ubon; about the only mode of travel to Bangkok was a 12-hour train ride, so the round trip took an entire day.

Because of the high operating tempo at Ubon, the 25th squadron did experience some errors and accidents. Aircraft had to be reconfigured on short notice from operations. Of course, these orders flowed to the base from the White House, to Pacific Air Forces Headquarters in Hawaii, to Seventh Air Force Headquarters in Saigon, and on to the base. In one evening, an aircraft could be loaded with a centerline full of sensors, external fuel tanks under each wing, and missiles and electronic jamming pods. Later that same evening, the aircraft might have to be reconfigured for an early morning mission with a full complement of 500-pound bombs. From personal experience, I can attest that accidents happen under such circumstances. A fully fueled 600-gallon external centerline fuel tank was accidentally unlocked by maintenance and dropped on the ramp when it was thought to be empty. At the end of a 12-hour, 6-day shift, simply taking off the fuel cap to check did not enter anyone's mind.

An ordinance technician was killed when a cluster bomb unit exploded during offloading operations in the base munitions area. Disaster was narrowly avoided when munitions technicians with a "preloaded 6-pack" (six 500-pound bombs loaded on a multiple ejector rack, or MER) fell off an MJ-1 bomb loader as it was turning a corner between revetments. The load was not tied down as it should have been, and the preload tumbled end over end, with the fuses installed but not armed. In at least two instances, 500-pound bombs that had failed to drop off the aircraft after bomb release over the target did not fall off the aircraft until its final approach to the base.[1]

One F-4 (not a 25th TFS aircraft) crashed on takeoff because the pilot had placed the landing gear handle in the up position after taxiing onto the active runway. As the jet raced down the runway, it temporarily became airborne. The gear switch sensed weight off wheels, and as the gear started up, the aircraft lost the ground effect that it had been flying in. The aircraft settled back down, plowing up trees and dirt at the end of the runway.

Each F-4 carried a drag chute (deceleration parachute) in a container at the aft tip of the airframe. USAF pilots used the drag chute on every landing to slow the heavy aircraft down. The drag chutes were delivered to each aircraft, prepackaged by the parachute shop, and the crew chiefs inserted them into containerized pods after a flight. Unfortunately on one or two occasions at Ubon, because of the high operations tempo, a drag chute would be incorrectly installed so that the D-ring (the steel ring securing the drag chute to the airframe) was not properly locked in place. On several instances upon landing, when the pilot pulled the handle in the cockpit to deploy the drag chute, the door opened; the pilot chute then deployed, pulling the unlocked main chute and packing container completely out of the aircraft. The packed drag chute would then bounce along the runway for quite some distance as the aircraft raced down the runway, brakes glowing red as the pilot tried to slow the plane down. Again, the tempo of operations often caused errors to occur.[8]

Combat operations for the 25th TFS were no different from those for any other unit on base. The squadron flew most missions during the day, dropping sensors on the Ho Chi Minh Trail primarily in Laos. Generally the squadron operated two-ship sensor drop missions. One ship dropped the sensors, and the other sowed antipersonnel mines near the sensor field to prevent the enemy from attempting to render the sensors inoperable if discovered.

A normal F-4D sensor mission consisted of a centerline MER loaded with six ADSIDs or FADSIDs, two external fuel tanks (one under each wing at the outboard station), three cluster bomb units (typically CBU-24s) on each inboard wing station, one 180-degree reconnaissance camera mounted in the left forward missile well, and an AIM-7 Sparrow missile in each aft missile well. At times the F-4Ds also carried at least one ALQ airborne electronic jamming pod to assist in defeating enemy radar-controlled guns or missiles. One more trick used by the ground crew was to toss a few chaff packages into the speed-brake wells as added protection for the aircrew. These packages would fall out of the well when the speed brakes were opened; the metal chaff was dispensed over a wide area by air currents and then drifted slowly to earth, masking the aircraft to enemy radars.

A typical day for a 25th TFS aircrew at Ubon consisted of sitting through a 2-hour intelligence briefing—covering enemy antiaircraft artillery in the target area, types of activity suspected, search and rescue available to the aircrews, and alternate diversion air bases if required.

About 1 hour before takeoff, the aircrew spent time in operations; there, they went over flight planning and, based on the combat load of their assigned aircraft, calculated takeoff distances, climb speeds, and so on. Next came the ride out to the flight line, where the aircraft was ready and waiting. Generally, the pilot made a walk-around inspection of the aircraft, checking for leaks or anything out of the ordinary. The aircraft crew chief accompanied the pilot on this inspection; as they walked around the aircraft, the crew chief pulled out the ground safety pins for the landing gear, drag chute, and arrestor hook. While the inspection took place, the assistant crew chief helped the weapons systems officer get strapped into the back seat. As a general rule, the ground crew applied electrical power to the aircraft before the aircrew arrived. Also, since the F-4's inertial guidance system operated via mechanical gyros and took about 15 minutes to align (find its location in space), the ground crew usually had this system aligned and operating before the aircrew arrived.

After the pilot completed his walk-around and was strapped into the front seat, the engines were started and a complete systems checkout was conducted. This included verifying operation of the flight control system, the wing flaps, speed brakes, ram air turbine, and in-flight refueling probe door. When the checks were completed, the crew chief signaled with a thumbs-up; the aircraft was then sent on its way to the final check area at the end of the runway. There, the aircraft received a final check for leaks and to make sure all panels and doors were closed. The weapons stations were then armed, and the aircraft was cleared for takeoff.

Pilots sometimes made the mistake of placing the landing gear control handle in the up position before takeoff. The weight of the landing gear kept the gear switch up and closed, and the gear stayed in the down position until takeoff. After liftoff, the landing gear automatically came up because the pilot had previously placed the handle in the up position. This was not part of the before-takeoff checklist; it was a shortcut for the pilots, one less thing to worry about after takeoff—besides, the aircraft climbed better with the gear up. It also reduced the chances of over-speeding the gear (letting the gear remain down past the allowable speed limit). However, as mentioned earlier, on several occasions at Ubon this procedure had drastic effects for aircraft and aircrew. After several such accidents, an 8th TFW directive mandated that pilots would not shortcut the checklist.[8]

The flying was dangerous. For example, on two occasions 25th TFS aircraft flew into 200-foot-tall trees in Laos; fortunately, they were able to return to base. Although they brought their crew back, both aircraft were out of commission for a long time. Photos at the end of this book show the damage sustained to one of the aircraft. Most aircraft returned with some type of combat damage. In a more unusual event, an aircraft returned to Ubon with a puncture in the aft canopy Plexiglas. The damage occurred when a pod of 2.75-inch folding fin rockets were fired off the left inboard wing station pod. These unguided rockets were not very accurate, and they quite often lost their stabilizing fins. On this mission, a few of the rockets lost fins just after leaving the launch tube; one fin flew off and into the aft canopy, just missing the weapons systems officer. Of course, other aircrews were not so lucky; some were lost over enemy territory, and the aircrew was listed as missing or killed in action.

The squadron was not limited strictly to sensor drops. It was also tasked with conducting interdiction and attack missions during the war. When not dropping sensors, the aircraft were loaded with 500-pound bombs and sent on missions over North Vietnam and Laos. Others stood alert duty, awaiting sensor signals that would indicate enemy movement along the trail. The normal complement for these missions was a 600-gallon centerline-mounted external fuel tank, a triple ejector rack (TER) with three 500-pound bombs mounted on the left inboard wing station, a TER with two 500-pound bombs and an electronics countermeasure pod (on the lower of the three stations) on the right inboard wing station, and a TER with three 500-pound bombs or CBUs mounted on each wing outboard station (this was the normal load for the outboard stations, but it had the capability to be loaded with an MER containing up to six 500-pound bombs). The 180-degree panoramic camera was installed in the left forward missile bay, and three AIM-7 Sparrow missiles filled the remaining three missile bays. The F-4D was not provisioned with an internal gun; however, two AIM-9 infrared air-to-air missiles were sometimes mounted on rails at the wing inboard stations. This was in addition to the bombs loaded on these stations.

Not having a gun in the F-4 was one of those wonderful ideas that flowed out of the Department of Defense in the 1950s. The F-4 was originally designed as a naval interceptor. Its primary mission was to defend the carrier battle group from hostile aircraft. As such, it was equipped with long-range radar and the then new AIM-7 Sparrow radar-guided air-to-air missile. The thinking at the Pentagon was that the F-4 would find the hostile incoming aircraft at long range and fire an AIM-7 missile beyond visual range to kill the aircraft. When the USAF accepted the F-4, the service had no qualms about not having a gun. After all, hadn't missiles replaced guns? And with long-range radar and ground-controlled radar intercepts, guns were considered passé. Then came Vietnam, and the Soviet and Chinese built MiG-17s, MiG-19s, and MiG-21s that were operated by the North Vietnamese and Russians. All three aircraft had powerful guns that could wreak havoc on allied aircraft. Aircrews would find MiGs at their six o'clock positions, firing heavy cannons at them—sometimes very successfully. This threat led the USAF to develop an externally mounted gun pod for use on aircraft like the F-4. Aircraft assigned to Ubon tested a wide variety of gun pod placements on the F-4. The most unusual configuration was one pod on each of the four wing stations. The configuration threw out a lot of lead; but because of accuracy problems, it was determined to be useless.

Of course, there were some humorous episodes at the base; one in particular stands out. A 25th TFS aircraft returned to the flight ramp with the aft canopy missing. The weapons systems officer stated that on final approach, the canopy simply flew off the aircraft. Maintenance inspected the aircraft thoroughly, found the canopy in the jungle off the end of the runway, and fitted it back onto the aircraft in an effort to determine what went wrong. Not finding anything, the crew installed a new canopy several weeks later; the aircraft flew without incident the rest of the time it was at Ubon. Near the end of that weapons systems officer's time at the base, he wandered down to the flight ramp, hands in pockets, and got the ground crew together. He asked them if they really wanted to know what happened that day the canopy came off. Sensing a good story, they all gathered around to listen.

His story went like this: On final approach the guy, a young lieutenant at the time, had a lot of trash in the rear cockpit—candy bar wrappers, wastepaper, and so forth. He thought that if he opened the canopy just a bit, he could toss the trash overboard. After all, he reasoned, the aircraft was on final and moving relatively slowly. Well, he said, when he tried to crack open the canopy a few inches, it instantly flew off the aircraft. Everything not tied down flew out, including the aircraft and mission paperwork on his lap. Concerned about being blacklisted not only by operations but also by the crew chief, he made up what he thought was a convincing story: "I was just sitting there, minding my own business, when the canopy came off." The mechanics had a good laugh and chalked it up to experience; but deep inside, they did not appreciate all the extra work he had put them through.

As noted, airborne delivery of the sensors was a difficult task for the aircrew. The F-4s of the 25th Tactical Fighter Squadron were required to deliver the sensors within 262 feet of deflection error and 268 feet of range error. They usually dropped the sensors within an area of probability of 61 feet in range and 18 feet in azimuth—which was amazingly accurate for an aircraft traveling at high speed over hostile terrain. To gain some perspective on the accuracy of these sensor drops, consider a football field, which measures 100 yards (300 feet) between goalposts. Now, 61 feet in range is equivalent to less than one-fourth the length of a football field.

Difficult enough for any aircrew, the task was made even more difficult by the high speed and low altitude required for a successful sensor drop, as well as by the overall stability problems associated with the various sensors they carried. To add to this mix, the aircrew might be taking ground fire from enemy positions. Ballistics trajectories of the various sensor designs made for interesting landing locations. Even so, most of the sensors were dropped at or near their intended locations. However, some landed right in the middle of well-used enemy roadways in Laos.[5, 6]

After completing the primary sensor drop mission, the two-ship flight's secondary mission was armed reconnaissance; they were tasked with working with a forward air controller to attack ground targets as directed. At times 25th TFS aircraft remained airborne at night, responding to sensor activations as directed by the ISC. When sensor activations were detected, the ISC contacted the airborne attack aircraft and provided LORAN target coordinates. The weapons systems officer then typed the coordinates into the LORAN system, setting it up for automatic weapons release. Upon arriving at the specified location, the aircraft automatically released the weapons. This approach was an effective response to sensor activation because it could be accomplished in any weather.[9, 10]

After each flight, the aircrew was required to undergo a maintenance debriefing. This review covered the condition of the aircraft in general as well as any specific systems maintenance problems encountered during the flight. The F-4 was a manpower-intensive aircraft to maintain, and the aircrews held their maintenance technicians in high regard. However, and more important, an intelligence debriefing was also required. This briefing covered mundane questions such as the flight's call sign, assigned ordinance, FAC used during the mission, time on target, bomb damage assessment, and any unusual happenings or sightings. The aircrew was also asked specific questions, including whether they had encountered any enemy 85-mm antiaircraft fire. The 85-mm always drew the greatest number of questions from the intelligence technicians during debrief. Questions about the 85-mm centered on the burst altitude, burst color and smoke, color of the ground fire flash, and so on. The aircrew also had to provide information about the aircraft's heading, altitude, airspeed, and coordinates during the sighting.[11]

For its important work and the gallantry of its pilots in conducting air operations over Laos, Cambodia, and Vietnam in support of the Igloo White program, the 25th TFS received the following honors: Vietnam Campaign Vietnam Air Offensives, Phase III streamer; the Vietnam Air/Ground streamer; Vietnam Air Offensive, Phase IV streamer; the Tet 1969 Counter Offensive streamer; the Vietnam Winter–Spring 1970 streamer; the Cambodian Sanctuary Counter Offensive streamer; the Southwest Monsoon Campaign streamer; the Commando Hunt V, VI, and VII streamers; the Vietnam Ceasefire streamer; the Presidential Unit Citation—Southeast Asia, the Air Force Outstanding Unit Award with Combat "V" device; and the Republic of Vietnam Gallantry Cross with Palm Leaf.

During its stay in Southeast Asia, the squadron conducted operations during the following time frames and events: Southeast Asia combat operations from May 1968 through January 1973; support of the evacuation of U.S. personnel from Phnom Penh, Cambodia, in 1975; and support of the evacuation of U.S. and selected Vietnamese personnel from Saigon in 1975.

The squadron supported combat operations and flew airstrikes on the Cambodian defenders of Koh Tang Island during the *Mayaguez* incident of 1975.[1, 7]

Notes

1. Information in this chapter comes from my own recollection of events that transpired during my tour with the 25th TFS at Eglin AFB, Florida, when the squadron was reactivated and deployed to Ubon, Thailand. I had a 1-year assignment at Ubon with the 25th Squadron.

2. From *The 25th Tactical Fighter Squadron History, 33rd Fighter Wing* (Maxwell AFB, AL: Air Force Historical Research Division, Organizational History Branch) at http://afhra.maxwell.af.mil/rso/squadrons_flights_pages/0025fs.html (accessed January 15, 2007).

3. Later in the war, artwork was deleted from squadron aircraft. Apparently there was some concern that some of the nastier artwork would find its way into

the papers and magazines back in the States, and this would reflect poorly on the U.S. Air Force.

4. The aircraft artwork was a reflection of the overall shape and proportions of a local Thai woman who was favored by one of the pilots flying that aircraft. “Judy’s Front 40,” as can be expected, was a reference to the woman’s décolletage.

5. *Project CHECO (Southeast Asia Report) Igloo White: July 1969–December 1969, A Contemporary Historical Examination of Current Operations, Concepts, Policies and Doctrines*.

6. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee of Preparedness Investigating Subcommittee of the Committee on Armed Services* (November 18– 20, 1970). U.S. Government Printing Office, Washington, DC.

7. During the Vietnam War, an Air Force Wing was comprised of four squadrons. Each squadron was assigned approximately 25 aircraft.

8. *Project CHECO (Southeast Asia Report), Corona Harvest*, Interview no. 200 (June 12, 1969, 3–6). This interview was conducted with a 25th TFS weapons systems officer.

9. I actually witnessed one such incident during my stay at Ubon. The F-4 was loaded with four wing-mounted 500-pound bombs and a full 600-gallon centerline fuel tank. It got into ground effect, lifted off slightly due to a dip in the runway at Ubon, and the gear started up. The pilot must have sensed what was happening because he jettisoned the centerline fuel tank and kept the engines in full afterburner. Unfortunately, the aircraft settled back down onto the runway and slid off into the overrun. The undercarriage was significantly damaged, but the aircrew walked away unhurt.

10. *Project CHECO (Southeast Asia Report), Corona Harvest*, Interview no. 200 (June 12, 1969, 20–23). This interview was conducted with a 25th TFS weapons systems officer.

11. *Project CHECO (Southeast Asia Report), Corona Harvest*, Interview no. 200 (June 12, 1969, 42). This interview was conducted with a 25th weapons systems officer.

CHAPTER 11

Vietnamization of the Sensor System: Project Tight Jaw

BASED ON the successes of the sensor system, in March 1969 the United States Joint Chiefs of Staff (JCS) determined that a Vietnamese sensor program run entirely by the South Vietnamese would greatly aid in maintaining the security of the country and its armed forces. The program developed into Project Tight Jaw with the JCS directing, as a first step, that the U.S. sensor program in South Vietnam be expanded to include the Republic of Vietnam Armed Forces (RVNAF). The plan was to provide the Vietnamese with their own sensor system, which they would eventually operate independently of the U.S. program. In June 1969 the commander of United States Forces, Military Assistance Command, Vietnam (COMUSMACV) issued Operations Plan 103-69, authorizing the implementation of a combined U.S./RVNAF border surveillance and anti-infiltration program for the western border areas (Cambodia and Laos) of the Republic of Vietnam. The system was forecasted to cover an area from the demilitarized zone (DMZ) in the north to the Gulf of Thailand in the south.[1]

In July 1970 the U.S. military conducted an examination of the northern Military Region I (MR-I) area to determine the feasibility of the Vietnamese system. During this same time frame Military Assistance Command, Vietnam (MAC-V) proposed that the Vietnamese Air Force (VNAF) should eventually take over the DART I facility in Quang Tri Province and the DART II facility at Pleiku. Having the two systems already in place at those two strategic locations would reduce the overall cost of developing an entirely new system for the Vietnamese. Each DART facility was to be equipped to handle 476 sensors. The VNAF was to have the capability to implant sensors and to monitor them with an airborne platform dedicated exclusively to the Vietnamese sensor system. At the time of the recommendation, no specific airborne platform was identified; but the Pave Eagle II aircraft (the modified Beechcraft Bonanza that operated out of Nakhon Phanom as a relay platform) was considered a strong candidate.[1, 2]

By early 1970, Pacific Air Forces (PACAF), Seventh Air Force in Vietnam, and the USAF Advisory Group all agreed that the VNAF should be given authority to implant sensors. However, all three opposed the so-called Vietnamization of the sensor program, and for good reasons: the sensor system was classified as Secret, and the U.S. military was hesitant about giving away its secrets. The United States did not want to give up its ability to operate the DART facilities until the American military withdrawal was nearly completed.

The VNAF also would be tasked with operating an additional aircraft platform for airborne relay. This would create logistics problems for the VNAF, which was already operating many different types of aircraft. As an alternative, a simple relay-monitoring system compatible with the U.S. Army's Battlefield Area Surveillance System (BASS) was proposed. It was determined that personnel resources and budgetary constraints limited any VNAF effort approaching the capability of the Igloo White program. The BASS system seemed the most logical choice at the time.

VNAF participation in the sensor system would be responsive to the Army of the Republic of Vietnam (ARVN) directions and limited to a support role. VNAF would aid the ARVN in deploying sensors and would respond to any request for air assets from the ARVN. This system was in marked contrast to Igloo White, which was run primarily by the USAF.

In October 1970, COMUSMACV agreed that the Vietnamization of Pave Eagle II aircraft and the two DART facilities was impractical. The Vietnamese just did not have the personnel or the finances to operate such an elaborate system. A different recommendation was forthcoming from COMUSMACV. Instead of a specialized airborne platform dedicated specifically to radio relay (the Pave Eagle II), emphasis was placed on developing an unsophisticated palletized airborne relay (PAR) system to be loaded into existing VNAF transport-type aircraft. It was planned that the PAR would become integrated into the BASS system, which by this time had been programmed for the VNAF. It seemed that Project Tight

Jaw was now well into the planning stage and implementation relatively assured.[3]

By September 1971, the airborne relay platform for the PAR installation had been selected—the venerable Douglas C-47. Relatively large quantities of C-47s were available in Vietnam. The aircraft had been widely used during the war—flying cargo between bases, air-dropping much-needed supplies to besieged troops and isolated combat bases, making paratroop drops, and operating as an airborne gun platform. The C-47s were an excellent choice; not only were they numerous in Vietnam, but the VNAF had been operating them for more than a decade. The aircraft was easy to maintain, reliable, and cheap to operate.

The C-47 was actually considered an interim PAR airborne platform. The program planned to use the C-7 Caribou as the airborne platform of choice for the Vietnamese sensor program. The C-7 was a Canadian-built aircraft (Canadair) used extensively by the U.S. Army in Vietnam. However, until the U.S. Army could afford to release the Caribou to the VNAF, the C-47 served as the interim platform. The plan called for the C-7 to enter the VNAF inventory sometime in 1973, when it was hoped the Vietnamese would be able to take over the brunt of fighting from the U.S. Army. If for some reason more aircraft were needed as airborne platforms, or the Vietnamese needed the C-47 for other more pressing duties, then plans were formulated to use VNAF C-119s and/or C-123s. These aircraft were already in the VNAF inventory, although their numbers were relatively small.[4]

Project Tight Jaw envisioned PAR-equipped C-47s to be fully capable of relaying sensor data to ARVN ground stations by the end of 1972. The BASS program was formally selected to be the basis for the Vietnamese sensor program. The system was starting to form into a very real and valuable part of the Vietnamization program envisioned by U.S. President Nixon. However, some official red tape was beginning to be encountered. The RVNAF Joint General Staff (JGS) had its own multiple layers of bureaucracy (not surprisingly, it was based on both the French and American systems). As the Vietnamese military high echelon saw it, the JGS would first be required to authorize the VNAF to use aircraft for the PAR and airborne relay. The JGS would need to balance the usage requirements for C-47 aircraft. Would taking C-47s from the roles they already played, such as resupply and troop transport, and converting them into airborne relay platforms significantly affect VNAF operations? This was but one of many questions facing the JGS. The JGS, knowing that the

USAF would not be supporting the Tight Jaw effort, wanted to make sure Tight Jaw would not affect overall VNAF operations.[5]

As envisioned, the Vietnamese system was to be self-sufficient and completely independent from the American military by the end of 1972. In the new plan, the ARVN would be responsible for the sensor system. ARVN units would be tasked with hand emplacement of sensors, and ARVN command staff would request VNAF to air-deliver sensors at locations selected by the ARVN command. VNAF C-47 aircraft would be airborne, constantly relaying sensor data to the Vietnamese equivalent of the U.S. Army's BASS program. VNAF fighter-bombers would be called in for strike missions against areas identified by the system to contain enemy activity. The system was envisioned to be a mini Igloo White for the South Vietnamese. But before the system could be fielded, there was a lot of bureaucracy to work through.

Unfortunately, events overtook Project Tight Jaw. In 1972 the Nixon administration and its Vietnamization program had started the withdrawal of U.S. forces from Vietnam. U.S. fighter-bomber units were being withdrawn in large numbers. As a result, ground support operations were turned over to the VNAF with their less-capable light attack aircraft—the Northrop F-5 and Cessna A-37 jet fighter-bombers and the Korean War era propeller-driven Douglas A-1 attack aircraft. During this time frame, a great influx of military hardware flowed into South Vietnam. Large quantities of F-5s and A-37s had arrived from other Military Assistance Program countries as well as from the United States. The USAF was turning over transport aircraft as well as AC-119 gunships to the VNAF. This influx of materiel swamped the RVNAF and temporarily placed Tight Jaw on hold.[6]

The next event in Vietnam effectively ended the Vietnam sensor program. The Communist 1972 Easter Offensive completely surprised both the Vietnamese and the Americans. The Igloo White program was winding down; sensor strings were not being replaced as their batteries ran down or became unusable for other reasons. Due to the degradation of the sensor system, the Easter Offensive was not expected. Although fierce battles took place in South Vietnam, the South Vietnamese military—assisted by American advisers and aircraft—beat back the North Vietnamese Army and their Viet Cong brethren. The battle was a victory for the South Vietnamese.

The American military withdrawal, coupled with the Easter Offensive of 1972, placed Project Tight Jaw on permanent hold by both the

American military and the Vietnamese JGS. After 1972, the degradation of sensor fields and ultimate loss of the Igloo White program deeply affected the South Vietnamese military. No longer were interdiction attacks carried out on the Ho Chi Minh Trail in Laos and Cambodia in response to sensor activations. The North Vietnamese increasingly used these two countries to infiltrate men and materiel south, into virtually all areas of South Vietnam; and they continued to expand their land holdings in Laos and Cambodia. The North Vietnamese supplied Communist rebels in Laos and Cambodia and assisted them in toppling their respective governments. Eventually, the North Vietnamese moved massive amounts of men and materiel into South Vietnam—including Soviet and Chinese supplied surface-to-air missiles and Soviet-manufactured Strella man-portable antiaircraft missiles and tanks. The missiles, coupled with radar-directed antiaircraft guns, had devastating effects on the VNAF. As the years passed and the Communists became more brazen in their occupation of Laos and Cambodia, the implementation of Project Tight Jaw became inconsequential.[1, 2, 7]

The North Vietnamese occupation of Laos and Cambodia—and the transfer of war materiel into these two countries, as well as into South Vietnam—directly violated international agreements. Moreover, the abrogation of the Paris Peace Accords was yet another slap in the face of international agreements and laws signed by the North Vietnamese government.

Notes

1. *Project CHECO Report, Igloo White Program: July 1968–December 1969, Logistics Buildup North Vietnam*, November 1968. This is from the Commander in Chief, Pacific, to Chairman Joint Chiefs of Staff.

2. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee of Preparedness Investigating Subcommittee of the Committee on Armed Services* (November 18, 1970), 34–35, 68–69. U.S. Government Printing Office, Washington, DC.

3. The PAR concept was simple. The electronics equipment required for airborne relay was placed on a specially designed rack and then installed on a special pallet that could be loaded onto a Vietnamese C-7, C-47, C-119, or C-130.

4. After the signing of the 1972 "Peace Agreement," the VNAF was operating the A-1, F-5, A-37, C-47, AC-47, C54, C-119, AC-119, C-130, O-1, and UH-1. Another aircraft, especially one needed in very small numbers, would have greatly tasked both operations and maintenance of the relatively small VNAF.

5. The Vietnamese JGS had good reason to be concerned. The C-47 was really the most valuable airborne transport for the Vietnamese military. There were very few Vietnamese C-130s and C-119s, and the U.S. Army was slow in turning over the C-7 to the Vietnamese. Even loosening a few of these valuable assets could have profoundly affected logistics support of the South Vietnamese military.

6. Just before the "Peace Agreement," the United States and its allies shipped in some 80 F-5 fighter-bombers to Bien Hoa Air Base (just north of Saigon). The aircraft came from such diverse countries as the United States and Iran. Most of these aircraft sat disassembled or in flyable storage from the time they arrived until the end of the war.

7. In 1974, two F-5 aircraft from Bien Hoa Air Base returned from missions with man-portable Strella missile hits in their engine tailpipes. The aircraft were flown in support of ARVN units not far from the base. The Strella was at that time the world's premier man-portable, infrared-guided, ground-to-air missile.

CHAPTER 12

Conclusion

IT CAN generally be said that U.S. involvement in the Vietnam War was a dismal failure. Planning combat operations from the White House in Washington, D.C., for a war 8,000 or so miles away in Southeast Asia while almost completely disregarding the advice of on-site combat commanders was by far one of the most insane ideas to come out of the Johnson administration. Indeed, President Johnson was fond of saying: "Those boys can't hit an outhouse without my permission." During the Johnson administration, until late 1967, the president held a luncheon each Tuesday at the White House. He invited a small group that included the secretary of state, the secretary of defense, and the president's press secretary (occasionally, Johnson invited other civilians). The Tuesday meetings were held to select the targets to attack, determine the number of sorties flown, and devise the tactics to be used by pilots flying the missions over North Vietnam. These Tuesday meetings never included any members of the military—not even the chairman of the Joint Chiefs of Staff.

White House orders to our pilots on what and where to bomb were not only very strict but also sometimes quite specific. For example, a target located more than 206 feet away from the Ho Chi Minh Trail could not be bombed. Thanks to a leaky administration, the Walker spy ring, and the antimilitary press, the North Vietnamese found out about these restrictions and moved their antiaircraft weaponry more than 207 feet from the trail network. MiG bases could not be bombed—there was a more than 30-mile deep restricted zone between Vietnam and China that our pilots could not fly into, regardless of the situation. When chasing enemy aircraft that had fired on them, our pilots were under orders to break off the engagement if the enemy aircraft flew into the restricted zone. Frequently during the war, aircraft were fired on by Russian ships in Haiphong harbor; but again, our pilots were restricted from firing back.

The Joint Chiefs of Staff (JCS), senior staff officers from all the services, and senior civilian administrators should all be held accountable for the continued loss of allied lives in this no-win situation. Had the members of the JCS, the chairman, or anyone of high authority resigned as a protest to the way the administration was conducting the war then perhaps the outcome would have been different. But careers apparently were more important, and so the powers that be continued to pacify the administration by condoning the ongoing debacle for the sake of their own job security and retirement considerations.

Had the war been fought as other wars had—that is, to win—then perhaps as early as 1964 allied forces could have taken offensive action to destroy meaningful targets in North Vietnam, targets that directly affected the war in the south. Bombing all logistics supply storage areas, lines of communications, mining ports, and so forth could have significantly slowed the flow of men and materiel into the south. This would have given the South Vietnamese time to become the democracy the allies were striving for in that now nonexistent country. The slow, "punishing" escalation in the bombing campaign allowed the North Vietnamese time to build up forces in South Vietnam and at the same time develop a sophisticated air defense system in North Vietnam. Placing bombing exclusionary zones around Hanoi, Haiphong, and other cities that were being used as logistics centers for the war in the south was a recipe for the disaster that followed. In late 1964, North Vietnam had only 6 antiaircraft fire control radars for use against allied bombing missions; a year later, it had approximately 96. By late 1967, more than 450 radars were providing the North Vietnamese military with complete early warning radar coverage of almost all of North Vietnam.

Nevertheless, exclusionary zones had been established around major North Vietnamese cities. Flights within 50 miles of the border between China and North Vietnam were restricted. An exclusionary zone was established for North Vietnam's capital of Hanoi as well as for the port city of Haiphong, where tons of munitions were stored. Flights into or near these exclusionary zones were severely dealt with by U.S. commanders and headquarters staff. U.S. military personnel could not attack port cities where ships offloaded and temporarily stored tons of war-making materiel and other logistics supplies. A large percentage of these munitions and supplies were then sent to transshipment sites in and around Hanoi. Apparently it made more sense to the Johnson administration and the JCS not to attack the logistics pipeline at the source. They preferred waiting until the logistics flowed into the pipeline and were on their way to South Vietnam, thus placing at risk not only our pilots attempting to interdict this flow but also our servicemen and allies in South Vietnam who would be on the receiving end of the munitions once the North Vietnamese had obtained them.[1]

The JCS did have an effective plan to win the war early on. In May 1964 they established a Joint Working Group (JWG) tasked with identifying targets in North Vietnam that, if attacked, would most significantly affect the war. The JWG came up with what was called the JCS 94-Target List. This was a comprehensive roster of targets that if attacked would render North Vietnam incapable of carrying on the war in the south. The targets identified included airfields, communication facilities, transportation centers, power generation facilities, and storage depots—in short, they were the logical targets to attack during a war. Unfortunately, the Johnson administration decided not to implement the JWG list. Instead, they opted for a slow escalation approach, such as the "Rolling Thunder" bombing campaign. The Rolling Thunder campaign allowed the North Vietnamese time to disperse their infrastructure, move important targets into civilian areas, and generally make it difficult for American pilots to successfully attack and interdict lucrative targets in North Vietnam.[2]

How differently would the war have turned out had it not been run from the White House? If the war had been decentralized and run by operational commanders, would John Walker's spy ring have so deeply influenced the war's outcome? Walker gained access to top-secret documents concerning strike packages, routes, times, and so forth. This information was transmitted from Washington, D.C., to the Seventh Fleet and then onward to operational commanders. Walker was able to access this information and pass it on to his Soviet contacts, who then passed it to North Vietnamese intelligence. As a result, the North Vietnamese air defense system could be placed on alert, knowing the exact path and arrival time of the strike package.

With the above said, the South Vietnamese and their allies valiantly fought the war. Due to the severe restrictions on bombing north of the 19th parallel and to the prohibition of cross-border large-scale military actions, the electronic wall was the only logical method of attempting to reduce the flow of men and materiel into South Vietnam. The wall was initially intended to significantly reduce or eliminate allied air operations over North Vietnam, thus saving the lives of pilots as well as Vietnamese civilians. Attacking the Ho Chi Minh Trail, it was thought, would ideally have a significant impact on the war in the south. By the early 1970s the wall had been almost entirely erected; but with the peace talks in Paris ongoing and American involvement in the war winding down, the electronic wall was slowly becoming deactivated at a time when information from the sensor system could have been most helpful to the future of South Vietnam by providing valuable information on enemy activity and intent.

Contrary to media depictions, the Ho Chi Minh Trail was much more than an unsophisticated, haphazard series of narrow dirt roads built with the help of patriotically dedicated men and women. Conscripts from North Vietnam, Laos, and Cambodia built and maintained this vast network. Military service was mandatory; antiwar demonstrations or activities did not take place in North Vietnam. Its totalitarian leaders simply did not allow any form of antigovernment demonstrations.

U.S. intelligence estimated the Ho Chi Minh Trail at 3,500 miles in length—stretching from southern North Vietnam through Laos, into Cambodia, and finally into the delta area of South Vietnam (well south of Saigon). After the war, the North Vietnamese would admit that the trail was approximately 8,100 miles in length. In Laos alone its length was an estimated 1,700 miles; it was a sophisticated logistics network made up not only of major routes, roads, and trails but also of vehicle parks, petroleum pipelines, and storage and bivouac areas.

In 1959 the North Vietnamese and their Communist brethren in Laos and Cambodia, in flagrant violation of international treaties and with complete disregard for international borders, started clandestinely building this network. In 1961 at a conference in Geneva, Switzerland, the United States and North Vietnam (among other countries) signed an agreement guaranteeing the neutrality of Laos. North Vietnam had no intention of keeping this promise; it used the Ho Chi Minh Trail to continue infiltrating men and materiel into Laos as well as Cambodia and South Vietnam. In 1965 U.S. intelligence estimated that 3,000 North Vietnamese per month were using the trail to infiltrate into Laos. A single intelligence source estimate placed close to 100,000 North Vietnamese in Laos and Cambodia for network maintenance and protection. Moreover, as stated earlier, there was an unconfirmed report that 14,000 to 15,000 Communist Chinese were stationed in Laos; of that number, 3,000 to 5,000 were specifically dedicated to antiaircraft weaponry operations and maintenance, and the rest worked on road construction.

Cuba also played a role in the operation of the Ho Chi Minh Trail. In May 2005 the Cuban government revealed that 23 Cuban military engineers had assisted the North Vietnamese in widening sections of the trail over a 7-month period starting in 1973. Cuban Colonel Roberto Leon reportedly stated that he supervised the team responsible for widening the trail. This work ultimately led to the increased flow of North Vietnamese troops and supplies down the trail and the eventual defeat of the South Vietnamese military.[3]

The United States was hamstrung over keeping its promise of Laotian neutrality and at the same time helping its South Vietnamese allies to maintain the fledgling south's democratic government. Not wanting to invade Laos as well as Cambodia, the U.S. government came up with a plan to monitor the trail electronically and clandestinely attack any detected enemy activity on it. That plan was the genesis of the Igloo White program—a program that, because of the American withdrawal from Southeast Asia, was not allowed to come to fruition and be effective in stemming the illegal flow of traffic in Laos and Cambodia.[4, 5]

Perhaps the most telling indictment of North Vietnamese violations of Lao territory is a letter by Lao Prince Souvanna Phouma to Chou En Lai, the prime minister of the Council of Government of the Peoples Republic of China. The letter, dated 28 November 1967, states in part:

> In spite of the energetic denials of the aggressor, who is one of the signatory powers for the 1962 Accords, troops coming from NVN have for more than twenty years lent their support to the NLHS. This has been proven in indisputable fashion by all sorts of accounts—by the International Commission of Control, the British Government made it known, by NVN prisoners captured with their war material during battles which their units were carrying out on Laotian soil, by Laotian refugees (who number five hundred thousand) who come from the PL zones. In short, no one can deny that the Hanoi government is supporting by arms a Lao political party, which paradoxically has representatives in the Tripartite Government, which is at present responsible for the affairs of the Kingdom. This, then, is the fundamental fact which explains that Laos, five years after the Geneva Conference (1962), still remains a dangerous spot of tension for all of Southeast Asia and for the world. The fault and the responsibility—

> I regret to say—fall totally on the Hanoi government which does not wish to admit and to carry out sincerely the principles of pacific coexistence and which, on the other hand, given the reason of its own war against the Saigon government and the United States of America, needs this strategic route known throughout the world as the Ho Chi Minh Trail. This trail crosses a good deal of Laotian territory. (several years ago, the Hanoi government termed the trail "pure imperialistic invention)."[6]

The Lao prince attempted to turn Laos into the neutral country that was guaranteed by the Geneva Accords. In a 29 February 1968 letter to the minister of foreign affairs of the Union of Soviet Socialist Republics co-chairman of the 1962 Geneva Conference on Laos, the prince's letter stated in part:

> By this message the Lao Government, while solemnly and energetically protesting against the flagrant aggressions of North Vietnam, against the national sovereignty, the independence of Laos, and the Geneva Accords of 1962, of which it is a signatory, ask you to kindly consider the necessary steps in order to terminate the hostile and illegal acts of North Vietnam.[7]

North Vietnamese violations of the Geneva Accords are well documented. However, incursions into Cambodia by the South Vietnamese Army in the early 1970s helped to shed more light on the vast amounts of materiel stockpiled in the border areas. For example, during a South Vietnamese operation code-named Toan Thang 42—conducted in April 1970 in the "Fishhook," an area of Cambodia that juts into South Vietnam near the South Vietnamese town of Katum and the Cambodian town of Snuol—the South Vietnamese found an extensive logistics complex containing more than 1,500 weapons, millions of rounds of ammunition, and tons of supplies. This complex was so vast that American Army advisers on the operation called it "The City." The cache was the largest discovered during the war; several weeks of work were required to search and remove or destroy it all.[8]

In June 1970 the South Vietnamese military completed three incursions into the Cambodian border area, where they discovered the following:

- Enough rice to feed 25,000 North Vietnamese troops for a year
- Individual weapons to equip 55 full-strength army battalions
- Enough crew-served weapons to equip 33 full-strength army battalions
- Rocket, mortar, and recoilless rifle ammunition for more than 9,000 average attacks
- A total of 11,362 North Vietnamese regular army soldiers killed

During these operations, American advisers were restricted by presidential decree from traveling more than 30 kilometers into Cambodia. For more than 14 months after the incursions, there were almost no enemy operations in South Vietnam; those that did occur were small and infrequent.[9]

It is well known that the NVA used the U.S. bombing halts and cease-fires to resupply forces in Laos, Cambodia, and South Vietnam. As an example, during the first three weeks of November 1967, an estimated 1,665 tons of war-related materiel flowed from North Vietnam into Laos and ultimately South Vietnam. During the bombing halt of 4–23 November 1968, an estimated 14,200 tons were moved. This estimate was based on reconnaissance flights and photos of storage areas and truck movements. Photos from a reconnaissance flight over the Mu Gia Pass on 8 November 1968 (during the bombing halt) showed 350 military personnel walking southbound on Route 15 in Laos. Also photographed were 700 fuel drums—out of an intelligence estimate of 3,000 in the area—as well as stacks of ammunition boxes. All of these items were being loaded onto trucks in clear view of, and indifference to, reconnaissance flights. The NVA were not in the least bit bothered by the over-flights; they were well aware of the bombing halt and knew they would not be attacked. Another reconnaissance flight on 17 November 1968 revealed 55 trucks heading south on Route 15 in Laos. Aerial photographs revealed bulldozers repairing bomb-damaged roads on the trail network in Laos. Also during November 1968, the NVA reactivated sea routes for delivery of war materials into South Vietnam. Large ships were photographed sailing south from northern ports and offloading cargo onto crafts such as sampans and other small boats. It was apparent that the truck destruction campaign tied into the Igloo White program was becoming very successful, once again forcing the North to attempt using sea routes to resupply forces in the south.[10]

The successful defense of the Khe Sahn combat base in early 1968 set in motion the expansion of the Igloo White program. Had the sensor system not performed as planned—or worse yet, not been available—the combat base could have fallen to the enemy. The media, due to the secret nature of the system, had not reported the numerous allied lives saved by the sensor system during this one battle. More successes followed; more lives were saved; more equipment was rescued from damage or destruction—all due to a secret system that at the time could not be revealed or commented on by the military.

The Commando Bolt operation was perhaps the most effective Igloo White campaign to interdict the logistics flow of men and materiel along the Ho Chi Minh Trail. During the Commando Bolt program, from May 1971 through November 1972, the USAF claimed 25,000 trucks damaged or destroyed. During March 1972 alone, the USAF claimed 3,000 trucks damaged or destroyed. It was estimated that the combined Commando Bolt operations had a significant logistics impact on North Vietnamese plans to take over South Vietnam. After the final Commando Bolt operation, U.S. military intelligence estimated that the North Vietnamese had approximately 8,000 trucks in storage within North Vietnam. After the 1971 monsoon season, that figure rose to 12,000; but it did not make up for the vehicle losses suffered by the NVA during Commando Bolt operations.[10]

Trucks were shipped by land and sea from China, Russia, Poland, East Germany, and Czechoslovakia. By mid-1971 the number of trucks damaged or destroyed appeared to be seriously affecting the ability of Communist bloc countries to maintain replacements for those trucks lost. The cost of maintaining the war was beginning to take a toll on its participants. To many Western military leaders, as well as some journalists, it seemed as though those countries backing North Vietnam would soon decide that the cost outweighed ultimate victory on the battlefield. Unfortunately, the Watergate scandal and its political fallout effectively ended U.S. support of South Vietnam.[11]

Perhaps some of the most telling accolades to the Igloo White system were those generated by the military and classified as Secret. These messages were declassified after the required 30-year period. One letter, dated 12 November 1970 from the commander in chief of Pacific Air Forces, stated:

> The Igloo White sensor surveillance system is regarded the prime source of intelligence data on enemy logistics movements in Steel Tiger, which is unaffected by weather, darkness, or enemy defenses. The system is employed in areas where other intelligence sources,

> such as road watch teams and visual reconnaissance cannot operate effectively. Igloo White has established its value in past interdiction campaigns by providing the capability to accurately assess the enemy's intentions and tactics. It also provides a measure of the effectiveness of our own interdiction operations. The system is an integral part of the Commando Hunt V plan.[12]

The letter goes on to say: "In its contribution to Commando Hunt III, Igloo White was a prime intelligence source. It generated real time and non-real time target data." The letter ends with this comment: "Igloo White sensors are the major and most reliable source of calculating enemy logistics throughput."[12]

A 21 January 1971 message from the 7th Air Force director of intelligence stated: "Sensor data is the preferred source for input and throughput calculations because of the nighttime, all weather capability that it possesses." The message also stated: "Electronic surveillance of enemy's LOCs allow an assessment of the lucrativity of different areas, an assessment that is essential in planning and timing changes in the interdiction campaign." (*Note:* LOC is an acronym for lines of communications.) Later in the message, the writer stated: "The use of sensors gives us a surveillance capability that is not always available with either visual or photo reconnaissance. The sensors are capable of detecting enemy vehicular movement regardless of the prevailing weather, jungle canopy, AAA, etc. Sensors have released airframe resources for other uses, and have allowed us to more effectively direct our strike forces to the most lucrative areas."[12] A February 1971 message from the 8th Tactical Fighter Wing at Ubon, Thailand, stated:

> In frag day 5 Feb 71, B-57Gs of this wing destroyed 35 trucks which set a record for trucks destroyed during one night's operation. Fourteen of the 35 trucks were located and destroyed as a direct result of Headshed advisories. The same night, Headshed advisories to the AC-130 gunships were responsible for the destruction/damage of 35 trucks. In-flight Headshed advisories and TFA support of daily target leads have been instrumental in the recent record breaking truck BDA of the wing.

(*Note:* The Headshed reference was the term used to identify specific targets detected by the Igloo White sensor system.)

Critics of the electronic wall, both in and out of the military, have commented that the high truck kills reported by such programs as Commando Hunt and Commando Bolt could not possibly have been as high as reported. Those critical of the sensor program cite that the high truck kills reported would surely have left the Laotian countryside littered with truck carcasses. While on the surface this reasoning appears logical, it must be pointed out that forward air controllers, reconnaissance photos, and attacking allied pilots did report significant quantities of damaged and destroyed vehicles. However, these vehicles were quickly moved away from the road network and stripped of usable parts. The jungle then took its toll on them; in most cases, the foliage soon engulfed them.

As a point of reference on this matter, during the Korean War the USAF—operating with only 120 World War II vintage propeller-driven Douglas B-26 medium bombers deployed as attack aircraft—destroyed close to 2,000 trucks, damaging an additional 3,600 during a single week in August 1951. This damage was inflicted on the enemy while operating in the hazardous mountain terrain of the Korean Peninsula.[13]

Without the sensor system—the so-called electronic wall that has been so ridiculed by the media over these many years—the loss of allied military and civilian life and destruction of valuable equipment would have been astronomically higher. Indeed, without the use of the sensor system, military successes not only on the battlefield but also in attempts to pacify the South Vietnamese civilian population would have been extremely difficult. The protection provided to the users of the system allowed for security of villages and combat bases that would have been unimaginable in previous wars. It is time to reconsider the benefits that were provided by this system, as well as the gallantry and dedication to duty of those responsible for its inception, implementation, and operation during the war in Southeast Asia.

Even so, the Igloo White program was doomed from the start. Because the South Vietnamese and their allies had no authorization to attack the source of the logistics pipeline in the Hanoi and Haiphong areas, the enemy could maintain a constant logistics flow. The trail network in Laos alone was 1,700 miles. To better comprehend not only the size but also the terrain, consider this: The Sierra Nevada mountain range in northern California is approximately 400 miles long and 40 to 80 miles wide. The overall area and mountainous terrain is similar to the area in Laos that our pilots were required to attack. Detecting and attacking a well-hidden enemy clandestinely moving within the area would be extremely difficult. Couple this with the wide array of antiaircraft artillery, surface-to-air missiles, and small arms fire, and you can imagine the problems our airmen faced under these circumstances. Also consider that when an aircraft crashes in the Sierra Nevada, rescuers usually have a hard time finding the wreckage even when they know the general area of the crash site. When in 1965 the U.S. ambassador to Laos flew over a section of the trail network in Laos, he could not see the road because of the dense tree canopy. However, once on the ground, he could see that the road was well constructed and maintained.[11]

The sophistication of the defensive system around the trail improved over the years. Antiaircraft defenses grew from 23-mm cannon to 37-mm, both with crude optical ring sights, to 57-mm and 85-mm radar-directed weapons. In March 1969 the first AC-130 gunship was hit and destroyed by antiaircraft fire over Laos. By March 1971 the North Vietnamese had moved Soviet SA-2 surface-to-air missiles into Laos for trail protection. It became increasingly difficult for allied airmen to effectively attack the trail system in Laos and Cambodia. Those in Washington simply did not have the political will to order military forays into Laos and Cambodia to meet the enemy on the ground. Only limited "incursions" into the border areas were allowed late in the war. These incursions resulted in negative press coverage and anti-American demonstrations in the United States and around the world. Apparently, world opinion was against allied self-defense incursions into countries neighboring South Vietnam but not against the occupation of these neighboring countries by the North Vietnamese.

With the 1973 Paris Peace Accords to end the war, the United States agreed not only to pull out of South Vietnam but also to terminate its support of the Royal Lao Army. The neutralist government in Laos was therefore forced to significantly reduce the size of its military; consequently, Royal Lao military units were withdrawn from the border areas. This left the North Vietnamese free to greatly expand logistics support of NVA, Viet Cong, Khmer Rouge, and Pathet Lao units. Again, in their quest to conquer South Vietnam and create a new Communist Indochina governed by the military might of Communist Vietnamese, the North Vietnamese did not respect the neutrality or territorial integrity of neighboring countries. The United States was bound by international law and could not interdict the flow of materiel flowing down the Ho Chi Minh Trail without approval of their respective governments. The Peace Accords of 1973 opened the door for the North Vietnamese to complete their takeover of the south just two short years later. By the end of the 1970s, Laos and

Cambodia had become subservient to Vietnam. NVA units, often wearing civilian clothing, remained in both countries.[14]

Throughout the years from the late 1960s through the early 1970s, the electronic sensor system had continued to provide many benefits. It operated 24 hours a day, 7 days a week, with no sick days or vacation time. The sensors operated remotely and in any type of weather. They provided intelligence in areas that were either not accessible to on-site human observation or were in areas considered too hostile for allied forces. Stored data became historical archive material for future reference, to be considered in planning airstrikes. Most important, the sensor system gave military managers an intelligence overview of the enemy's logistics pipeline and its impact on the various theaters of operation within Southeast Asia.

Future applications of sensors were recommended in the 1970s. These included using the system for worldwide border surveillance and interdiction, with a system of satellites replacing the data relay aircraft. Monitoring areas such as demilitarized zones was one of many recommendations proposed. In the late 1970s, the U.S. Central Intelligence Agency (CIA) was using a derivative of the Igloo White sensors. Built to look like rocks and animal dung, the small sensors detected seismic activity to a range of approximately 1,000 feet. The sensors could pick up vehicle and troop movements and relay the information in digital format to a receiving station in much the same way that the Igloo White program operated.

Starting in late 2001, India and Pakistan again clashed over the province of Kashmir. In 2002 the clashes reached such significance that both nuclear-capable countries were seriously considering war. In an effort to reduce tensions and track those groups stirring trouble in the region, the United States and India held a series of talks aimed at determining the feasibility of deploying sensors throughout the disputed area in Kashmir—known as the Line of Control. This new electronic wall on the India–Kashmir–Pakistan border would be only slightly different from the original Vietnamese program. Improved and long-lasting nickel-cadmium and solar-powered systems had already replaced the original lead-acid batteries. Manned orbiting relay aircraft will eventually be replaced with relay drones such as the Global Hawk or Predator and/or military communications satellites for global coverage.

Of the many improvements made to the sensors, the most important was in the sensor power system. Batteries with an average life span of about 30 days powered the original sensors. Research into developing alternative power sources has resulted in sensors powered during the day by solar cells that recharge energy-efficient lithium batteries for night and inclement weather operations. Sensor reliability has also improved over the years. Progress in silicon chip technology has led to a much more reliable system; it currently provides a multifold increase in available sensory data, reaching levels that in the mid- to late 1960s were considered unimaginable. Some current sensor versions are capable of transmitting live video feed via satellite to anyplace on earth. This new technology also allows for much smaller sensors with increased capabilities.

In the late 1990s, the U.S. military developed what was popularly called a sleeper weapon. Officially designated the armed tactical unattended ground (ATUG) device, it is a direct descendant of the devices used during the Vietnam War and described in this book. The ATUG is designed to be air-dropped in areas suspected of harboring the enemy; once in place, it remains inactive until awakened by seismic or acoustical activity. It can also be awakened by transmitting an activation signal from airborne, land, or sea-based monitoring facilities. Once activated, the ATUG ejects a missile or a special warhead to attack enemy targets. The ATUG is rather large—an estimated weight of 2,000 pounds, with a 1,000-pound warhead.

The U.S. Navy, working with the Defense Advanced Research Projects Agency (DARPA), has developed what is called a micro-internetted unattended ground sensor, or MIUGS. The system is based on the Vietnam era sensor system and can be air-dropped or hand-placed at strategic locations where, like its Vietnam era predecessor, it awaits seismic activity. Upon detecting activity, the sensor transmits a signal to a command site or orbiting aircraft such as an AWACS or JOINT STARTS, or to an unmanned aircraft such as a Predator or Global Hawk. The signals are then processed and the information passed on to either a manned or unmanned reconnaissance/attack aircraft to investigate and/or attack as required. The MIUGS location is pinpointed via a global positioning system (GPS) signal. If a strike is required, a smart bomb is dropped to home in on the GPS location.

The Distributed Sensor Network (DSN) is another program that builds on the Vietnam sensor system. The DSN is an integrated sensor system incorporating a wide variety of sensors, including fourth-generation and later Vietnam era sensors as well as imaging sensors that incorporate micro television and video recording devices. This sensor system can track troop and vehicle movements as well as low-flying aircraft.

If you would like to experience a sensory system in operation, then take a trip to just north of Las Vegas. Drive north on highway 376 (the

Extraterrestrial Highway) to Tonopah or Rachael, Nevada. When you arrive at either of these locations (be prepared because it is a long, monotonous drive and very hot in the summertime), ask for a tour of the area around the infamous Area 51, a supersecret air base in the middle of nowhere. Near the perimeter of the base, if you try to cross the border (marked by signs stating the area is under the control of the U.S. government), patrol vehicles and aircraft will meet you. Your presence was detected by a sensor system that had its genesis during the Igloo White program.

With new and improved power sources, expanded sensory capabilities, and greater reliability, sensors now last longer and have refined capabilities. At strategic locations along the U.S. border with Mexico in the south and Canada to the north, electronic sensors similar to those used during the Vietnam War are able to detect the presence not only of foot and vehicular traffic, but also of biological and nuclear materials. Operating 24 hours a day, 7 days a week, these sensors provide a needed boost to the understaffed border patrol agents currently tasked with securing our borders in times of both war and peace. Orbiting aircraft have presumably been replaced with satellites for signal processing and onward transmission; however, transmission relay towers can be constructed to relay sensor signals to a receiving station. This in itself should save a tremendous amount of money and manpower. It also does away with placing the men in harm's way. The new sensors can also be hardwired; that is, connected directly to a receiving station via communications and power cables.

The war on terrorism has spawned a new generation of sensors with expanded capabilities. DARPA has initiated several special sensor projects for use in the war on terrorism. One sensor, based on the old EDIT sensor, has the ability to detect electronic activity at a significant range. It is hoped that this sensor will be able to detect electronic emissions from cell phones or other such communications devices used by enemy combatants in sparsely populated areas, thus giving friendly forces a location or bearing for the source of the emission. This sensor may warn friendly forces of potential threats in their immediate area. Another item that DARPA has under wraps is the anti-sniper sensor. This device uses a laser microphone built into a small, mobile lab. The device gives friendly forces the unique capability of listening in on conversations taking place at some distance from the lab. In operation the laser beam is pointed to a specific area in the sky, directly above the area where intelligence needs to be gathered. Scattering of the laser light in the atmosphere directly above the site allows the lab to listen in on any conversations occurring in the immediate area. So, as can be seen, the sensors used during the Vietnam War continue to improve, and their capabilities are expanding.

Those who think that sensors are outmoded in this day of orbiting imaging satellites and AWACS/JOINT STARS aircraft may want to reconsider that view. Reconnaissance satellites have fantastic intelligence gathering abilities. Their photo resolution is phenomenal. However, the best-guess total of all U.S. military and National Reconnaissance Office intelligence gathering satellites is less than 10. These national assets are in great demand; they have a fixed supply of fuel for maneuvering from one orbit to another, depending on national security concerns. Once the fuel supply is exhausted, the satellite is rendered almost useless unless it can be serviced in orbit or returned to earth. Because these satellites are placed in very high earth orbits, the space shuttle cannot service them like it services satellites orbiting closer to earth. So the use of these national assets is extremely limited in nature, and their cost is enormous.

The AWACS and JOINT STARS aircraft are ideal for airborne battlefield command and control. The radars in these aircraft are of such high quality that battlefield commanders can identify not only airborne aircraft locations but also vehicle traffic and troop movements. However, as in the case of reconnaissance satellites, these aircraft are limited in number; and their sensors are only as good as the terrain they are operating over or near. Vehicle and troop/personnel movements through the deep valleys and gorges of countries like Afghanistan or in the rain forest of Brazil may be difficult to detect. Placing sensors in areas of suspected enemy movement, or forecasted movement, may be the only way of detecting and dealing with the enemy. Unmanned aircraft are also a viable means of detecting the enemy. These craft can stay aloft for extended periods of time, sending back real-time video and collecting signals intelligence. However, they suffer from the same drawback as satellite and manned aircraft—limited availability. An unmanned aircraft/sensor combination would make an ideal sensor system. Unmanned aircraft can perform on-site verification of activations and provide real-time imagery of the suspected area. Unmanned aerial vehicles like the Global Hawk can stay airborne for 24 hours at a time, making them perfect for the sensor relay and interdiction role.

And so it may come to pass that 40-plus years after the inception of the electronic wall in Vietnam, those scientists, technicians, specialists, aviators, and mechanics who labored in secrecy—and were at times ridiculed—may well be counted with those few who actually made a difference in the defense of freedom.

For those interested in viewing some of the sensors described in this book, the author recommends visiting the following locations:

The Patuxent River Naval Air Museum (approximately 70 miles south of Washington, D.C.) The museum, located in a scenic and peaceful area of southern Maryland, is next to the Patuxent River Naval Base. The visitors' entrance is at gate one on Route 235. Admission is free, and a wide variety of aircraft and test equipment are on display. Sensors on display at the museum are a thumbtack acoustical sensor and an ADSID seismic sensor. Both are in very good condition, painted in the standard jungle camouflage colors used during the Vietnam War. Also on display are U.S. Navy Sonobouys. This museum provides a unique view of the Vietnam sensors as well as the Sonobouy, offering a rather good comparison of the similarities and differences between the two. It also gives the visitor some idea of what might have been involved in converting a Sonobouy into a Phase I sensor at the inception of the electronic wall.

The USS *Hornet* Museum (on the former U.S. Naval Base at Alameda, California) A U.S. Navy Sonobouy is on display at this museum. This sensor, which has a portion cut away to reveal the inner electronic workings, is interesting to see. The museum itself is the aircraft carrier USS *Hornet*. Visitors can wander about the ship unescorted, and there are guided tours of the engine bay, berthing areas, and "island." Parking is free, but there is a small charge for admission. From the flight deck of the carrier visitors get a breathtaking view of the San Francisco skyline, including both the Golden Gate and San Francisco–Oakland Bay bridges.

Notes

1. Transcripts of the U.S. Senate, *Hearings before the Electronic Battlefield Subcommittee of Preparedness Investigating Subcommittee of the Committee on Armed Services* (November 18–20, 1970). U.S. Government Printing Office, Washington, DC.

2. Charles T. Kamps, "The JCS 94-Target List: A Vietnam Myth That Distorts Military Thought," *Aerospace Power Journal* (Spring 2001): 67–80.

3. Australian Associated Press report dated Tuesday, May 3, 2005. Report quoted the official Cuban paper, *Rebel Youth*. Colonel Roberto Leon was inter-

viewed by the paper, which stated that Cuba's involvement in the Vietnam War was "one of the greatest secrets of the 1965–1975 war."

4. The reference for China's involvement in the Ho Chi Minh Trail is taken *from Project CHECO Report, Igloo White Program: July 1968–December 1969, A Contemporary Historical Examination of Current Operations. Truck Parks and Storage Areas—Enemy Resources*, 66. The Project CHECO reports were classified as Secret and, as required, remained so for 30 years after the war ended.

5. There is a note on page 3 of "Current Summary of Enemy Order of Battle in Laos," dated August 15, 1968, from Headquarters U.S. Military Assistance Command, Vietnam—Office of Assistant Chief of Staff J-2 and originally classified as Confidential. This note lists Engineering Strengths in Laos during that time frame at 13,450 and states that the figure "Includes command, tactical support and service personnel who are predominantly Pathet Lao but who include foreign advisors." All other references in the publication list NVA (North Vietnamese Army), not "foreign advisors." This could be a tacit reference to the Chinese.

6. *White Book on the Violations of the Geneva Accords of 1962 by the Government of North Vietnam* (Vientiane: Ministry of Foreign Affairs of Laos, 1968), 79–81. Referenced letter is Annex A, number 22, to the book.

7. *White Book on the Violations of the Geneva Accords*, 77.

8. General Donn A. Starry, *Mounted Combat in Vietnam* (Washington, DC: Department of the Army, Vietnam Studies, 1978), 172. Stock number 008-020-00747-1.

9. Starry, *Mounted Combat in Vietnam*, 179.

10. Logistics Buildup North Vietnam—November 1968 memo from Commander in Chief, Pacific, to Chairman Joint Chiefs of Staff.

11. Information on parks and storage areas along the Ho Chi Minh Trail came primarily from the Senate Hearings, as referenced in preceding chapters, and from many of the Project CHECO reports also referenced.

12. Logistics Buildup North Vietnam—February 1971 memo from Commander in Chief, Pacific, to Chairman Joint Chiefs of Staff.

13. The 452nd Bomb Group (light) was based at the K-9 Airfield in Pusan, Korea; this group operated the Douglas B-26B and flew night interdiction missions. During these missions, the aircrew searched for truck headlights. The unit became very adept at locating and destroying truck convoys.

14. Laotian Brigadier General Soutchay Vongsavanh, "Logistics Base Areas," in *RLG Military Operations and Activities in the Laotian Panhandle* (Washington, DC: U.S. Army Center of Military History, 1981).

APPENDIX 1

U.S. Navy Observation Squadron 67 (VO-67), OP-2E Aircraft Serial Numbers

Naval Serial Number (BuNo)	Martin Aircraft ID #
131428	MR-1
131436 (combat loss in Laos—crew lost with aircraft)	MR-2
131478	MR-3
131435	MR-4
131486 (combat loss in Laos—crew lost with aircraft)	MR-5
131455	MR-6
131484 (combat loss in Laos—two crewmembers lost with aircraft)	MR-7
131462	MR-8
131525	MR-9
131423	MR-10
128416	MR-11
128417	MR-12

Aircraft Modification (from SP-2H to OP-2E)

Exterior

APS-20 radome removed
Magnetic anomaly detector removed

Wing-tip fuel tanks removed
Two 7.62-mm mini wing guns installed
APQ-131 radome installed
Camera pod installed

Interior

Engine fire extinguishers installed
APQ-131 terrain avoidance system installed
ARC-131 VHF FM radio installed
APN-157 LORAN system installed
ARN-141 radar altimeter installed
KA-50 vertical camera system installed
KA-51 oblique camera system installed
ASQ-123 sensor activation panel installed
Armor plating installed
Two 7.62-mm M-60 gun pods installed
APN-153 Doppler navigation system installed
Self-sealing wing fuel tanks added
ALE-29 chaff dispenser system installed
Norden bombsight installed
Flight deck escape hatch modified
APR-25 and APR-27 systems installed
SST-181 X-Band radar transponder installed
Bomb bay sensor dispenser installed
Hydraulic system shut-off valves installed

Notes: Unfortunately, the OP-2E is no longer in existence. All were scrapped after the Vietnam War. However a close representation, the SP-2H aircraft BuNo 141234, is on display at the Naval Air Museum in Pensacola, Florida. Although this aircraft was not used in Southeast Asia, it is representative of the type before conversion to OP-2E.

APPENDIX 2

U.S. Army 1st Radio Relay Research Company (CEFLIEN), EP-2E Aircraft Serial Numbers

131526
131531
131429
131485
131492
131496

Notes: Although the aircraft were transferred from the U.S. Navy to the U.S. Army, they retained the U.S. Navy serial numbers (BuNo's). Serial number 131492 was the only one of the five aircraft to retain the original Plexiglas nose. In the other four aircraft, the Plexiglas nose was replaced with nose armor. Serial number 131485 is on outdoor display at Fort Rucker, Alabama. It is the only remaining example of the type. The original designation of the aircraft was P2V-5FD. In 1962, aircraft designations were standardized per direction from the secretary of defense. The version was then reidentified as the EP-2E.

APPENDIX 3

USAF 25th Tactical Fighter Squadron, F-4D Aircraft Serial Numbers

66-8732
66-8768
66-8770
66-8772
66-8777 (squadron commander's aircraft)
66-8779
66-8782
66-8784 (combat loss in Laos, January 1970—crew lost with aircraft)
66-8787
66-8788
66-8789
66-8790
66-8791 (combat loss in Laos, September 1969—crew successfully recovered)
66-8792
66-8793
66-8794
66-8795
66-8796 (combat loss in Laos, April 1969—crew successfully recovered)
66-8797
66-8798
66-8799

Notes: In 1967, twenty-one F-4Ds of the 25th TFS were equipped with the AN/ARN-92 LORAN system for Igloo White operations. During 1970, seventy-two more aircraft were modified with LORAN systems under the Mod 2038D project at Clark Air Base, the Philippines. All LORAN-equipped aircraft also had a KB-18 camera installed in the forward left-hand missile bay. This camera was capable of 180-degree, horizon-to-horizon daytime photo coverage. The photo coverage was a must when dropping electronic sensors. With the photos, the specific location of the sensors could be matched to the terrain.

APPENDIX 4

USAF 552nd AEW and CON Wings, EC-121R Aircraft Serial Numbers

67-21471	67-21481	67-21491
67-21472	67-21482	67-21492
67-21473	67-21483	67-21493
67-21474	67-21484	67-21494
67-21475	67-21485	67-21495
67-21476	67-21486	67-21496
67-21477	67-21487	67-21497
67-21478	67-21488	67-21498
67-21479	67-21489	67-21499
67-21480	67-21490	67-21501

Notes: These thirty USAF EC-121R aircraft were converted from Navy EC-121K and EC-121P aircraft. Submarine detection gear was removed and Igloo White equipment installed. The EC-121 was chosen for this role due to its long range, endurance, and comfortable, spacious pressurized interior cabin. Very few of the 31 aircraft ever were actually airborne and in use at any one time in Southeast Asia. Maintenance requirements required a pool of aircraft available for continuous Igloo White coverage for the numerous orbits flown in Southeast Asia.

Two aircraft, serial numbers 67-21493 and 67-21495, were lost due to crashes near their operating base at Korat, Thailand. In these two crashes, a total of 22 lives were lost; 6 crewmembers sustained major injuries.

APPENDIX 5

USAF 552nd AEW Wing, YQU-22A/B Pave Eagle Aircraft Serial Numbers

YQU-22A	QU-22B	QU-22B
68-10531	69-7693	70-1535
68-10532	69-7694	70-1536*
68-10533	69-7695	70-1537
68-10534	69-7696*	70-1538
68-10535	69-7697	70-1539
68-10536*	69-7698*	70-1540
	69-7699*	70-1541
	69-7700*	70-1542
	69-7701	70-1543
	69-7702*	70-1544
	69-7703	70-1545
	69-7704*	70-1546
	69-7705	70-1547
		70-1548

Notes: Aircraft serial numbers 68-10531, 68-10532, 69-7694, 69-7697, 69-7705, 70-1546, and 70-1548 were all dropped from USAF records due to combat loss in Southeast Asia. Aircraft 68-1534 was returned to the United States after the conflict in Southeast Asia and was operated under civilian registration number N83475. In October 1984 this aircraft crashed into mountainous terrain in Virginia and was completely destroyed. Aircraft

69-7693 returned to the United States and was registered as N75210. The aircraft is undergoing restoration to QU-22B configuration. For information, contact QU-22info@nbook.net or QU-22 network. Aircraft 69-7699 resides at the National Museum of the USAF. As with all aircraft associated with the USAF Museum, 69-7699 has been painstakingly restored to Vietnam era condition. An asterisk (*) indicates aircraft that did not serve in Southeast Asia.

APPENDIX 6

B-57G Night Intruder Aircraft Serial Numbers

52-1578
52-1580
52-1582
52-1588
53-3860
53-3865
53-3877
53-3878
53-3886
53-3889
53-3898
53-3905
53-3906
53-3928
53-3929
53-3931

Notes: The B-57G was a highly modified version of the 1950s era B-57 subsonic day medium bomber. Two J65-W-5 turbojet engines powered the aircraft. All sixteen B-57Gs were modified B-57B airframes that had previously served with the USAF in Vietnam.

Under the Tropic Moon 3 modification program, the B-57Bs were modified by Westinghouse Electric, Martin Aircraft, and the U.S. Air Force

Systems Command into B-57G versions for use in Vietnam as a special operations use aircraft. Some of the Tropic Moon modifications included installing a laser range finder, low-light television camera, forward-looking infrared detection system, multifunctional radar, digital computer, and special communications equipment and replacing four 20-mm M39 wing-mounted cannons with downward-firing 20-mm Vulcan cannons.

Aircraft 53-3931 crashed in Laos on 12 December 1970. The aircrew ejected and was subsequently rescued, but the aircraft was completely destroyed. All remaining B-57G airframes were returned to the United States in the 1970s; all were eventually scrapped. The National Museum of the USAF at Wright-Patterson AFB near Dayton, Ohio, has a B-57B on display; it is representative of the type before modification into the "G" configuration.

APPENDIX 7

Beechcraft A36 and QU-22 Specifications

Engine

QU-22B = Continental GTS10-520, six-cylinder, turbocharged developing 375 horsepower
A36 = Continental IO-520B, six-cylinder, aspirated developing 285 horsepower

Propeller

QU-22B = Hartzell model W10178H-11, three-bladed, wooden, geared for slow turning
A36 = McCauley two-bladed, metallic, constant speed

Electrical System

QU-22B = 28VDC generator with 8-kW belt-driven AC alternator, with the addition of 6 Igloo White external antennas
A36 = 12VDC with 70-amp AC alternator

Fuel System

QU-22B = Internal wing fuel tanks as well as external fuel wing tip tanks
A36 = Internal wing fuel tanks only

Service Ceiling

QU-22B = 20,000 feet
A36 = 16,000 feet

Maximum Takeoff Weight

QU-22B = 5,200 pounds
A36 = 3,600 pounds

Seating

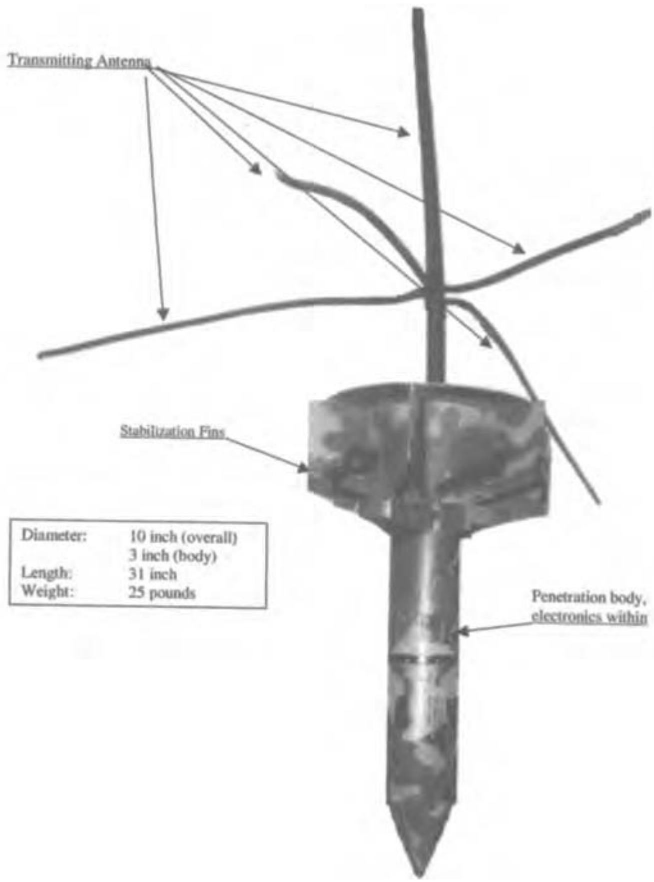
QU-22B = One only
A36 = Up to 6 (including pilot)

Wingspan

QU-22B = Wingspan extension (3-foot total extensions)
A36 = Standard cord/spar

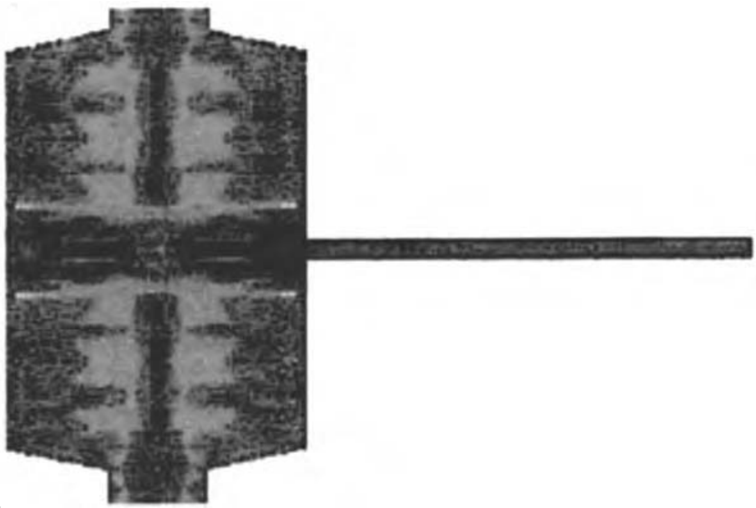
Attachments

A-1 Air-delivered seismic intrusion detector (ADSID).



A-1

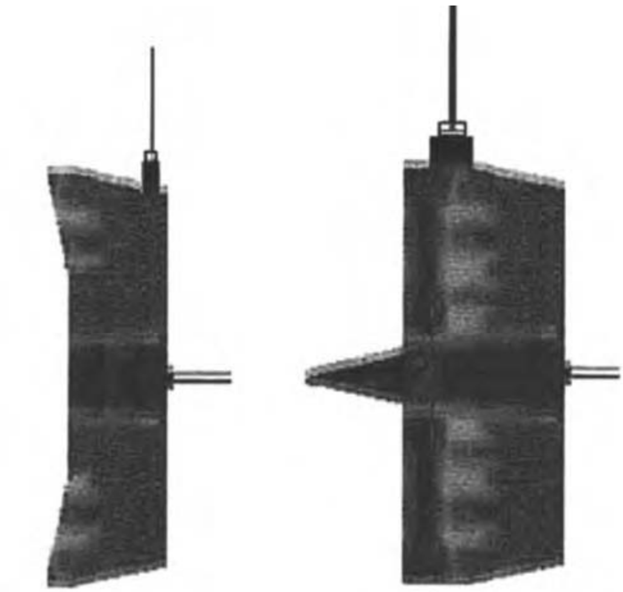
A-2 Hand-delivered seismic intrusion detector (HANDSID). The HANDSID was, as its name implies, hand-delivered to a site by an infantryman or special forces operations teams. The device detected seismic activity and sent a coded signal to a DART or Portatale site. The batteries could be replaced in these units by unlocking latches surrounding the middle of the sensor. Once the latches were unlocked, the sensor could be split in two and the batteries accessed for replacement. A version of this sensor had a hardwired hook-up that supplied power to the sensor and carried activation signals directly to a nearby site.



A-2

A-3 MINISID and MICROSID. As their names imply, these were small seismic sensors; infantrymen or special forces operations teams placed them at specific locations. The MICROSID was small, lightweight, and thus very portable; it fit easily in the palm of one hand. Because of its small size, signal range for this sensor type was limited. They were used primarily as perimeter defense for small patrols camped for the night in the jungle. A small, lightweight electrical cable was plugged into the sensor when in use. This cable not only carried the power to operate the sensor but also carried the seismic signals detected by the sensor back to the receiver at the base camp. The MICROSID was normally used with the

Portatale receiver. It had no internal battery power and relied on an external power source. The MINISID was slightly larger than the MICROSID. At its base was a spike device used for firmly implanting the sensor into the ground. The spike also acted as a seismic antenna, allowing the sensor to pick up seismic signals at a greater range than that of the MICROSID. The MINISID carried internal batteries; but some versions were manufactured with electrical connectors, allowing for operations similar to those of the MICROSID.



A-3

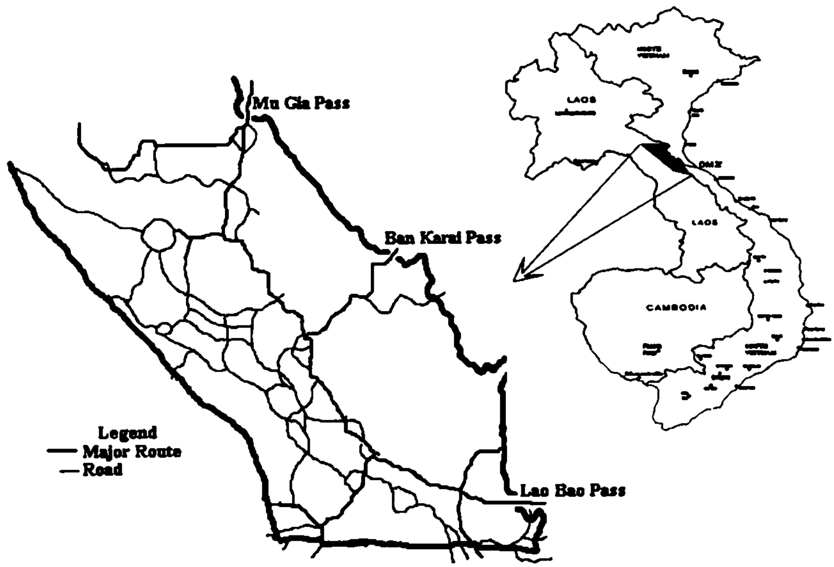
A-4 Fighter air-delivered seismic intrusion detector (FADSID). The FADSID was specifically designed to be carried on the F-4D aircraft. The sensors were designed to replace the original ADSIDs, which would still be air-delivered by slower-moving aircraft and helicopters. The FADSID was slightly longer than the ADSID, and as can be seen, the antenna system was secured in place during flight. When the sensor hit the ground, the antenna sections detached from the main body and sprang into operating position. The FADSID was also a bit more aerodynamic than its predecessor, so it could be delivered with a slight increase in accuracy.

A-4

A-5 Engine detection sensor (EDIT), Phase III. The EDIT sensor was designed to detect pulsed radio frequency energy from unshielded gasoline-powered vehicles. The sensor was air-dropped and floated to earth under a small camouflaged parachute. The sensors were dropped in jungle areas so that the parachute canopies snagged onto tree limbs; the sensors were then suspended high above the ground. The EDIT III and Commike III sensors used the same casing; as a result, they appeared somewhat similar.

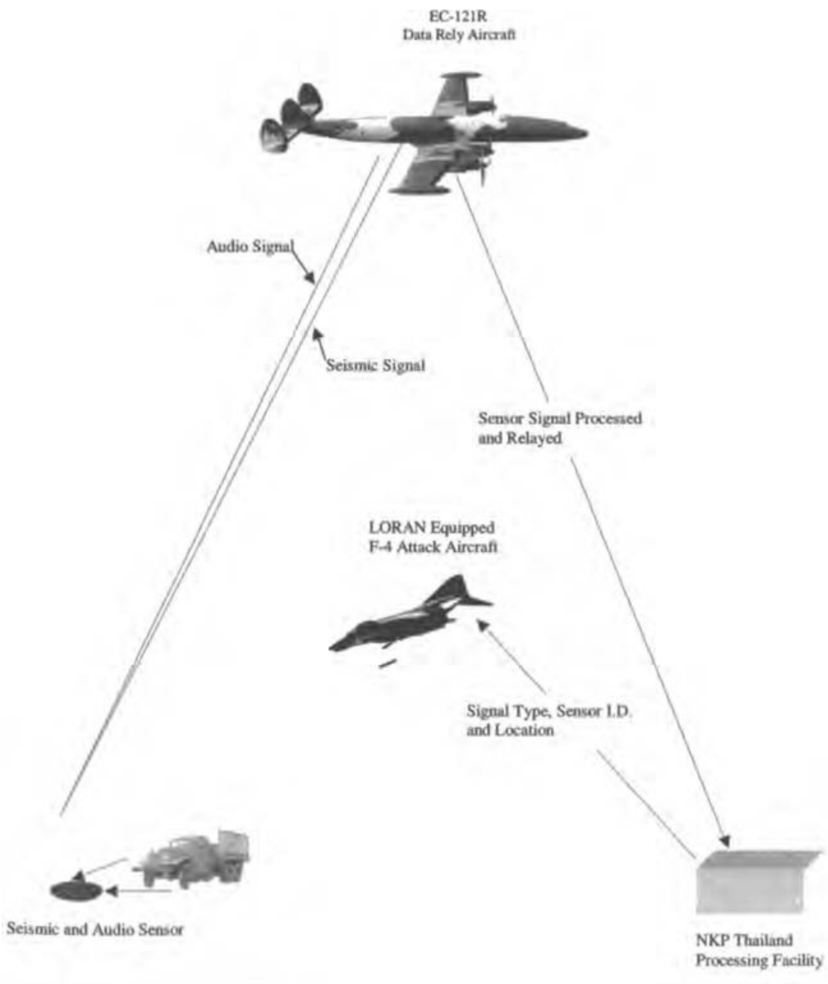
A-5

A-6 The Laos trail network—a representation of a section of the Ho Chi Minh Trail network in the Steel Tiger area of Laos. Due to misinformation by the press, the trail was actually quite an elaborate network of major routes and roads. Actual trails, truck parks, and bivouac areas are not represented in this illustration. As this depiction of a small section of Laos indicates, the network was quite elaborate. The Pathet Lao provided assistance with the transportation network in Laos. However, an extremely large number of North Vietnamese army troops ensured network security and repair. The North Vietnamese willfully ignored international borders, stationing troops in Laos and Cambodia.



A-6

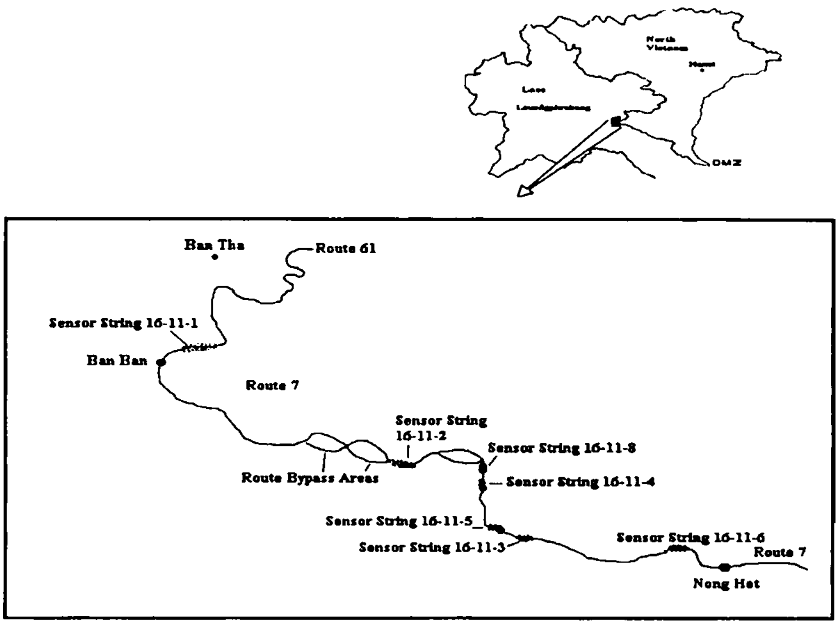
A-7 Data relay and attack.



A7

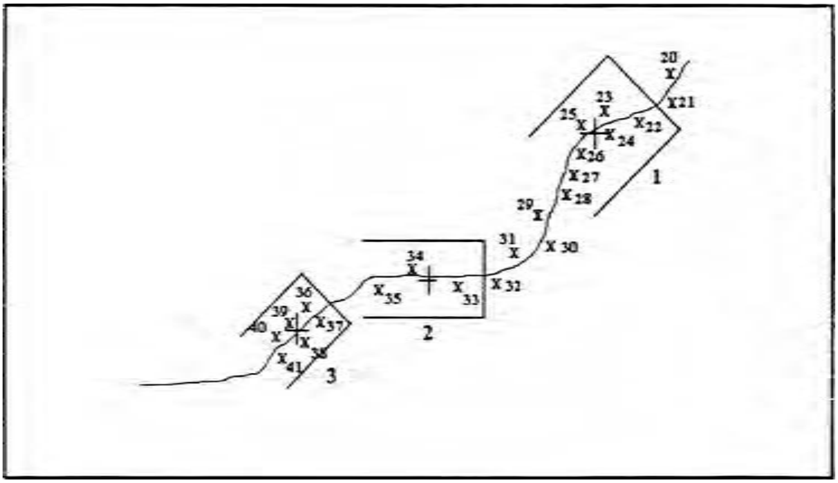
A-7

A-8 Sensor strings on Route 7 in Laos, October 1969. This illustration is based on actual sensor string locations along a portion of Route 7 in western Laos in late October 1969. The sensor strings have been air-dropped at strategic locations along the route. Route 7, along with Route 61 (shown at the top of the route system), were part of the elaborate Ho Chi Minh Trail that snaked its way south from North Vietnam. Sensor string numbers correlated to specific sensor type and location. When a sensor string was activated, a signal was sent to the ISC at Nakhon Phanom (NKP) alerting intelligence monitors of activity within the string. Specific sensor signals identified where in the string the activity was taking place. ISC personnel then contacted forward air controllers (FACs), which investigated the area for potential air strikes.



A-8

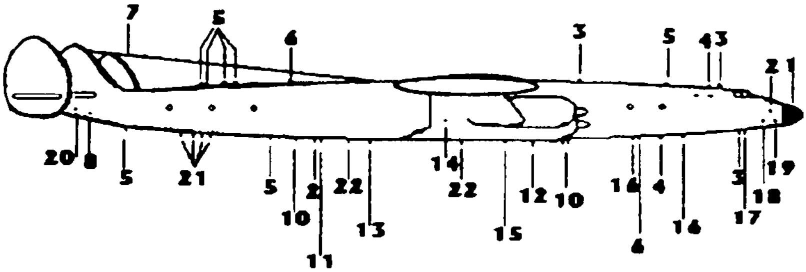
A-9 Representation of a moving target computer display Commando Bolt mission. An IBM 360 computer program generated this representation, which approximates what a technician seated at a computer monitor at the ISC in Thailand would have seen during the Commando Bolt campaign. The "X" indicates sensor locations along the trail, which is represented by the line running diagonally across the screen. Numbers ranging from 20 through 41 next to each sensor location indicate minutes past the current hour at which vehicles are expected to arrive. Traffic flows from the top of the trail representation toward the bottom (upper right to lower left). The U-shaped areas identified as 1, 2, and 3 are target boxes identifying where fighter-bomber attacks are to be initiated. Predictions in the minute representations are computer-generated calculations based on sensor inputs (sensor activations and the time between activations). Large crosses within each U-shaped target box are desired mean points of impact (DMPI) for each target box. Few outside of the Igloo White community knew of the system's sophistication or its abilities and limitations. The information remained classified for 30 years after the end of the Vietnam War.



A-9

A-10 EC-121R relay platform. The external antenna locations are as follows:

1. APS-42 Search Radar
2. Wilcox 807 VHF Radio
3. ARC-27 UHF Radio
4. ARA-25 VHF/DF Radio
5. ARC-51BX UHF Radio
6. APX-6 IFF/TACAN Receiver
7. 618T-3 HF/LOGSN Radio
8. APN-22 Radar
9. FM-622 VHF Radio
10. S-Band Radio Relay
11. AAR-52 Radio
12. AAR-52A Radio Receiver
13. AAR-71 Radio Relay
14. ARN-12 Marker Beacon
15. ART-47 Radio Relay
16. ARN-6 Loop Antenna
17. ARN-21 TACAN
18. ARN-18 Glide Slope
19. ARN-14 VOR
20. APR-21/25 Radio
21. ALT-28/ALR-27 Warning Radar



A-10

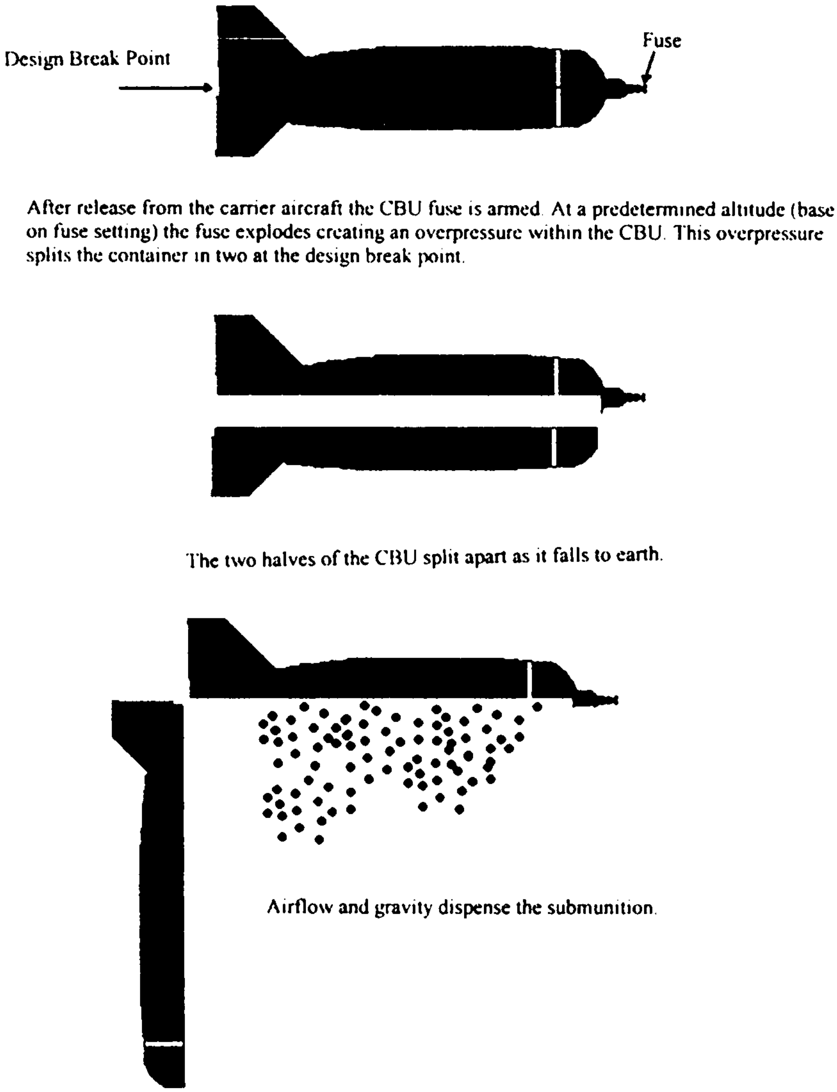
A-11 Relay orbits. In the illustration, these orbits are as follows:

Orbit	Orbit Name	Aircraft Type	Orbit Duration
1	Rose	EC-121R	10 hours
2	Pink	EC-121R	18 hours
3	Green	EC-121R/QU-22B/C-130	21 hours
4	Blue	EC-121R/QU-22B/C-130	18–24 hours
5	White	C-130	10.5 hours
6	Red	C-130	10 hours
7	Lavender	EC-121R/QU-22B	10 hours
8	Purple	EC-121R	10 hours (night flights)
9	Orange	EC-121R/QU-22B	10 hours (night flights)
10	Black	EC-121R	18 hours
11	Amber	EC-121R	Daily as required


NORTH
VIETNAM
LAOS
1
2
DMZ
3
4
5
6
7
8
9
CAMBODIA
SOUTH
VIETNAM
10
11

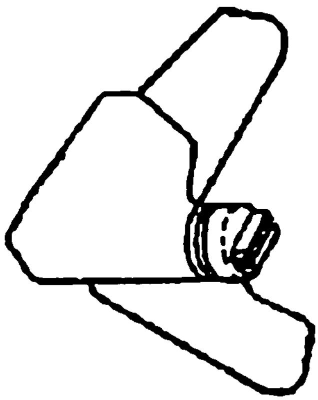
A-11

A-12 Cluster bomb unit operation.



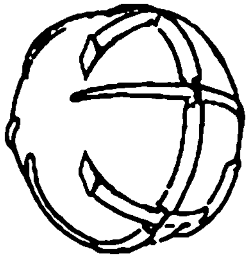
A-12

A-13 Dragontooth/APERS submunition. The dragon's tooth, also known as the antipersonnel submunition (APERS), was a wide-area antipersonnel submunition dispensed from a CBU-24 or similar container. Each container held several hundred of these pressure-activated submunitions (each about 5 inches wide by 3 inches long). Once over the target area, the carrier aircraft released the container. During its fall, and at a specific height aboveground, the container split in two and dispensed the submunition over a wide area.



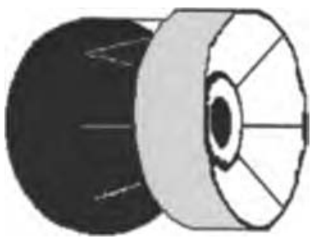
A-13

A-14 Wide-area antipersonnel mine (WAAPM) submunition. The WAAPM was also known as gravel. Like the dragon's tooth, the WAAPM was dispensed from CBU-24 or CBU-42 containers, each holding about 80 of these small mines. Gravel was dispensed in the same way that the dragon's tooth submunitions were. However, once out of the container, the mine began spinning due to the design of its outer skin. After a specific number of spins, the mine became armed. Once it was on the ground, any contact or disturbance set it off. The internal explosive fractured the outer metal housing, sending blast and metallic fragments flying in all directions. WAAPM sizes varied widely, from 1 inch in diameter to a maximum of about 4 inches in diameter.



A-14

A-15 BLU-66 antipersonnel bomblet. The Bomb Unit Live-66 (BLU-66) was an antipersonnel bomblet that killed by fragmentation. The bomblet was carried in a CBU-46 container. After being released from the carrier aircraft, the CBU split apart at a predetermined altitude, spewing as many as 80 of these mini-bombs. They were phased out of use in Southeast Asia in the early 1970s.



A-15

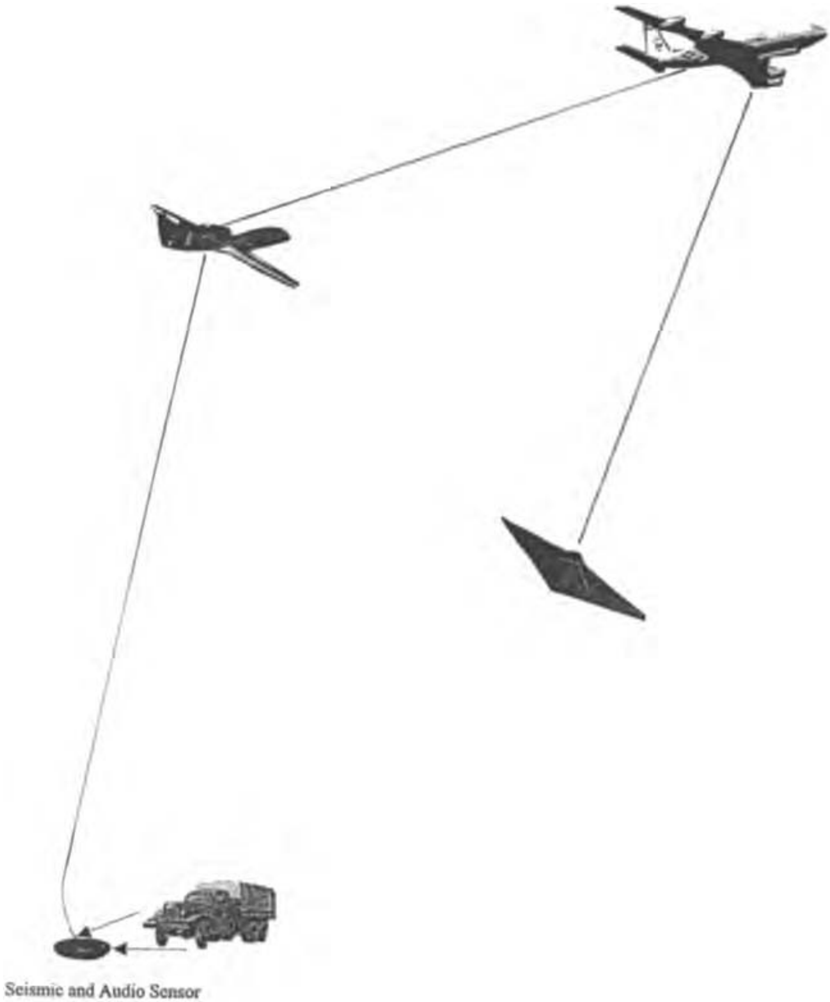
A-16 BLU-53 chemical bomb. The Bomb Unit Live-52 (BLU-52) chemical bomb was filled with 270 pounds of CS-1 or, depending on availability, CS-2 riot control gas. It was effective against troop concentrations and was non-lethal. The bomb was released from the carrier aircraft; upon hitting the ground, its thin skin broke open, releasing the chemical agent. The bomb unit was rather large, about 6 feet in length and 10 inches in diameter.

A-16

A-17 BLU-31 land mine. The blunt nose of the BLU-31 land mine was designed to prevent it from being buried too deeply in the earth. A delayed-action fuse armed the 750-pound weapon. Once released from the carrier aircraft, the mine fell unguided to earth. Upon contact with the ground, delayed-action fuses (in both the nose and tail) were armed. The land mine continued burrowing into the earth a short distance, partially burying itself. Once armed and in the ground, the mine was passive until the fuse detected seismic activity of a specific threshold, indicating vehicle movement. Upon reaching the specific threshold, the weapon exploded. The land mine was 7.5 in length and 16 inches in diameter. It was effective against wheeled and tracked vehicles. However, due to its rather large size, it disturbed the earth and foliage and was not hard for the enemy to find.

A-17

A-18 Future unmanned battlefields.



A-18

Photos

THIS SECTION contains photos of various types of aircraft, along with detailed descriptions. Unless otherwise specified, the photos are courtesy of the author.

P-1 A Korat-based EC-121R of the 553rd Reconnaissance Squadron airborne over the Thai countryside in January 1969, courtesy USAF. The photo was taken as the aircraft was departing from Korat, outbound to an assigned relay orbit over Laos. Thirty former U.S. Navy EC-121K and EC-121P aircraft were converted into the EC-121R version and operated by the USAF in Southeast Asia. Modifications included removing the bulbous upper and lower radomes as well as associated submarine detection gear. The dark oval at the top of the aircraft indicates where the upper airborne search radar was located before being removed.

The EC-121s were military versions of the Lockheed Constellation commercial transport. Manufactured in the mid-1950s, the "Connie" was called the Queen of the Skies by many aviation enthusiasts because of its beauty. It was designed to carry passengers in comfort across the vast open waters of the Atlantic and Pacific. The original Constellation, Lockheed model L-049, became operational in the mid-1940s and was pressed into government service at the end of WWII as both a troop and cargo transport. Other versions were modified with a wide variety of creature comforts to fly VIPs around in luxury.

Although no EC-121R examples are on display, many examples of the C/EC-121 can be seen in museums across the United States. At least two flying examples also exist, and they are routinely requested to fly at U.S. air shows. One of these two is a pristinely restored L-1049H, a

P-1

Super-G Constellation, painted in 1950s era TWA colors and carrying the name "Star of America." This aircraft is based at the Airline History Museum in Kansas City, Missouri. The second flying example is a beautifully restored L-1049 Connie, originally painted in the colors of the Military Air Transport Service (MATS) of the U.S. Air Force. This aircraft was purchased by Korean Air and is currently on display in Korea. The Netherlands possesses a beautifully restored Connie, painted in KLM Royal Dutch Airlines colors. U.S. President Harry Truman's Connie, the Columbine, has been restored to flying condition and operates on the tour circuit. It is nice to see such organizations dedicated to giving future generations the pleasure of seeing such works of art flying once again.

Nonflying examples of the EC-121 are located at the National Museum of the USAF, Wright-Patterson AFB, Ohio (EC-121K); Warner-Robbins AFB, Georgia (EC-121K); Tinker AFB, Oklahoma (EC-121K); Naval Air Museum, Pensacola, Florida (EC-121K); and Combat Air Museum, Topeka, Kansas (EC-121T).

P-2 An OP-2E Neptune aircraft, assigned to U.S. Navy Squadron VO-67, parked on the ramp at Nakhon Phanom (NKP), Thailand (courtesy USAF). Sparse conditions of the early days at NKP are evident in this photo. Notice the pierced steel planking on the parking ramp and the wooden operations building with control tower behind the aircraft. Also notice the cockpit escape hatches, left open to cool down the interior of the aircraft.

The OP-2E was a modification of the SP-2E Special Operations aircraft. The SP-2E, originally developed in the late 1940s, was a highly modified U.S. Navy P2V-5F maritime patrol aircraft. PMBR notation in the photo points to the special weapons bomb racks. These racks carried a wide variety of sensors and ordnance, including the Igloo White sensors, mini-gun pods, and the suspension and release unit (SUU-11). Mini-gun pods could also be carried on these underwing pylons. A slight "chin" under the glass nose houses the APQ-131 radar unit. Jet pods under each wing, just outboard of the propellers, greatly assisted the aircraft in takeoff performance and cruising speed. Each jet pod housed a J-34 turbojet engine that provided additional thrust for takeoff, cruise, and emergency power.

P-2

Two Wright R-3350-32W turbocompound radial engines, producing in excess of 3,000 takeoff-rated horsepower each, powered the OP-2E.

Unfortunately, no OP-2E aircraft are known to exist. However, the Naval Air Museum at Pensacola, Florida, has an SP-2E on display. The SP-2E is a good representation of the Igloo White OP-2E.

An SP-2H, serial number 14915, has been restored to flying condition by the Mid-Atlantic Air Museum. The museum acquired the aircraft from the Davis-Monthan AFB storage facility. The P2V Neptunes continue to soldier on as fire bombers. They are based at several locations throughout the United States, primarily in Idaho and California, and are used in putting out forest fires on an as-required basis.

P-3 An airborne B-57G Night Intruder, photo taken in July 1971, courtesy USAF. The color scheme of black, dark green, and tan gave the aircraft a sinister look, but the colors were effective for night operations. Originally designed in the early 1950s as a medium-range, twin-engine subsonic jet bomber, the B-57 became an effective interdiction aircraft. The design evolved, first becoming the RB-57 (used as a recce platform), then the WB-57 (ostensibly used for weather observation and forecasting), and finally the ultimate attack aircraft, the B-57G Night Intruder.

Shown to great effect in this view of aircraft 53-3906 is the bulbous nose housing specialized radar that was able to pinpoint and track moving targets. Visible in a chin just under the radome is an optically pure window for the low-light television system. Viewing windows for various

P-3

sensors can be seen on the forward fuselage just under the cockpit. In addition to the specialized radar, the B-57G carried a low-light television camera, a laser range-finding system, and an infrared detection system. It was the ideal aircraft for attacking motorized traffic traveling the trail system in Laos and Cambodia. Ordnance load initially consisted of four wing-mounted, 500-pound general-purpose bombs. However, by early 1971 the aircraft was capable of carrying four 500-pound laser-guided bombs. The underside of the aircraft was also equipped with a unique, downward-firing, 20-mm Gatling-gun cannon. Mounted on a hydraulically operated swivel, the cannon was remotely controlled by the weapons systems operator in the rear cockpit.

Only one B-57G was lost in combat. The aircraft entered the war in the early 1970s, and by 1974 all had been withdrawn and stored at Davis-Monthan Air Base near Tucson, Arizona. They were eventually scrapped in the late 1970s. No examples of the B-57G exist today.

P-4 The QU-22B Pave Eagle aircraft 69-7699, shown to great advantage, courtesy USAF. The large raised engine cowling is clearly visible just behind the propeller. Under this highly modified cowling was the oversized generator, which provided current to the Igloo White electronic equipment. Notice the black vampire bat under the pilot's window on the side of the aircraft. The QU-22B pilot's call sign was Vampire. In white lettering within the black vampire is the name of the aircraft crew chief; the opposite side also had a vampire painted on it, with the pilot's name. This particular aircraft, which

P-4

is at the National Museum of the USAF, is one of a few remaining examples of the type. It was kept in the United States for testing purposes (primarily at Eglin AFB, Florida), assigned to the Tactical Air Command, and was never flown in Southeast Asia. The aircraft was subsequently transferred to Davis-Monthan AFB for storage and final disposition. Luckily, the USAF Museum was able to rescue it for posterity.

Originally intended as a replacement for the EC-121R, the QU-22's small size (it could easily fit under the wing of an EC-121) would have made it a much smaller target for enemy ground fire. It was also considered much more reliable, and easier to maintain and operate, than the huge four-engine, aviation-gas-guzzling EC-121. Unfortunately, the loss of several QU-22s over Laos—due primarily to engine problems—contributed to its removal from service in Southeast Asia.

P-5 Air-delivered seismic intrusion detectors (ADSIDs) waiting to be loaded onto a 25th Tactical Fighter Squadron aircraft. The photo was

P-5

P-6

taken in late 1968 at Ubon Royal Thai Air Base, Thailand. Six ADSIDs on the centerline station was considered a normal load.

P-6 Unique view of a 25th Tactical Fighter Squadron F-4D aircraft with two SUU-42 acoustical delivery pods mounted on the outboard wing stations (photo taken at Ubon, 1969). Because the SUU-42 was a very aerodynamic device, it could be carried at high speed on the F-4. Just visible in the photo are three 500-pound bombs on the inboard stations of each wing. A centerline fuel tank, twin AIM-7 Sparrow missiles, and a camera pod in the left forward missile well (not visible) rounded out this load destined for Laos.

P-7

P-7 View looking forward of the previously described SUU-42 delivery pod. Ejection tubes are clearly visible on the aft portion of the pod. AIM-7 Sparrow missile clearly visible.

P-8 Forward view of the CBU-42 (cluster bomb unit) mounted on the inboard station of a 25th Tactical Fighter Squadron aircraft (photo taken at Ubon, 1969). The CBU-42 was very clean and aerodynamic, a requirement for being carried on the high-speed F-4 aircraft. The aircraft had just returned from a mission over Laos. Empty dispenser pods are evident in the photo. Notice the AIM-7 Sparrow radar-guided missile, visible on the underside of the aircraft. The large yellow rectangle on the fuselage is a placard area, where weapons loading technicians were required to enter the type of munition the aircraft carried. The information was required to alert anyone working around the aircraft as to its status (i.e., aircraft loaded with CBU-42, AIM-7, ARMED; or, if weapons ejector cartridges removed, DE-ARMED).

P-9 Aft view looking forward of same aircraft (photo taken at Ubon, 1969). The AIM-7 missiles show up well in the photo. Red "remove before flight" streamers, attached to munitions safety pins, can also be seen in photo. Aircraft were parked in open (uncovered) revetments.

P-8

P-9

P-10

P-10 This 25th Tactical Fighter Squadron F-4D, serial number 68-8789, flew into trees over Laos during a high-speed, low-altitude sensor drop mission in early 1969. The aircraft is seen parked on the ramp at Ubon Royal Thai Air Base, Thailand. Although the aircraft was heavily damaged, the aircrew was able to fly it back to base. Notice the damaged AIM-7 missile radome at the right-hand side of the photo.

P-11

P-11 Front view of the aircraft previously described. The crew chief is in front of the aircraft, and the damaged radome is evident in the photo.

P-12

P-12 Another view of aircraft 68-8789 damage (photo taken at Ubon). Extensive damage to the wing can be seen. Notice that the ADSIDs carried by the aircraft are gone from the racks visible in the bottom photo. The crew completed the mission and returned safely to base, a testament to the dedication of aircrews supporting Igloo White.

P-13 An ADSID implanted in the ground after being dropped from an aircraft, courtesy DOD. Notice how well the sensor is hidden among the jungle foliage. The sensor's baseplate and antenna are just visible, blending in well with surrounding scenery.

P-14 The nerve center of the electronic wall is well illustrated in this photo of the infiltration surveillance center (ISC) ground station, courtesy USAF, Maxwell AFB Archives. Shown are USAF technicians working at the Nakhon Phanom (NKP), Thailand, sensor-processing center. Noncommissioned Officers (NCOs) are seated at the computer terminals, monitoring electronic signals from sensors along the Ho Chi Minh Trail. Portions of the IBM 360 computers can be seen on the far wall. Computer printouts of sensor signals provided a hard copy of sensor information. For historical

P-13

P-14

P-15

reference, signals were also recorded on magnetic tape. The white rectangular blocks on the display consoles lit up when a sensor was activated. Each display block was given a code number to indicate the particular sensor activated. The processing center operated 24 hours a day, 7 days a week.

P-15 Computer room at the ISC in Thailand, courtesy USAF, Maxwell AFB Archives. IBM 360 computers can be seen in the background; IBM electronic printers are in the foreground. For security reasons, the facility was housed in windowless buildings.

P-16 ADSID III seismic sensor, courtesy DOD. Notice that the horizontal antenna elements are not fully extended. They are held in place by a

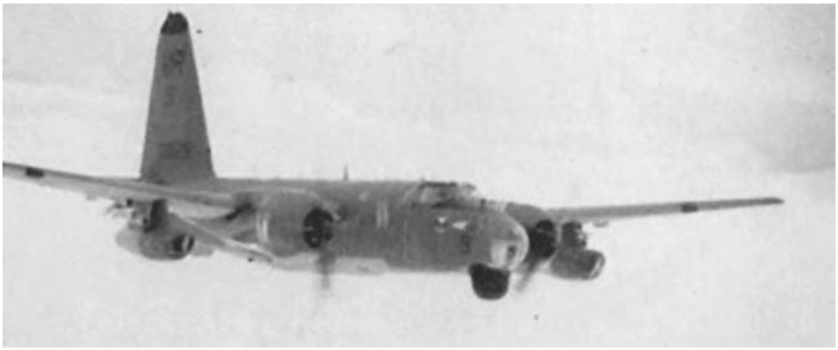
P-16

P-17

retaining ring to prevent damage during storage, loading, and in-flight carriage to the target. Upon impact the ring separates, allowing the antenna elements to fully extend. In most cases, the Southeast Asia paint scheme blended well with the surrounding jungle.

P-17 CH-3 helicopter drop of an ADSID sensor, courtesy USAF. The sensor was tossed out the open helicopter door. Initially the sensors were to be fired via a launcher mounted on the bottom of the helicopter. However, the launcher did not work out; the thrust used was far too great, and the sensors were inoperative upon hitting the ground.

P-18 VO-67 Squadron OP-2E in flight on a mission over Laos, courtesy USAF. Just visible under each wing, outboard of the underwing jet pods, are the pylon racks and ADSID sensors.



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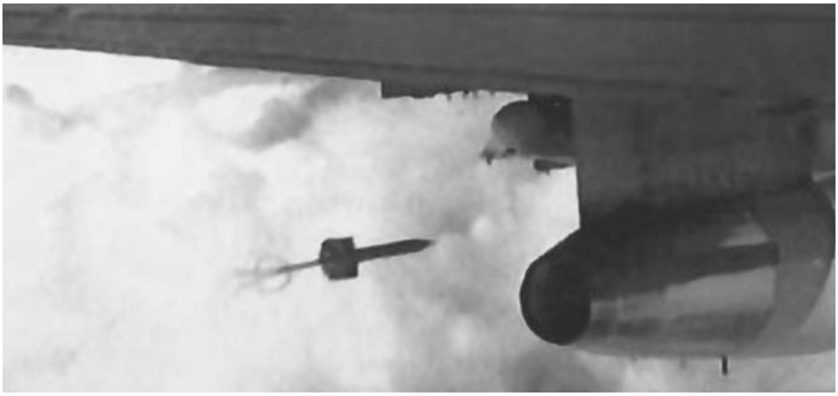

P-19

P-19 Sensor drop from the left wing of an OP-2E over Laos, courtesy USAF. The sensor has just been released, and its antenna retaining rings are still in place as the sensor falls to the earth.

P-20 Acoubouy sensors being loaded into SUU-42 dispenser at Ubon Royal Thai Air Base, Thailand (courtesy USAF). This three-man opera-

P-20

tion required two sensor loaders and a supervisor reading the loading checklist. Notice the Tactical Air Command patch on the loader's right breast pocket.

P-21 An AC-47 Spooky gunship on the ramp at Da Nang Air Base, South Vietnam. These cargo aircraft were converted to gunships by the addition of three 7.62-mm mini-guns, installed on the left-hand side of the aircraft. They also carried flares for night attack and observation missions. Late in the war, the aircraft were turned over to the South Vietnamese Air Force.

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P-22 Close-up view of the gun ports on the AC-47. The windows of the original C-47 were removed so that the three 7.62-mm mini-guns could fire through the openings. A rudimentary optical sight was mounted on the instrument panel in front of the pilot.

P-23

P-23 The AC-130 was extensively used over South Vietnam and Laos. A replacement to both the AC-47 and AC-119, the AC-130 was the ultimate gunship. As can be seen in the photo (taken in Ubon in 1969), these aircraft carried a wide variety of weapons. They were used as truck killers on the Ho Chi Minh Trail in Laos.

P-24

P-24 Photo (taken in Ubon, 1969) of the same AC-130 showing the removed left-hand elevator. It was damaged by antiaircraft fire while on an Igloo White support mission. All AC-130 aircraft at Ubon were painted flat black, with flat red military lettering.

P-25 An extensively damaged Grumman OV-1, seen on the ramp at Ubon Royal Thai Air Base, Thailand, in 1969. The aircraft was flying forward air

P-25

controller (FAC) duties over Laos when it encountered stiff antiaircraft fire. As the photo reveals, it took a skilled pilot to fly this aircraft back safely.

P-26 This B-57 was damaged while on a combat mission in support of Igloo White operations over Laos. Eighty percent of the right-hand horizontal stabilizer has been blown off by antiaircraft fire. It was a skillful pilot who flew the aircraft safely to Ubon Royal Thai Air Base, Thailand.

P-26

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P-27 The Cessna Skymaster forward air controller (FAC) aircraft was used extensively to support Igloo White. These two Skymasters were photographed in 1968 on the ramp at Ubon Royal Thai Air Base, Thailand. These Skymasters, painted for night operations, had loaded rocket pods under their wings.

P-28 This Skymaster displays the normal daytime paint scheme used by some FACs during the late 1960s (photo taken in Ubon, 1968).

P-29 A Grumman A-6A Intruder returning to the ramp at Da Nang Air Base, South Vietnam, after a mission over Laos. With its sophisticated radar system and all-weather capability, this two-seat aircraft was used extensively for interdiction missions.

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P-30 The venerable Douglas Skyraider was the propeller-driven workhorse of Vietnam. The aircraft was used to deliver a heavy munitions load in support of Igloo White operations. As this photo (taken at Bien Hoa Air Base, South Vietnam) reveals, it was also used extensively by the Vietnamese Air Force (VNAF). These VNAF Skyraiders are being prepared for combat after storage. Due to its slow speed and vulnerability to ground fire, the Skyraider was withdrawn from combat duty. However, when this photo was taken in 1974, the VNAF badly needed the aircraft.

P-31 25th Tactical Fighter Squadron F-4D aircraft, serial number 68-797. The photo, taken in 1968, shows this F-4D being prepared as a flack suppression aircraft in support of an Igloo White airdrop in Laos. Four CBU-24 canisters are on the centerline, and two 2.75-inch rocket pods occupy each inboard wing station.

P-32 The nerve center of the electronic wall is well illustrated in this photo taken at the ISC ground station (courtesy USAF, Maxwell AFB Archives). The technician is working at the Nakhon Phanom (NKP), Thailand, sensor-processing center. Computer printouts of sensor signals provided technicians with a hard copy of sensor information. *Note:* Although this photo is marked as Secret, the Igloo White information and photos have since been declassified.


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P-31


SECRET
GSM Using Light Pen IBM
2250 Display Console.
FIGURE 11
SECRET

P-32

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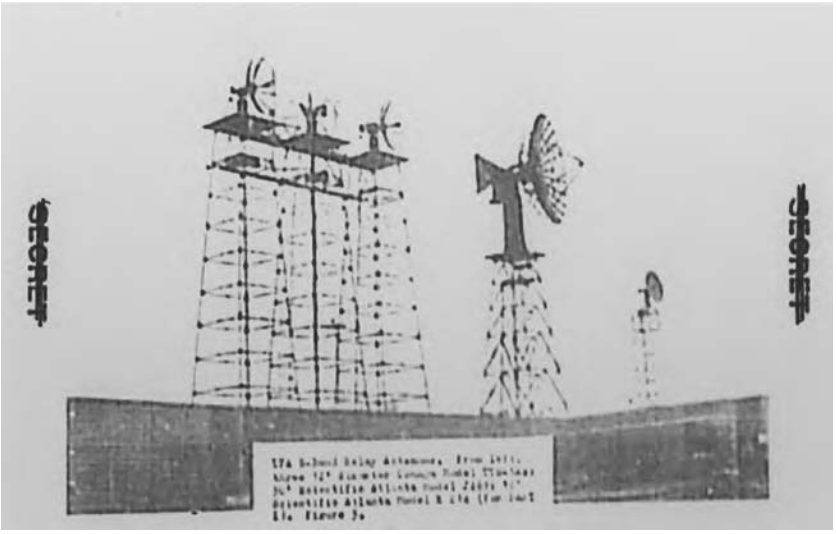
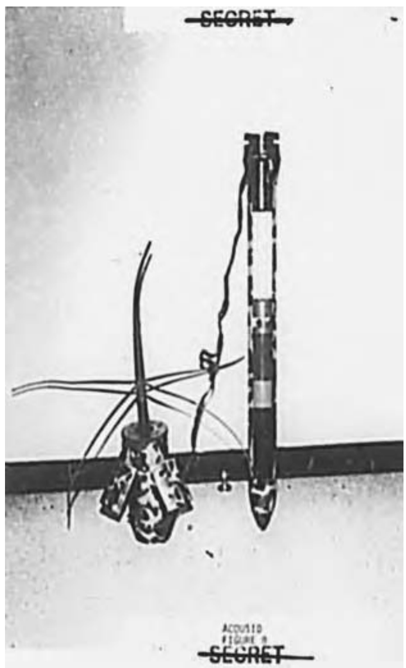
P-33 This photo shows technicians at work in a DART I van in South Vietnam, courtesy USAF, Maxwell AFB Archives. The technicians are monitoring X-T plotters. Somewhat cramped quarters were typical of DART vans; the priority was mobility, not comfort. *Note:* Although this photo is marked as Secret, the Igloo White information and photos have since been declassified.

P-34 The infiltration surveillance center (ISC) at Nakhon Phanom (NKP) Royal Thai Air Base, Thailand (courtesy USAF, Maxwell AFB Archives). The ISC was the heart of the electronic wall. This photo shows the extensive antenna array found at the base. It also shows why the facility was called the Dutch Windmill; the radar arrays do somewhat resemble the vanes of a windmill. *Note:* Although this photo is marked as Secret, the Igloo White information and photos have since been declassified.



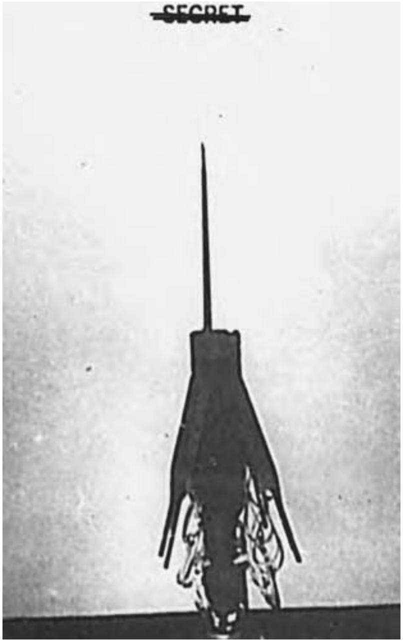
P-34

P-35 An ACOUSID sensor, shown partially disassembled, courtesy USAF, Maxwell AFB Archives. The ribbon cable connecting the sensor's antenna to electronics within the main body is clearly visible. On the floor is a plastic-encased antenna, resembling a tree sapling, that will be connected to the baseplate. The lower portion of the main body contains the sensor battery; the upper portion contains the electronics. *Note:* Although this photo is marked as Secret, the Igloo White information and photos have since been declassified.



P-35

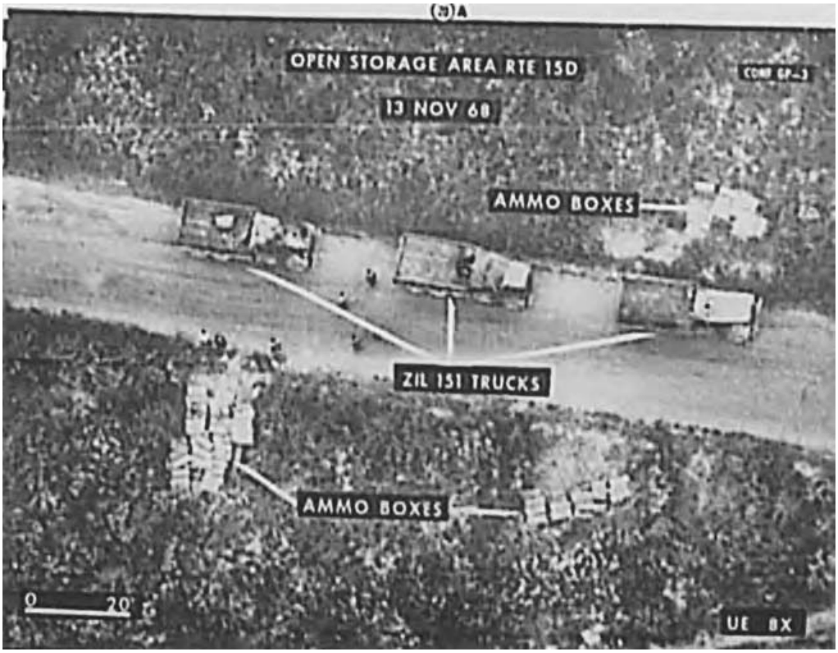
P-36 A FADSID sensor, shown with antennas folded down for carriage on high-speed aircraft. This photo (courtesy USAF, Maxwell AFB Archives Department) is from Secret documents that have since been declassified.



P-36

P-37 An armed USAF recon aircraft photographed this truck convoy as it passed through an open storage area on the Ho Chi Minh Trail in northern Laos. The photo (courtesy USAF, Maxwell AFB Archives Department) shows three Russian ZIL-151 trucks and a large amount of boxed ammunition. Notice personnel on the road; they are in no way intimidated by the over-flight, because they know that a U.S.-imposed bombing halt is in effect—meaning no air attacks. Also notice the large, well-maintained road.

P-38 A helicopter-delivered seismic intrusion device (HELIOSID). *Note:* Although this photo (courtesy USAF, from Maxwell AFB Archives Department) is marked as Secret, the Igloo White information and photos have since been declassified.


OPEN STORAGE AREA RTE 15D
13 NOV 68
AMMO BOXES
ZIL 151 TRUCKS
AMMO BOXES
0 20'
UE 8X

P-37


SECRET
SECRET

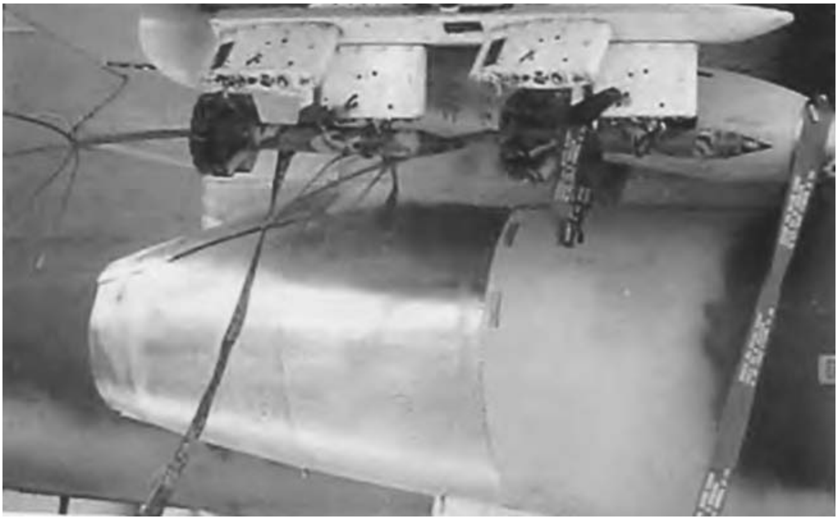
P-38

P-39 Although commonly called the thumbtack because of its appearance, this sensor was actually an acoustic seismic intrusion detector (ACOUSID). The device combined acoustic and seismic sensors. At its top, a whip-type transmitting antenna and an acoustic microphone are mounted.

P-40 A Douglas A-1 Skyraider loaded with two Pave Pat munitions is ready for takeoff from Nakhon Phanom (NKP), Thailand, courtesy DOD. The Pave Pat munition was a fuel/air explosive designed to ignite in midair and cause a tremendous explosion.

P-39

P-40



P-41

P-41 ADSID sensors, mounted on the right-hand wing outboard station of a U.S. Navy OP-2E aircraft operating from Nakhon Phanom (NKP), Thailand, courtesy DOD. The view is looking inboard. The right-hand jet engine pod is visible behind the sensors. Red "remove before flight" streamers are also visible.

Additional Sources

FOR PORTIONS of this book, I have drawn on my experiences with the Igloo White program in Southeast Asia. In addition to the resources given in the notes at the end of each chapter, information has also been drawn from the following sources.

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ANTHONY J. TAMBINI was a member of the United States Air Force's 25th Tactical Fighter Squadron, 8th Tactical Fighter Wing. He was stationed at Ubon Royal Thai Air Base, Thailand, from 1968 through 1969. He also served as a flight engineer and logged more than 500 flight hours in combat zones. Before retiring in 2004, he worked for Northrop Grumman for three years in Vietnam as a technical adviser to the Vietnamese Air Force, eight years in Saudi Arabia as a quality control adviser to the Royal Saudi Air Force, one year in Korea as a logistics adviser to the Korean Air Force, and on the F/A-18E/F flight test team at Patuxent River Naval Air Test Center. Mr. Tambini is also the author of *Douglas Jumbo's The Globemaster* (1999) and *F-5 Tigers over Vietnam* (2000).