I. Origin and Early Development

The genesis of the gunship is relatively obscure, even though the idea was tested as early as 1926–27 and appeared in various proposals during 1939 and 1942. The concept, in its simplest form, combined a long-known aerial maneuver with previously employed weapons. Nonetheless, nearly two decades passed before firing laterally from an aircraft in a pylon turn caught on as a useful combat tactic. Its development stemmed directly from battlefield needs of the war in Southeast Asia. Like many new ideas, this one nearly succumbed in infancy. That the gunship eventually evolved into an effective and impressive weapon system was due mainly to a handful of men who early saw its potential and doggedly urged its adoption.

One of the strong proponents of the gunship idea was Ralph E. Flexman, an Assistant Chief Engineer with Bell Aerosystems Company, Buffalo, N.Y. In early 1962 he became intrigued with the problems of limited war and counterinsurgency operations. Bell had received several contracts to work on hardware associated with limited war, coincident with rising American involvement in the Vietnamese guerrilla war. From this focus of concern came a proposal for a gunship. On December 27, 1962, Flexman submitted to Dr. Gordon A. Eckstrand, Behavioral Sciences Laboratory, Wright-Patterson AFB, Ohio, several ideas that he and his Bell associates were working on. He wrote that:

> . . . with respect to aircraft, we believe that lateral firing, while making a pylon turn, will prove effective in controlling ground fire from many AA [antiaircraft] units. In theory at least, this should more than triple the efficiency of conventional aircraft on reconnaissance and destructive missions.[1]

Of course, the idea of firing a weapon from the side of an aircraft was not new. Swivel-mounted machineguns on World War I aircraft fired laterally at air and ground targets. In 1926–27, 1st Lt. Fred Nelson, a supervisor of one phase of an air training program at Brooks Field, San Antonio, Texas, successfully experimented with a DH-4, equipped with a fixed-mounted, side-firing .30-caliber machinegun. Nelson flew in a pylon turn, sighted through an aiming device on a wing strut, and scored accurate hits on a ground point marked with lime. In 1939 Capt. Carl J. Crane, recalling the Nelson exploits, proposed a side-firing pursuit aircraft in an Air Corps Tactical School thesis. The famed Flying Fortresses and Liberators of World War II relied on waist gunners to help ward off attacks of German and Japanese interceptors. Several C-47 transports of

the 443d Troop Carrier Group—in support of British Brigadier Orde Charles Wingate's operations against Japanese-held Burma—carried .50-caliber machineguns that fired from both sides of the aircraft.[2] These historical precedents, however, were largely forgotten.

The pylon turn harked back to the air races and flying training of early aviation. A unique recent use, however, stuck in Flexman's mind. He had read an account of a South American missionary, Nate Saint, who executed the maneuver with a long rope extending from the aircraft to the ground. This had permitted amazingly accurate delivery of mail and other objects to remote villages.[3] In addition, Flexman recalled his experiences as a flight instructor, when he had pivoted his plane over a fencepost and held the post in view at the tip of the wing. He therefore believed it reasonable that with a very small sight one could fire ammunition along the sight path to a target. All this pointed to possible counterinsurgency applications.[4]

Perhaps most influential to the development of Flexman's proposal was his contact with Gilmour Craig MacDonald of Ames, Iowa. In fact, this inventive and imaginative individual should be credited with the first formulation of the gunship concept. On April 27, 1942, as a first lieutenant in the 95th Coast Artillery (AA), he had suggested a way to increase the effectiveness of civilian aircraft on submarine patrol:

> With a view of providing means for continuous fire upon submarines forced to the surface, it is proposed that a fixed machine gun be mounted transversely in the aircraft so that by flying a continually banked circle the pilot may keep the underseacraft under continuous fire if necessary.

MacDonald further pointed out the advantage of the side-firing pylon-turn maneuver, in keeping the submarine crew from bringing its own antiaircraft guns into action. He contrasted this with the normal forward-firing aircraft, that might make one pass at the submarine, then lose precious minutes in positioning for another.[5] Nothing came of the proposal.

MacDonald wrote on May 2, 1945, to the Research and Development Service Sub-Office at Dover Army Air Base, Dover, Del., suggesting a transverse-firing T-59 Superbazooka be installed in a liaison-type aircraft. He visualized that a plane so armed, flying a pylon turn, could pin down enemy soldiers in their foxholes and strike tanks effectively. World War II was waning, however, and the proposal died.[6]

Sixteen years later, with President John F. Kennedy's new administration emphasizing counterinsurgency operations, MacDonald resurrected his old ideas. On September 14, 1961, he (then an Air Force lieutenant colonel) submitted a recommendation, "Transverse Firing of Rockets and Guns," to a Tactical Air Command (TAC) panel on limited war problems. To his way of thinking, lateral firing could offer some real benefits to spotter and liaison aircraft.[7] In a follow-up submission to the panel on September 19, 1961, he declared: "By flying a banked circle, the airplane can keep the gun pointed continuously at a target, and by flying

along with one wing low, limited longitudinal strafing can be done without worrying about pullout." His proposed project would "investigate launch, fire control, and ballistic problems," cost an estimated $100,000, last about six months, and take one hundred hours of test time on a liaison-type aircraft using the Eglin AFB, Fla., land and water ranges.[8] But again the MacDonald proposal failed to arouse a response.

During a reserve active duty tour in late 1961 at Eglin AFB, Ralph Flexman first met Gilmour MacDonald. From the latter he learned of MacDonald's proposal to the TAC Limited War Committee and of the flying missionary's feats.[9] Back at Bell Aerosystems, Flexman mulled over the pylon-turn/lateral-firing concept and introduced it at a Bell brainstorming session in late 1962.[10] This led to his letter to Dr. Eckstrand.

Flexman had concluded by April 16, 1963, that lateral firing from a pylon turn was definitely feasible. He reported to his Air Force professional colleagues the concept's advantages in limited war operations. Aircraft often lost guerrilla-war targets between first sighting and the time of the second pass. In contrast, an aircraft rolling immediately into a pylon turn could sweep a target with instant effective fire from a fixed aiming point. Flexman further foresaw that lateral fire from a low-flying, slow-speed aircraft could provide wider coverage, a high angle of fire, and a capability for pinning down enemy troops.

Nevertheless, the concept contained three major questionable areas: ballistics of the projectiles as they were fired and their dispersion, ability of the pilot to aim his lateral weapon and hold the target, and the reaction time necessary to change from straight-and-level flight to an on-pylon turn. Flexman suggested to Capt. John C. Simons that a test program examine these points and at the same time demonstrate the validity of the concept.[11]

Captain Simons had known Ralph Flexman for several years as a result of their mutual interests in aeronautically related human factors research. Flexman had sent him a copy of the 1962 letter containing the idea of a pylon-turning side-firing gunship. Additionally, Simons was familiar with the South American missionary's long-rope delivery techniques while flying a pylon turn.[12] Simons carefully weighed the informal proposal for testing, discussed it with Flexman by phone, and became an advocate.[13] He strongly supported the concept, viewing it as opening up a profitable new research area, and would "bet anyone a case of beer it will be much larger than 'lateral firing' as its only use."[14]

On April 26, 1963, Captain Simons forwarded Flexman's tentative test proposal to several offices of the Aerospace Medical Research Laboratory (AMRL) and Wright-Patterson AFB offices interested in limited war and counterinsurgency development.[15] Replies to this referral for comment and support, however, did not reflect Captain Simons' complete confidence in the concept. A May 8, 1963, response, for instance, named general areas needing investigation (reminiscent of Flexman's concerns): "What is the dispersion due to sighting wander? Under what conditions can a pilot sight a 'pop up' target and convert to an 'on pylon' attack against the target?"

Again, would the lateral gun firing be an "operationally useful technique" and would a gunner-operated waist gun have advantages over a pilot-aimed one? There was the suggestion some of the questions might be answered by using cameras rather than actual gunfire and by consulting on ballistic matters with Eglin AFB units.[16]

Meantime, one of Captain Simons' supervisors referred the concept to two different Aeronautical Systems Division (ASD) review boards of weapon and ballistics experts. Both boards evaluated the idea, raised serious doubts about the ballistics associated with side-fired weapons, then rejected the concept as technically unsound. This was in marked contrast to Flexman's position when he wrote Simons on April 16, 1963, commenting on questions involving the ballistics of laterally-fired weapons. He cited the published work of Dr. W. H. T. Loh, Associate Chief Engineer of Bell Aerosystems. Dr. Loh had developed equations that could be computer-programmed to define the trajectory of weapons fired from aircraft in an on-pylon turn. Flexman estimated that for about $200,000 a computer study would verify the concept's feasibility, provided the weapons used were of high muzzle velocity such as .30-caliber or above.[17]

Captain Simons firmly believed only an actual firing test would clear away all concern with ballistic problems. So in May 1963, he proposed to sidestep local flight-support requirements and request the United States Army Laboratory, Ft. Rucker, Ala., to determine the dispersal patterns of the side-firing guns. This effort collapsed, however, when supervisors told him he "should not get involved with the weapons aspect."[18] Even though success of the concept might hinge on live-firing test results, they considered dabbling in weapon trajectories as stretching a research psychologist's duties a bit too far.

Nevertheless, Captain Simons persisted in his search for support. An important factor was the encouragement of his immediate supervisor, Dr. Julian Christensen, who did not want to see the idea die without a test.[19] On May 20, 1963, Simons submitted to the Deputy for Engineering, ASD, a "Request for Support of Limited War Study." It proposed a nine-month study: six months to check dispersal patterns by sightings from an unarmed aircraft in an on-pylon maneuver; two months for testing a weapon mounted in a T-28 aircraft; and one month of operational analysis to weigh such factors as vulnerability, time-over-target, and ultimate design. Some of the groundwork for this request grew out of Simons' discussions with two interested pilots of the ASD office, Capts. J. D. Boren and J. A Birt. Already the proposed air-to-ground firing study bore the tentative nickname, "Project Tailchaser."[20]

Meanwhile, Captain Simons diligently pursued test arrangements. In June he prepared a flight-test plan for his branch to establish skill and display requirements and to develop sighting techniques. Rejection of the concept by the ASD review boards had seemingly blocked support from the flight-test section. Simons therefore sought permission to fly some of

the sighting tests in conjunction with other projects. One of his superiors gave him under-the-table approval for a few test flights.[21]

Later that same month, Simons flew a T-28 at Wright-Patterson AFB, accompanied by a test pilot Capt. Harley Johnson. He executed the pylon turn and visually tracked a target from the left cockpit window. A grease-penciled horizontal line on the glass served as a rudimentary sight. Target-tracking continued for ten minutes under varying lateral distance, airspeed (110–220 knots), altitude (500–3,000 feet), and pitch angle. On a second T-28 flight that took off after dusk, Simons found that by turning up the cockpit lights he could track a light on the ground with is makeshift sight.[22]

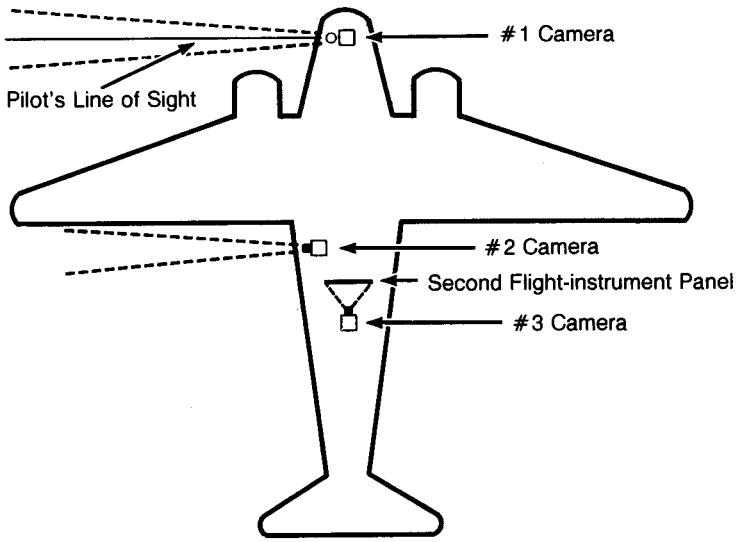
Both these flights added convincing evidence that an aircraft could track line, point, and area targets while in a pylon turn. A prime case in point was Captain Simons' holding a truck in the sight as the vehicle drove from a route parallel to the aircraft to one at right angles—a portent of the tracking that was to make the gunship justly famous. Simons observed that on-pylon tracking in low-speed aircraft was free of the "yaw rigidity and changing control forces" that often degrade the performance of high-speed planes. He marveled at the pylon turn's simplicity and the ease with which a target could be acquired and held in the sight.[23]

Near the end of June, Simons and Captain Boren flew a C-131 for three hours to check lateral-sighting techniques in a cargo aircraft. Flying low over southern Ohio, the pilot banked the aircraft about ten degrees and with rudder control followed a road, keeping it in view with the single horizontal line on the left-side cockpit window. Tracking this continuous target proved easy both from the standpoint of flying and sighting. Next the pilot singled out silos, barns, moving horses, and even fighting geese as point targets. The aircraft rolled into a pylon turn around the object selected. Finally, he changed the horizontal line on the window to a vertical one. This did not affect case of tracking but precise sighting along a line was lost. From this flight Simons concluded that cargo aircraft could acquire and keep targets in the sight during a pylon turn, and saturate them with assumed ballistic dispersion patterns.[24]

The first T-28 test flight had convinced Captain Simons that the concept's ballistic problems could be overcome. A ballistic expert agreed they might be ironed out provided there was a fixed-mounted gun.[25] Advocating ever more strongly the air-to-ground study. Simons started to improve the gunship apparatus. Working from Simons' suggestions, SSgt. Estell P. Bunch, also of the medical research laboratory, prepared the plans and supervised the fabrication of a holder into which gunsight reticles could be inserted.[26] Reticle designs included a horizontal line, a vertical line, concentric circles, a cross, and combinations of these.[27]

Plans to verify sight and gun alignments followed. In June 1963 one of the C-131Bs at Wright-Patterson was fitted with a new sight, mounted at the pilot's left cockpit window. The sight's optical axis was perpendicular to the aircraft's flight path. Next, three synchronized cameras were installed. One 16-mm motion-picture camera was positioned to record the sight

Camera Installation for Lateral Sighting



alignment. Another, in the cargo compartment back of the wing, aimed through a window where a gun might be positioned. A third camera was placed to photograph the special flight instrument panel in the cargo compartment. The panel showed altitude, airspeed, turn and bank, and attitude factors. From this test equipment Simons hoped to obtain enough data to plot pilot error involving altitude, line-of-sight distance, wind, indicated airspeed, and to secure realistic inputs for computing the firing geometry.[28] Later, a second version of a camera installation was prepared including one camera to record the pilot's sight alignment and three cameras to represent guns. This concept was presented to the Aeronautical Systems Division flight test organization but was delayed indefinitely because of lack of priority.

In July 1963 Captain Simons gave his supervisor a progress report on test flights and preparation of test equipment. He highlighted his success in tracking various targets and urged that the next step be turnover of the C–131 to ASD cargo flight-test personnel. Suggested test equipment was installed in this aircraft. Flexman believed two flights should supply ample data to analyze the essential firing functions before actual firing tests. Looking to the future, he foresaw ASD research into minimum and maximum tumbling characteristics of ammunition fired from the waist gun, the prospect of using the on-pylon technique for pickup and delivery, and possible use of a laser beam to designate targets, or side-looking infrared equipment to acquire night targets during the pylon turn.[29] That these three areas had significant development later establishes Simons as farsighted indeed.

As a fallout from the Simons proposal of May 20, 1963, a meeting was held on July 1. Attending were Captain Simons, Lt. Col. James L.

Hight and Captains Birt and Boren, the latter three from ASD's Directorate of Crew Subsystems Engineering. On July 3 this group officially supported testing the concept.[30] By August Captain Simons had the part-time services of Captains Birt and Boren to help set up sighting-definition flights. On October 28 a new flight-test plan changed Project Tailchaser from a lateral-firing to a lateral-sighting project because of resistance to the firing phase. The plan prescribed use of a C–131 and later a T–28 in flights from Wright-Patterson AFB, possibly Ft. Rucker, Ala., and Eglin AFB. Captain Boren became project manager, with Captains Birt and Simons and Sergeant Bunch designated engineers. Capt. Edwin J. Hatzenbuehler was named project pilot.[31]

The plan projected three hundred testing hours spread over one year. It allotted two weeks for installing test apparatus, followed by twenty-five flying hours in a C–131 to select targets, check out equipment, and develop pilot techniques. A second phase specified that flight-test pilots validate experimental designs and techniques. The final phase stipulated that a C–131 evaluate designs by tactical pilot subjects. After analysis of these C–131 flights, a T–28 would fly a pattern similar to the initial flight tests but keep adaptation to a particular counterinsurgency aircraft in mind. Flight tests were expected to include simulated firing passes at point, line, or area targets, and at varying altitudes and airspeeds. All tests were to be recorded on film.[32] At last it appeared a firm test plan was ready.

Heartened by the latest flight-test plan, Captain Simons reported to Ralph Flexman on November 13 that all test equipment had been installed in the C–131B aircraft and checked out. The first flight was set for November 15 but Simons cautioned that problems persisted—chief among them a need for funds to sustain a complete flight-test program.[33]

Crablike progress ensued and the C–131B camera test equipment stood idle. The part-time officers, Captains Birt and Boren, were recalled by their units for higher-priority duties. Project Tailchaser was virtually at the bottom of the list of priorities and was likely to stay there, in view of the increased attention given Vietnam-related counterinsurgency developments. Test flight were hard to arrange. In seven months the C–131B made just two flights and these were preliminary procedure checkouts.[34] Not a single actual or camera-verified firing test had taken place. People remained skeptical of the whole concept. Frustrations mounted with the seemingly endless delays.

With undimmed enthusiasm, Captain Simons, Sergeant Bunch, and other pioneers of the concept's early testing, remained convinced of Tailchaser's potential. On February 10, 1964, they were cheered by news from Captains Boren and Birt of a flight set for the near future, "hopefully in February." Technicians reinstalled the cameras (they had been removed from the C–131B) and boresighted them like guns.* Test pilots scanned aerial photos of Ohio's Clinton County seeking test targets. But over this

*A boresight line is an optical reference line used in harmonizing guns, rockets, or other weapon launchers.

activity loomed the priorities problem, a roadblock to the tests. At one point ASD returned the sighting-project files to the medical research laboratory, commenting the project deserved total attention of several people whom it could not provide and admitting "limited surveillance and informal management of the project" had fostered delays.[35] Again the planned flights failed to take place.

Finally a few flights were made in the summer of 1964. By this time, however, the press of his other duties forced Captain Simons to give up his gunship responsibilities. He picked 1st Lt. Edwin Sasaki, a fellow medical laboratory researcher interested in the project, to act in his stead as human performance engineer on the lateral-firing team.[36] In addition, the project pilot, Captain Hatzenbuehler, was replaced by Maj. Richard M. Gough and he in turn by Capt. Ronald W. Terry. Despite these changes, Simons kept up his interest in Project Tailchaser's development, reiterating that the concept's acceptance hinged on live-firing tests.[37]

The appearance of Captain Terry as a project pilot proved a propitious development. His personality projected a subtle blending of tact and tenacity, self-confidence and openness, intelligence and common sense, and, most significant for the progress of the gunship, an uncommonly convincing salesmanship. Also, his past mental conditioning made him keenly receptive to the gunship's possibilities. In the spring of 1963 he had served on an Air Force Systems Command (AFSC) team in South Vietnam. Its job was to assess problems in the field and suggest hardware developments to deal with them, the overall goal being a five-year development program to satisfy Southeast Asia requirements. The team probed for almost six weeks, visiting bases and talking with the men who worked alongside of and advised the South Vietnamese.[38] Combined with this firsthand knowledge was Terry's fighter pilot experience. He knew how hard it was to place ordnance on a target in bad weather, at night, and in tight tactical situations.[39]

Captain Terry first came across Project Tailchaser while perusing the files in Flight Test Operations at ASD. Obviously, the project had been dormant for some time. Yet as he read, Terry was intrigued by the potential of the idea for development and use in Vietnam. Disregarding the ballistic skeptics who branded the concept unworkable, he obtained permission to work on Tailchaser. Immersed in the project, Terry's interest heightened and he gained approval at several points to evaluate the idea further. Finally, he drafted a scenario for a tactical operation employing a side-firing weapon system, mainly in defense of hamlets and forts. He viewed this system as performing a policeman-on-the-corner or prowl-car role, prepared for anything and able to respond anywhere at most anytime. ASD's Limited War Office warmly welcomed the scenario and promised to sponsor it.[40] This achievement, together with Terry's first C-131 flight where he practiced lateral-firing techniques, fueled his enthusiasm.[41] He became primarily responsible for restoring momentum to the gunship idea.

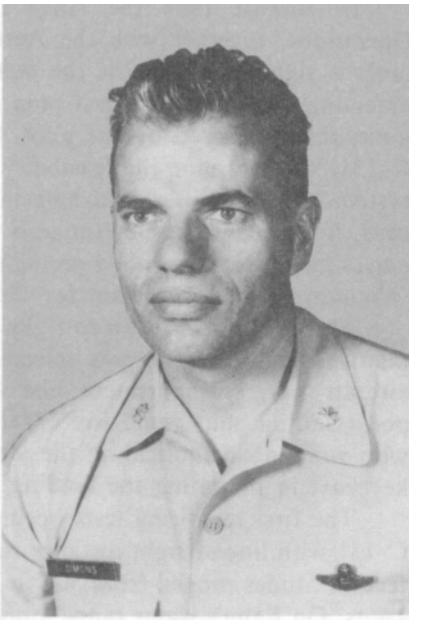
In August 1964 the ASD Limited War Office and Flight Test Operations, together with the Aerospace Medical Research Laboratory, took a significant step in the testing of the lateral-sighting study. An amendment to the flight-test plan specified that one or two small-caliber guns, remotely fired by the pilot, be installed in the cargo doorway of a C–131 "to determine the feasibility of firing guns with the lateral sighting system." Eglin AFB would help install the guns and conduct the ground tests, firing blanks to determine if the mounts could stand the recoil. The amendment also prescribed preflight boresighting and safety precautions.[42] Groundwork had been laid for the long-awaited firing test.

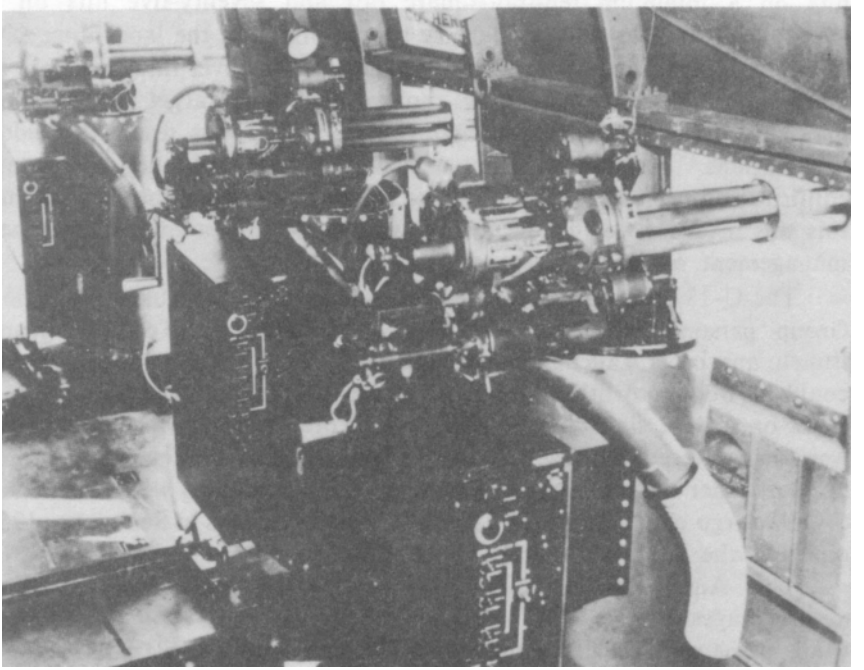
The C–131 was flown to Eglin to become the testbed for the firing. A relatively new weapon was selected and installed on the left side of the aircraft's cargo compartment. The General Electric SUU–11A, 7.62-mm gun pod (Gatling gun) could fire 6,000 rounds-per-minute.[43] Sergeant Bunch, who worked on fabricating the sight and other test equipment, played a key part in mounting the Gatling gun.[44]

The first live-firing tests occurred in late summer. The pilot flew the C–131 with line-of-sight distance to the target varying from 1,750 to 9,000 feet. Altitudes ranged from 500 to 3,000 feet and airspeed from 115 to 250 knots. On Eglin's water range a one-second firing burst scored twenty-five hits on a minimum ten-foot-square raft and seventy-five hits on a maximum fifty-foot-square one.[45] A testing phase on the land range saw twenty-five manikins scattered in different positions over three-quarters of an acre. A three-second firing run on this area target hit nineteen manikins, ten of them considered "killed."[46] The test results exceeded expectations.[47] As Captain Simons had long predicted, they adequately confirmed the concept's feasibility and convinced many of the skeptics that this was indeed a worthwhile weapon system. At this point ASD assumed management of the program.

The C–131 test results aroused the interest of 1st Combat Application Group personnel at Eglin AFB. They asked Captain Terry, Sergeant Bunch, and other Tailchaser crewmembers if a gun kit in side-firing mode could be built into other aircraft. Specifically, they wanted to modify a C–47 or C–123, since Air Force Special Forces units in South Vietnam were using these aircraft.[48] Captain Terry jumped at this opportunity, and in short order three of the Gatling guns (called miniguns) were installed in a C–47 cargo compartment.[49] The C–47 side-firing tests in September 1964 repeated the successes of the C–131 tests.

The Air Force carefully weighed the combat advantages and disadvantages of this C–47 with laterally-firing guns. The aircraft was available as were the crews to fly it. The plane could carry a large volume of ammunition and flares and could be used for cargo, troop, and reconnaissance missions. It possessed two-engine safety, long alert capability, lengthy time-over-target, and the capability to loiter for flaredropping. In flight the crew could select ordnance; choose varied





Top left: Lt. Col. Ronald W. Terry.

Top right: Lt. Col. John C. Simons.

Bottom: SUU-11A Gatling (miniguns).

weapon dispersion patterns; arm, disarm, maintain, and repair weapons; and carry out immediate bomb damage assessment (BDA).* Some of these things any slow-mover could do, others only could be done in large cabin aircraft.[50] Admittedly one major disadvantage did exist—the C–47's vulnerability to ground fire and aerial intercept. Critics swiftly seized upon this weakness and argued that it was formidable enough to cancel out all the aircraft's advantages and nullify its usefulness.

Captain Terry was articulate in pointing up the advantages of the side-armed C–47 in a Vietnam-like setting. He considered the Gooney Bird a Johnny-on-the-spot that could cover a hamlet with continuous fire, holding off the enemy until arrival of additional air or ground support. Terry knew his fighter operations and pictured the serious problem of precise ordnance delivery in tight situations involving rugged terrain, bad weather, night flying, hard-to-detect targets, and exact location of friendly forces. The fighter pilot relied mainly on a forward air controller (FAC) for target acquisition and location of friendly forces. Once on his own, the pilot faced a sea of green jungle that often thwarted his efforts to acquire or reacquire targets.[51]

On the other hand, the C–47 could fly over the terrain and spot friendly forces and the probable location of the enemy. Then, after acquiring and locking on a target in a pylon turn it could deliver continuous fire with the near-surgical precision of artillery. If the first bursts missed the target, instructions quickly furnished by an observer on the ground or in the aircraft put the fire on the mark. Moreover, the accuracy of the side-firing miniguns allowed wider discretion in attacking within basically friendly territory. In contrast, use of napalm, bombs, and rockets could, and did break up attacks on hamlets but might require an aid program later to rebuild these same villages.[52] As to the C–47's vulnerability, Captain Terry felt the aircraft could be effective flying above the range of small-arms fire expected in South Vietnam. Certainly it should be less vulnerable than the helicopters already being used extensively as gunships. Arguments on the gunship went on in a similar vein at various Air Force command levels.

Captain Terry kept talking to different people about the potential of the modified C–47 and briefings moved steadily up the command chain. These efforts culminated with a presentation on November 2, 1964, by Captain Terry and Lieutenant Sasaki to Gen. Curtis E. LeMay, Air Force Chief of Staff, and other Air Staff members. General LeMay reacted favorably and directed that a team go to Vietnam, modify a C–47 and test it in combat.†

*This term encompasses the determination of the effect of all air attacks on targets (e.g., bombs, rockets, or strafe); also referred to as "*battle* damage assessment."

† Later General LeMay spoke of gunships with less favor: "It's not a very good platform and you can't carry the load. You don't have the range, staying capacity, or anything else. They're too vulnerable both on the ground and in the air." Despite these sentiments the General was the one who first committed the Air Force to the aircraft. [Intvw Dr. Thomas G. Belden, Chief Historian, Ofc/AF Hist, with Gen. Curtis E. LeMay, March 29, 1972.]

Six miniguns were also to be installed in aircraft there. Sergeant Bunch's projected assignment to Turkey was deferred while he prepared another gunsight for the test.[53] The administrative machine moved to high gear to support the overseas combat test.

At this time American concern over Vietnam mounted, as South Vietnamese ability to repel Viet Cong (VC) and North Vietnamese attacks appeared to be deteriorating rapidly. By the spring of 1964 the initiative had passed to the communists; 200 of 2,500 villages lay in enemy hands, and "incidents" surged to 1,800 per month. South Vietnamese forces faced serious recruiting problems. Troop morale was low, losses of weapons and desertions were high.

Increased Viet Cong activity in the Mekong River Delta area climaxed with a major defeat of the South Vietnamese in July 1964. In August the Tonkin Gulf incident and attacks on U.S. facilities deepened American concern and involvement. On the night of October 31/November 1 the Viet Cong attacked Bien Hoa AB, inflicted serious damage, and cast serious doubt on airbase security. Seven U.S. and Vietnamese Air Force (VNAF) aircraft were destroyed, sixteen U.S. and two VNAF aircraft damaged. In addition, the political turmoil in Saigon grew.[54] These events generated a need for greater U.S. aid and air power if the country was to be saved. In beefing up Vietnam units, the Air Force eagerly sought new ways to bolster counterinsurgency operations.[55]

The Air Staff prepared the way for the C–47 combat tests by telling the Commander in Chief, Pacific Air Forces (CINCPACAF) of the side-firing aircraft's advantages. The plane could loiter around targets, change firing patterns, correct malfunctions in flight, and deliver great quantities of ordnance accurately on the target. While best fitted for night and counter-insurgency operations, its great slant range* might enable it to strike targets on steep mountain slopes or in other previously inaccessible spots.[56]

CINCPACAF notified both the Commander in Chief, Pacific Command (CINCPAC) and the Commander, United States Military Assistance Command, Vietnam (COMUSMACV). The latter requested the program be stepped up, estimating that effective test and evaluation should take from sixty to ninety days.[57] On November 12, 1964, Lt. Gen. James Ferguson, Air Force Deputy Chief of Staff for Research and Development, wrote to Maj. Gen. Joseph H. Moore, Jr., 2d Air Division commander in Vietnam. He asked General Moore to personally evaluate the system, chiefly from the standpoint of its value on night missions. He added that tests at Eglin had shown it "highly effective against troops in wooded terrain," and stressed that the upcoming C–47 test and 7.62-mm minigun evaluation reflected the swing of research and development (R&D) application to counterinsurgency requirements.[58]

The testing decision posed a dilemma to the Air Staff for it had begun to oppose unrestricted evaluation of equipment in South Vietnam. The

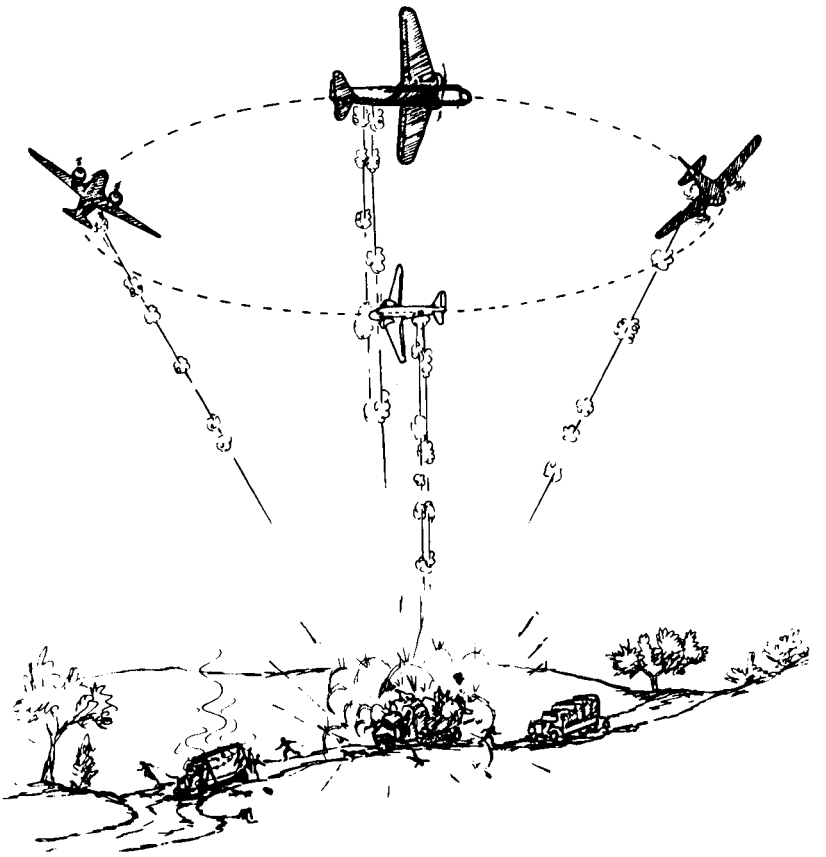
*Slant range: the line-of-sight distance between two points not at the same elevation.

Streams of tracer fire pour on an illuminated target from a circling C-47.

opposition sprang mainly from a feeling that the U.S. Army had used such tests to support its case on service roles and missions. Nevertheless, the gunship needed some kind of combat trial to prove its validity. The Air Staff therefore steered a middle course by considering the gunship a "unique" R&D item to be closely controlled as to roles and missions controversies.[59] It told the Military Assistance Command, Vietnam (MACV) that interest in the gunship test was primarily on "operational use of this equipment in RVN [Republic of Vietnam] rather than a test of the equipment."[60] Walking this fine line between operational and hardware evaluation would not be easy.

Meanwhile, Gen. Walter C. Sweeney, Jr., head of the Tactical Air Command, doubted that the gunship could survive the gunfire expected in Vietnam and fulfill its mission. He flatly said, "This concept will place a highly vulnerable aircraft in a battlefield environment in which I believe the results will not compensate for the losses of Air Force personnel and aircraft." He further saw a successful gunship test weakening the Air Force in its battle with the Army over use of helicopters in offensive fire-support

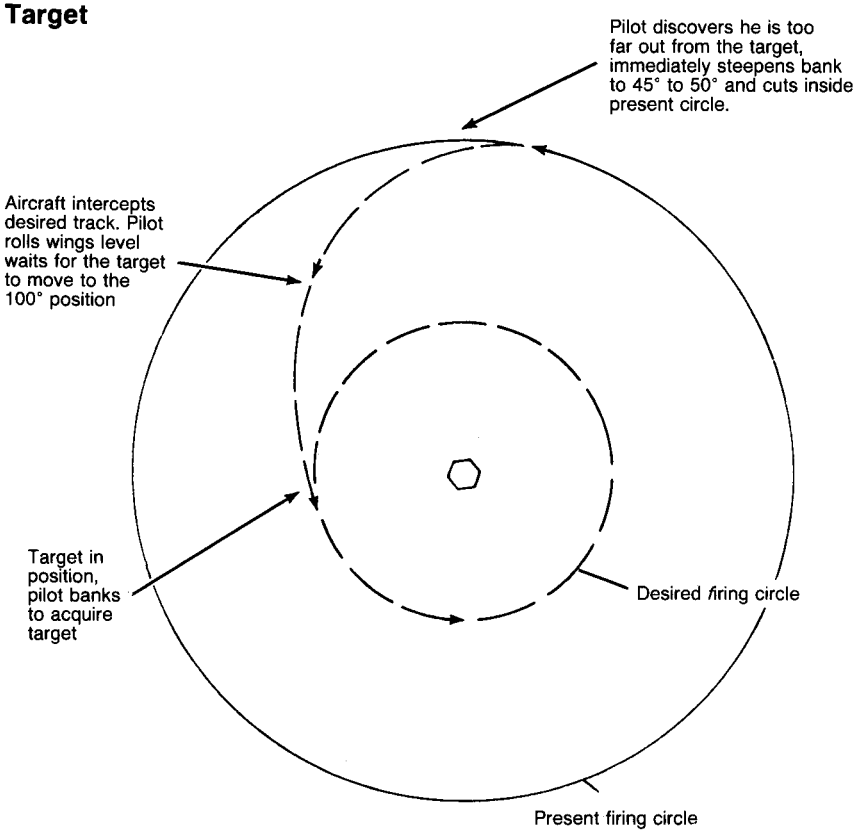
Basic Gunship Principle



missions. Conceivably, it might encourage the Army to use transports in a ground-support role. What's more, if the gunship was made a permanent weapon system, its use might be "disastrous in some future conflict." [He seemingly had in mind a more conventional war such as a North Atlantic Treaty Organization (NATO)-Soviet conflict in Europe.] General Sweeney could only conclude " . . . we should continue to vigorously oppose the offensive . . . employment of all such highly vulnerable aircraft."[61] His criticism presaged an enduring opposition among many people in the Tactical Air Command. Significantly, TAC was the command charged with employing the gunship!

The Air Force Chief of Staff rejected the TAC commander's position on gunships. Gen. John P. McConnell, Vice Chief of Staff, explained the Air Force position to General Sweeney. He pointed out that the side-firing C-47 was to be evaluated for specific counterinsurgency missions, and gave

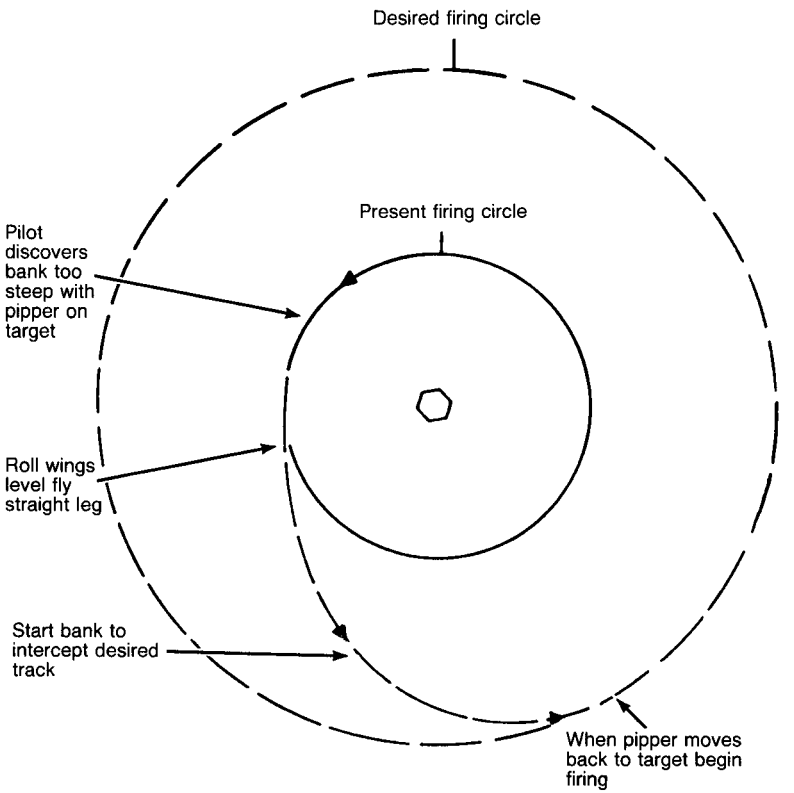
Procedure To Decrease Lateral Distance to Target



every appearance of being well suited for the Southeast Asian environment. He accented the gunship's anticipated role of defending hamlets and outposts under night attack. Thus he indirectly fingered an alarming weakness in tactical air's night operation capabilities and strike aircraft responsiveness. There were too few strike aircraft for airborne alert. Furthermore, those on ground alert could not react quickly enough to prevent the enemy from overrunning outposts and villages. At least the armed C–47 might be able to hold off the enemy until strike aircraft arrived. General McConnell admitted the survivability problem of transport aircraft but deemed it most desirable to test the concept in counterinsurgency situations.[62]

The test team headed by Captain Terry arrived in South Vietnam on December 2, 1964. Gun kits for modifying two C–47s, gunsights, and ammunition arrived on December 9.[63] Bien Hoa Air Base, near Saigon, became the staging base since it was the center of C–47 operations. As personnel and equipment arrived, the whole operation fell under the

Procedure To Increase Lateral Distance to Target



supervision of the Joint Research and Test Activity (JRATA).*[64] In quick order the team installed the gunsight (a converted 16-mm camera reflex viewfinder with cross-hair reticle),[65] guns, and other ancillary equipment in C-47s made available.[66] The team had modified the first aircraft by December 11, the second by December 15, but did not modify the third because two guns had failed during early operation of the first aircraft.[67] Simple, reliable, manually-operated flare dispensers for night tests were installed in the cargo-compartment doors. These modified aircraft were first known officially as FC-47s due to their tactical role and for want of a better designation.[68]

Captain Terry set about introducing the gunship concept to the C-47 crews assigned to the project from the 1st Air Commando Squadron

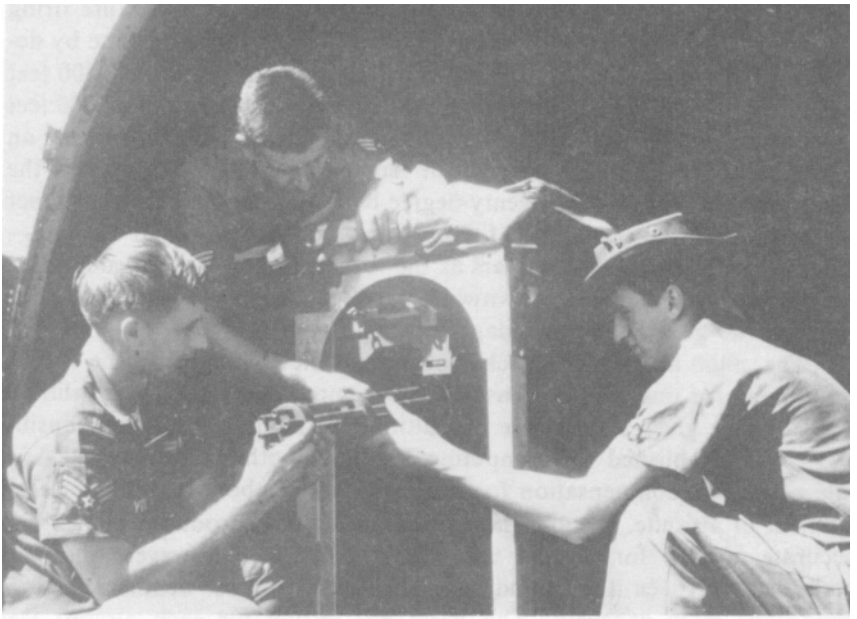
*In February 1964 the Joint Chiefs of Staff ordered all Vietnam research and test agencies combined in one command. COMUSMACV therefore established JRATA on April 23, 1964, consisting of representatives from the U.S. Army, the Air Force, and Office of the Secretary of Defense/Advanced Research Project Agency. The Commander, JRATA, advised COMUSMACV on research development, testing, and evaluation.

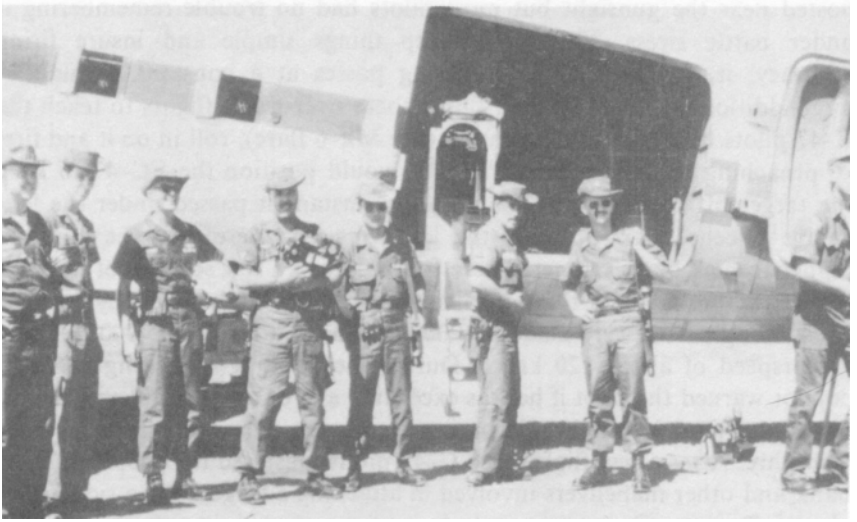
(ACSq).[69] He especially stressed boresighting the miniguns because firing was anticipated near friendly troops. Rough boresighting was done by depressing the guns about 10 degrees and aiming at a target some 2,500 feet away. For inflight boresighting the pilot flew a 20-degree bank at 2,000 feet above mean sea level around a flare dropped in the sea. After making an approximate setting in the gunsight he flew parallel to the direction of the flare's smoke. While in the twenty-degree bank he kept the gunsight pipper on the head of the smoke and fired a three-second burst from one gun—watching with the other observers as the rounds kicked up the water. Next he executed upwind and downwind passes to negate wind effect, then adjusted the gunsight for windage.[70]

The pilot also made checks for proper elevation, using the setting determined for one gun to adjust the other guns. This setting was valid for only a single given slant range. An altitude to angle-of-bank relationship had to be established for computing settings of other slant ranges. As a rule of thumb, compensation for range was set at about ten mils for each 500 feet of altitude. In sum, these boresighting tests produced mil settings accurate enough for tactical use. Above 2,500 feet, however, observers could scarcely see the rounds hit the water unless weather and sea conditions were excellent. The basic mil setting for each aircraft was posted near the gunsight but most pilots had no trouble remembering it under battle stress. Finally, to keep things simple and insure firing accuracy, it was decided to fly firing passes at a constant altitude.[71]

Additionally, Captain Terry used these over-water flights to teach the C–47 pilots how to acquire a target (the Mk–6 flare), roll in on it and fire. Approaching the target area the pilot would position the FC–47 to keep the target off the left wing, banking the instant it passed under the left-engine nacelle. This dropped the left wing and permitted the gunsight pipper to pick up the target. There followed just a few seconds of tracking before the pilot fired a three- to five-second burst while in the pylon turn. Most firing passes were made at 3,000 feet, a slant range of 5,000 feet, and an airspeed of about 120 knots. During the tracking and firing pass, the copilot warned the pilot if he was exceeding any of these established limits. If so, the pass would be discontinued at once. The training progressed smoothly. After a few flights, the C–47 pilots mastered the proper angle of bank and other maneuvers involved in attacking a target with a side-armed aircraft.[72]

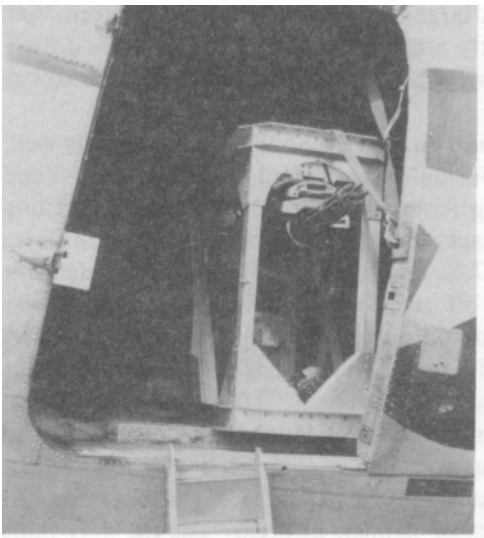
The FC–47 carried a crew of seven Air Force personnel plus one Vietnamese observer. The pilot (aircraft commander) fired the guns while controlling the aircraft as the copilot monitored instruments and coordinated crew activities. A flight mechanic kept an eye on the various aircraft systems. The navigator checked the aircraft's position, and in the target area worked with the Vietnamese observer to verify target information and establish liaison with ground forces. Two gunners were assigned to load and troubleshoot inflight operations of the miniguns. A loadmaster armed and dropped flares from the rear cargo door.[73]

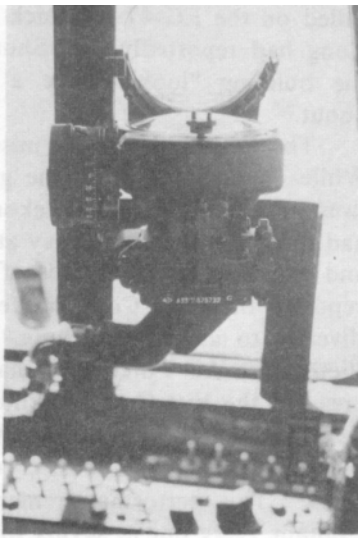


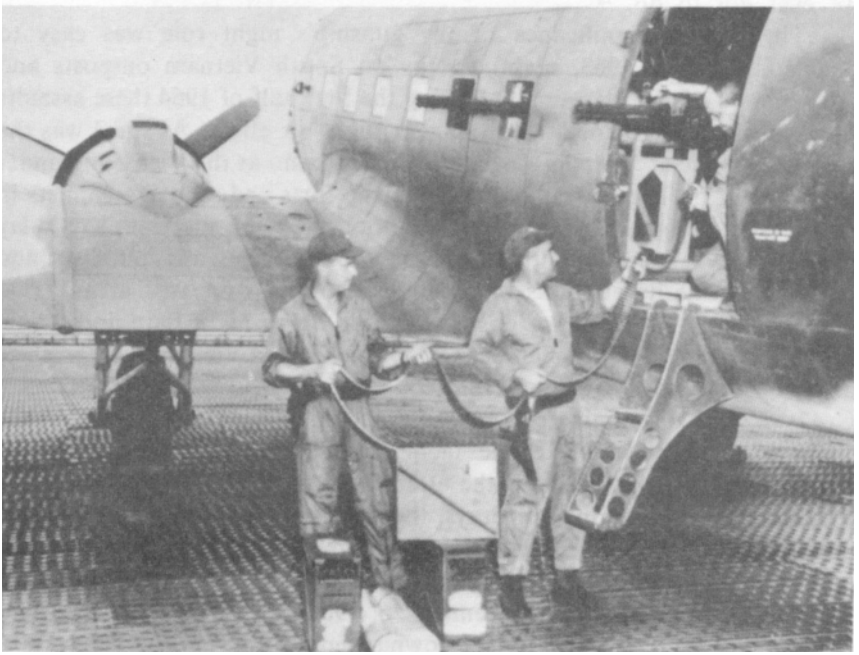


P. 18 (top): Installing minigun in AC-47; bottom: Members of one of the first AC-47 teams.

P. 19 (top left): A 7.62 minigun in the doorway of an AC-47; top right: AC-47 gunsight mounted at the left side of cockpit; bottom: Loading ammunition into a Spooky.







Additional observers frequently accompanied this crew during the test and evaluation period.

The FC-47 flew the first of several day combat missions on December 15, 1964.[74] On this sortie Captain Terry and the crew worked with a forward air controller, seeking targets of opportunity and trying to become familiar with counterinsurgency operations and theater rules of engagements.[75] The gunship fired accurately on enemy sampans, buildings, trails, and suspected jungle staging areas. On the afternoon of December 21, an FAC called on the FC-47 to attack a large structure into which fourteen Viet Cong had reportedly run. Shortly after the strike, friendly forces found the building "looking like a sieve" and twenty-one bodies scattered about.[76]

The FC-47's first night mission on December 23/24 went equally well. While on airborne alert, the gunship was directed toward Thanh Yend (west of Can Tho in the Mekong River Delta area), where the Viet Cong had the outpost under heavy attack. The FC-47 dropped seventeen flares and expended 4,500 rounds of 7.62 ammunition. The outpost defenders reported the Viet Cong broke off their assault. Next the aircraft was diverted to aid Trung Hung, an outpost twenty miles farther west. A Vietnamese Air Force C-47 had already dropped seventy flares over the area but the Viet Cong continued their onslaught. The gunship used eight flares and 4,500 rounds of ammunition. Trung Hung defenders announced that the Viet Cong offensive ceased with the first burst of fire from the skies.[77] This performance marked the FC-47 as a night operator. As Captain Terry put it, saving forts or hamlets at night "was the only thing we ever got to do."[78]

The sudden significance of the gunship's night role was easy to understand. Since 1963, night attacks on South Vietnam outposts and hamlets had soared alarmingly. During the first half of 1964 these assaults spotlighted the need for a much greater night air effort. At stake was the entire Republic of Vietnam's pacification program, as the Viet Cong under the cover of darkness assaulted and overran forts and strategic hamlets in government-designated "safe areas." Continued enemy successes would lay bare the RVN's incapability to protect these villages and outposts and effectively stifle its attempts to reestablish control over vast areas.[79]

June 1963 saw a sharp upswing in Air Force night flare and strike-support missions.[80] By September C-123s had joined Vietnamese flareships on airborne alert.[81] No longer did the mere dispensing of flares from a C-47 or C-123 intimidate the enemy in night attacks.[82] Now the Viet Cong adopted more aggressive tactics. When the flareship (or attack aircraft) arrived, they stopped the attack only to renew it when the plane left. After these softening-up forays, the fort or village would be overrun.[83] Small wonder the Air Force hurried the gunship into night operations, putting it on airborne alert to compensate for its slow reaction speed and to enlarge its coverage. By December 26, 1964—eleven days after its first combat mission—the gunship had flown seven training and sixteen combat

sorties, expending 179,710 rounds and experiencing thirty-three malfunctions.[84]

Brig. Gen. John K. Boles, Jr., USA, Director of the Joint Research and Test Activity, flew as observer on the gunship mission of December 28. Captain Terry piloted the FC–47 to Ngai Giao, a district capital thirty-seven miles from Bien Hoa. The Viet Cong were attacking the town and its fort. Arriving over the area at 2030, the aircraft found each corner of the small triangular fort outlined with flarepots and designated by a fire arrow.* The gunship dropped Mk–6 flares and swept the embattled fort's perimeter with gunfire. To prolong support Captain Terry fired the guns singly. In more than one hour and twenty minutes, eighteen flares were dropped and seven thousand rounds fired—the miniguns were reloaded once.[85] Viet Cong tracer fire failed to hit the gunship. General Boles noted: "At the end of the mission the personnel at the post reported that due to the air support the VC attack had been broken off and they were extremely grateful for this support."[86] As the aircraft departed Ngai Giao for its orbiting station over Saigon, the crew reloaded the guns. At about 2230 the FC–47 was directed to support another outpost, but the Viet Cong ended the assault before the aircraft could fire a shot. At midnight this airborne alert mission ended. It had demonstrated once more the gunship's unique capability in night operations.

A still more dramatic demonstration of gunship power unfolded on the night of February 8, 1965. The aircraft was sent to the Bong Son area to help blunt a Viet Cong offensive in the Vietnamese highlands. From 1850 to 2310 the miniguns blazed, pouring 20,500 rounds onto a hilltop where the enemy had dug in. This strike killed about three hundred Viet Cong.[87]

Gunship techniques were essentially the same in day and night operations with adjustments to accommodate flares. Few targets, for example, required a lateral pass (flying parallel to a target). Hence the pilot attacked in a pylon turn and returned to "his most advantageous flare drop position in a minimum of time."[88] Nonetheless, night operations did disclose problems. General Boles highlighted one—dropped flares started fires in woods, rice stacks, or houses. He cited the Ngai Giao support mission with six or eight confusing fires started near flare markers on the corners of the fort. This made it difficult for the gunship crew to find the fort as operations progressed, and location might have become impossible had one of the fort's corner flares burned out. General Boles suggested that Tiara† replace flares for marking enemy targets and use of an airborne floodlight be considered.[89]

*The fire arrow could be made of many materials; metal gas cans filled with gasoline-soaked sand were often used. Ignited, it was easy to see at night. Hamlet defenders relayed to strike aircraft the enemy's position with reference to the fire arrow.

†Nickname for a chemiluminescent material which the Army tested for possible use in bombs or mortar projectiles. When released in the air, Tiara glowed rather than flamed and gave off little light. It worked poorly in humid and hot weather. For these reasons the Army did not put Tiara in bombs or other projectiles.

In response to General Boles' suggestion, the Air Force mounted a large searchlight in the doorway of an unarmed C–47 and tested it. From the normal operating altitude of 3,000 feet above ground level the searchlight's intensity was too weak on the ground for easy target identification. With the C–47 simulating the gunship, tests showed the searchlight when fixed-mounted for level flight lost effectiveness as the plane banked to fire. If aligned with the gunsight, it likewise detected few targets. Seemingly, the best answer would be to install an improved lighting system in a separate aircraft which would work with the gunship.[90]

While the Air Force sought an effective airborne lighting system, the gunship relied on flares for illumination. The most commonly used flare, the Mk–24 Mod 3, could illuminate an area with two-million candle-power for three minutes. The Mk–24 would not completely burn out in the air if released below 2,500 feet. Most crews therefore dropped it at 3,000 feet on a crosswind heading upwind from the suspected target. After dropping the flare the pilot held the same heading for fifteen seconds, meanwhile trying to avoid having the gunship illuminated with its own flares and attracting ground fire. This interval also gave the flares time to ignite and permitted the pilot to survey the area before executing a pylon turn and acquiring the target. An attack technique evolved whereby the pilot would dip the left wing, fire, level out, dip the left wing again, fire, and level out again. After two to four firings and 2½ to 3 minutes, the pilot would have returned to the original flaredrop position. Then by dropping more flares, constant illumination could be maintained over the target area. At times the flares alone discouraged enemy night attacks or halted those in progress.[91]

Two or three flights were usually required to check out the pilot and other gunship crew members in combined flare and firing operations. This presupposed, however, a crew experienced in day firing and night flare drops. The dive, bank, and climbing-turn maneuver was quickly discarded as too complex and not needed. Its varying air speed and angle of bank proved far more dangerous at night than the pylon turn and hampered target acquisition and firing accuracy as well.[92] Most of these gunship test missions were flown over the flat Mekong River Delta area where terrain problems were few.[93]

The gunship fired tracer ammunition on night missions to see where the minigun rounds were hitting. The gun's rapid fire appeared as tongues of flame spewing from the black sky accompanied by a distinctive sound. An impressive sight, it boosted the morale of fort and hamlet defenders but terrorized the enemy. It didn't take long for the FC–47 to earn the nicknames of "Puff, the Magic Dragon" and "dragonship."*

FC–47 missions, particularly night ones, highlighted the language difficulties and equipment problems in air-to-ground communication.

*Stories differ on the nickname's origin. Captain Terry believed it derived from a mix of 1964 being the Chinese Year of the Dragon, stories from captured enemy prisoners about tongues of fire from the gunship and recollections of the fairy tale, *Puff the Magic Dragon.* Others trace its origin to the children's song, popular in late 1964, regarding a magic dragon.

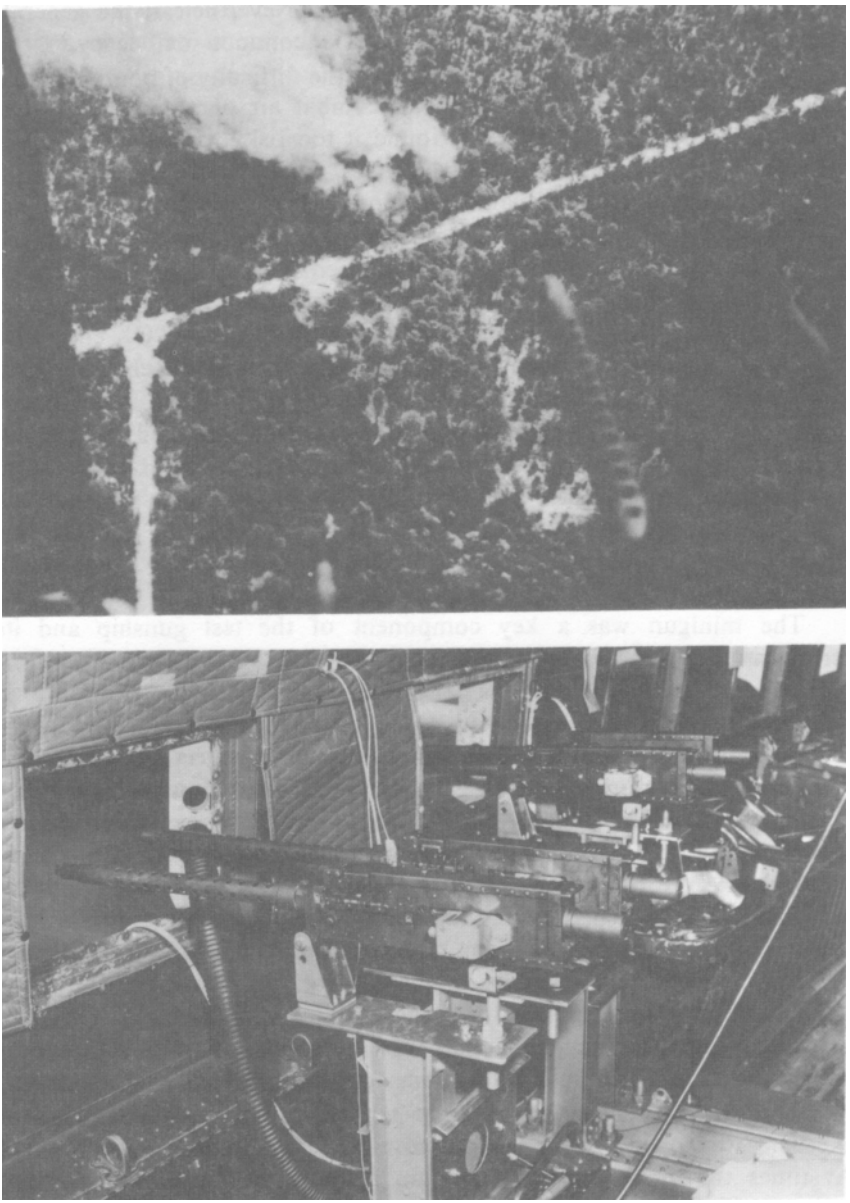
Adequate communication was crucial to precision firing during close support of a besieged post. Few American advisors were in the many forts and villages. Most contact was therefore with Vietnamese and the gunship carried a Vietnamese observer to facilitate conversations. The navigator's task was to determine what support the ground personnel needed. To eliminate confusion this sometimes involved a painstaking exchange of notes with the observer. General Boles considered the Ngai Giao mission of December 28 "quite successful in that the communications worked fine and the man on the ground was able to speak and be understood by us and by our Vietnamese Air Force officer aboard." Nevertheless, the general noted that inadequate communication was a common deficiency.[94]

Additionally, the gunship test accented the difficulty of bomb damage assessment, a problem common to all combat air operations in South Vietnam. Ground teams frequently found it too risky to penetrate enemy territory to assess results of an FC–47 attack. Furthermore, the Viet Cong carefully removed their casualties under cover of darkness. Having no BDA capability of their own, the gunship crew turned to the man on the ground who had to report what had happened. Playback on the aircraft's tape recorder produced little more than "number one"; "more, more, same thing"; "good shooting"; until that sure indicator of success "OK enemy go away now" was heard. Added to this was a trickle of intelligence on some strikes that filtered to the test team via American advisors. Despite this dearth of BDA detail, the gunship attacks did keep forts and villages out of enemy hands.[95] General McConnell and other top Air Staff members had followed the combat test with intense interest. Even without the specifics, they warmly greeted the FC–47's tactical success and foresaw its efficiency in outpost defense, freeing fighters from some night commitments.[96]

The minigun was a key component of the test gunship and its performance was closely evaluated in combat operations. The final evaluation report on the gun was not published until February 1965. But in late January, Headquarters, Pacific Air Forces (PACAF) notified Air Force headquarters it had ample information and could project the number of pods needed for future operations. It said the tests had shown the pod "easy to load, maintain, and capable of quick turn-around." The malfunction rate was low and the maintenance personnel needed no extensive special training. PACAF concluded that "a high degree of accuracy and reliability has been demonstrated," making the minigun an effective weapon for both day and night missions in Vietnam. It requested 126 guns to equip up to fifty aircraft.[97] The Air Staff had been pressing for this figure because of an established one-year lead time for procurement.[98] It notified PACAF a few days later that procurement action was under way, with a $4.3 million authorization in fiscal year 1965 funds for the first eighty-two guns.[99]

The Air Force test team's final report considered the minigun an excellent weapon for the side-firing aircraft but not entirely trouble free. At times the locking lug on the gun rotor service would break. This

Top: Machinegun-equipped gunship attacks target; bottom: .30-caliber machinegun in early AC-47.



allowed the gun to overspend because no provisions were incorporated to interrupt power when all ammunition had been expended. Life of the gun was thereby reduced. There was also a need for greater cooling of the gun. The report recommended modifications to correct these deficiencies and develop a more compact and accessible pod.[100]

While the combat tests failed to silence critics who deemed the gunship vulnerable to ground fire, they did demonstrate the FC-47's capability to operate in South Vietnam at the 1965 counterinsurgency level. During the missions the aircraft met with small-arms fire (mostly .30-caliber) but took few hits. Due to the gunship's orbiting altitude most of the rounds arrived nearly spent. In one case a round penetrated the cabin, hit the navigator in the heel, but caused no injury.[101] Such incidents were enough, however, to generate recommendations for armor to protect the FC-47 during close-range strike operations. The test team's report concluded that the gunship could hit the majority of targets yet be relatively invulnerable to ground fire.[102]

Commanders found it unnecessary to await completion of the combat evaluation before charting the gunship's future course. Interim test results so intrigued General Moore, 2d Air Division commander, that he asked for a squadron of FC-47s as quickly as possible.[103] On February 23, 1965, General Ferguson, then serving as Commander, Air Force Systems Command, strongly seconded the request to Air Force headquarters. He noted that:

> . . . the reports which have been received indicate spectacular success in killing Viet Cong and in stopping attacks together with concurrent great psychological factor way out of proportion to effectiveness of other aircraft strike efforts and ground force efforts.[104]

Ferguson urged prompt production of gunpods and planning for conversion of a better transport aircraft to a gunship. He called for a "highest Air Force and Department of Defense level" review, so that every possible channel can be cut in producing this needed capability.[105] On March 2 the Air Staff requested the PACAF commander's requirement for gunships, stressing the special significance of the associated minigun requirement.[106] Study of the type and extent of the gunship force had begun.

The Air Force test team's report noted that the FC-47's size kept it from realizing its full potential in night strike operations. For future gunships, the report recommended an aircraft having more cargo compartment space and greater payload.[107] A PACAF capabilities study of March 12, 1965, suggested the Air Force use the C-131 (or its T-29 counterpart) as the gunship airframe and that a squadron of sixteen aircraft be sent to South Vietnam. On March 20 the PACAF commander proposed adopting the C-131 for its advantage of speed and double payload over the aging C-47.[108] After reviewing the test team's and PACAF's recommendations, the Air Staff ordered a feasibility study on April 20 to weigh these recommendations against the availability of aircraft.[109] On May 12 the Air Staff decided to utilize the C-47 as the

gunship for Southeast Asia.[110] No serious questions were raised regarding the suggested size of the gunship force.

On June 18 PACAF formally proposed a sixteen-plane FC–47 squadron to Air Force headquarters. Foreseeing difficulties in minigun production, the proposal specified four C–47s should be modified with .30-caliber machineguns at once. The twelve minigun-equipped aircraft were to follow as soon as possible. When their supply permitted, miniguns would replace the interim .30-caliber guns. Aircraft, aircrew, support personnel, and equipment were to be provided in one package from outside PACAF. Of the 329 personnel (79 officers and 250 airmen) projected, about one-fourth were to be in place for the first four gunships. Upon Air Staff approval of this proposal, PACAF would seek CINCPAC and COMUSMACV concurrence in the deployment.[111] On July 13, 1965, Air Force headquarters directed that a gunship squadron be sent to South Vietnam, the move to be completed by November 9.[112]

After the Air Force completed FC–47 combat testing and the study of a future gunship force, many essential items fell into place. Operational tactics were defined, problem areas pinpointed, the need for the gunship capability established, available airframes and equipment determined (the minigun remaining a trouble spot), and the first gunship squadron ordered deployed. A new weapon system moved into the Air Force inventory.[113]

In retrospect, several significant points of the gunship's early history stand out. One thread throughout the entire story of gunship development is the part played by improvisation. Captain Simons first tested the concept in the old T–28 and later in the C–131. Combat evaluation took place in the C–47, one of the oldest planes in the Air Force. A camera viewfinder initially served as the gunsight. The miniguns, although new, just happened to be available at Eglin Air Force Base where the gunship tests were held. Assembling gunship components was largely a matter of tapping local shop resources and ingenuity. Improvisations seemed endless and contrasted sharply with the long slow stages of engineering, test, and manufacturing required for most modern weapon systems. Likewise, the gunship tactic of side firing from the pylon turn synthesized old aerial maneuvers and weaponry ideas. This make-do-with-what-you've got attitude gave the gunship system rare economy and availability that would continue to spur its future evolution and sophisticated development.

A related factor was the tortuous path the side-firing concept traveled before being accepted as a valid basis for a combat weapon. At several critical junctures the proposal almost died. It faced bureaucratic oblivion, burial in government files, rejection by ballistic experts, plus the usual delaying problems of time, manpower, and money. Some critics doubted an aircraft employing the concept could survive in combat, and some believed the idea violated Air Force doctrine. Only the dogged persistence of key individuals enabled the concept to emerge from such a deadly thicket.

The role of four imaginative and determined men was outstanding. Most Air Force developments involve team effort with credit for improvements and changes broadly shared. The gunship was no exception. Nevertheless, in evaluating the gunship's origin, one is struck with the singular results produced by MacDonald, Flexman, Simons, and Terry. Each of these men focused on problems of counterinsurgency warfare. Each studied the Vietnam war with intense interest and saw new combat challenges. Each pushed the gunship concept to help meet counterinsurgency requirements after he discovered that current Air Force aircraft, tactics, and weapons could not. MacDonald's inventive mind seized upon the old pylon turn, merged it with a laterally-fired weapon, and introduced a new concept. Flexman pursued and transmitted the idea, stressing all the while its value in the Vietnam war. A pilot in three wars, Simons recognized the problems in placing munitions on targets with the precision called for in guerrilla warfare. Since the side-firing aircraft could help attain this accuracy, Simons refused to let the idea die. On his Southeast Asian trip in 1963, Terry learned firsthand what was needed to deal with attacks of insurgents. He therefore felt the concept had to be tried. In the tenacious attack on the problems at hand, each of the four men served in a distinctive yet overlapping role. MacDonald can be tabbed the "originator," Flexman the "catalyst," Simons the "tester," and Terry the "seller." Their evolutionary efforts combined to create the unique weapon system employed in Southeast Asia—the gunship.