The very successful day for TACAIR on 11 May was also a very costly one. As part of their general attack plans, the VC/NVA had added additional AAA batteries to an already impressive array. One U.S. Army captain on the ground said he had "never heard so much 37mm and 23mm firing" in his life as he heard that morning. The enemy had clustered the weapons for self protection as well as to shoot down allied aircraft. At one location were four or five 37mm and the same number of 23mm weapons all surrounded by .51 caliber weapons. One A-37, one Cobra, and two FAC operated O-2s fell to the murderous fire by late afternoon.

One source of air support on 11 May was not at all hampered by the intense AAA. The huge B-52 bombers in planned and diverted missions dropped tons of bombs in target boxes containing attacking enemy troops as close as 600-800 meters to defensive positions. On one occasion, a large enemy force had inflicted heavy casualties on the eastern perimeter and was engaged by the 81st Ranger Battalion. A B-52 strike on a hill containing the enemy force virtually annihilated it, ending the attack. General Hollingsworth reported that many enemy were fleeing from ARC LIGHT boxes "only to be attacked by air and ground fire." The coordination of B-52 strikes and TACAIR "allowed us to punish the enemy severely."

By 1630 on 11 May, the battle for An Loc was still raging. The VC/NVA held the two salients although unable to close them. At the same time, the attacking forces kept up constant pressure on the ARVN through tank thrusts, ground attacks, and steady fire into ARVN positions by mortar
and artillery pieces. The government forces had already confirmed over 200 hostile dead, but General Hollingsworth estimated that the actual count might have gone to five times that amount. The tactical emergency was still in force and TACAIR, gunship, and B-52 sorties were planned through the night and into the next day.

The success of the B-52s despite the heavy AAA fire combined to point up a problem area for air and ground forces never really resolved. When the American A-37 went down, FACs called off strikes in the immediate area including the diversion of a B-52 strike. One U.S. Army captain on the ground felt that the momentum of the battle had swung to the defenders and that the planned B-52 strike would have "annihilated" the VC 5th Division, but that the opportunity was lost. This procedure was not liked by the Senior Adviser to the ARVN 5th Division from a tactical point of view, but he recognized the desire to rescue the downed airman and offered no alternate proposal. One FAC noted later that pilot faith in all possible being done to effect a rescue if they went down was absolutely essential to morale and thus made combat pilots more effective.

On the morning of 12 May, a maximum amount of aerial strike support worked to blunt intensified ground attacks and to reduce the two enemy held salients. By 0500, two PT-76 tanks were destroyed and TACAIR moved against ground forces surging from the north. This movement blunted, TACAIR concentrated on methodically attacking enemy advances. VNAF Al Skyraiders armed with 250 lb. bombs and Spectre gunships with the PAVE
AEGIS 105mm system aboard concentrated on the western salient. In the northeast, the VC/NVA salient was so narrow that only the accurate fire of the Spectre armament could be used. The Spectre used its equipment with spectacular results. One tactic involved ground placement of Claymore mines on the perimeter of the salient. Spectre then used its 105mm howitzer to drive the VC out of bunkers and to get them moving with the cannon fire to seek cover. Those VC not hit from the air ran into the automatic Claymores and detonated them.

While the ARVN seemed to be holding successfully on the ground the second day of the renewed attack, things took an ominous turn in the air. During the day, several possible sightings were made of Soviet-made SA-7 STRELA missiles being fired at F-4s and FACs. At 1837, an AC-130 Spectre reported five such missiles fired at him. The first four exploded 1000 feet below the aircraft. The fifth was on a light path to miss the aircraft, but jinked into the AC-130.* Although there was extensive damage, the aircraft was able to return to base. Because of the already serious AAA hazard, Cobras were operating with difficulty and FACs had already had their minimums raised to avoid the AAA. In addition, the A-37 low level napalm strikes had also been stopped. Now the SA-7 threatened other low level aircraft and techniques as well.

*Later investigation determined that the missile homed in on the 2KW covert light which is in the same frequency spectrum as the infrared homing head of the "Strella." The LLLTV operator on the gunship inadvertently acquired the oncoming missile as it was fired and tracked its approaching trajectory. The missile simply veered to follow the light beam, and struck the aircraft just aft of the 2KW light. All crews were subsequently apprised of the incident and no longer attempted to track the missiles.
During the night of 12/13 May, heavy attacks continued, spearheaded by tanks. Almost all tanks used here in May were PT-76 light amphibious models suggesting that earlier campaigns in MR III had decimated the NVA medium tank resources. The VC/NVA chose to attack on this night because of extremely bad flying weather. With no TACAIR available, the ARVN defenders found themselves under direct fire from tanks from the north and east, threatened by troop movements from the west, and under general pressure from the south. The "key factor" in blunting this attack were six B-52 strikes after which "direct fire from the tanks stopped" and did not resume for the rest of the night. In addition to an unknown number of enemy casualties, the B-52s destroyed two tanks and an ammunition dump.

When the weather improved slightly after midnight, Spectre began to fly, engaging troop concentrations and equipment. And, through all this time, artillery rounds increased in numbers until they were impacting in An Loc at the rate of one every five second. In spite of the tanks, troop movements, and artillery support, no ground attack materialized. General Hollingsworth cited Spectre's "magnificent performance" during the marginal weather. In the final analysis, however, he thought that the B-52 strikes "spoiled another apparent enemy effort to seize An Loc."

On 14 May, a USAF 0-2 aircraft on a FAC mission over An Loc was shot down by an SA-7, STRELA missile. With a second confirmed hit on a USAF aircraft in three days, new procedures had to be instituted in the SA-7 threat area. In the opinion of USAF experts in May, although the SA-7 was used like the U.S. Army Redeye missile, it was "operationally and
physically similar to the AA-2 ATOLL/Sidewinder IA reduced to one-half scale." Designed for low, slow flying targets, the missile launch envelope was dependent on target velocity. At the time, 7000-9000 feet was estimated as safe for slow targets (helicopters and FACs) and 6000 feet for higher speed aircraft such as A-1s and C-130s. Since the missile's seeker assembly was directly proportional to the IR signature of the aircraft, emergency measures put into operation included hard turns toward the missile thus shielding the aircraft's IR signature and the dropping of flares with a strong IR signal to decoy the missile away from the aircraft. As a general safety measure slow moving aircraft were restricted to operation at 7000 feet or higher depending on the aircraft and its mission. For example, while the FACs flew at 7000 feet, 10,000 feet was instituted for C-130 aerial resupply missions.

The high altitude restrictions in known SA-7 high threat areas caused immediate and material changes in tactical air support for the forces at An Loc. The AC-119 Stinger was an immediate casualty to the SA-7 envelope because it was only effective up to 4500 feet (3500 feet optimum) with its miniguns (7.62mm machine guns) and up to 6500 feet with its 20mm cannon. Above these altitudes, the respective bullets began to tumble and to lose their penetrating qualities. The Cobra helicopter gunships, as all other helicopters, were also restricted from the known SA-7 areas. Perhaps most notable was the impact on the FACs. Although their recommended altitude was 3500 feet, many FACs flew lower on special reconnaissance missions. Now these pilots had to use binoculars while flying at twice
twice the recommended optimum altitude for FAC operation, even when firing marking rockets for TACAIR. The pilots did not like these inconveniences which also reduced their effectiveness, but quickly adjusted to the new operating altitudes.

While the shelling of An Loc continued at an extraordinary rate—3025 rounds on 13 May, 2038 on 14 May, 2690 on 15 May, 1980 on 16 May—the VC/NVA ground attacks on the city decreased in frequency, intensity, and duration. Overall, the action seemed to be shifting somewhat to the south—the VC 5th and VC 9th Divisions possibly disengaging—while the NVA 7th Division continued to stall the relief column south of An Loc.

The 16th of May demonstrated in microcosm the general trend the battle of An Loc was beginning to take in the air and on the ground. The tactical airlift of supplies was continuing at a satisfactory rate and no outstanding deficiencies were noted, except for medical supplies. U.S. Skyhook helicopters delivered two 155mm howitzers to a point south of An Loc that placed the guns within range of the entire defense perimeter. In another attempt to help break the relief forces through, an ARVN infantry battalion was airlifted to a position nine kilometers south of An Loc near QL-13. In addition to these movements, steady air power support of ground objectives continued to erode enemy equipment, personnel, and morale. On the night of 15/16 May, an AC-130 Spectre engaged tanks south of An Loc, destroying two. The B-52 bombers pounded suspected and known enemy troop locations causing havoc and many casualties. Few firm enemy casualty statistics could
be ascertained at this time due to the unstable ground situation. One indication, however, was provided by a report from the commander of an NVA battalion who, because of the B-52 attacks, requested "permission to withdraw" from the area. The An Loc defenders called for additional TACAIR strikes on the suspected position.

On the ground, the ARVN defenders began finally to show more vigor in patrolling and reconnaissance missions in spite of heavy incoming artillery. For example, one patrol successfully flanked the VC entrenchment in the western salient although it was unable to drive the VC from their bunkered positions. In another action, an element of ARVN rangers captured and immobilized a twin 57mm anti-aircraft gun mounted on a T-54 tank chassis. The weapon was identified later as a ZSU-57/2 and was the first one seen in MR III. The unaggressive hostile response to these patrol actions and the report that TACAIR could not find "any targets in the immediate vicinity of the town" seemed to represent a new phase in the battle. General Hollingsworth reported that information available to him indicated that decimated enemy units had withdrawn "from the immediate vicinity of An Loc as a result of the heavy losses inflicted by TACAIR and B-52 strikes."

Although the level of hostile effort against An Loc itself steadily decreased, the NVA 7th Division continued to interdict QL-13. Progress of the relief column was painfully slow at best, and on many days no progress was made at all. Enemy action along the highway became no more
than a stubborn holding action; fewer attacks were made on the government forces, and when attacks did occur, they quickly dissipated. For example, on 23 May, troops and tanks were spotted moving south toward the ARVN column. Spectre engaged the tanks and destroyed three by 0400; by 0600, the "attack" ended before it really began. The NVA troops along the highway declined in effectiveness under constant harassment from the air. Two captured NVA 7th Division officers indicated that their units' casualties were very heavy, some companies of the 209th Regiment down to only ten men. Constant allied bombardment, coupled with other hardships, was causing major breakdowns in enemy morale and fighting spirit to the extent that some troops were "no longer responding to orders from superiors." Another POW report indicated that the NVA 7th Division received 360 replacements in May, but none during the first eighteen days in June. The troops received rice only once each day and "morale was low due to fear of B-52 strikes, sickness, and poor leadership." 129

In spite of these problems encountered by the interdicting forces, the relief column still moved too slowly to suit American advisers. General Hollingsworth felt that ARVN was just not trying hard enough. He considered the C-130 heavy drops to the ARVN 15th Infantry Regiment "to be a misuse of assets" because it was "inefficient" and it degraded "the incentive for the 21st Division to open Highway 13." Thus he requested the drops be halted, but COMUSMACV did not concur, and the drops continued. 130

For the city of An Loc, enemy stubbornness in the capital and on the highway, plus bad weather inhibiting TACAIR, prolonged the formal siege.
Lt General Nguyen Van Minh, Commanding General of MR III, had no doubt about the eventual outcome, however. With over 3100 ARVN and 1500 territorial forces troops combat effective at An Loc, his principal concern was getting the more than 1000 wounded medevaced out of the city. On 12 June, the last of the VC/NVA were driven from the town itself and on 14 June, reinforcement of An Loc with 1650 fresh troops by U.S. helicopter was completed. With things seemingly under control, General Minh declared the siege "over" on 18 June.

South of An Loc the battle still continued. Finally, on 23 June, General Hollingsworth reported that the 46th Regiment had made it through to An Loc along QL-13. ARVN sources reported that the enemy had anticipated an ARVN force coming south from An Loc to aid the relief force. The NVA had set up an interdiction to stop this movement on QL-13 just prior to an ARC LIGHT strike. Two strikes, 15 minutes apart, had been planned for the area and the results were devastating. Caught in the open and without warning, the NVA force simply dissolved. Hollingsworth asserted that these B-52 strikes "proved to be decisive" in getting the 46th Regiment through. This action did not mean that the highway was then permanently opened, for small pockets of resistance in heavily bunkered positions continued to sporadically interdict the highway for weeks to come. The mainforce units were gone, however. Intelligence sources noted that the headquarters of the VC 5th Division had moved to Cambodia, north of Svay Rieng and that main elements of the VC 9th Division were heading west toward the Cambodian
Thus on 26 June, the pockets notwithstanding, General Hollingsworth reported to General Abrams that "unless we receive our share of replacements designated for COSVN, the campaign is over."
CHAPTER IV
CONCLUSION

The course of events on the first day at An Loc dictated the parameters of the struggle to emerge during the ensuing weeks. By driving the government forces into a small area in the southern part of the city, the VC/NVA were able to completely surround the defenders with troops and gun positions. This action then set two conditions destined to inhibit aerial support of the ARVN. First, the ARVN's area of operations and limited combat effectiveness outside their defensive perimeter greatly reduced the drop zone possibilities for aerial resupply. Second, the VC/NVA were able to mass sophisticated AAA, supplemented eventually by SA-7s, around the small area to restrict aerial resupply by conventional helicopter and low level CDS techniques. Further, these ground to air defenses limited and then precluded effective mission fire support by Cobras and Stingers.

In addition, loss of ARVN artillery support resulted in the air arm assuming total responsibility not only for resupply but also for providing firepower to help suppress attacks and to break VC/NVA strength and morale around the city in order to end the siege itself.

The small area of operations and the amount of air support required intensified the normal battle zone command and control problems for the Air Force. Over the battle area, the principal responsibility for controlling airstrikes, coordinating airspace, performing visual reconnaissance, and coordinating aerial resupply fell to the USAF FAC. Some of the special duties of the FAC included controlling some VNAF TACAIR; advising aircraft
of "safety" hazards such as AAA and impending B-52 strikes; coordinating special mission aircraft such as Cobras, Stingers, and Spectres; following the ROE; and avoiding known civilian areas. Each FAC kept track of the overall situation by talking to U.S. Army advisers on the ground via FM radio, contacting III DASC via VHF through a radio relay station (call sign: Rash Control), and the other four FACs in the An Loc area by UHF radio. In his "spare" time, the FAC had to keep track of as many as ten sets of aircraft above him, all with different ordnance, capabilities, and times on target. It was no wonder that the commander of the 8th SOS judged the FACs "almost superhuman."

Even for the "almost superhuman" FACs, conditions at An Loc dictated a change. It was virtually impossible for FACs to keep up with the myriad of sorties and contacts that had to be accomplished and still provide each ground commander the most effective support the Air Force was able to provide. The Seventh Air Force solved this problem by assigning one FAC as the Command and Control or "King" FAC. Flying high over An Loc, the "King" maintained contact with ground commanders thus keeping himself apprised of the changing field conditions. He also kept in contact with the airborne TRAC Commander or Deputy Commander who gave the FAC advice on ground conditions and support for additional TACAIR requests if required. The city of An Loc was divided into two working areas with one FAC responsible for each area. All incoming TACAIR sorties were assigned to the "King" by III DASC. The "King" then reallocated this TACAIR to one of the two FACs working the city below him. If the airspace over the city itself was saturated, the "King" would reassign the overload TACAIR to one of the two FACs working south of
An Loc. Both Army and Air Force commanders were most pleased by the effectiveness of this system. Overall the FACs were highly rated by everyone. In the words of the U.S. Senior Adviser to the ARVN 5th Infantry Division, the FACs "accomplished virtually the impossible" and were "leading contenders for the 'Most Valuable Player' award."

The high intensity AAA, but especially the introduction of the SA-7 at An Loc, forced the Air Force to modify standard aerial resupply procedures and to reassess the use of gunships in tactical situations. In both cases, temporary adjustments were made which proved viable by the conclusion of the battle. However, both would lead to Air Force study on permanent modifications of techniques and equipment to enhance future effectiveness of the systems in tactical warfare situations.

The failure of the low level CDS technique at An Loc brought frustration but few supplies. Army ground commanders could not understand why the Air Force could not resupply the city effectively. Air Force officers were concerned that supplies dropped often were not recovered. A joint meeting of C-130 pilots and U.S. Army advisers was called to discuss the problem. Brigadier General John R. McGiffert II, Deputy Commander, TRAC, was present at the meeting and said that the session did much to "clear the air." Army officers learned for the first time, for example, that heavy ground fire occasionally set loads of ammunition or fuel afire in the cargo areas. Immediately ejected, these loads contributed to the poor delivery record by the low level CDS technique. Even though more sympathetic to Air Force problems, the Army was very anxious for an improved supply system. At the same time, the Army ground advisers tried
to establish more efficient distribution procedures for those supplies
that did reach the defenders.

Meanwhile, as soon as the CDS resupply seemed to be inadequate, the
Air Force immediately had begun to introduce other techniques as recounted
earlier. Since Army and Air Force experts had to be flown into Vietnam
from other areas and since only limited high altitude equipment was avail-
able in the theater, the Air Force was not able to resolve the problem as
quickly as it would have liked. On 3 May the aerial resupply had reached
the nadir. On the following day HALO drops began which immediately raised
optimism for success which was subsequently borne out.

On another level, an SA-7 conference held on 11-12 May by the USAF
Tactical Fighter Weapons Center discussed the impact of the SA-7 on aerial
resupply. The conference recommended that if airdrop techniques became
critical, Hq TAC should "deploy a C-130 AWADS (Adverse Weather Delivery
System) squadron to SEA for use in high altitude airdrops and low altitude
airdrops in instrument meteorological conditions." As a result of the
airdrop problems at An Loc and other areas, the 61st TAS deployed ten AWADS
equipped C-130E aircraft between 21 and 24 May 72 to run combat tests on the
system. Although "only two aircrews had completed any type of high
altitude airdrops" and tactics for AWADS airdrop were "oriented primarily"
toward standard CDS low level tactics and procedures, test emphasis was
placed on airdrops from altitudes above the effective ranges of 37mm AAA,
and SA-7s. Test drop zones were also reduced by 1/2 to 1/3 of the
recommended size in AFM 3-4. The test team concluded that, based on its
tests and on experiences such as An Loc, AWADS training should be revised to include high altitude techniques, and that a study group should review AWADS employment results in detail.  

The second major change brought about by the high intensity AAA and the SA-7 at An Loc was in the use of gunships. The initial and primary role for the AC-119 in Southeast Asia was "close air support for troops in contact." Working at its normal operational altitude of 3500 feet over An Loc, the Stinger's 7.62mm miniguns and 20mm cannon were very accurate. One Army adviser at An Loc asserted that the Stingers were "a great weapon. You just move them around like pointing your finger." Unfortunately, the Stinger required a relatively permissive air environment that did not exist at An Loc. Forced up and away from the highly defended city, the Stingers performed area reconnaissance and sought targets of opportunity. In these roles, the aircraft proved most effective in impeding the flow of supplies to the VC/NVA forces around the provincial capital.

Just prior to An Loc the AC-130 Spectre's mission role was "night interdiction and armed reconnaissance with less emphasis on close air support of troops in contact," because of technical improvements which had developed the Spectre into the most effective truck killer in the USAF inventory. It was at An Loc that the emphasis shifted from interdiction to support of troops in contact and close air support. The AC-130's 105mm howitzer was very accurate and highly effective. One Army officer recounted that Spectre crews were provided with a map of the city. This resulted in one pilot reporting that his instructions from a ground commander might be "go north along the main street for three blocks, turn
east there, and hit the second house from the corner." The Army was high in praise for Spectre. The Senior Adviser to the ARVN 5th Infantry Division reported that Spectre aircraft "were responsible for breaking up numerous assaults before they got started." The ability of the Spectre PAVE AEGIS to destroy buildings within 10-20 meters of friendly troops was "especially advantageous." In his summary, Colonel Ulmer recommended that Spectre "be further developed as a conventional part of the USAF limited war weaponry" and that lightweight X-Band beacons become a standard issue for every TOC.

The more conventional TACAIR provided superb support as had been expected; the A1Es, A-37s and F-4s performed their roles with distinction. While not as accurate as slower moving aircraft, the F-4s' greater capacity for armament was prized by ground commanders. Brigadier General McGiffert found it "a tremendous weapon" and most valuable against AAA and troop dispersions outside of the town itself. The A1Es were more accurate, but could not carry the same punch as the F-4s. All in all McGiffert thought the "A-37 proved to be the very best compromise" for close air support at An Loc and General Vogt stated that the work of the 8th SOS and its A-37s was "absolutely spectacular." While some problems were encountered in the use of TACAIR at An Loc, adjustments made by Seventh Air Force either solved the problems or at least mitigated their effects. One was the difficulty in keeping TACAIR on station at all times. The U.S. Navy practice of launching 18-20 aircraft at the same time not only overloaded the FACs, but also caused gaps
UNCLASSIFIED

FAC and Spectre Street Map of An Loc

FIGURE 8

UNCLASSIFIED
in TACAIR coverage. The Air Force attempted to insure aircraft such as A-37s were on station between these flights, but this was not always possible.

Another solution was to refit, rearment, and return the TACAIR to the combat area in as little time as possible. The action taken here was to provide a turn-around facility manned by experienced and dedicated personnel. Bien Hoa was such a facility. One noteworthy two hour period on 2 June may suggest the efforts expended. On that day, six USAF F-4s were expected at 1540 to join four F-4s already on the ground for servicing and munitions loading. At the same time, however, three A-7s, two A-6s, and six Navy F-4s arrived with no advance warning for the same services. By 1735, all 21 aircraft had been serviced and were either in the air or taxing for takeoff. Efforts like this one turned in by the men of the 152/377th FOL greatly enhanced TACAIR effectiveness at An Loc.

Another problem that emerged was that U.S. Army Advisers at the user level did not always have a working knowledge of the capabilities, uses, and limitations of the various munitions available from the Air Force. The comment above by Col Ulmer on beacons is instructive. The I-band (x-band) beacons had been provided to Army units at An Loc, but the Army did not learn to use the beacons effectively until late in the campaign. For example, during the first onslaught at An Loc a Spectre arrived on the scene to find the weather poor. The Spectre commander then queried Col Miller as to whether he had an x-band beacon. At first Miller said no, but in a few minutes he called the Spectre crew and said he found a
box with "a bunch of electronics gear in it" in his bunker. After confirming that the beacon was the proper one, Col Miller asked for a few minutes to "read the instructions and set this baby up." Once he had set it up the battery was too weak to run the system. The point was, of course, that the ground forces didn't even know the system existed and therefore were not prepared to use it in combat. Another example was that of an Army ground adviser who refused F-4 support on one occasion because he didn't understand the fuze settings on the ordnance. While there were many examples of this type, the problem was not critical in the overall scope of the campaign and largely solved itself as Army personnel gained experience in working with the new Air Force weapons. One Army after action report suggested that in a campaign like this in the future it would be useful to have an Air Force team brief the ground advisers on weaponry available. In retrospect, in spite of these problems, the Air Force was able to make adjustments and thus Col Ulmer judged TACAIR to be "a major contributor to the successful defense of An Loc."

The B-52 was used extensively in the tactical situation at An Loc and received only the highest praise from Army officers involved in the campaign. Over 700 ARC LIGHT missions were flown in April and May, primarily in support of An Loc. Although accurate post-strike assessments of the missions were not available due to battle conditions, hundreds of VC/NVA personnel were killed and many tanks and other military equipment were destroyed by the B-52 raids. The 3d Ranger Group reported that ARC LIGHTs not only destroyed enemy troop formations, but when employed close to the city virtually eliminated mortar and AAA until the VC/NVA were able to move up replacements.
In addition to inflicting substantial material losses, the B-52s had an enormous psychological impact on the enemy as well. When VC/NVA units moved into a village for support, the villagers often tried to move out because they feared their community "would be subject to B-52 strikes." Prisoners reported that their leaders told them B-52s were used only against civilian targets and not against troops in the field. When struck out in the open by ARC LIGHTs, mass confusion resulted with VC/NVA withdrawing from the field, ending the attacks, and sometimes requesting permanent withdrawal from the areas involved.

Originally conceived as a weapon for strategic use, the B-52 proved extremely valuable to the ground commander's needs in the battlefield situation at An Loc. On planned missions, the 5th Division TOC proposed target boxes and forwarded the proposal through channels for approval. These target boxes were often planned as close as "800 meters from potential friendly troops." The schedule of approved requests usually was received by the ground commander by 1800 for the following twelve hours. Once the B-52s were in the air, missions were not cancelled unless the FAC called for an abort during a search and rescue attempt. (This occurred once at An Loc). From the Army commander's point of view, the B-52 became increasingly important because the ARC LIGHTs could be diverted to a higher priority target if required. Less common was the Ground Target Change (GTC) that was made a minimum of three hours prior to launch. Brigadier General McGiffert said that the GTCs became so effective because of the tremendous cooperation shown by the SAC ADVON personnel in making the B-52
missions responsive and flexible. By the end of May, McGiffert recounted that almost ninety percent of all B-52 missions at An Loc were GTC.

The "Heavy Arty" warning of impending B-52 strikes brought two problems to the forefront. Safety requirements dictated all TACAIR be cleared from the target box twenty minutes prior to drop. Ground commanders sometimes spoke of this time requirement with frustration because all TACAIR left the areas. The Senior Adviser to the ARVN 5th Infantry Division recommended "shortening the 'clear area' time to five or ten minutes" and "providing prompt 'all clear' notification." The other problem was that no warning was sufficient unless all aircraft were able to receive it. On occasion, FACs working over An Loc did not receive "Heavy Arty" warnings. One Army adviser related that Sundog 34 was notified he was in an ARC LIGHT box and was told to move out. The FAC acknowledged "Roger," the adviser continued, but "about that time the B-52 struck--anyway you could hear the bombs going off and that's the last we heard of him. So I feel he was caught in the B-52 strike." While this incident was not substantiated, FACs did cite cases when they found themselves hoping for the best in the midst of an ARC LIGHT strike. One FAC pilot pointed out that a "Heavy Arty" warning could be missed if the proper equipment was not turned on or if a FAC were flying in an area where radio transmissions were weak. One suggestion was for the B-52s to provide encoded warnings "to FAC and aircraft controllers well in advance of strikes" so that all would know more precisely the time and location of ARC LIGHT strikes.
There was no surrender ceremony at An Loc. The defenders had shown unexpected stamina and had held; the VC/NVA units, badly crippled by airstrikes, slowly drifted toward Cambodia. Although unable to mount any serious attacks, small pockets of VC/NVA continued to interdict the major highway into An Loc, forcing aerial resupply to continue. Inside the city, nothing was preserved; "the stench of garbage and death" pervaded the air. Every vehicle in the city stood devastated. Ninety-five percent of An Loc was destroyed, the rest damaged. Perhaps some seventy percent crumbled before the ceaseless indirect fire, while ten percent of the destruction resulted from airstrikes, the remaining from ground combat.

An Loc was a battle fought with massed forces, intense firepower, and sophisticated equipment "representative of a midintensity conventional war situation." The biggest mistake on the part of the VC/NVA was their underestimation of the role of air power in such a situation. Convinced they could inhibit or even restrict air support by AAA and SA-7s until they could overrun the provincial capital, they could not anticipate that Air Force adjustments to the new situation would result in even more effective firepower through increased use of B-52s and other TACAIR support innovations. Thus in the final analysis, air support was "the predominant factor in swaying the balance of power over a numerically superior, well equipped enemy force" at An Loc.
APPENDIX I

USAF COMBAT LOSSES: MR III 1 Apr - 30 Jun 72*

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<th>DATE</th>
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<th>TYPE A/C</th>
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<td>Log</td>
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<td>A-37</td>
<td>CAS</td>
<td>23mm</td>
<td>1K</td>
</tr>
<tr>
<td>14 May</td>
<td>0645</td>
<td>02A</td>
<td>FAC</td>
<td>SA-7</td>
<td>1R</td>
</tr>
<tr>
<td>5 Jun</td>
<td>0200</td>
<td>02A</td>
<td>Recon</td>
<td>gf</td>
<td>II</td>
</tr>
</tbody>
</table>

*This list was extracted from USMACV (MACDO-21), Working Paper, "Hits and Losses for USAF Aircraft," 1 Jan 72 - 1 Jul 72, undtd (S).

**The 21st TASS considers these two losses as possibly due to SA-7s, but the rockets were not confirmed.
APPENDIX 2

OPERATIONAL COMBAT EVALUATION
ON
THE ADVERSE WEATHER AERIAL DELIVERY SYSTEM (AWADS)

AUGUST 1972

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APPENDIX 2

OPERATIONAL COMBAT EVALUATION
ON
THE ADVERSE WEATHER AERIAL DELIVERY SYSTEM (AWADS)

1. INTRODUCTION

a. This report contains an operational evaluation of the Adverse Weather Aerial Delivery System (AWADS) conducted during combat operations in Vietnam between 21 May - 15 July 1972. The areas covered in the evaluation include: the initial training required to meet operational commitments, the deployment and employment of the 61st TAS into combat aerial delivery, aircraft and equipment reliability, supply and maintenance support, and recommended improvements in the equipment and training for the employment of AWADS aircraft.

b. AWADS DESCRIPTION. AWADS is a multi-purpose avionics system designed to assist aircrews in performing aerial delivery missions under conditions of low visibility or darkness. This system provides the capability to position aircraft without assistance from ground aids, for an accurate aerial delivery (113 meters design aircraft position parameter). The AWADS package consists of a multi-function forward looking radar (X and Ka band), coupled with a computer to provide automatic Computed Air Release Point (CARP) computations and guidance to the CARP. It includes station keeping equipment (SKE) to allow aircraft to maintain fixed separation in formation under night and adverse weather conditions. Further detailed information of this system is contained in TAC TEST Reports 70A-037A and 71A-024A.
c. AWADS TRAINING. The initial aircrew training concepts to operate AWADS equipped C-130's are oriented toward low level (500 ft AGL) and mid-level (3500 ft AGL) navigation, with a transition to standard drop altitudes (600 ft for the Container Delivery System (CDS) - 1000 ft for personnel and equipment). The quality and quantity of this training is fully adequate to provide the skill level required for these operations. The required training of 12 navigation legs, airborne radar approaches, and station keeping equipment (SKE) indoctrination are well balanced to provide an excellent base for improvising new procedures when necessary.

d. DEVELOPMENT AND EMPLOYMENT OF 61ST TAS. The 61st TAS deployed a command element, 20 aircrews, and 10 AWADS equipped C-130E aircraft to Tan Son Nhut Air Base, RVN, between 21 and 24 May 72. Upon arrival, immediate training requirements and programs were initiated to (1) employ aircrews in Ground Radar Aerial Delivery System (GRADS) using the MSQ-77 ground radar for directing mid and high level drops (6500 to 11,000 ft AGL); (2) to conduct mid and high level AWADS airdrops; and (3) to improvise techniques to overcome the design limitations of AWADS equipment (see TAC TEST 71A-024A).

The GRADS airdrop checkout started on 22 May, and all 40 assigned crews were trained by 18 June 72. GRADS training consisted of one observation ride for the pilot, navigator, and loadmaster. This was followed by one supervised drop, and an unsupervised successful drop for the entire crew. A flight check and written examination was then administered to all crew members to insure standardized procedures, compliance with PACAF, 374th TAW, and 61st TAS theater training objectives, and also to enhance operational safety.
AWADS employment commenced on 1 June 72, after aircrew training and reliability of aircraft positioning had been established in comparison with GRADS. Significant results were achieved in AWADS releases using the natural Offset Aiming Point (OAP), radar beacon, and SKE procedures. Unit aircrew proficiency and knowledge in AWADS was greatly increased.

The flexibility of having three procedures (AWADS, SKE, and GRADS) allowed crews to transition from one procedure to another to overcome equipment malfunctions. This feature increased the probability of mission success and completion.

2. EVALUATION FACTORS

a. PERSONNEL: During the evaluation, 40 qualified aircrews were used to accomplish the GRADS drops. From these 40 aircrews, 12 qualified AWADS aircrews were selected to operate the AWADS equipment. Navigators alternated on an equal number of airdrops and drop zones for each system used. The 61st TAS provided 16 different AWADS equipped aircraft based on a daily scheduling availability.

b. WEATHER: Weather conditions during the airdrops varied from clear at drop altitude to the ground, clear at drop altitude with an undercast, and solid weather from drop altitude to the ground. Turbulence also varied from light to moderate, particularly while flying under instrument conditions.

c. WINDS: Altitude winds varied in direction, and velocities from 1-40 knots were encountered. During the latter part of the evaluation,
wind shears between the ballistic fall and drop altitude caused a significant variance in impact distance, particularly when high velocity chutes (85-120 FPS rate of fall, two 15 ft or one 22 ft ring slot) were employed. This wind shear condition did not cause a significant impact miss distance when high altitude low opening (HALO) chutes (220 FPS, one 15 ft ring slot drogue with one G12D opening at 500 ft) were used. The twofold CARP problem encountered in HALO deliveries has been identified in TAC TEST REPORT 71A-024A.

d. CIRCULAR ERROR AVERAGE (CEA): The overall CEA of both GRADS and AWADS was determined by 4, 12, and 16 bundle airdrops made from 6500 to 11,000 ft AGL. The distance between the desired and actual point of impact was estimated by an experienced ground observer.

e. DROP ZONE DIMENSIONS: Because of the fluid tactical situation, DZ dimensions varied significantly from the criteria established in AFM 3-4 and the recommended interim DZ sizes found in TAC TEST 71A-024A.

f. BRIEFINGS: Prior to airdrop missions, crew briefings highlighted the complex mission specifics, enemy activity in the DZ area, and weather. An increased emphasis was placed on navigator radar studies with respect to the Offset Aim Point (OAP) and predicted scope interpretation.

3. EVALUATION RESULTS, DISCUSSION, AND RECOMMENDATIONS

a. AWADS OPERATIONAL EMPLOYMENT:

(1) Tactics for AWADS airdrops are oriented primarily toward standard MCM 55-130 CDS low level tactics and procedures. However, combat
drops conducted were from 6,500 to 11,000 ft AGL. The most common drop altitude of 10,000 ft was raised to 11,000 in high threat areas to avoid 37mm anti-aircraft fire and to obtain assurance of SA-7 SAM avoidance. Future airdrop tactics must be examined in the event similar hostile threats force an increase in altitude.

(2) While GRADS releases require an exact ground speed, altitude, and track to assure accuracy, this is not necessary for AWADS releases. Therefore, weather and enemy fire can be avoided more readily using AWADS because changes in track, airspeed, and altitude are allowed through computer computations. Also, in the event of computer/radar failure on one aircraft during a drop, AWADS aircraft have an alternate mode of dropping by utilizing SKE and standard 2,000 ft formation trail tactics as developed by TAC.

(3) Advantages seen in AWADS airdrops warrant renewed investigation in the use of higher speed releases, recomputation of CDS flap settings to attain optimum gravity extraction values and aircraft altitudes, and improvements to the aircraft empennage structure to support higher airspeeds. The use of airspeeds of approximately 130-135 KIAS at 10,000 to 15,000 ft MSL with aircraft weights of 150,000 lbs is not desirable.

(4) Examination of current load ballistics must be conducted to improve drop accuracy and to expand the potential of airdrop capability. Load rigging techniques and equipment, such as the A22 containers, must be improved to sustain increased descent velocity and impact speeds experienced in high altitude airdrops.
(5) During periods of heavy rain showers, the Ka Radar became unusable, and most offsets did not show on X-Band radar. Because of this problem, the first drop at Kontum was made with the use of a ground radar beacon. The location of the drop zone, with respect to friendly forces, demanded the beacon be placed 300 yards prior to the leading edge. Using beacons with a large output (300 watts) caused radar scope "ringing" at 2 NM which hindered the navigator's adjustments of the crosshairs. To eliminate this problem, the 201X mini-ponder beacon (5 watts) was used and found to be highly satisfactory. This mini-ponder beacon also has a coded two pulse transmission which is extremely useful with crosshair placement in AWADS aircraft. However, when using a beacon for offset aiming, beacon time delay is a factor which must be considered. If the beacon placement is prior to the DZ and the CARP is beyond the DZ, as was the case at Kontum, radar crosshair placement must stop as much as 1 1/2 minutes from release. The computer must then be allowed to dead reckon (DR) for that length of time. This caused the beacon offset impact miss distance to be a little larger than the average radar return offset impact miss distance. It is recommended that future radar beacon drops be made only with the 201X mini-ponder to eliminate the "ringing" effect on the radar scope. Also, careful consideration should be taken in the placement of the beacon with respect to the DZ in order to minimize the beacon delay effect.

(6) From 16 total DZ's, 10 were examined and radar offsets were picked for AWADS use. The remaining six DZ's are under study and awaiting tactical reconnaissance photography for closer examination by the intelligence
and radar strike section. Most of the offsets used may be picked from 1-50,000 or 1-25,000 scale charts without the use of photography. However, in the case of An Loc where a natural return could not be found and a man-made return had to be used, photography was used to update charts and to determine if the proposed offset within the city had been destroyed by enemy action. In order to maximize the Ka-Band radar energy near the offset, it was most desirable to have an offset that was 4,000 yards or more from the target. If the offset was in the target area, the navigator would lose the return at 1 to 1 1/2 minutes from airdrop release, allowing the computer to DR to the release. This type of offset did cause the impact miss distance to be larger than the average, but was acceptable in most cases. Offset range bearing data measured from the chart was found to be within acceptable limits when the target and offset were on the same chart (1-25,000 or 1-50,000 scale). However, errors up to 400 yards or more were found when the target and offset were on two different charts. This problem was eliminated with the use of Sentinel Lock data obtained by the AWADS radar strike section. It is recommended that Headquarters TAC conduct an in-depth study of the target materials and data available or needed for AWADS employment on a world wide basis.

(7) The use of SKE in a resupply role was excellent. If one AWADS aircraft had a computer or radar failure, it could follow another AWADS aircraft and use SKE to complete the drop. This capability was found to be useful in cutting the time for a group of aircraft to return to base. SKE could also be used for GRADS, allowing the time on the site to be cut in half; thus eliminating long and expensive orbit times.
b. SUPPORT OPERATIONS

(1) The failure of the 61st TAS to deploy with proper intelligence radar strike support personnel caused a 10 day delay in the implementation of AWADS into aerial delivery in SEA. The intelligence section was later manned from existing PACAF resources, and the radar strike section was manned with 61st TAS aircrew personnel. To avoid such delays in future AWADS employments, it is recommended that an intelligence and radar strike section be positioned within the squadron to allow immediate response to the worldwide tactical situation.

(2) Other factors causing delays were lack of proper equipment and material essential to AWADS targeting. Charts used in the selection of Offset Aim Point data were not immediately available upon arrival at Tan Son Nhut AB, but were later obtained. Errors in the charts caused large miss impact scores with GRADS. This was later solved with Sentinel Lock (ACIC) data which was used to devise offset aim point information for the AWADS employment. It is recommended that Headquarters TAC complete an in-depth study of targeting equipment and support required for AWADS to sustain a worldwide operation.

(3) In the present AWADS training program, high altitude airdrops are not addressed. All aircrews within the 61st TAS have received adequate training to support low altitude airdrop operations. However, at the time of deployment, only two crews had completed any type of high altitude airdrops. These were conducted under test conditions. Thus, during the initial employment, crews were being trained under combat conditions. It is recommended that the AWADS training program be increased to include four
high altitude airdrops, with one high altitude airdrop added to the interim AWADS continuation training. Also, navigator proficiency in computerized radar techniques must be increased by additional radar training during and after UNT.

(4) The manning for the deployment of the 61st TAS AWADS was sufficient, except for three areas. First, a radar strike section must be developed to handle daily planning for numerous targets in a fluid tactical situation. The manning should include two trained 1545 AFSC personnel to provide 24 hours operations. This section should not be manned from assigned crew resources. Second, the intelligence section should be assigned to the squadron and manned with one 8044, 20670, and 20650.

(5) A stabilized personnel management program to identify qualified C-130 AWADS navigators and to retain them in an operational AWADS unit is essential now. A procedure using an AFSC identification shredout designator would allow personnel planners sufficient data to eliminate expensive training, loss of sophisticated skills, and also improve the combat readiness posture of TAC AWADS units.

c. AWADS MAINTENANCE. Significant material failure and repair data covering the AWADS equipment field repair capability and spares requirements have been developed. Specific failures and limiting factors have been submitted to allow material analysis. A resume of failures from 15 May - 15 July by LRU is provided:
AWADS equipped C-130's launched 480 missions from Tan Son Nhut AB with ten late takeoffs and zero aborts, for a reliability rate of 97.9%.

The ten delays were charged as follows: maintenance - 4, operations - 4, and rigging - 2.

d. EQUIPMENT LIMITATIONS

(1) The current method for updating the rate of fall in the AWADS computer is a low-altitude approximation which results in significant errors in adjusted rates of fall for high-altitude airdrops. To eliminate this error, the navigator manually computes the adjusted rate of fall using mean altitude and temperature and enters it into the computer. To insure that the computer uses this adjusted rate of fall, the navigator inserts the standard day temperature for the true drop altitude into the computer to overcome any formula deficiency.

*The IP-988 and 0-1552 are married units and adjustments must be made simultaneously.
**All GNORS aircraft (2 for 12 days total) have been attributed to antenna failure. No spare antennas were deployed with the 61st TAS.
(2) The display and ground clearance altitude of the AWADS computer is derived from pressure altitude information supplied by the central air data computer (CADC). Significant errors in computer altitude information could have contributed to errors in computer release point solutions and aircraft release positions if corrections had not been applied. To correct this error, the navigator ascertained the D value for the aircraft drop altitude and converted this value to an altimeter setting by adding it to 29.92. This value was then inserted into the computer. The display altitude now read true altitude and eliminated sighting angle and total time of fall computation errors.

(3) In airdropping loads with high velocity chutes, the ballistics are entered into the computer as they are normally, except for rate of fall. An adjusted rate of fall is entered as stated in paragraph (1) above. When employing HALO type chutes, the procedures outlined in TAC TEST 71A-024A were used except for rate of fall. Again, the adjusted rate of fall is entered as stated in paragraph (1) above.

(4) The AN/ASN-24 (V) navigational computer determines the wind at altitude. A 70 percent factor of this altitude wind was used as the ballistic wind for all computer CARP computations. In most cases, this factor was sufficient to put the first four bundles within 100-200 meters of the desired point of impact. An adjustment was then applied to the offset aim point range and bearing to correct for any error in the ballistic wind and to move the second 12 bundles closer to the point of impact. It is interesting to note that one knot of wind error would cause the load to drift 50 meters off target when using high velocity chutes.
(5) The computer is allowed to compute the CARP using the 70 percent wind factor except when a wind shear is found to exist. If a ballistic wind of more than 4 knots and 60 degrees from the computer ballistic wind is found, a different procedure is used. The navigator plots the actual CARP using the ballistic wind found on climbout or reported by other means. A standard set of ballistics known as airborne radar approach ballistics are inserted into the computer. The range and bearing from the computed CARP to the Offset Aim Point is then measured and inserted into the computer as an offset. The computer then positions the aircraft for release at the navigator's computed CARP.

(6) It is recommended that a ballistic wind component be added to the computer program now under revision. This item had been investigated and rejected because of the reliance on availability of drop zone sizes to meet the criteria established in AFM 3-4. Changing the range and bearing of the offset to overcome present ballistic wind computer program deficiency is not a desirable method. These ballistic computation errors have been recognized in TAC TEST 71A-024A and are under revision at this time.

(7) The APQ-122 Ka-radar posed a problem because of its narrow beam width which produced a small band of video when at altitudes above 8,000 AGL. This factor, coupled with the 15 degree down tilt antenna limitation, does not allow the navigator to track a target during a release which is under 4,000 yards from the aircraft. Most offsets were chosen beyond 4,000 yards to allow the navigator to track the offset throughout the release.
(8) The effect of weather on the Ka-band radar was noted on many occasions and found to be extreme in the area of heavy rain showers. Often the navigator is required to use X-band radar for initial crosshair placement, and then switch to Ka-band radar within 60 seconds to make the final crosshair placement.

e. CEA AND CEP ANALYSIS. The overall CEA of 123.4 meters for 362 GRADS drops was a highly acceptable CEA for the system. In order to have an index to rate AWADS, we used the GRADS drops as comparison. The overall CEA for AWADS after 49 drops and prior to beginning airdrops at An Loc was 112.8 meters. The An Loc airdrop posed a particular problem because the offset was 450 yards from the target and was lost 1 minute prior to release. The computer would have to DR up to release time with no corrections from the navigator. The second problem encountered at An Loc was wind shear. By the time a suitable solution for wind shear was designed, the CEA was increased by six 400 to 600 meter scores. The overall CEA for AWADS after 96 airdrops was 172 meters. A quantitative and qualitative analysis has been completed covering AWADS airdrop releases and aircraft positioning error. The mean average of all AWADS scores thru 15 July was 172 meters. Resolution of these scores, parallel and perpendicular to the aircraft axis, showed a 10 meter forward and 35 meter right bias to the center of the drop pattern. The 10 meter longitudinal offset was almost exactly duplicated and thus substantiated by a lateral study of 250 GRADS drops made from the same aircraft using similar loads. This was probably caused by inaccuracy in computations for air forward travel distance to load exit. The 35 meter error is not readily explainable, but is significant.
It is possibly due to computer ballistic wind determination error, since a parallel GRADS analysis showed symmetry about the planned impact point to within 0.8 meters in the lateral direction. The standard deviation of the drops about the mean impact point, parallel to the aircraft, was 172 meters and displayed a slight elliptical tendency for AWADS. The use of ground troops to render accurate reports may have affected the validity of our statistical analysis. However, the large number of drops addressed should cancel the adverse effects and permit useful interpretations of these results. The full details of the study will be available upon return of the 61st TAS.

f. DROP ZONES. The DZ sizes used in GRADS and AWADS drops were as much as 1/2 to 1/3 smaller than the recommended size as prescribed in AFM 3-4, or the interim, size recommended by TAC TEST 71A-024A. In some cases, the DZ dimensions varied and became smaller under combat conditions which posed a problem. Bundles with a missed impact distance of 150 meters from the desired point of impact became unrecoverable. As in the case of An Loc, after the first correction was computed the ground commander would have each aircraft move his impact point so as to resupply each individual combat unit. This was done to aid him in his recovery and transportation problems, and also to limit the exposure time of his men to hostile enemy fire. The average size of all DZ's used by GRADS and AWADS was 420 X 470 meters, while the average size of all the DZ's used by AWADS was 340 X 520 meters. The following is a list of DZ sizes in meters used by the AWADS aircraft:
LOCATION  SIZE  LOCATION  SIZE
An Loc  500 X 500  Kontum  300 X 600
Ben Het  300 X 600  Minh Thanh  100 X 100
Chi Linh  300 X 500  Svey Rieng  IP Coord Only
Dak Pek  200 X 700  Xuyen Moc  300 X 500
Dak Seang  200 X 600  *Hoc Mon  400 X 900

9. **FLYING HOURS REQUIRED-AWARDS VERSUS GRADS.** The flexibility allowed by the AWADS self-positioning capability became readily apparent when flying hours during AWADS and GRADS airdrop missions were compared. The problem of acquiring radar time from the MSQ-77 sites, because of the relative priorities established for strike aircraft (fighters and B-52's) versus aerial resupply, were the primary reasons for the difference in flying hour requirements. A review of Kontum airdrops revealed that higher priority missions caused several aircraft to divert for refueling and then return to the drop area. At Kontum, the average flying hours per AWADS mission was 2.7; thus a saving of 2.1 hours over GRADS missions was realized. Another example was provided at An Loc where the average GRADS mission was 2.4 hours, while AWADS missions were 1.2 hours. These flying hours requirements held true throughout the various drop zones served. Use of AWADS airdrops improved the efficiency of the tactical airlift force.

*Used as a DZ for ARVN and for test drops.*
4. SUMMARY

a. The successful application of AWADS in combat validates the accuracy and reliability of this system in comparison with other airdrop systems. Further, it allows a new flexibility in tactics, provides alternatives to increase mission reliability, and can operate without ground based assistance. Consequently, the stated limitations present in AWADS warrant new investigative efforts.

b. It is recommended that Hq TAC or TAWC convene a study group to review in detail the AWADS employment results and identified problem areas. Corrective action to these problems is essential to assure immediate response and success of AWADS on a worldwide employment.
FOOTNOTES

1. USMACV, Perintrep, Apr 72, p 6 (S).
2. Intvw (S), Maj Paul T. Ringenbach, Capt David K. Mann and Mr. Mel F. Porter with Gen John W. Vogt, Commander, 7AF, 12 Nov 72.
4. Project CHECO, The USAF Response to the Spring 1972 NVN Offensive: Situation and Redeployment 10 Oct 72 (TS). The information synthesized from this report is classified no higher than secret. Intvw (C), Maj John Cash and Capt Peter Melly with CWO Davis, G2 Order of Battle Section, Hq TRAC, 23 May 72. (Hereafter cited as Davis Intvw.)
5. Ibid.
6. USMACV, Perintrep, Apr 72, p 4, (S), USMACV Command Center (CC) "Duty Officer's Log," 31 Mar 72-1 Apr 72 (C).
7. USMACV (CC), "Duty Officer's Log," 1 Apr 72-2 Apr 72 (C); 7AF Daily Intelligence Briefing, 2 Apr 72 (S); (Hereafter cited as 7AF DIB).
9. Davis Intvw (C).
11. USMACV, Perintrep, Apr 72 (S), p 3, Davis Intvw (C); Maj John Cash, USA with CWO David B. Johnson, OB Specialist for Northern MR III and Cambodia, 23 May 72. (Hereafter cited as Johnson Intvw).
12. Intvw (C), Maj Hitti, USA with Maj P. Bentson, Asst G3, TRAC, 26 May 72. (Hereafter cited as Bentson Intvw).
13. 7AF DIB, 5 Apr 72 (S), CAS Report FVS-29,197, 5 Apr 72.

15. USMACV (CC), "Duty Officer's Log," 6 Apr 72 (C).


18. CAS Report FVS-29,203, 6 Apr 72 (S).

19. AC-130 Mission Report (Spectre 10), 5 Apr 72 (C); Project CHECO microfilm roll #662 (S) contains all the AC-130 Mission Reports cited in these footnotes.


21. CAS Report FVS-29,205, 6 Apr 72 (S); "Backchannels," 061000H-071000H Apr 72 (C).

22. AC-130 Mission Report (Spectre 05), 6 Apr 72 (C); Intvw (C), Maj Paul T. Ringenbach with Capt Robert Shumway (Sundog FAC, CHICO 07), 21st TASS, 22 Sep 72. (Hereafter cited as Shumway Intvw).

23. AC-130 Mission Report (Spectre 15), 6 Apr 72 (C).


25. CAS Report FVS-29,205, 6 Apr 72 (S).

26. CAS Report FVS-29,211, 7 Apr 72 (C); 7AF DIB, 7 Apr 72 (S).

27. AC-130 Mission Report (Spectre 11), 7 Apr 72 (C).

29. Bentson Intvw (C); Debriefing of Maj Thinh upon his arrival at An Loc (C), 4 Apr 72. (Hereafter cited as Thinh Debriefing); CAS Report FVS-29,214, 7 Apr 72 (C).

30. USMACV (CC). "Duty Officer's Log," 7 Apr 72 (C); Miller, "After Action Report (C):" Bentson Intvw (C).

31. USMACV (CC), "Duty Officer's Log," 7 Apr 72 (C); Intvw (C), Maj John Cash, USA with Capt Marvin C. Zumwalt, Infantry Regiment of the 18th ARVN Division, 18-19 Apr 72. (Hereafter cited as Zumwalt Intvw).

32. AC-130 Mission Reports (Spectres 10 and 17), 7 Apr 72 (C).

33. Zumwalt Intvw (C).

34. Zumwalt Intvw (C). "Backchannels," 081000H-091000H, Apr 72 (C); Stars and Stripes, 9 Apr 72 (U).

35. "Backchannels," 061000H-071000H Apr 72 (C); AC-130 Mission Report (Spectre 01), 7 Apr 72 (C).

36. AC-130 Mission Report (Spectre 09), 8 Apr 72 (C).

37. AC-130 Mission Report (Spectre 02), 7 Apr 72 (C).

38. Shumway Intvw (C) and a survey of AC-130 Mission Reports (C) during the crucial periods of the battle for An Loc.


41. Miller, "After Action Report," (C). Sector Forces are Regional and Popular Forces under the control of the Province Chief.

42. "Backchannels," 071000H-081000H Apr 72 (C).

43. 7AF DIB, 8 Apr 72 (S); CAS Report FVS-29,243, 9 Apr 72 (S); CAS Report FVS-29,231, 9 Apr 72 (S); CAS Report FVS-29,251, 12 Apr 72 (S); CAS Report FVS-29,279, 14 Apr 72 (S).

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44. CAS Report FVS-29,231, 9 Apr 72 (S); CAS Report FVS-29,257, 12 Apr 72 (S).

45. CAS Report FVS-29,243, 9 Apr 72 (S); CAS Report FVS-29,244, 10 Apr 72 (S), Utmer, "After Action Report," pp 22, 10, 11, (FOUO); CAS Report FVS-29,231, 9 Apr 72 (S); CAS Report FVS-29,251, 12 Apr 72 (S).

46. Thinh Debriefing (C).

47. Miller Intvw (C).

48. Msg (C) Bunker to SECSTATE, "Thieu Visits Front and Emphasizes his Role as Commander-in-Chief," 15 Apr 72.

49. Miller Intvw (C).

50. Ibid; 1/Lt Richard Joslyn, "Narrative Input for Army Greenbook, 3d Bde (Sep), 1st CAV DIV (AM), 1 July 1971 to 30 April 1972," 19 May 72 (U).

51. 7AF DIB, 14 Apr 72 (S); CAS Report FVS-29,273, 13 Apr 72 (S); "Backchannels," 121000H Apr 72 (C); Debrief Deputy Senior Adviser (Capt Moffett) to 3d Ranger Group at An Loc from 8 Apr-31 May 72 with Hq TRAC staff, early Jun 72 (C), (Hereafter cited as Moffett Debrief); Bentson Intvw (C); Intvw (C) Maj John Cash with Maj Raymond Haney, Inf Adviser at An Loc, 19 Apr 72. (Hereafter cited as Haney Intvw).

52. Intvw (C), Lt Peter Melly with Maj Larry McKay, CO 79th ARA at 3d Bde, 1st Air Cav, 26 May 72; Bentson Intvw (C); Col William Miller to Brig Gen James F. Hamlet, CG 3d Bde, 1st Air Cav (Airmobile), Subj: "Battle of Loc Ninh (An Loc)," 13 May 72 (U).

53. USMACV (CC), "Duty Officer's Log," 13-14 Apr 72 (C); "Backchannels," 131000H-141000H Apr 72 (C).

54. AC-130 Mission Report (Spectre 17), 13 Apr 72 (C).

55. Shumway Intvw (C). For a more detailed explanation of the command and control problems over An Loc see Chapter IV.

56. CAS Report FVS-29,290, 15 Apr 72 (S); CAS Report FVS-29,299, 15 Apr 72 (S); "Backchannels," 141000H-151000H Apr 72 (C).

57. CAS Report FVS-29,299, 15 Apr 72 (S).

58. CAS Report FVS-29,412, 24 Apr 72 (S); Msg (C) Bunker to SECSTATE, 15 Apr 72.

59. CAS Report FVS-29,279, 14 Apr 72 (S).

60. Charles Black, "An Loc is Key to Saigon," Columbus (Ga.) Enquirer, 17 May 72 (U).

62. MACV J3, "Report of Significant Activities," 15 Apr 72 (C); Bentson Intvw (C).

63. "Backchannels," 161000H-171000H Apr 72 (C).


65. Ulmer, "After Action Report," p 29 (FOUO); 7AF DIB, 17 Apr 72 (S).

66. USMACV (CC), "Duty Officer's Log," 16-17 Apr 72 (C); Davis Intvw (C).


70. 7AF DIB, 22 Apr 72 (S); quoted in Ulmer, "After Action Report," p 14 (FOUO).


74. Ibid; tab 1, p 3.

75. "Backchannels," 241000H-251000H Apr 72 (C).

76. "Backchannels," 251000H-261000H Apr 72 (C); 7AF Director of Information news release "C-130 Crews Create Lifeline to An Loc," 1 Jun 72 (U).

77. CAS Report FVS-29,488, 30 Apr 72 (S); "Backchannels," 301000H-011000H May 72 (C).

78. AFM 3-4 requires a larger CDS zone than was available; "Combat Airdrop Report," and p 2, tab 1, p 3, 4 (C).
79. 16th SOS Working Paper Draft for the squadron history Apr-Jun 72 (S) p 20, 21; Stinger Mission Report #5228, 25 Apr 72 (C) reviewed at 18th SOS, NKP, RTAFB.

80. CAS Report FVS-29,536, 3 May 72 (S); "Backchannels," 271000H-281000H Apr 72 and 011000H-021000H May 72 (S).


82. Intvw (C) Maj John Cash with Maj Kenneth A. Ingram, Sr. Arty Adviser to the 5th DCAT at An Loc from 1-3 May 72, 1 June 72. (Hereafter cited as Ingram Intvw).

83. Ibid. (C); "Backchannels," 021000H-031000H May 72 (C). Hq TRAC Debrief of Capt Moffett and Maj Ingram, undtd, p 9 (C).

84. Ingram Intvw (C), Vogt Intvw (S).


88. Ibid; 051000H-061000H May 72 (C).


90. Intvw (C) Maj Cash with Capt Moffett, 3rd Rgr Gp Adviser at An Loc, 1 Jun 72; Moffett Debrief (C).

91. CAS Report FVS-29,547, 4 May 72 (S); "Backchannels," 031000H-041000H May 72 (S).

92. 7AF (DOLCE/Lt Col Weeks) Form 4, Col R. J. Downs, Director of Airlift to 7AF DO, undtd (U).

93. Hq TRAC Debriefing of Capt Moffett and Maj Ingram, undtd, p 9 (C).

94. 7AF DIB, 5 May 72 (S); CAS Report FVS-29,604, 8 May 72 (S).

95. 7AF DIB, 7 May 72 (S).


100. Ingram Intvw (C).
101. Moffett Debrief (C).
102. Ibid.
103. Ulmer, "After Action Report," p 17 (FOUO); 7AF DIB 11 May 72 (S).
104. 7AF DIB, 11 May 72 (S); Brig Gen James F. Hamlet, USA, Memo for Gen Wm Maddox Jr, "Destruction of Armor by Helicopters," 18 May 72 (S).
105. Moffett Debrief, p 20 (C).
106. Intvw (C) Lt Peter Melly with Lt Col Gordo Weed, C.O. 8th SOS, 14 Jun 72. (Hereafter cited as Weed Intvw).
107. Moffett Debrief, p 21 (C); CAS Report FVS-29,653, 11 May 72 (S).
108. Intvw (C) Lt Peter Melly with Maj Munsch, G3 TRAC, 23 May 72, (Hereafter cited as Munsch Intvw); Moffett Debrief, p 45 (C); "Backchannels," 111000H-121000H May 72 (C).
110. Moffett Debrief, p 22 (C).
112. Ulmer "After Action Report," p 17 (FOUO); Maj Kenneth A. Ingram, Division Artillery Team Adviser, ARVN 5th Division, Debriefing, 10 Jun 72 (C). (Hereafter cited as Ingram Debrief); Hq TRAC Debriefing of Capt Moffett and Maj Ingram, undtd, p 6 (C).
113. Intelligence Report for 12 May 72 (0500H-1500H) (S) and Night Intelligence Report for 12/13 May 72 (S). Both located on Project CHECO Microfilm roll #637 (S) also Letter: Hq PACAF (DOOF/Lt Col Kyle), subj: CHECO Report, Battle for An Loc (U), dated 11 Jan 1973 (S).
114. CAS Report FVS-29,665, 12 May 72 (S); Shumway Intvw (C); "Backchannels," 121000H-131000H May 72 (C).
115. CAS Report FVS-29,665, 12 May 72 (S).
116. CAS Report FVS-29,669, 13 May 72 (S); USMACV (CC) "Duty Officer's Log," 13 May 72 (C).
117. 7AF DIB, 13 May 72 (S).

118. CAS Report FVS-29,675, 13 May 72 (S); "Backchannels," 121000H-131000H May 72 (C).

119. TACTICAL ANALYSIS BULLETIN, Vol 72-2, 1 Jul 72, p 2-4 (S), quotation on p 2 and CMDR, 21st TASS, Lt Col J. Morgan, 16 Nov 72 (U).

120. Ibid., p 4, 5.

121. Intvw (C) Capt P. Melly with Stinger crew members at Bien Hoa AB, 26 May 72; Project CHECO Report, Fixed Wing Gunships in SEA, 30 Nov 71 (S), Figure 11.

122. Shumway Intvw (C) and Maj G. Lange, Chief Airlift Operations, Hq MACV.

123. CAS Report FVS-29,726, 17 May 72 (S); CAS Report FVS-29,719, 16 May 72 (S).

124. USMACV (CC) "Duty Officer's Log," 16 May 72 (C); CAS Report FVS-29,732, 17 May 72 (S).


126. CAS Report FVS-29,744, 18 May 72 (S).

127. "Backchannels," 181000H-191000H May 72 (C); CAS Report FVS-29,764, 20 May 72 (S); CAS Report FVS-29,772, 20 May 72; 7AF DIB, 21 May 72 (S).

128. 7AF DIB, 23 May 72 (S).

129. CAS Report FVS-30,107, 21 Jun 72 (S); CAS Report FVS-30,128, 23 Jun 72 (S).


131. CAS Report FVS-29,777, 21 May 72 (S).

132. CAS Report FVS-30,048, 15 Jun 72 (S); "Backchannels," 081000H-091000H Jun 72 (S).

133. Ibid., 221000H-231000H Jun 72 (S).

134. CAS Report FVS-29,882, 31 May 72 (S); CAS Report FVS-30,148, 25 Jun 72 (S).


136. Ulmer, "After Action Report," p 23 (FOUO); Shumway Intvw (C); Weed Intvw (C).
UNCLASSIFIED

137. Shumway Intvw (C); Intvw (S) Maj Walter Scott Dillard, USA, with Brig Gen John R. McGiffert II, Deputy Commanding General, TRAC, during the battle of An Loc 10 Oct 72, (Hereafter cited as McGiffert Intvw); Ulmer, "After Action Report," p 24 (FOUO).


139. McGiffert Intvw (S).

140. Ingram Intvw (C).

141. Ibid., "Backchannels," 041000H-051000H May 72 (C).

142. USAFTFWC, SA-7 Tactics Conference Report published in the USAFTFWC, TACTICAL ANALYSIS BULLETIN, Vol 72-2, 1 Jul 72, p 22 (S).

143. "Operational Combat Evaluation on the Adverse Weather Aerial Delivery System (AWADS)," Aug 72 (C), p 2. Because of the limited distribution of this study, it has been included as an appendix to this report for reference purposes.

144. Ibid., p 7, 4.

145. Ibid., p 7, 14.

146. Project CHECO, Fixed Wing Gunships in SEA (Jul 69 - Jul 71), 30 Nov 71, p 31 (S), (Hereafter cited as CHECO, GUNSHIPS.)


148. CHECO, GUNSHIPS, p 35, 61 (S).

149. Hq TRAC Debrief of Capt Moffett and Maj Ingram, unstd, p 4 (C); Intvw (S) Maj J. C. Thomas with Lt Col R. F. Kelsey, 16th SOS staff officer and pilot on the PAVE AEGIS weapon system, 5 Jul 72.


151. McGiffert Intvw (S); Vogt Intvw (S).

152. Otas A. Sleep, Lt Col, USAF to "Men' of the 377 FOL," Bien Hoa, 2 Jun 72 (U).

153. 16th SOS Quarterly Historical Report, Apr-Jun 72, "Beacon Offset Firing," (S); U.S. Army Advisers to ARVN 5th Division, "After Action Report Draft" (C).

155. McGiffert Intvw (S); Also see Abrams Msg (C) (150851Z May 72) to CDR 8AF which states in part, "There is no question that the B-52s have been a major factor, and in preventing the enemy's accomplishment of most of his major goals."


159. CAS Report FVS-29,863, 28 May 72 (S); CAS Report FVS-29,726, 17 May 72 (S).

160. Ulmer, "After Action Report," p 25 (FOUO); Intvw (C) Maj J. Cash and Lt P. Melly with Col Franklin, Senior Adviser to 21st ARVN Division, 25 May 72. Col Franklin confirmed that the Army requested B-52 strikes closer than 1000 yards from friendly troops.

161. McGiffert Intvw (S).


163. Moffett Debriefing, p 26 (C).

164. Shumway Intvw (C).


167. Braddock, "Debriefing" (U).


169. Intvw (C) Maj J. Cash with CWO Davis, TRAC G2 OB Section at TRAC Hq, 23 May 72.
170. Quote from Ulmer, "After Action Report," p 51 (FOUO). The view that air power was primarily instrumenal for the failure of the VC/NVA to take An Loc can be found in numerous sources. For some examples see McGiffert Intvw (S); Hq TRAC Debrief of Capt Moffett and Maj Ingram, undtd p 1 (C); Franklin Intvw (C), p 3; McManus to McGiffert, "Activities Report, 3d Ranger Group," p 4 (U); "Backchannels," 131000H-141000H Apr 72 (S); and Vogt Intvw (S).
<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Definition</th>
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<tbody>
<tr>
<td>AAA</td>
<td>Antiaircraft Artillery</td>
</tr>
<tr>
<td>ARC LIGHT</td>
<td>(S) B-52 Operations in SEA</td>
</tr>
<tr>
<td>ARVN</td>
<td>Army of the Republic of Vietnam</td>
</tr>
<tr>
<td>ATC</td>
<td>Air Target Change</td>
</tr>
<tr>
<td>AWADS</td>
<td>Adverse Weather Aerial Delivery System</td>
</tr>
<tr>
<td>CARP</td>
<td>Computed Aerial Release Point</td>
</tr>
<tr>
<td>CAS</td>
<td>Close Air Support</td>
</tr>
<tr>
<td>CBU</td>
<td>Cluster Bomb Unit</td>
</tr>
<tr>
<td>CDS</td>
<td>Container Delivery System</td>
</tr>
<tr>
<td>COMUSMACV</td>
<td>Commander, U.S. Military Assistance Command, Vietnam</td>
</tr>
<tr>
<td>COSVN</td>
<td>Central Office for South Vietnam (Headquarters for all VC activities in South Vietnam)</td>
</tr>
<tr>
<td>DAISY CUTTER</td>
<td>(S) MK-82 (500 pound HE) or MK-84 (2000 pound HE) bomb with fuze extended; designed to explode at the surface to kill personnel and defoliate</td>
</tr>
<tr>
<td>DASC</td>
<td>Direct Air Support Center</td>
</tr>
<tr>
<td>FAC</td>
<td>Forward Air Controller</td>
</tr>
<tr>
<td>FFAR</td>
<td>Folding Fin Aerial Rocket</td>
</tr>
<tr>
<td>FSB</td>
<td>Fire Support Base</td>
</tr>
<tr>
<td>GRADS</td>
<td>Ground Radar Aerial Delivery System</td>
</tr>
<tr>
<td>GTC</td>
<td>Ground Target Change</td>
</tr>
<tr>
<td>HALO</td>
<td>High Altitude Low Opening</td>
</tr>
<tr>
<td>IR</td>
<td>Infrared</td>
</tr>
<tr>
<td>LAW</td>
<td>Light Anti-Tank Weapon</td>
</tr>
<tr>
<td>LZ</td>
<td>Landing Zone</td>
</tr>
<tr>
<td>MACV</td>
<td>Military Assistance Command, Vietnam</td>
</tr>
<tr>
<td>MEDEVAC</td>
<td>Medical Evacuation</td>
</tr>
<tr>
<td>MR</td>
<td>Military Region</td>
</tr>
<tr>
<td>PAVE AEGIS</td>
<td>System employing a 105mm howitzer on an AC-130E gunship</td>
</tr>
<tr>
<td>POW</td>
<td>Prisoner of War</td>
</tr>
<tr>
<td>ROE</td>
<td>Rules of Engagement</td>
</tr>
</tbody>
</table>
SPECTRE STINGER
Call sign for AC-130 gunships
Call sign for AC-119K gunships

TAC
Tactical Air Command

TACAIR
Tactical Air

TAS
Tactical Air Squadron

TOC
Tactical Operations Center

TRAC
Third Regional Assistance Command

VC
Viet Cong

VC/NVA
A mixed force of Viet Cong and North Vietnamese regulars

VNAF
South Vietnamese Air Force