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HERBICIDE OPERATIONS IN SOUTHEAST
ASIA, JULY 1961-JUNE 1967

Charles V. Collins

Pacific Air Forces
APO San Francisco 96553

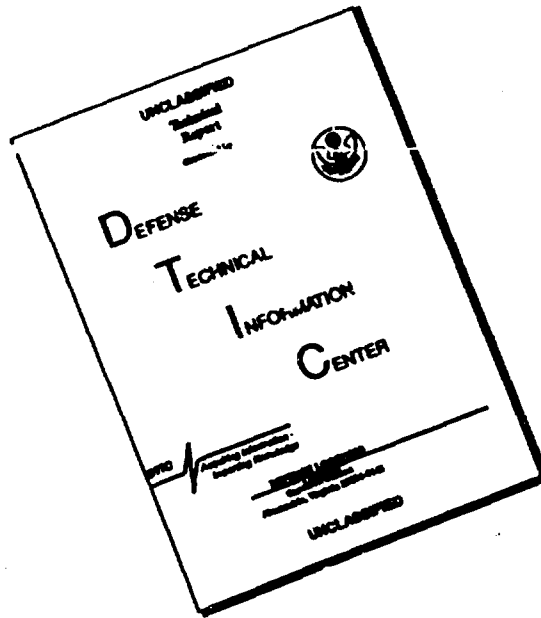
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PROJECT
Contemporary
Historical
Evaluation of
Combat
Operations
REPORT

**HERBICIDE OPERATIONS
IN
SOUTHEAST ASIA
July 1961-June 1967**

11 OCTOBER 1967

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**HQ PACAF
Directorate, Tactical Evaluation
CHECO Division**

**Prepared by:
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SEAsia Team**

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PROLOGUE

Herbicide operations in the Republic of Vietnam have proved to be very useful as a tactical weapon. Basically, two types of missions are conducted: defoliation of jungle foliage and destruction of crops in areas controlled by the Viet Cong (VC). Many factors have served to motivate these operations. Some of the more important considerations include the desire to eliminate enemy camps and secure areas (safe havens), to obtain better vertical visibility in heavily-canopied jungle for the purposes of reconnaissance and interdiction, to minimize cover along transportation routes to prevent VC ambush, and to destroy trees and vegetation surrounding special forces bases and communication routes to aid in base security measures and to preclude sabotage of communication facilities. Crop destruction operations were undertaken with the hope of denying the Viet Cong valuable foodstuffs by destroying crops and food resources in the immediate area. This would force the enemy to move from place to place to obtain food and would not allow him time to perfect his camp defenses or to develop long-range offensive programs. With these ideas in mind, the concept of using herbicides was proposed, tested, and put into operation in Southeast Asia.

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CHAPTER I

EARLY OPERATIONAL HISTORY

Deployment and Testing

The first adaptation of herbicides to modern warfare was marked by British use (Malaya, 1948) of helicopters to dispense chemicals for controlled crop destruction. This action also permitted increased surveillance of their Chinese terrorist enemy. These early British defoliation missions were, by contemporary standards, relatively safe in that the Chinese guerrilla was ill-equipped to resist this type of air operation and because most of the areas covered had been previously secured by ground forces. ^{1/}

The first consideration of herbicide operations in the RVN came in July 1961 when CHMAAGV suggested their use to destroy cover along communication routes and to deny the enemy his source of food. As the result of this suggestion, the CDTC/RVNAF was formed and began research on the practicability of crop destruction/defoliation operations. The first test was conducted in August 1961, along Route 13 in Chon Thanh. ^{2/}

Meanwhile, the Special Aerial Spray Flight (SASF), under Tactical Air Command, was being queried on the spray capabilities of the C-123 aircraft. This unit was stationed at Langley AFB, Virginia, and prior to July 1961, had been involved almost exclusively in dispensing insecticide in the United States. The unit consisted of three C-47s, two L-20s, and two C-130s. There were four pilots and some 22 support personnel. ^{3/}

In November 1961, MC-1 spray tanks were installed in six C-123 aircraft selected by TAC from the inventory at Pope AFB, N. Carolina. Other modifications of the aircraft included removal of all unnecessary equipment, installation of armor plating on the cockpit floor, installation of an engine oil supply in the cargo compartment, and plumbing that would permit the spray tank to be used as an additional fuel storage tank, if required. These modified aircraft were flown to Southeast Asia by personnel of the Special Aerial Spray Flight on a TDY basis. For deployment purposes, the unit was included in the operations plan for Project FARMGATE--the project under which the first USAF deployment to the RVN was begun in November 1961. In December 1961, a specific operations plan for the SASF was published; the project was coded "RANCH HAND."^{4/}

On 28 November 1961, the move to SEA began. Six C-123s and 69 personnel were involved. On 6 December 1961, all landed safely at Clark AFB, Philippines, and set up temporary operations until ordered to move three aircraft, on 7 January 1962, to Tan Son Nhut, RVN. The primary purpose of RANCH HAND during early 1962 was to perform missions to test the soundness of the defoliation concept as well as to determine optimum chemical concentrations and methods of delivery.^{5/}

RANCH HAND aircraft flew their first experimental mission on 12 January 1962 on a target that lay on Route 15, northwest of Saigon. In addition to RANCH HAND aircraft, the VNAF had one C-47 aircraft and several H-34 helicopters which were used to test the herbicide concept. Some tests were

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conducted in the Ca Mau Peninsula region. ^{6/} The initial tests continued until 20 March 1962 when they were terminated to await evaluation of the chemical effects on the foliage. ^{7/} An Army brigadier general arrived in Vietnam in April 1962 with a team of four evaluators to "determine the feasibility of the use of chemicals applied as spray by aircraft or ground equipment against tropical vegetation in selected target areas in South Vietnam." The team was primarily concerned with the ability of the spray "to improve roadside and jungle visibility as an aid in aerial and ground surveillance of routes of enemy movement and supply, to reduce ambush opportunities for the enemy, and to aid in exposing enemy jungle areas." The team evaluated 21 targets in 11 areas and concluded that, to be effective, a larger concentration of agent should be used. ^{8/}

Following this evaluation, the Ambassador and COMUSMACV were delegated the authority to conduct defoliation missions, following certain guidelines, namely: "Such operations would not include crop destruction and would be limited to clearing roadsides, powerlines, railroads and other lines of communications, and the areas adjacent to depots, airfields and other field installations." ^{9/}

During the period January-March 1962, many training missions were also flown. It was on one low-level mission, in February 1962, that a RANCH HAND aircraft crashed, destroying the aircraft and killing the three crew members. The cause of this crash has never been determined. A replacement aircraft was immediately flown from Clark AFB to keep RANCH HAND's strength at three aircraft. In March 1962, the remaining two aircraft were flown from Clark to

Vietnam. During the evaluation of the initial tests, three of the five RANCH HAND aircraft had the spray equipment removed and were used for logistics missions as part of Project MULE TRAIN, which was also operating out of Tan Son Nhut. On one of these missions, the second RANCH HAND C-123 was totally destroyed while attempting a short field takeoff. The crew, however, was saved.^{10/}

After the evaluation was completed in May 1962, two RANCH HAND aircraft were flown back to the U.S., leaving only two in Vietnam to be used for herbicide operations. One of the two departing aircraft returned to Langley AFB, Virginia, via the Pacific route; the other was sent, by request of the State Department, to help with a widespread locust crop destruction problem in Iran and Afghanistan. After completing this mission, the crew proceeded to Langley via the Atlantic Ocean, thereby becoming the first and only C-123 crew and aircraft to complete an "around-the-world" flight. This aircraft is still in the RANCH HAND inventory and is fondly known as "Patches" because of the large number of hits from ground fire that she has received.^{11/}

Early Defoliation Operations

Based on the recommendation of the evaluating team, the two remaining C-123s were modified to increase the flow rate to 1½ gallons per acre.^{12/} Following these modifications, in August 1962, requests were approved for defoliation of six areas of the Ca Mau Peninsula. These further tests were conducted between 3 September 1962 and 11 October 1962. One additional C-123 was recalled to Vietnam to aid in these missions,^{13/} which were personally

observed by the Commanding General of the U.S. Army Chemical Corps. These tests were successful and resulted in approximately 90-95 percent increased visibility along the canals. ^{14/}

In December 1962, targets were sprayed along roads located in the mountains near the city of Qui Nhon. After these missions were completed, defoliation activities were halted until the advent of the rainy season the following June. (The chemicals being most effective during the wet season when the vegetation is growing.) During the period January-May 1963, RANCH HAND aircraft were used to fly logistics, navigational aid testing, and radar target missions. ^{15/}

In June and July 1963, projects included defoliation of a canal in the Ca Mau Peninsula and along the powerline from Dalat to Saigon. VNAF H-34 helicopters aided in the second operation where mountainous terrain made low-level flying extremely hazardous. During this period, the Saigon-Phan Thiet railroad was defoliated, as were many roads and canals.

In August, spray aircraft were again used against locusts. Two C-123s flew 17 sorties in Thailand, starting on 31 August, completing the project on 16 September 1963. In October and November, RANCH HAND aircraft resumed defoliation missions in Vietnam. Four projects, involving 65 sorties, were flown during these two months. ^{16/}

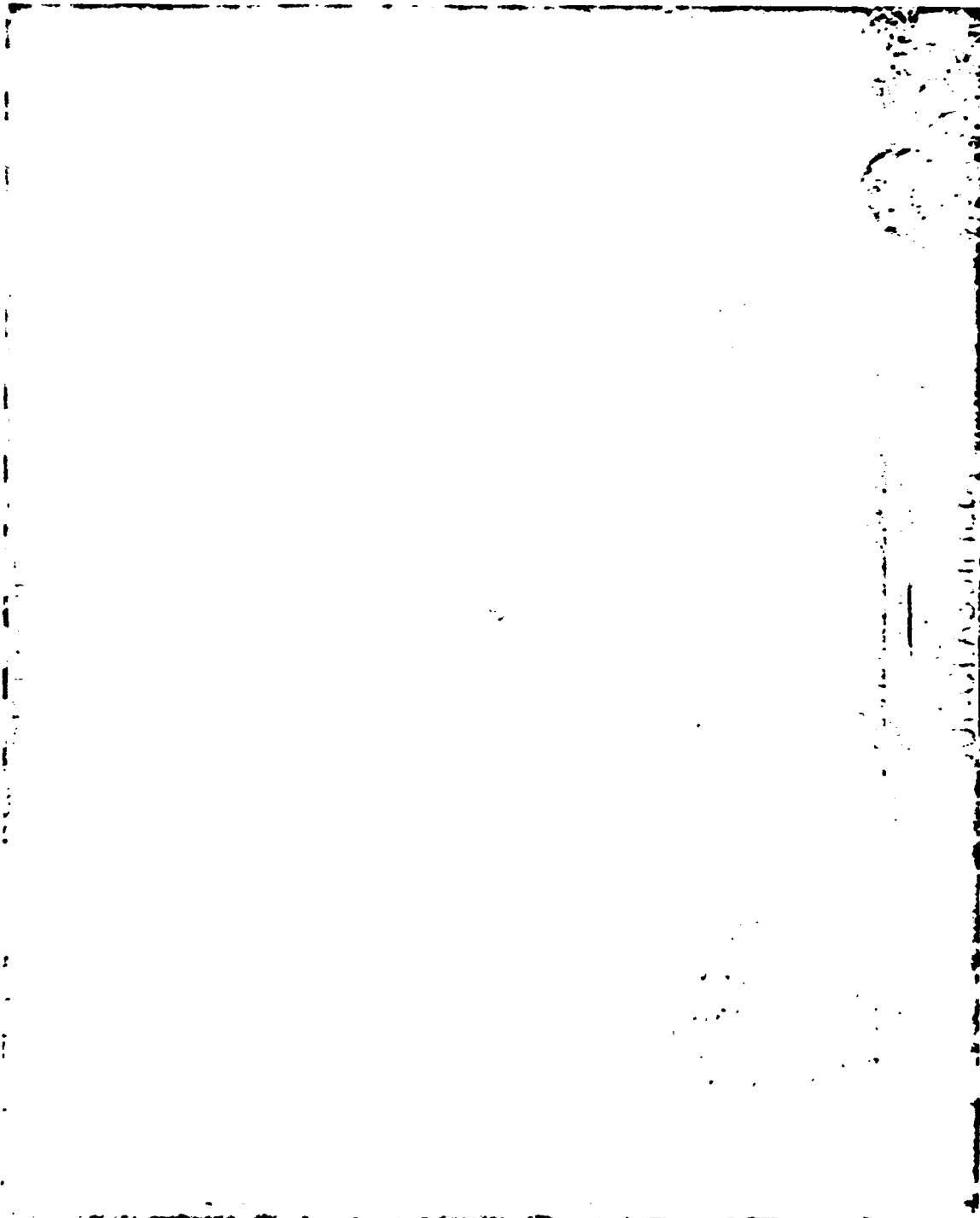
In September 1963, in response to a Department of Defense request, MACV conducted an overall evaluation of all defoliation operations conducted between September 1962 and September 1963. MACV concluded that defoliation

operations had a definite military value in counterinsurgency operations and recommended the program be continued. With the subsequent approval by the State and Defense Departments the program, in fact, increased in magnitude. In January 1964, authority was delegated to division senior advisors for hand-spray operations. This greatly reduced the lag time that had existed from proposal to completion of small defoliation projects: i.e., around ^{17/} depots, airfields and outposts.

In most cases, during 1963, areas to be defoliated were no longer secured by ground forces and ground fire was being encountered more and more often. To reduce ground fire effectiveness and to take advantage of optimum weather conditions (i.e., low temperatures and surface winds), night missions were proposed in December 1963. Initial attempts, utilizing a flare-ship to light the target area, proved disadvantageous in that the flares silhouetted the spray aircraft. Additional objections to these night missions noted the reduction of chances for rescue and survival, plus the requirement for targets to be located in relatively unobstructed areas to permit rapid maneuvering - an uncommon situation. Coordination procedures attending the use of flare-ships imposed an additional disadvantage. As a result of these drawbacks, night missions were used sparingly and were never flown over the same target on successive nights. ^{18/}

During 1963, fighter cover began to be used in conjunction with defoliation missions. However, the rules of engagement in effect at that time precluded the effective use of this fighter support. Fighter aircraft were not allowed to prestrike a target, but were limited to defensive actions for

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rescue operations or post-strike action when the spray aircraft had been fired on by the enemy. It should be mentioned that herbicide operations in RVN had, by this time, surpassed the level of conflict experienced by the British in Malaya. Many of the targets sprayed by RANCH HAND crews were not secure and ground fire was increasing as the enemy became aware of the role of the camouflaged C-123s. 19/

As happened in 1963, from January to June 1964 RANCH HAND aircraft were used mainly for MULE TRAIN logistics missions and Tactical Air Positioning System (Decca) tests. Some projects in the Mekong Delta were completed during this period; largely defoliation of lines of communication and around special forces camps. As 1964 proceeded, ground fire became more accurate as the VC improved their antiaircraft techniques. Delta projects were rapidly becoming among the "hottest" in Vietnam as the VC gained control of the IV Corps region. Areas previously secure were now being fortified by enemy forces. Some ground security was realized through coordination with the Vietnamese Navy, who would hit targets as far inland as their weapons permitted but, basically, it was the fighter escort that provided mission protection. 20/

Because of the increased concentration of VC in the delta south of Ca Mau, the crews of RANCH HAND developed a new "pop-up" delivery technique. This involved flying very low (about 20 feet above the ground), through open areas and then "popping up" to 150 feet for the spray run over the target. The average number of hits per aircraft per mission amounted to about four until 30 April 1964. On this date, 50-caliber antiaircraft

fire and, apparently, air-burst mortar fire was encountered. The co-pilot of the lead aircraft was wounded and over 40 holes were counted in this aircraft. Missions were suspended pending military evaluation of the situation. The policy was then established to schedule multiple targets in the delta area. This would allow the RANCH HAND crew to break off a hot target and spray one that was not as active. As a further measure, the same target was not sprayed more than two days in succession. This gave the VC little time to amass troops and antiaircraft weapons in the area. ^{21/}

During May and June 1964, RANCH HAND personnel moved to Da Nang on two separate occasions. Dirt roads connecting Vietnamese outposts along the Vietnam-Laotian border were the main targets to be sprayed. These roads wound through mountainous terrain, making spray delivery extremely difficult. On the other hand, the short turn-around time from Da Nang made it possible to fly more missions, covering several targets in a short period of time. This prevented the VC from getting troops into the target area before the project was completed. As a result, only four hits were sustained during 26 sorties out of Da Nang. ^{22/}

In July, RANCH HAND began spraying more targets in the delta, including defoliating VC safe havens such as the mangrove areas in the Go Cong Province. The Viet Cong had gained almost complete control of the Ca Mau Peninsula area, by this time, and antiaircraft fire was a regular event on these spray missions. Nevertheless, sorties were frugged into the area until the project was completed on 22 July 1964. ^{23/}

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It was about this time that the first PCS pilots were reporting to RANCH HAND. During the first two and a half years in SEA, RANCH HAND crews had been assigned on a four- to six-month TDY basis. During this time period, 800 sorties had been flown and 250,000 gallons of defoliant dispensed over some 80,000 acres. ^{24/}

Early Crop Destruction

During the same three-year period, crop destruction techniques and concepts were developed for use in the RVN. Research of crop destruction techniques had begun at the same time as defoliation research. However, there existed a natural aversion to destruction of food resources, and that, coupled with a desire to not be placed in a politically embarrassing situation, held back crop destruction operations. The period from March - October 1962 was marked by messages and meetings discussing the merits and disadvantages of crop destruction. At one such meeting, between Mr. Thuan, RVN Secretary of State, and President Kennedy (25 September 1962), the latter stated that the United States needed assurance on two points concerning crop destruction: "First, that the GVN could differentiate between Viet Cong crops and Montagnard crops and, secondly, that the usefulness of such an exercise would outweigh the propaganda effect of Communist accusations that the United States was indulging in food warfare." As a result of the meeting, President Kennedy queried MACV/AMEMB with the following: "1) The accuracy of current aerial delivery systems? 2) Can sufficient numbers of targets in a susceptible stage of growth be attacked with enough significant effect to warrant political cost of operation? 3) What

alternative sources of food can be provided to take care of friendly people whose crops may be affected? 4) What targets would you now recommend in light of foregoing questions?" ^{25/}

MACV answered all questions in an acceptable manner and, on 4 October 1962, the State/Defense Departments authorized crop destruction, in principle and gave the following guidelines to the Country Team for program implementation: "(1) The program should only be implemented where stage of crop growth gives reasonable prospects of success; (2) targets should be selected in areas where maximum damage is done to Viet Cong and minimum to non-communist peasants; and (3) the Country Team should consider psywar aspects carefully with a view to minimizing anticipated adverse political repercussions both inside and outside RVN." ^{26/}

On 21-23 November 1962, the first crop destruction missions were flown in Phuoc Long Province. The operation, using H-34 helicopters and hand sprayers, ruined an estimated 300 hectares of crops consisting of rice, beans, and manioc. An estimated 1,000 tons of rice were also later confirmed as destroyed during the operation. More projects of the same nature were completed between November 1962 and March 1963. On March 20, 1963, with MACV concurrence, the Embassy sent a message to the State Department recommending that defoliation and crop destruction be continued in specific situations and areas where their employment would hurt VC military effectiveness. The message further recommended that the Ambassador and COMUSMACV be given authority to approve crop destruction requests. ^{27/}

Because of the increasing propaganda being disseminated by the People's

Army of Vietnam, the State Department, in May 1963, requested an evaluation of the crop destruction program and set forth the following doctrine for crop destruction operations: ^{28/}

"...All crop destruction operations must be approved in advance by Assistant Secretary Far East and the Department of Defense.

"Crop destruction must be confined to remote areas known to be occupied by VC. It should not be carried on in areas where VC are intermingled with native inhabitants and latter cannot escape. Also should be limited to areas where VC do not have nearby alternative sources of food or areas in which there is available food deficit e.g., high plateau and Zone 'D'."

Task Force Saigon Evaluation Team reviewed the crop destruction program and in October 1963, advised the State Department that this type of operation was an effective weapon against the VC and recommended that authority be given to the Ambassador and COMUSMACV to approve crop destruction operations as military requirements presented themselves. Still the State Department withheld the approving authority that had been requested. Authority to conduct crop destruction operations was granted Ambassador/MACV for individual areas, but it was not until 29 July 1964 that authority for approval of all crop destruction activities was delegated to the Ambassador and COMUSMACV. ^{29/}

During the period March 1963-July 1964, crop destruction missions were flown against targets which lay in areas outside government control. These targets included areas surrounding VC training centers, hospitals, logistic supply installations, and way stations along infiltration routes.

Since the first crop destruction project, a total of 1,325 hectares of VC foodstuff had been destroyed. Three hundred hectares were completed in 1962, 79 hectares in 1963, and 946 in 1964, up to the time of delegation of authority for target approval to the Ambassador. 30/

CHAPTER II

EXPANDED HERBICIDE OPERATIONS

In July 1964, the Special Aerial Spray Flight became Detachment #1 of the 315th Troop Carrier Group. Col. David T. Fleming took command of the unit and several modifications were made during the summer of 1964. A new pump installation, for example, increased the spray delivery rate to three gallons per acre. A further modification included the addition of armor to protect the spray equipment operator, as well as the instrument panels of all RANCH HAND aircraft. ^{31/} Crop destruction missions during July and August were flown by H-34 helicopters in the Binh Thuan Province and resulted in 80 percent destruction of the VC crops within that province. ^{32/} Although the projects in Binh Thuan Province appeared successful, the overall results of crop destruction operations was somewhat limited. This was largely due to failure to obtain approval for crop destruction missions when VC control of the people and terrain was limited. Other reasons were lack of experience and motivation on the part of RVNAF pilots and poorly engineered equipment. These factors eventually led to the FARMGATE concept, using mixed US/VN crews. ^{33/}

Defoliation missions against communication/transportation targets continued through the fall of 1964. On 3 October, RANCH HAND flew its first crop destruction mission under the FARMGATE concept, involving the major food producing areas adjacent to War Zone D. This project, nicknamed "Big Patches", covered a period of ten days during which heavy ground fire was experienced. As a result of this small-arms antiaircraft activity,

40 spray aircraft sustained hits. ^{35/}

On the second crop destruction project (Hot Spot) in the Phuoc Long Province, one spray aircraft took a hit in its left engine. The engine burst into flames and was immediately shut down. The fire extinguisher had no effect on the flames and the left engine nacelle fuel tank was subsequently jettisoned. The aircraft made an emergency landing at Bien Hoa with the fire still burning. This was the first emergency incident recorded. ^{36/}

In December 1964, RANCH HAND received another C-123 so that, at the end of 1964, four spray-equipped aircraft were on hand. Each C-123 could be expected to fly a maximum of 45 hours a month (20-25 sorties), assuming no additional maintenance time was required due to battle damage. ^{37/} The C-123 has proven to be an excellent choice for spray operations with its dual, rugged and simple support systems backing up two reliable reciprocating engines. Up to this time, a total of 139 hits had been received but RANCH HAND had not lost an aircraft or a crew member during tactical missions. ^{38/}

During 1964, a total of 257.7 square kilometers of roads, railroads, canals, and VC base areas were defoliated and 15,215 acres of crops were destroyed. ^{39/} To accomplish this task, 363 spray sorties were flown by RANCH HAND crews. Seventy-two survey flights were also flown. ^{40/} The C-123s were flown approximately 48 percent of their maximum capacity during 1964, but, during the last four months, they used 92 percent of the available time. This utilization underscores the increased emphasis on

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defoliation toward the end of CY 1964. That RANCH HAND aircraft were not flown to maximum capability was due to: (1) the herbicide program was still a small program during the first part of 1964; (2) operations had been terminated when ground fire became excessive, and (3) the chemicals were most effective during the wet, growing season so that some sorties were cancelled because of weather. ^{41/}

Crop destruction had been carried out during 1964 mainly by the H-34 helicopter, using the HIDAL system under VNAF control. There were five HIDAL systems in Vietnam at the end of 1964 with seven helicopters available to use the system. Each aircraft had a capability similar to that of the C-123 in hours of flying time but not in area covered. Each H-34 could fly 45 hours a month thereby performing 20 to 25 spray sorties. ^{42/}

The H-34/HIDAL systems were utilized about 23 percent of maximum capability during May to October 1964. During this time, 128 herbicide sorties were flown, accomplishing crop destruction over an estimated 2,605 hectares. ^{43/} These H-34 aircraft, along with the RANCH HAND aircraft, sprayed 6,086 hectares (or 15,215 acres) during the entire year. ^{44/} From May to December, the H-34 systems were used only 14 percent of their available time. However, it must be remembered these helicopters were used in troop and cargo movement missions when not engaged in crop destruction missions. ^{45/}

In 1965, RANCH HAND continued to fly more and more sorties on both defoliation and crop destruction projects. Project 20-33 included 15 individual targets (three more were later added to the project) located approximately 65 miles east of Saigon. These targets were heavily foliated areas along roads and railroad lines. The VC had been hitting National

Highway 1 and the railroad between Saigon and Nha Trang. Operations began 30 October 1964 and continued through 29 January 1965. Forty sorties were flown in one 14-day period during January 1965. Some 36,600 gallons of herbicide were dispensed and two hits from ground fire received during the operation. ^{46/}

A similar project included targets along the main shipping channel from Saigon to the ocean. It was hoped that defoliation would decrease VC sniper activity and minelaying operations. If the banks of the channel were cleared, increased surveillance of the area would be possible. This project began on 1 March and ended on 19 March 1965. Forty-two sorties were flown and 27,000 gallons of chemicals delivered. Hostile ground fire caused only two hits during the period. ^{47/}

Project "Sherwood Forest"

Planning for Project Sherwood Forest began in December 1964 and was to involve the RANCH HAND crews in a new type of operation, combining the spray aircraft with other C-123 cargo crews in a massive attempt to burn out a section of the Boi Loi Woods. This area, approximately 26 miles north-northwest of Saigon and extending to within a few miles of the Cambodian border, had long been a VC stronghold. The target area included a 48 square mile section of the jungle which had a very heavy canopy cover. This had permitted the VC to use the area for the past ten years with little fear of observation and to develop it into the center of their operations in SVN. It was occupied by regular VC troops, who had devised an intricate system of caves and trenches hidden under the heavy canopy of

the jungle. Supplies for this stronghold were readily obtained by the VC through easy access to the Ho Chi Minh Trail, a major infiltration route to the south. Because reconnaissance of the area had previously been futile, it was hoped that Project Sherwood Forest would expose the key locations so that airstrikes could be pinpointed against specific targets. ^{48/}

The plan, presented by Brigadier General Robert R. Rowland, Chief of the Air Force Advisory Group, was to heavily bomb the area, then to defoliate using the spray aircraft of RANCH HAND. After the chemicals had killed and dried the target vegetation the 48 square mile section was to be "bombed" with 50-gallon fuel drums loaded on pallets. Each aircraft would carry 24 drums. The pallets had M-6 night flares attached and rigged to ignite the fuel after dropping. The hope was that the defoliant would have sufficiently dried the area so that when the fire bombs were dropped, a huge fire storm, aided by strong surface winds, would be created. To insure development of the fire, A-1E aircraft from the 34th TAC Group were to follow the C-123 cargo aircraft with strikes of incendiary. ^{49/}

RANCH HAND personnel defoliated the area after two days of intensive bombing by the A-1E and A-1H Skyraiders, which dropped 800 tons of explosives on target in 139 sorties. This was the first time prestrike missions had been approved and was effective in decreasing the ground-fire hit ratio. Initial spraying of the target area covered the period 22 January-18 February 1965. On this project, the largest undertaken to date in the RVN, 102 sorties were flown and 78,800 gallons of defoliant delivered over 7,500 hectares of forest. Spray aircraft received 79 hits from ground-fire, with

injuries sustained by three crew members. ^{50/}

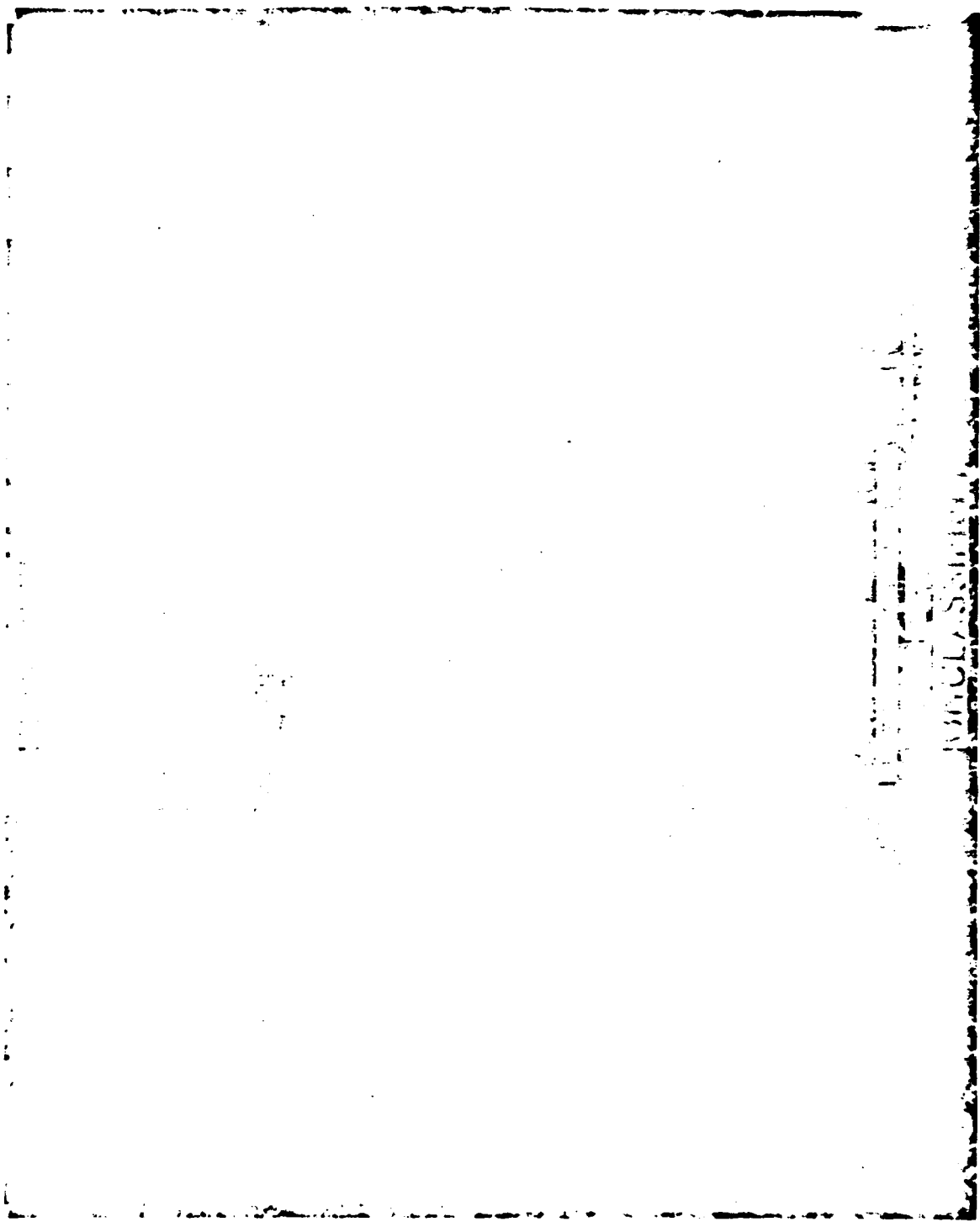
By the end of March, the chemicals had taken effect, the dry season was almost over, the winds were favorable and success was anticipated. The C-123s of the Air Commando Group, led by Col. Fleming, came in to drop the flare-rigged fuel barrels. Following were the A-1Es and B-57s loaded with tons of incendiary and incendiaries. Soon a huge circle of flame and a tall column of smoke marked the target area. Secondary explosions indicated enemy presence in the jungle, although warning had been given and over a thousand civilians had left the area. ^{51/}

The project ended in disappointment, however. The operation had been carried out as planned, but a huge rain cloud formed over the target. The rain quenched the fire, which did not spread as predicted due to unexpected slow surface winds. By morning the fire was out. ^{52/}

Although the project was not completely successful, the Boi Loi woods were no longer the safe haven they once had been. Vertical visibility had been increased by the defoliation missions. These missions were made difficult because, after bombing the area for two days, the element of surprise was gone and the RANCH HAND aircraft were prime targets for the VC infantry company left in the area. Nevertheless, the operation marked another development in the use of herbicides in the war in RVN. Defoliants ^{53/} were again to be used in this type of operation later in the war.

Following Sherwood Forest, crop destruction missions continued with Project "Yankee" which covered targets in and around the An Lao Valley,

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Binh Dinh Province. It was hoped the villagers would leave their homes and seek new ones in areas controlled by the GVN, thereby causing logistics problems for the Cong by eliminating the immediate supply of food. Operations started on 27 March 1965 and ended on 18 April 1965. Thirty-seven sorties were flown, during which 27,300 gallons were delivered. Nine hits were taken by RANCH HAND aircraft. ^{54/}

Increased Fighter Support

Project "Swamp Fox" was to become the largest defoliation project, to date, in South Vietnam. Targets included areas in Bac Lieu, Box Xuyen, and Vinh Binh Provinces. The VC stronghold in these areas contained arms factories, repair shops, hospitals, and training camps, all operating without fear of harassment. Defoliation operation would help aerial surveillance and permit observation of supply and troop movements in the area. These operations started on 30 April 1965. A-1E aircraft from Bien Hoa prestruck each target area and provided cover for the 84 RANCH HAND sorties. A Forward Air Controller was also used. The project was terminated on 25 May 1965. Spray aircraft sustained 124 hits and dispensed 77,600 gallons of defoliant. Five crewmen were slightly injured as the result of ground fire. The project was about 70 percent complete when it was terminated because of the heavy ground fire. ^{55/}

Following the termination of "Swamp Fox", a reevaluation of defoliation was conducted by MACV-J2. Herbicide operations were considered to be of great tactical use and a desirable weapon, although 2AD and PACAF expressed

concern for the safety of the crews. A tactical study indicated the need for an increase in the ratio of fighters to spray aircraft and concluded that more time on target for the fighters was desirable. As of 30 June 1965, RANCH HAND aircraft were to fly cargo missions until more A-1E aircraft at Bien Hoa finished their training to fly cover for spray operations.^{56/}

The A-1E had several advantageous features in its use as a support aircraft for spray missions. It had the necessary airspeed and maneuverability and could carry the ammunition required to suppress ground fire during spray operations.^{57/} As an example of their use in the IV Corps area, four A-1Es were generally used per mission. Each was armed with mixed loads of bombs and 20mm ammunition. The fighters pre-struck VC gun installations, based on reports from the FAC working in the area, followed three to five minutes later, by the C-123s.^{58/}

During the summer and early fall of 1965, crop destruction missions were flown in the Kontum and Binh Dinh Provinces. On 20 October 1965, operations commenced in War Zone D. This project continued until 17 December, with 163 sorties being flown and 137,650 gallons of chemicals being delivered. Fighter support for the C-123s now included F-100, F-5, and A-4 aircraft in addition to the A-1E.^{59/} Also, during September and October, three more C-123 aircraft were being modified for spray operations by the Fairchild-Hiller facility at Crestview, Florida. These three aircraft were brought to Tan Son Nhut by newly trained crews and were in place by 13 November 1965. In November, the designation of the spray-configured aircraft was changed from C-123 to UC-123. Other changes in the RANCH HAND

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operation included the use of flying helmets with a clear, extended visor. This was done to minimize the effects of shrapnel and other flying debris in the cockpit as the result of ground fire. ^{60/}

Tactics were also changed to prevent the number of hits from increasing. Spray aircraft flew in a close-up, nose-to-tail echelon formation on straight targets where undisciplined forces were found. This was not done, however, where fire was concentrated or where troops were highly disciplined and trained in firing at aircraft. Fighter tactics still included pre-strike, poststrike, or a combination of both. There existed some question whether fighter prestrike to gain ground security was of more value than the natural element of surprise. The complex process of target acquisition was also becoming a problem about this time. The coordination process required as much as a year, at times, and as a result, the backlog of RANCH HAND work had occasionally dwindled to a single project. ^{61/}

In November and December 1965, targets included more "lines of communication" type of defoliation missions. On 25 November, a smaller project began along the banks of the Oriental River. In 18 sorties 24.2 square kilometers were sprayed with 14,000 gallons, with 34 hits being received. Cover was provided by F-100s with help from a FAC and with the "Jolly Green Giant" rescue helicopter standing by. ^{62/} Other projects in December included areas in Kien Hoa Province and Phuoc Tuy Province. These projects were larger and, in Kien Hoa, 70,450 gallons were delivered between 7 December 1965 and 31 May 1966. ^{63/} The Phuoc Tuy project began on 18 December 1965 and ran through 30 January 1966 with 60,000 gallons of defoliant delivered. ^{64/}

It might be mentioned, at this time, that a shortage of defoliant was noted. In a letter from the 309th ACS to 315th ACG, dated 12 November 1965, it was stated that aircraft were on standby for two days for lack of chemical. ^{65/} The shortage of defoliant in more recent times has grown to such proportions that it compares in magnitude to the munitions shortages reported earlier in the conflict. ^{66/}

Operations in Laos

In December 1965, herbicide operations were begun in Laos, with sorties being flown from Tan Son Nhut and Da Nang. Two UC-123 aircraft and crews had been deployed to Da Nang Air Base, with the first spray mission flown on the 6th of December. ^{67/} The purpose of the operation in Laos was the exposure of foot trails, dirt roads and other LOCs that crossed into SVN and made up the Ho Chi Minh Trail. This infiltration network leads from NVN, through the eastern portion of the Laotian panhandle, to the Cambodian border.

Weather, ground fire, and high mountainous terrain all combined to make these operations in Laos extremely hazardous. Strong surface winds dispersed the spray, making it less effective than normal, and requiring several missions to properly defoliate any given target. ^{68/}

Operations in this area continued into 1966 and, by late March, most of Routes 92, 922, 96, and 965 had been targeted and defoliation had commenced. The Forward Air Controllers in both Steel Tiger North (Cricket) and Steel Tiger South (Tiger Hound) also recommended targets as operations progressed. In early May, operations began north of the 17th parallel, in

Laos, with a concentrated effort being made in the Steel Tiger North area, where strong enemy opposition was first noted, with .50-caliber antiaircraft fire being encountered during at least five missions. ^{69/}

As of 30 June 1966, approximately 1,500 kilometers of roads and trails in Laos had been sprayed to a width of about 250 meters on either side of the road. During the operation, 220 sorties and over 200,000 gallons of herbicide had been used. Many fighter pilots and FACs attributed at least partial credit to RANCH HAND for the destruction of over 1,000 trucks on these roads. ^{70/}

Operations in the RVN - 1966

While missions were being flown in Laos during early 1966, other activity was taking place in SVN. During January, 130 sorties and 118,500 gallons of chemical were delivered by RANCH HAND in the Vung Tau, Bac Lieu, Saigon, Nha Trang, and Pleiku areas. The two aircraft at Da Nang had deposited 59,800 gallons against lines of communication and suspected VC supply and storage areas in Laos. ^{71/} In February, 45 defoliation and 48 crop destruction sorties were flown in the I Corps region, with 63 sorties in Laos. This amounted to 156 total sorties flown and 145,300 gallons of chemical dispensed during February. ^{72/}

One project of note involved a plan to fly missions near Tan Son Nhut without a navigator. This project was nicknamed "Mac's Folly," after the originator of the concept. The idea was to take off from Tan Son Nhut, fly a predetermined fixed heading until intercepting a Tacan position, then

turning onto the target based on the Tacan fix. This project (3-20-2-66) was started on 20 February and completed on 29 August 1966, but was not too efficient, with later observations of the target area revealing that the spray strips were somewhat randomly positioned. ^{73/}

Another project of interest, accomplished in early 1966, involved the use of RANCH HAND aircraft in another jungle burning project (Hot Tip I and II) on Chu Pong mountain. This 29 square kilometers of mountain area was covered with a thick canopy. Defoliation was performed by UC-123s, with 17,000 gallons of orange defoliant being delivered between 24 January and 6 February 1966. An additional 5,000 gallons were delivered on 22 and 23 February at the request of MACV. ^{74/} This project, however, was also doomed to failure. On 18 March 1966, during a MACV briefing, Major General C. E. Hutchins wanted to know the results of the Chu Pong defoliation project. He was told that weather, humidity, ordnance, and delivery methods were all satisfactory, but "the damned trees just wouldn't burn"...Only 5 percent, ^{75/} in fact, had burned.

In March, April, and May, more sorties were launched in the Kien Hoa and Phuoc Tuy provinces, as well as in Laos. March saw 116 sorties flown in SVN and 47 in Laos; a total of 148,450 gallons of defoliant had been delivered. ^{76/} April saw a 20 percent increase in sorties and a 4.4 percent increase in gallons dispensed. ^{77/} In May, 11 additional aircraft were programmed and were being modified for assignment to the Special Aerial Spray Flight in SEA within the calendar year. Chemical supplies were also being increased to meet the expanded activity. Sorties flown in SVN during

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May were 218, with 199,450 gallons of herbicide being delivered. In Laos, 5,000 gallons had been dispensed in 26 sorties. ^{78/} Just two years previously, during May 1964, 20 sorties had been flown in SEA dispensing 11,075 gallons of chemicals. ^{79/} The growth of the herbicide concept in this brief period is apparent.

In May, the shortage of herbicide was again felt. On 14 May, two aircraft and crews were recalled from Da Nang due to unstable political conditions and lack of chemical. However, two UC-123s were redeployed to Da Nang shortly thereafter, arriving on 30 May. ^{80/} In June 1966, the first RANCH HAND aircraft to be lost during a tactical mission was downed by ground fire during a defoliation mission in Quang Tin Province in I Corps. The two spray aircraft involved had received sporadic ground fire and, on the fifth pass over the area, one lost an engine. It impacted in a hedge row near a rice paddy and subsequently burned. Six USMC helicopters responded to the May Day call. Two of these landed amid ground fire and rescued all three crew members. The pilot of the downed aircraft was ^{81/} seriously injured; the others suffered only minor cuts and bruises.

In July, major modifications of the spray aircraft were undertaken. A new spray tank and a 20-hp pump, capable of delivering 400 gallons per minute, were added. The complete system is known as the A/A 45Y-1 Dispenser System. A 10-inch dump valve was installed, replacing the five-inch valve previously used. A new tail boom, 20 feet long and weighing 120 pounds, was fastened on the aircraft with Hayes mounts. This new system could spray at a rate of 250 gallons per minute (3 gallons/acre)

and the entire 1,000 gallons could be dispensed by the new pump in four minutes of spray time. ^{82/}

During the summer 1966, the first spray missions over NVN were flown. Two missions, starting in NVN, continued southward through the Mu Gia Pass into SVN. In August, crop destruction targets were scheduled in the A Shau Valley, which became a very "hot" target area during the month of September. ^{83/}

Area defoliation in War Zone D began in August under a low priority. Many sorties during August and September were also flown in the Iron Triangle region, also a priority target at the time. War Zone C defoliation began around the first of September and continued throughout the fall of 1966, with many smaller targets along roads also being struck from time to time. Activity in IV Corps, under project 4-20-1-66, began in August, in the Mekong Delta area. In short, the herbicide operations were now being performed in all areas of the RVN with hostile fire expected in most of them. ^{84/}

Since November 1965, RANCH HAND had been using seven aircraft. In April, COMUSMACV had decided to defoliate War Zones C and D and had requested 11 additional UC-123s to assist in this task. ^{85/} Three aircraft arrived in August, four in September, so that by 10 October 1966, 14 UC-123 aircraft were in place at Tan Son Nhut. ^{86/} In September, scheduling commenced for defoliation missions in the area just south of the DMZ. Clear weather in the area sometimes permitted as many as four sorties per aircraft during a single day. So many missions were flown that, again, the

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supply of herbicide ran low and maintenance began to fall behind. The crews had to slow down to let things catch up. ^{87/}

There was some question as to the military requirement for defoliation in or near the DMZ. On 27 August 1966, COMUSMACV explained to CINCPAC that political considerations for defoliating in this area appeared to conflict with the military requirement. ^{88/} However, in October 1966, COMUSMACV requested permission to defoliate into the northern section of the DMZ and adjacent infiltration routes in NVN. The response to this request was that only the southern portion of the DMZ should be authorized for defoliation. Northern projects would wait for an evaluation of the military/political results evolving from the approved program in the southern portion. MACV would conduct a qualitative assessment of the southern DMZ defoliation operation in support of this evaluation. ^{89/}

In the period from September to November 1966, an attempt was made to insure fighter cover for RANCH HAND sorties. There were cases of aborting the mission when air cover could not be obtained—especially true in the III and IV Corps areas. The policy of flying only with air cover is still in existence. ^{90/}

On the 15th of October, the Special Aerial Spray Flight, 309th Air Commando Squadron, was discontinued and the 12th Air Commando Squadron was administratively formed, retaining the code name RANCH HAND. Lt. Col. Robert Dennis was assigned as the first commander of the 12th ACS, whose primary mission remained unchanged. ^{91/} Although temporarily organized

under the 14th ACW, ^{92/} it was permanently established under the 315th ACW, Troop Carrier.

On 31 October the second RANCH HAND aircraft was lost in the Iron Triangle region. All crew members were rescued, although the aircraft was totally destroyed. ^{93/} On 1 December 1966, the 12th ACS was moved to Bien Hoa. By the end of December, there were 14 aircraft on hand, two en route from the States, and two in modification in the Zone of Interior, ^{94/} which accounts for the 18 aircraft authorized.

Activity in Laos was increasing during the month of October 1966, primarily because of the weather conditions near the DMZ and the A Shau Valley, at this time of year, which hampered defoliation activities. Laos targets were relatively "cool" and only small amounts of hostile fire were received. Further south, in the Rung Sat Special Zone, defoliation activity had begun during October and November. A test, using 1½ gallons of orange per acre, was being conducted on the mangrove trees in the area. A similar test was also tried at the same time in project 4-20-1-66 in the delta region. Both tests showed that the reduced rate was ineffective as many areas had to be redone at a later time. ^{95/}

During December, January and February, the main areas of activity were in War Zones C and D, with as many as 29 sorties a day being flown. The mission at Da Nang was halted temporarily during January because of weather but, in February, sorties from Da Nang were again flown into Laos and inside the southern portion of the DMZ. ^{96/} Authority to defoliate the southern portion had been granted on 27 November by the Secretary of

State. ^{97/}

Ground fire activity was beginning to pick up making the missions over Laos more hazardous for the vulnerable UC-123s. The roads and infiltration routes in Laos were drying out and traffic was increasing. The third RANCH HAND aircraft to be lost during a tactical mission went down over Laos on 31 January 1967. This time the entire crew was lost. ^{98/}

Project "Pink Rose"

Project Pink Rose was the third time defoliation aircraft were used in a jungle burning program. The tests, based on the previous projects "Sherwood Forest" and the burning of Chu Pong Mountain, were not completely successful to say the least. ^{99/} Pink Rose was to be a full-scale test program with 7AF coordinating the efforts of the U.S. Forest Service personnel, RANCH HAND crews and SAC B-52 ARC LIGHT forces stationed in Guam. The target areas (one in War Zone D and two in War Zone C) were selected on 6 November. ^{100/} Each target was a square box, seven kilometers on each side, which contained about 12,000 acres of heavily canopied jungle. During the first discussions CINCPAC suggested Orange dessicant be used, followed by a second application some two months later. Finally, this could be followed by an application of Blue delivered several days before ignition. ^{101/} The operation plan directed the initial treatment of the targets be accomplished by the following dates: Area A-14 November 1966; Area B-16 November; and Area C-18 November. All areas were, in fact, completed by 27 November 1966. Orange dessicant was planned for Areas A and B while

Area C was to get White. Rate of delivery was the normal three gallons per acre. In January 1967, a second application of the same herbicides was completed. The agent Blue was to be applied ten days before ignition, at the rate of three gallons/acre in Areas A and C and 1½ gallons/acre in Area B. No operational problems were encountered as the defoliation of these areas was accomplished in accordance with the procedures specified by the Chemical Division, MACV-COC7. Aerial reconnaissance of the target areas indicated that results were equal or better than expected. Ground parties inspected the areas and confirmed good drying throughout the forest. Approximately 225 sorties were flown and 255,000 gallons of herbicide were delivered in these three target areas. 102/

The actual ignition of the targets took place as follows: Target C was ignited on 18 January 1967; target A on 28 January; and target B on 4 April. This particular order was necessary to prevent conflict with current ground operations. Thirty B-52s from the 3rd Air Division units on Guam were used on each of the first two strikes to deliver the ignition units. On the third strike, only 15 B-52s were used and the target box was compressed to provide a density of incendiary bomblets three times greater than that used on the first two missions. The ignition units were comprised of M-35 bombs, M-14 tail fins, two M-152/AN-152A1 fuzes per bomb, and M23 Type B arming wires. Coordination between 7AF, 3AD, and MACVCOC was excellent. All strike aircraft were on target as scheduled and were properly spaced by the use of the MSQ-77 "Skyspot" radar, operating alternately from the Bien Hoa and Dalat sites. Target saturation with

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the bomblets was satisfactory. The weather was good on the last two targets; the first had been slightly overcast with some surface winds, but this was not considered a major factor influencing the effectiveness of the 103/ fire storm.

The effectiveness of the operation varied with the area. In target C, the burning was ineffective. Only the well-drained grass areas burned freely, with most fires spreading no more than two feet from the point of ignition unit impact. Smoke was intense in the area, but very little 104/ damage was done by the fire.

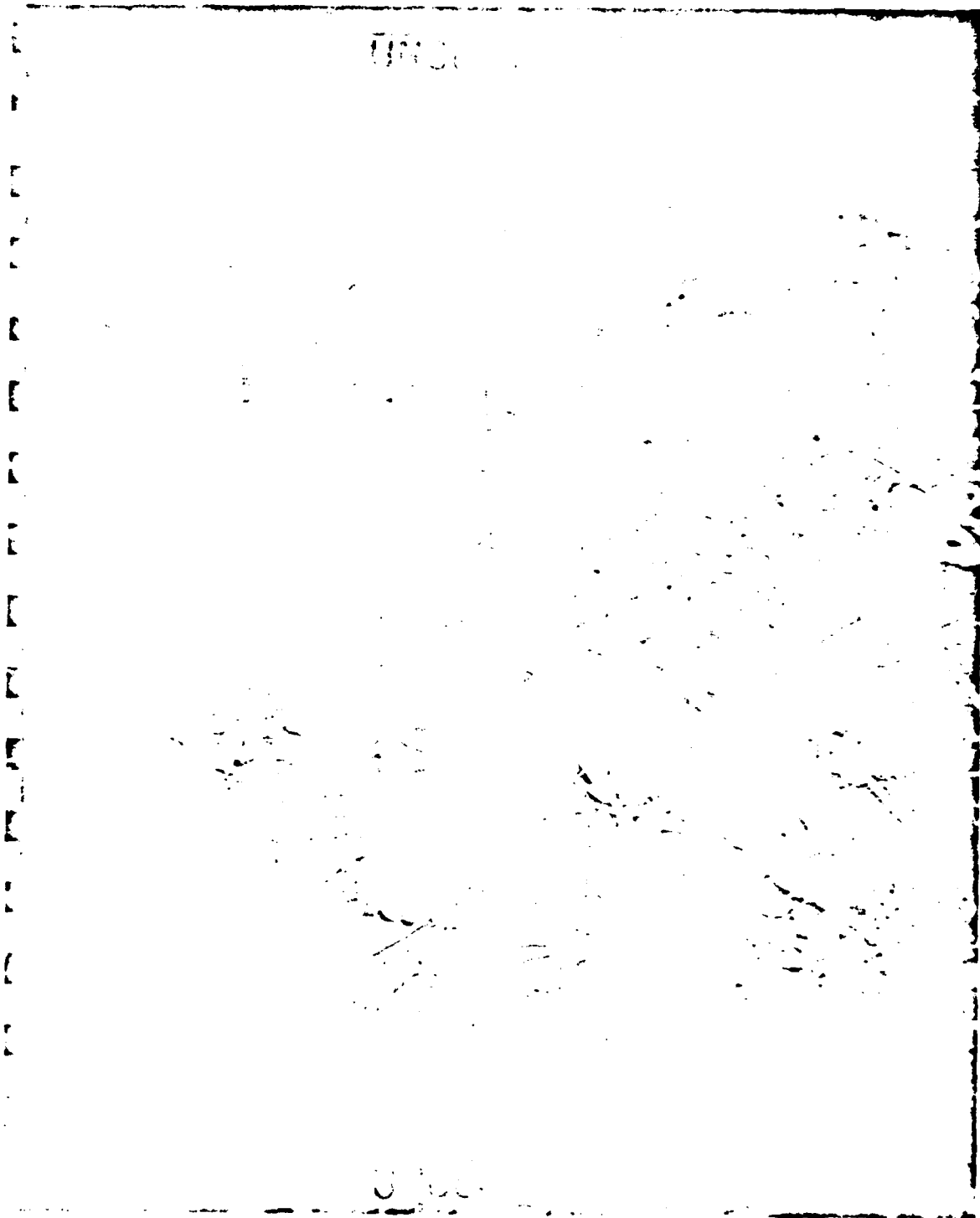
Area A had much the same results. Open areas again burned well, but the fire under the canopy did not spread as desired. Under double canopy, the fire spread only about six feet from the ignition source, resulting in the burning of only three to five percent of the area. Under single canopy, spread was only slightly better. Burned area amounted to about nine to 12 percent of the available forest. Crown canopy removal was negligible. Again the smoke was intense and rose to about 9,000 feet, but subsequent flights through the area failed to reveal much change in 105/ canopy thickness or aerial visibility.

Target B, with the close-packed bombing, still had negligible results. About 50% of the fires did meet but, because of the thin canopy, did not burn. Overall damage to the forest was not appreciable. The major conclusions were that this technique was ineffective as a means of removing jungle canopy and that results did not warrant the high cost of resources 106 to continue testing.

Between February and June 1967, six more aircraft were received by the 12th ACS. Two arrived in February, one in March and three in June, bringing the total number of aircraft on hand up to 20. ^{107/} (As this report was being written, the fourth RANCH HAND aircraft was lost, with its entire crew, during a tactical mission.) ^{108/}

In the last four months, IV Corps targets have received many sorties. RANCH HAND has also been working II Corps and War Zones C and D. War Zone C projects were nearly completed as of May 1967, however. In II Corps, there are currently 10 active projects in support of Operations Francis Marion, Pershing, and Byrd alone, ^{109/} as well as other crop destruction projects. Certain areas near Cambodia in II Corps are being requested by the U.S. Army commanders rather than originating from the ARVN or province chiefs. Targets in these areas, as well as some small projects, are being flown at the present time. It is safe to say that RANCH HAND's current missions are scattered throughout all four combat zones. ^{110/}

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CHAPTER III

CURRENT CONCEPT OF OPERATIONS

Aerial defoliation and crop destruction are the two types of herbicide missions flown by the 12th Air Commando Squadron. Other spray operations, such as defoliation around special forces camps, airfields, depots, and other smaller projects, can be done with hand equipment or H-34 helicopters. These smaller operations are usually accomplished by the U.S. Army or the VNAF. The large area defoliation missions are flown exclusively by crews from RANCH HAND. The crop destruction projects are flown in accordance with the State/DOD-approved FARMGATE concept which provides for the use of VNAF markings on the spray aircraft and a VNAF 111/ observer as part of the crew.

Types of Equipment

The types of equipment used to accomplish the various spray operations include the UC-123 aircraft, H-34 helicopters, Buffalo turbine units, and hand spray units. The UC-123 is made by Fairchild and is a very reliable aircraft. With two R-2800 reciprocating engines, it has a combat range of 250 miles and takes a crew of four when a navigator is used. Tacan navigation equipment is available and communications equipment includes UHF, VHF, ADF, FM, and HF capability. The UC-123 utilizes an MC-1 spray tank of 1,000 gallon capacity and associated spray equipment such as the wing and tail booms, pumps, and plumbing, all of which make up the A/A 45Y-1 Dispenser System. This system provides three gallons of defoliant per

acre which is delivered at a speed of 130 knots and is capable of clearing an area 80 meters wide and 16 kilometers long. ^{112/}

The H-34 helicopter spray system was initially developed by the U.S. Navy Disease and Vector Control Center as a potential insecticide delivery system. The HIDAL system using the H-34 has a capacity of 200 gallons and a delivery rate of three gallons/acre. The spray is normally delivered at 50 knots and cuts a swath of 75 meters. This system is vulnerable to ground fire because of the slow delivery speed and requires excessive maintenance. ^{113/}

The Buffalo turbine is a trailer-mounted spray system used in ground operations. The turbine is gasoline driven, has a 100-gallon capacity, and is used primarily along roads and similar targets. Under favorable wind conditions, this ground system can effectively spray a strip 75 meters in width. ^{114/}

The hand spray units, used on the smallest defoliation projects, consist of a back-pack type of dispenser with a capacity of three gallons. ^{115/}

Command and Control

The control of the use of herbicides for defoliation and crop destruction is a joint effort by the GVN and the U.S. government. The responsibilities of the GVN are exercised through the JGS 202 Committee, which meets, as necessary, to consider requests and to write directives for herbicide operations. It is composed of members from High Command J-3 Section, J-2 Section, J-4 Section, J-5 Section, VNAF, and RVNAF/CDTC. ^{116/}

COMUSMACV and the Ambassador have the authority to approve U.S. missions in support of GVN herbicide projects. Senior U.S. advisors at corps and division level are delegated the authority to approve defoliation requests which employ hand-spray and ground-based power spray operations falling within defined guidelines. The State Department and the DOD establish the overall policies for herbicide use. 117/

The Director, COC, is responsible for all target planning and operation. He reviews all plans of selected targets forwarded by the JGS 202 Committee. His recommendation is then forwarded to the MACV 203 Committee for evaluation and review of the proposal. This Committee has the MACV Staff Chemical Officer as its chairman and is composed of members representing COC, J-2, POLWAR Advisory Directorate, USAID, and the Embassy. Seventh Air Force will be represented when aerial missions are involved. 118/

A typical project request will originate from a province chief, a U.S. field commander, and/or an ARVN commander. It then goes through the JGS 202 Committee procedure and is forwarded to MACV for their coordination. After review by the 203 Committee, the proposal is formally coordinated with J2 and the POLWAR Directorate. Then, after approval of the U.S. Embassy, the Chief of Staff, MACV, will send a letter to the Chief, JGS, signifying U.S. approval of the project. The Chemical Branch then notifies 7AF TACC, who forwards this approval to 12th ACS for execution of the project. 119/

The targeting priorities are established by MACV. These priorities

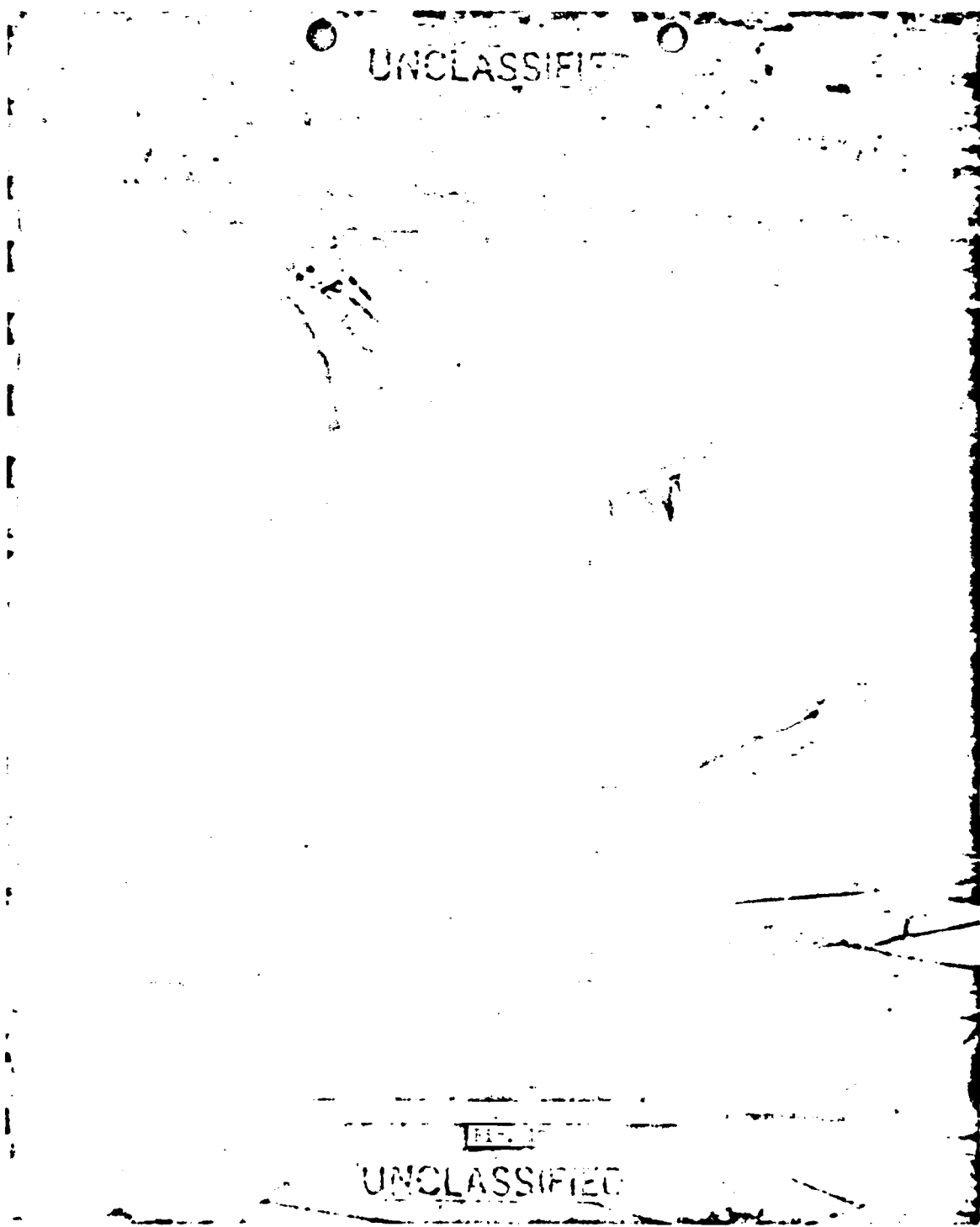
are formed into two lists, one for defoliation and one for crop destruction projects. Upon receiving execution approval from TACC and the target priority from MACV, 12th ACS submits a request for a fragmentation order to TACC. TACC, in turn, sends out a warning order to the field units who are in or might be entering the target area. TACC will then publish the final 120/ fragmentation order for project execution.

During the initial coordination of the project, a survey flight of the area had been conducted by RANCH HAND personnel and a representative of MACV. A coordination meeting was also held between the province chief, MACV Chemical Officers, Vietnamese military personnel, and RANCH HAND personnel. These meetings and survey flights help to familiarize RANCH HAND personnel with the objectives and the peculiarities of each project. Then, on the day before the actual spray mission is flown, the crews can review the project and plan the mission. 121/

Missions and Tactics

The actual mission is usually flown during the early morning hours to take advantage of the optimum weather conditions. Temperature in the target area in excess of 85 degrees or surface winds greater than 8-10 knots can result in a mission abort. High temperatures can cause the spray to rise off of the target; excessive surface winds will blow the spray away from the area. Both effects will render the mission largely ineffective and, in fact, may cause damage to friendly areas near the target. Weather must also be considered because of the limitations of the cover aircraft who fly support for the spray sorties. 122/

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The code name for "fragging" purposes is "Traildust"; the call sign for the UC-123s during the spray mission is "Hades." All RANCH HAND flights require fighter cover ^{123/} and are flown under the control of a FAC. ^{124/} The mission itself may take 45 minutes or more in the target area because of the necessity to maneuver up and down the sides of mountains. The "spray-on" time is four minutes, which permits the 1,000 gallon tank to be emptied at the rate of three gallons per acre. The "Hades" aircraft fly as low as possible without sacrificing safety and delivery speed is at 130 knots. Each aircraft sprays a swath about 80 meters wide and 16 ^{125/} kilometers long.

Between 18 and 27 sorties are flown daily, six being scheduled out of Da Nang. The number of aircraft flying each mission varies with the target, but generally three or four aircraft spray each target in loose trail formation. Each has a crew of three (pilot, co-pilot, and flight mechanic), except the lead aircraft which has four crew members, the fourth being the navigator for the mission. In the past, these crews were made up of volunteers who received C-123 training at Hurlburt Field (Eglin AFB, Fla.), after which special spray training was given for three-four weeks at Langley AFB. As of 1 July 1967, all training will be conducted at ^{126/} Hurlburt.

The tactics used on spray missions vary with target type and depend, generally, on weather, target terrain, and the amount of ground resistance expected. If the weather is clear, the spray aircraft will remain at altitude (3,000 feet AGL) and then rapidly descend at about 2,500 feet per

minute to spray altitude. If ceilings are low, a low-level approach may be made to reach the "spray-on" point. If terrain permits, one long straight run will be made. Other spray patterns include flying a race track pattern or a "Plum Tree" tactic, which involves making 90 - 270 degree turns at the end of the target area. If the target is discovered to be "hot," the spray aircraft can make one pass and then divert to another target for the rest of the mission. On all spray missions, regardless of the tactics used, a FAC can be very helpful in directing the UC-123s after observing the previous spray run. 127/

In mountainous country, such as Laos, special tactics have been developed. The roads were overgrown with foliage and the path was hard to follow. Sometimes a lead aircraft would fly at a slightly higher altitude, where visibility was greater, and thus be able to lead the other spray aircraft along the road. At the end of one run, a different aircraft would take the lead. Another technique involved throwing smoke grenades to mark the road before starting the spray run. In this case, the procedure is to fly from smoke-point to smoke-point, thereby following the road. A third tactic, not as effective as the other two, is to have the navigator DR the path of the spray aircraft along the road. This technique requires a prior knowledge of the road, however. Along the sides of the mountains, 128/ a contour-type of spraying is employed.

Fighter tactics are also important to the success of the RANCH HAND mission. On a "cool" target, fighters may fly top cover for the "Hades" aircraft and conserve their fuel for a more lucrative target. On some

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other targets, low-level dry runs are sufficient to keep the guns quiet. On hot targets, in a free bomb zone, a prestrike may be called for. This involves the use of CBUs, napalm, 20-mm, or all three. ^{129/} Two different kinds of CBUs are currently used: CBU-2 (anti-personnel) or CBU-12 (white phosphorus). ^{130/} The spray aircraft start their run shortly after the prestrike to take advantage of the ordnance effects. Many times, the FAC will call a post-strike after the spray mission is completed. ^{131/} The effectiveness of the fighter cover can be seen by the declining hit/sortie ratio. For example, in April 1967, 164 hits were taken by 499 sorties. In May, only 88 hits were received while flying 519 sorties. Finally, in June, ^{132/} 67 hits were received by 581 sorties.

When ground fire is received, the flight mechanic, who sits in a bullet-proof box at the rear of the aircraft, will throw a smoke grenade out the rear door. This will generally emit a red smoke, but can be any color. At the same time, the pilot will make a radio transmission to the effect that ground fire was received from the right or left, as the case may be. Due to the lag time associated with the smoke grenade, an accurate strike will be obtained if the FAC will direct the fighters to a point ^{133/} about 300 meters behind the smoke.

At the present time RANCH HAND has a secondary mission, that of spraying insecticide for the control of malaria-carrying mosquitoes. An insecticide test program started on the 14th of October at Bangkok, Thailand, and on 17 October, a combined test and treatment program was started in the RVN. One aircraft currently being used is the UC-123 that made the

"round-the-world" flight, "Patches." This aircraft is not camouflaged because the insecticide has a corrosive effect unless the aircraft is coated with an alodine treatment.

Insecticide spraying involves longer missions and the conservation of fuel becomes critical. On the other hand, it is not as vital to spray along exact coordinates because mosquitoes are migratory insects. RANCH HAND currently flies about 20 sorties per month, dispensing 12,000-13,000 gallons at the rate of 8 ounces of insecticide per acre. At this rate, 134/ one tank of insecticide will cover about 15,000 acres.

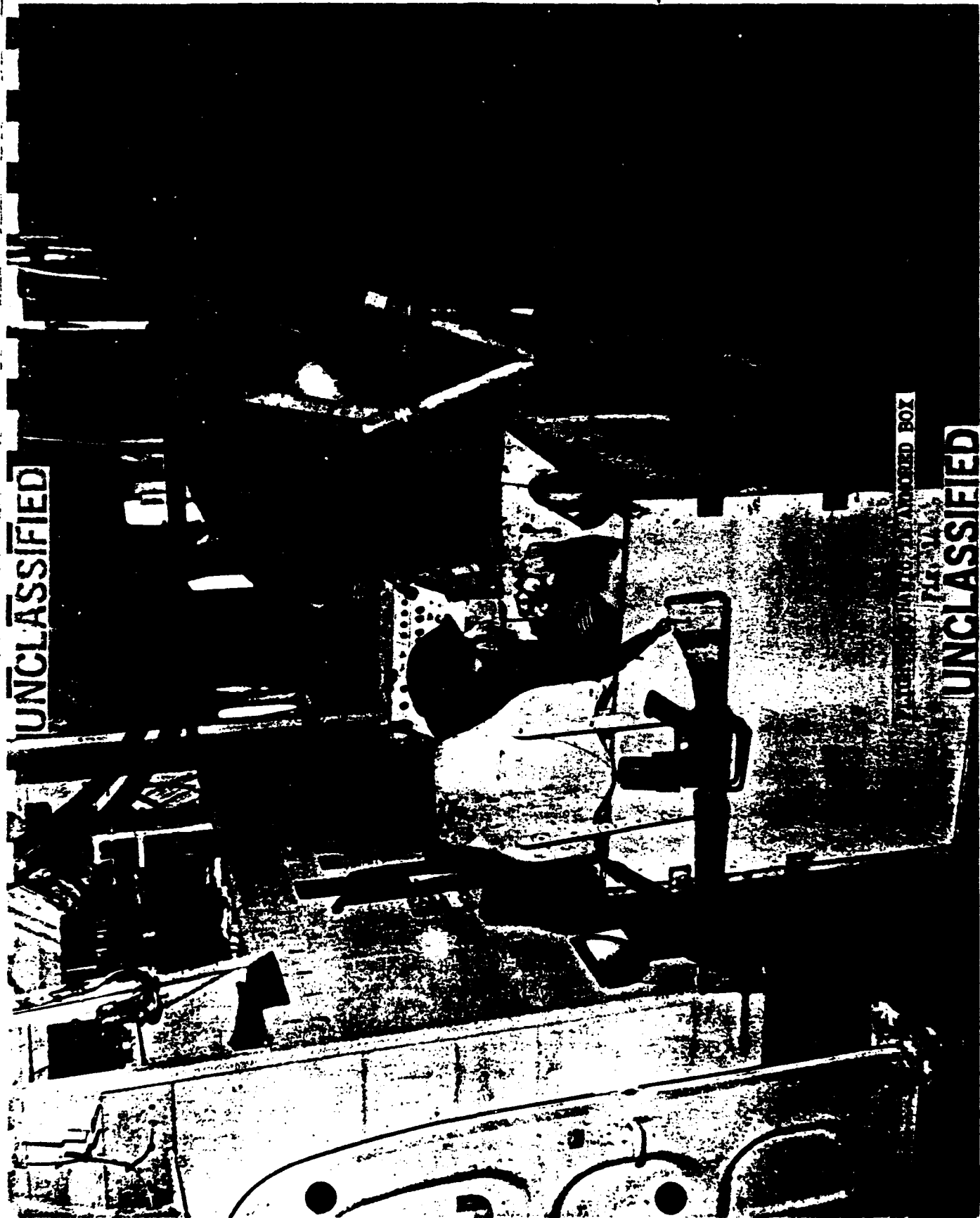
The insecticide aircraft and 15 other CU-123s used for the defoliation and crop destruction missions are stationed at Bien Hoa Air Base. The other three aircraft are deployed to Da Nang Air Base. The operation at Da Nang is limited to flying crews and maintenance personnel, with very little administrative work being done there. The targeting officers maintain target folders and working charts for each project. Other records are 135/ kept at Bien Hoa, where the 12th ACS has its headquarters.

One of the main jobs at both Bien Hoa and Da Nang is that of targeting officer. He is responsible for preparing "frag" requests, attending project coordination and planning meetings, going on the survey flights, preparing and maintaining the project folders, recording and reporting mission results, and maintaining a project chart or log. Frag requests are called in to TACC five days in advance of the mission. In these requests are included the project and target number, fighter rendezvous coordinates, FAC rendezvous coordinates, the time over target, and special requests such

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as flak suppression artillery fire, etc. After the mission, a DAAR is completed and relayed to TACC on a daily basis. ^{136/}

Two modifications in equipment have recently been made to improve the operation. One of these has been the addition of an orange stripe across the top of the aircraft to aid in fighter recognition. Prior to this addition, fighters would have trouble locating the camouflaged spray aircraft until the spray was turned on. The second modification includes a change in ground handling equipment. To facilitate refilling the MC-1 spray tanks, a group of old F-6 refueling trailers have been jointed in tandem. A system of high capacity pumps and manifolds has made it possible for four aircraft to be filled with any of the three herbicides currently in use at the same time. At Da Nang, 12 of these F-6 trailers have been hooked up, providing a storage capacity of 60,000 gallons. At Bien Hoa, 18 trailers are available, giving a storage capacity for 90,000 gallons of herbicide, although only half of the system is hooked up for use. ^{137/}

Characteristics and Availability of Herbicides

The types of herbicides currently in use are Orange, White, and Blue. Orange is composed of 2,4,D (dichlorophenoxyacetic acid) and 2,4,5T (trichloro phenoxyacetic acid) and is used on broad-leaf vegetation and also on mixed targets. It is the best suited for the foliage found in RVN. White (Tordon 101) is composed of trichloropicolinic acid and 2,4,D. It is most effective against broad-leaf vegetation and, because of its low volatility, is used on targets where the spray line is critical. Blue

(Phytar 5606) is a water-based desiccant and kills by drying. It is composed of sodium cacodylate and dimethylarsinic acid and is used primarily for 138/ grass-type t rgets.

It should be emphasized that these chemicals are non-toxic, non-corrosive (except for Blue which is slightly corrosive in nature), and generally not harmful to any form of human or animal life. The aircrews are exposed to it daily and, in the U.S., defoliants of this type are used on over 400 million acres annually. Defoliants, in general, have been used for the past 20 years without ill effects and ARVN troops have been exposed to it for the past few years without harm. Defoliants are non-poisonous and food or water may be consumed without fear of the resulting effects. Reportably, some RANCH HAND personnel have actually ingested some of the agents during demonstrations to show that there is no danger. 139/ The spray does not poison the soil, which may be replanted after irrigation or 140/ replowing.

Prior to FY 67 there were isolated cases where the RANCH HAND opera- 141/ tion was slowed up or temporarily stopped because of the lack of herbicide. However, during the last half of 1966, it became apparent that a herbicide shortage was developing which might have long-range effects on the entire herbicide concept. The reasons for this shortage appeared to be: (1) the programmed increase in RANCH HAND aircraft available for herbicide missions, (2) increase in the efficiency of the operational units using the chemicals, (3) the increasing number of project requests and the improved responsiveness to these requests, and (4) the introduction of major defoliation

projects such as the DMZ program. ^{142/}

Various proposals for the solution of the shortage problem were presented to MACV during the latter part of 1966. These included the suggestion that a substitute herbicide, effective only against broad leaf vegetation, be procured. This proposal was unacceptable because jungle foliage is too varied for this substitute to be effective. Another suggestion involved using a modified but less destructive mixture, which also was unacceptable since it would require an increase in the number of sorties. A third alternative was to mix the herbicides with 50 percent diesel fuel. COMUSMACV rejected these proposals and asked DOD to explore all possible sources to obtain the additional quantities of herbicide ^{143/} requested.

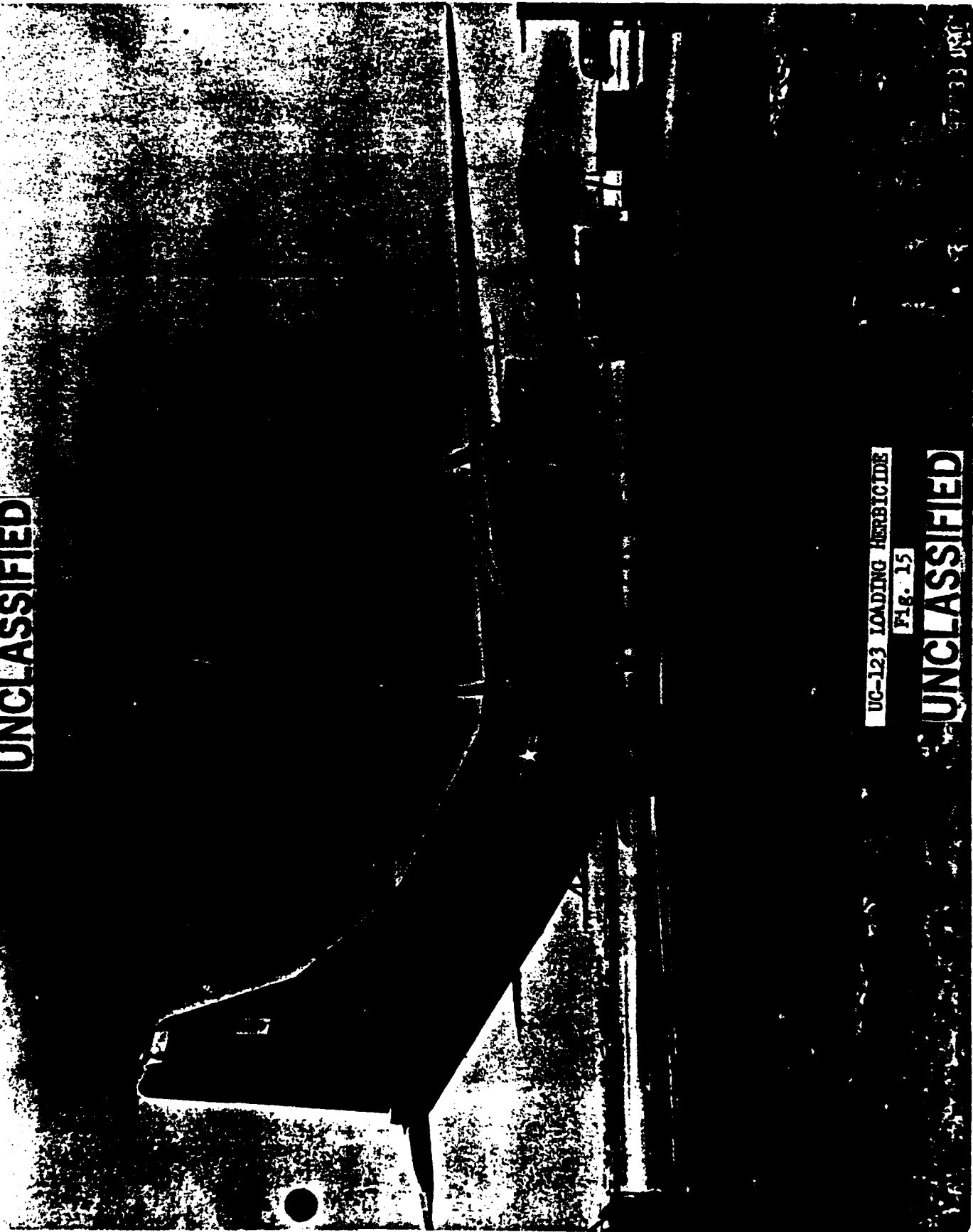
By January 1967, MACV had revised the requirements for FY 67 and FY 68. For FY 67, the total requirement would be 6.44 million gallons. This meant a shortage of some 2 million gallons predicted by June. For FY 68, the revised estimate was 11.9 million gallons leaving a shortage of nine million gallons expected for this time period. ^{144/} Even 11.9 million gallons seems conservative when all valid FY 68 target areas are considered. The requirements for FY 69 appear to be about the same as FY 68, based on ^{145/} aircraft delivery capability.

The responsibility for establishing and submitting herbicide requirements rests with COMUSMACV. The herbicides are actually procured by Defense General Supply Center, based on these annual FY requirements. SAAMA

has the responsibility for initiating purchase requests, which are sent to DGSC, and for shipping the herbicide to SEA. The Vietnamese Army is responsible for accounting procedures and issuing the herbicide. This responsibility extends from the time the chemicals are off-loaded in 146/ country to receipt by the dispersing unit.

As FY 67 progressed, MACV stated that any proposal which would degrade the herbicide program, with attendant intangible costs in lives and equipment, was unacceptable. 147/ An evaluation of the effects of Orange and White agents showed that the two chemicals compared favorably over an extended period of time. The advantage to Orange was that it reacted faster, while White is less volatile and can be used near friendly 148/ areas. Still, the effects of White are approximately the same once the chemical has taken effect and observations of defoliated areas showed 149/ that White was about as effective as Orange after a six-month period. Therefore, White was to be used as a substitute for Orange to make up the deficit in herbicide through FY 69. MACV has accepted White in this capacity and long-term plans for expansion of Orange-producing facilities in the U.S. have been postponed until future requirements for SEA become firm and until projects for the development of new and more effective 150/ herbicides are completed.

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UC-123 LOADING HERBICIDE

FIG. 15

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CHAPTER IV

RESULTS AND EFFECTS

The visible effects of the spray vary, depending upon the agent used and types of foliage in the spray area. The first effects of Blue are visible within 24 hours. However, agent Orange is the quickest reacting, killing in four to seven days. White takes about four weeks for visible effects to occur. After six weeks most of the leaves are dead, but it takes up to four months to be able to see through to the ground. Some dense jungle foliage requires two applications of Orange before the upper and lower vegetation is completely defoliated. Grasses, on the other hand, are killed within the first week. 151/

Most crops die within a few days. A few types may be salvaged if immediate action is taken by the farmer. Rooted vegetables, such as carrots and potatoes, are examples. Cabbages can be partially saved if the outer leaves are removed and the cabbage washed. Some trees sprout new shoots within two or three months if the tree had not died as the result of the spray. Bamboo and banana trees have some resistance to certain types of spray, but not to all of the herbicides. 152/

The results of defoliation and crop destruction show the value of this technique as a tactical weapon. Defoliation around bases, lines of communication, and infiltration routes has greatly increased vertical visibility. This permits us to observe the actions of the enemy and prevent his resupply activities and ambush operations. This also provides friendly

troops with security during road clearing operations and other activities. ^{153/}

Herbicide operations in I Corps have made a favorable impression on the field commanders and there exists a desire for continued and increased activity, with special emphasis placed on developing quick-response to the field requirements as they develop. Recently, the Commanding General in I Corps praised the results of spray activity for improving the security of Camp Carroll and for reducing the threat of ambush along Route 9, Quang Tri Province. His general comments cited the following results of herbicide operations: ^{154/}

- (1) Enhancement of visual observation by ground and aerial reconnaissance.
- (2) Improvement of fields of fire.
- (3) Interdiction of LOCs.
- (4) Reduction of enemy ambush capability.

The Commanding General of II Corps agrees that defoliation results in increased visibility and greater security. He would like to see defoliation aircraft positioned in II Corps. ^{155/}

The VC Propaganda

Since the early testing period of the herbicide operation, VC propaganda has been increasing in magnitude and hostility. It is usually aimed at the GVN and the U.S. for using chemicals in the war. ^{156/} The propaganda

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AERIAL VIEW OF DEFOLIATED AREA

Fig. 16

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does not seem to differentiate between the use of chemicals for defoliation purposes and that used for crop destruction. It generally attacks the U.S. for the horrible atrocities the spray has caused. Examples of some typical terminology are: "US aggressors have lost all human character," or "behaving like a pack of deranged dogs, like a pack of blood thirsty devils who outdo even the Hitlerite fascists in ferocity."^{157/}

The VC propaganda usually is disseminated by radio broadcasts or by VC cadre meeting in the villages. Both methods exaggerate the effects of the spray and attempt to arouse hatred in the hearts of the people. The radio reports emphasize the effects on animals and small children or old people, claiming all manners and types of illnesses. An example is contained in the following statement of NFLSV Central Committee:^{158/}

"In the past few years, thousands of persons were killed and hundreds of thousands of others affected by US toxic chemicals. Recent preliminary investigations by the NFLSV Medical Committee and the Liberation Red Cross showed that in some localities the number of persons killed by US chemical poisons had increased 30 percent. Fifty-six percent of the local population got intestinal diseases by eating poisoned food, and 75 percent of them become consumptive. More barbarous still, US poison substances have killed fetuses and seriously affected milk secretion of many mothers and rendered them unable to feed their babies...Moreover from 50 to 60 percent of the draught animals lost their vigor and stopped breeding, while the poultry were completely killed."

It must be remembered that the chemical spray is non-toxic and has had no effects on aircrews or ARVN regular troops, nor have there been any ill-effects reported during use of these chemicals in the United States.^{159/}

Yet the VC propaganda campaign is vigorous and descriptive. After a 160/ defoliation operation in Kien Hoa, a report claimed the following:

"So far, nearly 500,000 people, the bulk of the province population, have been affected more or less seriously. 46,000 of them, mostly women, children, and old folks, are in a grave state, getting itchy all over their bodies, nausea and swellings. The body of Mme Khai of Hoa Than Hamlet Two, Luong Hoa village, Giong Trom district, was swollen to the point that she could hardly walk. Mr. Tai's children, two boys and one girl died after eating poisoned fruit. Mrs. Muoi's 3 year old boy, of Long My village, same district, who was playing in his mother's arms, suddenly died after violent throes... In addition, hundreds of people seriously affected were sent to hospitals. Toxic chemicals exerted also a damaging effect on domestic animals. Hundreds of head of cattle were killed by eating poisoned grass. Thousands of others were affected. Tens of thousands of poultry, pigs and dogs died also."

Much of our knowledge of VC propaganda techniques is derived from interrogation of VC deserters or captured troops and documents. One VC returnee claims that after any defoliation mission, special cadre move into the villages nearby and attempt to arouse feelings of hate and resentment against the U.S. for conducting the defoliation operations and also against the ARVN for permitting "chemical warfare" to be carried out. 161/

The propaganda program of the VC is evidence they fear the results of herbicide activity and, almost in desperation, are trying to negate the results of such operations. They are unable to protect the people from the results of the spray and the people associate spray activity with the presence of VC troops in the area. 162/ It is realized that repeated crop destruction could cause long range food shortage, thus the people attempt to leave for

areas controlled by the GVN. This hurts the VC even more since there are then fewer peasants to produce crops for the troops. ^{163/} Therefore, the propaganda is designed to retain the support of the people by putting the blame for their hardships on the GVN and U.S. ^{164/}

Crop Destruction Effectiveness

Crop destruction missions have probably hurt the VC most. It has resulted in the destruction of their immediate food supply (as much as 70 to 80 percent of civilian production may go to VC in the area) ^{165/} and made it imperative they bring food in from other areas or move to new positions. If they bring food in, troops are tied up in the process of production and resupply that would otherwise be available for tactical operations. If they move to another area, any long range offensive plans from the former base have to be cancelled. Their base defense measures and equipment must be uprooted and the whole unit is displaced. This requires time which otherwise could be used in maneuvers against U.S. and ARVN activities. In addition, when VC troops are required to move into a new area, the civilian populace are embittered because their own food supply must be used to feed the VC. ^{166/}

In order to prevent the necessity for moving to a new area, the VC have undertaken food preservation programs. Harvested food is covered with plastics and other tight-fitting material to avoid contamination by the spray. ^{167/} Local farmers are advised by the VC to scatter their crops, to intermix vegetable plots with rice paddies, thereby making them less

vulnerable to spray operations in any one area. ^{168/} One contingency plan called for the immediate harvesting of crops following the spray mission in hopes of salvaging portions of the crop. ^{169/} Other attempts to offset the effects of crop destruction include increased emphasis on animal husbandry and wildlife preservation. ^{170/}

If attempts to store food and protect crops from the spray are unsuccessful, then the VC must obtain food by other means. Usually VC dietary staples, such as rice and vegetables, are procured by increased taxation, purchases, and transportation of supplies from local caches or from rice depots in SVN and other locations outside of SVN. ^{171/} VC mobile units usually carry only enough food for one day and must rely on obtaining additional food from villages they pass through. ^{172/} This results in a food shortage for both VC and civilians, especially if crops in the area have been sprayed. The unwillingness of the civilians to give up food to the VC was displayed when, during a food shortage in Quang Tri Province in late 1966, VC had to enter hamlets that had not been hit by spray missions and acquire food by force. ^{173/}

In 1966, the total area covered was double that sprayed in 1965; ^{174/} however, the total amount of food destroyed by crop destruction operations amounted to only two percent of the total produced in SVN. ^{175/} Crop destruction efforts, however, have been successful because of selective targeting procedures and VC food rations have been reduced up to half the normal amount following crop destruction operations in some VC controlled areas. ^{176/} A captured NVA combat support company commander reported that

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crop destruction operations have caused both military and civilian food shortages, particularly vegetables. ^{177/} Another document states that loss of crops is a significant and urgent problem and calls on various districts ^{178/} to expedite rice collections to meet combat requirements.

Other captured documents and statements reveal that the chemicals are very effective against most types of crops. One VC has reported hearing of a defoliation operation in the Boi Loi area, in July 1966, which killed many food crops: "The affected crops were rice, peanuts, tomatoes, cucumbers, mangoes, bananas, and peppers. After two days all the crops died. First the bananas, then peanuts, rice, cucumbers, tomatoes, peppers, and finally the mangoes died." ^{179/} Another report stated: "The powder sprayed in the first defoliation destroyed all fruit, rice, potato, and manioc crops." ^{180/} Many other reports talk of the destruction of various crops, the spray missions that caused the killing, and the resulting food shortages that develop. ^{181/}

Result of Defoliation

Defoliation missions caused almost as much trouble for the VC. These operations destroy their safe havens, curtail their ambush activities, provide the environment for better reconnaissance of VC movements and operations, and damages the morale of the troops. ^{182/} Among some tactical troops, defoliation which exposes their position is feared as much or more than crop destruction. One captured VC stated: "The canopy of the forest was destroyed by the defoliant spray within two or three days, but the

undergrowth was not affected to any great extent. The VC feared discovery of their locations much more than they feared destruction of crops by defoliation." ^{183/}

Because defoliation does expose the position and the operations of the VC, many times the sprayed area is evacuated following the spray attack. Area defoliation projects have been successful along these lines. Early efforts in safe haven defoliation in the Go Gong Province resulted in the VC completely evacuating the area, thus assisting the province in their pacification efforts. ^{184/} Another example of area evacuation occurred when the banks of the Vai Co river were defoliated and the VC left their sheltered positions there. ^{185/}

The VC do not like to move, however. As previously mentioned, this requires giving up all plans and base defensive operations. It causes the unit to be exposed to our reconnaissance and strike aircraft, and they must either move or fight to stay where they are. ^{186/} Before crossing defoliated areas, VC units may wait for nightfall, ^{187/} use camouflage, ^{188/} or proceed individually and regroup after the entire unit is across the defoliated area. ^{189/} In any case, valuable time is wasted.

Because of the disruptive effects of defoliation, the VC attempt to prevent this type of activity. One order that appeared in a captured document points out the VC prohibit cutting of trees along highways and impose rather severe penalties on violators. ^{190/} They fire on defoliation aircraft, even though they will probably receive a strike by the fighters, because they have exposed their position. ^{191/} When they can gain advance

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DEFOLIATION ALONG ROADS & POWER LINES

Fig. 17

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warning of the spray mission, they may preposition troops to attempt to shoot down the spray aircraft. Another attempt to curtail spray activity involves placing Claymore mines in the tops of trees and setting them off when the aircraft fly close enough. ^{192/}

Effects on VC Morale

One of the principle effects of herbicide operations is the damage to VC morale. The VC troops become demoralized when they have to break camp or attempt to procure food, after spraying had destroyed their immediate supply. They will not usually eat food once it has been sprayed. ^{193/}

The members of food production units are especially demoralized when their efforts prove to be futile. ^{194/} When crop destruction and defoliation activity causes the civilians to turn against them and leave the area, the VC again are discouraged. In cases of civilian dislocation, the VC not only lose the food but also the labor which was producing it, and VC gains from taking over the abandoned property seldom are equal to the loss of productive effort by the departing refugees. ^{195/}

Another demoralizing factor is noted in their own propaganda. Even some leaders have misconceptions of the effects of the herbicides. ^{196/} VC medical officers instruct members of units not to eat the contaminated food as it would "damage their health and cause stomach and liver disorders." ^{197/} One recommendation to those who are exposed to the chemicals is to eat green bean soup. ^{198/} Another official VC document discusses plans to "research the utilization of charcoals and ashes to counteract the effects of poison,

to draw the poison out of the surfaces of rice seeds and coconuts in order to utilize them," and directs the units to not allow livestock to graze in sprayed areas or to be given food that has been sprayed. ^{199/} VC officials also instructed the men to wear homemade or issued gas masks as "bodily contact would cause physical harm or in some cases even death." ^{200/} Propaganda of this type causes concern among the VC troops because of the suggested dangers associated with the spray. ^{201/} On the other hand, it sometimes tends to strengthen their motivation because they feel the poor civilians are being exposed to undue hardships. ^{202/}

Effects on Civilian Populace

The effects on the civilians are somewhat harsh if they are located within a VC controlled area. Many of the civilians do not understand why the crops and trees are being defoliated. One former Main Force platoon leader related: "Almost none of the people understand the purpose of crop destruction by the GVN. They can only see that their crops are destroyed. Added to that, the VC pour propaganda into their ears. Therefore, a number of people joined the VC because they'd suffered from damage." He went on ^{203/} to speculate on the use of spray for maximum effectiveness:

"In my opinion, to get the maximum result out of the sprayings, the GVN should warn the people beforehand and explain to them why, call on them to move to the GVN controlled area, and assure them that they'll have plenty of jobs in the GVN areas. When the people understand the purpose of the crop destruction, and if they know that their living is assured in the GVN controlled areas, they won't be resentful towards the GVN. Thus, the chemical would become a perfect weapon."

Many of the captured documents and interrogations reveal the hardships of the people. They point out that the chief sufferer from crop destruction operations is the local worker, because his livelihood is ruined. ^{204/} When crops are partially destroyed, the VC confiscate a greater portion thereby hurting the civilian almost as much as would total destruction of the crops. ^{205/} In areas where crop destruction is heavy, both the VC and the U.S. are blamed for the calamity. ^{206/}

"The villagers felt angry with the GVN and the Americans but they blamed the Front people, whose presence in the area had caused the destruction of their crops by chemical spraying... They blamed everybody (VC, US, and GVN) and said: 'We have suffered too much already. All we ask is peace in order to earn our livings more easily.'"

As the result of the hardship imposed by remaining in VC controlled regions, many people moved to GVN areas. They do not necessarily respond to our psywar techniques or warnings about the forthcoming spray operation but, after the defoliation has occurred, they will leave the area. One VC cadre reported, after one defoliation mission, that about 60 percent of the population had lost faith with the VC and the majority of the civilians moved to GVN controlled areas. ^{207/} Indications are that many times more would leave if the VC would let them. ^{208/}

Spray operations often supply the needed motivation to make the civilian decide to leave the VC area. One returnee reported: ^{209/}

"The truth is, if these people moved to GVN-controlled areas, it was not only because their crops had been sprayed with chemicals; because since their areas had been hit by bombs and mortars, they had already had the

intention to leave; and they would probably have done so, had it not been for the fact they could not decide to part with their crops. Now that their crops were destroyed by chemicals, they no longer had any reason to be undecided...."

There have also been cases of accidental destruction of crops in friendly areas. In two cases, aircraft with engine failures have had to dump the spray over a friendly area. In other cases, leaking from the spray nozzles has caused some damage. ^{210/} One recent incident reportedly caused damage to a rubber plantation in III Corps. After an investigation by U.S. authorities, it was determined that seven plantations had actually suffered damage to the trees. The trees will recover, but the plantations will have suffered production loss during the latex tapping periods. ^{211/} Increased emphasis is being placed on maintenance programs and preflight tests to minimize this type of accidental damage. ^{212/}

Epilogue

RANCH HAND can expect to have its operation expanded even more during the ensuing months. The acceptance of the herbicide program and the favorable evaluation of its effects by field commanders makes it clear that this operation will increase in the future. According to Lt. Col. Dennis, RANCH HAND Commander, it will be feasible to dispense the desired quantities ^{213/} providing the number of aircraft and crews are increased proportionately. One important project that will be begun soon will be the defoliation of ^{214/} the northern portion of the DMZ.

Some forms the expansion of RANCH HAND may take involve the proposed

positioning of more F-6 refueling trailers at various places in-country to facilitate reloading of aircraft with herbicide. Suggested spots include Pleiku, Nha Trang, Qui Nhon, and Phu Cat. Spray aircraft may also be deployed to different areas in I Corps and II Corps. In addition, the Surgeon General has expressed a desire to acquire two additional spray aircraft for use in the insecticide program. ^{215/}

CBU-19 (tear gas) may be used by the fighters in the future as a means of securing the target area before spray activity. Army gas masks may be supplied to the RANCH HAND crews for their protection and other protective equipment has been proposed. Aerospace Medicine is concerned with neck protection for the crew and is developing a flak-resistant collar to be worn during the mission. A ceramic vest is also being purchased for the crews. Lastly, as an additional safety feature, the RANCH HAND aircraft ^{216/} have been equipped with locally designed windshield washers.

In the past six years, the herbicide concept has grown from a research and development test program into an effective tactical operation. Statements from the enemy confirm that operations are producing the desired results. Military and government leaders from both the United States and GVN have consistently evaluated the herbicide program as an effective tactical weapon and expressed the desire for continued and expanded activity in both defoliation and crop destruction projects.

While the immediate result of herbicide activity is the destruction of crops and vegetation, Lt. Col. Dennis points out there may be some long-range

benefits derived from this operation. Defoliation may prove to be economically profitable by assisting in the clearance of large areas to be used for farming, as is now being done in the delta. The dead timber can possibly be converted to useful charcoal. Cleared areas will not suffer from erosion problems since the root systems of the vegetation are left intact and the land will have been almost completely cleared at the cost of about twenty-six dollars an acre. Therefore, what may presently appear to be a completely destructive operation may, in fact, be a worthwhile investment for the people of Vietnam.

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FOOTNOTES

1. (S) Draft, Herbicide Operations in RVN, 1 June 1965; in the files of 12th ACS.
2. (S) Herbicide Operations in the Republic of Vietnam, undated; Doc. 1. (Hereafter referred to as Herbicide Operations Report.)
3. (S) TAC Aerial Spray Flight Operations in Southeast Asia, 1961-1964, undated; Doc. 2. (Hereafter referred to as TAC Aerial Spray Flight Report.)
4. Ibid.
5. (S) Ibid. See also: History of the 13th Air Force, January-June 1963, Vol. 1; in CHECO files.
6. (S) Herbicide Operations Report. See also: TAC Aerial Spray Flight Report.
7. (S) Draft, Defoliation and Ranch Hand in the Republic of South Vietnam, 1 July 1965, Doc. 3. (Hereafter referred to as Defoliation and Ranch Hand Report.)
8. (S) Herbicide Operations Report.
9. (TS) Hq USMACV Command History 1964; material extracted is (S).
10. (S) TAC Aerial Spray Flight Report. See also: Defoliation and Ranch Hand Report.
11. Ibid.
12. (S) Defoliation and Ranch Hand Report.
13. (S) TAC Aerial Spray Flight Report.
14. (S) Herbicide Operations Report.
15. (S) TAC Aerial Spray Flight Report.
16. Ibid.
17. (TS) Hq USMACV Command History 1964; material extracted is (S).
18. (S) TAC Aerial Spray Flight Report. See also: Defoliation and Ranch Hand Report.

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19. (S) Draft, Herbicide Operations in RVN, 1 June 1965; in the files of 12th ACS.
20. (S) TAC Aerial Spray Flight Report.
21. Ibid.
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23. Ibid.
24. Ibid.
25. (S) Herbicide Operations Report.
26. Ibid.
27. Ibid.
28. Ibid.
29. Ibid.
30. Ibid.
31. (S) Defoliation and Ranch Hand Report.
32. (S) Report, Evaluation of Crop Destruction in RVN, 1 July 1966; in 12th ACS files.
33. (TS) Hq USMACV Command History 1964; also:
(S) Herbicide Operations Report. Material extracted from TS document is (S).
34. (S) Report, Evaluation of Crop Destruction in RVN, 1 July 1966; in files of 12th ACS.
35. (S) Defoliation and Ranch Hand Report.
36. Ibid.
37. (C) Herbicide Program in RVN, 18 December 1964, Doc. 4.
38. (S) Draft, Herbicide Operations in RVN, 1 June 1965; in files of 12th ACS.
39. (S) Msg, COMUSMACV to CINCPAC, 161020Z January 1967, Doc. 5.
40. (C) Herbicide Program in RVN, 18 December 1964; Doc. 4.

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41. Ibid.
42. Ibid.
43. Ibid.
44. (S) Msg, COMUSMACV to CINCPAC, 161020Z January 1967, Doc. 5.
45. (C) Herbicide Program in RVN, 18 December 1964, Doc. 4.
46. (S) Summary of Defoliation Operations from 1 January 1965 to 8 March 1965, undated; also,
(S) Defoliation and Ranch Hand Report.
47. (S) Defoliation and Ranch Hand Report.
48. (U) Report, Operation Sherwood Forest, undated; in CHECO files. Also,
(S) Defoliation and Ranch Hand Report;
(S) Summary of Defoliation Operations from 1 January 1965 to 8 March 1965, undated.
49. Ibid.
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54. (S) Defoliation and Ranch Hand Report; also,
(S) Report, Evaluation of Crop Destruction in RVN, 1 July 1966; in 12th ACS files.
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56. (S) Summary of Defoliation Operations from 8 March 1965 to 30 June 1965, undated.
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81. (C) Seventh Air Force Daily Intelligence Operation, Nr 127, 21 June 1966.
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87. Personal Interview with Capt W. Marshaleck, Targeting Officer for 12th ACS from August 1966 to July 1967.
88. (S) Msg, COMUSMACV to CINCPAC, 270515Z August 1966.
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- 110. Personal Interview with Capt W. Marshaleck, Targeting Officer for 12th ACS from August 1966 to July 1967.
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- 121. (U) Ranch Hand Briefing Notes, undated, Doc. 11.
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APPENDIX I *

OPERATIONAL DATA

1. Defoliation Results

<u>CALENDAR YEAR</u>	<u>AREA DEFOLIATED</u>
1962	20.1 km ²
1963	87.3 km ²
1964	257.7 km ²
1965	655.2 km ²
1966	3,658.5 km ²

2. Crop Destruction Results

<u>CALENDAR YEAR</u>	<u>CROPS DESTROYED</u>
1962	750 Acres
1963	197½ Acres
1964	15,215 Acres
1965	68,250 Acres
1966	117,770 Acres

3. Aircraft Availability

<u>YEAR</u>	<u>AVERAGE NUMBER AIRCRAFT ASGD</u>
1962	3
1963	3
1964	3.5
1965	3.66

<u>YEAR</u>	<u>AVERAGE NUMBER AIRCRAFT ASGD</u>
1966	9.16
1967 (Estimate)	20.16
1968 (Estimate)	24.00

4. Hits Received by UC-123s

Pre 1966 - 787
 1966 - 894
 1967 - 693 (1st 6 months)

5. Comparison of Sorties Flown by RANCH HAND

	<u>1965</u>	<u>1966</u>	<u>1967</u>
Jan	55	188	554
Feb	61	174	520
Mar	23	149	534
Apr	21	145	499
May	75	194	519
Jun	0	192	581
Jul	40	130	
Aug	24	202	
Sep	43	247	
Oct	64	315	
Nov	108	407	
Dec	182	416	

* (Source: (S) Msg, COMUSMACV to CINCPAC, 161020Z January 1967.)

APPENDIX II *

HERBICIDE DELIVERY ESTIMATES
(in thousands of gallons)

<u>FY1968</u>	<u>BLUE</u>	<u>ORANGE</u>	<u>WHITE</u>	<u>TOTAL</u>
Jul 1967	48	300	180	528
Aug	48	325	180	553
Sep	48	350	180	578
Oct	48	350	225	623
Nov	48	325	300	673
Dec	48	375	400	823
Jan 1968	48	375	400	823
Feb	48	375	400	823
Mar	48	375	400	823
Apr	48	375	400	823
May	48	375	400	823
Jun	48	375	400	823
<u>FY1969</u>				
Jul 1968	48	400	400	848
Aug	48	400	400	848
Sep	48	450	400	898
Oct	48	700	250	998
Nov	48	750	200	998
Dec	48	800	150	998

	<u>BLUE</u>	<u>ORANGE</u>	<u>WHITE</u>	<u>TOTAL</u>
Jan 1969	48	800	150	998
Feb	48	800	150	998
Mar	48	800	150	998
Apr	48	800	150	998
May	48	800	150	998
Jun	48	800	150	998

* (Source: (S) Msg, JCS to RUHLHQ/CINCPAC, 072115Z April 1967.)

APPENDIX III

SUMMARY OF IMPORTANT EVENTS FOR
HERBICIDE OPERATIONS IN SEA

<u>DATE</u>	<u>EVENT</u>
August 1961	First research test was conducted.
December 1961	Six RANCH HAND aircraft arrived at Clark AFB.
January 1962	Three aircraft were deployed to Tan Son Nhut.
January 1962	First experimental mission was flown.
June 1962	Authority for defoliation missions was granted to Ambassador/COMUSMACV.
July 1964	Authority for crop destruction missions was granted to Ambassador/COMUSMACV.
January 1965	Fighter prestrike was used for the first time during Project Sherwood Forest, the first "fire storm" project.
December 1965	Operations began over Laos.
June 1966	First RANCH HAND aircraft to be lost during a tactical mission was destroyed.
October 1966	12th ACS was administratively formed.
October 1966	Insecticide missions began.
November 1966	Approval granted to defoliate the southern portion of the DMZ.
December 1966	RANCH HAND moved to Bien Hoa.
January 1967	Defoliation missions were completed for Project Pink Rose.
June 1967	Approval granted to defoliate the northern portion of the DMZ.

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GLOSSARY

ACS	Air Commando Squadron
AGL	Above Ground Level
AMEMB	American Embassy
ARVN	Army, Republic of Vietnam
CBU	Cluster Bomb Unit
CDEL	Combined Document Exploitation Center
CDTC	Chemical Division Test Center
CHMAAGV	Chief, Military Assistance Advisory Group, Vietnam
CINCPAC	Commander in Chief, Pacific
CMIC	Combined Military Interrogation Center
COMUSMACV	Commander, United States Military Assistance Command, Vietnam
CY	Calendar Year
DAAR	Daily After Action Report
DGSC	Defense General Supply Center
DMG	Demilitarized Zone
DOD	Department of Defense
DODIIR	DOD Intelligence Information Report
FAC	Forward Air Controller
FY	Fiscal Year
JGS	Joint General Staff
JUSPAO	Joint U.S. Public Affairs Office
MACV	Military Assistance Command, Vietnam
MACV-COC	MACV Combat Operations Center
NIC	National Interrogation Center
NVA	North Vietnam Army
NVN	North Vietnam
POLWAR	Political Warfare
RVN	Republic of Vietnam
RVNAF	Republic of Vietnam Air Force
SAAMA	San Antonio Air Materiel Area
SASF	Special Aerial Spray Flight
SEA	Southeast Asia
SIC	Special Interrogation Center
SVN	South Vietnam

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TACC
TDY

Tactical Air Control Center
Temporary Duty

USAID

United States Agency for International Development

VC

Viet Cong

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