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USAF PLANS AND POLICIES
R&D FOR SOUTHEAST ASIA
1965-1967

by

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FOREWORD

USAF Plans and Policies: R&D For Southeast Asia, 1965-1967 is the most recent publication by the Office of Air Force History (AFCHO) dealing with the war in Vietnam.

The author first considers--within the context of the U.S. Southeast Asian policy--the evolution of limited war R&D concepts prior to 1965 and then shows how these influenced USAF research and development programs in this area during 1965-1967. He examines the changes that the Air Force had to make in its R&D funding procedures, organization, and policies as it made the transition from peacetime to a war situation. He also reviews the development of conventional weapons and munitions as the Air Force shifted its emphasis from nuclear to limited war R&D.

Previous AFCHO studies on the war include: USAF Plans and Policies: Logistics and Base Construction in Southeast Asia, 1967; USAF Plans and Operations: The Air Campaign Against North Vietnam, 1966; USAF Deployment Planning for Southeast Asia, 1966; USAF Logistic Plans and Policies in Southeast Asia, 1966; USAF Plans and Operations in Southeast Asia, 1965; USAF Logistic Plans and Policies in Southeast Asia, 1965; USAF Plans and Policies in South Vietnam and Laos, 1964; and USAF Plans and Policies in South Vietnam, 1961-1963.

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I. R&D FOR LIMITED WAR

(U) During the mid-1950's, the United States Air Force, with the approval of the Eisenhower administration, concentrated the bulk of its resources on research, development, and acquisition of strategic and tactical nuclear weapons and the aircraft to deliver them. A decade later, when the United States intervened in Southeast Asia to prevent the overthrow of the Republic of Vietnam (RVN) by North Vietnam, it became clear that--as Gen. James Ferguson, Commander of the Air Force Systems Command (AFSC) put it--"our collective foresight has not been as perceptive as it might have been."[1] Heavily armed and prepared to destroy any enemy with nuclear weapons, the Air Force found itself handicapped to fight a jungle war and forced into accelerated research and development (R&D) programs to make up for years of neglect of conventional weaponry and munitions.

(U) There were, however, understandable reasons why the Air Force and the administration--in the aftermath of the Korean War--decided to emphasize strategic nuclear deterrent forces. For one thing, the bitter events of 1950-1953 with their domestic political implications led many civilian and military leaders to adopt the view that limited wars of the Korean variety ought to be avoided. The primary reason, however, for the emphasis on building a superior nuclear force was that it was vital to deter a "Pearl Harbor" type of surprise attack on the United States and its Allies by the nuclear-armed Soviet Union. Top Air Force officials supported the view that building the nuclear deterrent required the highest national priority. Many also suggested that such a superior nuclear force could be used to deter limited wars as well.[2]

([redacted]) Although in the late 1950's certain USAF officers argued that much more substantial resources should be devoted to the tactical force,* the overwhelming view remained that funds programmed for the general war force should not be channeled elsewhere. This opinion was expressed in November 1958 and February 1959 by Gen. Thomas D. White, USAF Chief of Staff. At that time, tactical air commanders proposed acquisition of aircraft for the 1960's which could operate effectively in all kinds of weather and from austere bases. According to this view, one of the Air Force's urgent requirements was for an all-weather reconnaissance strike bomber which could be used effectively at night. However, by 1959--with strenuous efforts under way to build an intercontinental ballistic missile (ICBM) force--it was clear that existing funds were destined for the higher priority weapons.[3]

Change in Emphasis

([redacted]) Concurrent with the early, limited (but increasing) American involvement in Vietnam, President John F. Kennedy assumed office in January 1961 and soon made known his intention to strengthen U.S. conventional and counterinsurgency (COIN) forces. On 8 March his Secretary of Defense, Robert S. McNamara, ordered an extensive review of defense policies and projects, including R&D programs related to limited war. Recommendations made in several studies undertaken by Department of Defense (DOD) agencies led to a Presidential decision to seek $122 million

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* Pre-eminent was Gen. Otto P. Weyland, Commander of the Tactical Air Command (TAC).

in new obligational authority "to speed up current limited warfare research and development programs and to provide for the initiation of entirely new programs." In a special message to Congress on 28 March 1961, the President warned that the Free World's security could be endangered "not only by nuclear attack, but also by being slowly nibbled away at the periphery, regardless of our strategic power, by forces of subversion, infiltration, intimidation, indirect or non-overt aggression, internal revolution, diplomatic blackmail, guerrilla warfare or a series of limited wars."[4]

([redacted]) Subsequently, the Alvarez panel*--commissioned to analyze limited war requirements for fiscal year 1963--issued two reports which warned that the United States was giving undue attention to the nuclear deterrent and pointedly recommended that much greater attention be devoted to non-nuclear tactical resources. The panel noted that the Air Force was basing its requirements primarily on general war and that research on non-nuclear ordnance, reconnaissance, and detection devices had been neglected. It recommended, among other things, that reconnaissance and strike capabilities be joined in a single plane. The panel also was critical of the serious neglect of the USAF tactical force.[5]

([redacted]) In January 1962--not long after the release of the Alvarez report--AFSC moved to meet the criticism by establishing the Office of the Assistant for Limited War (SCS-6) at its headquarters. Also, in April 1962, the Air Force formed the USAF Special Air Warfare Center (SAWC) at Eglin AFB, Fla., with the 1st Combat Applications Group (CAG) organized as a combat systems development and test agency under the SAWC.

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* Dr. Luis W. Alvarez, Lawrence Radiation Laboratory, University of California, was chairman of the panel, reporting to Dr. Harold Brown, Director of Defense Research and Engineering (DDR&E).

The 1st CAG concentrated on testing and evaluation of primarily short-term projects which might improve Air Force COIN operations. The Special Air Warfare Center was actually located at Hurlburt Field--part of Eglin AFB--and it undertook to develop tactical air doctrine while training crews for special air warfare in places like Southeast Asia. By mid-1963, SAW groups were in Vietnam and Panama. Further, the Air Force established the Tactical Air Reconnaissance Center (TARC) at Shaw AFB in May 1963 and the Tactical Air Warfare Center (TAWC) at Eglin AFB in September 1963.[6]

[redacted] Meanwhile, in one of his first moves to help the South Vietnamese government, the President in late April 1961 approved establishment of a combat development and test center (CDTC-V) in Saigon, South Vietnam. The center, comprising both Vietnamese and U.S. personnel, was placed under the control of the Vietnamese Joint General Staff. The American element consisted of the Advanced Research Projects Agency's research and development field unit in Vietnam (ARPA-RDFU-V). ARPA was under the control of the Director of Defense Research and Engineering.

[redacted] In June 1961--following the President's authorization of the CDTC-V--the Office of the Secretary of Defense (OSD) approved an ARPA proposal to conduct research, development, testing, and evaluation (RDT&E) for "remote area conflict." Called Project AGILE, this operation was supervised by ARPA's Director of Remote Area Conflict, Army Maj. Gen. R.H. Wienecke.* In November 1961, a combat development and test center was formed in Bangkok, Thailand (CDTC-T) with a field unit under ARPA/AGILE. Like the Vietnamese unit, the Thailand test center was under the

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* The position of the Director of Remote Area Conflict was established in late 1960 to assist the armed forces of various foreign nations in countering insurgents.

control of the host government. Several USAF officers--from the Office of the Deputy Chief of Staff/Research and Development (DCS/R&D)--were attached to the ARPA/AGILE field units in Saigon and Bangkok.*[7]

[redacted] As an OSD project, AGILE responded to Mr. McNamara's desire to use Vietnam as a laboratory for the development of "sublimited" war concepts. In the beginning, the field unit in Vietnam was organized to apply research and development methods to the problems faced by the Vietnamese Army (ARVN) in combating the Viet Cong insurgency. Emphasis was placed upon rapid solutions to COIN difficulties:[8]

> The objective of all our (AGILE) work is to enhance his (ARVN) effectivness; in particular, to give him weapons, equipment, and techniques... to permit aggressive pursuit of the enemy both day and night. Conversely, if he is not motivated to move out of fixed positions into active pursuit, as is usually the case, all the R&D projects in the world will not affect the course of the war.

In contrast, the Thai center stressed research projects which could be worked out over a longer period of time in a more stable political and military environment. As time passed, however, it became evident that the Vietnamese possessed only a limited ability in the CDTC-V and thus, to an increasing degree, Secretary McNamara felt that Vietnam provided an ideal environment for testing, evaluating, and improving American COIN concepts and operations. Also, with the passage of time, Project AGILE arranged for greater research participation by U.S. laboratories and industry for work which could not be done in the field.[9]

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* In late 1964, ARPA also established a small field office in Beirut, Lebanon.

A Roles and Missions Controversy

[redacted] The OSD directive which established ARPA in 1958--in the aftermath of the Soviet Union's launch of Sputnik I on 4 October 1957--required the military departments to furnish it with the necessary support. During the early 1960's, the Air Force share of ARPA-funded projects averaged about $100 million per fiscal year--approximately 40 percent of the total ARPA program.[10] By late 1964--with the increasing involvement of the United States in Vietnam and the growing view within DOD that many of ARPA's developing programs could better be handled by the military--the agency decided to concentrate on long-term R&D and less on current development programs. The latter included a number of ARPA-funded projects--such as the anti-personnel bomblet, short takeoff and landing (STOL) troop/cargo aircraft, radar foliage penetration, etc.--which were managed by the Air Force.[11]

([redacted] On 15 December 1964, Dr. Harold Brown, DDR&E, stated:[12]

> I expect the military departments to assume greater responsibility for such work (current development) as the ARPA/AGILE program is restructured. The Military Departments and ARPA should determine which of the current ARPA projects can appropriately be transferred with a view towards the greatest possible shift in the FY 1966 budget and complete transfer of responsibility for agreed-upon projects in the FY 1967 budget. There may still be a need to meet uniquely indigenous requirements. This will remain part of the AGILE mission.

([redacted] Dr. Alexander H. Flax, Assistant Secretary of the Air Force (R&D), subsequently advised DDR&E that the Air Force was "prepared to assume greater responsibility for the quick-reaction type current state-of-the-art hardware development" in areas of USAF responsibility. Discussions would be initiated with ARPA to determine those projects which could be transferred.[13]

[redacted] Concomitant with these developments, a roles and missions controversy developed between the Air Force and the Army. Concerned about an Army plan to test its combat support aircraft in South Vietnam--especially armed helicopters and Mohawk aircraft (OV-1C)--Gen. Curtis E. LeMay, USAF Chief of Staff, recommended in July 1962 that a joint operational evaluation group (JOEG/V) be formed in South Vietnam to conduct relevant testing. It was General LeMay's purpose to stop the Army from introducing air units into South Vietnam which the Air Force interpreted as an encroachment upon its traditional roles and missions. His proposal was approved by the Joint Chiefs of Staff (JCS) and the group was formally established on 21 July 1962 to evaluate joint service combat tests. Army Brig. Gen. Robert A. York was appointed director for both the combat development test center and the joint evaluation group.*

[redacted] However, the JCS directive did not constrain the services from conducting unilateral testing. Whereupon, the Army established a concept team in Vietnam (ACTIV) in October 1962 and the Air Force formed its 12-man Air Force Test Unit-Vietnam (AFTU-V) within the 2d Air Division+ in November 1962. The dominant USAF feeling at this time was that the Army was trying to build "a unilateral case" for the Howze Board concepts.[14] During the previous summers, the Army Tactical Mobility Requirements Board, or the Howze Board (Lt. Gen. Hamilton H. Howze, Chairman) had articulated the Army's plan to form airmobile divisions

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* For details on early USAF and service testing activities in South Vietnam including the question of the relative effectiveness of armed helicopters see Jacob Van Staaveren, USAF Plans & Policies in South Vietnam, 1961-1963 (AFCHO, June 1965), Chapter VI.

\+ Predecessor of Seventh Air Force.

under the "air assault" concept, using great numbers of helicopters combined with airborne units. The Air Force viewed this as an Army attempt to take over the close support air mission. It was in light of the increasing conflict between the two services over testing that the JCS in early 1963 recommended to Secretary McNamara that all testing in South Vietnam be controlled by a single organization under the Commander, U.S. Military Assistance Command, Vietnam (COMUSMACV). The Defense Chief agreed and in April 1963 he directed that appropriate plans be prepared by the Joint Chiefs in coordination with the DDR&E.[15]

([redacted] Subsequently, Adm. Harry Felt, Commander in Chief, Pacific Command (CINCPAC), submitted an implementing plan which was later revised to include suggestions made by the services, the Joint Staff, and the DDR&E. Both the Army and the Joint Staff wished to reduce ARPA's inroads into service testing activities and responsibilities. Also, the Army wanted its concept team in Vietnam to continue an effective test program. The Air Force--which had argued at the time of the establishment of the Army's concept team that testing in Vietnam was diluting direct U.S. assistance to Saigon--recommended that all testing be stopped in Vietnam. On 23 October 1963, in a memorandum to the JCS, General LeMay stated that "military test activities in Vietnam are detrimental to combat activity, contribute to delay in training of the Vietnamese... and should be discontinued as soon as practicable." He proposed that the Army, Air Force, and joint evaluation and test units be phased out and that ARPA's activities "be reduced to the very minimum."[16]

[redacted] In December 1963, after the Joint Chiefs found they could not agree on the approach to take with regard to Vietnam test activities, the decision was left to Gen. Maxwell Taylor, Chairman, JCS, on which changes to incorporate in a proposal to be sent to OSD. Although General Taylor accepted some USAF administrative changes, he also approved an Army suggestion which eliminated a requirement that test projects containing roles and missions issues be sent to the JCS for decision. Thus, this critical responsibility was shifted to CINCPAC at which level COMUSMACV could more readily assert a major Army influence. The Air Force had lost this battle.

Joint Research and Test Activity

([redacted]) Dr. Brown accepted General Taylor's proposed terms of reference and the JCS published them on 11 February 1964, establishing the Joint Research and Test Activity (JRATA) under MACV as the single, unified test agency. It replaced the JOEG and incorporated the ARPA field unit, the Army's concept team, and the Air Force Test Unit in Vietnam.* The JCS directed JRATA to emphasize the "direct improvement of combat capability for the forces involved," thus leaving long-term development to be accomplished elsewhere. Only equipment that required the Vietnamese combat environment was to be tested in-country. Also, in accordance with OSD instructions, the new joint test agencies were to avoid controversial roles and missions projects and select only those that promised to be of immediate value to the counterinsurgency effort in Vietnam.[17]

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* JRATA actually replaced the JOEG on 23 April 1964 with Army Brig. Gen. John K. Boles, Jr. (who headed JOEG) as Director. General Boles, as JRATA Director, served as the principal staff officer to COMUSMACV responsible for all matters relating to RDT&E and combat developments.

([redacted] In approving formation of the Joint Research and Test Activity in Vietnam, Mr. McNamara again restated the importance of the unique Southeast Asian environment. He hoped that the services could not only better the performance of the Vietnamese, but could also gain valuable experience in COIN operations and doctrine that could be applied to research, development, testing, and evaluation in circumstances and locales other than Vietnam. He envisioned that country as a laboratory for counterinsurgency RDT&E.

([redacted] Combat development (CD) and RDT&E objectives in Vietnam were aimed at enhancing the COIN capabilities of Vietnamese and U.S. forces and providing research, testing and combat development support to the Republic of Vietnam Armed Forces (RVNAF) and the combined US/RVN Combat Development Test Center, Vietnam.[*] A prime objective also was to enable the American scientific and military communities to develop new and improved COIN weapons, equipment, concepts, and techniques, and to evaluate operational and organizational concepts, doctrine, tactics, techniques, and materiel in the Vietnamese combat environment.[18]

([redacted] The Air Force remained unenthusiastic about establishment of the new joint activity and did very little testing in Vietnam since it considered JRATA to be dominated by--and oriented to--Army concepts.[+] In contrast, both the Army and ARPA spent substantial sums to test and evaluate equipment and concepts in actual combat. Within the Air Staff,

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* RDT&E evaluations were concerned with hardware and equipment. Combat developments pertained to concepts, tactics, techniques, and the organizational use of equipment.

\+ Among the equipment tested by the Air Force was the DECCA navigational system and a tactical air control system. Neither of these tests proved highly successful.

some officers felt that the Air Force should either support its own test unit or eliminate it. They believed the Air Force should not have established the test unit in reaction to the Army's program, but rather as a viable organization which could contribute significantly to solving USAF R&D problems.[19]

([redacted]) In March 1964, during a Joint Chiefs of Staff discussion of JRATA, General LeMay once again recommended that test activities in Vietnam be halted and the various test units phased out. Although the other members of the JCS favored a restatement of the majority view on JRATA, the USAF Chief of Staff succeeded in delaying the statement until after Secretary McNamara's impending visit to Vietnam that month. General LeMay hoped that, during this trip, Mr. McNamara might be persuaded through personal observations and discussions to discontinue service testing. However, as it turned out, Secretary McNamara decided to continue the joint activity. At this point, General LeMay directed the Air Force to conduct as much of its testing as possible in the Continental United States (CONUS) or "other appropriate locations" outside Vietnam to avoid interfering with combat operations. Testing and evaluation in Vietnam would be authorized only when final evaluation of equipment could not otherwise be completed. As a consequence of LeMay's directive, the Air Force made only minimal use of its Vietnam test unit during the next 24 months.[20]

([redacted]) In June 1966, the unified test agency approach also was rejected by Gen. William C. Westmoreland, COMUSMACV. In a message to Adm. U.S. Grant Sharp, CINCPAC, recommending that JRATA be disbanded, he said that while R&D into various systems had some joint

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aspects, for the most part such activity remained essentially a unilateral operation of each service and other agencies. Experience had shown, he reported, "a wide variation in the amount of resources, emphasis, and exploitation of the test units by the services."[21]

([redacted] As indicated, the Army and ARPA units had been the most active, while the Navy R&D Unit in Vietnam (NRDU-V)--established in February 1965--had made some use of JRATA's services. The USAF unit had been the least active, although in early 1965 Headquarters USAF "encouraged" the major commands to propose weapons, equipment, doctrine, and techniques for possible evaluation in Vietnam.[22]

([redacted] In any event, on 9 August 1966, Admiral Sharp concurred with General Westmoreland's proposal to disband JRATA and asked for additional information on the future organization of the ARPA R&D Field Unit. On 13 August, General Westmoreland replied that the ARPA unit would keep its "identity" under the supervision of MACV J-3. It would be responsible for coordinating research and development with the Vietnamese Combat Development and Test Center and at the same time provide a point of contact for the service test units. In early September, the JCS approved disestablishment of JRATA and recommended to OSD that the service test units be returned to the component commanders and that the ARPA unit be assigned to MACV. Deputy Secretary of Defense Cyrus Vance concurred on 23 September, while noting that it was important that MACV staff supervision be provided to the overall R&D effort.[23]

([redacted]) Up to the time of its disestablishment on 15 November 1966, the Joint Research and Test Activity had completed 14 projects and had an additional 43 in progress. Of these, the Air Force Test Unit had completed

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three and had none in progress as of November 1966.[*] ARPA's research and development unit finished four projects and had 33 under active consideration; the Army unit completed four and had seven in progress; and the Navy's R&D unit finished three projects with the same number in progress.[24]

([redacted] By this time--although the Air Force had adopted several special research and development approaches, including the Southeast Asia Operational Requirement (SEAOR) system[+]--new problems plagued the USAF R&D effort. In early October 1966, COMUSMACV and the Seventh Air Force complained that new equipment was being sent to the theater prior to being tested adequately in the United States. Items that did not live up to expectations were gravel mines (XM-27), Bullpup missiles (AGM-12C), M-188 VT fuze as used with the F-105, F-4C radio relay pods, and forward-looking infrared (FLIR) sensors. COMUSMACV suggested that such items not be sent to the theater until they were operational.[25]

([redacted] According to Headquarters USAF, it had never planned to send completely untested items "until they had been demonstrated through tests in the ZI [Zone of Interior] to work satisfactorily and to offer some potential as a new capability or an improvement in the manner in which we are already doing a job." Thus, certain equipment and devices furnished in response to SEAOR's--such as forward-looking sensors and the battlefield illumination airborne system (BIAS)--were intended for and had been placed into immediate operational use. On the other hand, it had purposely introduced other new items of equipment into the theater for evaluation by combat units. The risk of failure was worth taking if it contributed to the development of a new system which would subsequently provide greater combat effectiveness.[26]

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* AFTU-V was manned by six officers and three enlisted men at the time of its dissolution. In contrast, the Army's concept team in Vietnam comprised almost 100 personnel including several civilian contract people.

\+ See pp 20-22.

II. R&D PROGRAMS AND PROCEDURES

([redacted] In December 1964, DDR&E directed the services to include substantial RDT&E funding for Vietnam in their fiscal year 1966 budget, to program even more for fiscal year 1967, and to "re-examine and improve procedures for accelerating the identification and flow of developed equipment to U.S. Forces."[1] Peacetime R&D programs and procedures, the services had already realized, were not geared to meet wartime demands for improved hardware. The task they faced was a difficult one--to identify quickly development projects that held the most promise for enhancing combat capability and then allocate funds to get them under way. Even after doing this, they still had to make an early estimate of overall project costs, budget for them, and provide funds throughout the development cycle of the equipment.[2]

([redacted] Since the initial, tentative nature of U.S. military intervention had not permitted R&D planners to identify long-lead items early enough to include them in the regular budget, the Air Force resorted to an interim solution. That is, it set up several small, special funds--such as Project 1559--to take care of immediate, urgent requirements of USAF limited war and special air warfare forces.*[3]

Identifying R&D Problems

([redacted] By late 1964, OSD, the Joint Chiefs, and the services were actively examining their R&D programs and procedures to decide what changes were necessary to make them more effective. The final criterion

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* See below, pp 19-20.

was whether alterations would aid U.S. combat operations in South Vietnam. On 30 November 1964, the JCS requested CINCPAC and COMUSMACV to submit a list of problems which required specific R&D solutions. These problems were to be the subject of an R&D conference of the services to determine actions to be taken.[4]

[redacted] The list--developed in February 1965 by General Westmoreland and concurred in by Admiral Sharp--identified 68 R&D "requirement/problem areas." In general, it reflected the increasing infiltration of enemy troops and materiel into South Vietnam and the need for intrusion, listening, and warning devices along with more effective U.S. night air operations and aerial surveillance. The last required improved night photographic systems which could produce intelligence of mountainous and valley terrain from an altitude of about 2,500 feet. R&D problem areas assigned first priority on the Westmoreland list included: surveillance; location, detection, and identification equipment; communications; munitions; helicopter modifications; and aircraft modifications including better fire support systems, guns, and dispensers. Also, there were requirements to develop brighter and longer-lasting flares without increasing their size or weight and to procure a napalm tank which could be dropped from a higher altitude.[5]

[redacted] On 1 March 1965, while the list was being reviewed by the services, Secretary McNamara reiterated his support for all military assistance required for South Vietnam. He said that cases had come to his attention in which restraints had been imposed by funding limitations and stated he wanted it clearly understood that "there is an unlimited appropriation available for financing of aid to Vietnam. Under no circumstances is lack of money to stand in the way of aid to that nation."[6]

([redacted] This was well and good, but the fact remained, as a USAF conference held at PACAF headquarters noted on 22 March, there was a dearth of unprogrammed money with which to meet R&D requirements in SEA. For example, although the 1st Combat Applications Group supported its short-term aircraft modification projects with "Fast Coin" money,* it had no funds to investigate promising R&D developments which might resolve long-term special air warfare problems. Too, a proposal to employ special procedures--such as those used by the Tactical Air Warfare Center during the 1964 "Goldfire" exercises to develop and evaluate new equipment--was deemed inappropriate since it required reprogramming action. Although the Air Force planned to support various R&D efforts under Project 1559, it recognized that unless more money was forthcoming, other arrangements would have to be made. Also, the USAF conferees at the PACAF conference agreed that liaison between the "R&D community" and the field could be improved by sending selected USAF technical personnel on temporary duty to Southeast Asia to obtain a better understanding of specific operational problems.[7]

Joint R&D Conference

([redacted] On 24-26 March 1965, a joint R&D conference was held at CINCPAC headquarters to determine in what areas the services could provide research and development assistance to CINCPAC and COMUSMACV.+ At this time, as was noted, it was Air Force policy to conduct "maximum

* A small, special fund provided specifically for aircraft modifications for Vietnam.

+ Present were representatives of the Joint Staff, ODDR&E, CINCPAC, COMUSMACV, and the services. Brig. Gen. Andrew J. Evans, Jr., Special Assistant for COIN and Director of Development, DCS/R&D, headed the USAF delegation, which included Col. M. E. Marston, Lt. Col. Lewis Watts, and Maj. J. W. Bradbury.

testing" in the United States "or other appropriate locations outside of the RVN to prevent unnecessary interference with the war effort." Further, Gen. John P. McConnell, USAF Chief of Staff since 1 February 1965, reiterated his predecessor's view that the evaluation of equipment in the Vietnamese combat environment would be authorized only when final evaluation could not be completed by other means.[8]

[redacted] The Air Force, the other services, and ARPA (Project AGILE) reported to the meeting on the status of approximately 350 R&D projects which might conceivably provide solutions to the 68 problem areas. After some discussion, the conferees decided that technically qualified service teams should brief COMUSMACV and CINCPAC and, further, that these teams should provide General Westmoreland with specific information that he might need to assist in drawing up requirements for new weapons or equipment.* They agreed that the most serious impediments to a dynamic R&D program were obsolete funding procedures, the slowness in meeting equipment requirements, and the complexity of existing "quick-reaction" procedures. Also, the conferees noted that many R&D personnel lacked basic knowledge of these procedures.[9]

[redacted] As far as funding was concerned, there was general agreement that ARPA should support those RDT&E projects which pertained solely to indigenous forces, although the services could provide funds (or a portion thereof) if they were in some way involved. Where a dual interest existed, funding could be resolved by mutual agreement between ARPA and the service.[10]

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* Briefings would cover the following R&D subjects: Communications, surveillance and target acquisition, reconnaissance and position fixing, mobility, ambush detection, weapons, and munitions.

([redacted] Several months following the R&D conference at CINCPAC headquarters, the Air Force convened a meeting at the Pentagon on 2-4 June 1965 to identify organizational, procedural, and funding devices which might "improve the USAF response to Southeast Asia technical support and operational requirements." In attendance were officials from Headquarters USAF, PACAF, TAC, AFSC, the Air Force Logistics Command (AFLC), and COMUSMACV (JRATA).[11]

([redacted] Among the decisions made at this meeting were that the 2d Air Division operations staff should be strengthened and that the Air Force test unit in Vietnam should evaluate new equipment only when in-country testing was required. Equipment tested in the CONUS would be deployed directly for operational use whenever possible. The conferees recommended that AFSC and TAC organize liaison offices within the 2d Air Division.[12] The AFSC office, subsequently established on 6 July 1965, was made responsible for providing technical assistance to the 2d Air Division in formulating operational requirements and helping the AFSC staff to orient its R&D effort. The goal was to improve response in fulfilling operational needs of theater tactical air forces.[13]

([redacted]) Also, the conferees decided that a special procedure was needed to identify a requirement, recommend a solution, and initiate the necessary actions to provide the improved equipment. The aim was to speed up the entire process. The procedure finally adopted was based on Southeast Asia Operational Requirements--the SEAOR's--which were to be submitted by 2d Air Division simultaneously to cognizant commands and Headquarters USAF.[14]

[redacted] Although the conferees reviewed and found the Special Air Warfare Center's "Fast Coin" and the Tactical Air Reconnaissance Center's "Fast Photo" and "Quick Reaction"[*] funding procedures adequate, they noted that:[15]

> ...the fulfillment of these requirements involves reprogramming, the money comes 'out of our hide' and, if the amount involves more than a $2 million adjustment to the budget, approval from DOD and Congress is necessary. A source of uncommitted procurement funds could improve responsiveness and leave funded programs unmolested.

Project 1559

[redacted] In response to an AFSC request for "quick reaction programming and funding" for limited war and special air warfare R&D, Headquarters USAF on 6 January 1965 issued a directive which established Project 1559. Allocated an initial $500,000, it was designed to provide a small fund from which money could be withdrawn rapidly to support testing and evaluation of existing equipment or to exploit technical advances for limited and special air warfare forces. Expenditures were increased to $851,000 in fiscal year 1965 and $7,450,000 in fiscal year 1966. Four million dollars was allocated the project in fiscal year 1967. Headquarters AFSC was authorized to approve R&D tasks whose costs did not exceed $25,000.[+] For tasks requiring greater expenditures, Headquarters USAF authorization was needed.[16]

[redacted] Project 1559 funds supported efforts to fulfill specific Southeast Asia requirements or advanced tactical warfare technology.

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* "Fast Photo" was a special fund to accelerate promising reconnaissance projects, "Quick Reaction" to improve electronic intelligence and countermeasures equipment.

\+ AFSC delegated this authority to the Deputy for Limited War, Aeronautical Systems Division.

Approximately two-thirds of project resources was devoted to exploiting technology and one-third to evaluating existing equipment. Although not designed solely for Southeast Asia, the project did produce the quick response desired by Headquarters USAF to meet Vietnam needs. For example, during fiscal years 1965 and 1966, the following short-term R&D projects were funded by Project 1559 in support of Vietnam forces: Wild Weasel radar homing and warning (RHAW) equipment; aircraft fuel tank fire suppression; aircraft crash removal sling; FLIR testing in Vietnam; improved flying clothing and survival equipment; QRC-160-1 electronic countermeasures (ECM) pod modification; and intrusion alarm devices for perimeter defense.*17

The Air Force Establishes SEAOR's

([redacted]) In accordance with a 6 July 1965 directive issued by Gen. William H. Blanchard, USAF Vice Chief of Staff,+ the SEAOR procedure was adopted whereby the 2d Air Division identified and forwarded its immediate requirements simultaneously to PACAF, AFSC, AFLC, other cognizant commands, and Headquarters USAF. The objective was to obtain rapid decision-making and response. On receipt of a SEAOR, while PACAF investigated its validity, AFSC's Aeronautical Systems Division office (Deputy for Limited War) prepared a Best Preliminary Estimate (BPE). Should the SEAOR be validated, the BPE would then be forwarded to Headquarters USAF for review. If approved, the need could be

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* For a complete list of Project 1559 tasks through August 1968, see Appendix 2.

\+ For details on General Blanchard's directive, see Wolk, USAF Logistic Plans and Policies in Southeast Asia 1965 (TS), (AFCHO, June 1967), Chapter I.

fulfilled by either modifying existing equipment already in production or undertaking to develop new requirements.[18]

[redacted] General Blanchard's directive was a direct result of the June 1965 conference at USAF Headquarters which recommended that an expedited procedure be established. Without it, war requirements would have to be processed through normal channels in accordance with Air Force Regulations (AFR) 57-3 or 57-4 (for Class V modifications). Documented only by the 2d Air Division (by its successor, Seventh Air Force, after 8 April 1966), the SEAOR's were designed to be completed in a relatively short time (about 12 months). Numbered consecutively as required operational capabilities (ROC's) or Class V modifications, they included proposed improvements in the following areas: tactical fighters; command and control; electronic intelligence/electronic countermeasures (ELINT/ECM); reconnaissance; munitions; life support and rescue; and airlift, support, and miscellaneous.*[19]

[redacted] Unfortunately, in late 1966 and 1967, the completion of USAF projects was impeded by a dearth of funds and the large number of active SEAOR's. As a result, Southeast Asia operational requirements were not fulfilled as quickly as originally expected. Part of the difficulty stemmed from the submission and approval of long term SEAOR's which could not be completed in a relatively short time. Thus, by the end of March 1968, 306 SEAOR's had been processed but only 39 were completed, 64 were cancelled, and 203 were still active.[20]

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* See Appendix 1 for a complete list of SEAOR's, active and cancelled--including ROC's and Class V modifications--through February 1968.

([redacted] To deal with this and other problems, a TAC/PACAF/ Seventh Air Force working group met between 18 February-13 March 1967 at Tan Son Nhut AB, Vietnam. The working group recommended that requirements be clearly established and documented by responsible agencies in order to reduce the number of SEAOR's, to more clearly establish their priority, and to determine which required the most money and greater effort. Following the general officer review of the SEAOR procedures at Wright-Patterson in November 1967, a Headquarters USAF SEAOR Review Board was established to consider the overall management problem with the emphasis on approval and funding, especially within USAF headquarters. The board was scheduled to begin its work in January 1968.[21]

([redacted] Since a central SEAOR fund did not exist, the Air Force had found it necessary to procure money from a wide variety of sources including Project PROVOST (see below) and modification, procurement, and emergency funds. But the process of securing money from supplemental and emergency funds proved complex and time-consuming. As had been noted, the Air Force during 1965 and 1966 also often used small "fast reaction" funds including "Fast Coin" for aircraft prototyping and testing ($2.5 million in fiscal year 1966); "Fast Photo" for reconnaissance projects ($2.0 million in fiscal year 1966); and the so-called quick reaction capability (QRC) for electronic intelligence and countermeasures equipment ($6.2 million in fiscal year 1966).[22]

PROVOST

([redacted]) In July 1965, Mr. McNamara created a Vietnam support expediting task force to propose solutions for R&D problems. Not long after, OSD began a special program, designed to meet fiscal year 1966 R&D needs for Southeast Asia, which became known as priority research and development objectives for Vietnam operational support (PROVOST).[23]

([redacted] Acting on Mr. McNamara's guidance, on 29 July 1965 Dr. Brown, DDR&E, advised the Chairman, JCS, and the services that it was a matter "of the greatest urgency that all appropriate outputs from our R&D programs and all our R&D capability be made available to give maximum materiel support to our forces in Vietnam as rapidly as possible." He directed his Deputy for Tactical Warfare Programs, Dr. Thomas P. Cheatham, to review immediately defense R&D programs.[24] On 2 August, Dr. Cheatham asked the military departments to submit a list of weapons and equipment that could be made available in the near future as well as programs that might be accelerated and initiated. This marked the beginning of PROVOST and produced an Air Force request on 6 August for $212.9 million for Vietnam RDT&E. Initially, OSD approved $22.9 million* in the fiscal year 1966 emergency supplemental budget request submitted to and approved by Congress.[25]

([redacted]) The following indicated PROVOST funding for the Air Force:[26]

(Millions)

	FY 1966	FY 1967	FY 1968
Programmed Funds	$ 00.0	114.8	112.8
Supplemental Funds	71.1	33.0	24.9
Emergency Funds	30.1	19.0	15.9
	$101.2	166.8	153.6

* Primarily for forward-looking infrared equipment, night low altitude proximity fuzes, jungle bomblet, manpack radar, large optics for low light level television (LLLTV), and cluster and incendiary munitions.

([redacted] Southeast Asia projects funded through supplemental or emergency sources during fiscal years 1966 and 1967 were considered part of PROVOST. Programs that had received money from the basic budget, but were considered to apply to Southeast Asia were also listed under PROVOST. These included specific SEAOR's and near-term (up to 18 months) "Shed Light" projects.*[27]

([redacted] In March 1966--with SEA war requirements rising steadily--the director of defense research established a senior PROVOST steering group to review Southeast Asia R&D. This group prepared a "master" list which identified priority requests for new equipment and other requests for acceleration of equipment already in production or modifications to existing equipment. The first USAF input to this list was submitted in April 1966. The senior PROVOST group was responsible for determining--on a continuing basis--what priority rating and emergency funding would be given to programs not covered in the budget. USAF PROVOST-funded projects included such items as: installation of nose cannons in the F-4; A-7A modifications; development of Shed Light equipment; modifications to the B-52; and modifications to the AGM-45A Shrike missile.[28]

([redacted] In late 1966, after reports were received that some items of equipment were malfunctioning immediately after being sent to Southeast Asia,+ OSD reminded the PROVOST steering group that hardware should not be deployed to the theater unless adequately tested and evaluated in the CONUS. This would insure not only that the equipment would work, but

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* See Chapter V.

\+ Including XM-47 gravel mines, AGM-12C Bullpup, forward-looking infrared, and F-4C radio relay pods.

also that only minimum testing would have to be done in the war zone. In this regard, OSD directed that the JCS be provided a list of all inadequacies of any weapon systems prior to their being released for operational use.[29]

Directorate of Technical Applications

(U) On 29 May 1967, an AFSC Directorate of Technical Applications for Southeast Asia (D-TAFSEA)--also known as Project 1822--was organized at the Air Proving Ground Center (APGC) at Eglin AFB, Fla., to identify operational problems which might be solved by near-term interim fixes. The advantages of locating the Directorate at the proving ground center included the tactical environment itself as well as the availability of AFSC and TAC personnel, including a large number of Vietnam returnees. This project was closely related to the SEAOR process and TAC's required operational capabilities program.[30]

(U) Solutions proposed were to be confirmed by construction and testing of prototype equipment with the results documented so that procurement specifications could be drawn up by the appropriate agencies. Funding in fiscal year 1968--expected to total about $2.0 million--covered such items as a modified optical fuze for the Sidewinder missile and improved area denial mines. In general, the Directorate of Technical Applications worked directly with industry to find possible solutions to problems which primarily involved munitions, aircraft avionics, communications, surveillance, and support.[31]

(U) Air Force plans for 1968 and 1969 called for the directorate to continue to identify SEA problems which could be ameliorated by interim analysis, improvisations, and changes of existing technology. USAF officials hoped most of these interim fixes could be worked out within less than a year.[32]

III. COUNTERING THE NVN AIR DEFENSE SYSTEM

(U) Several weeks after the United States launched its "Rolling Thunder" air campaign against North Vietnam (NVN) on 2 March 1965, the President explained in a major policy statement that America's objective was to insure "the independence of South Vietnam and its freedom from attack" by outside forces. He also stated on 17 April that the United States would "try to keep [the] conflict from spreading. We have no desire to devastate that which the people of North Vietnam have built with toil and sacrifice. We will use our power with restraint...." Indeed, the air campaign he authorized proved to be highly selective, featuring clear-cut restrictions on targets that could be struck. In general, the administration's strategy was to increase pressure gradually on the North Vietnamese regime rather than to deliver an early, heavy blow against its important facilities or resources.*

[redacted] Perhaps the key Northern target which was forbidden to U.S. fighter-bomber attack was the Haiphong harbor complex, which remained the enemy's major facility for importing war materiel from the Soviet Union and eastern European bloc nations. The critical materiel that poured into the enemy's ports included heavy air defense equipment designed to take its toll of attacking U.S. aircraft.

([redacted]S-Gp 4 NOFORN) During 1965, one of the most worrisome aspects of the war was the growing sophistication of NVN air defenses, especially radar-controlled surface-to-air missiles (SAM's) and anti-aircraft artillery (AAA). The SAM and AAA threat combined with MIG's and small arms

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* See Jacob Van Staaveren, <u>USAF Plans and Operations in Southeast Asia 1965</u> (AFCHO, October 1966), for details of the restrained American air campaign.

fire presented Air Force and Navy pilots with a formidable air defense--one that in 1965 steadily improved over the rudimentary system of 1964. As a consequence, the American air effort was degraded as aircraft were diverted from strike missions to flak and SAM suppression and combat air patrol (CAP).* The heavy, sustained enemy defensive fire lessened the accuracy of U.S. attacks--even in good weather--frequently forcing the fighter-bombers to release their ordnance at high altitudes.[1]

([redacted] This increasingly serious situation affected the entire American air campaign against the North. By mid-1965, it was clear that Hanoi, with the help of the Soviet Union, was carrying out its plan--announced in February 1965--to construct complete SA-2 missile installations.+ The first SA-2 complex was built in April and by 10 July five had been placed in the greater Hanoi area. On 23 July, two NVN Fan Song missile fire control radar signals were intercepted approximately 20 nautical miles (NM) west of the Communist capital. On the 24th, an F-4C aircraft (one of a flight of four) was shot down by a surface-to-air missile.[2]

([redacted]) Subsequent photography indicated that the North Vietnamese had built two new SAM sites (numbers 6 and 7) in the area in which the F-4C had been intercepted. On 27 July, 48 USAF F-105 aircraft attacked sites 6 and 7 with a loss of six planes--five to AAA and one to operational causes.

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* F-4C's flew so-called MIGCAP missions against enemy fighters. In April 1965, to facilitate these operations in areas beyond USAF ground control intercept coverage, the Air Force deployed three EC-121's to Tan Son Nhut AB under Operation "Big Eye", primarily to detect enemy planes on airborne radar and "call" MIG warnings. These EC-121's also warned aircraft away from unfriendly borders. The Big Eye operation later evolved into "College Eye," which comprised expanded missions with more effective equipment including the QRC-248.

\+ The SA-2 was a Mach 3.5 radar-guided missile providing an effective kill probability from 1,500 feet to altitudes above the ceiling of USAF tactical aircraft at a range of about 20 miles.

Post-strike reconnaissance showed that one site was unoccupied and the other comprised dummy missiles and equipment. On 12 August, a Navy A-4 was shot down by a SAM in an area which indicated that the enemy was deploying SAM's outside the Hanoi sanctuary.[3]

[redacted] The NVN air defense system included a centrally operated early warning network which provided SAM and AAA units tracking data to help acquire targets. Most individual SA-2 batteries also could acquire targets by using the "Spoon Rest" or similar search radars. In addition, the Fan Song fire control radar might be used as a limited acquisition radar. Because the Fan Song radar could be held in a ready condition by discharging radiation into a dummy load (thereby seldom having to radiate), it became increasingly difficult for U.S. pilots to locate these sites.*[4]

Air Staff Task Force on SAM's

([redacted] On 13 August 1965, in an effort to resolve this serious problem, General McConnell directed that a special task force analyze the defensive (SAM and AAA) threat and recommend measures for coping with it. An Air Staff Task Force on SAM's in Southeast Asia was chartered on 16 August under the chairmanship of Brig. Gen. Kenneth C. Dempster, USAF Deputy Director of Operational Requirements. Among the basic assumptions that guided the group's study were that: (1) the war in Southeast Asia would continue, probably at an increased level of intensity; (2) political restraints on attacking certain NVN targets would not be lifted; and (3) tactical

* The Fan Song featured a continuously sweeping antenna. The two track-while-scanning radar beams continued to sweep even after acquiring the target, thus searching for another target while still tracking the first.

nuclear weapons would not be authorized for use at the present level of fighting.[5]

([redacted] The work of the task force was influenced by the results of recent "Rolling Thunder" activity over the North--including the shootdowns. They indicated that USAF crews had not received adequate warning while under radar surveillance, that their aircraft lacked electronic countermeasures equipment and that they found it difficult to find targets precisely or to fix radar locations. Also, the cycle of processing intelligence, deciding upon strikes, and actually launching them consumed an excessive amount of time. These factors--together with the existing bombing constraints--made it difficult for pilots to locate and destroy the SA-2 sites.[6]

[redacted] After a comprehensive analysis of the NVN defensive environment, current USAF aircraft, tactics, and the possibilities for improving equipment in tactical aircraft, the task force reached the following conclusions:[7]

1. Effective 360° S-band radar homing and warning was urgently required by the USAF tactical force in SEA.

2. Tactical electronic intelligence (ELINT) equipment had to be improved.

3. No all-weather reconnaissance system existed in SEA.

4. Improvements should be made in strike and reconnaissance tactics.

5. Self-screening and stand-off ECM was required.

6. Airborne communications security was inadequate.

7. An improved navigation system was needed for all-weather target location.

8. Tactical fighters possessed no means of recording strike results.

[redacted] In view of these deficiencies, the Air Staff Task Force promulgated a series of short and long term recommendations. With regard to RHAW devices, of immediate importance was the necessity to test and evaluate receivers and vector systems in order to provide 360° warning in the S- and C-bands along with adequate homing. Concomitantly, jamming techniques and ECM pods required testing and evaluation. The group specifically recommended that flight testing of the F-100F (vector/IR-133 homing) prototype be expedited along with determining the best tactics for employment. F-100F and F-105F modifications also were recommended so they could be used in the role of "hunter-killers" against the SA-2 sites. Long term proposals included developing, testing, and evaluating advanced navigation, RHAW, ECM, ELINT, and other systems in order to improve substantially the USAF capability against the Hanoi defensive network.[8]

[redacted] In late August, the Air Force Council--and on 30 September, General McConnell--approved the task force's conclusions and recommendations. The Chief of Staff specifically approved acquisition of 360° RHAW equipment, development of prototype hunter-killer-F-100F's equipped with various detection devices, and conversion of an F-105 to an EF-105F configuration by installing homing, warning, jamming, and ELINT apparatus. He also directed the Air Staff to modify and test QRC-160-1 ECM pods, procure a limited quantity of KA-60 panoramic cameras, and accelerate the installation of LORAN D avionics in the F-100, F-105, F/RF-4, and the RF-101. For the longer term, he approved development of advanced RHAW and reconnaissance equipment. On 2 October 1965, the new Secretary of the Air Force, Harold Brown,* concurred in these proposals, but requested that the F-105 not be converted until the F-100F hunter-killer tests had been evaluated.[9]

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* Brown, formerly DDR&E, became Air Force Secretary on 1 October 1965.

[redacted]

Wild Weasel

[redacted] In accordance with the Chief's direction, four F-100F aircraft--designated "Wild Weasel I"-- were modified to carry special equipment. This included the APR-25 vector RHAW receiver to detect S-band signals (emitted by SA-2 fire control radar and early warning/ground controlled intercept radar), and C-band signals (from improved SA-2) and the X-band airborne intercept radar. They also were equipped with the APR-25 (WR-300) L-band warning receiver to indicate missile guidance emissions, and the IR-133 panoramic receiver that could detect S-band signals at a greater range than the APR-25. The KA-60 panoramic camera and a dual track tape recorder also were installed in the Wild Weasel I aircraft.[10]

[redacted] From 11 to 18 October 1965 the four modified F-100F's underwent an accelerated test and training program at the USAF Tactical Air Warfare Center, Eglin AFB, Fla. The special Eglin radars (SADS-1 and SADS-2) simulated the S- and C-band NVN Fan Song radars. The test results showed that crews could detect the SADS radars from a distance of 220 NM at 10,000 feet and 40-50 NM at 150 feet altitude. Whereupon, the four aircraft were deployed to Korat, Thailand on 25 November and assigned to the operational control of the 388th Tactical Fighter Wing. They began to fly missions on 3 December with the primary objective to seek out and destroy SA-2 installations. Providing threat warning to strike planes and ELINT collection were secondary missions.[11]

[redacted] In late 1965, the appearance of a growing number of SA-2 installations prompted the Air Force to increase the number of Wild Weasel I aircraft to seven while also planning for deployment of seven Wild Weasel III F-105F's. This decision was made by the Air Council on 30 December 1965 and approved by General McConnell on 6 January 1966. The F-105F's

[redacted]

would be equipped with the same RHAW apparatus as the Wild Weasel I aircraft. The three additional F-100F's were modified by 24 January 1966 and deployed to the theater in late February. Modifications for three F-105F's were completed on 23 February and five were deployed to Southeast Asia by mid-April 1966. USAF planning also called for deploying four Wild Weasel IV F-4C's to Southeast Asia in mid-1966, but this program never materialized.[12]

([redacted] The Wild Weasel I missions flown from Thailand beginning in December 1965 were part of the "Iron Hand" anti-SAM air campaign.* The F-100F radar homing and warning equipment was operated by an electronic warfare officer in the back seat of the aircraft. So-called "search and destroy" tactics were developed for the Wild Weasel I missions. The strike force or flight included one Weasel F-100F carrying two rockets and 20-mm ammunition and normally leading three F-105's, each armed with two rocket pods and three 500- or 750-pound bombs. The F-100F, as the hunter aircraft, attempted to home on SA-2 radar emissions by flying a planned track between 4,500 and 15,000 feet while the electronic warfare officer monitored the special RHAW equipment. During the search, direct homing or a circular approach might be used. The F-105 killer aircraft trailed the Wild Weasel by about 15 seconds. After acquiring the target electronically, the F-100F would then attempt to acquire it visually and mark the target with rockets. Using the mark, the killer F-105's would deliver their ordnance.[13]

([redacted] Weasel planes were also employed as a threat warning source by accompanying strike aircraft and alerting them to stay above

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* Iron Hand was originally organized in early August 1965 as a special F-105 ground alert force designed to strike newly uncovered SAM sites. This concept proved unsatisfactory and in a matter of days the role of these Iron Hand aircraft was changed and they began searching for SAM locations over the North.

ground fire enroute to the target. In addition, ELINT missions were flown by EB-66's with the collected information used to plan future search and destroy missions. Infrequent ELINT missions were flown by lone Weasel aircraft along the NVN borders to gather data and familiarize crews with the signal environment. Starting on 3 April 1966, after the F-100F's (and the F-105's) were equipped with the AGM-45 Shrike missile, the Wild Weasel planes themselves began attacking the Fan Song fire control radars.* If feasible, a dive delivery of the Shrike was made by the lead aircraft as the rest of the Weasel flight maneuvered as before for a homing run and attack.[14]

[redacted] Between late November and 23 December 1965, the F-100F's helped to develop operational tactics and gain experience on Iron Hand missions. However, poor weather in the target areas during this period led to cancellation of many sorties and hampered others. During the bombing truce on 24 December 1965-30 January 1966, all Iron Hand sorties were halted and the Wild Weasel aircraft flew only 49 ELINT missions over Laos and the Gulf of Tonkin. Poor weather between 31 January and late March again interfered, although two SA-2 installations were attacked. In April and May the weather improved and five SAM installations were hit with heavy damage inflicted on three of these sites.[15]

[redacted] From December 1965 to 15 May 1966, 394 Wild Weasel I sorties were actually planned but 247 were cancelled, primarily because of poor weather in the target area. The 147 Iron Hand sorties actually

* The missile was first carried on a combat sortie on 3 April 1966, but a malfunction prevented launch. The first launch occurred on 18 April.

flown included the following:[16]

Runs on SA-2's	29
Weather Prevented Runs	29
Insufficient Fan Song Activity	83*
Mission Change	5
Equipment Malfunction	1
	147

The 29 attempted Wild Weasel runs broke down as follows:[17]

SA-2 Sites Attacked	13
Fan Song Turned Off During Run	10
Weather Aborted Run	3
Run Aborted Because of Restricted Area	2
Aborted Due to Malfunction	1
	29

Of the 13 sites actually attacked, SA-2 batteries were seen in only five cases because of enemy camouflage. Through 23 July 1966, ten SA-2 sites had been destroyed or damaged; six SA-2 vans were probably damaged by Shrike missiles; five AAA sites had been destroyed or damaged; and 11 AAA radars were probably damaged by the Shrike. Two F-100F's and two Wild Weasel III F-105F's were lost in combat and one F-100F to engine failure.[18]

[redacted] As indicated, the most serious handicap facing the Wild Weasel force was its inability to visually acquire targets, most of which were camouflaged.+ Bad weather was an important factor as was a 4,500-foot altitude restriction imposed on Weasel aircraft for safety reasons. Also, the lack of ranging equipment forced the F-100F's to come in close to an SA-2 site and then pull up to acquire it visually, a tactic which made

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* Including Fan Song emissions from restricted areas where USAF aircraft could not penetrate.

\+ Some missile installations were completely hidden in wooded areas or camouflaged to look like small villages.

the aircraft vulnerable to ground fire. In addition, target restrictions prevented USAF aircraft from attacking various batteries, which eased the enemy's problem since he was apparently aware of where the Wild Weasels operated. Too, he undoubtedly obtained maps from downed flyers which indicated the restricted areas.[19]

[redacted] Nevertheless, although Wild Weasel aircraft were not the answer to the missile threat, they did aid the U.S. air campaign and at the same time made NVN defensive operations more difficult.[20]

Night Song Study

([redacted] Even as the Air Force employed new anti-SAM and anti-AAA equipment during 1965 and 1966 and continued to explore advanced measures for countering the NVN defensive environment, the North Vietnamese improved their defenses. A continuous flow of Soviet and Chinese weapons made the enemy even more formidable and by early 1967 it had developed an almost complete ground-controlled intercept (GCI) system for the entire country. All critical areas were covered by SAM missile control radars and AAA fire control. Also, an early warning radar network was developed and--along with improvements to the GCI, AAA, and SA-2 Fan Song radars--could be expected to increase in effectiveness in the near future. North Vietnam's important Red River delta was especially heavily protected by surface-to-air missiles.

[redacted] In view of these developments, on 10 January 1967 Deputy Secretary of Defense Vance requested the Chairman of the Joint Chiefs of Staff and the service secretaries to re-examine the U.S. tactical air campaign against the NVN defensive network. Mr. Vance observed that the relatively low U.S. tactical aircraft attrition rate might be more difficult to maintain if the enemy continued to improve his air defenses. He specifically pointed to the continuing NVN improvements in the area of pilot training and MIG utilization, air control and integrated use of SAM's and MIG's, use of radar controlled weapons and flak traps, and modified SA-2 defenses. Although he noted the overall satisfactory U.S. loss rate, he was concerned with the "relatively high aircraft attrition in some areas of route packages V and VI."* [21]

[redacted] On receipt of Mr. Vance's comments, the Chairman of the JCS established a study group to re-examine the air effort against NVN defenses. The so-called Night Song Study Group was under the direction of Maj. Gen. John B. McPherson of the Office of the Director of the Joint Staff. In its report dated 30 March 1967, the Night Song group stated that the enemy had[22]

> expanded the capabilities of his air defense system faster than we have intensified the effectiveness of measures against it. This he has done while, at the same time, achieving substantial accommodations to the other effects imposed by the overall air campaign, in other segments of the NVN national structure. The principal factor which has enabled him to do both of these is that his highest capacity avenue for importation of war-supporting essentials has remained exempt from attack. Other restraints in our application of graduated pressures have contributed.

[redacted] The report went on to note that better American equipment, munitions, and tactics--as important as they were--could not by themselves assure a substantial improvement against the NVN defense until a sustained and coordinated air campaign was conducted against the complete enemy target system, especially the facilities used to import and distribute the war-supporting essentials from the Soviet Union and Communist China.[23]

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* Route packages V and VI comprised the area north of latitude 20-31 N--including the Hanoi and Haiphong areas--extending east and north to the Chinese border and west to the Laotian border.

([redacted]) Nevertheless, the Night Song study reiterated the need for improvements and advances in U.S. equipment to increase the effectiveness of USAF aircraft over the North. The report noted that the two principal limitations of RHAW systems were the inability to determine accurately the range to the target radar and the difficulty of fixing precisely enemy radar frequencies, especially in an area where there was a high density of similar radars. Accelerated development of the inverse LORAN technique was recommended to counter all pulsed radars in the S- and C-bands. The report also stated an "urgent requirement" for the following items: (1) QRC-160-8 pod (S- and C-band) for greater power and wider frequency coverage; (2) ALQ-81/100 (S- and C-band) unit for deception jamming; (3) the QRC-335 deception repeater and fuze jammer to counter SAM and AAA radars and missile fuzing; (4) QRC-314 missile fuze jammer; and (5) modification to the X-band pod to counter the X-band SA-3 radar.[24]

([redacted] In general, the report's major proposals emphasized the need for night and all-weather equipment in more aircraft along with the "highest priority" for RHAW and self-protection countermeasures for all U.S. aircraft flying over North Vietnam. Beyond fiscal year 1968, it was proposed that the development of optical countermeasures be accelerated and that LORAN C/D receivers be installed in USAF strike and attack aircraft. Development of infrared (IR) equipment to detect missiles and IR countermeasures to deflect IR missiles in flight was also recommended.[25]

[redacted] Underlying the entire Night Song analysis was the conclusion that restrictions against attacking targets in populated areas--thus excluding critical elements of the NVN defense--had made the U.S. air effort much more difficult. These constraints, the report noted, "have diluted the effectiveness of U.S. tactical airpower and have tended to channel U.S. air operations into general patterns which the enemy can more easily anticipate." Since the most important weakness of the enemy was his total dependence on external sources of supply, the group proposed a "broad air campaign" be started--to include the mining of deep water ports and the Gulf of Tonkin--to reduce the flow of war materiel into North Vietnam. At the same time, it stated that all SAM's, AAA, and radars could not be destroyed because they were both numerous and difficult to locate accurately and that further, a "conclusive" campaign against the defense could not be waged because the United States did not have the nonnuclear weapon systems or munitions to mount a successful campaign. The report mentioned a shortage of the most effective weapons and fuzes required to destroy enemy guns and SAM's.*[26]

Aftermath of Night Song

[redacted] After reviewing the Night Song report, Deputy Secretary of Defense Vance asked the secretaries of the Air Force and Navy to "assure" him that present R&D programs and technological effort were properly focused toward the "earliest possible resolution" of the problems discussed in the report. Secretary Vance was particularly concerned with the indications that the services did not possess the nonnuclear weapons and munitions needed to conduct a comprehensive offensive against the enemy's defenses and that the U.S. capability to mount night and all-weather operations was inadequate.[27]

* On this point, see Herman S. Wolk, USAF Logistic Plans & Policies in Southeast Asia 1966 (AFCHO, Oct 1967), Chapter II.

([redacted] Secretary Brown replied on 21 September that any assurance as to the adequacy of current developmental programs "must always be given with qualifications." He observed that Air Force research and development was the result of a process of rigorous selection based upon budgetary and technological factors:[28]

> Although the total funding that is identifiable to solutions of problems highlighted in the Night Song Study appears to be commensurate with the allocation of industrial and technical resources to the national involvement in SEA, more money and higher priorities would have to be applied to accelerate certain programs and initiate others before I could give the assurances I feel are desired.

Dr. Brown advised that much of the USAF developmental program had been reoriented toward the needs of Southeast Asia, despite funding difficulties. An influx of additional money, he said, would "improve the pace" of research and development.[29]

Electronic Countermeasures

([redacted] The USAF campaign against the NVN defensive network was multi-faceted, including not only RHAW equipment and tactics, but also electronic countermeasures and intelligence programs. In 1965, the burgeoning enemy defense opposing the USAF Rolling Thunder strikes--featuring radar-controlled SAM's and guns--presented the Air Force with perhaps the most sophisticated and concentrated defensive system ever faced by the United States and thus forced a re-examination of its ECM equipment and tactics.

[redacted] The Air Force divided ECM into two categories--support and self-protection countermeasures. Support ECM was provided primarily by the USAF EB-66's with stand-off jamming equipment designed to counter early warning/ground control intercept (EW/GCI), SAM, and AAA radars. Self-protection countermeasures were designed for use by strike aircraft against SAM and AAA radars.[30]

([redacted]) Between April and September 1965, nine RB/EB-66's were deployed to Vietnam (Tan Son Nhut) and Thailand (Takhli) as the 41st Tactical Reconnaissance Squadron in order to give ECM/ELINT support to Rolling Thunder missions.* The EB-66's, as originally employed in Southeast Asia, orbited just outside the lethal range of the SAM's while jamming the SAM/AAA radars. To obtain the maximum protection afforded by the jamming, strike aircraft had to stay between the EB-66 and the SAM, but this tactic limited their target approach routes. In late 1965, as the number of SAM installations increased and the enemy's camouflage and mobility improved, the EB-66's became less effective. Although the North's EW/GCI equipment could be degraded in varying degrees in a specific locality, the entire enemy air defense system could not be suppressed. With air defense filter centers, the North Vietnamese could still maintain overall tracking of the raid--even in the area under direct jamming from ECM aircraft--by employing unjammed radars, communications "crosstell," ground observers, and strobe cross-plots.[31]

[redacted] In late 1965 and 1966, as more MIG's appeared over the North to challenge USAF strike pilots (along with the enemy's use of increasingly sophisticated defensive equipment and integrated tactics), the EB-66's became more vulnerable and were driven farther back from

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* The data obtained by these aircraft revealed the increasing integration between MIG's and enemy GCI along with the placement of early warning and height finder radars in North Vietnam. The EB-66's were augmented in 1965 by three EC-121D "Big Eye" aircraft and four EC-130B "Silver Dawn" craft.

the major target areas. After an EB-66 was shot down on 2 April 1967, orbits for these aircraft were moved back from the "high threat areas." During the remainder of 1967, they were used only infrequently and then for shallow penetrations. Thus, as the EB-66 declined in effectiveness--especially against the frequencies of the SAM/AAA radars--major emphasis was placed on jamming acquisition GCI radars. Also, these aircraft provided data on enemy radars and their order of battle.[32]

Pod Development

[redacted] In September 1965, the Air Staff Anti-SAM Task Force observed that ECM for USAF fighter craft over the North was actually "non-existent." At the same time, it also noted that a "marginal" ability was possessed in stand-off jamming. According to the report:[33]

> ... tactical fighter aircraft do not possess self-screening ECM devices. This seriously limits the freedom of action desired and required by fighter-bomber crews. Equipping fighter-bomber aircraft with self-screening ECM devices will make them less vulnerable to the SAM and AAA threats.

[redacted] For the immediate future the task force recommended equipping tactical fighters with noise jamming and deception countermeasures. It proposed that the barrage noise-jamming QRC-160-1 ECM pod be modified for use against the S-band SA-2's. As of September 1965, TAC possessed 100 of these pods and the task force estimated--after modification and testing--they could be delivered in less than a year for use on F-100's, RF-101's, F-105's, and F-4C's. It recommended employing the ALE-29 chaff dispenser on tactical fighter and reconnaissance planes. As far as stand-off jamming was concerned, B-66B "Brown Cradle" aircraft with multiple jammers were proposed for deployment to Southeast Asia.[34]

[redacted] For the longer term, the QRC-160-8 ECM pod appeared the most promising against the SAM's and AAA guns since it could respond to multiple threat radars and was compatible with the F-100, F-105, and the F-4C. The possibility of employing the QRC-249B countermeasure pod, fuze jammers, retro-directive jamming antennas, and the Haber pneumatic chaff/ IR flare dispenser was also explored.[35]

([redacted] The QRC-160-1 pod was preset on the ground to counter the S-band Fan Song and Fire Can (AAA) radars. In September and October 1966, the pod was tested in combat flights over North Vietnam by F-105's (one pod on each outboard wing station) of the 355th Tactical Fighter Wing at Takhli. Missions were flown in heavily defended areas and indicated that pod-carrying aircraft were not tracked and fired upon by SAM's or AAA.* The pods were then introduced in number in late 1966 and by 1 January 1967 all strike aircraft flying into high radar density locations carried them.[36]

([redacted] In March 1967, the Night Song Study Group report noted the urgency of equipping USAF tactical strike aircraft with protective devices and recommended using the QRC-160-8 pod which had higher power and provided wider coverage compared to the 160-1 pod. By early 1968, the 160-8 had been used effectively in the theater, demonstrating more flexibility than the QRC-160-1. Also in 1968, the Air Force deployed the QRC-335, a deception repeater and noise jammer to work against SAM and AAA radars. This new pod showed promise of giving more protection to aircraft flying over the North. Also under active development were the QRC-288, designed against C-, S-, L- and X-band radars; the QRC-314 missile fuze jammer; and an advanced S- and C-band stand-off jammer. In addition, USAF planners were studying an advanced tactical electronic warfare system (ATEWS), which included jammers and passive receivers, for use against the entire enemy radar threat from early warning to terminal guidance radars.[37]

* However, the ECM pods sometimes jammed RHAW equipment as well as the enemy radars. Pod-equipped aircraft also experienced increased fuel consumption.

[redacted]

IV. DEVELOPMENT OF CONVENTIONAL MUNITIONS

([redacted] As noted in Chapter I, from the end of the Korean War until after the Kennedy administration assumed power, the Air Force emphasized nuclear weaponry rather than conventional munitions research and development. This trend was dictated by the prevailing basic national security policy and was reversed only reluctantly after that policy changed in 1961. For example, AFSC proposed to Headquarters USAF in late 1961 that it be authorized to start a $40 million nonnuclear munitions development program. But the Air Force orientation at this time was still nuclear; in 1961 it was deeply involved in deploying its Atlas and Titan ICBM's and had barely begun to test fire its Minuteman. It was against this background--after the AFSC request had been reviewed by the Air Staff and at the Secretarial level--that Systems Command was directed to program only $15 million in fiscal year 1963 for conventional munitions R&D.[1]

([redacted]) During the early 1960's, TAC had frequently asked for a strengthened conventional munitions development program to make up for the lengthy period--almost a decade--in which it had been afforded low priority.* In view of what happened in Vietnam during 1964-1967, it is painfully ironic to realize that TAC had recognized the need to improve conventional munitions, but the necessary money to develop and produce them was not forthcoming. For example, in 1960-1962, the Air Force

* In December 1963, TAC reiterated that it was still relying too heavily on the 750-pound bomb.

[redacted]

lacked not only advanced air-to-surface missiles* and anti-vehicle and anti-personnel ordnance, but also equipment which could locate the enemy in the jungles of Vietnam and fuzes which could penetrate the canopy without detonating prematurely. Consequently, when the United States entered the Vietnam war in force it did so with a serious shortage of precisely the kind of conventional war munitions and equipment needed in Southeast Asia.[2]

Inadequacy of Munitions

([redacted] During 1963-1965, when the United States became fully committed to the war in Vietnam, the Air Force possessed some stockpiled iron bombs from World War II and the Korean War plus some general purpose bombs developed after 1953. Too, some developmental work had been done on low level dispensers for fragmentation bomblets, but an entire family of new dispensers had to be designed and produced. In general, as the 1962 Cuban missile crisis pointed up, the conventional war stockpile and existing production lines were inadequate to meet the need.[+3]

([redacted] Problems arising from the use of the older munitions appeared soon after large-scale air operations began in early 1965. Aircrews discovered that such munitions dropped from high-performance aircraft flying at low altitudes frequently resulted in ricocheting bombs. The problem was corrected by a USAF modification to the Navy-developed

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* Its general weaknesses in this area were driven home during the Cuban missile crisis of October-November 1962, when the Air Force had to turn to the Navy to borrow Zuni air-to-surface missiles. Other nonnuclear munitions in short supply during the crisis included 20-mm ammunition, fire-bombs, and 2.75" rockets.

\+ See Herman S. Wolk, <u>USAF Logistic Plans & Policies in Southeast Asia 1965</u> (AFCHO, June 1967), Chapter III.

Snakeye fin bomb. Also, pilots found that World War II bombs created structural flutter when their jets approached the speed of sound. To resolve this problem, the Air Force ordered the design and production of new ordnance with the proper shape for the specific aircraft. Specialized munitions also were identified as a requirement to meet the specifications of low speed COIN aircraft (T-28's and B-26's) as well as jet fighter-bombers. Dispensers used on jets at speeds of at least 400 knots, it was found, were not compatible with the COIN aircraft. Further, to counter the enemy's surface-to-air missiles, steps were taken to acquire retarded bombs which could be dropped at low levels. However, long before these became available, pilots discovered that they could evade the missiles at medium altitudes and avoid the dangerous low altitudes where they became vulnerable to heavy AAA fire.[*4]

([redacted] Since much of the air campaign was directed against the enemy's lines of communications (LOC's), top priority was given to development of weapons that could penetrate the jungle canopy and explode on the ground rather than in the trees. Too, emphasis was placed on so-called area denial munitions or mines that could stop enemy personnel and vehicles. What was needed then, according to the Air Force, was a "family" of munitions which could accomplish a variety of tasks.[5]

Accelerated Ordnance Program

([redacted]) As a result of the above requirements, General McConnell on 29 June 1965 directed that specific categories of munitions be developed

* See Chapter III, "Countering the NVN Air Defense System."

as quickly as possible for use in Southeast Asia. This accelerated ordnance program was to emphasize development and procurement of munitions for special missions. The Chief of Staff stated the new ordnance was required "to remove major operational deficiencies and to attain improved strike effectiveness for combat operations in Southeast Asia." Noting the urgency of the program, he said:[6]

> I consider early availability of modern ordnance to field units one of the most vital factors for improving force effectiveness... it is imperative that this new ordnance be made available to the field at the earliest practicable date.

([redacted] Each new munition that promised to improve operational effectiveness in Southeast Asia was to be proposed for concurrent engineering development and production. General McConnell directed that there should be no delay in making arrangements with appropriate contractors and also that naval ordnance should be reviewed for possible application to USAF missions. A qualified technical team was to be sent to SEA to supervise the introduction of new munitions into the theater. The Chief of Staff directed that the following munitions programs be accelerated: Missile and hard target ordnance - AGM-12C Bullpup, M-117 retarder, AGM-45A Shrike anti-radiation missile, CBU-3/A anti-tank, AGM-62 Walleye and the MK-82 retarder; anti-personnel and anti-materiel - BLU-24/CBU-12 jungle bomb, Sadeye dispenser, Rockeye III, Dragontooth land mine, napalm-B flame fuel; fuzes - FMU-54 retarded bomb fuze, FMU-26 multi-purpose, FMU-35 long delay, M-910 proximity, FMU-30 land mine fuze, and the FMU-43B 20-mm proximity fuze.[7]

Flak Suppression Ordnance

([redacted] As mentioned, in early 1965--coincident with the start of the American air campaign against the North and the use of SAM's against U.S. aircraft--the Air Force possessed only limited flak suppression munitions, primarily the CBU-2.* The disadvantages of this munition were many and included a low-level delivery and restricted area coverage. Also, in some cases, premature detonation of CBU-2 bomblets had caused damage to aircraft. The Air Force requirement was for a munition which could be released from higher altitudes (6,000-8,000 feet). Indeed, early USAF experience in air operations over the North indicated that the majority of Air Force (and also Navy) combat losses had been caused by AAA fire, often from relatively small caliber guns, during the attack phase. The Air Force wanted a weapon that not only could be dropped from a higher altitude, but that would give wide area coverage.[8]

([redacted] In May 1965, in response to this requirement, the Air Force Armament Laboratory at Eglin AFB began development of the CBU-24 flak suppression munition. Funds for concurrent development and production were provided on 13 May 1965 by a DOD supplemental appropriation for contingency programs. Early USAF planning called for a buildup in production from 500 units per month in late 1966 and early 1967, to 2,810 units by July 1967 and 8,000 per month by January 1968. The first CBU-24 production munitions were delivered to Southeast Asia in March 1966 and the first cluster bomb was dropped in April.[9]

* For additional discussion of this point, see Chapter III, "Countering the NVN Air Defense System."

[redacted]

([redacted] Although basically a flak suppression munition, the CBU-24 also was partially effective against personnel and light materiel targets. It weighed about 750 pounds, resembled the M-117 bomb in shape and size, and contained approximately 700 BLU-26 bomblets. During 1966 USAF pilots were unanimous in stating that flak bursts ceased or were significantly reduced after the CBU-24 had been delivered. In 1967 the Air Force modified about 10 percent of these munitions to include a random delay fuze which would keep AAA gunners from manning their weapons after the first bomblets exploded.[10]

([redacted] By March 1967, however, the demand for the CBU-24 had far exceeded the production. As a result, it was "severely rationed" and became one of the most critical items on the SEA munitions supply list. In March, although production reached 570 bombs per month, Headquarters USAF estimated that it would take another 14 months--after funding approval--before monthly production reached 8,000 bombs. A monthly rate of 16,000 units could be achieved in approximately 18 months from the date of funding approval. In early 1967, the production/expenditure schedule was as follows:[11]

CBU-24	Jan 1967	Jul 1967	Dec 1967	CY 1967
Production	520	2200	7450	32,640
Desired Expenditure	8050	8050	8050	96,600
Forecast Expenditure	700	1475	2100	16,550

([redacted] Although it had proved highly satisfactory, the CBU-24 still did not meet all the requirements of a flak suppression weapon. The ideal flak suppression weapon, theater commanders reported, should be aimed immediately after a pilot spotted a target and fired as the aircraft moves off. In response to this need, the Air Force developed--and in early 1967 tested--a cluster warhead with the AGM-12C Bullpup. This warhead, which

[redacted]

held about 800 BLU-26B bomblets, by the close of 1967 had completed R&D feasibility tests. Operational evaluation in Southeast Asia was scheduled for early 1968.* Also, in July 1967, Headquarters USAF published a development directive (Project "Pave Joy") which called for demonstrating two guidance techniques for the Bullpup--the Martin ACT and the Chrysler DC systems. At the same time, Project "Pave Way" was formed in order to develop the laser, electro-optical, and infrared guided bombs.[12]

[redacted] In connection with the task of countering the enemy SAM's, USAF pilots had experienced some success with the AGM-45A Shrike missile as a SAM radar locator and suppressor. Also under development was an improved anti-radiation missile, the so-called Standard advanced radiation missile (ARM), which featured offset launching, extended range, and a superheterodyne receiver to provide greater sensitivity. In early 1967, the Joint Chiefs of Staff recommended a phasedown of Shrike procurement for SEA from 8,320 to 7,040 units per month by the end of fiscal year 1968. A comparable "one-to-one" substitution of the first 300 ARM would be made. In early 1967, the AGM-62 Walleye TV-guided missile was used over North Vietnam (seven were fired in March with six direct hits reported) with impressive results.[13]

Penetrating the Jungle Canopy

[redacted] Since 1965 the U.S. commanders in Vietnam recognized that--because of the SEA topography--they would need weapons that could penetrate the jungle canopy and destroy enemy troop concentrations, base

* The AGM-12C with the bomblet warhead was designated the AGM-12E. The 800-bomblet pattern covered an area 600 feet in diameter.

camps, and materiel targets. Early in the war the BLU-3 bomb was the primary weapon available and designed to penetrate and explode on impact. However, the initial experience with this munition indicated that it tended to detonate in trees or to tumble through the canopy and fall as duds because the fuze did not receive sufficient impact.[14]

([redacted] In order to provide a reliable jungle penetration munition, the BLU-24 bomb was developed. Designed to be ejected from the same dispenser as the BLU-3, the BLU 24 was configured so as not to detonate until the bomb penetrated through the trees to the ground. This bomb entered the SEA operational inventory in late 1966 and the pilots reported that the results were satisfactory.[15]

Area Denial Munitions

([redacted] The major problem that faced the United States in Vietnam was interdiction of the flow of men, supplies, vehicles, and materiel from North Vietnam over jungle trails into South Vietnam. In early 1965, the Air Force recognized that it was deficient in the kind of area denial munitions that could prevent and delay the enemy movement of men and materiel. It was believed that, if such munitions were available, they could substantially reduce the overall flow, especially during darkness and bad weather when most of the enemy infiltration occurred. The development of mines, especially, which could self-destruct at a given time, might prove to be a major factor in the U.S. interdiction effort.[16]

([redacted] Anti-personnel and anti-vehicle mines had been under development since 1962. In 1965 the Air Force formulated plans for accelerated development specifically of the dragontooth and trip wire anti-personnel mines. The CBU-28/A dragontooth was a plastic-encased mine, weighing about one ounce, that could be set off by foot pressure. Designed to injure, but not kill, it was the only USAF munition which used a binary liquid explosive warhead. It was also effective against vehicle tires. The first production mines would possess an 18-hour life (later models would have longer periods). The mines were to be delivered from a downward-ejecting dispenser (SUU-13/A) with each dispenser holding between five and six thousand mines. The F-4C was capable of carrying up to 17 dispensers.[17]

[redacted] The CBU-34/A trip wire anti-personnel mine was the most advanced of its type. Weighing less than a pound, it ejected at least eight wires after hitting the ground and could be detonated by anything passing within its deadly circle. If not detonated within 150 hours, the mine would self-destruct. One B-52 was capable of carrying 54,800 mines.[18] Also under development was the CBU-33/A vehicle land mine with a magnetic fuze, weighing approximately 20 pounds. In 1965, an advanced supersonic dispenser for this mine--which was capable of stopping vehicles and tanks--was under development. The F-4C could carry about 300 CBU-33/A mines.[19]

[redacted] In late 1965 and early 1966, development, production, and deployment of area denial ordnance were supported strongly by Secretary of the Air Force Brown and General Westmoreland. On 13 January 1966, Assistant Secretary of the Air Force Alexander Flax recommended to Dr. John S. Foster, DDR&E: (1) removal of restrictions on advanced and engineering development of area denial weapons; (2) release of $400,000 which had been deferred for the trip wire mine; (3) provision of $250,000 emergency money to adapt the dragontooth for B-52 delivery; (4) provision of $3.1 million to finish RDT&E of the trip wire in 15 months and provide an interim mine in nine months; (5) reprogramming action for fiscal year 1966 production of 960 SUU-13/dragontooth dispensers; and (6) reprogramming of $3.8 million in fiscal year 1966 procurement funds to produce 500,000 trip wire mines per month. Dr. Foster subsequently released withheld funds and provided additional OSD emergency funds for RDT&E only.[20]

[redacted] Meanwhile, Secretary of Defense McNamara directed a "maximum effort" and attendant funding for advanced production engineering and "volume production" of gravel, dragontooth, and trip wire mines and he requested an estimate of SEA needs.* On 21 January 1966, General Westmoreland submitted a concept of operations and the following monthly requirements: Gravel and dragontooth, 691,000, and trip wire, 1,645,000. Admiral Sharp, CINCPAC, agreed with COMUSMACV's recommendations and emphasized the importance of using area denial ordnance in Laos and North Vietnam.[21]

([redacted] Dr. Flax subsequently sent a memorandum to Dr. Foster reporting on the successful results of the dragontooth test program and proposing immediate production of 23,400,000 mines in 4,875 SUU-13/A dispensers at a cost of $60.23 million. In response to Dr. Foster's request to him to investigate whether or not to accelerate introduction of the area denial weapons, Air Force Secretary Brown recommended on 11 April 1966 that they proceed to deploy an entire family of "mutually supporting" mines "to compound" the enemy's movement problem and "to reduce countermeasure effectiveness."[22]

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* In 1966, much of the impetus for the development and production of area denial ordnance resulted from Mr. McNamara's decision to go forward with an air-supported barrier system. For a detailed discussion of this system, see Wolk, <u>USAF Plans and Policies: Logistics and Base Construction in Southeast Asia, 1967</u> (AFCHO, October 1968), Chapter IV, "The Anti-Infiltration System."

([redacted] Secretary Brown noted that employment plans could be established parallel with development and production. Too, production could be increased severalfold by establishing additional production lines if requirements justified such a procedure. As far as the trip wire mine was concerned, Dr. Brown observed that its operational employment could be advanced by about six months by adopting both an interim and final design version in production. The Air Force, he reported, also had examined the services' anti-vehicle land mine programs and since there did not seem to be an "optimum" anti-truck mine under development, he suggested that the Air Force proposal should be treated as a separate program.

([redacted]) Based on the current status of the area denial munitions programs, sortie effectiveness, and operational needs, Secretary Brown advised that:[23]

1. A family of air-delivered land mines properly used in sufficient quantities could make a significant impact on our operational effectiveness in Southeast Asia.

2. Employment plans will be developed to fully exploit or quantify the potential of air-delivered mines in Southeast Asia. We have no experience in their use (except for the anti-railroad mine) and we have little but theoretical studies and speculation as to how an enemy may react to their use, both psychologically and by countermeasures.

3 Decisions and implementing directions are now needed on mine production programs to avoid slippage in field availability and to assure procurement of sufficient quantities to make an early impact on our operational effectiveness in Southeast Asia.

([redacted] Several weeks later, Dr. Brown discussed area denial ordnance with Deputy Secretary of Defense Vance and gained tentative agreement on major segments of the program. On 28 April, he sent a revised program to OSD "which would retain the vital options to provide a field capability on the same dates as previously proposed, but would reduce the commitment of fiscal year 1966 funds," thus deferring "certain decisions" on procurement until more information was available.[24]

[redacted] The Air Force Secretary recommended initial dragontooth production using semi-automated tooling, thus providing an operational capability about six months earlier than if the Air Force waited for a fully automated production line. With fiscal year 1966 money of $14.7 million, interim production could start while an automated assembly line was readied to turn out 1,500,000 mines per month, beginning about March 1967.[25]

[redacted] Also, Dr. Brown recommended acquisition of an interim trip wire mine in order to provide an earlier operational capability. If this project was approved by 1 May, the first production articles could be available in January 1967. The first wire mines in their final configuration could be ready as early as April 1967. He suggested fiscal year 1966 expenditures of $11,739,000.

[redacted] In the case of the anti-tank land mine, he proposed 1966 funding of $1.25 million for long lead time tooling to form a production base for 45,000 mines (1,500 dispensers) per month for the initial deliveries in March 1967.

([redacted] Secretary Brown asked OSD for an early decision on his proposal, declaring that "any further delay in these programs will result in at least an equal slippage in initial operational capability for all three mines."[26] The next day, 29 April 1966, Secretary Vance approved the programs.[27]

[redacted] Still another anti-vehicle mine under development--which would replace the MLU-10/B--was the BLU 31/B, an 800-pound blunt nose mine, employing the FMU-30/B electronic fuze, also under development, which would detonate on a pressure signal from passing vehicles. This fuze would self-destruct the BLU-31/B in approximately 85 hours if no vehicle passed. Advantages of the BLU-31/B included a small entry signature on penetration. It was effective not only against trucks and jeeps, but also against tanks and locomotives. It was scheduled for combat use by late 1968.[28]

[redacted] Other advanced fuzes under development for the Air Force by the end of 1967 were the FMU-56/B, a high altitude electronic proximity fuze for the CBU-24/49 bombs; the FMU-57/B, another electronic proximity fuze for use with general purpose bombs; and the FMU-35/B long delay fuze which was used in Southeast Asia beginning in December 1967. The FMU-57/B, scheduled for employment by February 1968, was designed for low altitude delivery against soft targets.[29]

V. NIGHT AND ALL-WEATHER OPERATIONS AND RECONNAISSANCE

[redacted] No greater R&D challenge faced the Air Force in Southeast Asia than that involving night and all-weather operations. When it found itself engaged in major air activities in Vietnam and Laos in early 1965, the Air Force had neither adequate equipment nor devices to effectively conduct such operations. The result was that the enemy enjoyed relative freedom of movement at night and during bad weather, at least up to mid-1966.[*]

([redacted] Recognizing the problem, the Air Force beginning in 1965 initiated a series of R&D projects to upgrade its night operations in the theater. The goal was to develop better night bombing control facilities and procedures, improve circular error probables (CEP's), and acquire a variety of equipment to help pilots to locate the enemy under conditions of darkness and poor weather. High priority was placed on improving night armed reconnaissance[+] (greatly enhanced with deployment of the RF-4C to the theater) and intruder/interdiction missions.[1]

([redacted] Unfortunately, the acquisition of necessary "black box" equipment to hit the enemy with air-to-ground weapons accurately and around the clock proved time-consuming. Even by 1967, progress with regard to operations in the hostile north had been slow. Maj. Gen. A. J. Evans, Jr., USAF Director of Development, observed in March 1967 that

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* Dr. Eugene G. Fubini, former Deputy DDR&E, reflecting on the Vietnam war, said in September 1967: "Where is he (the enemy)? Where are his mines and booby traps? Where is his camp? Where does he go at night? I and others failed to recognize the importance of these questions back in 1964 and 1965." [Quoted in Aviation Wk & Space Technology, 4 Sep 67, p 19]

\+ The great majority of night operations over North Vietnam were classified as armed reconnaissance missions.

the "R&D community has been made well aware of night/all-weather limitations and the severe constraints placed on tactics and techniques by such problems as night navigation, target detection, target marking, weapons delivery accuracy and poor attack assessment."[2]

[redacted] The director noted that 92 percent of USAF night missions over North Vietnam had been flown by F-4's and that 70 percent of the bomb damage had been unobserved because of navigational and visibility limitations. And yet, with respect to tactical night RDT&E, the main thrust was to develop and test hardware primarily for use at low speeds and altitudes in the permissive, in-country environment of South Vietnam. "We have not solved," General Evans stated, "the problem of improved combat effectiveness at night and reduced attrition in an exacting hostile environment." He noted that funding for major R&D items in fiscal year 1967 totaled $77 million, which he felt was inadequate.[3]

MSQ-77 "Combat Sky Spot"

[redacted] In 1966, among the remedies employed to ameliorate the situation was the MSQ-77 "Combat Sky Spot," a van-mounted precision radar (previously designated the MSQ-35) designed as a training aid some 15 years ago. As the MSQ-35 van-mounted radar set, it was originally used by the Strategic Air Command to score simulated bombing during training missions. The MSQ-35 computer was programmed with the ballistics of the weapon designated for simulated release. After indicating aircraft speed, altitude, and track at the instant of release by radar, the precise simulated ground zero point could be calculated by the set.[4]

[redacted] By reversing this procedure, the MSQ-35 operator could guide the pilot by voice command to a pre-determined release point and on the operator's voice countdown the pilot manually released the bomb. Maximum range was originally about 100 NM, but the tracking radar was modified to extend it to approximately 200 NM. In late 1965 and early 1966, F-100 aircraft tests at Matagorda Island showed a CEP of 486 feet at 44 NM and 607 feet at 94.6 NM. After additional testing and equipment modification, the Air Force deployed the first MSQ-77 Sky Spot to Bien Hoa in March 1966. Four other sets were subsequently sent to Pleiku, Nakhon Phanom, Dong Ha, and Dalat.* As a result, improved coverage was provided for Air Force, Navy, and Marine aircraft over South Vietnam and Laos as well as large parts of North Vietnam and pilots were able to increase the pressure on the enemy around the clock and in adverse weather.[5]

([redacted]) The introduction of the MSQ-77 along with the Tactical Air Control System (TACS)--which provided a link between ground troops and supporting aircraft--helped improve close air support during 1966. After forward air controllers (FAC's) were equipped with the X-band beacon which enabled them to pinpoint better the positions of ground forces, there was a further increase in close air support effectiveness. Modifications to F-105 and F-4C radar led to additional improvements in the Air Force's ability to support ground forces in poor weather.[6]

([redacted]) By March 1967, more than 15,000 sorties had been controlled by Sky Spot at night and under poor weather conditions. On several occasions it was used to direct munition drops as close as 250 meters to U.S. forces.[7]

* On 1 November 1967, another MSQ-77 became operational in Laos, but it was destroyed by the enemy in March 1968. (DJSM-800-68 (TS), Memo for DDR&E, CSAF, CNO, et al, 28 June 68, subj: Update of the NIGHT SONG Study).

Operation Shed Light

[redacted] Troubled by inability to interdict the increasing night infiltration of enemy troops and equipment, the Air Force in early 1966 established Operation "Shed Light," a high priority program aimed at acquiring a much improved night air strike capability. The first phase of this program investigated the major night and all-weather operational deficiencies and then proposed solutions which would produce major improvements at an early date. The second phase was planned as a concerted drive to follow up on these recommendations. The Air Force hoped to upgrade substantially the night air campaign by improving sensors, airborne illumination, command and control, guidance, etc., and by accelerating the flow of new equipment into the operational inventories. USAF planners believed that Shed Light analysis would also enhance daylight operations.[8]

[redacted] The study phase was undertaken by a group within the Office of the USAF Deputy Chief of Staff, Research and Development, during 7 February-5 March 1966. Primary night strike deficiencies were identified to be inadequate navigation, inability to find and see targets, and unsatisfactory combat CEP's. The study group decided that current R&D programs provided a substantial base from which to expand the Air Force effort and that some improvements--primarily in terrain illumination and use of ground radars--could be made within a year. Within three-to-seven years it anticipated that significant improvements could be realized which would transform USAF night operations.[9]

[redacted] A strong USAF RDT&E program was recommended which would lead to development of better target marking equipment, new sensors and sensor displays, a foliage penetration device, improved navigation systems such as Loran D, Doppler inertial Loran, and ground radio directors, new illuminators, improved visual weapon delivery, and a new self-contained night attack weapon system. The study group projected future acquisition of night operational equipment as follows:[10]

0-1 Years	1-3 Years	3-7 Years
	Preplanned Interdiction	
Flares/floodlights Ground radar Strike aircraft with beacons	Loran D in strike & reconn aircraft Loran D weapon delivery Zuni flares	New Self-contained night attack system
	Armed Reconnaissance	
	C-123/C-130 with floodlights, night sensors & improved day strike aircraft Night attack and C-130 Black Spot (Self-contained) RF-4C (Hunter)	New Self-contained system as above RF-111 (Hunter)
	Close Support	
Flares/floodlight and day strike aircraft	FAC with laser illuminator and strike aircraft with sensors FAC with offset beacon and strike aircraft with radar Improved illumination	New Self-contained system as above

[redacted] On 17 March 1966, General Blanchard, Vice Chief of Staff, formally established Shed Light as a USAF program. AFSC subsequently was asked to prepare a preliminary package plan which identified areas in which the study's recommendations could be implemented and to submit additional recommendations. Received on 9 June 1966, the plan was reviewed and approved by Secretary Brown and General McConnell. They directed the Air Staff to proceed as rapidly as posssible. A sum of $15.15 million in R&D funds and $8.1 million in modification and procurement monies were spent on the program in fiscal year 1966. In fiscal year 1967, expenditures were increased to $46.9 million for R&D and $34 million for modification and procurement.[11]

[redacted] Within Headquarters USAF, a Shed Light office was established under General Evans, the Director for Development. AFSC was made responsible for planning, programming, and carrying out research and development, with the Aeronautical Systems Division (ASD) at Wright-Patterson AFB, Ohio, designated as the "lead division." At AFSC headquarters, the Assistant for Limited War, DCS/Systems, was assigned the primary responsibility for Shed Light affairs.[12] By February 1967, some 65 Shed Light projects had begun and by early 1968 the total had climbed to more than one hundred. The evolving technology supported a number of aircraft prototype system projects, such as Tropic Moon I, II, and III, the so-called "Hunter" programs, and others (see below).[13]

Sensor Development

[redacted] The heart of the Shed Light project was the effort to improve sensor and illuminator devices so that the Air Force might have real-time* radar and target marking for night and interdiction operations. Although radar systems could detect targets moving as slow as three or four miles an hour and under rainy conditions, forward-and-side-looking radar and low light level television (LLLTV)--which would enable an aircraft crew to see targets covertly under starlight conditions or better--were considered essential. In this connection, development of laser equipment had progressed sufficiently so that line scanners could be placed into production by 1967

* Real-time was defined as the absence of delay in acquisition, transmission, and reception of data.

and rangers, designators, and seekers could be tested. An "eyeglass" optical viewer also was being acquired which provided improved angular resolution and "field of view" under starlight conditions.[14]

([redacted]) Since finding and marking of targets was basic to the control of an entire operation, and because the Air Force recognized the fundamental importance of obtaining real-time data for its interdiction operations, a number of first-generation prototype projects were given special emphasis as part of Operation Shed Light. One of the most important of these was the battlefield illumination airborne system (BIAS), a real-time reconnaissance and illumination unit which included Xenon arc lamps, downward-looking infrared and forward-looking radar with moving target indicator (MTI). The Xenon light units had originally been mounted in a C-123 and by late 1967 two C-130's with double fuselage pods were undergoing tests in South Vietnam. From 12,000 feet altitude, the 5,500-pound system could provide illumination four times brighter than full moonlight over a circle two miles across.[15]

[redacted] The BIAS-Hunter I project evolved from a combination of SEAOR's #50 (which described the requirement for the battlefield illumination airborne system) and #154 (designed to provide near real-time reconnaissance). In 1967, a prototype C-130 was being equipped to satisfy both SEAOR's. Eventually, 11 of these BIAS-Hunter RC-130S aircraft would be available, eight for deployment to the theater and three for support, training, and attrition. Delivery was scheduled for February 1969.[16]

([redacted]) Another Shed Light program, "Lonesome Tiger," featured an A-26A equipped with a forward-looking infrared radar (FLIR) unit for "first pass" night target detection. This project was completed in July 1967, but the detection ranges proved inadequate. The equipment was then transferred to Gunship II following the successful use of forward-looking apparatus in a Gunship II C-130A test plane. Complementing FLIR, and perhaps even more effective in detecting truck movement at night, was the low light level television sensor. The Air Force included LLLTV equipment in several test projects. A multiple sensor (automatic weapon delivery) night attack program ("Black Spot") began field tests in the spring of 1967 with two C-123K aircraft equipped with LLLTV, FLIR, radar (MTI), and laser ranging. An AM/FM clutter suppression apparatus was also installed. These sensors were combined with two analog computers and a Hayes cannister dispensing system to provide an integrated night attack ability. The objective of Black Spot was the detection and destruction of the enemy's night resupply operations. One of the C-123K's also possessed a "Black Crow" subsystem.* Engineering tests began with these aircraft in October and November 1967; they were scheduled to be deployed to the theater in June 1968 for six months of combat evaluation.[17]

([redacted]) Low light level television sensors also were used by the Air Force in its "Tropic Moon I and II" projects. Two Dalmo-Victor LLLTV systems were obtained for Tropic Moon I A-1E aircraft. These sets were designed to acquire targets under quarter moonlight conditions in low threat areas. Tropic Moon II featured three B-57's equipped with pod-mounted Westinghouse LLLTV. These deployed on 6 December 1967 to Phan Rang AB, South Vietnam for combat evaluation, scheduled for February-June 1968. Night strike/reconnaissance operations utilizing starlight were to be conducted at altitudes of 1,500-3,500 feet at speeds of 350-400 knots.

* The Black Crow sensor was a sensitive narrow band super-heterodyne receiver which could pick up electronic "noise" emitted from vehicle ignition systems, generators, strobe light dischargers, radar, etc.

([redacted]) Tropic Moon III was a project involving 16 B-57G's equipped with radar (moving target indicator), FLIR, LLLTV (improved over the Tropic Moon II system) and IR high resolution sensors with a digital computer system for better target detection, tracking, and weapons delivery. Tropic Moon III was expected to be especially effective against vehicles on the supply routes in North Vietnam and Laos during darkness. The program was approved by Headquarters USAF in late 1967 and by OSD on 24 February 1968. The estimated operational date for Tropic Moon III was late 1969.[18]

([redacted]) As part of Shed Light, the Air Force gave priority to acquisition of a low speed "self-contained night attack (SCNA) aircraft."* Planned as an integrated weapon system for night attack search-fix-kill tactics, the aircraft was to include LLLTV as the primary sensor with a laser ranger and automatic weapons delivery. On 12 June 1967, the Air Force signed a letter contract with the Grumman Aircraft Engineering Corporation for two SCNA prototypes (modification of the Navy's S-2) with an option to buy 12 production versions. Total fiscal year 1967 funding for the SCNA was $15.2 million. In late 1967, however, because of the large increase in funds required to support this project into 1968, Headquarters USAF decided to terminate it and on 12 January 1968 the SCNA was cancelled.[19]

* In January 1967, Gen. William Momyer, Seventh Air Force Commander, did not support this program, emphasizing instead the need for high performance aircraft for out-country operations. In supporting SCNA, Headquarters USAF stressed that a low speed aircraft could detect vehicles now on LOC's with a high kill probability. For some time to come, low speed aircraft would detect smaller targets at lower light levels than high speed aircraft. For the near future (18-24 months), then, Headquarters USAF argued for the S-2G SCNA as a major contribution toward improving night attack operations. [Dir/Dev Staff Study (S), 26 Jan 67, subj: Self-Contained Night Attack Aircraft (Shed Light).]

[redacted] In 1967, the Air Force also continued studies of a night forward air control (NIFAC) aircraft. A NIFAC test program, using the O-2A aircraft, began in July 1967 and was completed in November. Deployment of four O-2A's was scheduled for February 1968. Also, OV-10 aircraft night avionics was studied but because of the high cost of the program, work on a formulation package was delayed in December 1967. These systems, which were expected to improve significantly night forward air controller operations, incorporated a high resolution direct viewing device with excellent optics and a large intensifier tube.[20]

Laser Development

([redacted]) In connection with FAC operations, SEAOR #57, 14 September 1966, established a requirement for a laser target designator system which would be used by the airborne controller in concert with strike aircraft. Since target marking with smoke and flares warned off the enemy, the Air Force was greatly interested in developing an image-stabilized laser target designator, to be installed in the FAC's O-2A aircraft to accurately and covertly mark the target. A pod-mounted laser seeker which locked-on the energy return of the marked target would be carried aboard strike aircraft. In December 1967, after the first prototype laser designator system developed under Project "Pave Light" was delivered, the Air Force decided to use two O-2A FAC planes and four F-100 strike aircraft to test and evaluate the equipment. Also, in October 1967, it let a contract for design and fabrication of a stabilized laser illuminator which would allow accurate target designation from a high altitude at high speeds. This equipment would be tested in an F-4C.[21]

([redacted]) Support for these Shed Light programs was reiterated during a 19-21 October 1967 CINCPAC Target Acquisition Conference attended by representatives of the services, OSD, JCS, and ARPA. The conferees concluded that the development of night sensors should be continued and that the Tropic Moon I and II, Black Spot, and BIAS-Hunter configurations should be accelerated. They also supported the Hunter-Illuminator (Hunter II C-130) project and studies of the so-called "High Threat Hunter," an RF-4C designed to provide targeting information in near real-time and support target acquisition and strike operations against mobile and fleeting targets. The Hunter II C-130 would team up with a "killer" aircraft. A Hunter II configuration study was completed on 18 December 1967.[22]

Development of the Gunship

([redacted]) The development of the Air Force's side-firing gunships, which began with the conversion of the old C-47 to the AC-47 gunship, was based on the evolution of the MXU-470 7.62-mm minigun and the M-61 20-mm rapid-fire Vulcan cannon from the basic gatling gun. Each of these weapons--modified for side-firing--could fire 6,000 rounds per minute. Thus, the use of USAF gunships in Vietnam could be traced to a combination of new weapons adapted to old aircraft and matched to new tactics.[23]

([redacted]) The AC-47 ("Puff, the Magic Dragon") employed these side-firing mini-guns in attacking ground targets while the aircraft was in a pylon turn, giving the gunner a relatively stable view of the target. Initial tests at Eglin AFB in 1964 and operational tests in Vietnam in early 1965 demonstrated that flying 3,500 feet above the range of most ground fire and lighting the target with flares, the AC-47 could be very effective attacking the enemy in the vicinity of villages and hamlets. Because the early gun pods used on the AC-47 gunship took up too much space, modules were developed which provided more room and made it easier for the crew to service the guns in the air.[24]

[redacted] AC-47's were deployed to Thailand as well as to South Vietnam. From Nakhon Phanom and Udorn AB's in Thailand these gunships were used to strike targets in Laos. Overall, they performed very effectively and showed that a combination of the new and the old could adapt to the Southeast Asian environment.[25]

[redacted] So successful were the AC-47's that the Air Force decided to configure and deploy improved follow-on gunships. Gunship II, the C-130A tactical transport that the Air Force selected as a follow-on to the AC-47, was equipped with BIAS, four 7.62-mm miniguns and four 20-mm cannons (gatling guns). It also possessed three sensors (night observation device, side-looking radar, and SLIR), flare launcher, and a flare control system. As of December 1967, the Air Force planned to modify seven C-130A's to the Gunship II AC-130A configuration (in addition to the one already modified). They were expected to provide a much improved ability to attack the enemy's LOC's and support friendly ground forces. Theater evaluation of the one AC-130A--including close support missions in South Vietnam and interdiction in southern Laos--was successfully completed in December 1967.[26]

[redacted] Since the Air Force did not have sufficient C-130's to meet all its gunship needs, Secretary Brown approved modification of C-119K and G models to the gunship configuration. These aircraft were to be equipped with the same kind of guns and sensors as the AC-130. A contract for their modification was awarded to Fairchild Hiller in early 1968. The AC-119G's were to deploy to Southeast Asia in the first quarter and the AC-119K's in the second quarter of fiscal year 1969.[27]

"Combat Target" and Improved CEP's

([redacted]) In March 1967, General McConnell set up a special USAF task force to examine all aspects of all-weather bombing. Nicknamed "Combat Target," this task force was directed to submit recommendations to improve USAF all-weather bombing during 1968-70 as well as over a longer period. The group completed its work in October. In its report it noted that the criteria for delineating adequate conditions for visual dive bombing were 10,000 feet ceiling and a visibility of five miles. However, weather conditions over North Vietnam--according to an earlier USAF study--were worse than this about 59 percent of the time. PACAF data indicated that, in the six-month period between November 1966 and April 1967, more than 50 percent of sorties reported ineffective had been diverted for reasons of weather.[28]

([redacted]) To improve operations under these adverse weather conditions, the task force recommended that deployment of F-4D's be continued; the F-105 be modified for radar level bombing; the MSQ-77 Combat Sky Spot radar be sited so as to include coverage of Hanoi and part of the Haiphong area; the T-Stick II/Loran* program be accelerated; and six F-111A's--which were configured to operate in bad weather--be sent to

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* Long-range navigation. The T-Stick II/Loran program involved modification of the F-105 bombing system to improve CEP's. It was established in July 1966.

Southeast Asia in January 1968. It further recommended that all of these programs be pursued on a priority basis. For the longer term, the task force proposed that a combat CEP of 200 feet or less be established as a criterion for nonnuclear all-weather bombing systems.

([redacted]) The task force noted that despite the fact that the requirement for precision bombing in adverse weather had been recognized for years, the Air Force had never accorded it sufficient priority. Existing tactical aircraft--including the F-111--lacked one or more of the key elements needed for an all-weather system. As far as the CEP requirement of 200 feet was concerned, USAF equipment in use in late 1967--or programmed for all-weather bombing--would not provide the necessary precision. An adequate all-weather bombing radar system required high radar resolution, navigational accuracy of a high order, multiple offset aiming point equipment, and an accurate "continuous solution" bombing computer.[29]

([redacted] Deployment of the Loran system mentioned above--and its integration with the modified F-105 bombing system--followed developmental testing in 1965 when the Air Force decided to combine Loran-D receivers in fighter and reconnaissance planes with a Loran-C ground network. It hoped that a Loran-C/D system would provide the desired coverage at night and in poor weather while also improving the effectiveness of electronic photo and visual reconnaissance missions. The greater navigational accuracy of Loran-C/D would help pilots not only to fly to and from targets, but also to avoid SAM's and the enemy's air defense radar. The Air Force estimated the installation of the Loran-C/D network would cost approximately $28 million while procurement and installation of more than 300 airborne Loran-D systems would require about $20 million. In addition to the receiver (the same as the Loran-C AN/ARN-78 receiver), the Loran-D navigation set included a computer, map display, and instrument display coupler. This provided direct readout of pilot data, including the course and distance to any target, cross-steering correction, present position, and continuous map position.[30]

([redacted] Deputy Secretary of Defense Vance on 18 November 1965, approved the installation work and the deployment of the Loran-C/D system. The Air Force Logistics Command published an implementation plan on 11 March 1966 and Headquarters USAF approved it on 16 June. Some five months later, on 28 October, the Loran-C chain became operational in Southeast Asia. Also, under Project "Seek Place" (formerly "Razor Clam"), the Air Force on 4 November awarded a contract to International Telephone and Telegraph (IT&T) for 200 Loran-C/D receivers. These were scheduled to be installed in 32 RF-4C aircraft; 65 F-4C's; 20 RF-101's; 18 EB-66's; and 65 F-105's. Interconnection with the T-Stick II* system in the F-105 was planned, even though delivery postponements and funding difficulties delayed installation work. Six T-Stick II/Loran-D F-105's were scheduled to become operational in Southeast Asia by December 1968 with the modification work on 65 F-105's slated to be finished in early 1969.[31]

Reconnaissance Systems+

([redacted] An important aspect of the USAF research and development program for Southeast Asia was a multi-faceted effort to improve

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* Actually "Thunderstick II."

\+ Material pertaining to reconnaissance is also found in Chapter III, "Countering the NVN Air Defense System."

tactical reconnaissance. One project evolved from an ARPA reconnaissance test program in the summer of 1965 which used an infrared-equipped C-47 flying over targets in Thailand. These flights indicated that the normal operating altitude for IR night reconnaissance was 2,000-3,000 feet. Late in 1965, following the ARPA tests, MACV requested--and the Joint Chiefs of Staff approved--a project ("Dark Eagle") aimed at improving IR imagery techniques to insure that the experience gained in Thailand would be applied to reconnaissance over Vietnam. In addition, Dark Eagle evaluated side-looking radar (SLR) for tactical reconnaissance.[32]

([redacted] Following arrival of a USAF on-site assistance team at Tan Son Nhut in April 1966, the Air Force agreed to take control of the entire ARPA program. It redesignated the program "Compass Eagle" and in July 1966 began a series of tests using an RB-57 equipped with an AAS-18 IR scanner. The objectives were to improve IR imagery and SLR interpretation, develop IR, photo, and SLR interpretation keys for Southeast Asia, demonstrate the operational value of magnetic tape-recorded IR data, and provide operational feedback to the R&D community on imagery interpretation and intelligence extraction problems. In early 1967, General McConnell approved a one-year extension of Compass Eagle and continued expansion of the in-country data base. USAF plans called for using the AAS-18 IR scanner with the magnetic tape recorder as a pathfinder supporting RB-57 real-time acquisition.[33]

([redacted] On 26 April 1967, Dr. Foster, DDR&E, in a memorandum to the Air Force, observed that Compass Eagle was leading to "marked technical improvements in the target-finding ability of infrared and photographic sensors." Citing the use of the AAS-18 scanner with magnetic tape recorder along with aerial cameras, Dr. Foster said that the two-milliradian resolution provided by the AAS-18 was a significant improvement over the five-milliradian resolution produced by the same scanner in the RF-4C. Compass Eagle, he said, had shown:[34]

1. The potential of extracting meaningful targeting information from previously flown and available infrared and photographic imagery which was demonstrated by a cooperative effort with an Army field team which located a VC camp area not previously known.

2. By using a previously prepared data base, a greater amount of intelligence was extracted from infrared and photographic reconnaissance during initial interpretation.

3. The AAS-18 IR scanner with tape recording and playback exhibited promise of extending the limited range of targets presently detected on IR imagery.

([redacted]) Although Dr. Foster felt that the program had produced valuable information and useful techniques, he expressed concern that the results of these early tests might not have been incorporated into USAF reconnaissance operations in South Vietnam. He suggested that a special unit might be established to operate several especially equipped aircraft and a ground exploitation center. Another possibility would be to retrofit AAS-18 scanners in the field with magnetic tape recorders while simultaneously equipping interpretation centers with new exploitation techniques and apparatus. Observing that "we should treat with the utmost urgency the necessity to incorporate R&D results into our operating capabilities," Foster asked what plans the Air Force had to take advantage of the Compass Eagle results in Vietnam.[35]

([redacted]) On 3 May Mr. Harry Davis, Deputy Assistant Secretary of the Air Force (R&D), suggested to the Vice Chief of Staff, Gen. Bruce K. Holloway, that the Air Force consider sending more USAF support to

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field units in Vietnam and take steps to insure that its immediate photo intelligence report (IPIR) provided information of direct value to field units. He further proposed the Air Force prepare a satisfactory data base of selected areas of South Vietnam for the use of photo interpreters and foster a closer working relationship between interpreters and users. If this was done, during 1967 it should be possible to convert much of the R&D effort to direct operational support, thereby reflecting a substantial improvement in USAF night attack operations.[36]

([redacted]) In replying to Dr. Foster's query, Mr. Davis advised that the Air Staff had "been following closely the evaluation of the magnetic tape recorder" mentioned by the defense research director and was stressing the need for more sophisticated reconnaissance sensors and a system for deriving critical intelligence rapidly from raw data. Steps had already been taken to assess the compatibility of the magnetic tape recorder system with the improved RS-10 IR sensor being installed in four RB-57 Rivet Lock aircraft. If this proved successful, the kind of special operational unit discussed by the DDR&E could then be organized. As far as the R&D impact on operations was concerned, Mr. Davis observed that the Air Force's 13th Reconnaissance Technical Squadron (RTS) had been providing imagery interpretation and MACV's Combined Intelligence Center, Vietnam (CICV) had prepared data bases for operational planning and targeting. But, he said, there was no Air Force organization or system to monitor and update data bases by area or to follow up on changes and areas of interest detected on reconnaissance imagery. "It is believed," he said, "that filling this gap in exploitation will require a thorough evaluation of organization, responsibilities, operations and capabilities of MACV, Air Force and Army intelligence units supporting in-country operations."[37]

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([redacted]) In late 1967, the Air Force planned to use the USAF Compass Eagle team to provide intelligence interpretation support for such operations as the location of Viet Cong mortar and rocket emplacements to support base security operations, interdiction, and the location of VC training and staging areas. Interpretation techniques would also be developed for SLR, IR, and other sensors scheduled for the field. Also, the AAS-18 ground tape enhancement device at Tan Son Nhut would be replaced with a higher resolution RS-10.[38]

Deployment of the RF-4C

([redacted]) In 1965, the need for an all-weather high-resolution radar reconnaissance system became clear to the Air Force concomitant with the burgeoning SAM threat over North Vietnam. At the time, however, the Air Force did not possess an operational high-resolution system for locating SA-2 installations. It did have RF-4C's and decided to accelerate their deployment to Southeast Asia. Nine multi-sensor tactical reconnaissance RF-4C's arrived in the theater in November 1965 and nine more followed in December. By October 1966, the 16th and 12th Tactical Reconnaissance Squadrons (TRS) (18 UE) were at Tan Son Nhut and the 11th TRS (24 UE) was stationed at Udorn AB, Thailand. These aircraft were equipped with forward-looking and side-looking radar. They provided the Air Force its first operational multi-sensor day/night all-weather tactical reconnaissance capability.[39]

([redacted]) The APQ-102 side-looking radar was installed in every other RF-4C, providing observation and recording out to 10 miles on each side of the flight path or to 20 miles on one side only.* The planes also carried the LN-12 inertial navigation subsystem and a binary code data annotation subsystem which correlated radar pictures with geographical coordinates. Despite these devices and systems, several weaknesses existed which made the RF-4C less than the ideal system. The original RF-4C sensor package had been designed for the early 1960's and, in order to effectively employ this aircraft in Southeast Asia, it became necessary to add new sensors to insure survivability and permit the acquisition of precise targets on the required scale.

([redacted] Reliability of RF-4C equipment also became a problem as, for example, in the case of cameras (KS-72, KA-55) and the AAS-18 IR reconnaissance set. In addition, it was still necessary to fly at relatively low altitudes with the AAS-18 in order to obtain adequate resolution. The LN-12 navigation apparatus did not provide the accuracy required for comprehensive area coverage and the APQ-102 SLR could not penetrate foliage where auxiliary SA-2's were often located. Also, real-time data transmission and automated processing equipment for analysis and target identification were not available. To overcome these weaknesses, the Air Force initiated a number of projects to develop advanced detectors, optics, and recorders, and began engineering development of laser line scan cameras to obtain imagery similar to night tactical photography without the use of flash units.[40]

ROC For High Resolution Radar

[redacted] Despite its belated acquisition of IR, laser, and photographic cameras and low light level viewing devices--all of which could detect most

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* Actually, as of October 1966, the APQ-102 had been used infrequently in the theater.

tactical targets during clear weather--the Air Force still did not have the ability to obtain images and data through clouds or heavy precipitation. Existing reconnaissance radar equipment could penetrate weather to a degree, but the resolution was not high enough to detect and identify tactical size targets (for example, trucks, jeeps, and tanks).[41]

([redacted] To alleviate this problem, the Air Force in early 1968 drew up a required operational capability paper for a very high resolution radar system which would acquire, record, process, and provide immediate reporting of--and data link transmission of--imagery of tactical size targets under all weather conditions. The following specific capabilities were required:[42]

1. Breakout and recognition of tactical size targets.
2. Operation from altitudes of 500-60,000 feet throughout the speed range of tactical reconnaissance aircraft.
3. A ground map swath width of at least five miles (10 miles desired) at low altitudes and 20 miles (30 miles desired) at high altitudes on either side of the aircraft.
4. A minimum 30-mile (60-mile desired) reconnaissance stand-off capability from 40,000 feet AGL.
5. Simultaneous moving target indication (MTI) and ground mapping. MTI must be capable of detecting movement of tactical targets traveling at all speeds above three miles per hour.
6. A means to automatically annotate the film when targets of special interest are detected.

([redacted] Air Force plans to acquire a high resolution radar system included a first phase comprising a Class V modification of the APQ-102 radar.* In a second phase, the Air Force planned to initiate an advanced engineering development program which would satisfy the tactical

* The basic APQ-102 did not have sufficient resolution.

reconnaissance/intelligence requirements of the post-1973 time period. The system would include both side and forward looking sensors.[43]

Conclusions

[redacted] Despite the emphasis placed on limited war doctrine and systems development in 1961 by the Kennedy administration, it took more than five years for this concern to be translated into substantial weapons and munitions procurement with its concomitant effect on combat operations in Vietnam. Even in the early fall of 1967, Dr. Foster, DDR&E, pointedly stated that "our inability to counteract infiltration has emerged from this war as a serious deficiency." Not only were U.S. forces faced with the problem of restricting the flow of men and materiel into South Vietnam, said Dr. Foster, but they should also be able to monitor and control this infiltration. The "extreme difficulty" in doing this clearly required better equipment to help locate and accurately hit the enemy's LOC's, especially in darkness and unfavorable weather.[45]

[redacted] On this same point, a Rand Corporation study stated that the Southeast Asia experience had shown, as did the Korean conflict, that[46]

> air interdiction campaigns against a determined and clever enemy... are not going to be successful until suitable equipment for spotting mobile targets at night and for delivering weapons on targets (both fixed and mobile) with a high accuracy is installed in tactical strike aircraft. The major shortcomings demonstrated in out-country operations are primarily associated with air-to-ground delivery accuracy....Interdiction operations against the Ho Chi Minh trail in Laos have been hampered by the lack of suitable night-seeing devices tied to an adequate weapon-delivery system.

([redacted] Secretary Brown agreed, observing that "the limitations of air power in interdicting small flows of people and materiel have again been demonstrated." He noted, however, that the Air Force was becoming more efficient in its interdiction effort as time went on and that, with the introduction of important new equipment in 1968 and 1969, there would be significant improvement.[47]

([redacted] The Air Force Secretary was particularly hopeful for a "good interdiction campaign" in the Laotian and North Vietnamese panhandles because of improved tactics, new equipment, and better analysis. "When similar interdiction was tried in the past," he said, "one or more of these factors was lacking." During 1968-69, he looked to the following improvements to enhance substantially USAF interdiction: (1) better all-weather and night equipment on a variety of aircraft; (2) improved ordnance for F-4's and F-105's for striking roads and trucks; (3) more AC-130 gunships; (4) widespread use of night vision devices; (5) introduction of Tropic Moon A-1's; and (6) continual improvement of the "Muscle Shoals" system* which provided information about enemy truck movement patterns and individual truck convoys.

([redacted]) Originally, Muscle Shoals had been expected to provide data on convoys, but in practice it proved to be more effective in uncovering general movement patterns. Thus, USAF planners could establish specific choke points for road interdiction followed by attacks on trucks behind that point. Muscle Shoals was to become an important system which enabled the Air Force to predict where enemy truck traffic was likely to be in the future.[48]

* See Wolk, USAF Plans & Policies: Logistics & Base Construction in Southeast Asia 1967, Chapter IV, "The Anti-Infiltration System."

NOTES

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APPENDIX 1

SOUTHEAST ASIA OPERATIONAL REQUIREMENTS

Required Operational Capability (ROC)

Date	Number	Title
Aug 65	1 FY 66 ROC	Airborne UHF Automatic Relay (Cancelled)
Aug 65	2 FY 66 ROC	Radar Homing and Warning
Aug 65	3 FY 66 ROC	Airborne Command Post
Sep 65	4 FY 66 ROC	Airborne Ground Fire Warning Device
Oct 65	5 FY 66 ROC	Long Range Weather Radar (Completed)
Aug 65	6 FY 66 ROC	New FAC Aircraft (Cancelled)
Nov 65	7 FY 66 ROC	Air-to-Ground Rocket for Standoff Flak Suppression and Anti-Personnel/Anti-Materiel
Sep 65	8 FY 66 ROC	Self-Protection Electronic Warfare Equipment (Completed)
Sep 65	9 FY 66 ROC	Combined Visual and Shockwave Stimuli (Cancelled)
Sep 65	10 FY 66 ROC	CMR-312 Miniature Portable Warning Receiver/ Little Ears (Cancelled)
Sep 65	11 FY 66 ROC	Miniature Aircrew Survival Radio
Oct 65	12 FY 66 ROC	Gun Camera System
Oct 65	13 FY 66 ROC	F-105 Fuel Purge System and Expendable External Fuel Tanks (Cancelled)
Nov 65	14 FY 66 ROC	Air-to-Air Refueling System for the HH-3C Helicopter and Side Mounted Guns for Suppressive Fire (Completed)
Oct 65	15 FY 66 ROC	Search and Rescue Aircraft (Cancelled)
Nov 65	16 FY 66 ROC	Rectifier to support KA-55 camera (Completed)
Nov 65	17 FY 66 ROC	Twelve and Eighteen Inch Lens Cones for KS-72 Cameras (Completed)
Nov 65	18 FY 66 ROC	Munition Handling and Loading System (Cancelled)
Nov 65	19 FY 66 ROC	KA-71A Camera (On-going)
Nov 65	20 FY 66 ROC	New Aircraft Munitions (Completed)
Nov 65	21 FY 66 ROC	Universal Crash Removal Sling Aircraft (Completed)
Nov 65	22 FY 66 ROC	Intrusion Detection Equipment
Nov 65	23 FY 66 ROC	Aerial Supply Radio Beacon (Cancelled)
Nov 65	24 FY 66 ROC	Anti-Personnel/Materiel Devices (Cancelled)

Date	Number	Title
Dec 65	25 FY 66 ROC	Propane Fax (Cancelled)
Dec 65	26 FY 66 ROC	Data Block Reader in Support of RF-4C Sensor Interpretation (Cancelled)
Dec 65	27 FY 66 ROC	Foliage Penetrating Distress Signal System (Completed)
Dec 65	28 FY 66 ROC	IR Rescue Strobe System (Cancelled)
Dec 65	29 FY 66 ROC	Go-No-Go Personal Radio/Beacon Tester (Completed)
Jan 66	30 FY 66 ROC	Personnel Lowering Device (Completed)
Jan 66	31 FY 66 ROC	Wide Area Trip Wire Anti-Personnel Mine (Cancelled)
Jan 66	32 FY 66 ROC	Airborne Radio Direction Finding (ARDF) Equipment and Aircraft (Completed)
Jan 66	33 FY 66 ROC	Air-to-Air IFF
Jan 66	34 FY 66 ROC	IFF/SIF Interrogator Readout Equipment
Jan 66	35 FY 66 ROC	Night Attack Capability
Jan 66	36 FY 66 ROC	Improved Aircraft Flare System (Cancelled)
Jan 66	37 FY 66 ROC	Light Intensification Device
Feb 66	38 FY 66 ROC	Cockpit Readout for Infrared/Side Looking Radar (IR/SLR) Sensors (Cancelled)
Feb 66	39 FY 66 ROC	APT Photographic Recording Equipment (Completed)
Feb 66	40 FY 66 ROC	Portable Visual Approach and Airfield Lighting System
Mar 66	41 FY 66 ROC	Firebomb for MER/TER
Mar 66	42 FY 66 ROC	Anti-Vehicle Land Mine (Cancelled)
Mar 66	43 FY 66 ROC	Ground/Air Beacon System
Apr 66	44 FY 66 ROC	IFF Interrogator
Apr 66	45 FY 66 ROC	Data Link for Infrared Reconnaissance Target Imagery
Apr 66	46 FY 66 ROC	Rescue Direction Finding and Ranging System
May 66	47 FY 66 ROC	Target Marking Flare
May 66	48 FY 66 ROC	Arresting System
Jun 66	49 FY 66 ROC	Foliage Penetrating Reconnaissance Radar (Cancelled)
Jun 66	50 FY 66 ROC	Airborne General Illumination Light (AGIL)
Jun 66	51 FY 66 ROC	Automatic Aerial Color Film Processing Facility
Jun 66	52 FY 66 ROC	AGM-76

Date	Number	Title
Jul 66	53 FY 66 ROC	Tactical Airborne Fusion System (TAFUS)
Aug 66	54 FY 67 ROC	Tactical Video Annotation
Aug 66	55 FY 67 ROC	Tactical Precision Guidance Radar
Aug 66	56 FY 67 ROC	Increased Output Photoflash Cartridge
Sep 66	57 FY 67 ROC	LASER Target Designator System
Sep 66	58 FY 67 ROC	Pararescue Transceiver Helmet
Sep 66	59 FY 67 ROC	Forward Looking, Real Time Moving Target Indication (MTI) for RF-4 Aircraft
Oct 66	60 FY 67 ROC	Tactical Employment Command and Control System
Oct 66	61 FY 67 ROC	Semi-Automatic Tactical Control and Airspace Management System
Nov 66	62 FY 67 ROC	College Eye Modifications
Dec 66	63 FY 67 ROC	Water Conservation System to support photographic processing facilities
Jan 67	64 FY 67 ROC	Improved Visual Weapons Delivery System
Jan 67	65 FY 67 ROC	Area Denial Mines
Jan 67	66 FY 67 ROC	Improved Expeditionary Airfield Runway Surface
Jan 67	67 FY 67 ROC	Instrument Air Drop Capability
Jan 67	68 FY 67 ROC	Improved Magnification Device for Airborne Forward Air Controller
Jan 67	69 FY 67 ROC	Highly Mobile Ground Directed Bombing System (Cancelled)
Jan 67	70 FY 67 ROC	Tactical Miniaturized Microwave Equipment (Cancelled)
Jan 67	71 FY 67 ROC	Cargo Buffer Stop for C-130 Aircraft (Completed)
Feb 67	72 FY 67 ROC	Aerial Delivery of Bulk Chemical Agents (Cancelled)
Feb 67	73 FY 67 ROC	AC-47 Flare Storage Protection (Completed)
Mar 67	74 FY 67 ROC	Medium Altitude Photographic Sensor (MAPS) MR #1886
Mar 67	75 FY 67 ROC	New Forest Penetrator Rescue Seat (Completed)
Mar 67	76 FY 67 ROC	Aircraft Survivability
Mar 67	77 FY 67 ROC	Improved All Weather Weapon Delivery
Mar 67	78 FY 67 ROC	Precision Terminal Approach Aids for Combat Control Teams
Mar 67	79 FY 67 ROC	Improved Ignition System of Finned Napalm
Mar 67	80 FY 67 ROC	High Speed Carriage Capability for Jungle Penetrating Bomblet

Date	Number	Title
Mar 67	81 FY 67 ROC	Small Short Range Air-to-Air Missile
Mar 67	82 FY 67 ROC	Portable Weighing System
Mar 67	83 FY 67 ROC	Palletized Mail
Mar 67	84 FY 67 ROC	C-130 TACAN Approach Capability
Mar 67	85 FY 67 ROC	Improved Processor for Tactical Reconnaissance Film
Mar 67	86 FY 67 ROC	High Speed, High Altitude Deliverable Munitions
Mar 67	87 FY 67 ROC	Tactical Night Time Reconnaissance Sensor
Mar 67	88 FY 67 ROC	Cockpit Selectable Hi-Lo Drag Bomb
Mar 67	89 FY 67 ROC	High Efficiency Area Coverage Explosive Fuel Munitions
Mar 67	90 FY 67 ROC	Aerial Delivery of Water Mines
Mar 67	91 FY 67 ROC	Improved Radar Imagery Recording Capabilities
Mar 67	92 FY 67 ROC	Improved AN/AAS-18 Infrared Systems for RF-4C
Mar 67	93 FY 67 ROC	Munitions and Stores Management System (Cancelled)
Mar 67	94 FY 67 ROC	Family of Penetrating Weapons with Improved Capabilities
Mar 67	95 FY 67 ROC	Cloud Base Height Measuring Device
Mar 67	96 FY 67 ROC	C-7A Airlift of Livestock (Completed)
Mar 67	97 FY 67 ROC	Improved Reliability of Aircraft External Stores/Munitions Release System Class IV
Mar 67	98 FY 67 ROC	C-130 Adverse Weather Aerial Delivery System
Mar 67	99 FY 67 ROC	Improved Target Illumination Flares
Mar 67	100 FY 67 ROC	LASER Guided Munitions
Mar 67	101 FY 67 ROC	Tunnel Detection System
Mar 67	102 FY 67 ROC	C-7A and C-123B/K Integrated Automatic Weight and Balance System
Mar 67	103 FY 67 ROC	Improved Method of Destroying Trucks
Mar 67	104 FY 67 ROC	Step and Repeat Enlarging Printer
Apr 67	105 FY 67 ROC	Improved Terrain Following System for RF-4C Aircraft
Apr 67	106 FY 67 ROC	Increased Combat Effectiveness of F-4C
Apr 67	107 FY 67 ROC	Improved Methods for Harmonization of Aircraft Guns
Apr 67	108 FY 67 ROC	In-Flight Processing and Cassette Ejection
Apr 67	109 FY 67 ROC	Strike Film Viewer

Date	Number	Title
Apr 67	110 FY 67 ROC	Rear Hemisphere Protection for Tactical Aircraft (Cancelled)
Apr 67	111 FY 67 ROC	Aircraft Fuel Cell Explosion Suppression
Apr 67	112 FY 67 ROC	Identification Panels
Apr 67	113 FY 67 ROC	Improved Air-to-Surface Missile (Cancelled)
Apr 67	114 FY 67 ROC	Search and Rescue Night Recovery System
Apr 67	115 FY 67 ROC	Improved Command and Control Sub-System for 7th AF TACC and ALCC Operations (Cancelled)
Apr 67	116 FY 67 ROC	Multi-Purpose ECM for Strike and Reconnaissance Aircraft
Apr 67	117 FY 67 ROC	Detection of Moving Vehicular Traffic during all Weather/ Night Conditions
Apr 67	118 FY 67 ROC	Amplified Visual Identification System (F-4)
Apr 67	119 FY 67 ROC	Lightweight TACAN
Apr 67	120 FY 67 ROC	Automatic Incinerator for Destruction of Film and Photo Papers
Apr 67	121 FY 67 ROC	Improved Defoliation Capability
Apr 67	122 FY 67 ROC	Chaff and Infrared Cartridges for SEA Strike and Reconnaissance Aircraft
Apr 67	123 FY 67 ROC	Discretionary Descent System
Apr 67	124 FY 67 ROC	ALPHA Numeric Data Block for the RF-4C
Apr 67	125 FY 67 ROC	Bullet - Resistant Windshields and Side View Panels for SEA Rescue and Support Helicopters
Apr 67	126 FY 67 ROC	High Speed Carriage and Delivery Capability for RINGTROP (Cancelled)
May 67	127 FY 67 ROC	Multi-Channel (4) Communications Sub-System for Improved Security Police/Air Base Defense Operations
May 67	128 FY 67 ROC	Penetrating Fragmentation Bomblets
May 67	129 FY 67 ROC	Higher Altitude Delivery Capability for the Tactical Fighter Dispenser
May 67	130 FY 67 ROC	Anti-Light Vehicle Mine
May 67	131 FY 67 ROC	Self-Destruct for Sensitive Equipment
May 67	132 FY 67 ROC	Mosaic Mapping Aid
Jun 67	133 FY 67 ROC	A Noise Making Weapon for Psychological Warfare
Jun 67	134 FY 67 ROC	Proximity Fuzes
Jun 67	135 FY 67 ROC	Multiple Launch Capability for SHRIKE Missile
Jul 67	136 FY 68 ROC	Forward Firing Target Marking Device

Date	Number	Title
Jul 67	137 FY 68 ROC	Increased reliability of reconnaissance sensor/ navigation system
Jul 67	138 FY 68 ROC	Lightweight, Low Cube, Mobile GCA
Jul 67	139 FY 68 ROC	Cargo Air Drop Load Release System
Jul 67	140 FY 68 ROC	Modernization of Backpack UHF Radio Equip for SEA
Jul 67	141 FY 68 ROC	Electrical Transmission of Photographic Reconnaissance
Jul 67	142 FY 68 ROC	Secondary Explosion Identification Guide for Aircrew Debriefing
Jul 67	143 FY 68 ROC	Fuze Jammer
Jul 67	144 FY 68 ROC	Survival Kit Gas Masks
Jul 67	145 FY 68 ROC	Inverse Mode TACAN
Aug 67	146 FY 68 ROC	Tactical Electronic Warfare Manual
Aug 67	147 FY 68 ROC	Countermeasure for Visually-directed Weapons (Cancelled)
Aug 67	148 FY 68 ROC	Follow-on ARDF Aircraft (Cancelled)
Aug 67	149 FY 68 ROC	Aerial Film Degradation Indicator
Aug 67	150 FY 68 ROC	Power Ejection System for Aerial Delivery from C-130 Aircraft
Sep 67	151 FY 68 ROC	Proper Weapon System Operation in One Minute or Less (Cancelled)
Sep 67	152 FY 68 ROC	New Fuze for BLU-36 Bomblet
Sep 67	153 FY 68 ROC	Cargo Aircraft Automatic Flare Dispenser and Compatible Flare
Sep 67	154 FY 68 ROC	Airborne Real Time Day/Night Recon In-Flight Processing System
Sep 67	155 FY 68 ROC	Improved Viewer for RS-10 Infrared Sensor
Oct 67	156 FY 68 ROC	Small Package Aerial Pickup System
Oct 67	157 FY 68 ROC	IFF Warning for Fighter Aircraft (Cancelled)
Oct 67	158 FY 68 ROC	Improved Photo Interpretation Equipment
Nov 67	159 FY 68 ROC	Anti-tamper and Self destruct devices for bomblets
Nov 67	160 FY 68 ROC	463L Seat Pallet
Nov 67	161 FY 68 ROC	Map Overlays for Mobile GCA Units in SEA - Class IV
Nov 67	162 FY 68 ROC	All-weather Air Traffic Control Terminal Nav and Landing Aids
Dec 67	163 FY 68 ROC	Increased Landline Capability for Mobile RAPCONS & Mobile GCAs (1st report 1 Feb 68)

Date	Number	Title
Jan 68	164 FY 68 ROC	High Volume Leaflet Dispenser
Jan 68	165 FY 68 ROC	High Performance Leaflet Dispenser
Jan 68	166 FY 68 ROC	High Volume Leaflet and Radio Dispensing System
Jan 68	167 FY 68 ROC	Tactical ECM Escort
Feb 68	168 FY 68 ROC	Weapon for Landing Zone Construction
Feb 68	169 FY 68 ROC	Target Marking and Screening Weapon
Mar 68	170 FY 68 ROC	Helicopter Maximum Hover Weight Computer

Class V Modifications (V MOD)

Jul 65	1 FY 66 V MOD	Replace A-1E R-3350 WD Engine with R-3350 WE Engine (Completed)
Nov 65	2 FY 66 V MOD	Installation of SSB Radio in Five Each Aircraft (Cancelled)
Oct 65	3 FY 66 V MOD	Protective Armor for C-130 (Completed)
Nov 65	4 FY 66 V MOD	Modification of AC/DC System and Radio Relay Pod System in C-130 ABCCC (Completed)
Dec 65	5 FY 66 V MOD	ALR-20 Jamming Receivers and Miniature Remote Tuning Controls for B-66B
Jan 66	6 FY 66 V MOD	Proposal to Modify the ALA-6 DF Equipment Installed in RB-66C (Cancelled)
Nov 65	7 FY 66 V MOD	Provide HH-3E Aircraft in SEA with Fuel Dump Provisions (Completed)
Mar 66	8 FY 66 V MOD	Modification of Co-Pilots Window in U-10B for Leaflet Dispensing (Completed)
Dec 65	9 FY 66 V MOD	Install Additional Rocket Target Markers on O-1E/F Aircraft (Completed)
Dec 65	10 FY 66 V MOD	Install Ling-Temo-Vought Speaker System in Quick Speak Aircraft (Completed)
Dec 65	11 FY 66 V MOD	Proposal to Convert WB-66D Aircraft to Tactical Electronics Warfare Vehicle
Jan 66	12 FY 66 V MOD	Standardize COM/NAV Configurations on C-47 Aircraft (Completed)
Jan 66	13 FY 66 V MOD	Proposal to Update Electronic Reconnaissance Capability RB-66 Aircraft
Jan 66	14 FY 66 V MOD	Proposal to Modify O-1E/F Aircraft Fuel System Primer (Cancelled)
Feb 66	15 FY 66 V MOD	Installation of HF Radio in CH-3 Aircraft (Completed)
Feb 66	16 FY 66 V MOD	CH-3C Self Sealing Internal Tank Installation (Completed)

Date	Number	Title
Feb 66	17 FY 66 V MOD	Installation of FM 622 A FM Radio
Mar 66	18 FY 66 V MOD	CH-3C Sand Air Separator (Completed)
Apr 66	19 FY 66 V MOD	Install Tunable UHF Radio in O-1 Aircraft (Cancelled)
May 66	20 FY 66 V MOD	Install Fuel Flow Meters in C-123 Aircraft (Cancelled)
Apr 66	21 FY 66 V MOD	Miniguns on F-5 Aircraft (Cancelled)
Apr 66	22 FY 66 V MOD	F-100 Triple Ejector Rack
Apr 66	23 FY 66 V MOD	Replace AN/ARC-27 with Lightweight AN/ARC-31B/X in U-10B Aircraft
Apr 66	24 FY 66 V MOD	Install FM-622/AN/ARC-54 FM Radio in all HC-130 Rescue Aircraft in SEA (Cancelled)
Apr 66	25 FY 66 V MOD	Modify the AN/APQ-99 Forward Looking Radar System on the RF-4C (Cancelled)
Apr 66	26 FY 66 V MOD	Flashing Light on UC-123B Aircraft (Cancelled)
May 66	27 FY 66 V MOD	Modification of Minigun Mounts on C-47 (Completed)
May 66	28 FY 66 V MOD	Armor Plate on CH-3C (Completed)
May 66	29 FY 66 V MOD	ECM Equipment on C-130 Aircraft
May 66	30 FY 66 V MOD	F-105/J-75 Engine Analyzer (Cancelled)
May 66	31 FY 66 V MOD	Armor Plating in Front Pilot's Seat, O-1 Aircraft (Cancelled)
Jun 66	32 FY 66 V MOD	F-105D External Lighting System (Cancelled)
Jun 66	33 FY 66 V MOD	Hot Air Filter, O-1 Aircraft (Completed)
Jun 66	34 FY 66 V MOD	Installation of AN/ARA-50 Automatic Direction Finder in F-104A Aircraft (Cancelled)
Jun 66	35 FY 66 V MOD	Addition on Increased Stores Capability for F-104C Aircraft (Cancelled)
Oct 66	36 FY 67 V MOD	GCA's and RAPCONS in SEA
Oct 66	37 FY 67 V MOD	Replace Teletype Equipment in Mobile Vans (Completed)
Oct 66	38 FY 67 V MOD	F-105 ASG-19 Gun Sight System MR 1761
Nov 66	39 FY 67 V MOD	F-105 Emergency Flight Control System
Nov 66	40 FY 67 V MOD	RF-4C ELRAC
Nov 66	41 FY 67 V MOD	Install TACAN & Radar Altimeter in C-7/CV-2 Aircraft (Completed)
Nov 66	42 FY 67 V MOD	T-58-5 Engine in CH-3C Helicopter (Completed)
Dec 66	43 FY 67 V MOD	Hydraulic Hoist CH-3C Helicopter (Completed)

Date	Number	Title
Dec 66	44 FY 67 V MOD	Forest Penetrator Seat for CH-3C Helicopter (Completed)
Dec 66	45 FY 67 V MOD	Collins 101 Radio in CH-3C Helicopter
Dec 66	46 FY 67 V MOD	Single Side Band in T-39 Aircraft
Dec 66	47 FY 67 V MOD	F-105D AIM-9B Adapter/Launch Rail (Cancelled)
Dec 66	48 FY 67 V MOD	C-123B Propeller System
Jan 67	49 FY 67 V MOD	Sand Separator for HH-3C & HH-53 Series Aircraft
Jan 67	50 FY 67 V MOD	C-123 Propeller Reverse Indicating System
Feb 67	51 FY 67 V MOD	Crew Escape System T-28D
Feb 67	52 FY 67 V MOD	Exterior Lighting of Fighter Aircraft (Cancelled)
Mar 67	53 FY 67 V MOD	Installation of Shatterproof Windshield in UC-123B
Mar 67	54 FY 67 V MOD	Replacement Engine for EB-66 (Cancelled)
Mar 67	55 FY 67 V MOD	Zippers on Forest Penetrator Rescue Seats (Cancelled)
Mar 67	56 FY 67 V MOD	Modification to UH-1F Helicopters MR published
Mar 67	57 FY 67 V MOD	Installation of Psywar Audio Speaker System
Mar 67	58 FY 67 V MOD	VHF 101 Radios in VNAF O-1A Aircraft
Mar 67	59 FY 67 V MOD	AN/ARM TACAN on VNAF CH-34C and UH-34D Aircraft
Mar 67	60 FY 67 V MOD	F-4 Indexer Lights (Cancelled)
Mar 67	61 FY 67 V MOD	Retrofit VNAF CH-34C and UH-34D with IFF/SIF
Mar 67	62 FY 67 V MOD	Front Cockpit Ground Speed Indicator RF-4C Aircraft
Mar 67	63 FY 67 V MOD	Modification of External Stores Jettison Circuit F-4 (Cancelled)
Mar 67	64 FY 67 V MOD	Modification of Front Cockpit Attitude Indicator F-4
Mar 67	65 FY 67 V MOD	Addition of ECM Pod Loading Station, F-4 Aircraft (Cancelled)
Mar 67	66 FY 67 V MOD	Modification of VNAF C-47's with IFF/SIF
Mar 67	67 FY 67 V MOD	Modification of MAU-12B/A Inboard Pylons (Cancelled)
Apr 67	68 FY 67 V MOD	Modification of AN/ALT-16 Jammer
Apr 67	69 FY 67 V MOD	F-4 Radar Lock on Switch in Front Cockpit
Apr 67	70 FY 67 V MOD	Modification of O-1 UHF Radio Capability
Apr 67	71 FY 67 V MOD	Digital Indication of Slant Range Information for F-105 (Cancelled)
Apr 67	72 FY 67 V MOD	Improved GCA and RAPCON Radar Tracking
Apr 67	73 FY 67 V MOD	APQ-99 Forward Looking Radar RF-4C

Date	Number	Title
Apr 67	74 FY 67 V MOD	RF-4C Sensor Control Panel
Apr 67	75 FY 67 V MOD	Installation of AN/A1C-10 Interphone in VNAF C-47
Apr 67	76 FY 67 V MOD	Mod T-39 Weather Avoidance Radar
Apr 67	77 FY 67 V MOD	Retrofit/Mod of VNAF A-1 Aircraft with IFF/SIF
Apr 67	78 FY 67 V MOD	U-10D TACAN
May 67	79 FY 67 V MOD	Provide HF/SSB in one F-4 and one F-105 Strike Aircraft (Cancelled)
May 67	80 FY 67 V MOD	Improved AN/GRC-106 Operation
May 67	81 FY 67 V MOD	Fuel Dump Provisions, CH-3 Helicopters
May 67	82 FY 67 V MOD	Provide QRC-315 with Low Bank Tuner
May 67	83 FY 67 V MOD	F-100F Improvements
May 67	84 FY 67 V MOD	Improved ABCCC UHF Communication (Not Validated by PACAF)
May 67	85 FY 67 V MOD	Electric Attitude Indicator in AC/GC/C-47
May 67	86 FY 67 V MOD	Installation of Auxiliary Fuel Drop Tanks CH-3C
May 67	87 FY 67 V MOD	Increase Output of Power Amplifier for AN/GRC 125 Radios
May 67	88 FY 67 V MOD	Improved Capability for AN/APR-25/26 RHAW
May 67	89 FY 67 V MOD	Install SUU-11A/A Gun System in VNAF C-47 Aircraft
Jun 67	90 FY 67 V MOD	Replacement Windshield for HH-53, HH-3, CH-3C & UH-IF Helicopter (Cancelled)
Jun 67	91 FY 67 V MOD	Install Flowmeter and Calibration of UC-123B NERBICIDE Dispenser (Cancelled)
Jun 67	92 FY 67 V MOD	Improved Capability for AN/APR 25/26 RHAW
Jul 67	93 FY 68 V MOD	ECM Equipment for Search and Rescue (SAR) Aircraft
Jul 67	94 FY 68 V MOD	Tail Hook Installation for VNAF F-5C/D Aircraft
Jul 67	95 FY 68 V MOD	Standardize Airborne Sound System for SEA Psychological Warfare Aircraft
Jul 67	96 FY 68 V MOD	Installation of Documentary Camera System on 30 Addition F-105D
Jul 67	97 FY 68 V MOD	Improved Doppler Navigation System in HH-3E & HH-53 Helicopter
Jul 67	98 FY 68 V MOD	Installation of FM-622A FM Radios in 4 C-140 and 2EC-47D
Jul 67	99 FY 68 V MOD	Installation of SA-1800C Airborne Sound System in AC-47 (Cancelled)
Aug 67	100 FY 68 V MOD	RHAW 17 RB-57 Aircraft (Cancelled)
Aug 67	101 FY 68 V MOD	Combat Skyspot Beacon in VNAF F-5C/D
Aug 67	102 FY 68 V MOD	Lightweight Armor for HH-3E/HH-43B/F

Date	Number	Title
Aug 67	103 FY 68 V MOD	Combat Skyspot Beacon in A-37 for VNAF
Aug 67	104 FY 68 V MOD	Install AN/APR-25/26 RHAW in F-102
Aug 67	105 FY 68 V MOD	Install AN/APR 25/26 and QRC-335 in Black Spot Aircraft (Cancelled)
Aug 67	106 FY 68 V MOD	Install AN/APR 25/26 and QRC-335 in Tropic Moon Aircraft
Aug 67	107 FY 68 V MOD	Install AN/APR 25/26 and QRC-335 in Shed Light Aircraft (First Report upon receipt of BPE)
Aug 67	108 FY 68 V MOD	Boom receptacle IFR for EB-66 Aircraft
Sep 67	109 FY 68 V MOD	Parametric Amplifier for AN/FPS-20 Radar MR 1888
Sep 67	110 FY 68 V MOD	VHF Radio Communications for EC-47D Aircraft
Sep 67	111 FY 68 V MOD	APX-25 SIF/IFF Equipment for EC-47D Aircraft
Oct 67	112 FY 68 V MOD	Install Combat Skyspot Beacon in A-1H Aircraft
Oct 67	113 FY 68 V MOD	Beacon Assist Display in KY615/GPA122 IFF Decoder
Oct 67	114 FY 68 V MOD	Installation of Two Documentary Cameras on C-7 Aircraft (Cancelled)
Oct 67	115 FY 68 V MOD	Modernization of A-1G Aircraft
Oct 67	116 FY 68 V MOD	Modification of Improved QRC 312A Jammer
Nov 67	117 FY 68 V MOD	Install HF/SSB Communications in EC-47D Aircraft
Dec 67	118 FY 68 V MOD	Parachute Suspension Line Ballistic Cutter
Dec 67	119 FY 68 V MOD	AC-47 COMM/NAV Systems Improvements
Dec 67	120 FY 68 V MOD	Weather Satellite Television Ground Stations (TVGS)
Jan 68	121 FY 68 V MOD	Modification, Solid State Circuitry SEA Radar Sets (Cancelled)
Jan 68	122 FY 68 V MOD	Modify TACAN Systems in C-140A AIC
Feb 68	123 FY 68 V MOD	Modify F-105 D/F to Carry QRC-335
Feb 68	124 FY 68 V MOD	Additional VHF for RC-47
Feb 68	125 FY 68 V MOD	Improved HF Radio for EB-66B/C/E
Feb 68	126 FY 68 V MOD	Modification of WSR-57 Weather Radar
Feb 68	127 FY 68 V MOD	LORAN D for EC-121R
Feb 68	128 FY 68 V MOD	Combat Skyspot in OV-10A
Mar 68	129 FY 68 V MOD	Redundant Start System and Battery-HH-53B
Mar 68	130 FY 68 V MOD	Mobile Rapcons
Mar 68	131 FY 68 V MOD	AC-47 Smoke Elimination System

APPENDIX 2

PROJECT 1559 TASKS*

Task	Title	Date	Funds	Status
1	40 MM Grenade Launcher	14 Apr 65	7K	Completed
2	Dust Suppression for Airfields	2 Mar 65	19K	Completed
3	Intrusion Alarm System	1 Mar 65	6K	Completed
4	Disposable Parachutes	9 Mar 65	24K	Completed
5	Optical Tracking Telescope	25 Mar 65	17K	Completed
6	Target Scoring System	27 Mar 65		Disapproved
7	Summer Flying Suits	24 Mar 65	50K	Completed
8	Magnetic Field Gradiometer	22 Mar 65	85K	
9	Laser Designator System (Army)	23 Mar 65	360K	Completed
10	Portable Lighting Set	15 Mar 65	90K	
11	5.56 MM Gun Pod	23 Apr 65		Disapproved
12	Expandable Manpack Shelter		4K	Completed
13	25 Man Life Raft	25 Mar 65	10K	Completed
14	FACTOR - Comm. Terminal	15 Mar 65		Disapproved
15	Aircraft Arresting Gear (48)	9 Jul 65	208K	
16	RDT&E Data Mechanization	29 May 65		Disapproved
17	Manpack Radar IFF	28 Jul 65	86K	
18	Military Test Bed (TABS)	22 Jun 65		Disapproved
19	Oxford Rifle Sight	16 Jul 65	6K	Completed
20	Red Sea	20 Jul 65	158K	Completed
21	Laser Guided Bomb (100)	23 Jul 65	740K	Completed
22	Module for AC-47	8 Jun 65	100K	Completed
23	Ballistic Helmet	11 Aug 65	4K	Completed
24	LLLTV in A1-E A/C	2 Dec 65		Disapproved

* Numbers in parenthesis refer to SEAOR number which the 1559 Task supported.
K = thousands
M = millions

Task	Title	Date	Funds	Status
25	Portable Theodolite	9 Aug 65	2K	Completed
26	Tropical Coveralls	11 Aug 65	2K	Completed
27	Forward Looking IR (FLIR)	21 Jul 65	1.3M	
28	Integrated Armament Control System (93)	6 Aug 65	99K	Completed
29	Inflatable Ground Targets	24 Aug 65		Disapproved
30	Tactical Ground Base Transponder	1 Sep 65		Disapproved
31	DMED (SEEK BURST)	2 Dec 65	98K	
32	Portable Ceiling Light	19 Aug 65	.3K	
33	Balloon Abort Device	19 Aug 65		Disapproved
34	Rocket Atmos Data Collection	19 Aug 65	7K	
35	Low Altitude A/C Detection	12 Nov 65	25K	Completed
36	F.A.C. Camera	23 Aug 65		Disapproved
37	Special Purpose Receiver	19 Aug 65	20K	Terminated
38	QRC 160-1 ECM POD	15 Sep 65	35K	Completed
39	Battlefield Illumination	15 Dec 65	80K	Completed
40	Inerted Fuel Tanks (76)	11 Nov 65	51K	Completed
41	Airborne Laser Illuminator	15 Feb 66	180K	
42	Helmet Mounted Sight (TAPIS)	10 Dec 65		Disapproved
43	Universal Crash Removal Sling (21)	7 Jun 66	26K	Completed
44	Low Freq. Direction Finding (32)	Aug 65	80K	
45	KA-60 Camera for F-5			Disapproved
46	URC-10 Radio Battery	27 Sep 65		Disapproved
47	Day/Night TV Weapon Delivery	29 Sep 65		Disapproved
48	TER - 7 Racks	8 Oct 65	16K	Completed
49	Microwave Radar	6 Jun 66	25K	
50	Wheel Mounted A/C Arresting Gear	22 Oct 65		Disapproved
51	Mobilizer, Mobility Kit	17 Nov 65	8K	Completed
52	Portable Light Weight Shelter	29 Nov 65	24K	
53	Precision Aerial Delivery	29 Nov 65		Disapproved
54	Kalimar Zoom Binoculars	25 Jul 66	1K	Completed
55	Carolina Moon	4 Oct 65	500K	Completed

Task	Title	Date	Funds	Status
56	C-130 Armor			Disapproved
57	UHF Homing and Ranging	1 Nov 65	131K	
58	Explosion Proof Tanks (HH-3C) (76)	11 Nov 65	25K	Completed
59	LB4A Gun Camera Magazine	17 Nov 65	2K	Completed
60	Skoshi Tiger CBU-2	Nov 65	130K	Completed
61	B-57 Firepower	2 Dec 65	135K	Completed
62	Kinematic Bomb Computer	14 Dec 65		Disapproved
63	Paracommander Static Line	21 Dec 65	7K	Completed
64	F-4C Performance Computer	14 Dec 65	10K	
65	Survival Transceiver (179) (11)	16 Dec 65	465K	
66	C-130 Flare Launcher	16 Dec 65	210K	Completed
67	Automatic Voltage Regulator	16 Dec 65	21K	Completed
68	Radiometric Search Set	28 Jan 66		Disapproved
69	Photographic Film	28 Dec 65	2K	Completed
70	Spectral Zonal Reconnaissance	16 Dec 65		Disapproved
71	Velvet Glove	3 Jan 66	27K	Completed
72	Inflatable Landing Zone Marker	6 Jan 66	2K	
73	Airborne Ground Fire Detector (4)	18 Jan 66	100K	
74	Electronic Fault Detector	11 Jan 66	13K	Completed
75	Remote Controlled Smoke Gen.	12 Jan 66	170K	Completed
76	Ventilating Garment	10 Jan 66	20K	
77	New Defoliant for SEA	24 Jan 66		Disapproved
78	Sparrow Arm Test	7 Feb 66		Disapproved
79	Parachutist Lowering Device (30)	1 Feb 66	In House	Completed
80	Quick Copy Camera	24 Feb 66	1K	Completed
81	Helicopter LLLTV	22 Jun 66	In House	Completed
82	Quick Diazo Printer	4 Mar 66	6K	Completed
83	Intrusion Detection Equipment (22)	3 Feb 66	77K	Completed
84	Portable Air Conditioner	18 May 66	1K	
85	Balloon Puncturing Device	22 Jul 66	5K	

Task	Title	Date	Funds	Status
86	Foliage Penetration Flare (27)	28 Jul 66	102K	
87	IR Rescue Strobe (28)	18 Mar 66	15K	
88	ECM Mission Planning Kit (146)	14 Sep 66	51K	
89	IR Encapsulation	13 Apr 66	25K	
90	Ignition and Burst Detector	4 Apr 66	24K	Completed
91	SEE-SAMS	4 Apr 66		Disapproved
92	High Altitude/Low Opening HALO	19 Aug 66		Disapproved
93	Non-Lethal Visual Impairment	20 Mar 66		Disapproved
94	Laser Designator Seeker	7 Apr 66	501K	
95	Static Frequency Converter	17 Jun 66	150K	
96	LAP CHECK AIM 9B Missile	11 May 66	200K	Completed
97	Scotoscope (37)	18 May 66	125K	
98	Bullpup Missile Guidance	9 May 66		Disapproved
99	Image Stabilized N.O.D. (37)	25 May 66	150K	
100	Rapid Passenger Manifest	24 May 66	10K	
101	Laser Boresight Device (107)	27 May 66	8K	
102	Portable Metal Detector	3 Jun 66	.1K	Completed
103	IFF Interrogator (34)	8 Jun 66		Disapproved
104	Stabilized Optics (Dynalens)	18 Jul 66	22K	Completed
105	Weather Observation Kits (95)	20 Jun 66	.6K	Completed
106	Regenerative Repeater	29 Jun 66	205K	
107	Improved Aerial Machine Guns	20 Jun 66		Disapproved
108	Convert Ceiling Measuring Equip (95)	5 Jul 66	85K	
109	C-131 Sensor Test	18 Jul 66	1K	Completed
110	Ground/Air Beacon System (43)	18 Jul 66	140K	
111	Paint Spray Marking	17 Aug 66	1K	
112	Inverse Mode TACAN (145)	20 Jul 66	179K	
113	Soil Stabilization in SEA (66)	20 Jul 66	80K	
114	Hand Held Wind Measuring Set	22 Jul 66	13K	Completed
115	Fiberglass Aircraft	10 Jan 67		Disapproved

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Task	Title	Date	Funds	Status
116	Eleven Point Dividers	4 Aug 66	1K	
117	APQ-102 Radar Modification (91)	11 Aug 66	209K	
118	Paint Spray Materials	17 Aug 66	In House	
119	Air Droppable Rescue Package	15 Sep 66		Disapproved
120	Automatic Color Film Processing	30 Aug 66	100K	Completed
121	Target Locating and Reporting	12 Sep 66	Proj 7990	
122	Multi-Target Direction Finding (46)	20 Sep 66	628K	
123	PPS-5 Radar - Funded by AFSPD			
124	Battlefield Illumination - Funded by AFSPD			
125	Ultra Sonic Receiver - Funded by AFSPD			
126	Seismic Alarm System - Funded by AFSPD			
127	Portable Inertial Navigator	30 Sep 66		Disapproved
128	Aircraft Shelter	6 Oct 66	50K	
129	Have Cable	10 Oct 66	742K	
130	SEA Quick Look Tests	7 Oct 66	11K	Completed
131	AC to DC Power Pack	17 Oct 66	23K	
132	Coaxial Switch	17 Oct 66	4K	
133	Personnel Body Armor	9 Nov 66	16K	Completed
134	Hand Held FAC Cameras	23 Nov 66	12K	Completed
135	Manpack TACAN (119)	2 Nov 66		Disapproved
136	H.F. Power Amplifier	4 Nov 66		Disapproved
137	Night Aerial Photo Film	29 Nov 66	20K	
138	T-39 Air-to-Air Recovery	2 Dec 66	95K	
139	Retractable Fuel Tanks	19 Dec 66		Disapproved
140	Vibrationless Camera Mount	8 Feb 67		Disapproved
141	Omni-directional High Angle Ant.	20 Dec 66	53K	
142	Gunship	17 Jan 67	600K	
143	Rough Terrain Fork Lift	17 Jan 67		Disapproved
144	Chaff Rocket	14 Feb 67		Disapproved
145	Toxic Water Monitoring	12 Jan 67	26K	

UNCLASSIFIED

Task	Title	Date	Funds	Status
146	PAVE LIGHT	1 Dec 67	450K	
147	C-130 TACAN Improvement (84)	18 Jan 67	98K	
148	Silent Night Recce Aircraft	20 Jan 67	500K	
149	LF Antenna for TRN-24	28 Apr 67	25K	
150	Hand Held Stabilized Binoculars (68)	15 Mar 67		
151	Helmet Mounted Binoculars	15 Mar 67		Disapproved
152	Image Motion Compensator	10 Feb 67	20K	
153	AT-430 Series HF/VHF Transceiver	15 Feb 67	275K	
154	Portable Flood Light System	11 Apr 67	6K	
155	Inverted Flap Test	23 Feb 67	In House	
156	Air Transportable Weighing Platform			Disapproved
157	High Performance Laser Illum.	28 Feb 67	1.5M	
158	Camouflage Detector (HAVE INK)	16 May 67	22K	
159	Lt. Wt. Fuel Discharge Hose	20 Mar 67	2K	
160	Night Visual Guidance System	12 Jun 67	16K	
161	Air-to-Air Visual Recognition (118)	3 Apr 67	450K	
162	Parachute Extraction Line Release (139)	25 May 67	25K	
163	U-10 Muffler & Flame Suppressor	3 Oct 67		
164	SRO-1 IFF Interrogator for EC-121	26 Apr 67		
165	Three Lamp Modular AGIL	2 May 67		Disapproved
166	Power Ejection System	30 Jan 68		Disapproved
167	Fork Lift Weighing Device	29 Feb 68		Disapproved
168	Nose Dock for F/RF-4C	6 Jun 67	100K	
169	Active Magnetic Detection	3 May 67	100K	
170	Improved Body Armor	5 Jun 67	19K	
171	Photo Imagery Screener (109)	31 Aug 67	500K	Cancelled
172	Support of Laser Seeker Test	12 Jun 67	90K	Terminated
173	EIFF Interrogator	9 Jun 67	450K	
174	Commando Lava	18 Aug 67	19K	Terminated
175	Gyrojet Rocket Pistol	15 Jun 67		Disapproved

UNCLASSIFIED

Task	Title	Date	Funds	Status
176	Red Eye (81)	7 Jul 67	56K	
177	IFF Readout Equipment	1 Jul 67		Disapproved
178	Millimeter Wave Radiometry	22 Aug 67	450K	
179	Reconfig 2 Channel URC-10	3 Aug 67		Completed
180	Private Voice Comm System	3 Aug 67		Disapproved
181	Thrust Reverser	21 Aug 67		Disapproved
182	Air Deck Landing Mat	Oct 67	52K	
183	Electronic Location Finder	31 Aug 67	25K	
184	Pararescue Transceiver Helmet (58)	12 Sep 67	200K	
185	Type 3 IFF Capability (Proj 3782)	31 Oct 67	425K	
186	Variable Time Reefing Line Cutter	13 Sep 67	25K	
187	1 KW Illuminator	21 Nov 67	5K	
188	Mortar Location	27 Sep 67	5K	Cancelled
189	Rapidly Deployable Antenna Mast	3 Oct 67	16K	
190	Vanguard Motion Analyzer (109)	10 Oct 67	4K	
191	Whiffle Ball Expl. Supp (1822) (76)	23 Oct 67	110K	
192	Survival Kit Gas Mask (144)	14 Dec 67	25K	
193	Radioisotopic Search Beacon	29 Mar 68	298K	
194	Precision Terminal Approach Aids			Disapproved
195	Chemical Extinguisher Fire Supp. (1822) (76)	21 Nov 67	90K	
196	Nitrogen Fuel Tank Inerting Sys (1822) (76)	26 Dec 67	85K	
197	Chafette Warhead	15 Dec 67	7K	
198	Lt. Wt. Acquisition/Desig. System	25 Jul 68	300K	
199	MIG Warning System	26 Dec 67	400K	
200	College Eye Alert System (44)	26 Dec 67	22K	Approved
201	Remote Switch	26 Dec 67	3K	
202	Map Overlays for Mobile GCA (161)	22 Jan 68	.96K	
203	Retroreflective Materials	22 Mar 68	25K	
204	Palletized Mail (83)	25 Apr 68	5K	

UNCLASSIFIED

Task	Title	Date	Funds	Status
205	Helicopter Max. Wt. Hover Comp. (170)	6 May 68	5K	
206	Smoking Ammunition	26 Apr 68	100K	
207	Voice Recorder for Fighter A/C (166)	3 May 68	130K	
208	Real Time Truck Park Location	7 May 68	600K	
209	Laser Aug. ASQ-91 Weapon System (106)	23 May 68	25K	
210	Improved Rifle Sight	(Process of Being Validated)		
211	Laser Guided Missile	(Not Documented)		
212	Pave Crow	10 Jul 69	60K	
213	Support of DMES	12 Jun 68	25K	
214	Inverse Mode Antenna for ARN-21 (145)		150K	
215	Improved Forest Penetrator Seat	19 Nov 68	2.4K	
216	Improved ATAR (118)	19 Jul 68	250K	
217	Air-to-Ground ATAR Mod. (118)	19 Jul 68	150K	
218	Image Isocon LLLTV	15 Jul 68	200K	
219	Mark 86 Smoke Bomb	1 Aug 68	15K	
220	Data Link for Laser Line Scan (45/87)	15 Aug 68	482K	
221	100 Gal. Filament-Wound Plastic Fuel Tank	(Process of Being Validated)		
222	B-57 Bomblet Dispenser	5 Aug 68	157K	
223	GPA-22 De-Fruiter Modification	30 Aug 68	80K	

APPENDIX 3

NEW R&D ITEMS INTRODUCED TO SEA

Calendar Year 1966

COMMUNICATIONS, COMMAND, AND CONTROL

*Inflatable UHF Antennas
*AN/TRC-87 Radio Sets - Ground communication equipment
*Interference Calculators
*TPS-50 Manpack Radar
MSQ-77 Ground Control Radar

RECONNAISSANCE & COUNTERMEASURES

*Mobilab - Mobile Photo Processing Van
QRC 292-APR-14 Mod.
*Aerograph Film (Rolls) for night photography
Gun Camera System for F-100 and F-105 aircraft
KA-71 Camera - Reconnaissance and Bomb Damage Assessment Camera
Phyllis-Ann ARDF - Low Frequency Direction Finding - SEAOR #32
Starlight Scopes
Gun Camera Magazine
*Rapid Printers (DIAZO) - improved film printing capability
*ECM Mission Planning Kits
QRC-160-1 - Pod mounted S-Band ECM Jammer
Night Vision Devices
*QRC-302A ELINT Van - facility for evaluating electronic intelligence
*Photo Interpretation Shelters
*QRC-248A IFF Interrogator - Identification of friendly aircraft

SEARCH & RESCUE/PERSONAL EQUIPMENT

*Go-no-go Pers. Radio Test Equipment
Pers. Retrieval S.S. (HC-130H)
*Inert Fuel Tanks
*Parachute Lowering Device
HH-3E Helicopter
AN/RT-10 - Personnel Rescue Radio

AIRCRAFT SYSTEMS

F-5C
U-17A - Cessna 180 Aircraft
H-43F
Wild Weasel RHAW Systems

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* Test Quantity Only

OPERATIONAL SUPPORT

*Conventional Munition Effects Calc.
*Meteorological Van-AN/MMQ-2
*Wind Measuring Sets-AN/TMQ-15
*LAPES - Low Altitude Parachute Extraction System
*PLADS - Parachute Low Altitude Delivery
*Air Drop Platform - Low Altitude
Improved Fuel Service & Storage
Low RPM Diesel Generator
20 KW Turbine Generator
40 MM Grenade Launcher
Crash Removal Slings
Long Range WX Radar-WSR-57-improved weather reporting
Atmospheric Photo Recording Equipment
*Soil Stabilization Equipment

MUNITIONS: CONVENTIONAL MUNITIONS & TACTICAL MISSILES

BLU-3B Canisters
BLU-26/B Canisters
CBU-19/B Riot Control Cluster, Low Speed
CBU-22/A - Dispenser with white phosphorus bomblets
CBU-24/A - Dispenser with antipersonnel bomblets
CBU-25/A - Dispenser & Antipersonnel Bomb, Low Speed
WDU-4, 2.75" Flechette Warhead
*MAU-91/B Fin Assembly
SUU-11A/A gun pod
MXU-470/A gun module
AC-47 Modules - side firing machine guns
AGM-12C - Bullpup C
AGM - 45 (MR-69 Marker Warhead)
AIM-7D - air-to-air missile
AIM-7E - air-to-air missile

Calendar Year 1967

MUNITIONS

FMU-26/B, Fuzes
FMU-35/B, Fuzes
MAU-91A/B, Fin Assemblies
FMU-54/B, Fuzes

RECONNAISSANCE

Compass Dart "Q" Systems
Photographic Printing, Processing & Interpretation Facilities
RS-10 IR Sets for RB-57 Aircraft
Real Time viewers for Infrared Sensors
Color/camouflage detection film processor

ELECTRONIC COUNTERMEASURES

QRC-160A-8(T)/ALQ-87 ECM POD
QRC-318/ALT-28 Programmer/Transmitter
QRC-315/ALR-27 ECM receiver and tuner
QRC-316 Antenna
QRC-325/APS-107 Radar and Warning
QRC-312A-1 Spot Jamming Mod Kits for ALT-15
QRC-337A Mod Kits for ALQ-71
QRC-353A Chaff Cartridges
*ECM Mission Planning Kits
*QRC-248 Interrogators
QRC-317/ALR-31 See SAM's System
QRC-304 Programmer for ALT-22
QRC-128 Communications Jammer
QRC-310 Tape Recorder
QRC-311 Antenna
QRC-306 Antenna Drive Mod

A/C - MISSILE SYSTEMS

C-130-E ABCCC Aircraft
O-2A Aircraft
O-2B Aircraft
A-37A Aircraft
HH-53B Helicopters
AGM-12C Bullpup B Missiles
AIM-7E Missiles
MK I Mod O Guided Weapon (WALLEYE)
Gunship II

* Test Quantity Only

SEARCH & RESCUE/PERSONAL EQUIPMENT

AN/URT-27 Personal Locator Beacons
Foliage Penetration Flares
Personnel Lowering Devices
*Flight Chart Holders
A/C Safety Belts (Mod Kits for MA-5)
*Ballistic Helmets
*Improved Body Armor

COMMUNICATIONS, COMMAND, AND CONTROL

*Seek Dawn Controllers
IFF/SIF GPA-122 Identification Systems
UGC-32X Teletype Machines
FGC-97X Teletype Machines
SEABIT 24 Data Modems
Broadband HF Antennas
URG Receiver/Exiter HF Subsystems
Portable Transceiving HF Multicouplers
Rivet Top aircraft - SAM Locator

OPERATIONAL SUPPORT EQUIPMENT

*Intrusion Detection Devices (various types)
Plads Para Pak Equipment
AN/TMQ-14 Cloud Height Measuring Equipment
Portable Shelters
Submarine Cable Power Feed Racks
Portable Visual Approach & Airfield Lighting Systems
AIM-7 Missile Telemetry Scoring System

GLOSSARY

AAA	Anti-Aircraft Artillery
AB	Air Base
ACTIV	Army Concept Team in Vietnam
AEC	Atomic Energy Commission
AFB	Air Force Base
AFLC	Air Force Logistics Command
AFR	Air Force Regulation
AFSC	Air Force Systems Command
AFTU-V	Air Force Test Unit, Vietnam
AGM	Air-to-Ground Missile
AM	Amplitude Modulation
APGC	Air Proving Ground Center
ARM	Advanced Radiation Missile
ARPA	Advanced Research Projects Agency
ARVN	Army of Republic of Vietnam
ASD	Aeronautical Systems Division
	Armament Systems Division
ATEWS	Advanced Tactical Electronic Warfare System
BIAS	Battlefield Illumination Airborne System
BLU	Bomb Live Unit
BPE	Best Preliminary Estimate
CAG	Combat Applications Group
CAP	Combat Air Patrol
CBU	Cluster Bomb Unit
CD	Combat Development
CDTC	Combat Development and Test Center
CEP	Circular Error Probable
CICV	Combined Intelligence Center, Vietnam
CINCPAC	Commander in Chief, Pacific
CJCS	Chairman, Joint Chiefs of Staff
CNO	Chief of Naval Operations
COIN	Counterinsurgency
COMUSMACV	Commander, United States Military Assistance Command, Vietnam
CONUS	Continental United States
CSAF	Chief of Staff, Air Force
CSAFM	Chief of Staff Air Force Memorandum
CY	Calendar Year
DCS	Deputy Chief of Staff
DCS/R&D	Deputy Chief of Staff, Research and Development
DDR&E	Director, Defense Research and Engineering
DOD	Department of Defense
D-TAFSEA	Directorate of Technical Applications for Southeast Asia

ECM	Electronic Countermeasures
ELINT	Electronic Intelligence
EW	Early Warning
FAC	Forward Air Controller
FLIR	Forward-Looking Infrared Radar
FM	Frequency Modulation
FMU	Fuze Munition Unit
GCI	Ground-Controlled Intercept
ICBM	Intercontinental Ballistic Missile
IPIR	Immediate Photo Intelligence Report
IT&T	International Telephone & Telegraph
JCS	Joint Chiefs of Staff
JOEG/V	Joint Operational Evaluation Group/Vietnam
JRATA	Joint Research and Test Activity
LLLTV	Low Light Level Television
LOC	Lines of Communication
LORAN	Long-Range Navigation
MACV	Military Assistance Command, Vietnam
MLU	Mine Live Unit
MTI	Moving Target Indicator
NIFAC	Night Forward Air Control
NM	Nautical Miles
NRDU-V	Navy Research and Development Unit-Vietnam
NSC	National Security Council
NVN	North Vietnam
ODDR&E	Office of the Director of Defense Research & Engineering
OSD	Office of the Secretary of Defense
PACAF	Pacific Air Forces
PACOM	Pacific Command
PROVOST	Priority Research and Development Objectives for Vietnam Operational Support

QRC	Quick Reaction Capability
R&D	Research and Development
RDFU	Research and Development Field Unit
RDT&E	Research, Development, Testing and Evaluation
RHAW	Radar Homing and Warning
ROC	Required Operational Capability
RS	Reconnaissance System
RTS	Reconnaissance Technical Squadron
RVN	Republic of Vietnam
RVNAF	Republic of Vietnam Armed Forces
SAF	Secretary of the Air Force
SAM	Surface-to-Air Missile
SAWC	Special Air Warfare Center
SCNA	Self-Contained Night Attack
SEA	Southeast Asia
SEAOR	Southeast Asia Operational Requirement
SLIR	Side-Looking Infrared
SLR	Side-Looking Radar
STOL	Short Takeoff and Landing
TAC	Tactical Air Command
TACS	Tactical Air Control System
TARC	Tactical Air Reconnaissance Center
TAWC	Tactical Air Warfare Center
TRS	Tactical Reconnaissance Squadron
UE	Unit Equipment
US	United States
USAF	United States Air Force
VC	Viet Cong
VCofS	Vice Chief of Staff
ZI	Zone of Interior

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