TOP SECRET

25X1

25X1

Copy No. 33

CENTRAL INTELLIGENCE AGENCY

The Role of Airstrikes in Attaining US Objectives in North Vietnam

JCS Review Completed

25X1

ARMY and DIA review(s) completed.

25X1

MARCH 1966

TOP SECRET

25X1

Approved For Release 2008/10/16 : CIA-RDP80T01629R000300080014-9

FOREWORD

This report presents an analysis of the Rolling Thunder air offensive against North Vietnam, estimates the physical damage and human casualties resulting from the air campaign, and analyzes the US and South Vietnamese air operations employed to obtain these effects. Finally, the report evaluates the potential of air attacks as a weapon to achieve the stated objectives of the Rolling Thunder program, and considers alternative courses of action which are believed to be more promising ways of achieving the Rolling Thunder objectives. For purposes of comparison, some capsule evaluations of US experience gained from the air war against [redacted] North Korea also are presented.

CONTENTS

Summary Tables

Appendixes

Appendix Tables

[redacted] 25X1

Page

Illustrations

(Following Appendix C)

(Following Appendix D)

(Following Appendix E)

THE ROLE OF AIRSTRIKES IN ATTAINING US OBJECTIVES IN NORTH VIETNAM

Findings and Conclusions

Findings

1. The bombing of North Vietnam under the ground rules and at the force levels which applied in 1965 has obviously not achieved its major objectives -- reduction of the flow of supplies to the insurgent forces in the South and the forcing of Hanoi to enter into negotiations. Although the movement of men and supplies in North Vietnam has been hampered and made somewhat more costly, the Communists have been able to increase the flow of supplies and manpower to South Vietnam. Hanoi's determination to continue its policy of supporting the insurgency in the South appears as firm as ever. As a manifestation of US support and positive action in behalf of South Vietnam, the Rolling Thunder program has been more successful in attaining its third objective -- bolstering the confidence and morale of the South Vietnamese.

2. Even if the weight of attack were to be substantially increased, it is estimated that a continuation of the bombing under the ground rules which applied in 1965, and which are currently being followed, would not achieve the first two objectives noted above.

3. Air attacks almost certainly cannot bring about a meaningful reduction in the current level at which essential supplies and men flow into South Vietnam. Air attacks can, however, increase significantly the costs and difficulties associated with North Vietnam's support of the Communist forces in the South, complicate greatly the problem of maintaining essential economic activity in the North, and thereby bring meaningful pressures on the Hanoi regime. Therefore, it is concluded that, under drastically revised ground

rules, particularly through the removal of limitations on geographic areas which can be taken under attack, and with a significant revision of the target systems selected and the manner in which they are attacked, airstrikes against North Vietnam would be much more likely to contribute to the achieving of US objectives.

4. The effectiveness of air attacks in reducing the flow of supplies to a critical point is in large measure dependent on the course of ground combat in the South. Military action in South Vietnam against the Viet Cong and the regular units of the North Vietnamese army and their bases in South Vietnam on the one hand and the neutralization of their support facilities in North Vietnam on the other are complementary measures. Therefore, escalating the level of combat in South Vietnam is of major importance. The result would be substantially increased requirements for supplies from external sources to sustain the insurgency. These requirements could be increased to the point where the capacity of Communist overland supply routes would be tested and the costs of furnishing logistic support to the insurgent forces could be sharply boosted, particularly if local sources of supply in South Vietnam can be denied.

5. The choice of alternative target systems which might be attacked is limited. Neutralization of many of the target choices would have no direct impact on the course of the war since few of North Vietnam's economic resources are directly committed to the effort. An additional and fairly severe limitation on the choice of target systems results from the early stage of escalation in the present conflict. Without a declaration of war or a much higher degree of escalation, resort to unrestricted aerial warfare, including mass attacks on populated areas, does not appear to be a possible course of action at this time.

Conclusions

1. The US ground rules under which the air campaign against North Vietnam is waged should undergo drastic revision in order to enable conventional airstrikes to make a meaningful contribution to the achievement of the major US objectives.

2. More emphasis in air attacks should be placed on military-related targets in the northern part of the country. Sustained harassment of traffic movements in the southern regions (and Laos) on a more limited scale would contribute to the achievement of the overall objectives, but greater effort in the northern area of North Vietnam should increase the returns from air attacks.

3. A program of air attacks designed to optimize the furthering of these objectives at this stage of the war in South Vietnam would include the following targets. In combination, these attacks are clearly identified as against military or militarily related targets. They are neither directed at nor expected to bring about the collapse of the regime.

a. First, the neutralization of petroleum (POL) storage facilities and the Haiphong cement plant.* This should be done as quickly as possible to maximize effectiveness and prevent the North Vietnamese from taking countermeasures. The result would be to present the Communists with a major problem of military and economic supply, to complicate essential reconstruction, and to increase import requirements significantly.

b. Following neutralization of these facilities, the interdiction of the ports by mining, to throw the burden of military and economic supply primarily onto the rail lines, which probably would not be able to handle all import requirements. Coastal and inland waterways and highways would be used to an increased extent to help cope with the supply problem and would themselves begin to present more lucrative traffic targets.

25X1

* [redacted] the Sao Vang rubber factory at Hanoi is producing truck tires and therefore falls in the category of war-supporting industry in the same manner as the cement plant.

[redacted]

c. Following the mining of the ports, the concentration of bombing attacks on the China-North Vietnam lines of communication (LOC's), particularly the key rail targets. This effort, including 24-hour armed reconnaissance against rail, highway, and coastal and inland water traffic, should begin to bite into the essential traffic flows needed to keep the economy functioning normally. The cost of maintaining a flow of military-economic supplies would be very greatly raised over current levels.

d. The neutralization of selected military barracks and supply facilities if reconnaissance shows them to be in active use. Again, the attack should be carried out as quickly as possible since these facilities will probably be abandoned after the first strike.

e. The pre-strike estimates (DIA/JCS) of civilian casualties, assuming conditions of daylight alert, for the attacks against these fixed targets is less than 700. This is a minimum figure and would increase if shelter measures were ineffective or not taken, or if the assumed accuracy of the airstrikes were reduced. On the basis of 1965 experience the postulated armed reconnaissance sorties could result in as many as 1,000 casualties a month. Most of these, however, would be civilians directly engaged in moving logistic supplies or in keeping the lines of communication open.

f. It is recognized that strikes against previous sanctuary areas, particularly Hanoi, would probably lead to engagement of North Vietnamese air forces. Therefore, in carrying out the attacks outlined above, increased sorties to neutralize the air force and air defense forces would be necessary.

I. Objectives of the Rolling Thunder Program

The Rolling Thunder program, a systematic but restrained air offensive against selected economic and military targets in North Vietnam, was begun on 2 March 1965. The basic objectives of the air attacks on North Vietnam have been made clear in public statements by the President and other high officials of the US Government. These objectives are (a) to reduce the ability of North Vietnam to support the Communist insurgencies in South Vietnam and Laos; (b) to increase progressively the pressure on North Vietnam to the point where the regime would decide it was too costly to continue directing and supporting the insurgency in the South; and (c) to bolster the confidence and morale of the South Vietnamese.

II. The Logistics Target System*

North Vietnam's major contributions to the war in the South are its military manpower, its function as the control center for the insurgency, and its function as the logistic funnel through which materiel, mostly from the USSR and Communist China, is moved into South Vietnam. Consequently the attainment of the first objective of Rolling Thunder hinges almost exclusively on our ability to impede or to stop the flow of men and supplies from North Vietnam to South Vietnam. The logistics target system which must be attacked to meet this objective is of such a rudimentary nature, and the volume of traffic so small, that conventional air attack, particularly at the levels of 1965, is most unlikely to be an adequate weapon.

Under present combat conditions the Viet Cong and North Vietnamese forces are estimated to be dependent on external sources for less than 20 percent of their total daily logistic requirement. This movement from North Vietnam requires the use of less than 5 percent of the capacity of the supply corridor through Laos alone. Indeed, the capacity of this single route can provide the tonnage required from external sources even if the level of the Communist forces increases by nearly 40 percent and the intensity of combat reaches a scale more than 10 times its present level.** Although the capacity of the Communist

---

* See Appendix A.

** These figures pertain to illustrative projections which attribute to the Viet Cong and North Vietnamese main forces a capability to build up by the end of 1966 to a level of 155 battalion equivalents fighting once in every 3 days.

supply routes could be tested by heavy attacks with air weapons currently available, we believe that despite such attacks the land corridor could supply all logistic requirements even if the expanded Viet Cong and North Vietnamese forces were made completely dependent on external sources. To do so, however, would require a heavy commitment of manpower and materials to repair damage to lines of communication.

Even if the land route through Laos were successfully interdicted, the North Vietnamese could fall back on alternative infiltration routes to South Vietnam by sea or from Cambodia. These alternative routes probably would be adequate to enable the Communists to maintain their present level of activity, and to step up the firepower of their forces. These routes would also support an increase of present forces by as much as 40 percent, provided the level of fighting remained approximately at its present level.

III. The Rolling Thunder Attack*

A. Factors Conditioning the Nature and Scale of Attacks

The US and South Vietnamese air campaign against North Vietnam has been one of the most restricted and voluntarily limited air campaigns ever conducted by a major air power. It has been used as a carefully controlled means of gradual escalation to achieve strictly limited objectives. Consequently, the program has operated under a set of rigorously defined ground rules.

Self-imposed restrictions have limited both the choice of targets and the areas to be bombed. The existence of large restricted areas has effectively insulated almost 80 percent of North Vietnam's limited modern industrial economy from air attack; these areas contain 75 percent of the nation's population and the most lucrative military supply and LOC targets. In addition to area restrictions which limit armed reconnaissance attacks, there are specific sanctuary areas which are exempt from air attack. These areas include a 30-nautical-mile (nm) buffer zone along the Chinese border, a 30-nm radius around the city of Hanoi, and a 10-nm radius around the city of Haiphong.

Attacks on specific fixed targets are now limited to those approved in each Rolling Thunder program. These authorizations often provide additional restrictions limiting the number of strikes against approved targets and, in effect, exempt some types of targets from

* See Appendix B.

attack. There is, however, more flexibility in the type of targets for armed reconnaissance. A major restriction is the policy decision to avoid civilian casualties to the extent possible, which has resulted in many targets outside of the sanctuary areas not being approved for attack.

The overall effect of these area and operational restrictions has been to grant a large measure of immunity to the military, political, and economic assets used in Hanoi's support of the war in the South. The restrictions also insure an ample flow of military supplies from North Vietnam's allies. The preconditions established for the number of strikes and sorties, the methods of attack, and the avoidance of civilian casualties result in an operational disregard of basic principles of target selection. Among North Vietnam's target systems, not one has been attacked either intensively or extensively enough to provide a critical reduction in national capacity. No target system can be reduced to its critical point under existing rules.

Finally, the voluntary choice of such ground rules may well give the Hanoi regime an impression of divided counsel within the US Government. The limited nature of the US air attacks after the bombing pause may reinforce Hanoi's possible judgment that this restraint reflects a divisiveness and US reluctance to escalate the war.

B. Analysis of Rolling Thunder Operations

The Rolling Thunder attack on North Vietnam from 2 March 1965 through 19 February 1966 delivered a total of 37,000 tons of ordnance on more than 140 fixed targets and numerous targets of opportunity. A total of 42,597 sorties were flown -- approximately 57 percent by the US Navy, 41 percent by the US Air Force, and 2 percent by the South Vietnamese Air Force. Attack sorties -- strike and flak suppression -- accounted for over 60 percent of total sorties. In terms of ordnance expended the Navy-Air Force relationship was reversed, with the Air Force accounting for 62 percent of the total. This reflects the fact that the average ordnance load of sorties flown by the Air Force is slightly more than twice the average load for sorties flown by the Navy. Or stated differently, the Navy must fly twice as many sorties to deliver a given weight of ordnance in the target area.

A total of 181 aircraft and 154 men were lost. The estimated cost of ordnance expended, aircraft lost, and sortie overhead comes to a total of about $470 million. The assessable return in dollar terms

from this attack is $63 million in damage to economic and military facilities in North Vietnam.

Of the targets on the current JCS Target List that are outside sanctuary areas, all but 30 have been struck. Thus the opportunities within existing restrictions for striking new and important fixed targets are extremely limited. As a result of the lack of fresh fixed targets, armed reconnaissance is constituting an increasing share of the total Rolling Thunder attack. Armed reconnaissance has accounted for over 72 percent of total sorties flown and has delivered 68 percent of the ordnance expended by Rolling Thunder, but has accounted for only 21 percent of the estimated cost of damage to North Vietnam. The targets struck on armed reconnaissance usually involve lower restoration costs than do fixed targets, so the effectiveness of the program must be measured primarily in military, political, and psychological terms rather than economic.

The analysis of the air effort against North Vietnam in relation to total air activities in the Vietnamese war shows rather strong fluctuations in the weekly level of activity. This analysis suggests that these fluctuations may reflect a need to shift aircraft temporarily from attack on North Vietnam to support ground operations in South Vietnam or to attack targets in Laos.

There is a direct connection between losses and number of sorties flown, but the ratio of loss to sorties is higher for fixed target strike sorties than for armed reconnaissance strike sorties.

The air attack capability in the Southeast Asian area, including the B-52's in Guam, as indicated by performance in December 1965, is of course much greater than the effort levied against North Vietnam in 1965 and stands at about 630 sorties per day, or more than 26,000 tons of ordnance per month. This capability is directed against the three principal target areas -- South Vietnam, North Vietnam, and Laos -- as military and political requirements dictate. During the latter part of 1965, approximately 20 percent of the total air attack on the three areas was directed against North Vietnam.

IV. Effects of the Rolling Thunder Program*

A. Physical Effects

The estimated dollar cost for the restoration of economic and military targets attacked in the Rolling Thunder campaign is less than 10 percent of the value of the economic aid given to North Vietnam in recent years by Communist countries.

Restoration Costs of Facilities Attacked by the Rolling Thunder Program

	Million US $		
	Economic	Military	Total
Attacks on fixed targets	23.6	26.4	50
Armed reconnaissance missions	12.8	0.7	13
Total	36	27	63

Each month there has been a decreasing return in terms of bomb damage as fewer fixed targets outside the restricted area are available for attack and armed reconnaissance accounts for a greater share of the total air effort. The return has been particularly small since the resumption of bombing as a result of confining most of the effort to the low-value target system in the southernmost parts of North Vietnam.

About 57 percent of the total damage -- $36 million -- is attributable to the destruction of economic targets. This cost has been broadly distributed throughout the economic sector, and no one sector has been forced to bear unacceptably high levels of damage. In terms of national capacity the greatest damage was inflicted on electric power and petroleum storage facilities. These target systems lost 27 and 17 percent, respectively, of their national capacity. In each case, however, the target system had adequate cushion in the form of excess capacity to absorb these attacks, and economic activity could therefore be maintained at almost normal levels.

* See Appendix C.

The damage to military facilities is just over $27 million. Almost 60 percent of this damage was to military barracks, but the effect has been negligible. The damage to military targets has shown a definite downward trend since the peak month of July 1965.

The damage to military facilities not only has resulted in losses of equipment but also has prompted the abandonment of installations such as airfields and the dispersal of equipment and supplies normally stored in ammunition and supply depots.

B. Estimated Casualties

The United States has placed restrictions on the air offensive against North Vietnam in order to minimize civilian casualties. It has been to North Vietnam's interest to assert otherwise, however, and propaganda media attempt to give the impression that the air offensive has been a vicious and unrestrained assault on the civilian population, hospitals, schools, and other nonmilitary objectives. Nevertheless, in only one instance have Hanoi officials presumed to provide a total for the number of casualties.

Although the Rolling Thunder program has flown many thousands of attack sorties against targets in North Vietnam, the toll in human casualties has been light. Based on sample data, through the end of 1965, North Vietnamese casualties -- both civilian and military -- are estimated to have ranged from 11,700 to 14,800, divided about equally between killed and wounded.

Estimated Casualties Resulting from Rolling Thunder

	Military	Civilian	Total
Attacks on fixed targets	3,900 to 4,700	1,700 to 2,400	5,600 to 7,100
Armed reconnaissance missions	2,600 to 3,200	3,500 to 4,500	6,100 to 7,700
Total	6,500 to 7,900	5,200 to 6,900	11,700 to 14,800

About 55 percent of these casualties were military personnel. The strikes against JCS-designated fixed targets produced about two military for each civilian casualty, whereas the armed reconnaissance missions produced proportionately greater civilian casualties.

The civilians killed or injured by armed reconnaissance attacks were for the most part truck drivers or transport and construction workers rather directly engaged in maintaining the logistic pipeline to South Vietnam.

Approximately 3,000 civilian deaths (one-half of total civilian casualties) as a result of military action against North Vietnam is a small number. The impact of 3,000 civilian casualties is slight in a country where over 350,000 persons died in 1965 from other causes and where the accidental deaths alone produced casualties some three to five times greater than those resulting from the Rolling Thunder program.

C. North Vietnamese Countermeasures

The economic and military damage sustained has presented an increasing but still moderate bill to Hanoi, which in large measure can be (and has been) passed along to Moscow and Peiping.

The major effect of the attack on North Vietnam has been to force Hanoi to cope with disruption to normal economic activity, particularly in transportation and distribution. Reconstruction efforts have been hampered by difficulties in allocating manpower. The regime has relocated large elements of its urban population. Problems in the distribution of food have appeared, although these problems are not yet pressing. Where the bombing has hurt most has been in its disruption of the road and rail nets and in the very considerable repair effort which became necessary. On the other hand, the regime has been singularly successful in overcoming US interdiction efforts.

Much of the damage has been to installations which the North Vietnamese do not need to sustain the military effort. No attempt to restore petroleum storage facilities has taken place and only recently have there been indications of intent to repair some of the damaged electric power stations. In both cases the failure to restore or repair is explained by the existence of adequate excess capacity or the fact that the facilities which have been attacked were not of vital importance.

A similar phenomenon is noted in the absence of repair of military facilities. The military have chosen not only the outright abandonment of facilities such as barracks, but also the dispersal of the material usually stored in ammunition and supply depots.

An examination of destroyed and damaged facilities shows that only a small number were truly essential to the war effort. The major essential restoration has consisted of measures to keep traffic moving, to keep the railroad yards operating, to maintain communications, and to replace transport equipment and equipment for radar and SAM sites. These measures have probably been effected at a cost of between $4 million and $5 million, or between 5 and 10 percent of the total economic and military damage sustained in North Vietnam to date.

The increasing Soviet and Chinese commitments to sustain the flow of military and economic aid to North Vietnam imply an obligation to underwrite the economic restoration of the country on a grant basis or on favorable terms. This assurance is almost certainly a controlling determinant in Hanoi's attitude toward the loss of its economic facilities. In the Korean War, more severe economic losses did not deter P'yongyang during the conflict, and restoration assistance was provided by both China and the USSR.

Support of the insurgency in the South has been only indirectly affected by the bomb damage. North Vietnam's major inputs to the conflict in the South are its provision of military leadership and manpower and its function as the control center and logistic base for the Viet Cong and North Vietnamese force. North Vietnam serves essentially as the logistic funnel through which the flow of military supplies, particularly weapons and ammunition from the USSR and China, is maintained.

Despite the concentration of allied attacks in the South and in Laos and the resumption of bombing in the North, the movement of trucks during the current dry season along the infiltration routes through Laos is twice the level of a year ago, and the North Vietnamese are using larger trucks with heavier loads. The North Vietnamese through intensive efforts have increased the capacity of the lines of communication and made them less vulnerable to air attack. They have built new bypasses and ferries to circumvent bombed bridges, improved old roads and trails, and are constructing new roads. In several instances, roads previously limited to dry-season operation now have an all-weather capability. The current dry-season capacity of the interdicted route through Laos is adequate to accommodate a buildup

of the Viet Cong and North Vietnamese main force of at least 40 percent and an intensity of combat more than 10 times the present level. This estimate excludes any effect of attacks on truck traffic.

This ability to react and to offset the effects of the air attacks has not been without its costs. It is estimated that the diversion of manpower to tasks associated with dispersal programs and emergency repair and maintenance of lines of communication throughout North Vietnam may now require the full-time services of 200,000 workers (equivalent to about 10 percent of the nonagricultural labor force) and the part-time impressment of another 100,000. An additional 150,000 people are also obligated, on a part-time basis, to serve in various aspects of civil defense which take them away from their normal pursuits. Thus a significant share of the labor force is diverted in varying degrees to supporting the war in the South. The diversion of labor has been supplemented, particularly in the northern provinces, by Chinese logistic support troops.

D. Effect on North Vietnam's Allies

In response to the intensified US and Vietnamese air offensive in 1965, all countries of the Communist camp have extended economic assistance as proof of their support. The response on the part of North Vietnam's allies, however, has been more unstinting in political and economic support and much more restrained in the military field. The major economic and military aid programs have been undertaken by the USSR and Communist China. The Eastern European Communist countries have generally extended only token amounts of assistance.

Total assistance extended by China and the USSR in 1965 is on the order of $250 million to $400 million, of which military aid accounted for $150 million to $200 million.* This aid is a relatively insignificant drain on the capabilities of both countries. In 1965, for example, the value of military equipment and of economic aid provided to less developed countries of the Free World by the USSR was more than twice that supplied to North Vietnam in the same period.

* These estimates are based on the same methodologies as those used in national intelligence estimates. The costing of Soviet military systems in this manner has been carried on over a period of many years.

The USSR is by far the major source of military equipment for North Vietnam, supplying 70 to 95 percent, or $142 million, of the total provided in 1965. The major components of Soviet military aid were SAM sites (15 to 20), antiaircraft guns (1,000 to 1,200), planes (44), motor vehicles (2,600), radar, and jet fuel. China's identified military aid, totaling only $11 million, consisted principally of planes (8) and trucks (1,400). In addition, large amounts of infantry weapons and ammunition are provided by Communist China. The inclusion of the cost of this equipment would probably raise the value of China's total contribution by a few million dollars. Military aid from the Eastern European Communist countries -- consisting principally of small arms and ammunition, medicines and medical equipment, and some trucks -- is valued at only a few million dollars.

V. The Potential of Air Attacks Against North Vietnam*

The Rolling Thunder program has been handicapped, as would be any air attack program against North Vietnam, by the absence of an indigenous economic base heavily committed to the support of military operations. Additionally, the ground rules under which the program must operate are highly restrictive, and the air attack has been fragmented on a variety of military and economic target systems. The greatest weight of bombing has been expended on a comparatively invulnerable rudimentary transport network in the southern part of North Vietnam.

If the effectiveness of the campaign is to be raised significantly, two fundamental changes must be made. The first is a basic change in ground rules to remove area and target limitations including mining of the ports. The second is a more rational use of basic principles of target selection.

A. Some Principles of Target Selection

The following principles of target selection apply to the analysis of any industry or service that is being considered as a potential target system because of its contribution to military output or to the sustaining of military operations.

* See Appendix D.

1. Use Pattern

This factor covers the extent to which a particular system really contributes to military output or to military operations, to civilian uses, to export, and so forth. Certain of these uses are essential and others are nonessential. The more detail in which a use pattern can be analyzed the more illuminating the process becomes.

2. Depth

This factor covers the travel time of a product from the point of manufacture to the front-line strength of the enemy. The travel time, or lead time, on the steel industry, for example, to the front line is probably on the order of a year or more, whereas the aircraft assembly can be measured in terms of a few months.

3. Cushion

This factor includes a variety of considerations such as the extent to which pre-attack consumption must be cut back before essential requirements are affected, the extent to which the enemy can employ a substitute, the size of stocks, goods in the pipeline, and the like. The most important factor with respect to cushion is the determination of the so-called "critical point," which is the point to which the output of the target industry or service may be reduced without serious effect. Below the critical point the effects begin to be felt with increasing impact.

4. Target Vulnerability

This factor covers the appraisal of the physical vulnerability of a potential target system to attack by existing military means. The size of weaponry available and needed, the level of bombing accuracy which is achievable, the physical hardness of the target, and other pertinent considerations enter into this calculation.

5. Recuperation

This factor covers both the time and size of effort needed to repair or replace the essential parts of a damaged target system. For example, during the Rolling Thunder program the North Vietnamese, with Chinese assistance, have been able to repair 60- to 90-foot railroad bridges in from 48 to 72 hours, to repair 20-foot spans on highway bridges in from 20 to 24 hours, and to replace 100 feet of underwater crossings in from 8 to 10 hours. This speed of recuperation was sufficient to more than maintain the required logistic flows.

6. The Principle of Concentration

This factor is of overriding importance in attacks on either tactical or strategic target systems. The principle of concentration fixes attention on two primary factors:

a. The essentiality of taking all or the major part of any target system under attack, in order to cut through the cushion.

b. The essentiality of concentrating the attack in point of time to overwhelm the ability to reconstruct, repair, or disperse.

B. Fragmentation of Attacks

The spreading of bomb tonnage over a great variety of military and economic target systems but attacking no one of these in depth has been characteristic of the Rolling Thunder program. The unattacked targets represent, for any one system, more than adequate capacity to meet all essential requirements. The attacks on major targets in some cases have been phased over such long periods of time that adequate readjustments to meet the disruption had been effected.

C. The Military Significance of North Vietnam

The significance of North Vietnam to military activities in South Vietnam is measurable in terms of three basic functions which it assumes: (1) as a logistic funnel for the stockage and movement of supplies into South Vietnam; (2) as a source of manpower; and (3) as a control center for the direction of insurgency.

1. The Logistic Funnel

The North Vietnamese economy, which is basically one of subsistence agriculture, has only a small modern industrial center concentrated in a few urban centers, including Hanoi, Haiphong, Nam Dinh, Viet Tri, and Thai Nguyen. The country imports little food even in poor agricultural years and depends largely on domestic production to feed its population. Agriculture in 1964 accounted for almost one-half of the gross national product. North Vietnam produces only minor items of military equipment -- grenades, mines, mortars, and ammunition for small arms -- and must import all of its heavy military equipment

and most of its small arms, ammunition, and medical supplies from Communist countries.

2. Manpower

A major aspect of North Vietnam's military significance is its capacity both to train and to supply insurgent Viet Cong personnel for later infiltration into South Vietnam and to provide substantial increments of its own population, to serve in South Vietnam or in indirect support functions.

North Vietnam has a population of over 18 million. Since 80 percent of the labor force is engaged in agriculture and is greatly underemployed, this primitive economy has basically large reserves. A large-scale mobilization of manpower had reportedly been under way in North Vietnam during 1965.

The country has about 4 million draft-age males, almost all of whom have been put in the regular armed force, paramilitary organizations, or labor repair and maintenance battalions. An estimated 175,000 males reach draft age each year, of which at least 100,000 are physically fit for military duty.

It is estimated that North Vietnam has the capacity to train and infiltrate the equivalent of nine North Vietnamese battalions each month during 1966, or a total of approximately 54,000 men for the full year. The net additions to be made to the Communist forces in South Vietnam will depend, in addition to decisions on the rate of North Vietnamese infiltration, on the capability of the Viet Cong to train new and replacement troops and the casualty rates inflicted on Viet Cong and North Vietnamese forces during the year. North Vietnam has also demonstrated a capacity to mobilize large numbers of personnel for activities involved in supporting the insurgency in the South.

3. Control Center for Insurgency

The function of North Vietnam as the control center for Viet Cong insurgency is well documented [redacted] 25X1

The major instrument of political control and direction of the Viet Cong insurgency is the Lao Dong Party, specifically the Committee for the Supervision of the South, which is attached to the Party's Central Committee. The North Vietnamese Communist Party

[redacted]

and government linkage with the National Liberation Front (NLF) is close and clear. Hanoi maintains control over the NLF through the Communist leaders in South Vietnam to whom the North Vietnamese issue overall guidance.

D. The Logistics Target System

1. Results of the 1965 Campaign

During 1965, more than 2,700 strike and flak suppression sorties carrying more than 3,400 tons of ordnance were flown against fixed targets on LOC's in North Vietnam. Relatively few of these targets were located on the railroads and roads north and east of Hanoi. Armed reconnaissance played a very significant additional role in the program to interdict LOC's, but again concentrated for the most part in the southern parts of North Vietnam.

These attacks made it more difficult and expensive for North Vietnam to maintain normal economic activity and to support the war in the South. Nevertheless, overall performance by the modern transport system was maintained at the levels of 1964, even though some important export traffic movements -- for example, that of apatite -- were halted completely. The transport system directly involved in the movement of men and materials to Laos and South Vietnam was able to sustain and to increase the flow of this traffic. At the same time, the number of routes and bypasses was increased, thus making the network less vulnerable to air attack. The results of the interdiction campaign show clearly that the original expectation that it would reduce LOC capacity in the southern part of the country by about two-thirds and even more in the north could not be realized. The North Vietnamese had sufficient recuperability resources so that a two-thirds reduction in capacity was imposed for only a very short period of time if at all. The most successful interdiction -- the Hanoi-Lao Cai rail line -- apparently was effective because of the relatively heavy level of traffic on this line and the fact that it is one of the few major transport routes without alternative means of transportation.

Photographic examination [redacted] of 26 interdicted highway route segments shows that on 15 segments route capacity had been restored to previous levels, on 2 segments capacity had increased, and on 9 segments capacity had been reduced. Only on two of these nine segments had capacity been reduced more than 25 percent. On one of these, restoration required only a matter of hours; the other was not vital to maintaining traffic flows.

Traffic volume on the major infiltration routes is at levels substantially below -- only rarely over 25 percent -- even interdicted route capacities. Bomb damage on these routes is invariably repaired quickly and inexpensively.

In summary, the rudimentary nature of the logistic targets in the southern part of North Vietnam, the small volume of traffic moving over them in relation to route capacities, the relative ease and speed with which they are repaired, and the extremely high frequency with which they would have to be restruck -- once every three days -- all combine to make the logistics network in this region a relatively unattractive target system, except as a supplement to a larger program.

A significant lesson from the Rolling Thunder program to date is that the goal of sustained interdiction of the rudimentary road and trail networks in southern North Vietnam and in Laos will be extremely difficult and probably impossible to obtain in 1966, given the conventional ordnance and strike capabilities likely to exist. The ease with which bypass roads, river crossings, and ferries can be constructed and the ability to resort to human transport when necessary make these extremely unprofitable targets. This is borne out by experience in both the Korean War and the present conflict. In Korea the interdiction program flew sorties at three times the level of Rolling Thunder against a logistics target system moving almost 250 times the amount of supplies moving into South Vietnam. Yet the North Koreans and Chinese in a defensive position were able to move in their daily logistic requirement and make significant additions to stockpiles. They were, however, unable to mount a sustained offensive due to the logistic supply ceiling imposed by air attack.

The recent effort in Laos during the bombing pause also points out the relative ineffectiveness of conventional interdiction programs against simple high-capacity logistic systems made up of highway targets. During the five-week period of the bombing lull in December 1965 - January 1966, 9,000 sorties (8,000 of which were over the Panhandle) were flown to drop perhaps 18,000 tons of ordnance on the

supply routes to South Vietnam. Despite this effort, the level of truck traffic moving south on these routes was twice the average of 15 trucks per day moving south during the same period in 1965. For these reasons the sortie and ordnance expenditure presently used against supply routes in the southern region could probably be more effectively used against the more lucrative LOC targets in the northern part of North Vietnam.

2. A Preferred LOC Target System

The source of logistic supplies not obtainable in South Vietnam for the Viet Cong and North Vietnamese forces and for North Vietnam's defense forces is the military aid being provided by the USSR and China. Although the flow of supplies from these sources cannot be cut off, the movement could be made considerably more expensive and unreliable if authorization is granted to attack intensively the rail connections to Communist China and if the three major ports are effectively mined, thereby closing off the movement of oceangoing ships. At the same time, the flow of imports needed to sustain economic activity in North Vietnam could almost certainly be reduced.

About two-thirds of North Vietnam's imports are carried by sea transport and the remainder move principally over the rail connection with Communist China. Mining the entrances to the three major ports would effectively transfer almost all imports to rail transport. The rail connection to Communist China, which is currently used at only about one-third of capacity, would then be forced to attempt to operate at close to full capacity under interdiction conditions. If production in facilities such as the cement plant, and probably the rubber plant, were halted at the same time, an import requirement would be generated which would be far in excess of rail capacity. The logistics target system in the northern part of North Vietnam would then be more like such a system in a developed economy at war, which is required to maintain high levels of both economic and military traffic. The disruptive effect of interdiction of this rail system would then be more immediately felt. Sustained interdiction of the line would force Hanoi to allocate considerable amounts of manpower and materials to maintain the line and alternate highway routes. The repair of major bridge structures would be measurably more complex and expensive than the relatively simple expedients which keep traffic moving in the southern provinces and in Laos. Sustained 24-hour interdiction and destruction of locomotives and rolling stock by armed reconnaissance would probably stop all daylight traffic and disrupt nighttime traffic, thus slowing down the movement of supplies and making

the logistic resupply of Communist forces considerably less reliable than at present. As a result, some economic requirements at least would go unsatisfied.

The North Vietnamese would probably be forced to make greater use of alternate means of transport such as highways and coastal and inland waterways. Although it would be extremely difficult to interdict these systems, their greater use would increase the opportunities for harassment of actual traffic movements.

The specific program considered would include attacks on 29 major bridges and the four principal railroad yards and shops (see Table 1). The probable increase in aircraft losses resulting from a concentration of air efforts on the northern LOC's has not been analyzed. The initial strikes against these targets would require an estimated 1,670 strike and support sorties and 1,560 tons of ordnance. The restrike effort required to keep these targets interdicted has not been calculated, but it would involve armed reconnaissance on a 24-hour basis. An interdiction program only against the two rail connections to China -- the Hanoi-Lao Cai and Hanoi-Dong Dang lines -- would require an estimated 750 strike and support sorties monthly. Sustained interdiction and armed reconnaissance of the land transport targets in the north would probably require over 3,000 sorties monthly. This program would stop through traffic on major rail routes, but more intensive attacks would probably be necessary to deny the use of these routes for shuttle service. Successful attacks on these 33 land transport targets, the major portion of which are located on the more heavily used transport routes of the country, would be much more effective than attacking minor bridges in the south and other outlying areas, and from the standpoint of identification would be more easily carried out than attacks on the more obscured, smaller, and diverse transport targets in the south.

The interdiction of LOC's, to be effective, must be combined with the mining of the three major ports. The mining program would require initially 104 sorties and only 190 tons of ordnance. The closing of the ports to oceangoing traffic would throw almost all of North Vietnam's import traffic onto the rail connection to China. The Hanoi-Dong Dang line would then be operating at or close to full capacity. Further use would also be made of highway and coastal water routes. If other essential import requirements were generated by neutralization of industrial facilities, such as the Haiphong cement plant, import requirements would then exceed the capacity of the rail line. With only limited highway capacity available, interdiction of

25X1

Table 1

Logistics Targets Attacked Under Assumed Intensified Allied Air Offensive

25X1

Target Number	Name	Estimated Sorties			Ordnance Required (Tons)	Location by Area
		Strike	Support	Total		
Railroad Bridges						
18.24	Cao Nung Railroad Bridge over the Song Hoa	88	16	104	39.0	Northeast quadrant rural area
18.26	Lang Con Railroad Bridge NW	28	16	44	42.0	Border buffer zone rural area
18.58	Lang Dang Railroad Bridge over the Song Thuong	24	16	40	36.0	Border buffer zone rural area
18.74	Vu Chua Railroad Bridge over the Suoi Ngang	88	16	104	39.0	Northeast quadrant rural area
Highway Bridges						
17	Haiphong Highway Bridge over the Song Da Bach	35	18	53	50.0	Haiphong restricted zone rural area (mud flats)
18.31	Kep Highway Bridge over the Song Thuong	35	18	53	50.0	Northeast quadrant near villages
18.33	Thai Nguyen Highway Bridge over the Song Cau	35	18	53	50.0	Northeast quadrant near villages
18.36	Ha Gia Highway Bridge over the Song Cong	22	16	38	49.5	Hanoi restricted zone near villages

Table 1
(Continued)

Number	Name	Estimated Sorties			Ordnance Required (Tons)	Location by Area
		Strike	Support	Total		
Highway Bridges (Continued)						
18.38	Dan Phuong Highway Causeway over the Song Day	8	16	24	18.0	Hanoi restricted zone near villages
18.42	Xuan Mai Highway Bridge North over the Song Con	34	24	58	25.5	Hanoi restricted zone near villages
18.59	Long Khap Highway Bridge	40	16	56	90.0	Border buffer zone rural area
18.61	Bac Can Highway Bridge over the Song Cau	35	18	53	50.0	Northeast quadrant near villages
18.62	Lang Luong Highway Bridge over the Song Mo Ga	35	18	53	50.0	Northeast quadrant rural area
18.65	On Highway Bridge over the Song Thuon	32	16	48	24.0	Border buffer zone near villages
18.66	Me Xa Highway Bridge over the Song Ky	35	18	53	50.0	Northeast quadrant near villages
18.67	Chieng Chang Highway Bridge	32	16	48	48.0	Northeast quadrant rural area
18.71	Loc Binh Highway Bridge	34	16	50	76.5	Border buffer zone rural area

Table 1
(Continued)

25X1

Number	Name	Estimated Sorties			Ordnance Required (Tons)	Location by Area
		Strike	Support	Total		
Highway Bridges (Continued)						
18.72	Xuan Mai Highway Bridge SW over the Song Day	50	16	66	112.5	Hanoi restricted zone near villages
18.77	Ha Chanh Highway Bridge North	22	16	38	33.0	Border buffer zone rural area
18.78	Lam Highway Bridge NE	56	16	72	42.0	Northeast quadrant rural area
Combination Bridges						
11	Hai Duong RR/Highway Bridge over the Song Thai Binh	35	19	54	49.5	Hanoi restricted zone near villages
12	Hanoi RR/Highway Bridge over the Red River	34	24	58	76.5	Hanoi restricted zone near villages
13	Hanoi RR/Highway Bridge over the Song Duong (Canal Des Rapides)	28	20	48	63.0	Hanoi restricted zone near villages
15	Viet Tri RR/Highway Bridge over the Song Lo (Riviere Claire)	22	24	46	49.5	Hanoi restricted zone near villages
16	Dap Cau RR/Highway Bridge over the Song Cau	28	16	44	63.0	Hanoi restricted zone near villages
18	Lang Son RR/Highway Bridge over the Song Ky Cung	22	16	38	49.5	Border buffer zone densely populated

25X1

Table 1
(Continued)

25X1

Number	Name	Estimated Sorties			Required (Tons)	Location by Area
		Strike	Support	Total		
Combination Bridges (Continued)						
18.22	Co Trai RR/Highway Bridge over the Song Thuong	32	16	48	48.0	Hanoi restricted zone near villages
18.23	Bac Giang (Phu Lang Thuong) RR/Highway Bridge over the Song Thuong	22	20	42	49.5	Hanoi restricted zone near villages
18.25	Hai Duong RR/Highway Bridge East over the Song Rang	35	19	54	49.5	Northeast quadrant rural area
Railroad Yards and Shops						
19	Yen Vien railroad classification yard	6	24	30	13.5	Hanoi restricted zone near villages
20	Hanoi railroad car repair shops at Gia Lam	6	24	30	13.5	Hanoi restricted zone near villages
21	Hanoi railroad station and classification yard	18	24	42	40.5	Hanoi restricted zone densely populated
21.11	Thai Nguyen railroad station yards and shops	8	24	32	18.0	Northeast quadrant near industrial complex

25X1

Table 1
(Continued)

25X1

Number	Name	Estimated Sorties			Required (Tons)	Location by Area
		Strike	Support	Total		
Mineable Areas						
68	Cam Pha Mineable Area	8	12	20	25	Northeast quadrant rural area
69	Hon Gai Mineable Area	20	12	32	74	Haiphong restricted zone rural area
70.1	Haiphong Mineable Area	36	16	52	91	Haiphong restricted zone rural area

25X1

northern transport lines would then have a more immediate and direct impact. The flow of military supplies into North Vietnam and onward to South Vietnam would be slowed up and made more costly. Some economic imports would probably have to be foregone. In summary, the North Vietnamese regime would, by this program, be brought under far stronger pressures from air attacks than resulted from the pattern of airstrikes in 1965. At the same time, however, it is believed that this program would place no real restraint on the level of Communist activity in South Vietnam until requirements for resupply become much higher than now estimated.

3. Some Limits to Resupply

The upper limits on the level and cost of logistic support which the Hanoi regime would be willing to sustain cannot be quantified at this time. Several factors are relevant to the determination of that level. One factor is the limit to which local labor can be diverted to maintain the supply lines and support the logistic effort without an unfavorable impact on essential industrial and/or agricultural production. Substantial additional diversion of labor could necessitate imports of food to make up for production lost because of a shortage of farm labor. This could aggravate existing internal distribution and import programs, particularly if the major ports were closed and the rail and highway connections to China were being subjected to heavy interdiction.

A direct influence on logistic needs is the extent to which allied offensive operations in South Vietnam can force the Communists to use supplies at a higher rate or deny them access to existing stockpiles. If, for example, the buildup and level of combat projected for the end of 1966 also involved a total dependence on external sources for supplies, the North Vietnamese would have to supply about 250 tons a day to the insurgent forces in South Vietnam.

E. The "Will of the Regime" as a Target System

In addition to Hanoi's estimate of the US will to continue the war, three main factors appear to affect the determination of the regime to continue to support the war in South Vietnam: (1) the course of the war; (2) the degree of political and material support for the policy rendered the regime by its two main allies, the USSR and Communist China; and (3) the economic, social, and political consequences of supporting the war in South Vietnam within North Vietnam itself. The effort required in supporting the war in South Vietnam draws very

little on the physical resources of North Vietnam. The neutralization of given target systems within North Vietnam, however, would exact an increasing cost as the price to be paid for supporting the insurgency.

If air attack is to be a significant factor in the attaining of US objectives, a substantial revision must be made in the self-imposed ground rules. Air attack can increase significantly the price which North Vietnam pays to continue the war and reduce the ease with which it carries on its support of the war in the South.

A preliminary ranking has been made of the various possible target systems with the exception of lines of communication (which is discussed elsewhere) in a rough order of their importance to the military effort. This section presents a judgment on the feasibility or desirability of subjecting them to air attack at the current stage of the campaign and evaluates the probable impact of a postulated attack. Estimates of the forces and ordnance required for attack are presented only for those target systems which presently are in the preferred systems for a revised Rolling Thunder (see Tables 2 and 3). Six target systems have been considered: (1) the military supply system, (2) the military/economic system, (3) the modern industrial system, (4) the command and control system, (5) an agricultural system, and (6) the manpower system.

Extension of Rolling Thunder at this time is considered only for the first two target systems, in addition to the LOC system discussed separately. The details of these attacks are shown in the tables included.

1. Military Supply Targets

Twenty-six military barracks and/or supply targets remain unattacked although they are on the JCS target list (see Table 2). Since almost all of these are in the "sanctuary" areas, the extent to which they are occupied is not known. If reconnaissance were to reveal a significant level of activity at these facilities, they would be valid military targets whose neutralization would impede the flow of military supplies and disrupt military training programs in North Vietnam. The barracks on the list are those believed to be associated with military training programs in support of the infiltration. Virtually simultaneous attack would be needed for effectiveness, particularly the barracks attacks. Based on previous experience we can assume that these barracks will be abandoned after the first strike. The effect would be increasingly disruptive if other attacks on military/economic

Table 2

Military Supply Target System

JCS Target Number	Name	Estimated Sorties			Ordnance Requirement (Tons)	Remarks
		Strike	Support	Total		
Barracks						
22	Xuan Mai SSW	44	24	68	99.0	Hanoi Circle near villages
23	Xuan Mai NNW	28	24	52	63.0	Hanoi Circle rural area
31	Ha Dong Barracks/ Supply Depot	100	32	132	225.0	Hanoi Circle near villages
34	Vinh Yen North	46	20	66	103.5	Hanoi Circle near villages
35	Son Tay SW	34	20	54	76.5	Hanoi Circle rural area
39.29	Kep Ha NE	64	28	92	144.0	NE Quadrant near villages
39.33	Trai Thon	24	16	40	54.0	Hanoi Circle near villages
39.37	Vinh Yen NNE	26	20	46	58.5	Hanoi Circle rural area
39.38	Phu Tho NW	18	16	34	40.5	NW Quadrant rural area
39.41	Ngoc Thai	18	16	34	40.5	NW Quadrant near villages

Table 2
(Continued)

JCS Target Number	Name	Estimated Sorties			Ordnance Requirement (Tons)	Remarks
		Strike	Support	Total		
39.42	Son Dong SSE	54	16	70	121.5	Hanoi Circle rural area
39.43	Kep South	20	16	36	45.0	NE Quadrant rural area
39.44	Chi Ne	18	16	34	40.5	Southern rural area
39.46	Bien Son NNE	132	20	152	297.0	Southern near villages
39.51	Nom Son	8	8	16	18.0	Southern
Ammunition depots						
45	Haiphong	76	28	104	114.0	Haiphong Circle near villages
47.14	Vinh Yen	32	20	52	48.0	Hanoi Circle near villages
47.16	Hon Gai Explosives Storage	28	12	40	42.0	NE Quadrant rural area
47.17	Cam Ly	24	20	44	36.0	NE Quadrant rural area
47.21	Bac Giang	20	16	36	45.0	Hanoi Circle rural area

Table 2
(Continued)

JCS Target Number	Name	Estimated Sorties			Ordnance Requirement (Tons)	Remarks
		Strike	Support	Total		
Supply/ordnance depots						
58	Hanoi South	28	24	52	21.0	Hanoi Circle densely populated
59	Hanoi North	30	20	50	22.5	Hanoi Circle densely populated
60	Thai Nguyen North	14	20	34	10.5	Northeast quadrant near villages
62	Van Dien	16	20	36	12.0	Hanoi Circle near villages
63.11	Van Dien Vehicle Depot	58	32	90	43.5	Hanoi Circle near villages
63.14	Son Tay	34	24	58	25.5	Hanoi Circle near villages
Total		994	528	1,522	1,846.5	

25X1

25X1

and LOC targets are carried out simultaneously, in order to obtain a maximum disruption of the flow of essential military supplies into North Vietnam and their eventual redistribution to military consumers.

2. Military/Economic Targets

The economic targets in North Vietnam's modern industrial base which have a direct bearing on the regime's ability to support the war in the South are the major bulk petroleum storage facilities and the Haiphong cement plant (see Table 3). The petroleum storage installations sustain the supply and distribution activities within North Vietnam and through Laos, and are vital to the mobility of North Vietnamese military forces and to distribution and transport services for the civilian economy. The Haiphong cement plant as the sole producer in North Vietnam provides a major input to both normal construction activity and the reconstruction programs necessitated by Rolling Thunder attacks. Intelligence may reveal other war-supporting facilities falling in this category.

The extension of airstrikes against eight major POL storage terminals would deprive the regime of all but some 10,000 tons of storage dispersed in a variety of untargeted locations, including some 2,200 tons in small buried tanks at seven newly identified dispersed storage facilities. In addition, about 4,000 tons of residual capacity would remain in sites previously struck. The planned attacks would eliminate the principal bulk petroleum terminals in North Vietnam. Remaining storage would be less than one month's supply at 1965 levels.

A minimum of 440 sorties, comprising 280 strike aircraft and 160 support, will probably be required to neutralize these facilities. The ordnance requirement for these targets is estimated to be about 850 tons.

If the attack is to obtain optimum effect, it is imperative that it be carried out almost simultaneously on all petroleum storage targets. Simultaneous attack insures the most certain way of eliminating the cushion represented by excess storage capacity and stocks and of preventing countermeasures such as dispersal and thus of reaching the critical point in meeting essential requirements. The loss of petroleum storage facilities -- and their contents -- would have an immediate effect on the economy. The effect on normal industrial production activities would be slight because most of the industrial enterprises in North Vietnam rely on coal or electricity for energy. The major effect in the civilian economy would be in transportation and distribution.

Table 3

Military/Economic Target System

JCS Target Number	Name	Capacity (Metric Tons)	Estimated Sorties			Ordnance Requirement (Tons)	Remarks
			Strike	Support	Total		
Petroleum storage facilities a/							
48	Haiphong	72,000	58	24	82	196.0	Haiphong Circle near villages
49	Hanoi (Thanh Am)	34,000	36	24	60	121.5	Hanoi Circle rural area
51.1	Phuc Yen	14,000	50	24	74	169.0	Hanoi Circle rural area
51.17	Duong Nham	14,000	38	20	58	85.5	Hanoi Circle near villages
51	Nguyen Khe	13,000	40	20	60	135.0	Hanoi Circle near villages
51.13	Do Son	8,000	22	12	34	49.5	Haiphong Circle near villages
51.11	Bac Giang (Phu Lang Thuong)	6,000	20	16	36	45.0	Hanoi Circle near villages
51.14	Viet Tri	4,000	20	20	40	45.0	Hanoi Circle near villages
Total		165,000	284	160	444	846.5	
Cement plant							
	Haiphong	700,000 to 800,000	4	16	20	13.5 b/	Haiphong Circle densely populated

a. Previous strikes at four facilities have eliminated almost 37,000 tons of capacity.
b. Computed on the basis of an attack on the electric powerplant. The ordnance requirement would be heavier if the cement plant itself were attacked.

A sustained loss of petroleum storage facilities coupled with an inability to import even minimum operating requirements would have its greatest effect on military operations. North Vietnamese military forces account for about 60 percent of total petroleum consumption, or a monthly average of about 8,500 tons. North Vietnam with Chinese cooperation would probably be able after an initial period of disruption to maintain petroleum imports at almost normal levels even after the intensified attacks discussed in this report. Therefore, the supply of essential imports of petroleum for military requirements would appear to be almost certain.

Nevertheless, the attack would compound the difficulties of maintaining the flow of imports and military aid on the land transport connections to Communist China. The difficulties would be increased as attacks on other target systems increased the traffic flows in these land and coastal water transport routes.

An attack on the Haiphong cement plant would, by neutralizing North Vietnam's only producer of cement, create a major impediment to reconstruction and repair programs, at least in the short run. Over the longer term, cement could be imported from China. The import requirement could be on the order of 700,000 to 800,000 tons a year to meet all military and economic needs. If this volume were required, it would mean a doubling of the present tonnage of all seaborne imports, but it is probable that the total current requirements would not be considered essential under stringent transport conditions. If the cement and all seaborne imports had to be carried on the rail line from China, the total traffic volume would be in excess of the normal capacities of the Hanoi-Dong Dang rail line and the highway connections to China, and far in excess of their capacity under conditions of interdiction.

3. Industrial Targets

North Vietnam's small modern industrial sector contains a few highly prized and nominally lucrative industrial targets. Principal among these are the Hanoi machine building plant, the iron and steel plant at Thai Nguyen, and the Viet Tri chemical combine.

These plants and an additional 11 smaller plants constitute almost all of the modern industrial targets. They could be taken under attack by airstrikes involving about 500 sorties and the expenditure of slightly over 500 tons of ordnance. Alternatively a successful attack on the main electric power facilities could effectively put almost all of these plants out of operation.

Such an attack is often postulated as one which by depriving Hanoi of almost all of its modern economy and the major hallmarks of its economic progress will persuade the regime to enter into negotiations to end the war. This outcome is uncertain and probably unlikely. North Vietnam's modern industrial economy makes almost no direct or significant contribution to the war effort, which is sustained materially almost exclusively by supplies from other Communist countries. Since North Vietnam is essentially a subsistence economy, the modern industrial sector makes only a limited contribution to economic activity. The loss of industrial production would have almost no impact on the great mass of this agrarian society. The small element of the population directly affected would hardly be sufficient, or disposed, to persuade the regime to stop the war. For these reasons an attack on the modern industrial base of itself would not be likely to attain US objectives.

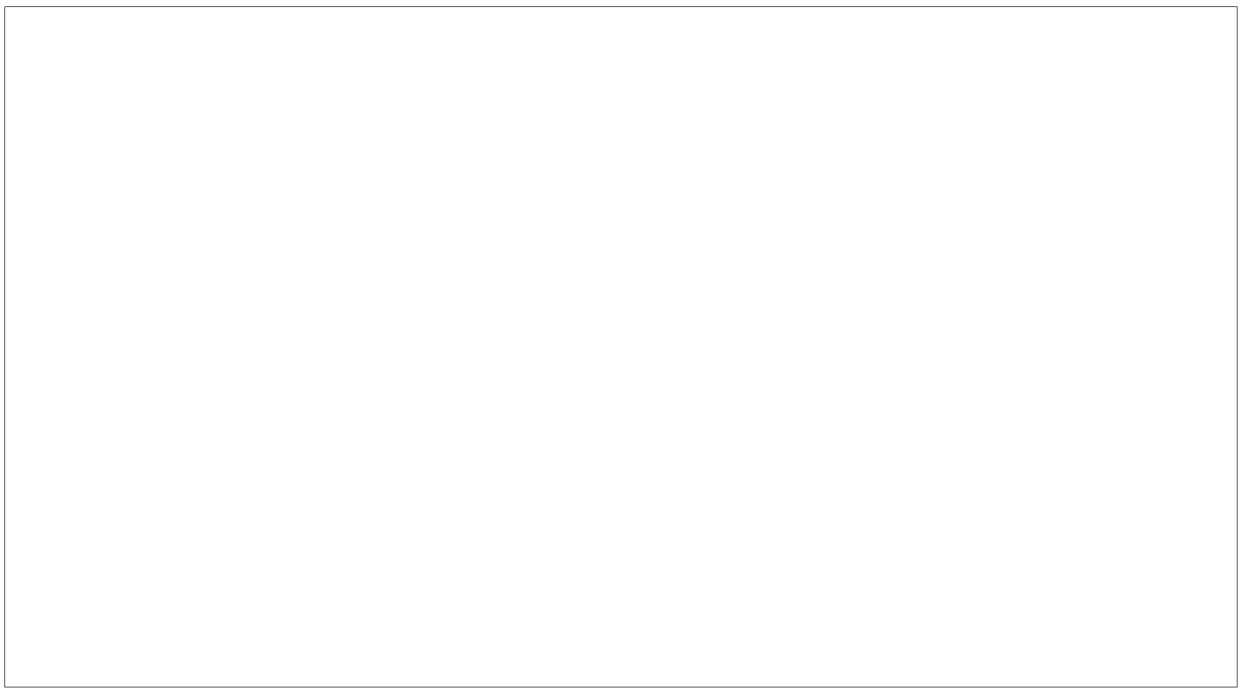
The experience of the Korean War also supports this judgment. Korea in 1950 was a country with a population considerably smaller and an industrial base much larger than those of North Vietnam in 1965. Most of Korea's modern industry was destroyed in the first three months of the war. One year later, hydroelectric plants were attacked to increase pressures on the regime. Attacks in the spring of 1953 against irrigation dams brought further pressure on the Korean leadership. This carefully phased program failed to force the enemy to accept UN truce proposals. In both North Korea and North Vietnam it is clear that the modern industrial base is too small to serve as a testing ground for the "hostage" concept of industrial destruction as a means of deterring aggression.

This potential target system does serve to provide a list of optional targets for possible use when other air attacks or activities in South Vietnam might produce indications of a weakening of Hanoi's determination to carry on with the war. At such a point, attacks on industrial targets could provide additional psychological pressure on the regime and the morale of its people.

4. The Command and Control, Agricultural, and Manpower Targets

The attacks on these targets are not recommended at this time. In each case the effects of the attacks are debatable and are likely to provoke hostile reaction in world capitals.

The breaching of the agricultural levees in the Red River delta region would be extremely difficult to do successfully and, moreover, would probably be rejected on humanitarian grounds. Even if carried out, any resultant loss of food supplies would fall on the lowest priority groups in the population.



The highest price to be imposed in North Vietnam would be represented by large-scale attacks on cities in order to maximize the number of casualties among skilled workers, thereby reducing their contribution to mobilization potential and to the maintenance of a viable economy. No calculations of the number of sorties, the volume of ordnance, or the probable number of casualties to be achieved by mass attacks on the eight urban cities have been made. To the extent that the attacks produce mass casualties and have a sufficiently harmful effect on civilian morale, the regime might find it increasingly difficult to continue with the war and might become more receptive to negotiations. However, attacks designed solely to produce mass casualties among a civilian population would be most difficult to support or justify at this stage of the war.

APPENDIX A

THE LOGISTIC SUPPLY OF VIET CONG AND NORTH VIETNAMESE FORCES IN SOUTH VIETNAM

I. Daily Supply Requirements

Viet Cong and North Vietnamese (VC/PAVN) regular combat forces in South Vietnam were estimated on 24 February 1966 at approximately 72,500 men, including 12,500 PAVN, 43,000 Viet Cong in the main force, and about 17,000 Viet Cong in separate companies and platoons in the local forces. Only the 55,500 troops (111 battalion equivalents of 500 men each) of the main force are believed to receive significant logistical support from external sources. Therefore, the logistic requirements for both external and internal support discussed in this Appendix pertain only to the 111 VC/PAVN main force battalions. The logistic impact of the introduction of 120-mm mortars into main force units and the use of PAVN antiaircraft artillery units in South Vietnam is not considered in detail in the following discussion. Taking such factors into consideration would require field reporting on ordnance expenditure which is not yet available.

The logistic requirements for three possible situations are considered: (1) the present level of the main force and the present level of combat, in which each battalion is assumed to fight about once in every 35 days; (2) the present level of the main force and escalated combat in which each battalion is assumed to fight once in every 7 days; and (3) the main force increased to 155 battalions each of which is engaged in combat once in every 3 days. The level of combat under the first situation is that prevailing during most of 1965. Under each situation a battalion is assumed to expend one-third of its basic load of ammunition during each day of combat. The estimated basic load of ammunition of a Viet Cong infantry battalion is 7.9 tons.* The weapons of the battalion include rifles, carbines, light machinegun/assault guns, 12.7-mm machineguns, 57-mm recoilless rifles, 40-mm rocket launchers, 60/61-mm mortars, and 81/82-mm mortars. Of the total basic load of 7.9 tons of ammunition, more than 4.9 tons are required for the 12.7-mm machineguns. The remaining 3 tons are fairly well distributed among the other weapons organic to the battalion. The number of rounds per weapon varies from 5 for each rocket launcher and 40 for each rifle and carbine to 1,760 for each 12.7-mm machinegun and 2,160 for each light machinegun. This does not seem to be a particularly generous ammunition allowance.

Daily logistic requirements for the VC/PAVN main force battalions under the various assumptions listed above are summarized in Tables A-1 through A-3.**

* Tonnages in this Appendix are given in short tons.

** Text continued on p. A-5.

Table A-1

Logistical Support for the Current Communist Main Force in South Vietnam Under the Current Scale of Combat a/

Short Tons per Day

Class of Supply	Requirements Supplied from Sources Within South Vietnam	Requirements Supplied from Sources Outside South Vietnam	Total Requirements
Class I (food)	55.5 b/	Negl.	55.5
Class II (quartermaster) and Class IV (weapons)	1.6 c/	3.7	5.3
Class III (POL)	1.4	Negl.	1.4
Class V (ammunition)	Negl.	8.3	8.3
Total	58.5 d/	12.0	70.5

a. A total of 111 battalions (86 Viet Cong, 25 PAVN) of 500 men each. Each battalion is engaged in combat once in every 35 days.
b. Calculated on the basis of two pounds of food per man per day, known from captured documents to be the VC/PAVN planning figure.
c. Quartermaster supplies only.
d. The 17,000 Viet Cong in the local forces require an additional 20.5 tons per day of logistic support from sources within South Vietnam. These local forces are assumed to be self-supporting and to obtain all their requirements for food, quartermaster supplies, weapons, and ammunition from indigenous sources. Although most of these troops are not equipped with the new family of 7.62-mm weapons, there have been indications that some units are beginning to be so equipped. If this is the case the requirement for these forces would be increased slightly and they would have to depend to some extent on logistic support from external sources.

Table A-2

Logistical Support for the Current Communist Main Force in South Vietnam Under an Escalated Scale of Combat a/

Short Tons per Day

Class of Supply	Requirements Supplied from Sources Within South Vietnam	Requirements Supplied from Sources Outside South Vietnam	Total Requirements
Class I (food)	55.5 b/	Negl.	55.5
Class II (quartermaster) and Class IV (weapons)	2.8 c/	23.0	25.8
Class III (POL)	1.4	Negl.	1.4
Class V (ammunition)	Negl.	41.7	41.7
Total	59.7 d/	64.7	124.4

a. A total of 111 battalions (86 Viet Cong, 25 PAVN) of 500 men each. Each battalion is engaged in combat once in every seven days.
b. Calculated on the basis of two pounds of food per man per day.
c. Quartermaster supplies only.
d. The 17,000 Viet Cong in the local forces require an additional 31.3 tons per day of logistic support from sources within South Vietnam.

Table A-3

Logistical Support for an Expanded Communist Main Force in South Vietnam Under an Escalated Scale of Combat a/

25X1

Class of Supply	Short Tons per Day: Requirements Supplied from Sources Within South Vietnam	Requirements Supplied from Sources Outside South Vietnam	Total Requirements
Class I (food)	77.5 b/	Negl.	77.5
Class II (quartermaster) and Class IV (weapons)	5.5 c/	35.6	41.1
Class III (POL)	1.9	Negl.	1.9
Class V (ammunition)	Negl.	135.9	135.9
Total	84.9 d/	171.5	256.4

a. A total of 155 battalions (116 Viet Cong, 39 PAVN) of 500 men each. Each battalion is engaged in combat once in every three days.
b. Calculated on the basis of two pounds of food per man per day.
c. Quartermaster supplies only.
d. The 17,000 Viet Cong in the local forces require an additional 48.8 tons per day of logistic support from sources within South Vietnam.

25X1

The total requirement for logistic support for the VC/PAVN main force under the present level of fighting is estimated to be about 70 tons per day, with somewhat less than 60 tons required from sources within South Vietnam and about 12 tons, or one-sixth, of the total required from external sources. The internal requirement is made up primarily of food and the external requirement primarily of weapons and ammunition. If the force level remains the same, but the level of fighting escalates to once in seven days, the total logistic requirement increases to about 125 tons per day with about 60 tons required from internal sources and nearly 65 tons or slightly more than one-half of the total from external sources. A buildup of VC/PAVN forces to 155 battalions and an increase in the level of fighting to once in every three days would bring about a substantial increase in dependence on external sources for logistic support. Under these circumstances the total requirement would increase to more than 255 tons per day with about 85 tons required from internal sources and more than 170 tons, or two-thirds of the total, from external sources. Even if the present scale of fighting and the present force do not increase significantly, there are indications that the requirement for external logistic support will increase gradually during 1966 because of the introduction of heavy mortars in main force units and the limited use of PAVN antiaircraft artillery units. Under these circumstances the logistic requirement from external sources for the present force might increase to more than 12 tons per day. The 12 tons per day is based essentially on the experience of 1965, but if the assumptions about ammunition expenditure for heavy weapons change, this figure might double. The following tabulation summarizes the total requirement figures under the various assumptions discussed above:

	Internal Requirement		External Requirement		Total Requirement [a]
	Tons per Day	Percent	Tons per Day	Percent	Tons per Day
111 battalions (current level of combat)	58	83	12	17	70
111 battalions (combat once in seven days)	60	48	65	52	124
155 battalions (combat once in three days)	85	33	171	67	256

a. Because of rounding, components may not agree with the totals shown.

II. Effect of a Denial of Supplies from Sources Within South Vietnam

A complete denial of supplies from sources within South Vietnam is difficult to imagine, but if it were to occur the Communists would essentially be required to ship into the country substantial tonnages of food each day in addition to the large amounts of weapons and ammunition already required. Quartermaster supplies and POL would present few problems because the amounts required would be relatively small. On an annual basis the food required would range from about 20,000 to 28,000 tons, under the three cases considered above. These tonnages are not large in comparison with the annual availability of rice in North Vietnam, amounting to less than 1 percent of the total. Thus it seems feasible to assume that the North Vietnamese could make available the additional food required. Moving the food to South Vietnam on a sustained and predictable basis, however, might be another matter, although the total logistic support required even under the most extensive scale of combat presented above is still within the estimated capacity of the overland supply route through Laos.

III. Route Capacities*

A. Land

The overland movement of the required tonnages from North Vietnam to the border of South Vietnam is restricted by the capacity of the routes in the Laotian Panhandle rather than by the capacity of the routes in the southern part of North Vietnam. Even route 15, the key route leading to Mu Gia Pass, has an estimated present dry season capacity of 450 tons per day, reduced from 600 tons per day in April 1965 as a result of allied air attacks. The capacity of route 102 leading to the Laos border north of the Demarcation Line is currently 100 tons per day. Over these two roads alone at least 550 tons per day can currently be delivered to the Laotian border.

Present road capacities within Laos are such that 450 tons delivered to Mu Gia Pass can be moved over routes 12, 23, 911, and 9 to Ban Dong where route 92 joins route 9. An additional 100 tons can be delivered to Ban Dong around the end of the Demilitarized Zone from the end of route 102. Thus the Communists can at present deliver 550 tons daily to Ban Dong at the junction of routes 9 and 92. From this point, 400 tons per day can be moved south on route 92 to the junction with route 922, over which 200 tons per day can be moved toward the South Vietnamese border. Before reaching this point, 50 tons per day can be diverted over route 921, also toward the South Vietnamese border. The remaining 150 tons can be moved further south on a segment of route 92, which has a capacity of 150 tons per day, and then over routes 923, 96, and 165 to the border of South Vietnam. Thus the present throughput capacity of the routes in the Laotian Panhandle appears to be about 400 tons per day. 25X1

25X1

it is quite possible that more than 400 tons per day can be delivered on a sustained basis to within a few miles of the South Vietnamese border if the Communists make an all-out effort.

It is expected that new access routes from North Vietnam and Laos into South Vietnam will be constructed in 1966. These routes will enhance the infiltration throughput capability by providing a more diverse choice of routes. A new road was observed under construction in late January in a northeasterly direction from route 911. This road may eventually become another border crossing between North Vietnam and Laos south of Mu Gia Pass. Further south, road construction has been under way between Chavane on route 165 and route 16 east of Attopeu. Recent track activity indicates that the work may have been completed, thus providing about 50 miles of motorable road

* For a map showing transportation routes in Cambodia, Laos, and Vietnam, see the map, Figure A-1.

25X1

further south on the supply route. Photography [redacted] also indicated that clearing operations were being conducted at a rapid rate southeast of route 16. If this work continued at the same rate as in early February, a road would have been open to the Cambodian border in the tri-border area (Cambodia, Laos, and South Vietnam) by the last week in February. The improvement of a route into this area is another indication of the increased activity in the Laotian Panhandle in support of Communist supply movements to South Vietnam.

Considering the present and projected level of construction and interdiction in the Panhandle it is estimated that the practical throughput capacity of the Laotian routes will be in the range of 400 to 700 tons at the end of 1966 and that the Communists will be able to sustain a movement of at least 400 tons per day to the end of route 165 or further south to route 16 and beyond if they so desire. On an all-weather basis the Communists are now able to move about 100 tons per day toward the border of South Vietnam -- 50 tons at the end of route 922 and 50 tons at the end of route 165. If it is assumed that 400 tons per day can be moved forward during the 180-day dry season and 100 tons per day during the rainy season, an average of about 250 tons per day can be moved forward on an annual basis.

It should be pointed out that these estimates of road capacity are for sustained movements of at least 90 days duration and that they make no provision for crash movements or various field expedients that the Communists have often employed in the past. For example, when short-term operational moves of 3 or 4 days are considered the road capacity may be doubled or even tripled. In general, it should be kept in mind that estimates of road capacity tend to err on the low side and that all the capacity figures previously cited are at best only very rough approximations of the use which the Communists can make of the cited routes.

Inland waterways have been used to supplement some sections of the road network both in North Vietnam and in Laos. Only one waterway in Laos, the Se Kong River, is known to be used to any extent as part of an infiltration route, although the alignment of other waterways, the Se Bang Hieng, the Se Pone, and the Song Ben Hai, makes them suspect infiltration routes. Aerial photography of the Se Kong between the southern end of route 92 and the point where route 165 leaves the river has revealed waterway improvements, native craft on the river, and portages of difficult sections. This waterway is navigable by canoes throughout the year, but its use during the dry season has probably been reduced since the completion of parallel route 96. The Song Ben Hai/Rao Thanh waterway in the Demilitarized Zone forms the border between North and South Vietnam. Although infiltration of personnel across this river has been reported, infiltration of supplies has not been observed. Use by canoes of this waterway throughout

the year for lateral movement within the Demilitarized Zone to interior tracks, trails, and tributary streams that provide access to South Vietnam is possible, however. Estimates of the capacity of these various waterways are extremely tenuous, ranging generally from 25 to 50 tons per day during the dry season to 50 to 500 tons per day during the rainy season. At best the inland waterways can be used to supplement portions of the road network but cannot be used for through movements.

In general, it may be concluded that the current and projected capacity of the route system through Laos during the dry season is much more than adequate to provide for the amount of tonnage required by Communist main force units in South Vietnam, even if the level of these forces increases by nearly 40 percent and the intensity of combat reaches a scale of more than 10 times its present level.

B. Sea

The capacity of the sea infiltration route from North Vietnam to South Vietnam cannot be quantified with even as much precision as the land route through Laos. Although sea infiltration has provided an important means of supply to the Viet Cong in the past, the sporadic nature of sea movements, the infrequency of detection, and the small number of voyages by any given craft in the course of a year make it very difficult to establish even a theoretical order of magnitude for shipments by sea, let alone the amounts actually moving.

The level of sea infiltration between North and South Vietnam is believed to have been drastically reduced since the inception of the US Market Time operation in 1965. Since that time, no craft identified as infiltrating supplies into South Vietnam by sea have been picked up. Because of the magnitude of the US Market Time operation it is probable that some infiltrating craft would have been intercepted if the North Vietnamese were making a concerted effort to move supplies in this manner. As of November 1965, it was estimated with 95 percent confidence that under the current scope of the Market Time operation only one infiltration craft could escape detection each day and 14 craft each night. If 15 small craft were actually able to get through the blockade during each 24-hour period and each craft carried about 4 tons of supplies each trip, then 60 tons could be delivered on a daily basis. With each craft making one trip a month between North Vietnam and South Vietnam, about 450 craft would be involved. Steel-hulled ships or the larger junks used for infiltration could carry 50 to 100 tons per trip. Even an occasional successful delivery by a ship of this type would add substantially to the amount of material being infiltrated. If the Communists made a determined and concerted effort to infiltrate supplies by sea, however, they would have to be willing to run the risk of experiencing substantial losses.

It can be concluded that the capacity of the sea route in the short term is essentially whatever the Communists want to make it. In the long run, however, this capacity is limited by the number of craft and trained crews available and by the costs the Communists are willing to pay in terms of craft sunk, crews captured or killed, and supplies lost during infiltration attempts. The Market Time operation has increased this potential cost immensely and probably will continue to discourage the Communists from making any serious attempts at large-scale sea infiltration as long as sufficient amounts of supplies can be moved south on the land route through Laos and lesser amounts can be moved along land or sea routes from Cambodia.

C. Cambodia

If the Cambodian government were to permit the use of its territory to support Communist military activities in South Vietnam, the Communists would be able to develop a major and secure supply system into the delta area of South Vietnam. This supply system would have the capacity to move the additional 1,200 tons of military supplies which it is estimated could be handled daily by the port of Sihanoukville. 25X1

In addition to the major port of Sihanoukville, Cambodia has three minor ports which are used mostly for fishing and naval activities. A small additional amount of tonnage could be delivered at these ports, but only one of them can accommodate small oceangoing ships. Clearance from Sihanoukville and the minor ports would be mainly by road transport, although coastal water transport using small craft would also be available. A railroad from Sihanoukville to Phnom Penh has been under construction for about five years, but a number of major bridges and most of the tracklaying on the 160-mile route remain to be completed. Cambodia is estimated to have about 10,000 trucks, and more could easily be imported.

The roads leading out of Sihanoukville have a greater capacity than the port itself and could easily handle 1,200 tons per day of military supplies for shipment to South Vietnam. Two roads could be used to clear Sihanoukville: (1) the Sihanoukville-Phnom Penh American Friendship highway and (2) the coastal route direct to South Vietnam. The direct impact of the use of these routes would be almost wholly in the southern part of South Vietnam, particularly in the Mekong Delta region.

The 145-mile Sihanoukville-Phnom Penh American Friendship highway, route 4, with a capacity of 7,000 tons per day in the dry season and 6,300 tons per day in the rainy season, is the major route available to clear the port. From Phnom Penh, supplies could be moved by

25X1

either highway or inland waterway to the South Vietnamese border. The best route, however, is highway route 1, which leads to the area facing Tay Ninh Province. Route 1 has a capacity of 3,600 tons per day in the dry season and 1,550 tons per day in the rainy season. The movement of 1,200 tons daily from Sihanoukville to the border on this route would require about 3,000 trucks. There are also two routes that extend north from the Phnom Penh area and connect with route 7, which approaches the northern border of Tay Ninh Province. These routes have lower capacities than route 1, especially in the rainy season, and the distance to the border is greater. From Phnom Penh, two slightly shorter routes extend to the border of Kien Giang and Chau Doc Provinces. At least 1,200 tons per day could be moved over these two routes throughout the year. The coastal road from Sihanoukville has a dry-weather capacity of slightly less than 1,000 tons per day and is the shortest route to the border, only 115 miles. In the rainy season, however, its capacity drops to 130 tons per day.

The major inland waterway is the Mekong River system, which has a capacity to move at least 6,000 tons per day south to the border from Phnom Penh with craft readily available. This capacity could be increased during the high-water season. Supplies could also be moved north to Stung Treng on the Mekong or on parallel route 13 which now is estimated to have a capacity of 3,650 tons per day in the dry season and 1,570 tons per day in the rainy season. From Stung Treng, supplies could be moved on route 19, on trails, or on minor waterways to VC/PAVN forces in Kontum and Pleiku Provinces. At one time, it was believed that this was a difficult route with less capacity than the Lao corridor, but route 19 is now estimated to have a capacity of 700 tons per day in the dry season and 250 tons per day in the rainy season.

The capacities of the various routes mentioned above are expected to remain at approximately the same level at the end of 1966. Although goods could be moved to border crossing points on these routes, the South Vietnamese government has checkpoints at the border crossings of each of the major routes, with the exception of route 1, so supplies would have to be dispersed at some point before the border was reached and moved on local roads, trails, and waterways. The border crossing point on route 1, however, is apparently under Viet Cong control, with the nearest known South Vietnamese military units located about 15 miles to the northeast.

It can be concluded that with sufficient trucks and drivers available, and in the absence of air interdiction, the total volume of supplies which could be cleared through the port of Sihanoukville could be moved forward to the South Vietnamese border over the main routes. In addition, supplies brought in through lesser ports along the Gulf of Siam could be moved by coastal and inland water routes and over trails to the border area.

IV. Options for Resupply

If the land route through the Laotian Panhandle were successfully interdicted, the Communists would be forced to fall back on the sea route and the various routes through Cambodia in order to supply their forces in South Vietnam. Some use might be made of an airlift, although resort to such a procedure would be highly unlikely, considering allied air superiority. However, if even two Il-14's could get through each night to airdrop supplies, they could deliver a total of nearly five tons per day.

The present external logistic requirement of 12 tons per day probably could be satisfied by the use of the sea route, the various routes through Cambodia, and an occasional airdrop. If only one or two small junks per day were able to evade the Market Time blockade, about half the requirement could be fulfilled. The remainder would have to come from or through Cambodia or by air. Through a combined use of normal commercial channels and clandestine means, the Communists could procure and move moderate amounts of supplies through Cambodia. However, it is doubtful that, through clandestine means alone, they could move, on a sustained basis, the entire 12 tons of military supplies needed daily by the VC/PAVN forces in South Vietnam.

If the 12 tons could actually be landed at Sihanoukville or other points along the coast, however, the Communists could undoubtedly move them forward into South Vietnam. At a minimum, the ability of the Communists to move goods clandestinely through Cambodia would be sufficient to provide an important adjunct to infiltration of supplies by sea.

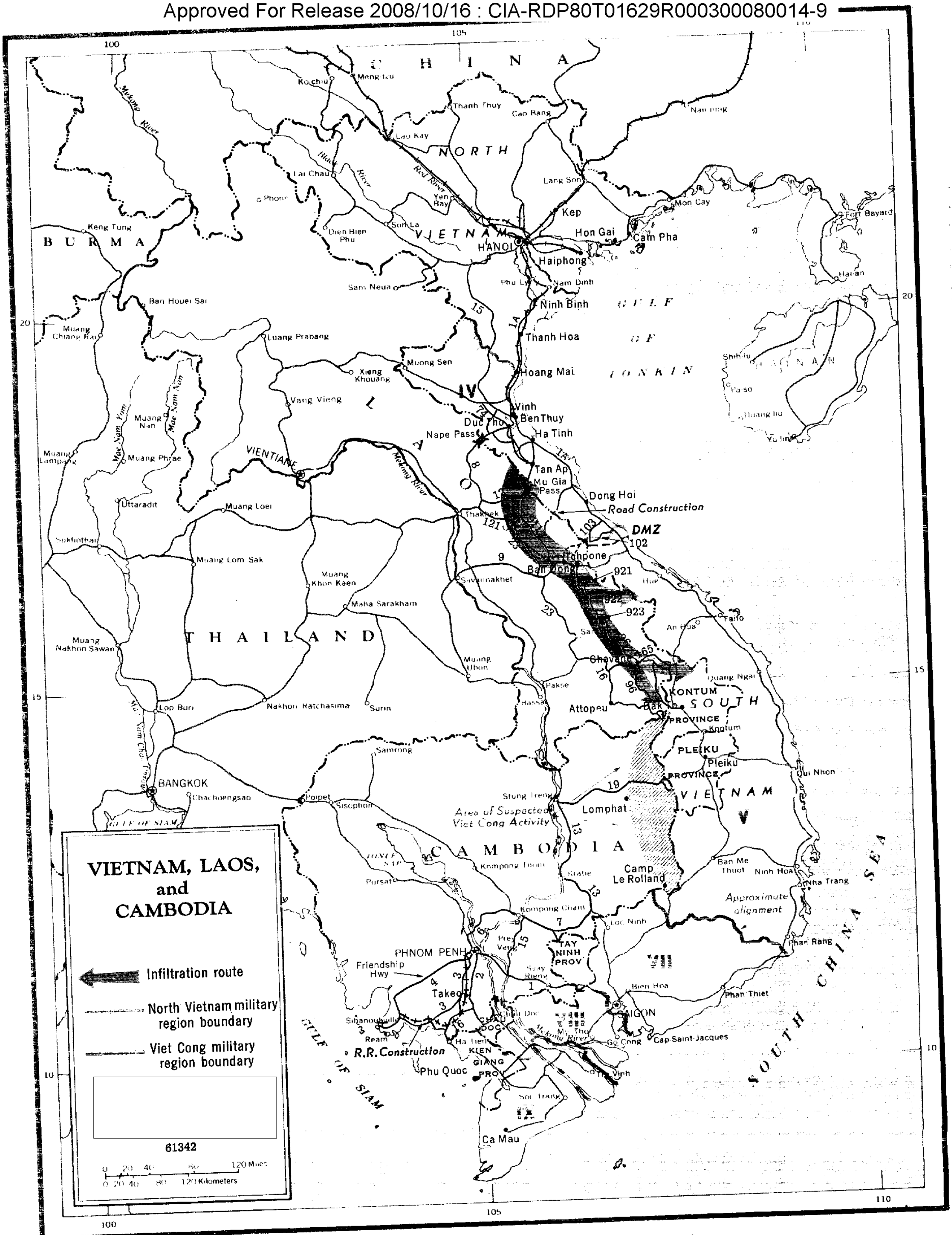
The external logistic requirement of 65 tons per day for the present force fighting once in every seven days would be almost impossible to fulfill without use of the land route through Laos unless the Cambodian government were openly to permit the use of its territory to support Communist military activities in South Vietnam. This is even more obvious in the case of the more than 170-ton logistic requirement for an increased force fighting once in every three days. As pointed out previously, the Communists would have to be prepared to face substantial losses if they attempted to bring in large tonnages by sea on a regular basis. They might succeed in this endeavor for a few weeks, but in the long run the attrition rate would be so high that the costs would probably prove to be prohibitive. Although the capability of the supply system through Cambodia is more than seven times the maximum projection of more than 170 tons of daily external logistic support, this capability could be used only if the Cambodians overtly abandoned their neutralist policies in order to support the Communists. Even if this happened, the capability of VC/PAVN forces to wage war in the central highlands of South Vietnam might be affected measurably by the cutting off of the Panhandle route because the central highlands area is more easily and directly supplied through Laos.

On balance, it does not seem likely that Cambodia will come out openly in support of the Viet Cong. Prince Sihanouk has been particularly sensitive to allegations that the Viet Cong are receiving weapons from Cambodia. Late in 1965, for example, Sihanouk asked the International Control Commission to institute control procedures in the port of Sihanoukville because of press reports concerning possible use of the port by the Communists. Other factors militating against a significant expansion of Communist supply operations through Cambodia include (1) the fact that the Communists would have to get Sihanouk's support to open Cambodian ports, and it is extremely doubtful that he would risk retaliation by such out-and-out cooperation, and (2) the fact that the Communists themselves would hesitate to establish a major supply route which would have to depend on Sihanouk, whom they undoubtedly consider on the basis of past performance to be thoroughly unreliable.

Recent information has indicated increased use of Cambodian territory by the Communists, particularly in the extreme northeast salient of the country. Large numbers of Viet Cong troops have been reported in the Lomphat area, and aerial photographs have shown numerous trails along the border area from the general vicinity of Camp Le Rolland north to route 19, which are believed to indicate Viet Cong activity. PAVN personnel have reportedly infiltrated through this area of Cambodia and some supplies have reportedly been carried from a warehouse on the Cambodian side of the border near route 19 to the Pleiku area in South Vietnam. It has been reported that during a 15-day period nearly 150 short tons were moved to the Viet Cong forces, or about 10 tons per day. This is the largest supply movement that has been reported taking place recently from across the Cambodian border over any sustained period of time, but is it considerably less than the 65 tons per day that would be needed by the present force under an escalated level of combat.

The inescapable conclusion seems to be that the Communists in South Vietnam would be cut off from external logistic support of more than 12 to 20 tons per day if the route through the Laotian Panhandle were blocked, unless Cambodia came out actively and openly in their behalf. It is believed that the latter contingency is unlikely to occur. It should be kept in mind, however, that with only 12 to 20 tons a day flowing in by the sea route and clandestinely through Cambodia, the Communists could maintain their present level of activity, could step up the firepower of their forces, and could even increase their present force by as much as 40 percent, provided the level of fighting remained approximately at its present intensity.

Furthermore, it is highly improbable that complete interdiction of the Panhandle road system could be achieved by air attack alone. Even with so-called successful interdiction, road capacities are probably reduced by no more than two-thirds for short periods of time, and a reduction of one-third over a longer period is about all that can be hoped for. Even where it is impossible to get through traffic moving again in a short period of time, porters can be used to move supplies around interdicted points and for longer hauls if necessary. Even if all road traffic through Laos were brought to a halt, small amounts of supplies could still be infiltrated by use of porters, bicycles, carts, and pack animals, using trails largely invisible from the air.



A-1 Vietnam, Laos, and Cambodia: Transportation

25X1

Appendix B

APPENDIX B

THE ROLLING THUNDER ATTACK

I. Factors Conditioning the Nature and Scale of Attacks

The US and South Vietnamese air campaign against North Vietnam has been the most restricted and voluntarily limited air war ever conducted by a major air power. It has been used as a carefully controlled means of gradual escalation to achieve strictly limited objectives. Consequently, the program has operated under a set of rigorously defined ground rules.

The Rolling Thunder program over time has extended both the area and the frequency of air attacks in North Vietnam. But self-imposed restrictions have limited both the choice of targets and the areas to be bombed. The existence of large restricted areas has effectively insulated almost 80 percent of North Vietnam's limited modern industrial economy from air attack; these areas contain 75 percent of the nation's population.

The area limitations for armed reconnaissance were confined originally by Rolling Thunder (program number) 7* to an area south of latitude 18 30 N and gradually moved northward, the northernmost extension occurring with Rolling Thunder 30/31 (3-17 September). (See the map, Figure B-1). This line continued until the bombing pause on 24 December 1965. Since the resumption of the attacks with Rolling Thunder 48, the line was pulled back to include the area south of a line running west along latitude 20 31 N to longitude 105 20 E then north to 21 00 N and continuing west to the Laotian border. This line effectively excludes the entire northern part of North Vietnam from armed reconnaissance.

In addition to these area restrictions on armed reconnaissance, attacks on fixed targets were generally held to the southern areas of North Vietnam, moving northward at about the same rate as the armed reconnaissance areas.

Within the general areas demarked by the limits of the armed reconnaissance areas, there are specific sanctuary areas that are exempt from air attacks. These areas include a 30-nautical mile (nm) buffer zone along the Chinese border, a 30-nm radius around the city of Hanoi, and a 10-nm radius around the city of Haiphong.

* For a correlation of the number of a specific Rolling Thunder program with the corresponding date, see Table B-1. For a correlation of the number of a specific week of the Rolling Thunder Program with the corresponding date, see Table B-2.

Attacks on specific fixed targets are limited to those approved in each Rolling Thunder program. These authorizations often provide additional restrictions which limit the number of strikes against approved targets. There is, however, more flexibility in the type of targets for armed reconnaissance. Initially, armed reconnaissance strikes were directed along specific routes against military transport facilities, ferries, radar sites, secondary bridges, and other targets of a military character. Subsequently, the objective was expanded to sustaining day and night interdiction of lines of communication (LOC) for maximum feasible periods through surveillance and destruction of targets of a military character that were encountered, including but not limited to trucks, ferries, lighters, radar sites, secondary bridges, road-repair equipment, and bivouac and staging areas. The objective of the coastal armed reconnaissance strikes was to include destruction of recognized North Vietnamese naval craft and other craft which fired on our aircraft along the North Vietnamese coast, in estuaries and mooring areas, and in the vicinity of coastal islands. For Rolling Thunder 18 (11-17 June) it was stated that daylight armed reconnaissance could include missions to obtain maximum surveillance of LOC's and selected missions with the primary purpose of conducting small precise attacks against pre-briefed military targets with secondary emphasis on the conduct of armed route reconnaissance. Next, Rolling Thunder 22/23 (9-22 July) authorized armed reconnaissance against airfields and JCS-numbered LOC targets which had been assigned in previous Rolling Thunder strikes and which were observed to be under repair.

Other current restrictions in the Rolling Thunder program include the mining of principal ports or attacks on major port facilities. Similar restrictions apply to attacks on major airfields in the northern areas of North Vietnam. There also are specific prohibitions against combat air patrol and screening aircraft attacking these airfields in hot pursuit. Since Rolling Thunder 28/29 (20 August-2 September), strikes against SAM systems within the armed reconnaissance area have been authorized. Until 24 December, SAM's in the Northeast area could be attacked after photographic identification, unless they were in the sanctuary areas. (An exception to the requirement of photographic identification permitted suppression of actual SAM attacks encountered in the course of authorized strikes on fixed targets in the Northeast area.) Since the resumption of bombing in January, strikes on SAM's in the Northeast area have not been authorized. Finally, a policy decision to avoid civilian casualties to the extent possible has resulted in many targets not being attacked.

The overall effect of these area and operational restrictions has been to grant a critical measure of immunity to the military, political, and economic assets used in Hanoi's support of the war in the South. The restrictions also insure a virtually unimpeded flow of military supplies from North Vietnam's allies. The preconditions established for the number of strikes and sorties, the methods of attack, and the avoidance of civilian casualties result in an operational disregard of basic

principles of target selection. Among North Vietnam's target systems, not one has been attacked either intensively or extensively enough to produce a critical reduction in national capacity. No target system can be reduced to its critical point under existing rules.

Finally, the voluntary choice of ground rules which result in an ineffective air campaign may well give the Hanoi regime an unwarranted impression of divided counsel within the US government. The even more limited nature of the US air attacks after the bombing pause may reinforce Hanoi's possible judgment that this restraint reflects a divisiveness and lack of US determination to get on with the war.

Table B-1

Equation of Rolling Thunder Number
with Corresponding Dates

Rolling Thunder Number	Inclusive Dates
1	(Cancelled)
2	(Cancelled)
3	(Cancelled)
4	(Cancelled)
5	2 Mar - 10 Mar
6	11 Mar - 18 Mar
7	19 Mar - 25 Mar
8	26 Mar - 1 Apr
9	2 Apr - 8 Apr
10	9 Apr - 15 Apr
11	16 Apr - 22 Apr
12	23 Apr - 29 Apr
13	30 Apr - 6 May
14	7 May - 13 May
15	18 May - 24 May
16	25 May - 3 Jun
17	4 Jun - 10 Jun
18	11 Jun - 17 Jun
19	18 Jun - 24 Jun
20	25 Jun - 1 Jul
21	2 Jul - 8 Jul
22/23	9 Jul - 22 Jul
24/25	23 Jul - 5 Aug
26/27	6 Aug - 19 Aug
28/29	20 Aug - 2 Sep
30/31	3 Sep - 17 Sep
32/33	18 Sep - 30 Sep
34/35	1 Oct - 14 Oct
36/37	15 Oct - 28 Oct
38/39	29 Oct - 11 Nov
40/41	12 Nov - 25 Nov
42/43	26 Nov - 9 Dec
44/45	10 Dec - 23 Dec
46/47	(Not Used)
48	31 Jan 66 - 28 Feb 66

Table B-2

Equation of Week Number with Corresponding Dates

Week	Inclusive Dates	Week	Inclusive Dates
1	1 Mar - 6 Mar	27	29 Aug - 4 Sep
2	7 Mar - 13 Mar	28	5 Sep - 11 Sep
3	14 Mar - 20 Mar	29	12 Sep - 18 Sep
4	21 Mar - 27 Mar	30	19 Sep - 25 Sep
5	28 Mar - 3 Apr	31	26 Sep - 2 Oct
6	4 Apr - 10 Apr	32	3 Oct - 9 Oct
7	11 Apr - 17 Apr	33	10 Oct - 16 Oct
8	18 Apr - 24 Apr	34	17 Oct - 23 Oct
9	25 Apr - 1 May	35	24 Oct - 30 Oct
10	2 May - 8 May	36	31 Oct - 6 Nov
11	9 May - 15 May	37	7 Nov - 13 Nov
12	16 May - 22 May	38	14 Nov - 20 Nov
13	23 May - 29 May	39	21 Nov - 27 Nov
14	30 May - 5 Jun	40	28 Nov - 4 Dec
15	6 Jun - 12 Jun	41	5 Dec - 11 Dec
16	13 Jun - 19 Jun	42	12 Dec - 18 Dec
17	20 Jun - 26 Jun	43	19 Dec - 25 Dec
18	27 Jun - 3 Jul	44	26 Dec - 1 Jan 1966
19	4 Jul - 10 Jul	45	2 Jan - 8 Jan
20	11 Jul - 17 Jul	46	9 Jan - 15 Jan
21	18 Jul - 24 Jul	47	16 Jan - 22 Jan
22	25 Jul - 31 Jul	48	23 Jan - 29 Jan
23	1 Aug - 7 Aug	49	30 Jan - 5 Feb
24	8 Aug - 14 Aug	50	6 Feb - 12 Feb
25	15 Aug - 21 Aug	51	13 Feb - 19 Feb
26	22 Aug - 28 Aug	52	20 Feb - 26 Feb

II. Analysis of the Rolling Thunder Operation*

The Rolling Thunder attack reviewed in this Appendix covers two periods. The first period of 43 weeks extended from 2 March through 24 December 1965 and included a 5-day pause (13-17 May) in bombing attacks against North Vietnam. The second period consists of 3 weeks -- 31 January through 19 February 1966. Between them was a 5-week period in which no bombing attacks were made on North Vietnam. An attempt has been made to take note of activity since the resumption of bombing, but the material in this Appendix is concentrated primarily on the 1965 period.**

A. Targets

In the initial weeks of the Rolling Thunder program, US attacks were limited to a primary target or to one of two alternates. If neither the primary target nor an alternate could be struck, ordnance was dumped in the China Sea. Vietnamese Air Force participation prior to or concurrent with US strikes was required, and armed reconnaissance was not authorized. Targets were selected from a list approved by the Joint Chiefs of Staff. This list grew out of a detailed study conducted by the Joint Chiefs in the summer of 1964, when they selected 94 of the most significant targets and routes for armed reconnaissance from among the 470 then known targets in North Vietnam. The target lists were grouped in 5 basic categories -- four fixed target systems plus routes for armed reconnaissance -- and have been continually revised. The tabulation (p. B-8) indicates the status of the fixed target lists as of 8 February 1966. The opportunity for striking fresh fixed targets of importance is extremely limited. Of 233 fixed targets on the current list, 134 have been struck. An additional 8 targets that have been dropped from the current list were also struck prior to being dropped. Of the 99*** targets on the current list that remain unstruck, 69 are inside sanctuary areas, and only 30 are outside. Of these thirty, 20 are in the key northeast area and hence are exempt from armed reconnaissance strikes.

After the beginning of April the attack was expanded to include armed reconnaissance sorties. The Rolling Thunder program defines armed reconnaissance as an air mission flown with the primary purpose of locating and attacking targets of opportunity -- that is, enemy

---

* Data in this Appendix were derived from individual strike reports given in the Bomb Damage Assessment (BDA) and therefore may not agree with data in other sections and Appendixes which have been derived from other sources such as execute messages and preliminary strike reports. The data, however, have been made as consistent as possible, given problems associated with correction of preliminary data and varied reporting systems.

** For a glossary of terms used in this Appendix, see p. B-32.

*** If mineable approaches to certain ports and naval facilities are considered separate targets, the total of unstruck targets may be regarded as 105, and the total of JCS targets as 239.

System	Targets	Struck	Targets Not Struck		
			Inside Sanctuaries	Outside Sanctuaries	
				Total	In Key NE Area
Airfields (11)	11	4	5	2	2
Lines of communication (74)					
Bridges	61	44 a/	17	2	2
Railroad yards	4	1	2	1	1
Railroad shops	1	0	1	0	0
Locks	8	1	1	6	2
Military installations (125)					
Military barracks/headquarters	57	40	10	7	2
Ammunition depots	17	12	3	2	2
Petroleum storage	13	4	6	3	3
Supply and ordnance depots	18	12	5	1	1
Communication facilities	5	2	3	0	0
Port facilities	6	2	2	2	2
Naval bases	3	2	1	0	0
(Mineable approaches to ports and naval bases)	(6) b/	0	N.A. b/	N.A. b/	N.A. b/
SAM support facilities	1	1	0	0	0
Radar sites	5	10 a/	0	1	0
Industrial installations (23)					
Electric power facilities	17 c/	6	9 c/	2	2
Other	6	1	4	1	1
Total	233	142 a/	69	30	20

a. Including struck targets (2 bridges and 6 radar sites) that have been dropped from the current JCS Fixed Target List.
b. Not applicable. A number of mineable approaches carry the same JCS target numbers as ports and naval facilities but should be regarded as separate targets.
c. Powerplants and 1 transformer substation.

material, personnel, and facilities in assigned areas or along assigned ground communications routes, and not for the purpose of attacking specific briefed targets. Gradually the authorization was expanded to include:

(1) Attacks against small pre-briefed military targets not on the JCS list, followed by armed route reconnaissance.

(2) Restrikes against previously struck JCS-designated fixed targets, excluding locks and dams, located within the armed reconnaissance area, with the objective of keeping them nonoperational.

(3) Attacks against possible SAM systems lying within Rolling Thunder armed reconnaissance areas.

B. Sorties

A total of 42,597 Rolling Thunder sorties were flown against North Vietnam from 2 March 1965 through 19 February 1966 (see Figure B-2). Of this total, 11,064 -- or approximately 26 percent -- were fixed target strike sorties, and 30,832 -- or 72 percent -- were armed reconnaissance strike sorties. The remaining 701 sorties -- 2 percent -- were leaflet drops, photoreconnaissance sorties not accompanying a strike mission, gift drops, and other miscellaneous sorties. The US Navy flew 57 percent of the total sorties, the US Air Force 41 percent, and the South Vietnamese Air Force 2 percent. The weekly distribution of these sorties by type of strike and by service is shown in Table B-3 and in Figures B-3 and B-4.

Excluding the 701 sorties on miscellaneous missions, there were 41,896 combat sorties, which is equal to approximately 9 percent of total combat sorties flown during the entire Korean War from June 1950 through July 1953, and to about 6 percent of total bomber sorties flown by US Army Air Forces against Germany during World War II, 1942-45. Of the combat sorties flown against North Vietnam 26,044, or 62 percent, were strike and flak suppression sorties, and 15,852, or 38 percent, were support sorties. The division by service closely approximated the division of total sorties flown. The US Navy flew 58 percent of the combat sorties, the US Air Force 41 percent, and the South Vietnamese Air Force about 1 percent. Data on total sorties and combat sorties flown from 2 March 1965 through 19 February 1966 are shown by program and service in Figure B-5.

The 11,064 fixed target strike sorties did not represent the total attack on JCS fixed targets. As indicated by Table B-4, 2,948 armed reconnaissance strike sorties participated in the attack on fixed targets. This amounts to approximately 21 percent of a total of 14,012 sorties flown against fixed targets between 2 March 1965 and 19 February 1966. (These armed reconnaissance sorties, however, accounted for only about 8 percent of the total ordnance -- 12,960 tons -- delivered on fixed targets. This reflects, at least in part, the fact that armed reconnaissance sorties attacking fixed targets are on multiple missions and expend part of their ordnance elsewhere.)

During the 43-week period from 2 March through 24 December -- prior to the 5-week cessation of bombing -- a total of 39,641 sorties were flown. Of these 27,932 -- or approximately 70 percent -- were armed reconnaissance strike sorties, 11,064 -- or 28 percent -- were fixed target strike sorties, and the remaining 645 -- or 2 percent -- were leaflet drops, photoreconnaissance missions, and goodwill gift*

* Text continued on p. B-13.

Table B-3

Rolling Thunder: Total Sorties, by Week
2 March 1965 - 19 February 1966

Week	Leaflet and Other	Fixed Target	Armed Recon-naissance	Total Sorties	Service		
					US		South Vietnamese Air Force
					Navy	Air Force	
2 Mar - 24 Dec 65							
1	0	128	0	128	0	108	20
2	0	0	0	0	0	0	0
3	0	342	0	342	195	123	24
4	0	157	0	157	70	47	40
5	0	393	0	393	219	135	39
6	0	471	224	695	456	219	20
7	0	296	150	446	231	200	15
8	0	362	451	813	400	379	34
9	0	165	385	550	305	211	34
10	0	438	262	700	378	292	30
11	198	71	317	586	228	322	36
12	199	356	198	753	400	333	20
13	0	336	434	770	279	463	28
14	0	315	303	618	185	423	10
15	4	302	296	602	288	294	20
16	0	266	341	607	290	287	30
17	0	409	291	700	390	282	28
18	2	334	329	665	398	237	30
19	4	261	393	658	416	226	16
20	6	284	361	651	402	229	20
21	24	415	347	786	443	329	14
22	6	461	473	940	586	321	33
23	0	488	747	1,235	826	397	12
24	24	346	902	1,272	960	306	6
25	0	323	905	1,228	856	362	10
26	0	208	1,097	1,305	737	556	12
27	0	24	1,020	1,044	625	419	0
28	0	495	1,340	1,835	1,026	798	11
29	0	478	1,021	1,499	675	824	0
30	13	346	1,118	1,477	735	732	10
31	15	122	1,063	1,200	782	418	0
32	16	263	1,684	1,963	1,276	679	8
33	17	0	992	1,009	718	291	0
34	20	150	1,079	1,249	732	517	0
35	20	78	1,138	1,236	795	441	0
36	5	129	1,317	1,451	997	454	0
37	10	107	1,276	1,393	885	508	0
38	10	214	1,127	1,351	935	409	7
39	6	161	1,061	1,228	572	656	0

Table B-3

Rolling Thunder: Total Sorties, by Week
2 March 1965 - 19 February 1966
(Continued)

Week	Leaflet and Other	Fixed Target	Armed Reconnaissance	Total Sorties	Service		
					US		South Vietnamese Air Force
					Navy	Air Force	
2 Mar - 24 Dec 65							
40	22	194	1,044	1,260	643	606	11
41	14	0	917	931	477	445	9
42	8	63	817	888	410	478	0
43	2	313	712	1,027	464	554	9
Total: 2 Mar - 24 Dec 65	645	11,064	27,932	39,641	22,685	16,310	646
Cessation of Bombing, Weeks 44-48, 25 Dec 65 - 30 Jan 66							
31 Jan - 19 Feb 66							
49	28	0	731	759	312	447	0
50	28	0	1,231	1,259	771	488	0
51	0	0	938	938	563	375	0
Total: 31 Jan - 19 Feb 66	56	0	2,900	2,956	1,646	1,310	0
Total Rolling Thunder 2 Mar 65 - 19 Feb 66	701	11,064	30,832	42,597	24,331	17,620	646

25X1

25X1

Table B-4

Attack on JCS Fixed Targets
2 March 1965 - 19 February 1966

Program	Sorties Flown					Ordnance Delivered		
	Strike and Flak Suppression	Support	Number	Percent Through 24 Dec 65	Percent Through 19 Feb 66	Tons	Percent Through 24 Dec 65	Percent Through 19 Feb 66
Fixed target 2 Mar - 24 Dec 65	6,928	4,136	11,064	80	79	11,960	93	92
Armed reconnaissance a/ 2 Mar - 24 Dec 65	1,778	1,046	2,824	20	20	840	7	7
Total 2 Mar - 24 Dec 65 a/	8,706	5,182	13,888	100		12,800	100	
Armed reconnaissance a/ 31 Jan - 19 Feb 66	113	11	124		1	160		1
Total armed reconnaissance through 19 Feb 66 a/	1,891	1,057	2,948		21	1,000		8
Total 2 Mar 65 - 19 Feb 66 a/	8,819	5,193	14,012		100	12,960		100

a. Including aircraft that were on multiple strike missions, in some cases striking more than one fixed target.

drops. Approximately 57 percent of the sorties were flown by the US Navy, 41 percent by the US Air Force, and 2 percent by the South Vietnamese Air Force. Data on sorties flown during the period 2 March - 24 December 1965 are summarized and distributed according to program, strike mission, and service in Figure B-6.

In the three weeks from 31 January through 19 February 1966 -- the period after resumption of bombing North Vietnam -- no fixed target strike sorties were flown. Out of a total of 2,956 sorties flown during the period, 56 were leaflet drops and 2,900 were armed reconnaissance sorties. Of the latter number, 124 were restrikes on 15 JCS fixed targets as follows:

Barracks	6
Bridges	3
Ammunition depots	2
Airfields	2
Port facilities	1
Railroad yards	1
Total	15

Sorties during this period are depicted graphically in Figure B-7.

C. Ordnance

During the period from 2 March 1965 to 19 February 1966, Rolling Thunder sorties delivered a total of 37,000 tons of ordnance on targets in North Vietnam.* This is equal to approximately 8 percent of total ordnance expended in air operations in the Korean War and to about 3 percent of the tons of bombs dropped by US Army Air Forces on Germany in World War II. When total ordnance delivered is related to total combat sorties, an average of nearly 0.9 ton per sortie is

* In this Appendix, ordnance is measured in short tons (2,000 pounds). All estimates of "ordnance delivered" are based on launch weights. As such, however, they must be regarded as minimum estimates, because of the methodology used in their compilation. They were compiled from data in BDA reports of individual strikes. Where type designations were not specific, for example "2 Bullpups," the smallest applicable type was consistently assumed. In this example the AGM-12 B, 250-pound Bullpup (launch weight: 567 pounds) was assumed, rather than the AGM-12 C, 1,000-pound Bullpup (launch weight: 1,778 pounds). Also, where types were indicated, but numbers were absent, for example "Napalm" or "Zuni," only one bomb of the smallest applicable type was assumed, although it is probable that more than one was dropped. Also no weights were included for such reports as "Fammo."

indicated. This is approximately the same average load per sortie as that indicated by the data for total ordnance expended and total combat sorties flown during the Korean War. The ratio of tons of bombs dropped to total bomber and fighter sorties flown by US Air Forces against Germany in World War II was more than 0.8 ton per sortie. When ordnance delivered in North Vietnam is related to total strike plus flak suppression sorties an average load of 1.4 tons per sortie is obtained, compared with an average load of 1.9 tons per bomber sortie flown by US Air Forces against Germany in World War II.

Of the 37,000 tons of ordnance expended on North Vietnam, the US Air Force delivered 62 percent, the US Navy 35 percent, and the South Vietnamese Air Force 3 percent (see Table B-5 and Figure B-8). Approximately 11,960 tons -- or 32 percent -- of the total were delivered on fixed target strikes, and more than 25,000 tons -- or 68 percent -- were delivered on armed reconnaissance. The latter figure includes about 1,000 tons (3 percent of the total) delivered on fixed targets by armed reconnaissance sorties. The weekly expenditure of ordnance is allocated to the fixed target and armed reconnaissance programs in Table B-6 and Figure B-9.

During the period 2 March-24 December a total of 34,300 tons of ordnance were expended on targets in North Vietnam. Of this amount, 11,960 tons -- or 35 percent -- were delivered by fixed target strike sorties and an additional 840 tons -- or 2 percent -- were delivered on fixed targets by armed reconnaissance strike sorties. Thus 37 percent of the total ordnance delivered during 1965 was on fixed targets. (The allocation of ordnance delivered during this period is indicated, by service and by attack program, in Figure B-10.)

In 1966, after the resumption of bombing, approximately 2,700 tons of ordnance were delivered during the period from 31 January through 19 February. As in 1965 the US Air Force delivered about 62 percent of the total. The share of the US Navy, which was 35 percent during 1965, increased to 38 percent during the 1966 period. The South Vietnamese Air Force, which delivered 3 percent of the ordnance in 1965, delivered none in the first three weeks after resumption of bombing in 1966. As indicated previously, there were no fixed target strike sorties during this period, but armed reconnaissance sorties delivered approximately 1,000 tons of ordnance on restrikes of JCS fixed targets. During the week of 6-12 February (the 50th week of the Rolling Thunder program) armed reconnaissance strike sorties delivered 120 tons of ordnance on fixed targets, the largest amount delivered on fixed targets by armed reconnaissance sorties during any single week of the Rolling Thunder program (see Table B-6 and Figure B-9).*

* Text continued on p. B-19.

Table B-5

Rolling Thunder: Ordnance Expended, by Week and by Service
2 March 1965 - 19 February 1966

Tons a/*

Week	Service			
	US		South Vietnamese Air Force	Total
	Navy	Air Force		
2 Mar - 24 Dec 65				
1	0	160	40	200
2	0	0	0	0
3	120	260	80	460
4	60	30	110	200
5	150	210	80	440
6	350	290	50	690
7	150	200	30	380
8	150	420	60	630
9	110	230	40	380
10	110	400	30	540
11	60	90	40	190
12	220	60	10	300 b/
13	150	410	50	610
14	90	440	20	550
15	290	380	40	710
16	190	660	50	900
17	420	520	50	990
18	270	380	50	700
19	380	360	30	770
20	340	310	10	660
21	400	430	20	850
22	370	430	50	840 b/
23	460	660	20	1,140
24	370	470	0	840
25	390	600	20	1,010
26	400	880	20	1,300
27	340	320	0	660
28	490	1,160	20	1,670
29	330	1,130	0	1,470 b/
30	470	1,080	20	1,570
31	370	430	0	800
32	480	1,000	10	1,490
33	280	500	0	780
34	340	860	0	1,200
35	280	840	0	1,120
36	460	700	0	1,160
37	400	850	0	1,250
38	370	480	20	870
39	400	740	0	1,140
40	260	550	10	820

* Footnotes follow on p. B-16.

Table B-5

Rolling Thunder: Ordnance Expended, by Week and by Service
2 March 1965 - 19 February 1966
(Continued)

Tons a/

Week	Service			
	US		South Vietnamese Air Force	Total
	Navy	Air Force		
2 Mar - 24 Dec 65				
41	230	430	0	660
42	210	270	0	480
43	240	640	Negl.	880
Total: 2 Mar - 24 Dec 65	11,950	21,260	1,080	34,300 b/
Cessation of Bombing, Weeks 44-48, 25 Dec 65 - 30 Jan 66				
31 Jan - 19 Feb 66				
49	260	510	0	770
50	400	700	0	1,100
51	360	480	0	840
Total: 31 Jan - 19 Feb 66	1,020	1,690	0	2,710
Total Rolling Thunder 2 Mar 65 - 19 Feb 66	12,970	22,950	1,080	37,000 b/

a. Rounded to nearest 10 tons except for grand total and total for 1965, which are to the nearest 100 tons. Deliveries of less than 5 tons are indicated as Negligible (Negl.).
b. Because of rounding, totals may not agree with the components shown.

Table B-6

Rolling Thunder: Ordnance Expended, by Week and by Program
2 March 1965 - 19 February 1966

Tons [a]

Week	On Fixed Targets (1) Total On Fixed Targets (Col 2+3)	On Fixed Targets (2) By Fixed Target Strikes	On Fixed Targets (3) By Armed Reconnaissance Strikes	On Armed Reconnaissance (4) Armed Reconnaissance Not On Fixed Targets	On Armed Reconnaissance (5) Total On Armed Reconnaissance (Col 3+4)	(6) Total (Col 1+4)
2 Mar - 24 Dec 65						
1	200	200	0	0	0	200
2	0	0	0	0	0	0
3	460	460	0	0	0	460
4	200	200	0	0	0	200
5	440	440	0	0	0	440
6	630	630	0	60	60	690
7	350	310	40	30	70	380
8	450	360	90	180	270	630
9	220	140	80	160	240	380
10	460	460	0	90	90	540
11	90	90	0	90	90	190
12	240	240	0	60	60	300
13	470	470	0	140	140	610
14	410	410	0	140	140	550
15	410	410	0	300	300	710
16	420	420	0	480	480	900
17	640	640	0	350	360	990
18	390	390	Negl.	310	300	700
19	200	200	0	570	570	770
20	360	280	80	300	380	660
21	380	380	Negl.	470	470	850
22	350	350	0	490	490	840
23	410	360	50	730	780	1,140
24	320	290	30	520	550	840
25	370	260	110	640	750	1,010
26	320	320	0	980	980	1,300
27	50	50	0	610	610	660
28	550	550	0	1,120	1,120	1,670
29	630	630	0	840	840	1,470
30	440	440	Negl.	1,130	1,130	1,570
31	170	160	10	630	640	800
32	240	230	10	1,250	1,260	1,490
33	10	0	10	770	780	780
34	180	150	30	1,020	1,050	1,200
35	220	170	50	900	950	1,120
36	140	70	70	1,020	1,090	1,160
37	150	140	10	1,100	1,110	1,250
38	200	170	30	670	700	870
39	140	130	10	1,000	1,010	1,140
40	160	130	30	660	690	820
41	30	0	30	630	660	660
42	60	20	40	420	460	480
43	240	210	30	640	670	880
Total 2 Mar - 24 Dec 65	12,800	11,960	840	21,500	22,340	34,300
Cessation of Bombing, Weeks 44-48, 25 Dec 65-30 Jan 66						

Table B-6

Rolling Thunder: Ordnance Expended, by Week and by Program
2 March 1965 - 19 February 1966
(Continued)

Tons [a]

Week	On Fixed Targets (1) Total On Fixed Targets (Col 2+3)	On Fixed Targets (2) By Fixed Target Strikes	On Fixed Targets (3) By Armed Reconnaissance Strikes	On Armed Reconnaissance (4) Armed Reconnaissance Not On Fixed Targets	On Armed Reconnaissance (5) Total On Armed Reconnaissance (Col 3+4)	(6) Total (Col 1+4)
31 Jan - 19 Feb 66						
49	0	0	Negl.	770	770	770
50	120	0	120	980	1,100	1,100
51	40	0	40	800	840	840
Total 31 Jan - 19 Feb 66	160	0	160	2,550	2,710	2,710
Total Rolling Thunder 2 Mar 65 - 19 Feb 66	12,960	11,960	1,000	24,050	25,050	37,000

a. Rounded to nearest 10 tons except for grand total and total for 1965, which are to the nearest 100 tons. Because of rounding, totals may not agree with the components shown. Deliveries of less than 5 tons are indicated as Negligible (Negl.).

D. Consistency of Attack and Delivery Capabilities

When either the data for sorties or ordnance are plotted by week, considerable unevenness in the attack on North Vietnamese targets becomes immediately apparent (see Figures B-3 and B-4 for sorties and B-8 and B-9 for ordnance). A hypothesis that weather might be the cause of the variation in intensity of attack was tested by adding to "sorties flown" the sorties that were canceled because of weather. Unfortunately, data on cancellations were available only for the period from 1 October through 24 December (see Table B-7). Even this somewhat inadequate sample, however, indicates that weather is not the cause of the apparent irregularity of attack. Adding the sorties canceled merely moved the fluctuations to a higher level but did not tend to eliminate them (see Figure B-4).

When the data for sorties and tons of ordnance delivered were grouped by months, the unevenness noted in the weekly data disappeared (see Tables B-8 and B-9). This becomes most apparent in the graphic presentation of the monthly data in Figures B-11 through B-14. The curves for sorties smoothed, built up gradually (with the exception of a slight dip in June*) to a peak in September and October, and thereafter fell off slightly in November and more sharply in December. When monthly sorties flown in North Vietnam were compared with monthly sorties flown in South Vietnam and Laos, sorties in other areas were found to increase at times when the number of sorties against North Vietnam declined (see Figure B-15). In June, sorties against targets in North Vietnam and Laos declined, but there was a nearly offsetting increase in sorties against targets in South Vietnam. In October, and to an even greater degree in November, there was a decline in the number of sorties against targets in North Vietnam, yet there was a more than offsetting increase in the number of sorties against targets in South Vietnam and Laos, so that the number of sorties for the combined area of North Vietnam, South Vietnam, and Laos showed substantial increase. In December, sorties against North Vietnam were flown only through $3\frac{1}{2}$ weeks. Had sorties been flown in the last week of December equal to the weekly average of the first $3\frac{1}{2}$ weeks, total sorties flown against North Vietnam would have been about the same in December as in November. The number of sorties against South Vietnam in December was somewhat greater than in November but was in keeping with the trend of previous months. The number of sorties flown against targets in Laos**

* A decrease in ordnance delivered is evident in May (see Figures B-13 and B-14), a month when the total number of sorties increased (see Figures B-11 and B-12). This is because airstrikes against North Vietnamese targets were suspended for political purposes for a 5-day period 13-17 May, but 397 photoreconnaissance missions were flown during the same period. The effect of these photoreconnaissance missions on total sorties flown is evident in the plotting of the data for May in Figure B-12 and even more evident in the plotting of data for the 11th and 12th weeks of the Rolling Thunder program in Figure B-3.

** Text continued on p. B-23.

Table B-7

Rolling Thunder: Cancellations Because of Weather
1 October - 24 December 1965

Dates	Week	Number of Sorties
October		
1 - 7	31/32	135
8 - 14	32/33	76
15 - 21	33/34	288
22 - 28	34/35	285
November		
29 - 4	35/36	191
5 - 11	36/37	42
12 - 18	37/38	201
19 - 25	38/39	205
December		
26 - 2	39/40	316
3 - 9	40/41	566
10 - 16	41/42	483
17 - 23	42/43	662
24	43	31
Total		3,481

Table B-8

Rolling Thunder: Total Sorties, by Month
March-December 1965

25X1

25X1

Month	Program			Total Sorties	Service		
					US		South Vietnamese Air Force
	Leaflet and Other	Fixed Target	Armed Recon-naissance		Navy	Air Force	
Mar	0	850	0	850	382	345	123
Apr	0	1,464	1,200	2,664	1,484	1,077	103
May	397	1,301	1,237	2,935	1,295	1,516	124
Jun	4	1,361	1,386	2,751	1,378	1,265	108
Jul	42	1,586	1,732	3,360	2,020	1,257	83
Aug	24	1,389	4,221	5,634	3,743	1,851	40
Sep	28	1,441	4,594	6,063	3,202	2,840	21
Oct	73	570	5,458	6,101	3,943	2,150	8
Nov	47	574	5,108	5,729	3,582	2,140	7
Dec	30	528	2,996	3,554	1,656	1,869	29
Total	645	11,064	27,932	39,641	22,685	16,310	646

Table B-9

25X1

Rolling Thunder: Ordnance Expended, by Month, by Program, and by Service
March-December 1965

25X1

Tons

Month	Program			Service		
				US		
	Armed Reconnaissance a/	Fixed Target	Total	Navy	Air Force	South Vietnamese Air Force
Mar	0	1,130	1,130	280	540	310
Apr	640	1,620	2,260	800	1,280	180
May	380	1,420	1,800	540	1,100	160
Jun	1,430	1,900	3,330	1,150	1,990	190
Jul	2,060	1,410	3,470	1,590	1,780	100
Aug	3,390	1,280	4,670	1,830	2,780	60
Sep	3,740	1,780	5,520	1,700	3,790	30
Oct	4,500	590	5,090	1,560	3,520	10
Nov	4,040	480	4,520	1,690	2,810	20
Dec	2,160	350	2,510	810	1,680	20
Total	22,340	11,960	34,300	11,950	21,270	1,080

a. Including 840 tons of ordnance expended by armed reconnaissance strike sorties on fixed targets.

increased markedly -- to an even greater degree than sorties against North Vietnam declined. Thus the data clearly reflect a decision to use in Laos those aircraft not used against North Vietnam in the last week of December. This analysis strongly suggests that the fluctuations noted in the weekly data were occasioned by necessity for temporarily shifting aircraft from attack on North Vietnam to support ground operations in South Vietnam or to attack targets in Laos.*

Thus it becomes clear that the capability of the US and South Vietnamese Air Forces for delivering ordnance on targets in North Vietnam cannot be defined in isolation. Forces available in Southeast Asia can be used, as necessity or policy dictates, in varying combinations and degree against the three principal target areas of South Vietnam, North Vietnam, and Laos. Prior to the cessation of bombing in North Vietnam in late December, the priority on sorties flown against targets in the three areas was: 1st priority, South Vietnam; 2nd priority, North Vietnam; and 3rd priority, Laos. The relative effort expended in the three areas is reflected in the following percentages of cumulative attack sorties flown against targets in South Vietnam, North Vietnam, and Laos during July-December 1965:

Target Area	Percent
South Vietnam	72
North Vietnam	20
Laos	8

The current delivery capability of forces now available in Southeast Asia is reflected in the 18,335 attack sorties flown during the

* A desirable test of the hypothesis that decreases in the intensity of attack on North Vietnam have coincided with increased air activity in other areas would be comparison of weekly data for each of the three areas concerned. Unfortunately, weekly data for sorties against targets in Laos and South Vietnam were not readily available, and the time available for preparation of this Appendix did not permit further investigation of this topic.

month of December 1965.* These attack sorties are allocated by service in the following tabulation:

Air Force	8,436
Navy	5,207
Marines	2,103
Vietnamese Air Force	2,589
Total	18,335

Allowing for the fact that the period covered by the 18,335 sorties included a cessation of air operations in North Vietnam from 1800 hours on 24 December through 31 December and in South Vietnam a 30-hour cessation over Christmas, an approximate capability of 630 sorties per day is indicated. A peak effort for a limited period of time could substantially increase this daily sortie rate, but the above data are indicative of a normal month-to-month capability. If the average load of 1.4 tons of ordnance per sortie observed for strike plus flak suppression sorties against North Vietnam is assumed for the 630 sorties per day, there exists in the Southeast Asian area a current capability for delivering more than 26,000 tons of ordnance per month. Allocation of 20 percent of this amount to attacks on targets in North Vietnam would result in delivery of slightly more than 5,000 tons per

* The attack sorties flown against targets in the three primary areas during December 1965 were distributed according to service and type of aircraft as follows:

	Service				Total	
Type of Aircraft	Air Force	Navy	Marines	Vietnamese Air Force	Number of Sorties	Percent
B-52	316				316	1.7
B-57	521				521	2.8
A-1	1,560	475		2,589	4,624	25.3
A-3		11			11	0.1
A-4		3,242	1,201		4,443	24.3
A-6		120			120	0.7
F-4	1,377	931	836		3,144	17.1
F-5	643				643	3.5
F-8		428	66		494	2.7
F-100	2,117				2,117	11.5
F-102	76				76	0.4
F-105	1,781				1,781	9.7
FC-47	45				45	0.2
Total	8,436	5,207	2,103	2,589	18,335	100

month -- an amount which approximates the average monthly delivery during the four-month period August-November and is somewhat below the amount delivered in the peak month of September (see Table B-9 and Figure B-13).

E. Increasing Share of Armed Reconnaissance in Total Effort

Next to the unevenness noted when weekly data for sorties and ordnance were plotted in Figures B-3 and B-9, the most evident fact was the steady increase in armed reconnaissance as a share of the total air attack on North Vietnam. The monthly summaries plotted in Figures B-11 through B-14 reveal even more clearly the relative shares of the various services and of the fixed target and armed reconnaissance programs in the total effort. The dramatic increase in the share of armed reconnaissance (see Figures B-12 and B-14) undoubtedly reflects the diminishing number of new fixed targets available for attack, broadened authorization for armed reconnaissance, and at least in part a change in definitions used in bookkeeping. As the number of categories of permissible armed reconnaissance targets has increased and, as re-strikes on fixed targets have come to be permitted on armed reconnaissance missions, some sorties have been classified as armed reconnaissance that previously would have been classified as strikes on fixed targets.

F. Relative Shares of Services in the Air Attack

The monthly data plotted for the period March-December 1965 clearly reveal that the US Navy has flown the largest number of sorties (Figure B-11) and that the US Air Force has delivered the largest share of the ordnance (Figure B-13). This fact is also evident from the data pertaining to the entire period from 2 March 1965 through 19 February 1966 (see Table B-10).

Table B-10

Share of Services in Total Sorties and Total Ordnance Delivered
2 March 1965 - 19 February 1966

Service	Percent of Total Sorties	Percent of Total Ordnance Delivered
US Navy	57	35
US Air Force	41	62
Vietnamese Air Force	2	3
Total	100	100

That the US Air Force delivered 62 percent of the ordnance but flew only 41 percent of the sorties highlights the fact that the average load of aircraft flown by the Air Force is greater than that of the Navy aircraft. During 1965 the average load of strike plus flak suppression sorties flown by the Air Force against targets in North Vietnam was slightly more than twice the average load of such sorties flown by the Navy. Consequently, the Navy must fly more sorties to deliver a given quantity of ordnance. This frequency of exposure was at first regarded as a significant fact in considering losses of aircraft.

G. Losses

During the period from 2 March 1965 through February 1966 a total of 181 aircraft and 154 men were lost on Rolling Thunder missions. (An additional 65 men were lost but recovered.) Losses by service are indicated in the following tabulation:

Service	Aircraft	Personnel	
		Lost	Recovered
US Navy	95	85	33
US Air Force	78	63	30
South Vietnamese Air Force	8	6	2
Total	181	154	65

The fact that the Navy suffered the largest number of losses seemed to bear out the hypothesis that there is a close connection between losses and frequency of exposure. Further investigation, however, revealed that Navy losses represent a smaller percentage of sorties flown than do Air Force losses (see Table B-11). It was concluded that differences in the types of missions flown were offsetting the influence of frequency of risk. During the period 2 March - 24 December 1965, roughly the same number of sorties against fixed targets were flown by both services -- 5,554 by the Navy and 5,050 by the Air Force. The Navy, however, flew about 1.6 times the number of armed reconnaissance sorties flown by the Air Force -- 16,932 by the Navy and 10,831 by the Air Force. Approximately 75 percent of the total number of sorties flown by the Navy were on armed reconnaissance, whereas only 66 percent of total sorties flown by the Air Force were on armed reconnaissance.* This difference becomes significant when aircraft losses are examined by type of mission.

* Details concerning armed reconnaissance and fixed strike sorties are available in the files of this Office.

Table B-11

Rolling Thunder: Relationship Between Aircraft Losses and Total Sorties Flown
2 March 1965 - 19 February 1966

Service	Total Sorties Flown	Aircraft Losses	Losses as a Percent of Sorties Flown
US Navy	24,331	95	0.39
US Air Force	17,620	78	0.44
South Vietnamese Air Force	646	8	1.2
Total	42,597	181	0.4

Of the total number of aircraft lost from 2 March 1965 through 19 February 1966, 106 were on armed reconnaissance missions, 74 were on sorties against fixed targets, and 1 was on a photoreconnaissance mission. However, an average of 7 aircraft were lost per 1,000 sorties against fixed targets, not including SAM sites, but the comparable figure for armed reconnaissance was only 3 aircraft per 1,000 sorties. (This lower loss ratio for armed reconnaissance sorties, coupled with the high percentage of total Navy sorties that are on armed reconnaissance, tends to explain why Navy losses amount to a smaller percentage of sorties flown than do Air Force losses.) From 2 March 1965 through 19 February 1966, losses of aircraft by type of task were 131 on strike missions, 11 on flak suppression missions, and 39 on other missions. This is a loss-to-sortie ratio of 0.5 percent for strike plus flak suppression sorties and of 0.2 percent for support sorties. Ground fire is the most frequently reported cause of aircraft loss. Only 12 losses were reported as being caused by SAM's.

During the period from 2 March 1965 through 19 February 1966 losses per 100 sorties against various target systems were as indicated by the following tabulation:

Target System	Losses per 100 Sorties	Target System	Losses per 100 Sorties
SAM sites	2.03	Powerplants	0.81
Railroad yards	1.80	Ports	0.46
Radar sites	1.59	Petroleum storage	0.41
Explosives plants	1.28	Supply depots	0.40
Naval bases	1.14	Ammunition depots	0.30
Bridges	0.89	Barracks	0.21

With the exception of the categories "Railroad Yards" and "Explosives Plants" -- which probably are not representative samples, because only one target of each category was struck -- the above tabulation probably is indicative of the relative intensity of defenses at the various types of targets.

Losses by type of aircraft are indicated in the following tabulation of data for the 1965 period. Losses ranged from 0.3 to 0.7 percent of sorties flown by the types of aircraft that flew the largest shares of total sorties. Several types of aircraft that flew fewer missions incurred higher proportional losses. For example, the data on the A-1E undoubtedly reflect both the small number of sorties flown and unfortunate chance circumstances.

Type of Aircraft Lost	Number of Aircraft Lost	Sorties Flown by This Type of Aircraft as a Percent of Total Sorties Flown by All Types of Aircraft	Losses as a Percent of Total Sorties Flown by This Type of Aircraft
F-105	54	23	0.6
A-1H	24	8.8	0.7
A-4E	15	12.2	0.3
A-4C	14	7.1	0.5
F-4C	10	9.3	0.3
F-4B	9	5.7	0.4
F-8D	8	1.8	1.1
F-8E	7	5.9	0.3
RF-101	6	0.7	2.1
RF-8A	6	0.9	1.7
F-100	5	1.0	1.2
RA-5C	3	0.3	2.3
A-6A	3	1.2	0.6
A-1E	2	0.01	50
EA-1F	1	1.8	0.1
B-57	1	0.4	0.7
Helicopters	3	Not included	N.A.

H. Costs

The total cost of the Rolling Thunder attack on targets in North Vietnam during the period from 2 March 1965 through 19 February 1966 is estimated at about $470 million. As indicated in Figure B-2, this figure represents approximately $330 million in aircraft losses, $80 million in the operational cost of sorties flown, and $60 million in the cost of ordnance expended.

During the period 2 March-24 December 1965 the program cost approximately $440 million. The cost of damage to the economy of North Vietnam during the same period has been estimated at about $63 million (see Table B-12 and Figure B-16). The value of the attack on targets in North Vietnam obviously must be measured in military, political, and psychological terms rather than economic. It must be noted, moreover, that a large share of the cost of the Rolling Thunder program is incurred in connection with armed reconnaissance strikes that frequently result in damage to targets having a lower restoration cost than that of most fixed targets. The cost of the armed reconnaissance program during 2 March - 24 December 1965 is estimated at approximately 63 percent of the total $440 million cost of Rolling Thunder. In contrast, only 21 percent of the estimated cost of damage to the economy of North Vietnam is attributed to the armed reconnaissance program.

Table B-12

Estimated Costs of Rolling Thunder
Related to Costs of Damage to the Economy of North Vietnam
2 March-24 December 1965

Million US $

Month	Sortie Overhead a/	Aircraft Losses b/	Ordnance c/	Total	Cost to North Vietnam d/
March	1.5	18.8	1.7	22.0	1.3
April	4.8	23.3	3.6	31.7	3.2
May	4.6	14.6	3.9	23.1	4.4
June	4.8	18.8	5.7	29.3	8.9
July	5.9	45.0	5.1	56.0	10.0
August	10.1	34.5	8.6	53.2	10.0
September	11.0	39.0	10.6	60.6	8.0
October	11.4	39.4	5.8	56.6	5.3
November	11.8	27.2	7.4	46.4	5.3
December	7.5	45.2	3.8	56.5	6.9
Total	73.4	305.8	56.2	435.4	63.3

a. Based on average operating costs per sortie for different types of aircraft as indicated by data contained in US Army, STAG, Assessment of the Air Effort in Vietnam and Laos, Annex A, Appendix II, Tab B, Appendix III, Tab B, and Appendix IV, Tab B, TOP SECRET. These data on average cost per sortie were applied to the sum of data on sorties contained in the BDA.
b. Average costs of production models of various types of aircraft taken from US Army, STAG, were applied to data on aircraft losses contained in the BDA.
c. Average costs of various types of ordnance taken from US Army, STAG, were applied to data on ordnance expended contained in the BDA.
d. Including restoration costs for damage in installations and equipment and losses incurred in agriculture and export.

Estimated total monthly costs of the Rolling Thunder program during March-December 1965 are compared with the estimated monthly cost of damage to the economy of North Vietnam in Figure B-17 and Table B-13. The pattern of the two monthly series is roughly similar; however, there is a wide gap between the two. The costs of the program exceed the value of damage to the North Vietnamese economy by $20 million to $50 million per month. It is evident that there is a direct relationship between damage caused and the scale of effort, but the cost is high.

Table B-13

Monthly Cost of Rolling Thunder
Compared with Cost of Damage to Economy of North Vietnam
2 March-24 December 1965

Million US $

Month	Cost of Rolling Thunder	Cost to North Vietnam	Difference
March	22.0	1.3	20.7
April	31.7	3.2	28.5
May	23.1	4.4	18.7
June	29.3	8.9	20.4
July	56.0	10.0	46.0
August	53.2	10.0	43.2
September	60.6	8.0	52.6
October	56.6	5.3	51.3
November	46.4	5.3	41.1
December	56.5	6.9	49.6
Total	435.4	63.3	372.1

I. The Attack on Fixed Target System

During the period from 2 March 1965 through 19 February 1966 a total of 14,012 sorties delivered 12,960 tons of ordnance on JCS fixed targets, as indicated by the following tabulation:

	Sorties		Ordnance Delivered	
Type of Sortie	Number	Percent	Tons	Percent
Fixed target strike	11,064	79	11,960	92
Armed reconnaissance	2,948	21	1,000	8
Total	14,012	100	12,960	100

The attack on fixed targets accounted for approximately 33 percent of all Rolling Thunder sorties flown and 35 percent of all ordnance delivered on North Vietnam. Strikes were made on 142 fixed targets.

During the last three months of 1965, the number of fixed target strike sorties and the amount of ordnance delivered by them declined absolutely in comparison with previous levels and also declined relatively as a share of the total Rolling Thunder attack (see Figures B-12 and B-14). In the period from 31 January through 19 February, no fixed target strike sorties were flown, but 124 armed reconnaissance sorties restruck JCS targets that had been attacked previously. The increasingly important role of armed reconnaissance strike sorties in the total effort against JCS fixed targets in the last few weeks of 1965, and in the period after resumption of bombing in 1966, is evident in Figure B-9.

Significant data pertaining to the attack on individual JCS fixed target systems during the period 2 March-24 December 1965 are summarized graphically in Figures B-18 through B-32 and in Table B-14.* These figures present, for each of the major target systems, aggregate data concerning system capacity, number of targets struck, number of sorties flown, tons of ordnance delivered, losses of aircraft and personnel, and -- where possible -- the cost of the attacks and the estimated cost for restoration of the damaged installation. When possible, similar data were also presented for individual JCS targets within the target systems. Data pertaining to military complexes such as combination barracks and supply depots or barracks and ammunition depots have been summarized separately to provide alternatives for combination with data pertaining to other targets that fit properly into a single category.

J. Glossary**

Rolling Thunder - An unclassified codename applied to the entire airstrike program against North Vietnam.

Strike - An attack conducted by one or more aircraft.

Sortie - One operational flight by a single aircraft.

Combat Sortie - One aircraft airborne on a mission against the enemy.

* The data concerning attacks on ferries also were summarized, although these targets have been dropped from JCS Fixed Target List.
** Definitions are in accordance with those contained in the Joint Chiefs of Staff Armed Reconnaissance Study Group Report, An Analysis of the Armed Reconnaissance Program in North Vietnam, Appendix 3, Annex A,

25X1

Included are the following, defined as applicable within the Rolling Thunder program:

a. Fixed Target Strike Sortie - One aircraft airborne on a primary mission against a pre-briefed JCS numbered target.

b. Armed Reconnaissance Strike Sortie - One aircraft airborne with the primary mission of locating and attacking targets of opportunity -- that is, enemy material, personnel, and facilities in assigned general areas or along assigned lines of communication; or for attacks on pre-briefed small military targets, followed by armed route reconnaissance; or for restrikes on JCS numbered fixed targets.

c. Flak Suppression Sortie - One aircraft airborne with a primary mission against enemy surface antiaircraft defenses.

d. Other Combat Sorties - One aircraft airborne with a primary mission of air interdiction, close air support, or combat air patrol.

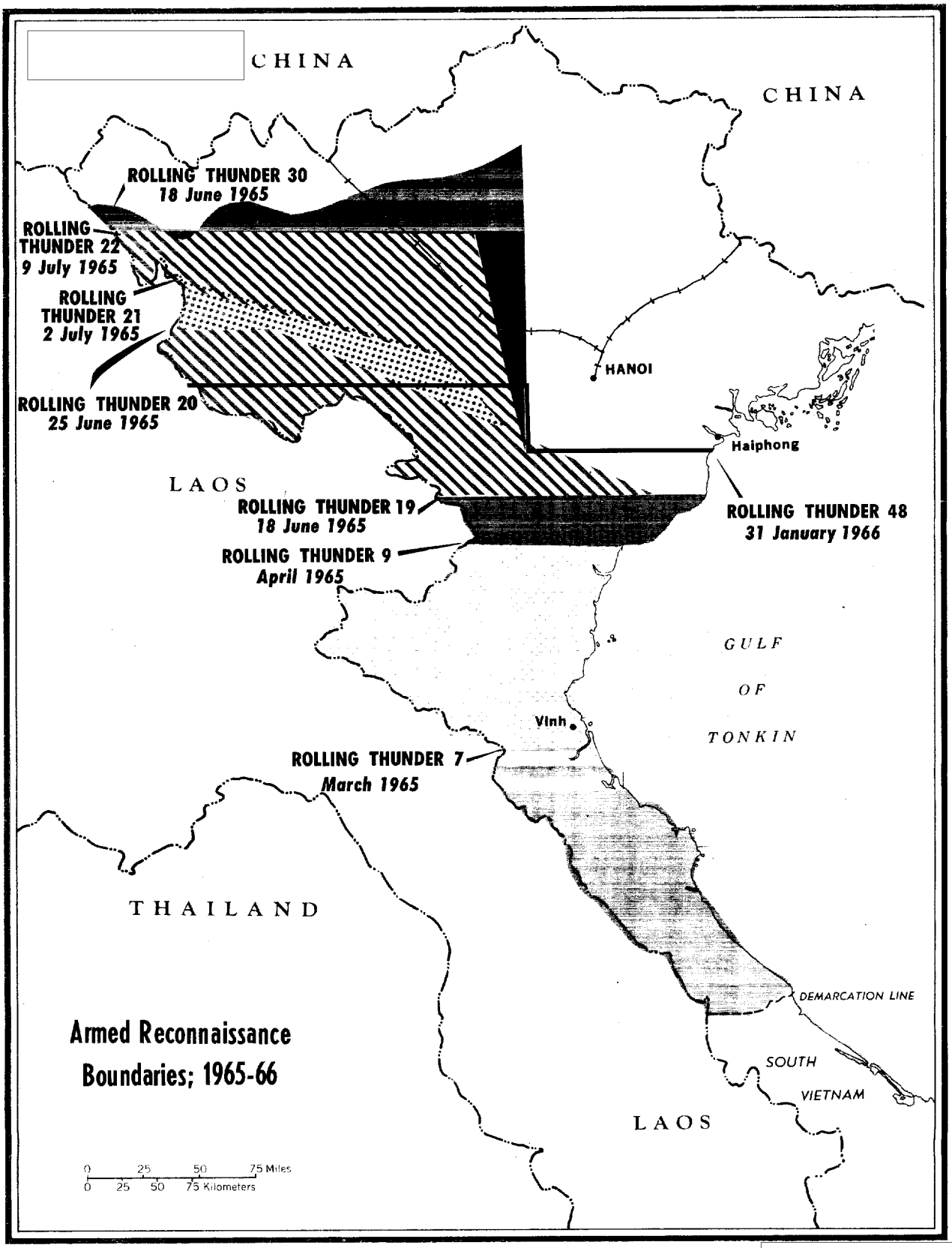
Combat Support Sortie - One aircraft airborne with the primary mission of providing operational assistance to combat elements. Included in the category are: escort, flare, refueling, bomb damage assessment, reconnaissance, air reconnaissance, photo-reconnaissance, pre-strike reconnaissance, search and rescue, weather reconnaissance, ELINT, COMINT, ECM, and ECCM.

Table B-14

Rolling Thunder: Statistical Summary of Attacks on Railroad Yards and Shops 2 March-24 December 1965

Number of targets	4 yards; 1 shop
Targets struck	2 yards (1 on JCS list; 1 not on JCS list)
Strikes	5
Attacking service	US Navy
Sorties	
Strike and flak suppression	75
Support	36
Total	111
Ordnance delivered	66 tons
Aircraft lost	2
Personnel lost	1
Personnel recovered	1
Cost to US	Million US $
Aircraft lost	2.40
Operational cost of sorties flown	0.13
Ordnance expended	0.04
Total	2.57

25X1



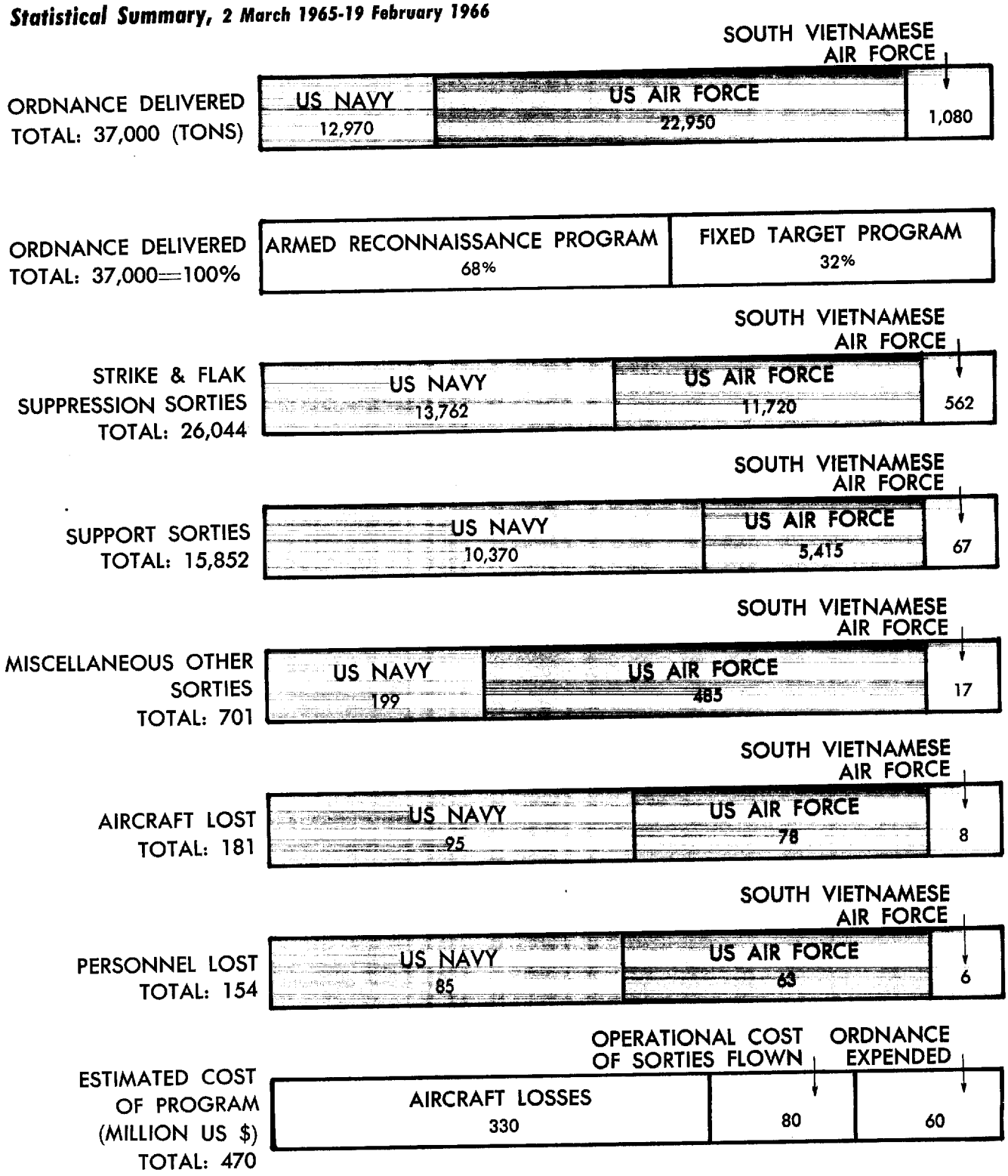
61385

B-1 Rolling Thunder: Armed Reconnaissance Boundaries

25X1

25X1

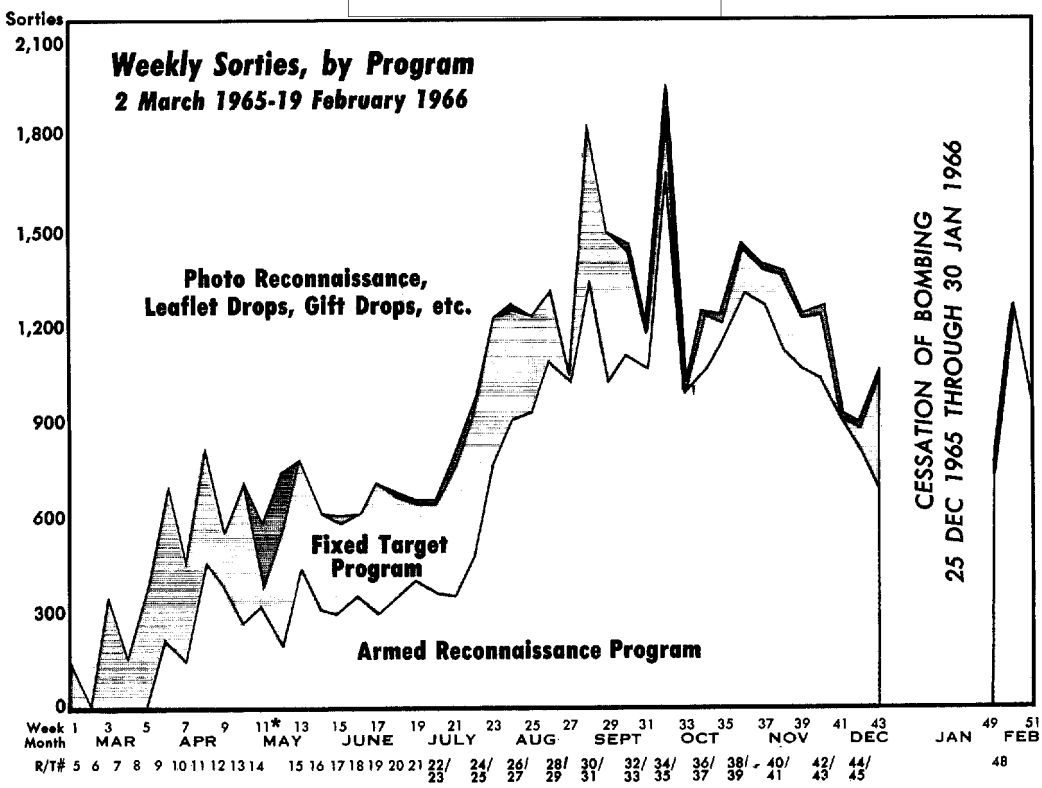
ROLLING THUNDER
Statistical Summary, 2 March 1965-19 February 1966



B-2 Rolling Thunder: Statistical Summary, 2 March 1965–19 February 1966

61353
25X1

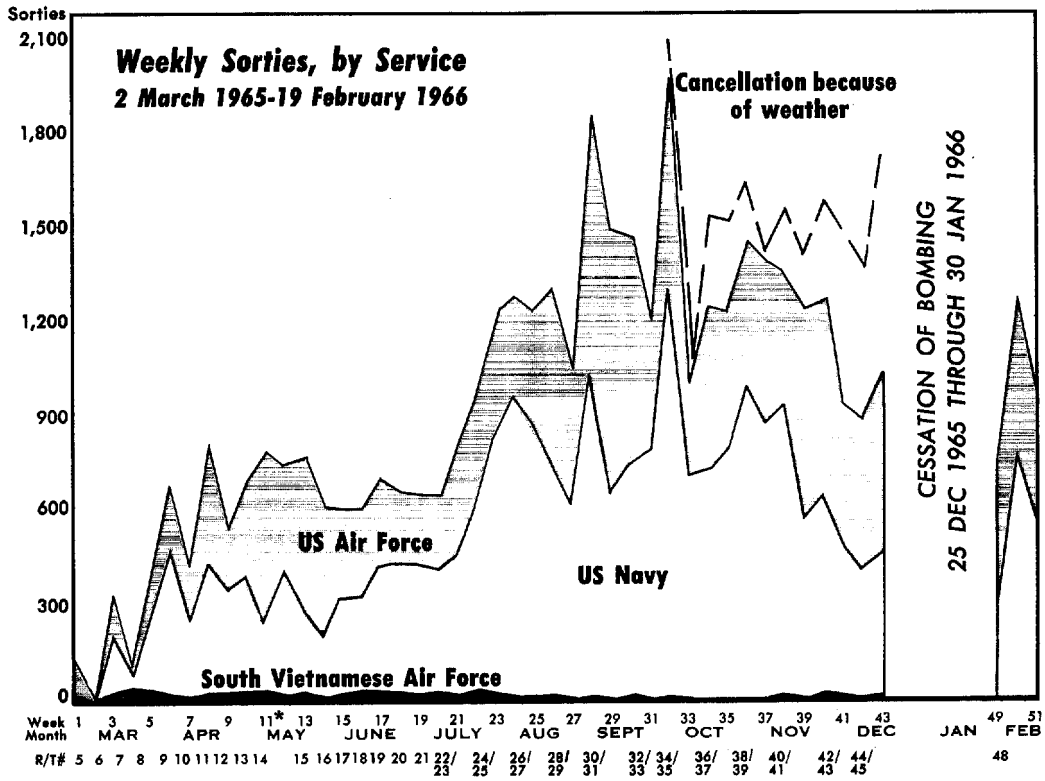
25X1



B-3 Rolling Thunder: Weekly Summary of Sorties, by Program
2 March 1965–19 February 1966

61354

*Five day suspension of bombing



B-4 Rolling Thunder: Weekly Summary of Sorties, by Service
2 March 1965–19 February 1966

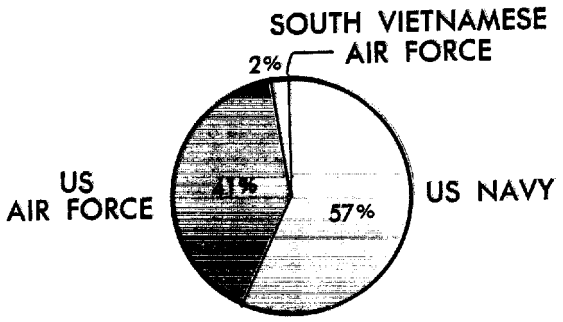
61355

25X1

25X1

ROLLING THUNDER
Sorties Flown, 2 March 1965-19 February 1966

SERVICE	NUMBER OF SORTIES
US NAVY	24,331—57%
US AIR FORCE	17,620—41%
SOUTH VIETNAMESE AIR FORCE	646— 2%
TOTAL	42,597



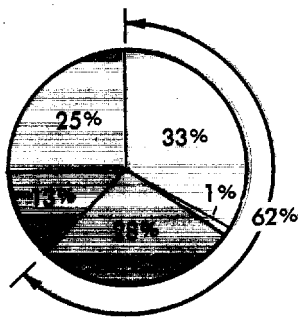
COMBAT SORTIES

STRIKE & FLAK SUPPRESSION SORTIES: 26,044— 62%

US NAVY	13,762—33%
US AIR FORCE	11,720—28%
SOUTH VIETNAMESE AIR FORCE	562— 1%

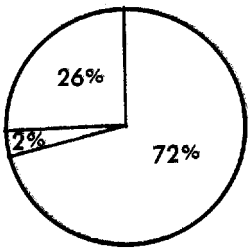
SUPPORT SORTIES: 15,852— 38%

US NAVY	10,370—25%
US AIR FORCE	5,415—13%
SOUTH VIETNAMESE AIR FORCE	67—NEGL.
TOTAL	41,896—100%



PROGRAM

FIXED TARGET SORTIES	11,064— 26%
ARMED RECONNAISSANCE SORTIES	30,832— 72%
LEAFLET DROPS, PHOTO RECONNAISSANCE, GIFT DROPS, ETC.	701— 2%
TOTAL	42,597—100%



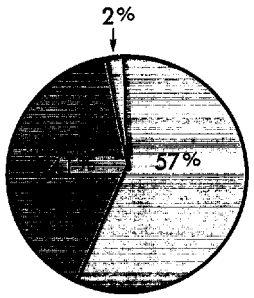
B-5 Rolling Thunder: Sorties Flown, 2 March 1965–19 February 1966

61356

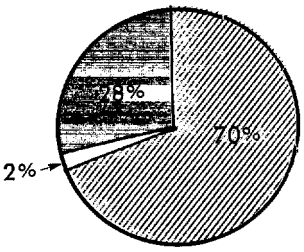
25X1

ROLLING THUNDER
Sorties Flown, 2 March 1965-24 December 1965

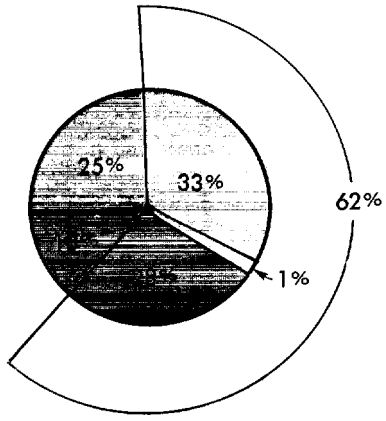
SERVICE	NUMBER OF SORTIES
U S NAVY	22,685
U S AIR FORCE	16,310
SOUTH VIETNAMESE AIR FORCE	646
TOTAL	39,641



PROGRAM	
FIXED TARGET SORTIES	11,064
ARMED RECONNAISSANCE SORTIES	27,932
LEAFLET DROPS, PHOTO RECONNAISSANCE, GIFT DROPS, ETC.	645
TOTAL	39,641



COMBAT SORTIES	
STRIKE AND FLAK SUPPRESSION SORTIES	24,057—62%
USN	12,728—33%
USAF	10,767—28%
VNAF	562— 1%
SUPPORT SORTIES	14,939—38%
USN	9,758—25%
USAF	5,114—13%
VNAF	67—NEGL.
TOTAL	38,996—100%

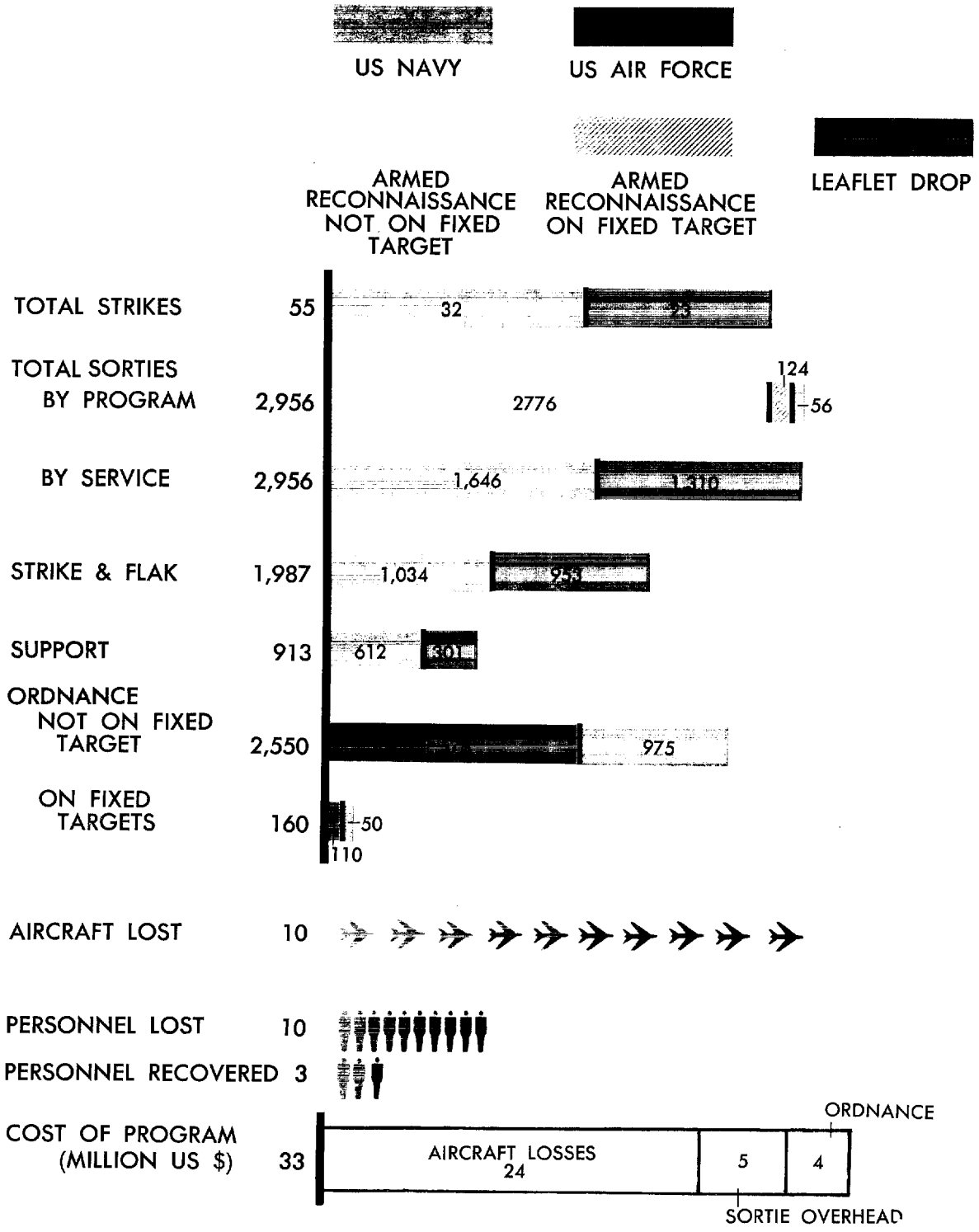


B-6 Rolling Thunder: Sorties Flown, 2 March–24 December 1965

61357 25X1

25X1

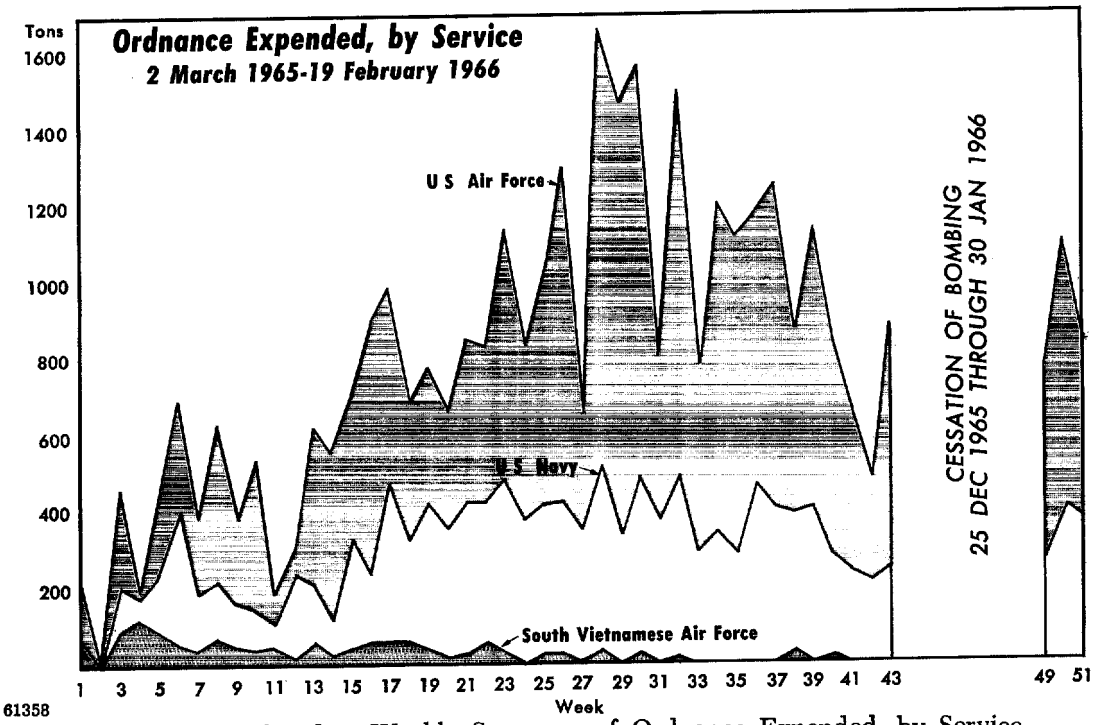
ROLLING THUNDER
Statistical Summary, 31 January-19 February 1966



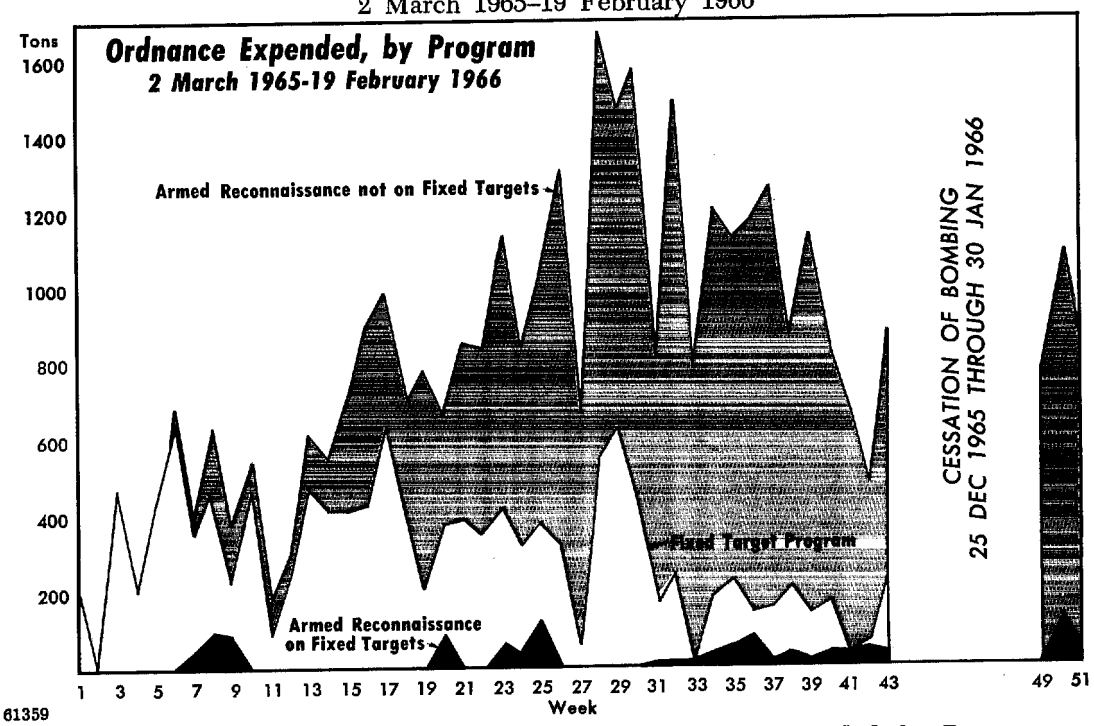
B-7 Rolling Thunder: Statistical Summary, 31 January–19 February 1966

61358 25X1

25X1



B-8 Rolling Thunder: Weekly Summary of Ordnance Expended, by Service
2 March 1965–19 February 1966

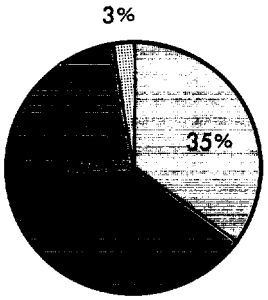


B-9 Rolling Thunder: Weekly Summary of Ordnance Expended, by Program
2 March 1965–19 February 1966

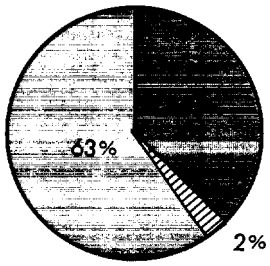
25X1

ROLLING THUNDER
Ordnance Expended, 2 March-24 December 1965

	TONS
U S AIR FORCE	21,300
U S NAVY	11,900
SOUTH VIETNAMESE AIR FORCE	1,100
TOTAL	34,300



	TONS
FIXED TARGET STRIKES	11,960
ARMED RECONNAISSANCE ON FIXED TARGETS	840
(TOTAL ON FIXED TARGETS	12,800)
ARMED RECONNAISSANCE NOT ON FIXED TARGETS	21,500



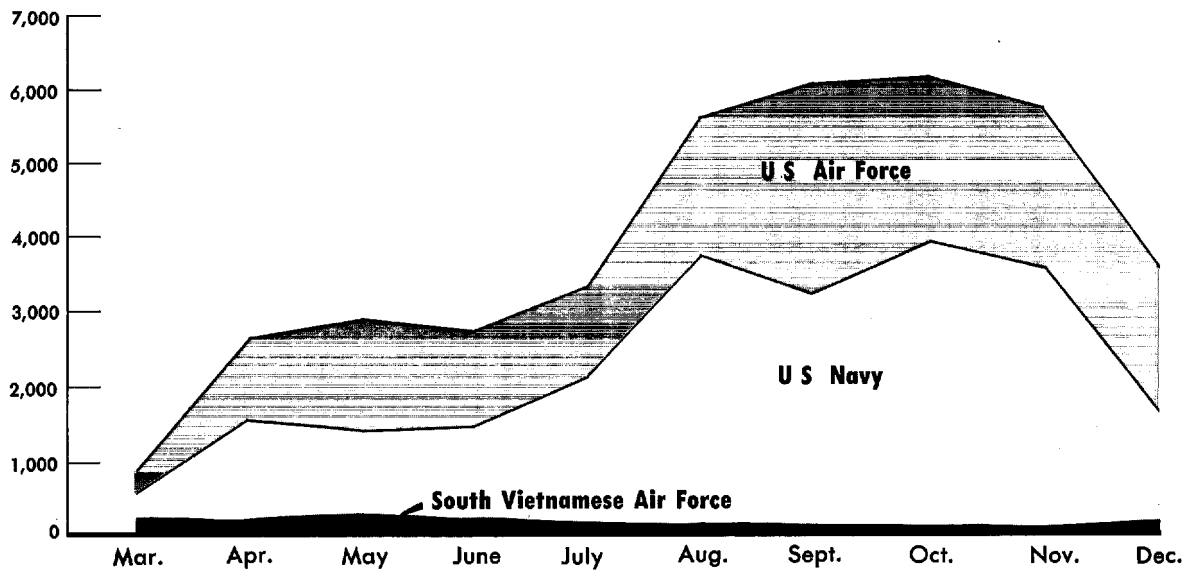
TOTAL ARMED RECONNAISSANCE	22,340
TOTAL TONS DELIVERED	34,300

B-10 Rolling Thunder: Ordnance Expended, 2 March–24 December 1965

61361

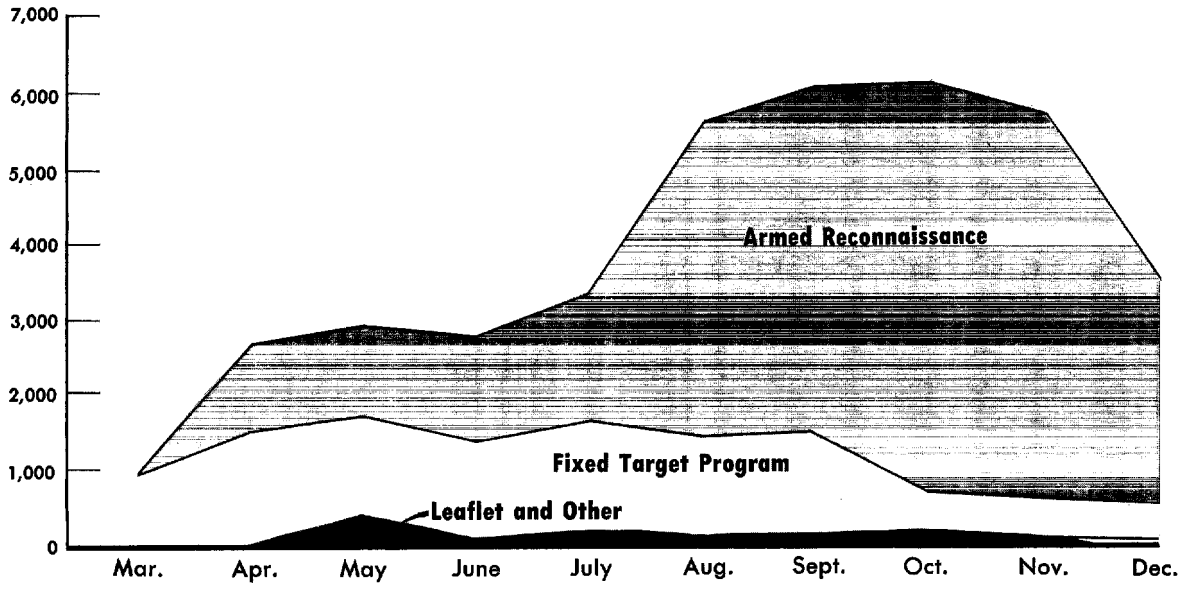
25X1

25X1



B-11 Rolling Thunder: Monthly Summary of Sorties, by Service, March–December 1965

61361 3-66 CIA

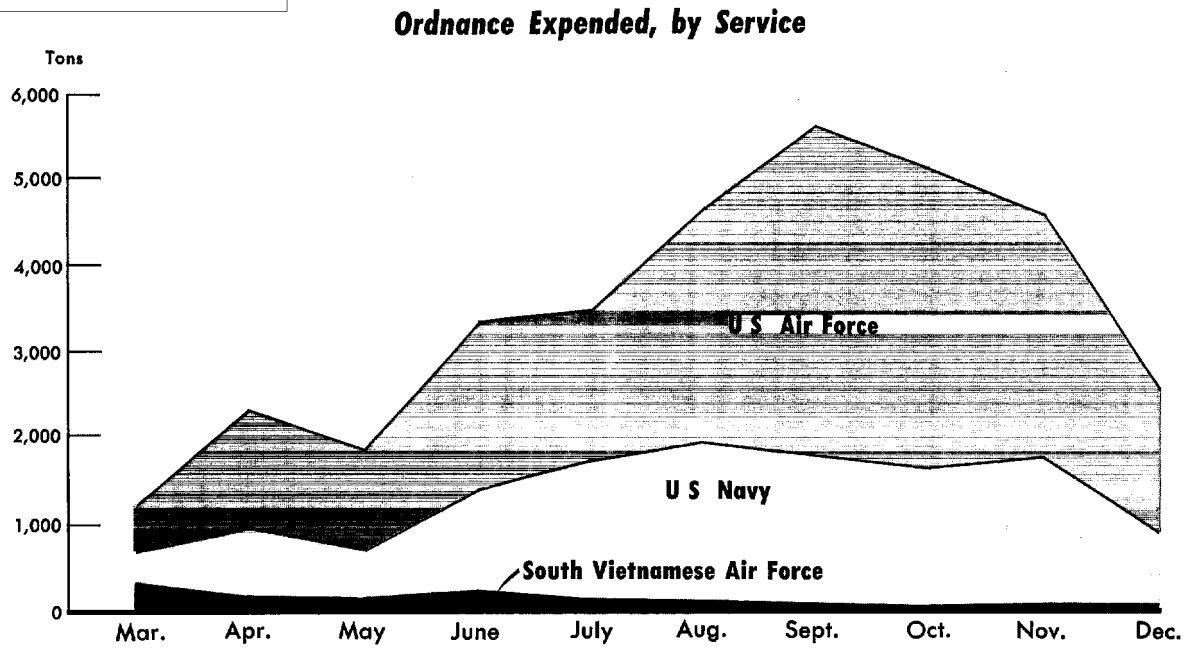


25X1

B-12 Rolling Thunder: Monthly Summary of Sorties, by Program, March–December 1965

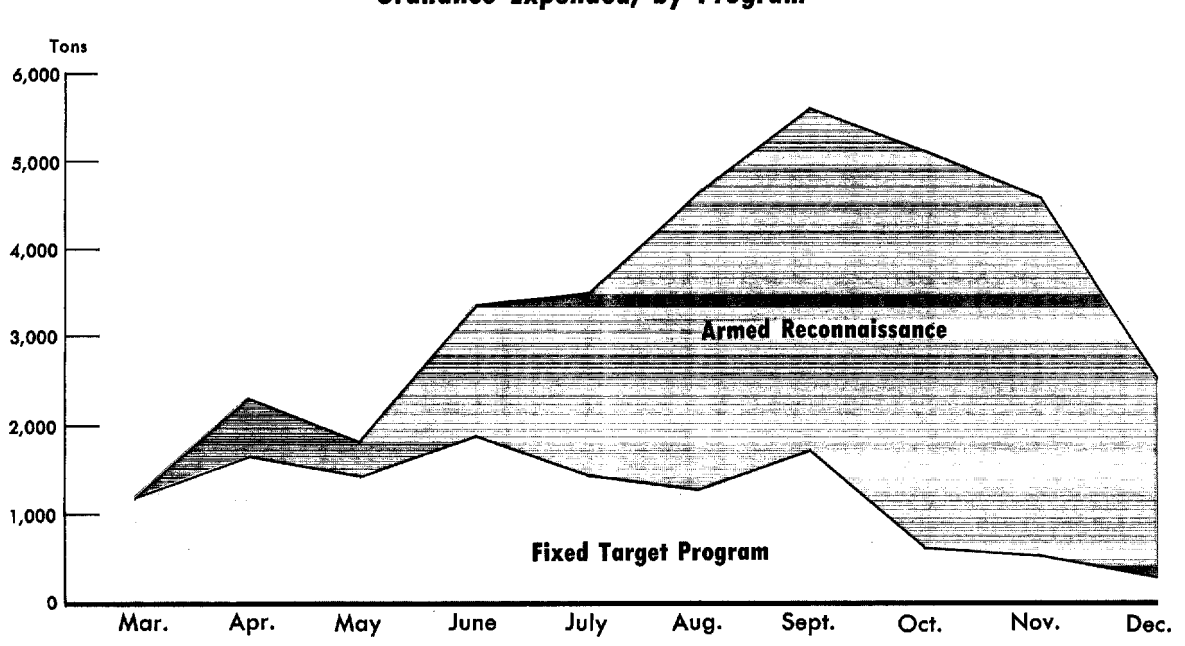
61362

25X1



B-13 Rolling Thunder: Monthly Summary of Ordnance Expended, by Service, March–December 1965

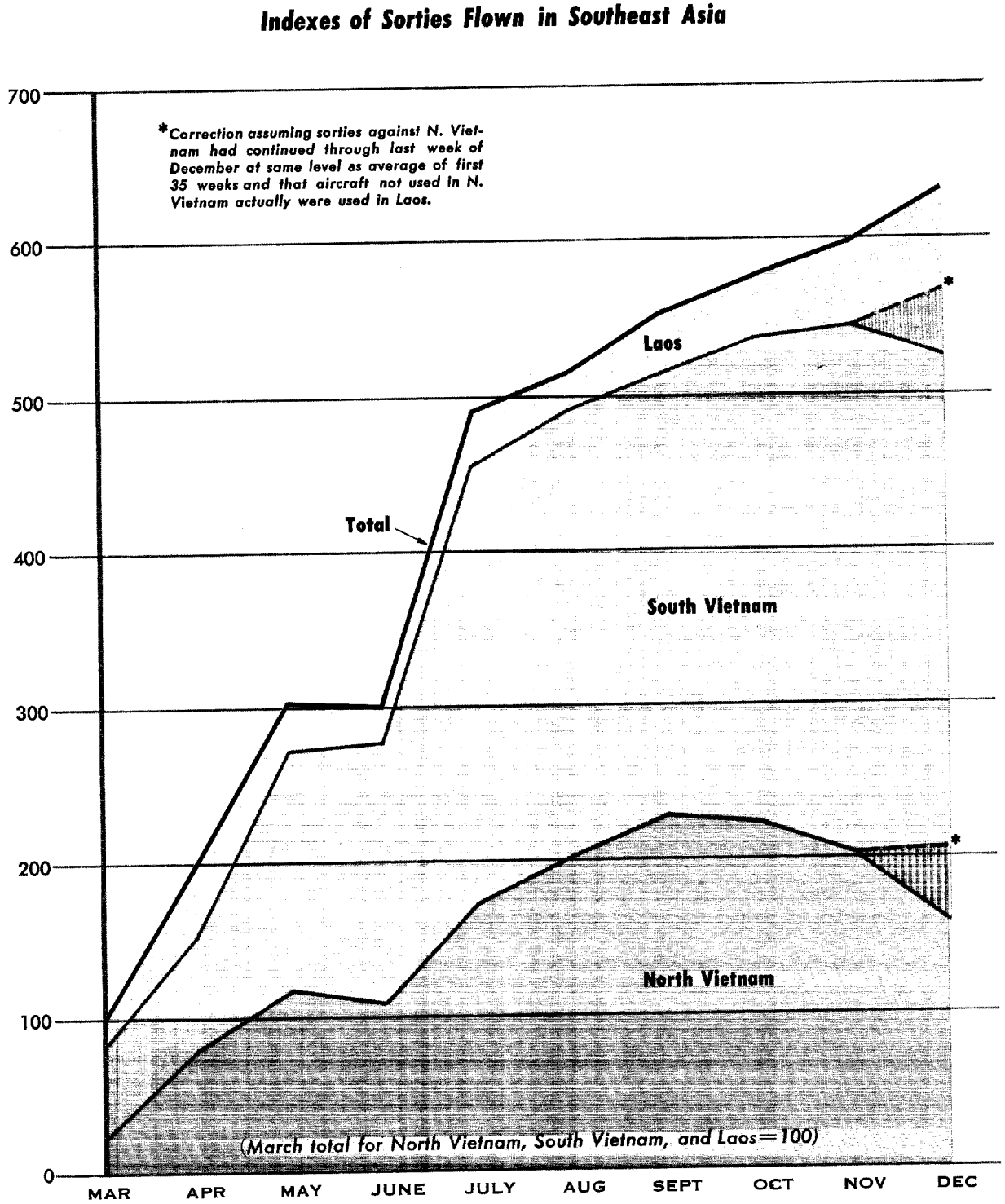
61363 3–66 CIA



B-14 Rolling Thunder: Monthly Summary of Ordnance Expended, by Program, March–December 1965

61364 3–66 CIA

25X1

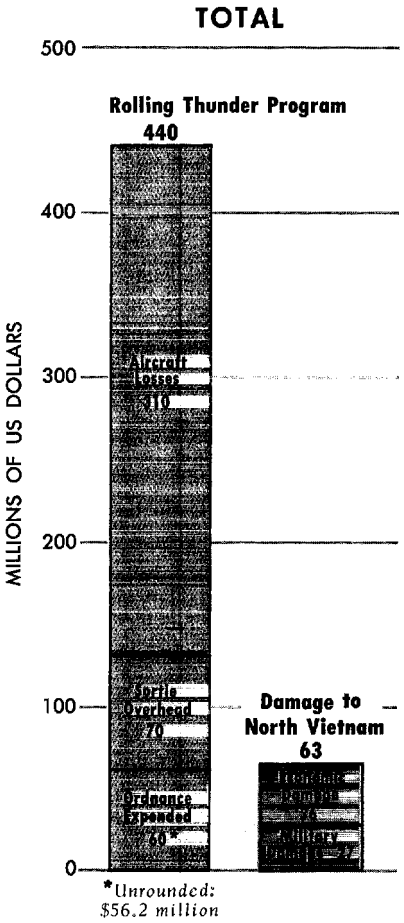


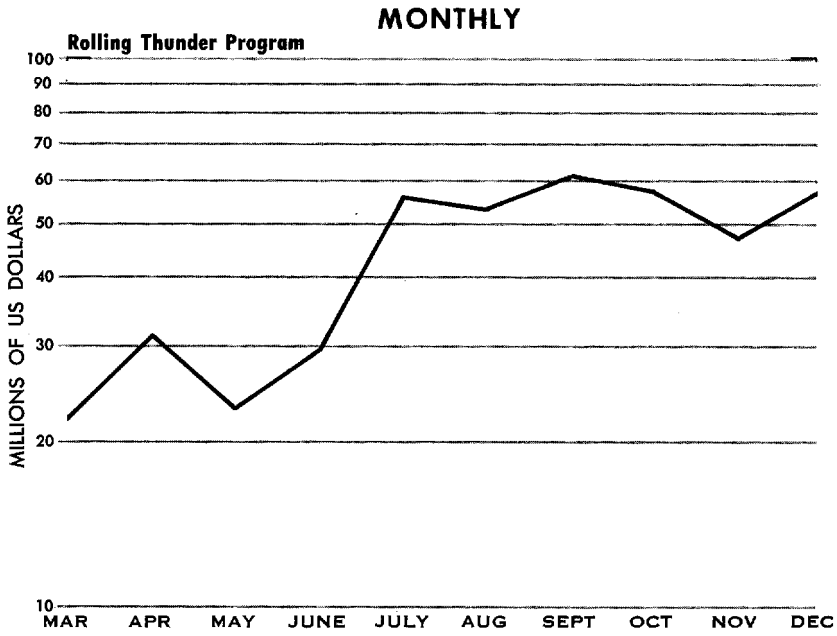
B-15 Indexes of Sorties Flown in Southeast Asia and the Relative Amount in Each Area March–December 1965

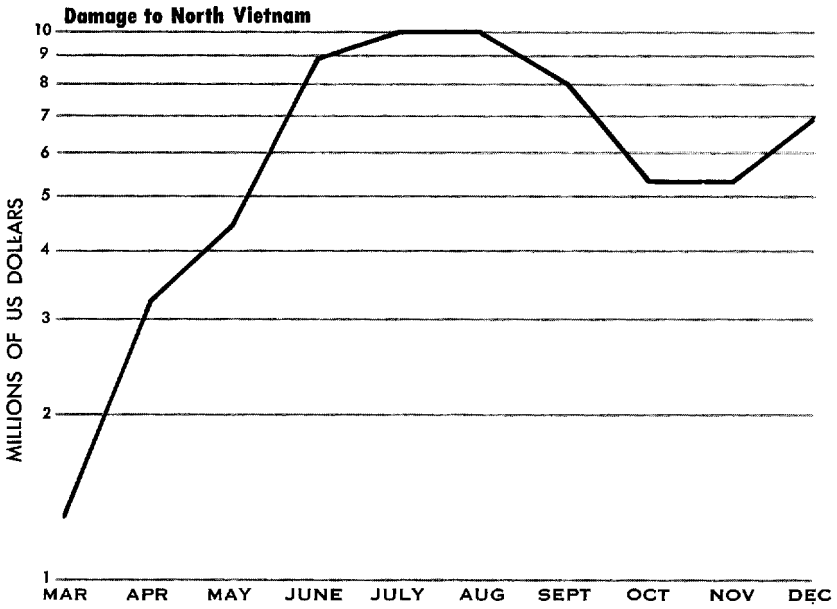
61365

25X1

Cost Related to the Cost of Damage





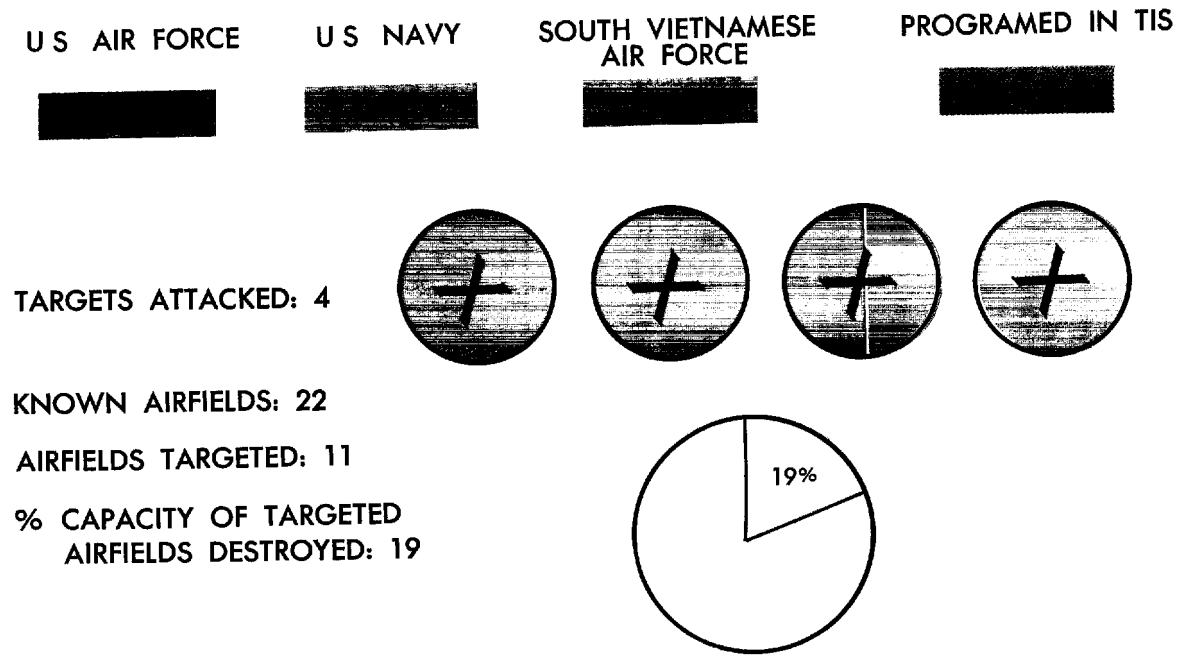


B-16, B-17 Estimated Cost of Rolling Thunder Related to the Cost of Damage to the Economy of North Vietnam
2 March–24 December 1965

61366

25X1

ROLLING THUNDER:
Attacks on Airfields, 2 March -24 December 1965



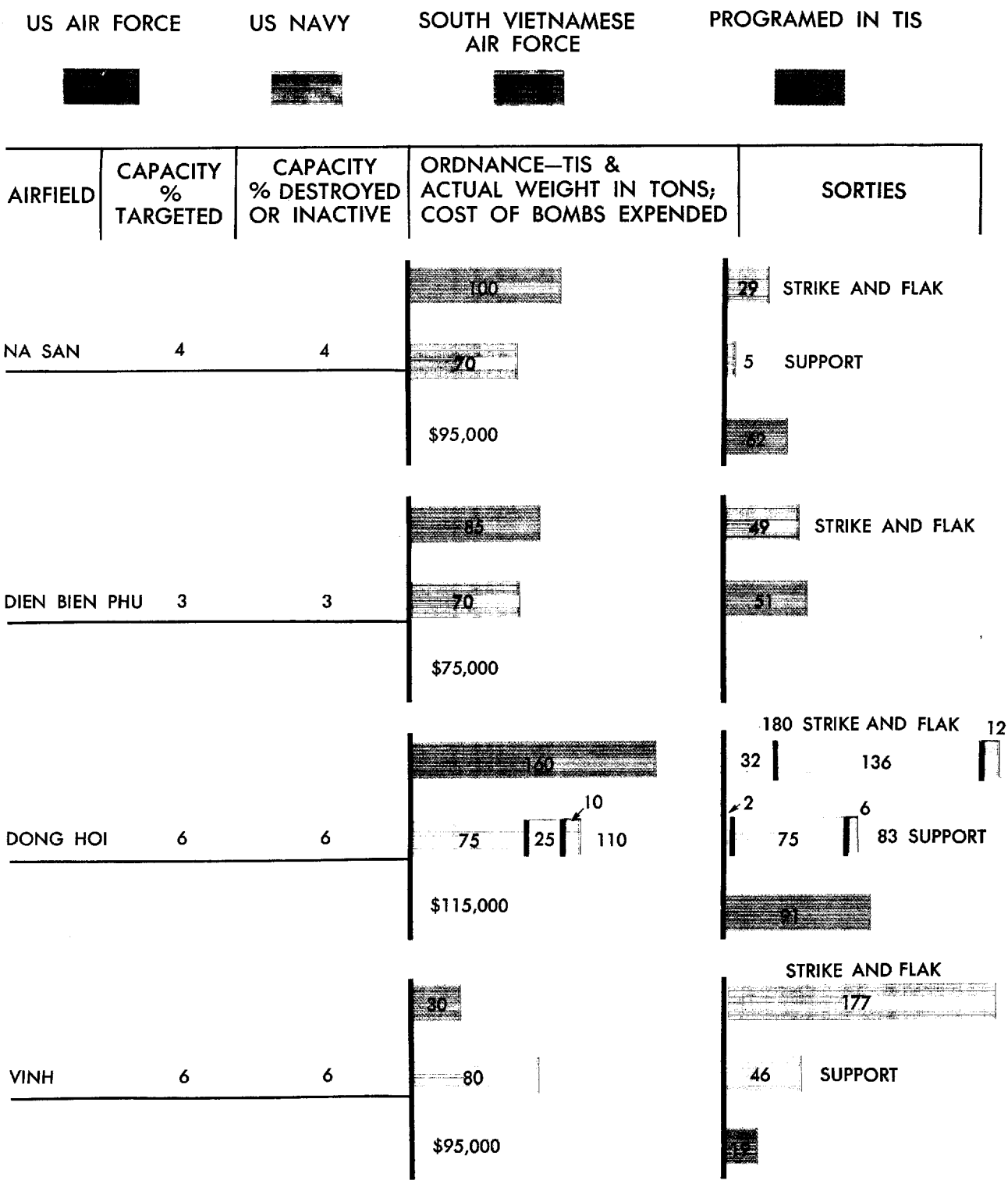
a) Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

B-18 a Rolling Thunder: Statistical Summary of Attacks on Airfields, 2 March–24 December 1965

61369

ROLLING THUNDER

Attacks on Airfields, 2 March-24 December 1965

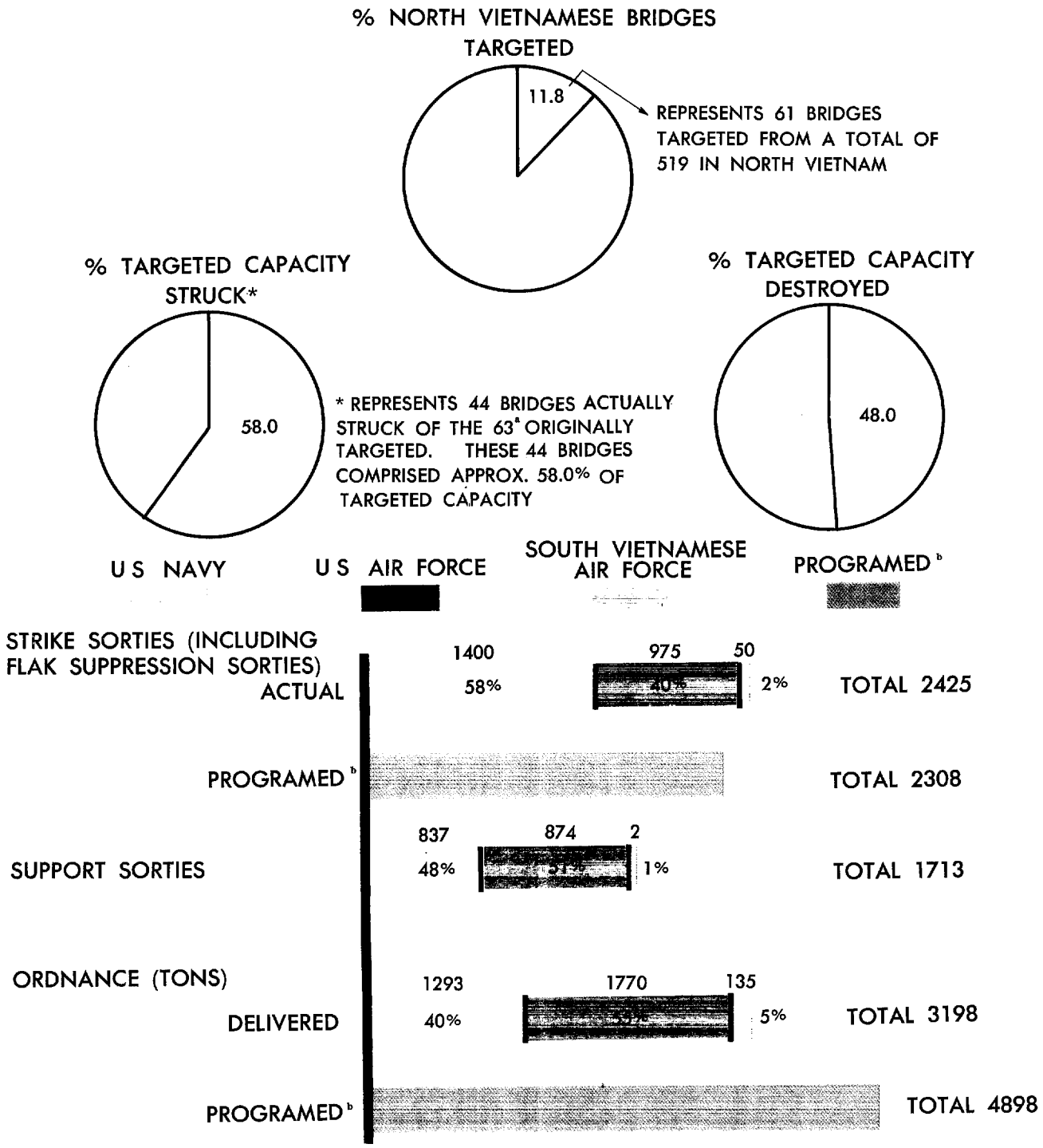


B-18 b Rolling Thunder: Statistical Summary of Attacks on Airfields, 2 March–24 December 1965

61386

ROLLING THUNDER

Attacks on Bridges, 2 March-24 December 1965



[a] TWO BRIDGES HAVE BEEN DROPPED SUBSEQUENTLY FROM THE TARGET LIST.

[b] UPPER LIMIT OF THE RANGE OF ORDNANCE AND SORTIES GIVEN IN THE TARGET INFORMATION SUMMARY (TIS) OF THE JOINT CHIEFS OF STAFF AS THE OPERATIONAL REQUIREMENTS FOR 70% DESTRUCTION OF THE TARGET

B-19a Rolling Thunder: Statistical Summary of Attacks on Bridges, 2 March–24 December 1965

25X1

ROLLING THUNDER
Attacks on Bridges, 2 March-24 December 1965

LOSSES:

PLANES

US NAVY 17 [46%]
US AIR FORCE 17 [46%]
SOUTH VIETNAMESE AIR FORCE 3 [8%]
TOTAL 37

PERSONNEL

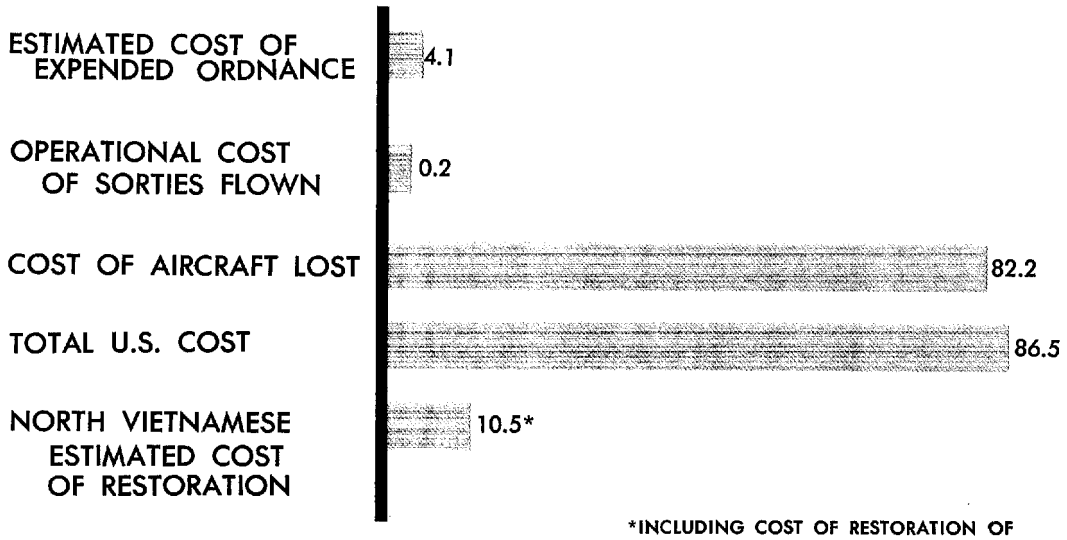
LOST

US NAVY 18 [51%]
US AIR FORCE 14 [40%]
SOUTH VIETNAMESE AIR FORCE 3 [9%]
TOTAL 35

RECOVERED

US NAVY 5
US AIR FORCE 4
SOUTH VIETNAMESE AIR FORCE 0
TOTAL 9

COMPARATIVE COST MILLION US $



*INCLUDING COST OF RESTORATION OF BRIDGES NOT ON JCS-TARGET LIST.

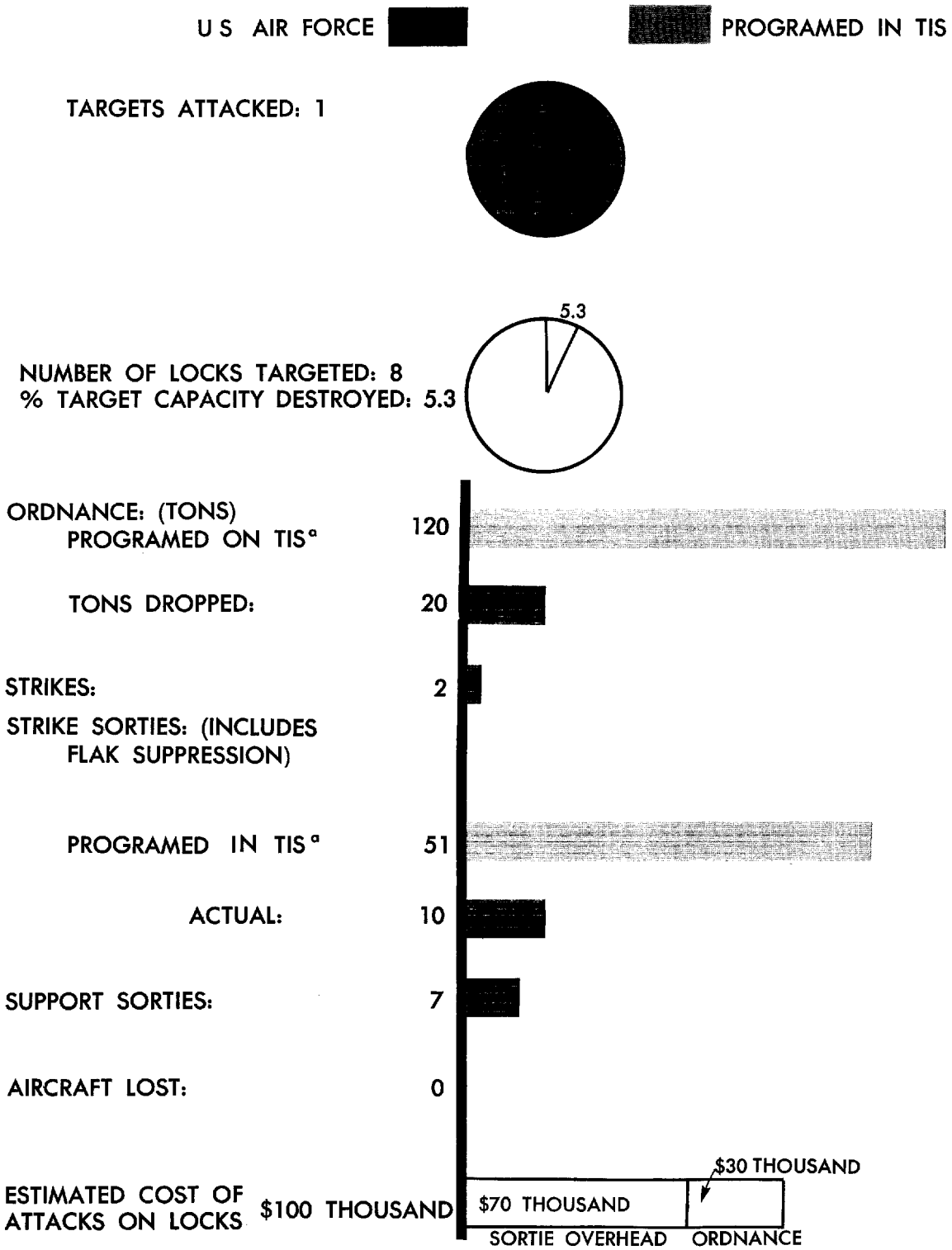
B-19b Rolling Thunder: Statistical Summary of Attacks on Bridges, 2 March–24 December 1965

61387

25X1

25X1

ROLLING THUNDER
Attacks on Locks, 2 March 1965-24 December 1965



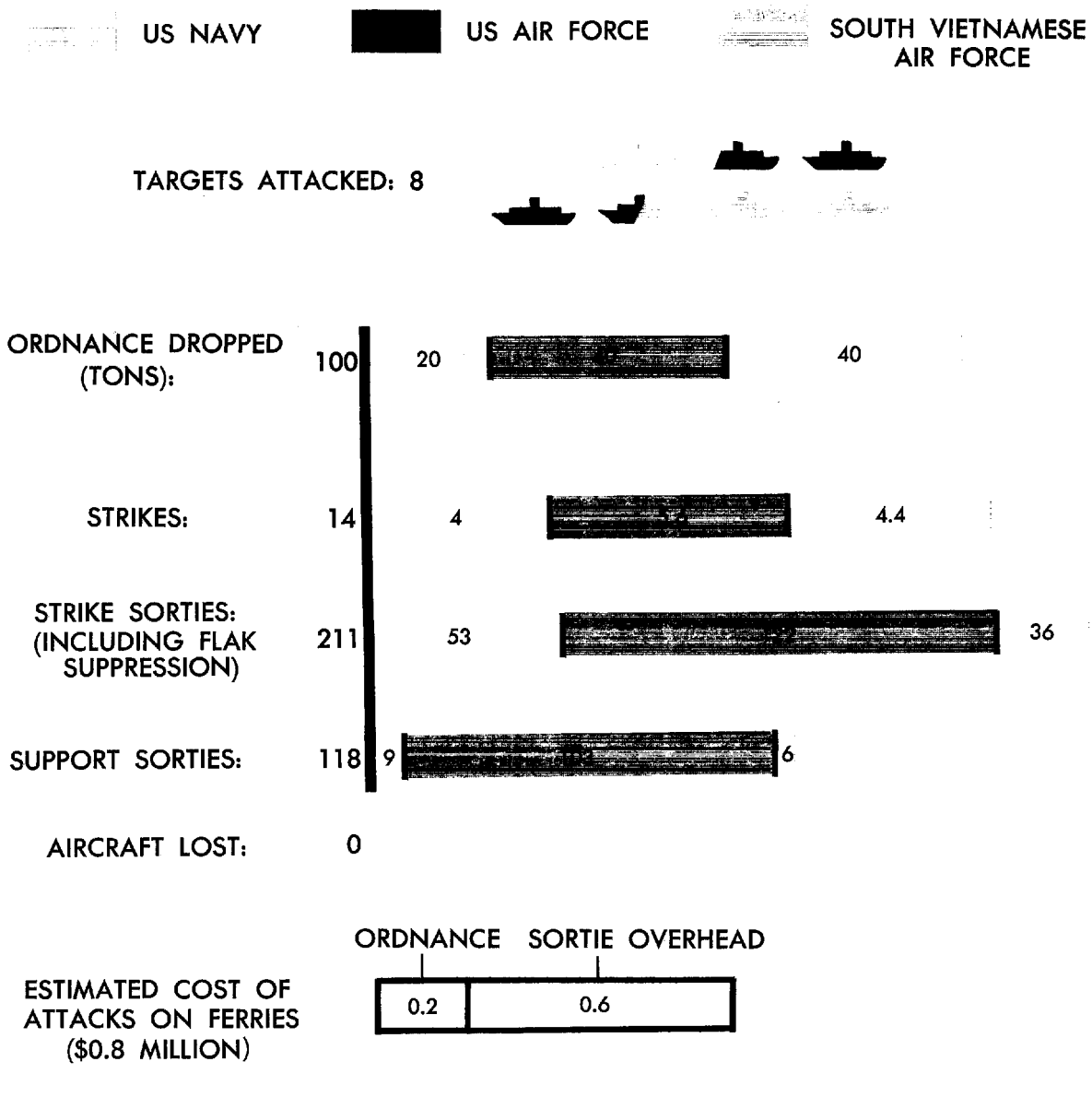
a) Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

B-20 Rolling Thunder: Statistical Summary of Attacks on Locks, 2 March-24 December 1965

61371 25X1

25X1

ROLLING THUNDER
Attacks on Ferries,* 2 March-24 December 1965

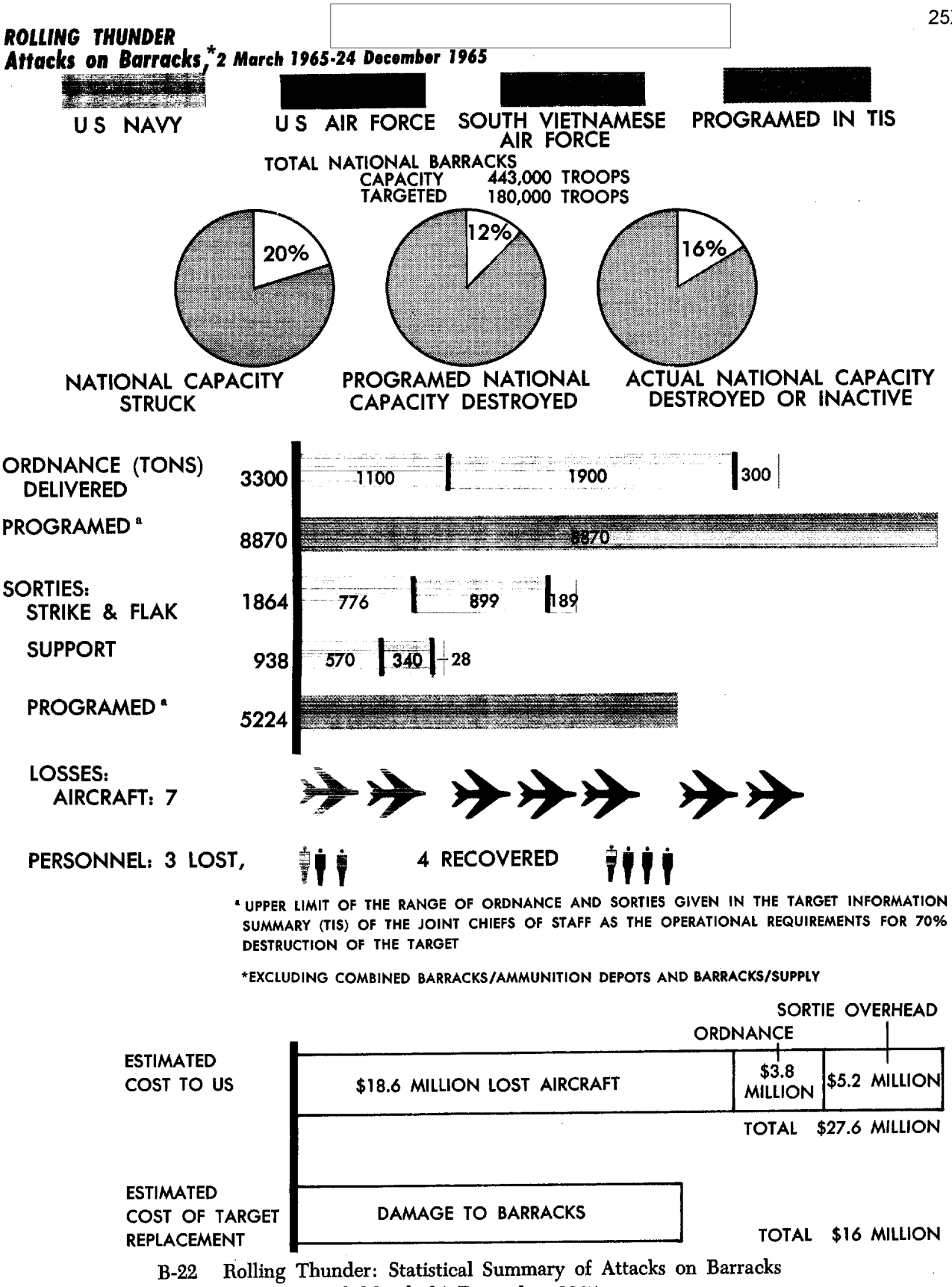


*FERRIES ARE NO LONGER JCS TARGETS

B-21 Rolling Thunder: Statistical Summary of Attacks on Ferries, 2 March–24 December 1965

61372 25X1

25X1



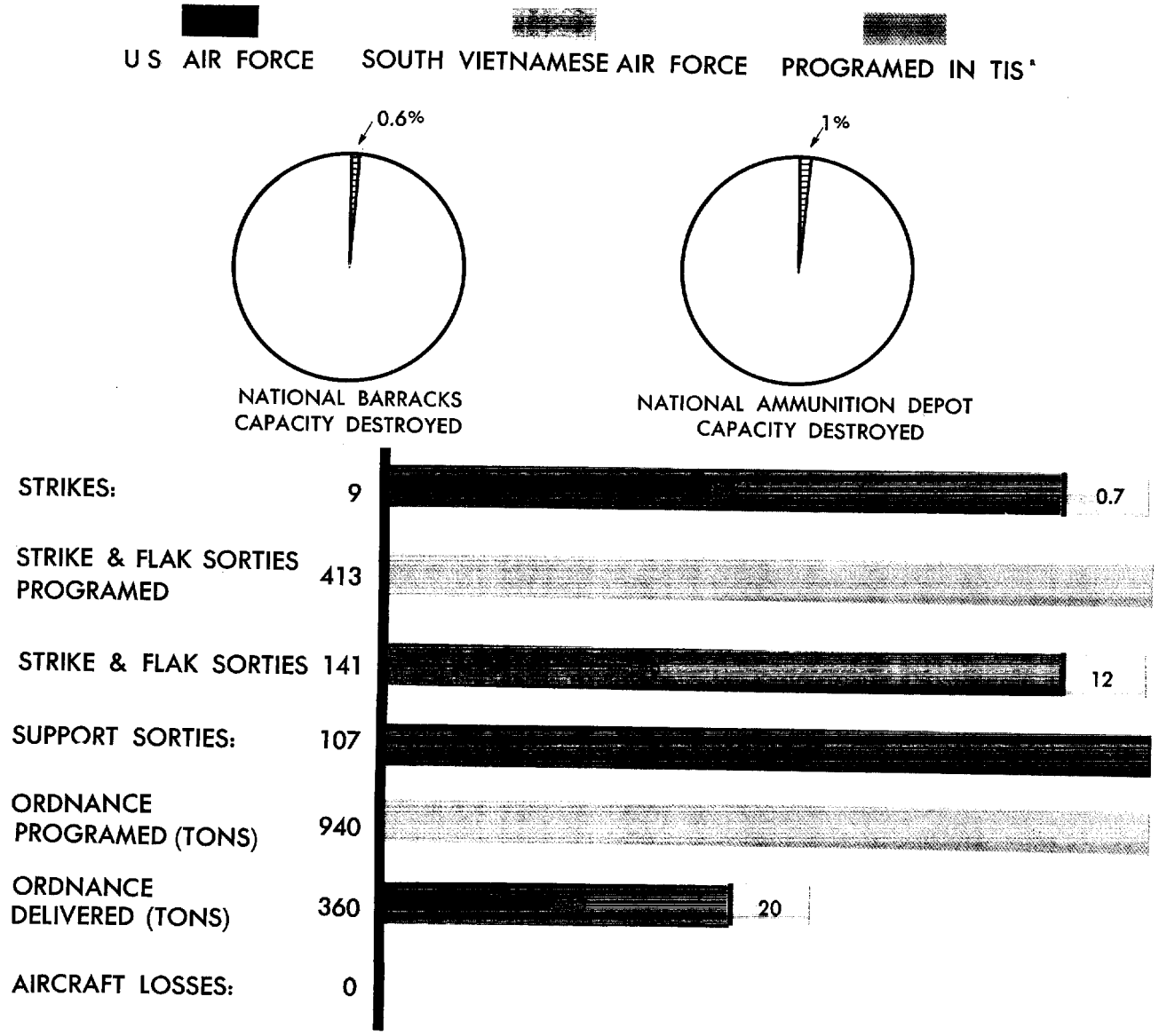
B-22 Rolling Thunder: Statistical Summary of Attacks on Barracks
2 March–24 December 1965

61373

25X1

25X1

ROLLING THUNDER
Attacks on Combined Barracks and Ammunition Depots



COST OF ORDNANCE DROPPED: $0.5 MILLION
OPERATIONAL COST OF SORTIES FLOWN: $ 0.7 MILLION

a) Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

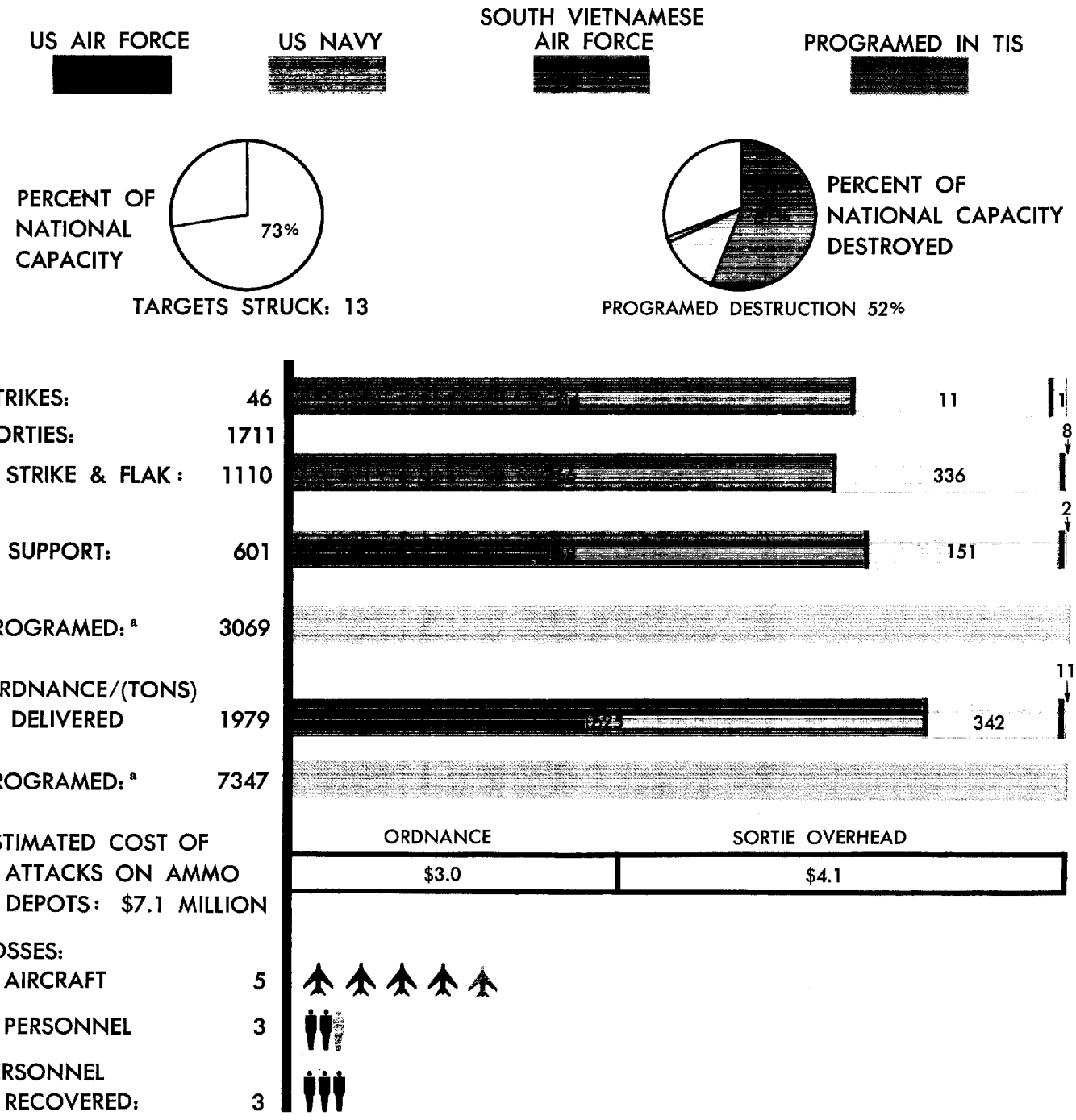
Note: Also see Fig. B-22 & Fig. B-24

B-23 Rolling Thunder: Statistical Summary of Attacks on Combined Barracks and Ammunition Depots 2 March–24 December 1965

61374 25X1

25X1

ROLLING THUNDER
Attacks on Ammunition Depots*, 2 March-24 December 1965



*EXCLUDING COMBINED BARRACKS AND AMMUNITION DEPOTS Note: Also see Fig. B-23

a) Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

B-24 Rolling Thunder: Statistical Summary of Attacks on Ammunition Depots*
2 March–24 December 1965

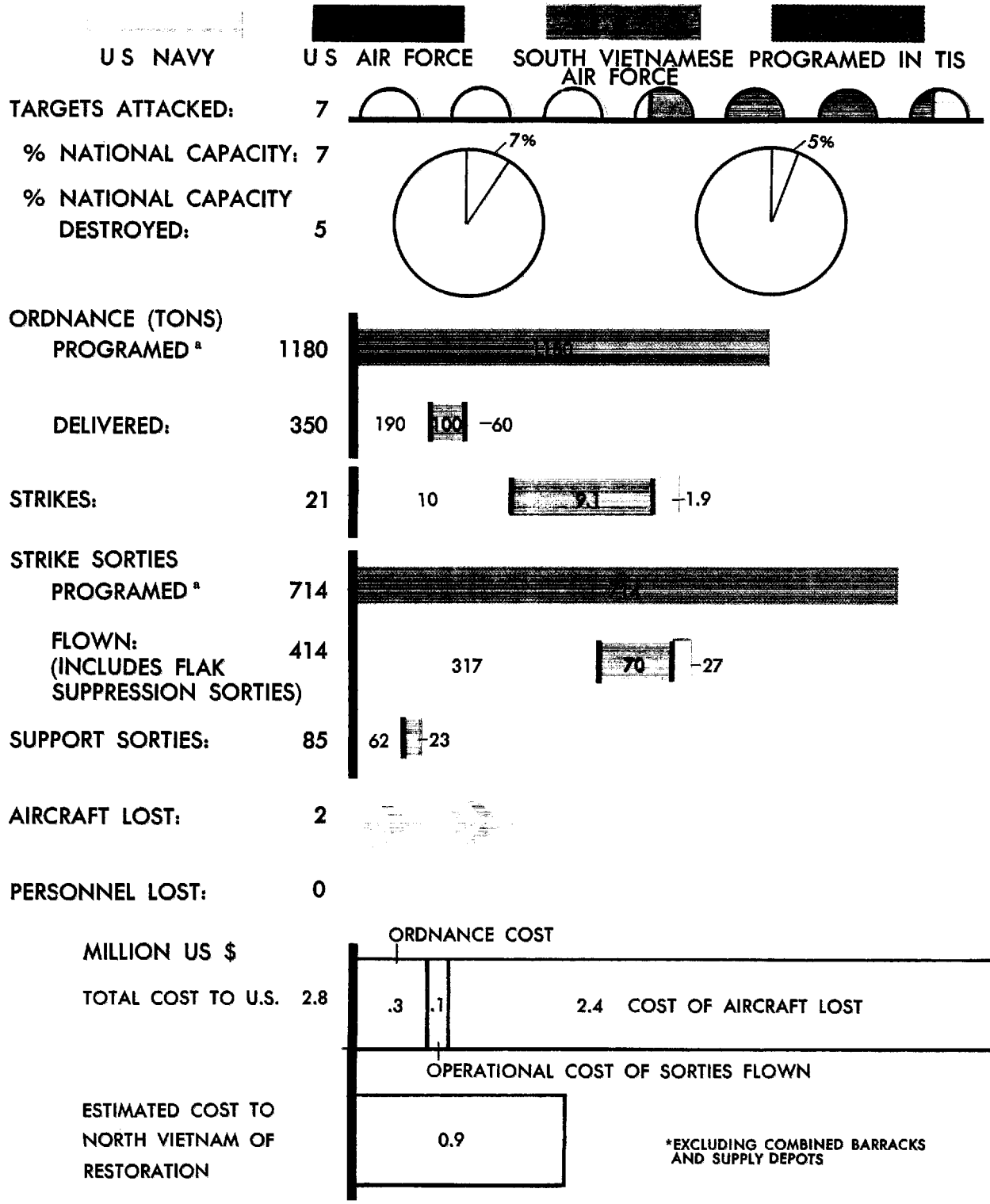
61375

25X1

[redacted]

25X1

ROLLING THUNDER
Attacks on Supply Depots,* 2 March -24 December 1965



a Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

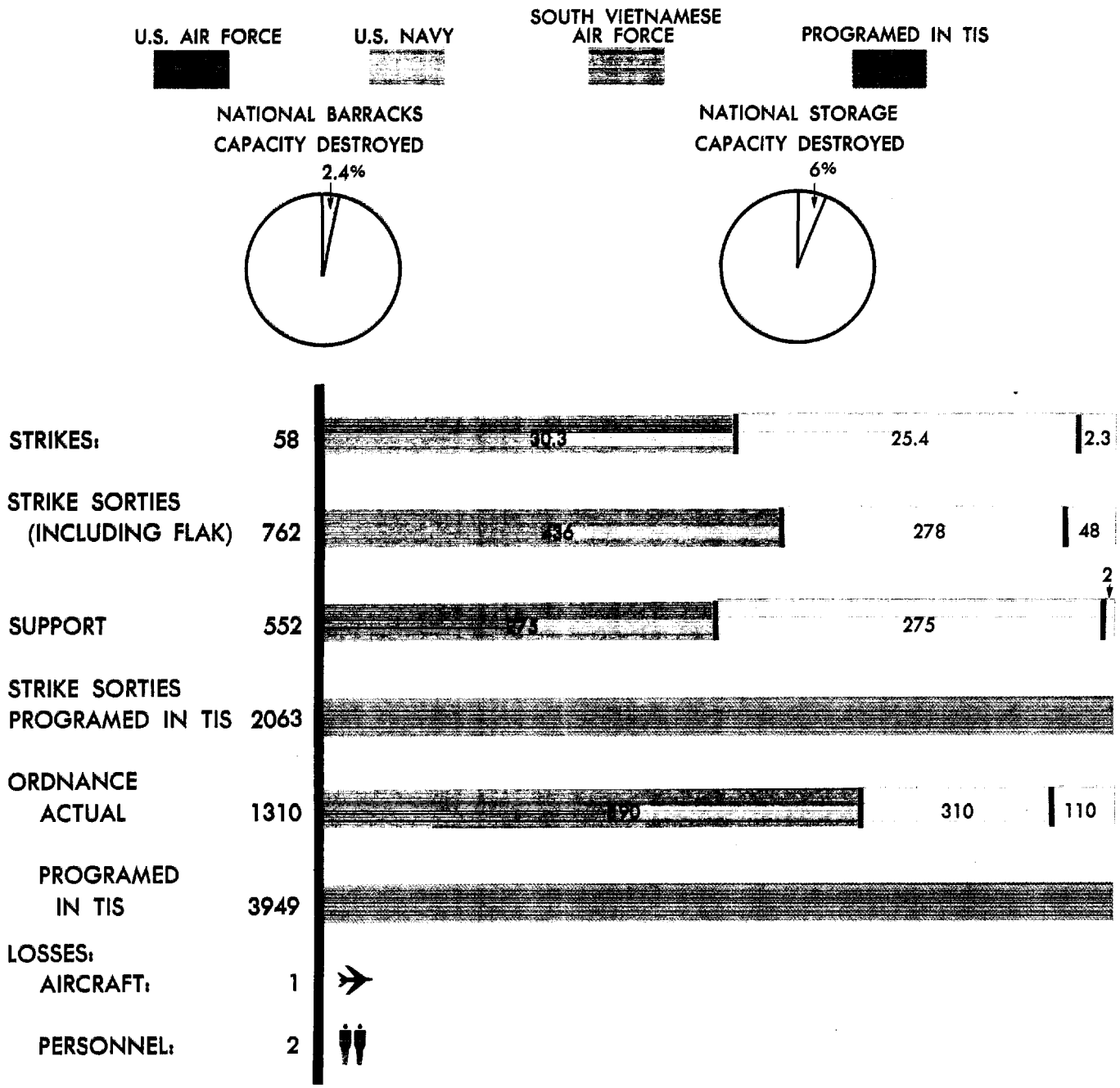
B-25 Rolling Thunder: Statistical Summary of Attacks on Supply Depots *
2 March–24 December 1965

[redacted]

61376 25X1

25X1

ROLLING THUNDER
Attacks on Combined Barracks and Supply Depots 2 March -24 December 1965



COST OF ORDNANCE DROPPED: $1.5 MILLION
COST OF AIRCRAFT LOST: $2.1 MILLION
OPERATIONAL COST OF SORTIES FLOWN: $1.1 MILLION

B-26 Rolling Thunder: Statistical Summary of Attacks on Combined Barracks and Supply Depots 2 March–24 December 1965

61377
25X1

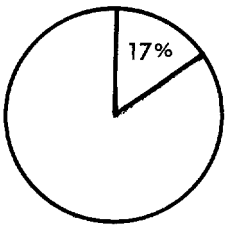
25X1

ROLLING THUNDER
Attacks on Bulk Petroleum Storage Facilities, 2 March-24 December 1965

TARGETS ATTACKED: 4

TOTAL NATIONAL CAPACITY: 216,000 METRIC TONS

% NATIONAL CAPACITY DESTROYED: 17



ORDNANCE (TONS)
PROGRAMED IN TIS 280
ACTUAL ORDNANCE EXPENDED 120

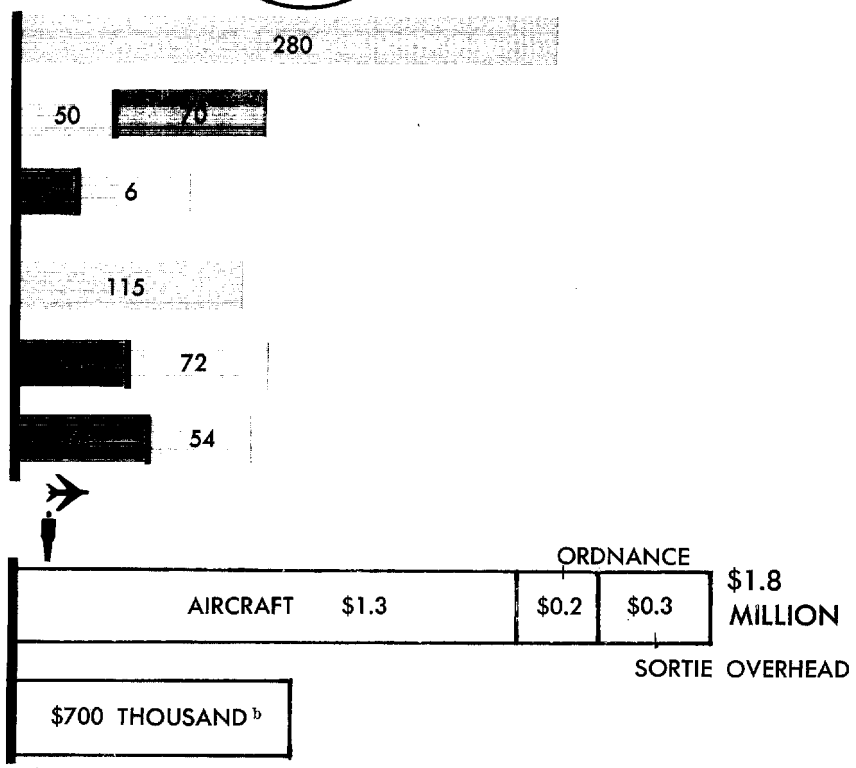
STRIKES: 9
STRIKE SORTIES (INCLUDING FLAK SUPPRESSION SORTIES)
PROGRAMED IN TIS 115
ACTUAL: 128

SUPPORT SORTIES: 121

AIRCRAFT LOST: 1
PERSONNEL LOST: 1

ESTIMATED COST OF ATTACKS ON PETROLEUM STORAGE FACILITIES

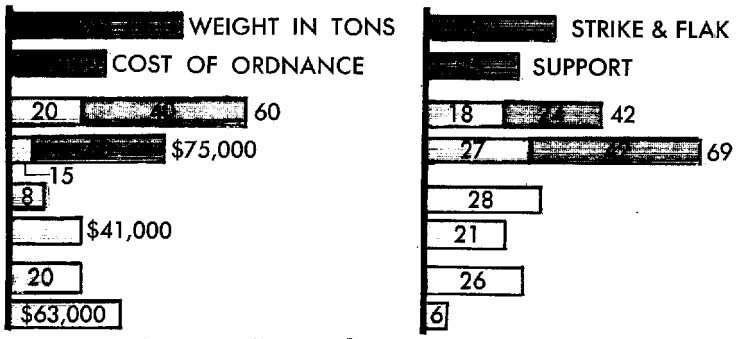
ESTIMATED COST OF TARGET RESTORATION



a) Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

b) Includes $210 thousand worth of damage inflicted in August, 1964.

BULK STORAGE SITE	CAPACITY 000 (MT)	% NAT CAP
PHU VAN	1	NEGL.
VINH	18	8
NAM DINH	12	6
PHU QUI	10	5



B-27 Rolling Thunder: Statistical Summary of Attacks on Bulk Petroleum Storage Facilities 2 March–24 December 1965 61378

25X1

25X1

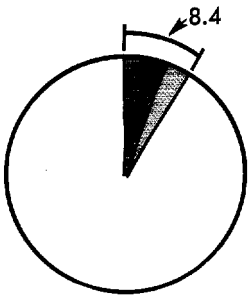
ROLLING THUNDER
Attacks on Port Facilities and Naval Bases, 2 March-24 December 1965

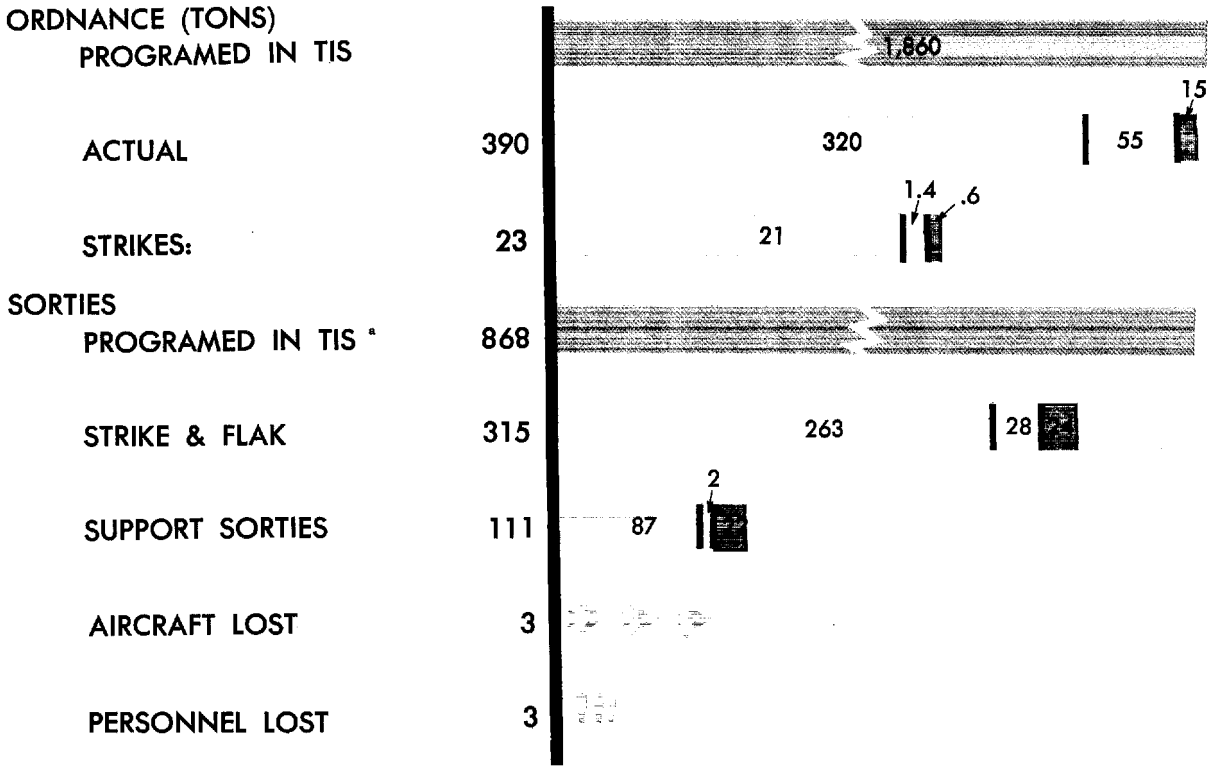
U S AIR FORCE | U S NAVY | SOUTH VIETNAMESE AIR FORCE | PROGRAMED IN TIS

TARGETS ATTACKED: 4

% NATIONAL CARGO HANDLING CAPACITY

PROGRAMED FOR DESTRUCTION	ACTUALLY [b] DESTROYED
8.4	5.7





[a] UPPER LIMIT OF THE RANGE OF ORDNANCE AND SORTIES GIVEN IN THE TARGET INFORMATION SUMMARY (TIS) OF THE JOINT CHIEFS OF STAFF AS THE OPERATIONAL REQUIREMENTS FOR 70% DESTRUCTION OF THE TARGET

[b] 15 PERCENT OF NORTH VIETNAMESE NAVAL BASE SUPPORT CAPACITY WAS DESTROYED AT THE TWO NAVAL BASES.

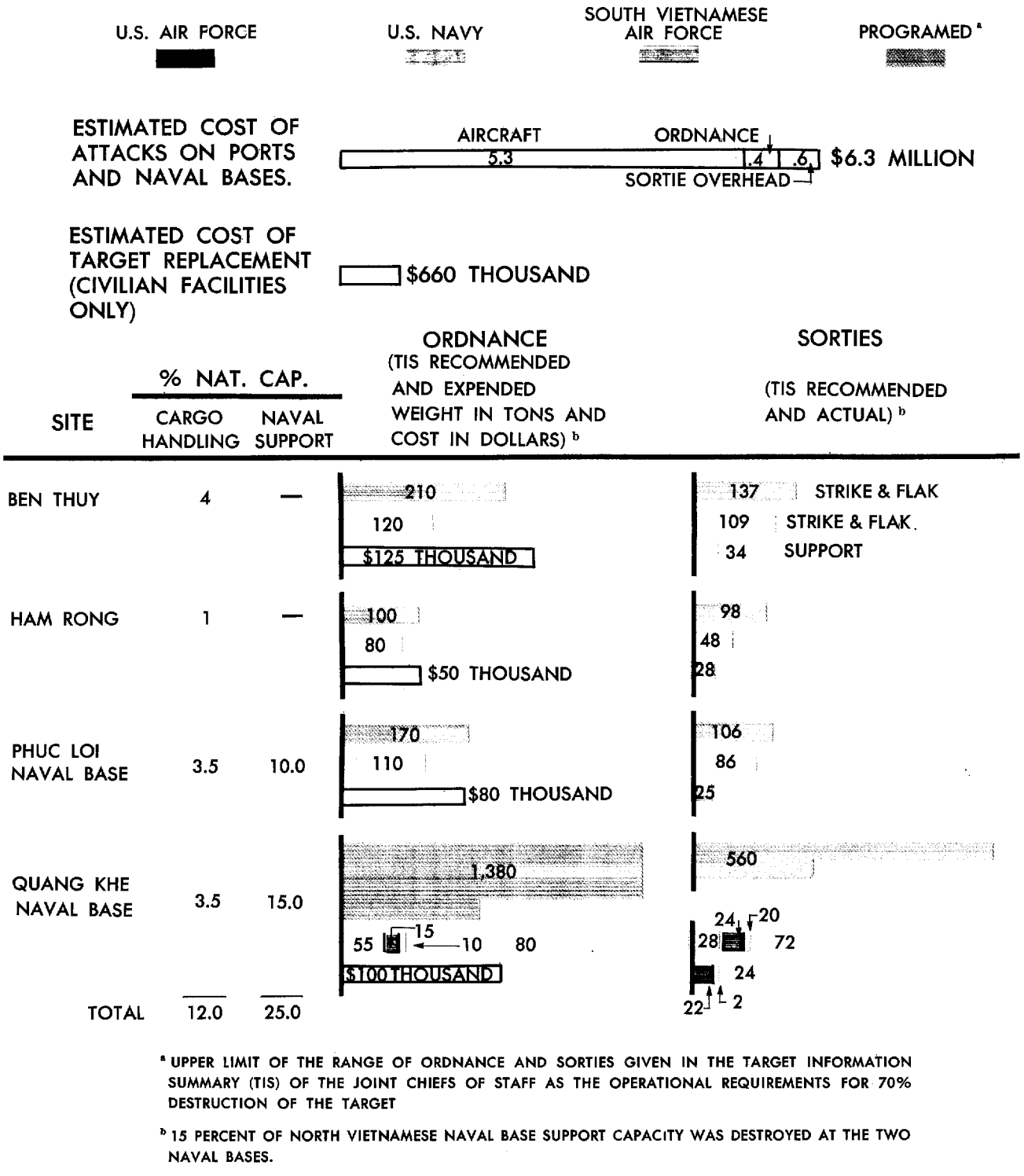
B-28 a Rolling Thunder: Statistical Summary of Attacks on Port Facilities and Naval Bases
2 March–24 December 1965

61379

25X1

25X1

ROLLING THUNDER
Attacks on Port Facilities and Naval Bases, 2 March-24 December 1965



[a] UPPER LIMIT OF THE RANGE OF ORDNANCE AND SORTIES GIVEN IN THE TARGET INFORMATION SUMMARY (TIS) OF THE JOINT CHIEFS OF STAFF AS THE OPERATIONAL REQUIREMENTS FOR 70% DESTRUCTION OF THE TARGET

[b] 15 PERCENT OF NORTH VIETNAMESE NAVAL BASE SUPPORT CAPACITY WAS DESTROYED AT THE TWO NAVAL BASES.

Figure B-28b Rolling Thunder: Statistical Summary of Attacks on Port Facilities and Naval Bases, 2 March–24 December 1965

61200
25X1

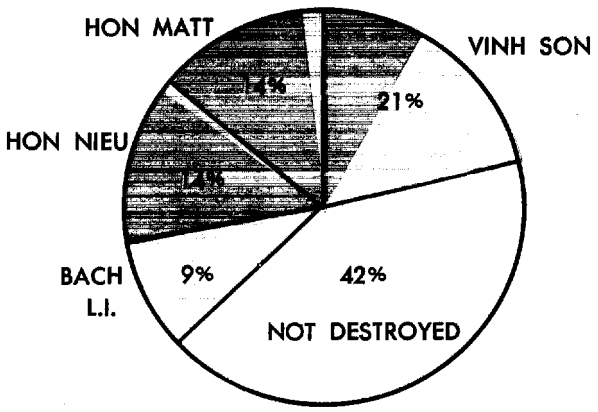
25X1

ROLLING THUNDER
Attacks on Radar Installations, 2 March 1965-24 December 1965

U S NAVY | U S AIR FORCE | SOUTH VIETNAMESE AIR FORCE | PROGRAMED IN TIS

PERCENT OF TARGETED CAPACITY DESTROYED

KNOWN RADAR SITES: 29
TARGETED RADAR SITES: 5
RADAR SITES STRUCK: 10



ORDNANCE (TONS)

PROGRAMED IN TIS: 130

DELIVERED: 680 — 53% | 36% | 11%

SORTIES

PROGRAMED: 61

ACTUAL:

STRIKE AND FLAK: 620 — 68% | 37% | 5%

SUPPORT: 350 — 52% | 48%

STRIKES: 66 — 19% | 79% | 2%

LOSSES:

AIRCRAFT: 11

PERSONNEL: 3 — PERSONNEL RECOVERED: 9

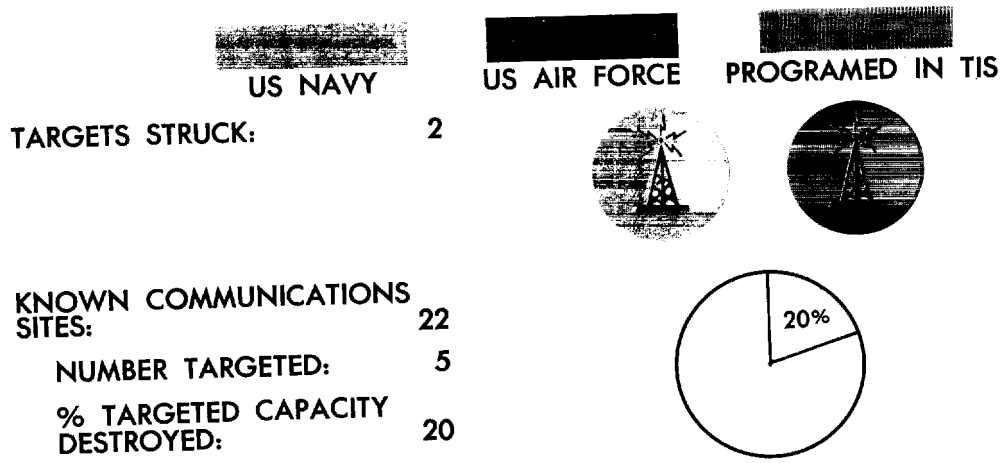
a) Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

B-29 Rolling Thunder: Statistical Summary of Attacks on Radar Installations
2 March–24 December 1965

61380 25X1

25X1

ROLLING THUNDER
Attacks on Communications Facilities, 2 March-24 December 1965



a UPPER LIMIT OF THE RANGE OF ORDNANCE AND SORTIES GIVEN IN THE TARGET INFORMATION SUMMARY (TIS) OF THE JOINT CHIEFS OF STAFF AS THE OPERATIONAL REQUIREMENTS FOR 70% DESTRUCTION OF THE TARGET

B-30 Rolling Thunder: Statistical Summary of Attacks on Communications Facilities 2 March–24 December 1965

613291 25X1

25X1

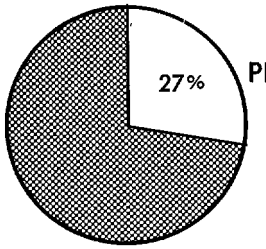
ROLLING THUNDER
Attacks on Electric Powerplants, 2 March 1965-24 December 1965

U S AIR FORCE U S NAVY PROGRAMED IN TIS

TARGETS ATTACKED: 6

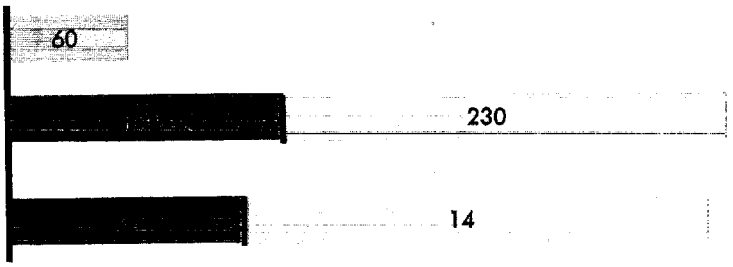
5 THERMAL 1 HYDRO

TOTAL NATIONAL CAPACITY: 175,000 KILOWATTS

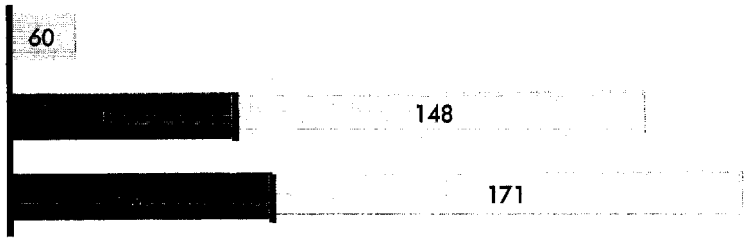


PERCENT NATIONAL CAPACITY DESTROYED: 27

ORDNANCE: (TONS)



STRIKE SORTIES (INCLUDING FLAK SUPPRESSION SORTIES)

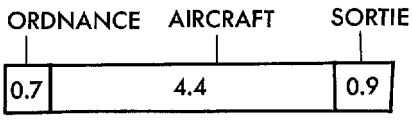


STRIKE AIRCRAFT LOST: 4

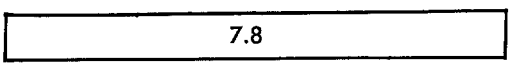
PERSONNEL LOST: 3

PERSONNEL RECOVERED: 1

ESTIMATED COST OF ATTACKS ON ELECTRIC POWER PLANTS (MILLION US$): 6.0



ESTIMATED COST OF TARGET RESTORATION (MILLION US$): 7.8



[a] INCLUDES 19 AIRCRAFT THAT ALSO ATTACKED FIXED TARGETS OF OTHER TYPES ON MISSION.

B-31a Rolling Thunder: Statistical Summary of Attacks on Electric Powerplants 2 March–24 December 1965

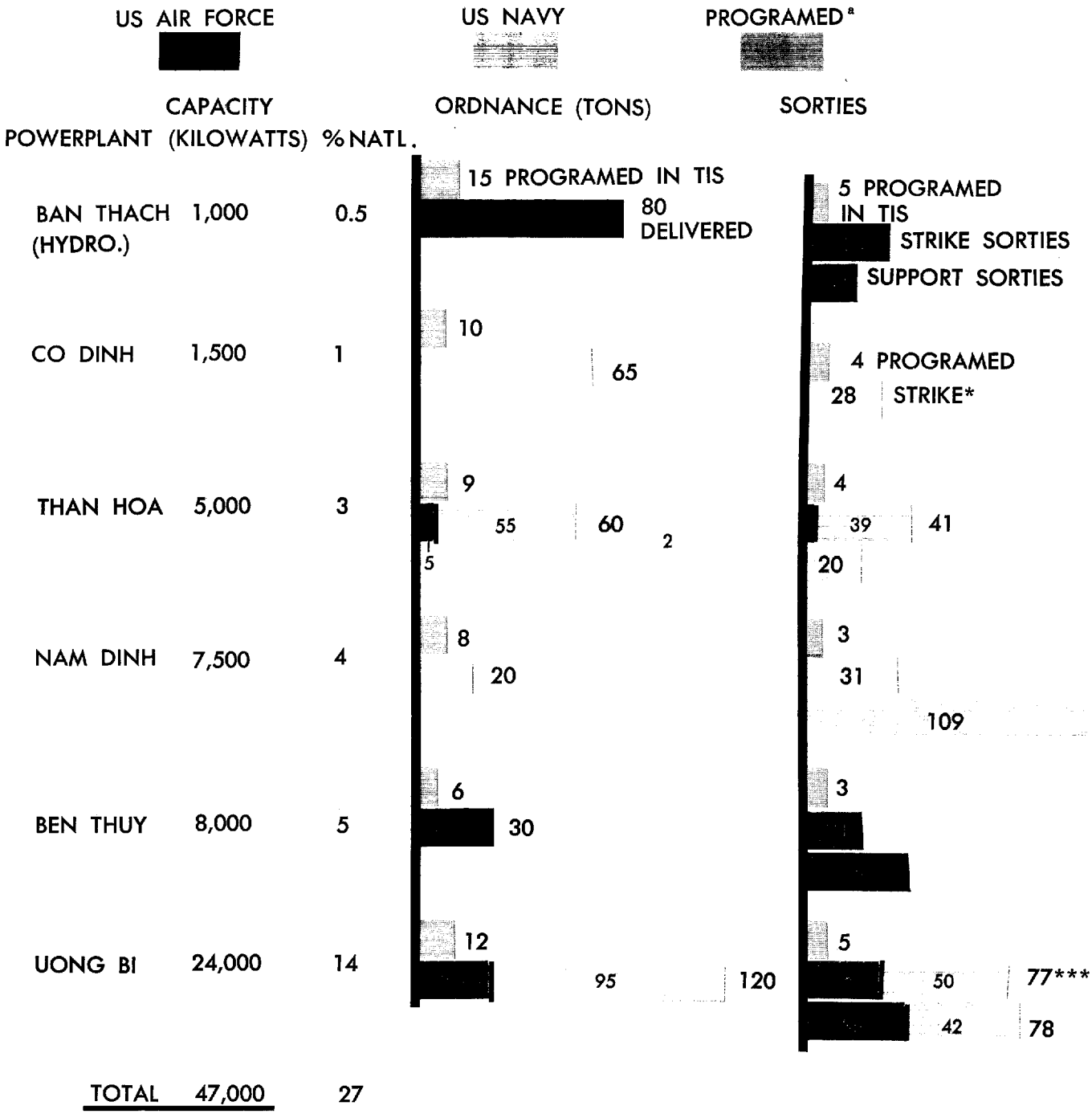
61382

25X1

25X1

ROLLING THUNDER

Attacks on Electric Powerplants, 2 March 1965-24 December 1965



a) Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

*ASTERISKS INDICATE NUMBER OF AIRCRAFT LOST.

B-31b Rolling Thunder: Statistical Summary of Attacks on Electric Powerplants 2 March–24 December 1965

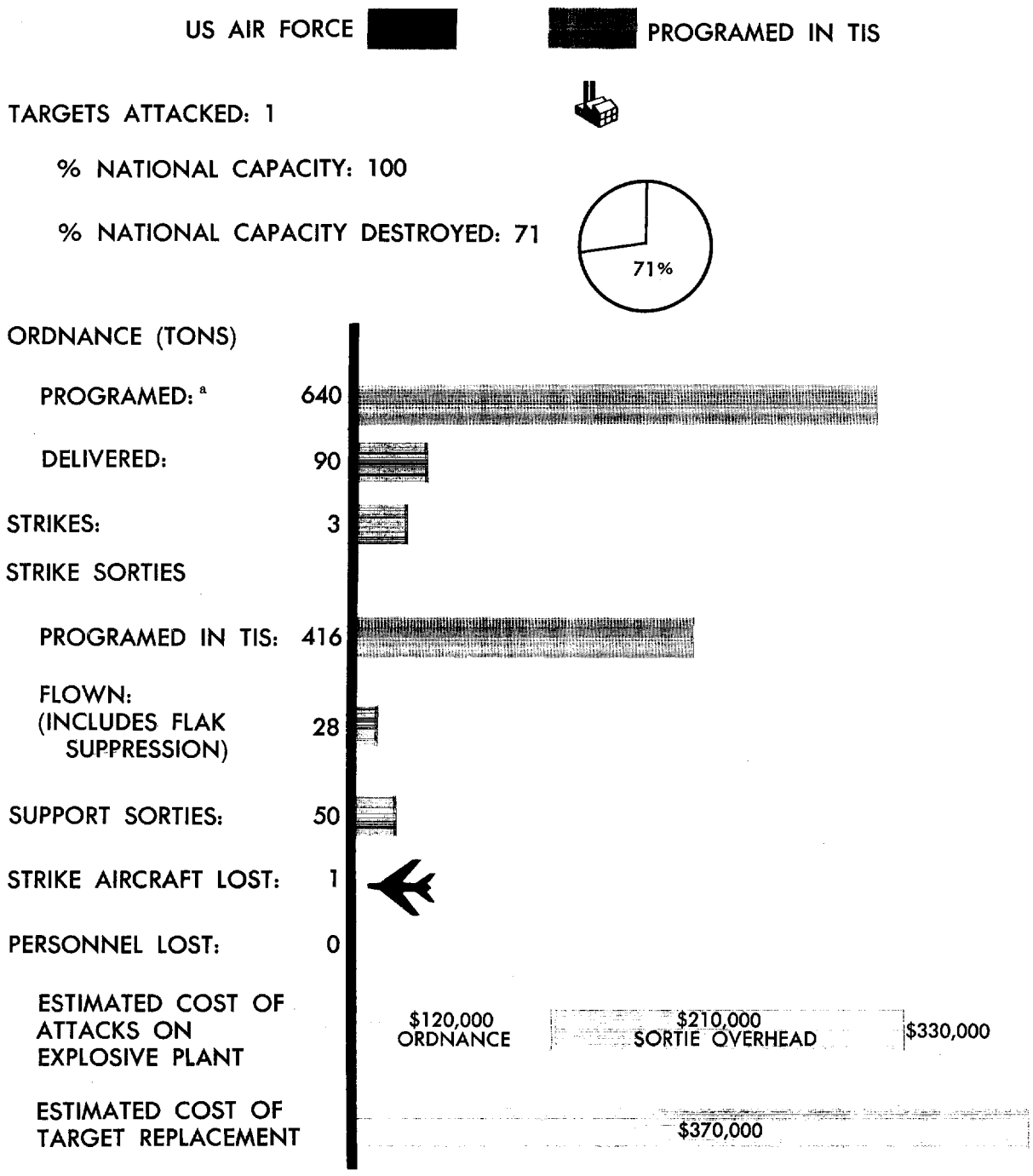
25X1

61390

25X1

ROLLING THUNDER

Attacks on Explosives Plants, 2 March 1965-24 December 1965



a) Upper limits of the ranges of ordnance and sorties given in the Target Information Summary (TIS) of the Joint Chiefs of Staff as the operational requirements for 70% destruction of the target.

B-32 Rolling Thunder: Statistical Summary of Attacks on Explosives Plants, 2 March–24 December 1965

61383

25X1

Appendix C

APPENDIX C

AN APPRAISAL OF THE EFFECTS OF THE BOMBING OF NORTH VIETNAM

I. Physical Damage

The cost of reconstruction or repair of the economic and military facilities in North Vietnam which were attacked under the Rolling Thunder program is estimated at about US $63 million. About 57 percent of the damage was inflicted on targets of an economic nature and roughly 43 percent against military targets. Strikes against assigned JCS targets (both military and economic) accounted for about 79 percent of the damage and armed reconnaissance missions for about 21 percent. Generally, most of the targets struck are located in southern North Vietnam and consequently are not of major importance either economically or militarily. The bulk of North Vietnam's important and as yet unstruck targets are located in the Hanoi-Haiphong complex. For a graphic presentation of the costs of reconstruction or repair of these economic and military facilities, see Figures C-1 through C-6. For locations of JCS targets, see the map, Figure C-7.

A. Economic

1. Powerplants

North Vietnam's pre-strike electrical generating capacity is estimated at 175,000 kilowatts. About 75 percent of this total was generated by the main electric power grid which is made up of eight large interconnected powerplants serving about 90 percent of North Vietnam's industry. Attacks on North Vietnam's electric power-producing facilities started in April 1965 and extended through 22 December. In all, six powerplants were struck, only two of which -- Ben Thach and Uong Bi -- are in the main power grid. The number of attacks against the powerplants ranged from two each against the Ben Thuy and Co Dinh powerplants to six against the plant at Thanh Hoa. The final powerplant to be struck was the one at Uong Bi, which was attacked four times in December (see Table C-1).

The six power facilities struck under the Rolling Thunder program effectively lost all their capacity to generate electric power, although the physical plants sustained varying degrees of destruction. Total power-generating capacity in North Vietnam has been reduced by about 27 percent while that of the main grid has been reduced by nearly 25 percent.

In general, the damage to the powerplants is so severe that none can be repaired quickly. In most cases, repair will necessitate dismantling and reconstruction of portions of the facilities, a process

Table C-1

Electric Powerplants Attacked Under the Rolling Thunder Program

Target Number	Name	Target Capacity (Kilowatts)	Target as a Percent of National Capacity	Dates of Attack (1965)	Percent of Target Capacity Currently out of Operation	Percent of National Powerplant Capacity Currently out of Operation	Cost of Restoration (Thousand US $)
82.1	Thanh Hoa	5,000	3	4 Apr 27 Jul 29 Jul 30 Jul 31 Jul 4 Aug	100	3	1,100
82.11	Ben Thuy	8,000	5	4 Jun 4 Jun	100	5	1,000
82.18	Co Dinh	1,500	1	8 Jun 10 Jun	100	1	400
82.15	Nam Dinh	7,500	4	28 Jul 29 Jul 2 Aug 3 Aug	100	4	2,000
82.21	Ben Thach	1,000	0.5	21 Aug 22 Aug 23 Aug	100	0.5	300
82	Uong Bi	24,000	14	15 Dec 20 Dec 22 Dec 22 Dec	100	14	3,000
Total						27 a/	7,800

a. Representing a net loss in national generating capacity of approximately 47,000 kilowatts. Total national electric power-generating capacity is 175,000 kilowatts.

almost as time consuming and costly as the original construction, and will require considerable foreign technical assistance as well as the importing of major components. At least six months will be required to restore three of the six plants to even partial operation (including the important Uong Bi facility) and from one to one and one-half years for the remaining three. Full restoration will require from one to two years and even longer for the Nam Dinh plant. Total cost of restoration is estimated to be $7.8 million.

The financial burden, however, is only partly indicative of the effect of the attacks. In order to reconstruct the facilities destroyed, large inputs of highly skilled personnel and materials embodying advanced technology will be required, forcing North Vietnam to make substantial diversions of resources from other priority needs as well as to require still more foreign assistance.

While destruction of the power facilities thus represents a distinct economic loss to North Vietnam, it is by no means of crippling proportions. Loss of capacity at those stations outside of the principal power network has resulted in local power shortages (in some cases stoppages) in the southern part of the country and in a reduction of the power available for agricultural irrigation. On the other hand, it is likely that the destruction of the capacity at the two network stations -- Nam Dinh and Uong Bi -- has been offset by an increased utilization of existing generating capacity in other powerplants joined to the network. Thus most of the major industrial requirements for power in the Haiphong-Hanoi area are probably being met.

2. Petroleum Storage

The allied strike on the major petroleum storage depot at Vinh in August 1964, in retaliation for the Tonkin Bay incidents, was the first attack on a North Vietnamese economic target. Since then, three other petroleum storage facilities have been bombed and the Vinh facility has been restruck (see Table C-2).

Pre-strike, major bulk petroleum storage capacity is estimated at about 190,000 tons,* located at 11 principal installations and a number of small, untargeted, local-issue storage points. Additional storage installations which were under construction at the time of the initial Vinh attack have been completed, and small, dispersed installations composed of semisurface, small, horizontal tanks have also been developed. The total oil storage capacity, therefore, is estimated to have been 216,000 tons, located in 12 principal installations and at small and untargeted sites.

Damage to the four storage installations which have been bombed represents a loss of 37,000 tons, or about 17 percent of the

* Tonnages are given in metric tons.

Table C-2

Petroleum Storage Facilities Attacked Under the Rolling Thunder Program

Target Number	Name	Target Capacity (Metric Tons)	Target as a Percent of National Capacity	Dates of Attack (1965)	Percent of Target Capacity Destroyed	Percent of National Storage Destroyed	Cost of Restoration (Thousand US $)
42.0	Phu Van	1,000	Negl.	6 May	100	Negl.	19
51.16	Phu Qui	10,000	5	18 May	80	4	151
50.0	Vinh	18,000	9	a/ 24 May 26 May 11 Sep 15 Sep 6 Oct	89	7	300
51.12	Nam Dinh	12,000	6	2 Jul 4 Jul	100	6	230
Total						17 b/	700

a. The facility at Vinh was attacked in August 1964, prior to the Rolling Thunder program.
b. Representing a loss in national storage capacity of approximately 37,000 metric tons. Total national storage capacity is 216,000 metric tons.

total capacity known to have existed in North Vietnam.* Individually, the strikes yielded complete destruction of capacity at Nam Dinh (12,000 tons) and Phu Van (1,000 tons), 80 percent at Phu Qui (originally 10,000 tons), and 89 percent at Vinh (originally 18,000 tons).

Total usable oil storage capacity in North Vietnam is estimated to have been 179,000 tons as of January 1966. This total includes 165,000 tons at eight principal and unattacked installations, 4,000 tons of residual capacity in two of the four bombed sites, and 10,000 tons in untargeted, dispersed, small storage sites. Total supply of petroleum to North Vietnam in 1965 is estimated to have been about 175,000 tons.

To restore the tankage damaged and destroyed at these four facilities would take from two to three months and would cost nearly $700,000. Materials for such a reconstruction would probably have to come from outside sources, presumably the USSR.

While loss of the storage facilities at Nam Dinh, Vinh, and Phu Qui has eliminated all bulk storage south of Haiphong, the economic effect has not been significant. Neither industry nor agriculture in North Vietnam is a large user of petroleum, and requirements could be met by makeshift storage and distribution procedures. In fact, it appears that North Vietnam has not chosen thus far to restore the bombed facilities but rather is dispersing petroleum supplies by the development of small storage depots elsewhere.

3. Manufacturing

Two manufacturing facilities have been bombed under the Rolling Thunder program. The Lang Chi Explosives Plant, attacked three times during July and August, is an assigned JCS target. The Nam Dinh Textile Mill, which is not an assigned target, was unintentionally damaged by a strike in late July against the Nam Dinh Thermal Powerplant, which lies adjacent to the mill (see Table C-3).

The damage sustained by both facilities is of little consequence to the economy or to North Vietnam's capacity to wage war. Although the Lang Chi plant is the only known North Vietnamese explosives producer, North Vietnam relies heavily on imports from other Communist countries. There is evidence in some recent years that Communist China has furnished virtually all the explosives required by North Vietnam. Damage to the Nam Dinh Textile Mill -- an important producer of cotton textiles -- was not extensive.

* The damage assessment includes the initial attack of the petroleum facility at Vinh, which took place prior to the Rolling Thunder program.

Table C-3

Manufacturing Facilities Attacked Under the Rolling Thunder Program

25X1

25X1

Target Number	Name	Target as a Percent of National Capacity	Dates of Attack (1965)	Percent of Target Capacity Destroyed	Percent of National Capacity Destroyed or Inactive	Cost of Restoration (Thousand US $)
47.2	Lang Chi Explosives Plant	100	24 Jul 7 Aug 8 Aug	71	57	370
	Nam Dinh Textile Mill	70 to 75 cotton spinning, 50 cotton weaving	28 Jul	5	3	800
Total						1,170

C-6

The attacks against the Lang Chi facility have reduced its capacity by nearly three-fourths, and the cost of restoration is estimated to be about $370,000. Restoration of the buildings damaged and destroyed could be done in a short time and the replacement of machinery would be relatively simple, although some of it might have to be imported.

Physical damage to the Nam Dinh Textile Mill is estimated to amount to a temporary loss of about 5 percent of the mill's productive capacity. The Nam Dinh mill accounts for 70 to 75 percent of North Vietnam's cotton-spinning capacity and for at least 50 percent of the cotton produced to meet its textile needs. The complete shutdown of the plant for a period of several months or longer could result in considerable shortages of textiles. Although the severe damage to the Nam Dinh Thermal Powerplant may have caused a temporary shutdown at the textile mill, it is very likely that alternate sources of power were soon made available. The cost of repair to the mill, including the replacement of damaged equipment, is estimated at $800,000. Replacement machinery can be imported from Communist China.

4. Bridges

a. JCS-Designated Highway Targets

Thirty JCS-designated highway bridges were destroyed or damaged by 59 attacks during the Rolling Thunder program through January 1966. The majority of these bridges are located on main highway routes in southern North Vietnam. With few exceptions, highway bridges located in the Haiphong-Hanoi area have not been attacked. Most of the highway bridges targeted by the JCS were successfully attacked during the early phases of the Rolling Thunder program -- few bridges were destroyed during the latter phases of the air war.

The highway bridges destroyed or damaged range in length from 100 to 500 feet and constitute most of the large bridges located outside of the Hanoi-Haiphong area. Generally, the North Vietnamese do not appear to have made a major reconstruction effort on these bridges. Fords, ferries, and pontoon bridges are usually pressed into service after a highway bridge has been destroyed. Major reconstruction efforts are undertaken only when the rivers are too deep to ford or when traffic bottlenecks occur because of the limitations encountered in using ferries and pontoon bridges.

b. JCS-Designated Railroad Targets

Six railroad bridges on the JCS target list have been destroyed or damaged in 20 attacks on the Hanoi-Vinh, Hanoi-Lao Cai, and Hanoi-Dong Dang rail lines. The rate of repair on rail bridges has been considerably more rapid than in the case of highway bridges.

Temporary bridge restoration on the Hanoi-Lao Cai and Hanoi-Dong Dang lines has, in certain instances, been made in less than two weeks.* Restoration on the Hanoi-Vinh line has usually taken considerably longer, though actual work time is about the same.

The economic and military importance of the Hanoi-Dong Dang and the Hanoi-Lao Cai lines undoubtedly account for the rapid restoration of these rail bridges, partly by Chinese railroad construction units. Restoration of the bridges on the Hanoi-Vinh line has been slower, probably reflecting both the more limited economic and military importance of the rail line south of Hanoi. It should be noted, however, that through rail service appears to have been reestablished between Hanoi and Vinh.

c. JCS-Designated Combination Railroad/Highway Targets

Six combination bridges have been destroyed or damaged in 19 attacks on the above-mentioned rail lines. These combination bridges have received the same priority for restoration as that given to rail bridges.

d. Armed Reconnaissance Bridge Targets

Some 660 bridges have been reported as being destroyed or damaged by pilots on armed reconnaissance missions during 1965. This figure undoubtedly contains considerable double counting and inaccurate assessments of the actual damage incurred. Estimates of destruction and damage on the basis of photographic evidence show less than 30 percent of the damage claimed by pilot reports, as shown in the following tabulation:

	Destroyed or Damaged	
	Photographic Evidence	Pilot Reports
Railroad and combinations	30	64
Highway bridges	145	593
Total	175	657

The costs of repairing damage inflicted on 42 JCS-designated bridges are estimated at $4 million and at $6.5 million for the 175 bridges struck by armed reconnaissance. Although the

* This restoration time represents reconstruction observed in photography; restoration could have been achieved in a shorter period of time.

armed reconnaissance effort has destroyed or damaged far more bridges than the strikes against JCS-designated targets, the JCS-targeted bridges are the major bridge installations.

Both money and inputs of skilled labor and material required ultimately for the complete restoration of the destroyed and damaged bridges will be considerable. Even with necessary substantial foreign assistance it appears that it will take the North Vietnamese at least five years after the present conflict is over to restore the existing damage.

5. Railroad Yards

Three railroad yards were struck under the Rolling Thunder program. Of the three, only the Vinh classification yard is on the JCS target list. Neither the Yen Bai yard (on the Hanoi-Lao Cai line serving northwest North Vietnam and Yunnan Province, China) nor the Nam Dinh yard (on the Hanoi-Vinh line serving southern North Vietnam) were assigned targets. They were attacked in conjunction with strikes against targeted facilities in the surrounding areas. These three yards represent about 10 percent of the total national railroad cargo-handling capacity. Both the amount of time and the cost involved in repairing the bomb damage to the rail yards are considered to be negligible (see Table C-4).

Although the damage inflicted on the rail yards succeeded in limiting and in certain instances in stopping temporarily the through movement of traffic along the lines, the bombings have not significantly hampered the operations of the major segments of North Vietnam's rail system.

The attacks on the Nam Dinh and Vinh yards added incremental damage to the operation of the interdicted Hanoi-Vinh line. However, the level of traffic normally moving on this line is relatively small. The damage inflicted on the Yen Bai yard, coupled with bridge interdictions along the line, limited through rail service between Hanoi and Lao Cai and since July has effectively halted exports of apatite, a principal North Vietnamese export.

Most North Vietnamese rail activity is centered on the Hanoi-Dong Dang (China) and Hanoi-Haiphong rail lines. Two large railroad yards are located in the Hanoi area (Yen Vien and Hanoi) and constitute approximately 60 percent of North Vietnamese railroad cargo-handling capacity. The heart of North Vietnam's rail system lies within the sanctuary area. Most of the locomotives, rolling stock, repair shops, and rail yards are within the Hanoi-Haiphong complex.

Table C-4

Railroad Yards Attached Under the Rolling Thunder Program

Target Number	Name	Dates of Attack (1965)	Damage	Cost of Restoration (Thousand US $)
21.1	Vinh Classification Yard N.W.	26 May 27 May 1 Jun	Main line interdicted in four places; four sidings interdicted	
	Nam Dinh Yard	2 Aug 4 Aug	Damage to switching wye, rail sidings, tracks, and buildings	70
	Yen Bai Yard a/	11 Jul 13 Jul 14 Jul	Damage to rolling stock; lines interdicted in numerous places	
Total				70

a. Hit in conjunction with strike against JCS Target No. 44, Yen Bai Ordnance Depot.

6. Maritime Ports

Six North Vietnamese ports representing 88 percent of the country's total maritime cargo-handling capacity have been selected as JCS targets. Under the Rolling Thunder program the ports of Ben Thuy and Ham Rong, serving Vinh and Thanh Hoa, respectively, have been struck. Approximately 60 percent of the cargo-handling capacity at Ben Thuy was destroyed and approximately 15 percent at Ham Rong. It is estimated that damage to the port facilities will cost about $660,000 to restore (see Table C-5).

The impact of this damage on North Vietnam's economy is of minor proportions. Ben Thuy and Ham Rong constitute only 5 percent of the nation's maritime cargo-handling capacity. Both ports serve southern provinces that are largely rural. Consequently, neither of the damaged ports plays an important role in the economy of North Vietnam. With the exception of machinery, most repair materials can be obtained locally. Reconstruction operations are not considered to be complex and probably could be completed in a fairly short period of time.

The most important ports, located in northeastern North Vietnam, have not been subjected to attack. The Haiphong port complex represents about 50 percent of the nation's maritime cargo-handling capacity and is by far the most active port in the country, handling most import and export trade. Cam Pha and Hon Gai, which handle primarily coal exports, make up an additional 32 percent of national cargo-handling capacity. These ports, representing 82 percent of the nation's cargo-handling capacity, are the only significant deepwater ports in North Vietnam.

7. Locks

Of the 91 locks and dams known to be in North Vietnam, 8 locks have been targeted because of their significance to inland waterways, flood control, and irrigation. Only one lock -- Bich Phuong Lock No. 3 -- located in Thanh Hoa Province, was struck under the Rolling Thunder program. This lock was attacked twice in August and was heavily damaged. The water level in the Song Chu canal undoubtedly dropped as a result of the attacks, and inland water traffic in the area was probably disrupted. Repair of the damage to the lock would take about 30 days, provided that the necessary manpower and material were readily available.

Simultaneous damage to the remaining seven locks would significantly hamper North Vietnam's inland water transport system. The destruction of the Ben Thon, Van Cau, and Lu Yen Locks in the Haiphong-Hanoi area would seriously lower the water level in the canals linking Hanoi and Thai Nguyen with the seaport at Haiphong. Since a significant portion of the goods transported in the Delta region move by inland water, the disruption of this bulk-carrier

25X1

Table C-5

Maritime Ports Attacked Under the Rolling Thunder Program

25X1

Target Number	Name	Target Capacity (Short Tons of Cargo Handled per Day)	Target as a Percent of National Maritime Cargo-Handling Capacity	Dates of Attack (1965)	Percent of Target Capacity Destroyed	Percent of National Cargo-Handling Capacity Destroyed	Cost of Restoration (Thousand US $)
71.0	Ben Thuy	3,130	4	5 Jun 6 Jun 8 Jun 9 Jul 10 Jul 11 Jul 17 Jul 19 Jul 21 Jul	61	2.4	470
71.13	Ham Rong	782.5	1	14 Jul 16 Jul 18 Jul	15	0.2	190
Total							660

route would present the North Vietnamese with considerable transportation problems. The destruction of the other four locks in Thanh Hoa and Nghe An Provinces would also present problems to canal traffic operating in the area.

8. Agriculture

Allied attacks on electric powerplants may have indirectly caused some agricultural losses in North Vietnam during 1965. The relatively good fall rice crop may have been reduced by some 30,000 tons as a result of the lack of electric power needed to operate the irrigation pumps in the southern provinces. The imputed loss is estimated to be $3.5 million.

Attacks on the electric power network in Thanh Hoa and Nghe An Provinces in mid-1965 probably interrupted irrigation services to nearly 100,000 acres of rice land. 25X1

25X1

A shortfall of 30,000 tons of rice would have little appreciable effect on the total rice production in North Vietnam, which averages about 4.5 million tons annually. Good weather conditions in 1965 probably more than offset the potential losses of rice attributed to irrigation difficulties -- the fall rice crop in Nghe An and Thanh Hoa Provinces was apparently above normal.

9. Export Loss

The allied air effort has resulted in a decline in North Vietnam's export of apatite and cement and possibly in the export of other commodities as well. Apatite exports during the second half of 1965 ceased as a result of the continual interdiction (July through December) of the Hanoi-Lao Cai rail line, although by mid-December the North Vietnamese had succeeded in restoring through rail service on the line. The decline in cement exports during 1965 probably reflects the increased internal consumption of cement in repairing damage inflicted by allied air attacks and in the subsequent reconstruction efforts. Export losses for cement and apatite are presented in the following tabulation:

25X1

	Thousand US $
Cement a/	3,140
2nd quarter	630
3rd quarter	1,050
4th quarter	1,460
Apatite	2,560
2nd quarter	1,030
3rd quarter	
4th quarter	1,530
Total	5,700

a. Some double counting in terms of restoration cost and export loss may be included.

The fluctuations in other North Vietnamese exports present contradictory patterns that cannot be related unequivocally to the conduct of the air war.

B. Military

1. Airfields

Only 11 of North Vietnam's 22 airfields are targeted and considered to have economic and military significance. Between March and October, airfields at Vinh and Dong Hoi in the south and at Dien Bien Phu and Na San in the northwest were attacked numerous times. Dong Hoi and Vinh have limited jet capability and the other two airfields are able to handle only reciprocating engine aircraft. These four airfields represent about one-fifth of North Vietnam's targeted airfield capacity. Although each of the bombed airfields has facilities left standing, the runways are heavily cratered and the fields are unable to receive air traffic. Total restoration of these airfields will probably cost about $380,000 (see Table C-6).

The damage inflicted on the airfields has had limited secondary military and economic effects. Air transport and passenger service is virtually nonexistent in North Vietnam, and the fear of US airpower has generally kept North Vietnamese aircraft within the confines of the sanctuary area surrounding Hanoi. It appears likely that even if the airfields had not been damaged, their vulnerable locations would have limited their usefulness as operating airbases.

Table C-6

Airfields Attacked Under the Rolling Thunder Program

Target Number	Name	Percent of Target Utility Destroyed	Target as a Percent of National Capacity	Percent of National Targeted Capacity Destroyed or Inactive	Dates of Attack a/ (1965)	Cost of Restoration (Thousand US $)
4.0	Dong Hoi	53.0 (inactive)	6	6	30 Mar 6 Jun 1 Jul 17 Sep 22 Sep 23 Sep	50
5.0	Vinh	10.0 (inactive)	6	6	8 May 30 Jun 1 Jul	43
1.0	Na San	45.0 (inactive)	4	4	25 Jun 23 Sep 24 Oct	144
2.0	Dien Bien Phu	94.0 (inactive)	3	3	2 Jul 8 Jul	143
Total			19	19		380

a. Dates of attack indicate only assigned strikes; in certain instances more attacks have been launched against a specific target than is indicated above.

The most important airfields in North Vietnam are located in the Hanoi-Haiphong area. The Phuc Yen and Kep airfields, near Hanoi, and the Haiphong airfield all have full jet-handling capability. These three fields represent about 50 percent of the targeted airfield capacity in the country. Airfields at Hanoi/Gia Lam and Haiphong/Kien An have limited jet-handling capacity and constitute an additional 25 percent of North Vietnam's targeted airfield capacity.

2. Naval Bases

From early March to late September the naval bases at Phuc Loi and Quang Khe were attacked periodically under the Rolling Thunder program. Of the five naval bases considered to be of targeting significance, the bombed facilities represent a relatively small share -- 25 percent -- of the total support capability available to the North Vietnamese Navy. The damaged facilities normally provide berthing, logistical support, and repair facilities for coastal patrol craft operating in the waters off central and southern North Vietnam.

Bombing succeeded in reducing the utility of Phuc Loi by nearly one-half and the operational usefulness of Quang Khe by nearly four-fifths. This damage hypothetically represents a 15-percent reduction in North Vietnam's total support capability to its naval forces. Restoration costs are estimated to be $790,000 (see Table C-7).

The impact of the damage on the North Vietnamese Navy and economy is of limited significance. With the possible exception of replacing or repairing destroyed or damaged machinery, most of the repair materials can be obtained locally. Repair operations are not considered to be complex and could be completed in a fairly short period of time. It is doubtful that the damage to the bases has seriously affected the operations of North Vietnam's small navy, which during the air war has generally operated in areas not subject to air attack. The major naval bases located at Haiphong, Port Walnut, and Hon Gai represent 75 percent of the naval support capacity and currently serve as the base of North Vietnamese naval operations.

3. Barracks

At least 45 and possibly as many as 50 of the 63 targeted barracks in North Vietnam have been attacked under the Rolling Thunder program. Two-thirds of the barracks attacked are located in the southern provinces, one-fifth in the south-central region, and the remainder in the northwestern provinces. Damage to the barracks represents a reduction of one-fifth in national housing capacity in barracks. If restoration were attempted, the total cost would be about $16 million (see Table C-8).*

* Text continued on p. C-22.

Table C-7

Naval Bases Attacked Under the Rolling Thunder Program

Target Number	Name	Target as a Percent of National Support Capacity of Naval Bases	Percent of Base Capacity Destroyed	Percent of National Support Capacity of Naval Bases Destroyed	Dates of Attack a/ (1965)	Cost of Restoration (Thousand US $)
74.1	Quang Khe Naval Base	15.0	47.0	7	2 Mar 28 May 21 Sep 24 Sep 27 Sep 28 Sep	130
71.1	Phuc Loi	10.0	78.0	8	20 May 12 Sep	660
Total				15		790

a. Dates of attack indicate only assigned strikes; in certain instances more attacks have been launched against a specific target than is indicated above.

Table C-8

Barracks Attacked Under the Rolling Thunder Program

Target Number	Name	Target Capacity (Number of Men Accommodated)	Percent of Targeted National Capacity	Dates of Attack a/ (1965)	Percent of Targeted Capacity Destroyed	Percent of National Targeted Capacity Destroyed or Inactive	Cost of Restoration (Thousand US $)
33.0	Dong Hoi Barracks NW	2,500	0.6	7 Feb 24 Jul 27 Jul	82	0.5	550
39.0	Chop Le Barracks NW	1,200	0.3	8 Feb 11 Feb 7 Jun 9 Jun 10 Jun	36 (inactive)	0.3	110
39.16	Hon Gio Military Barracks		N.A.	14 Mar	N.A.	N.A.	20
32.0	Vu Con Barracks Supply	500	0.1	21 Mar 23 May	71 (inactive)	0.1	90
39.2	Vinh Linh Barracks Cent. NE	1,500	0.3	4 May 5 July 22 Sep 24 Sep 27 Sep	39 (inactive)	0.3	40
39.8	Vinh Linh Barracks NW, Xom Cho	1,200	0.3	4 May 5 Jul	87 (inactive)	0.3	260
39.5	Xom Trang Hoa Barracks and Supply Depot	1,350	0.3	8 May	66 (inactive)	0.3	500
39.7	Vinh Linh Barracks East, Line Cong.	1,000	0.2	9 May	90 (inactive)	0.2	225
39.11	Hoan Lao Barracks	2,500	0.6	19 May 22 Sep 25 Sep	80 (inactive)	0.6	550
39.13	Phu Le Barracks/ Supply Depot	1,200	0.3	21 May	48 (inactive)	0.3	200
29.0	Quang Suoi Barracks NE	2,500	0.6	22 May 23 Jul 26 Jul 29 Jul	32 (inactive)	0.6	200
56.0	Phu Qui Barracks/ Supply Depot	3,000	0.7	23 May 19 Jun 20 Jun 21 Jun 22 Jun	55	0.4	700
39.3	Mu Gia Pass Barracks	600	0.1	25 May	74 (inactive)	0.1	150
39.1	Ben Quang Barracks SW	2,100	0.5	27 May 3 Jun 28 Jun	66 (inactive)	0.5	350

a. Dates of attack indicate only assigned strikes; in certain instances more attacks have been launched against a specific target than is indicated above.

Barracks Attacked Under the Rolling Thunder Program
(Continued)

Target Number	Name	Target Capacity (Number of Men Accommodated)	Percent of Targeted National Capacity	Dates of Attack a/ (1965)	Percent of Targeted Capacity Destroyed	Percent of National Targeted Capacity Destroyed or Inactive	Cost of Restoration (Thousand US $)
52.0	Vinh, Hqs. Military Region IV, Barracks/ Supply Depot	5,000	1.1	4 Jun 6 Jun 7 Jun 8 Jun 10 Jun 7 Aug 8 Aug 9 Aug 14 Aug 16 Aug 17 Aug	43	0.5	540
38.0	Vinh Barracks	9,000	2.0	7 Jun 9 Jun 10 Jun 30 Jul 31 Jul 1 Aug 2 Aug 5 Aug 11 Sep 12 Sep	N.A.	N.A.	800
28.0	Ban Xom Lom Barracks	10,000	2.3	12 Jun 14 Jun 16 Jun 10 Jul 14 Jul 18 Jul 19 Jul 20 Jul 21 Jul 5 Nov	57 (inactive)	2.3	1,425
39.18	Muong Sen Camp	400	0.1	12 Jun	72 (inactive)	0.1	70
39.21	Yen Phu NE	4,000	1.0	12 Jun 13 Jun 14 Jun 15 Jun 7 Sep	51 (inactive)	1.0	510
39.14	Badon Barracks	670	0.2	14 Jun 17 Jun	30 (inactive)	0.2	50
39.24	Sam Son Barracks West	1,200	0.3	16 Jun	22	0.1	70
25.0	Son La Army Barracks; Hq. Military Region NW	9,000	2.0	18 Jun 20 Jun 23 Jun 24 Jun 29 Jun 30 Jun 1 Jul 13 Jul 14 Jul 15 Jul 10 Aug 11 Aug	52	1.1	1,120

Table C-8

Barracks Attacked Under the Rolling Thunder Program
(Continued)

Target Number	Name	Target Capacity (Number of Men Accommodated)	Percent of Targeted National Capacity	Dates of Attack a/ (1965)	Percent of Targeted Capacity Destroyed	Percent of National Targeted Capacity Destroyed or Inactive	Cost of Restoration (Thousand US $)
37.0	Moc Chau Barracks	1,000	0.2	21 Jun 23 Jun 24 Jun	65 (inactive)	0.2	160
39.12	Dong Hoi Barracks	3,000	0.7	21 Jun 7 Aug 9 Aug	77 (inactive)	0.7	575
63.0	Thuan Chau Barracks/ Supply Depot	1,000	0.2	29 Jun 30 Jun 10 Aug 15 Aug 16 Aug	52	0.1	250
39.17	Don Bai Dinh Military Camp	400	0.1	29 Jun	100	0.1	100
26.0	Dien Bien Phu Barracks	10,000	2.3	2 Jul 11 Jul 15 Jul 26 Jul 28 Jul 29 Jul 8 Aug 10 Aug 11 Aug 12 Aug 13 Aug 16 Aug 17 Aug 18 Aug	52	1.2	1,300
39.22	Thanh Hoa Barracks South	1,500	0.3	8 Jul 21 Aug	36 (inactive)	0.3	140
39.25	Vinh Son Barracks South	3,500	0.8	14 Jul 18 Jul 19 Jul	52 (inactive)	0.8	450
39.26	Dong Cao Thon Barracks	5,500	1.2	21 Jul 22 Jul	88 (inactive)	1.2	1,210
39.28	Bai Thuong Barracks NE	2,300	0.6	28 Jul 31 Jul 2 Aug 5 Aug 22 Aug	56 (inactive)	0.6	400
39.27	Vinh Barracks NNE	2,300	0.6	2 Aug 4 Aug 5 Aug	43	0.2	250
39.31	Xom Trung Hoa Barracks	1,000	0.2	25 Aug 28 Aug 29 Aug	31	0.1	80
39.34	Ha Tinh Barracks/ Supply Depot	900	0.2	5 Sep 6 Sep	35 (inactive)	0.2	150

Table C-8

Barracks Attacked Under the Rolling Thunder Program
(Continued)

Target Number	Name	Target Capacity (Number of Men Accommodated)	Percent of Targeted National Capacity	Dates of Attack a/ (1965)	Percent of Targeted Capacity Destroyed	Percent of National Targeted Capacity Destroyed or Inactive	Cost of Restoration (Thousand US $)
39.36	Vinh Barracks NW	4,000	1.0	7 Sep 8 Sep 9 Sep 10 Sep 14 Sep 15 Sep	53	0.5	550
39.32	Xom Bang Barracks East	850	0.2	6 Sep 12 Sep 13 Sep	97 (inactive)	0.2	200
39.35	Co Dinh Barracks NW		0.2	7 Sep 9 Sep 10 Sep 12 Sep 14 Sep 15 Sep 16 Sep	100 (inactive)	0.2	250
47.1	Yen Khaai Barracks/ Ammunition Storage	2,500	0.6	9 Sep 10 Sep 11 Sep 12 Sep 14 Sep 15 Sep	50 (inactive)	0.6	450
39.6	Vinh Linh Barracks SW		0.1	9 Sep 10 Sep	94 (inactive)	0.1	100
61.0	Xom Chang Barracks South		0.1	24 Sep 30 Sep	31 (inactive)	0.1	165
63.13	Chuc A Barracks/ Support Area		0.3	6 Oct	56	0.2	250
39.39	Phu Van Barracks SSE		0.5	24 Oct 25 Oct 26 Oct	88	0.5	440
39.49	Quang Khe Barracks		0.2	23 Dec	N.A.	N.A.	Negl.
Total						18	16,000

Total estimated barracks capacity in North Vietnam (443,000 men) exceeds the standing requirements of the PAVN. The order-of-battle strength of the PAVN is currently estimated to be below 300,000. A distinct possibility exists, therefore, that many of the barracks, especially those in the southern provinces, were either inactive or operating at a low level of capacity at the time they were attacked. At present it appears that the North Vietnamese have not made a significant attempt to repair the damage inflicted on the barracks.

Although the long-run economic and military implications of the damage to barracks may be significant, the short-run effects seem to be considerably less formidable. If, as seems likely, strikes against many barracks succeeded only in destroying excess or unused capacity, there would appear to be little need for the North Vietnamese Army to restore these facilities in the immediate future. The destruction of numerous barracks has undoubtedly caused the PAVN inconvenience.

[redacted] in most instances barracks, if occupied, were abandoned after the initial strike. Troops from the damaged barracks apparently are being quartered with civilians in nearby towns, in tents, and in other makeshift shelters in surrounding areas.

Most of North Vietnam's more important barracks are located in the Hanoi-Haiphong complex and have yet to be attacked. The military strength in this area far exceeds that in the outlying areas already struck by US aircraft.

4. Supply Depots

Eighteen of North Vietnam's supply and ordnance depots are targeted under the Rolling Thunder program; these facilities represent one-third of the known national storage capacity. The depots struck constitute about 5 percent of national capacity, and the actual storage area destroyed is even less. Except for the Vinh Supply Depot (serving Military Region IV) and the Yen Bai Ordnance Depot (serving the Hanoi area), the depots struck are of relatively minor importance to the PAVN and are located in the southern provinces of North Vietnam (see Table C-9).

The cost of restoring these facilities is estimated to be about $3 million. These depots could be put back into limited operation within a few days by utilizing local materials and labor and

[redacted]

[redacted]

Table C-9

Supply Depots Attacked Under the Rolling Thunder Program a/

Target Number	Name	Target Capacity (Square Feet)	Percent of National Capacity	Dates of Attack b/ (1965)	Percent of Target Capacity Destroyed	Percent of National Capacity Destroyed or Inactive	Cost of Restoration (Thousand US $)
53.0	Phu Van SE	55,440	0.5	19 Mar 26 May	86 (inactive)	0.5	372
55	Vinh Son	84,480	0.8	19 Mar 20 Jun 22 Jun 24 Jun	47	0.4	144
54	Thien Linh Dong South	124,080	1.2	30 Apr 13 Aug	58 (inactive)	1.2	495
63.2	Dong Thanh Warehouse Area South	68,640	0.6	8 May 22 Jun	71 (inactive)	0.6	492
63.1	Vinh Loc	50,000	0.5	20 Aug	79 (inactive)	0.5	236
63.21	Dong Thanh Warehouse West	54,000	0.5	17 Aug 18 Aug 18 Nov	38	0.2	386
63.12	Phu Duc	30,000	0.3	26 Aug	100	0.3	N.A.
Total						4	3,000 c/

a. See also the following targets listed in Table C-8 which also have some supply/storage capacity:

JCS Number	Name	JCS Number	Name
25	Son La Army Barracks	52	Vinh, Headquarters Military Region IV, Army Barracks
32	Vu Con Army Barracks		
39.13	Phu Le Army Barracks	56	Phu Qui Army Barracks
39.34	Ha Tinh Army Barracks	63	Thuan Chau Barracks
39.5	Xom Trung Hoa Army Barracks	63.13	Chuc A Army Barracks

JCS Target No. 44, Yen Bai Ordnance Depot, listed in Table C-10, also has some supply/storage capacity.

b. Dates of attack indicate only assigned strikes; in certain instances more attacks have been launched against a specific target than is indicated above.

c. Including an estimated cost of $874,500 for restoration of the supply/storage depots within barracks. See footnote a.

into full operation within weeks if replacement supplies were forthcoming. In most cases, adjacent civilian buildings in the depot areas can be used for emergency storage. The largest supply depots have yet to be attacked. These include the Hanoi Supply Depot South at Quin Loi, the Hanoi Supply Depot North at Tay Ho, the Thai Nguyen Supply Depot (believed to be the largest supply depot in North Vietnam), and the Thuan Chau Barracks and Supply Depot.

5. Ammunition Depots

Thirteen ammunition depots have been struck during the Rolling Thunder program. Almost two-thirds of North Vietnam's ammunition storage capacity is estimated to have been destroyed, damaged, or deactivated as a result of allied airstrikes. The cost of restoring these facilities is estimated to be $4.5 million (see Table C-10). These figures, however, must be qualified. Most of the destroyed capacity has been located in the southern, central, and western areas of North Vietnam. It is also difficult to tell at what level of capacity these depots were being utilized before the airstrikes began. Although there is no indication that any ammunition depot resumed activity after being hit, it is estimated that a limited reactivation of the depots, using tents, could be accomplished in 10 days.

Of the ammunition depots attacked, Bac Can, Tai Xouan, Lang Het, Yen Son, and Yen Bai probably play a role in the ammunition supply arrangements between China and North Vietnam. The other depots are important for regional support of North Vietnamese troops and for supplying the Viet Cong and PAVN units in Laos and South Vietnam. The destruction of these depots probably has caused temporary delays but has not caused a cessation in the movement of ammunition.

Several ammunition depots not yet struck by allied forces seem to be fundamental to the overall supply network between China and North Vietnam. Their loss in the short run would be significant in hampering North Vietnam's military efforts in the south. For example, the destruction of the Hon Gai depot which serves the 320th Division in the Haiphong area would reduce ammunition supplies to Haiphong but might also eliminate secure storage for new stocks coming in from China. The Cam By depot, which supports the Hanoi-Haiphong complex, also serves depots to the south. Its destruction would delay the movement of supplies going south and would also deny additional storage for ammunition imported from China. The Haiphong depot is known to serve as a major ammunition storage area for ground forces in the Haiphong area and may also be used to store ammunition headed south. The Phu Lang Thuong depot mainly provides storage space for ammunition imported from China. The destruction of the above-mentioned facilities would initially limit the movement of ammunition from China to North Vietnam and would hinder the internal distribution of ammunition supplies.

Table C-10

Ammunition Depots Attacked Under the Rolling Thunder Program a/*

Target Number	Name	Target Capacity (Metric Tons)	Percent of National Capacity	Dates of Attack b/ (1965)	Percent of Targeted Capacity Destroyed	Percent of National Capacity Destroyed or Inactive	Cost of Restoration (Thousand US $)
64.0	Xom Bang	5,000	4	2 Mar	75.0 (inactive)	4	260
40.0	Phu Qui	9,000	8	15 Mar 30 Apr 22 May 4 Jun	62.0 (inactive)	8	300
41.0	Phu Van	3,800	3	19 Mar 5 May 6 May	71 (inactive)	3	150
47.18	Xom Rung	4,120	4	4 May 31 Jul	13 (inactive)	4	30
47.11	Hoai An	8,236	7	30 May 31 May 1 Jun	61 (inactive)	7	240
47.19	Dan Nuoc Chiev	11,900	11	20 Jun 22 Jun 24 Jun 6 Jul 23 Jul 6 Aug 8 Aug 11 Aug 18 Sep	48 (inactive)	11	530
43	Qui Hau	11,500	10	25 Jun 26 Jun 27 Jun 3 Jul 4 Jul 8 Jul	32 (inactive)	10	240
46	Ban Phieng Hay	1,500	1	25 Jun 30 Jun	50 (inactive)	1	50
47	Yen Son	10,000	9	9 Jul 10 Jul 11 Jul 12 Jul 20 Jul 25 Sep 26 Sep	58 (inactive)	9	960

25X1

25X1

* Footnotes follow on p. C-26.

Table C-10

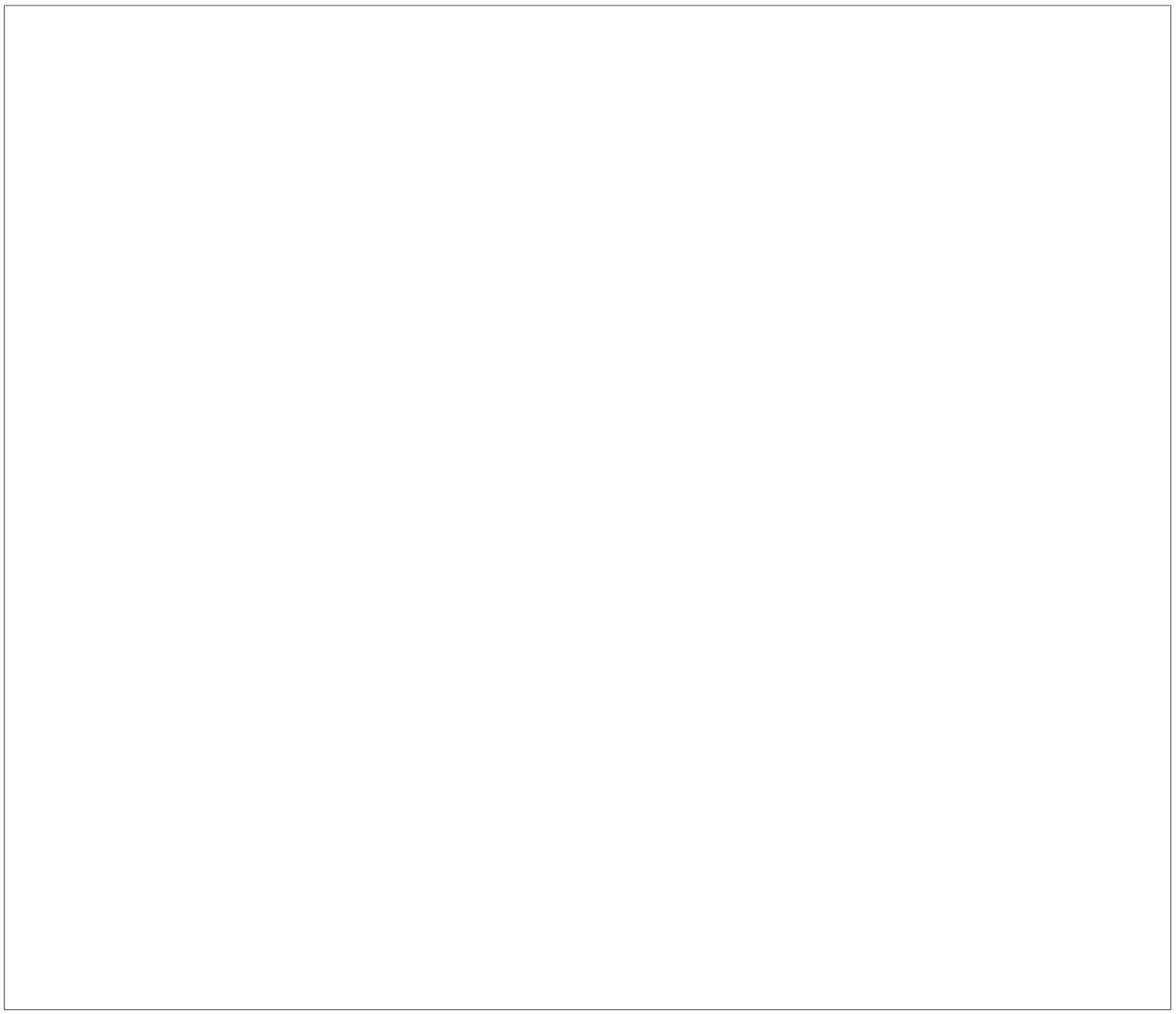
Ammunition Depots Attacked Under the Rolling Thunder Program a/
(Continued)

25X1

Target Number	Name	Target Capacity (Metric Tons)	Percent of National Capacity	Dates of Attack b/ (1965)	Percent of Targeted Capacity Destroyed	Percent of National Capacity Destroyed or Inactive	Cost of Restoration (Thousand US $)
44	Yen Bai		3	9 Jul 10 Jul 11 Jul 12 Jul 13 Jul 14 Jul 17 Jul	55	2	1,190
47.13	Tai Xouan	7,700	7	24 Jul 18 Sep 21 Sep 23 Sep 26 Sep	32	2	330
47.22	Bac Can	2,000	2	5 Sep 8 Sep 10 Sep 12 Sep 14 Sep 15 Sep	75 (inactive)	2	200
47.12	Lang Het	6,750	6	5 Oct	4	0.2	20
Total						63	4,500

a. See also JCS Target No. 39.31, Xom Trung Hoa Barracks, listed in Table C-8, which also has ammunition storage capacity.
b. Dates of attack indicate only assigned strikes; in certain instances more attacks have been launched against a specific target than is indicated above.

25X1



8. Radar

There were three radars destroyed and six damaged in Rolling Thunder operations through 24 December. One radar was struck as a target of opportunity under the armed reconnaissance program; all the rest were associated with the JCS target program either as primary targets or as a part of a SAM site. The estimated value of the radars destroyed is as follows:

Number	Type	Thousand US $
2	SCR-270 early warning	150
1	TRACKDISH fire control	245
Total		395

The radars damaged are believed to be of the types listed below:

Number	Type	Thousand US $
1	KNIFEREST B early warning	75
2	CROSS SLOT early warning	150
1	SCR-270 early warning	75
1	SPOONREST A early warning	75
1	FLAT FACE early warning/target acquisition	260
Total		635

The bombing of radar installations in North Vietnam has not been of crucial significance to the country thus far.

C. Armed Reconnaissance

During 1965 the armed reconnaissance phase of the Rolling Thunder program was primarily directed against transport vehicles, small bridges, occasional assigned fixed targets, ferry facilities, and small pre-briefed targets in selected regions of North Vietnam. Some 28,000 armed reconnaissance sorties inflicted about $13.4 million worth of damage (see Table C-11).

Beginning in late March, allied aircraft were authorized, on a limited basis, to attack locomotives, railroad rolling stock, vehicles, and hostile North Vietnamese craft on selected routes below the 20th parallel. As the program expanded, greater areas of North Vietnam were opened for attack and more sorties and targets were authorized for armed reconnaissance missions. At the peak of the air war, roughly two-thirds of North Vietnam (excluding the Hanoi-Haiphong area, the northeastern provinces, and a 30-mile buffer zone along the North Vietnam-China border) was open to armed reconnaissance attack.

Damage to transport equipment accounted for $6 million, bridges $6.5 million,* miscellaneous buildings $280,000, and military-associated targets about $670,000 (see Table C-12). Most of the damage was inflicted in the southern provinces.

* For a further discussion of bridges destroyed or damaged by armed reconnaissance, see section A, 4, above.

Table C-11

Cost of Damage Inflicted by Armed Reconnaissance Sorties a/

1965	Total Cost of Damage (Thousand US $)	Number of Armed Reconnaissance Sorties	Cost of Damage per Sortie (US $)
April	555	1,200	462
May	565	1,237	457
June	1,002	1,386	723
July	900	1,732	520
August	620	4,221	147
September	642	4,594	140
October	763	5,458	140
November	1,285	5,108	252
December	625	2,996	209
Total	6,957	27,932	

a. Excluding damage to bridges of $619,000 on armed reconnaissance sorties.

25X1

25X1

Table C-12

Inventory of Damage by Armed Reconnaissance Sorties a/

	Destroyed	Damaged
Transport equipment	1,176	1,916
Locomotives	6	6
Rail cars	227	592
Trucks	318	487
Vehicles	165	78
Ferry boats	53	56
Barges	263	487
Lighters and junks	144	210
Bridges/ferry landings	175	557
Road bridges	161	432
Railroad and combination bridges	14	50
Ferry facilities	0	75
Small pre-briefed targets	1,911	2,625
Barracks	93	137
Supply warehouses	71	105
Miscellaneous buildings	1,673	2,024
Radar and communications sites	9	133
Truck parks	3	138
Antiaircraft sites	62	88

a. The total estimated cost of damage is $13,450,000.

II. Civilian and Military Casualties

A. General Considerations

In general the estimates of civilian casualties are based on methodologies previously adopted by CIA. The estimates of military casualties have been provided by the Defense Intelligence Agency and have been accepted as presented subject to an adjustment of plus or minus 10 percent to allow for the probable bias inherent in pilot strike reports.

From early spring of 1965, when the governments of the United States and South Vietnam launched the Rolling Thunder program,* through 24 December, when a temporary halt in the bombing was ordered, North Vietnamese casualties -- both civilian and military -- are estimated to have reached a total of 11,700 to 14,800 killed and wounded. This estimate contrasts with a claim reportedly made last fall by Hanoi officials that total casualties had reached the 75,000 mark

The Rolling Thunder program has been specifically carried out with the view of avoiding civilian casualties where at all possible. It is estimated that roughly an equal number of civilian and military personnel have been killed or wounded during the course of the program, although military casualties slightly predominate in the ratio.** Strikes against the JCS-designated fixed targets, which are predominantly military, did not produce as high a ratio of civilian casualties as did the armed reconnaissance program. Bombardment of fixed targets resulted in a ratio of about two-thirds military to one-third civilian casualties. The armed reconnaissance missions, however, which were primarily directed against targets of opportunity -- both economic and military within certain prescribed areas -- and which comprised a larger share of the total Rolling Thunder sorties flown, resulted in a preponderance of civilian casualties -- estimated to be about 58 percent of the total casualties from armed reconnaissance. The civilians subjected to armed reconnaissance attacks are for the most part directly engaged in transport, construction, and repair activities directly related to the North Vietnamese war effort.

---

* Casualty estimates in this report reflect intelligence information available on all Rolling Thunder missions as well as the three missions of 7, 8, and 11 February which took place just prior to the inception of the Rolling Thunder program.

** Numerical data on casualties are presented in the following sections.

To illustrate further, bombing activities against fixed targets had tapered off considerably in the final two months covered by this report -- November and December 1965 -- and were in all but six cases directed toward the restriking of targets that had been covered by earlier missions. Furthermore, there were no targets struck in major urban areas. Under these conditions, bombing of fixed targets in November and December added only about 1 percent or less to the total of civilian casualties under the Rolling Thunder program. In other words, virtually all civilian casualties from strikes on fixed targets occurred in the first four-fifths of the timespan covered by the program. By way of contrast, armed reconnaissance during November and December added about 36 percent to total civilian casualties for this type of target. In other words, approximately one-fourth of all civilian casualties resulting from armed reconnaissance occurred in the final one-fifth of the period being studied.

Similar comparisons made for military casualties during November and December bear out these same general tendencies. Strikes on fixed targets during the two-month period added only a little over 1 percent to the total military casualties for this type of mission -- reflecting the fact that fewer targets were bombed and that they were often in an abandoned state, having been struck before. The increase in military casualties from armed reconnaissance for the final two-month period was also significant, amounting to about 45 percent.

B. Intelligence Sources for Estimating Casualties

The number of casualties from allied airstrikes in North Vietnam cannot be estimated with any precision.

25X1

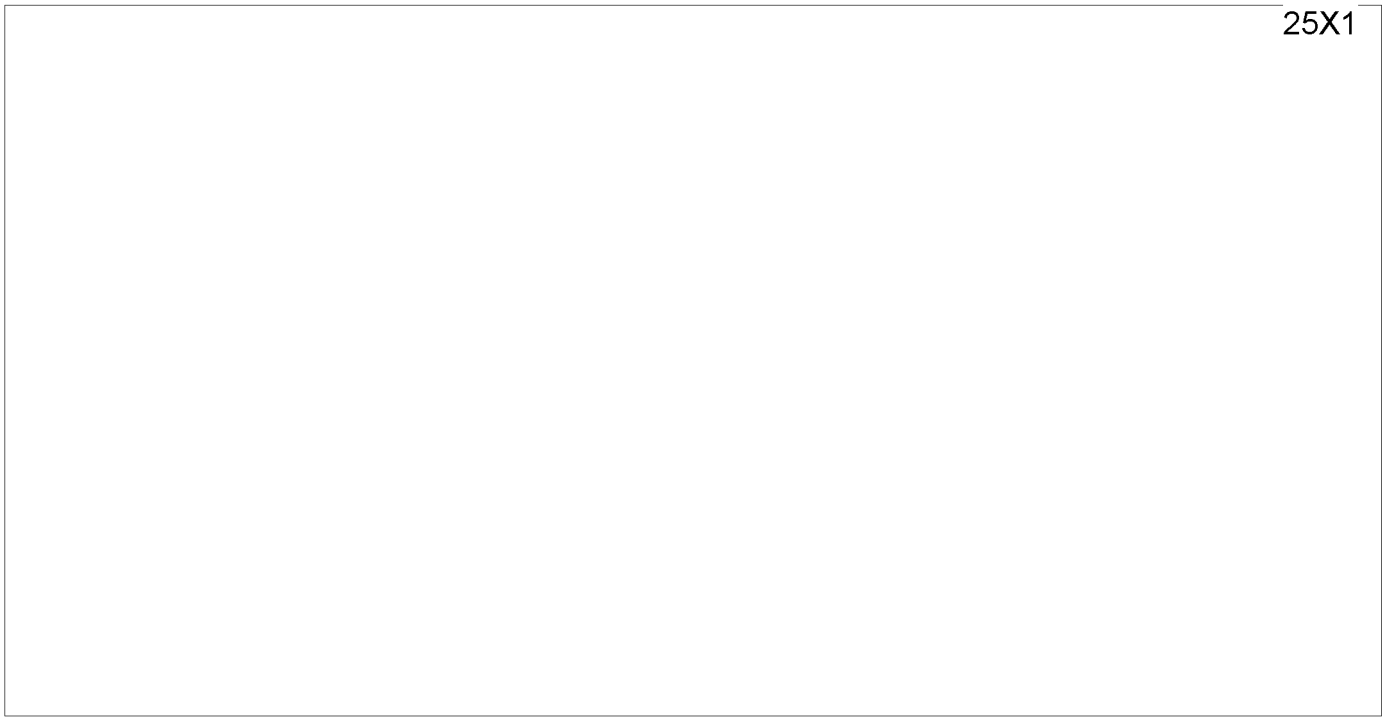
25X1

Although the United States adopted self-imposed restrictions on its air offensive against North Vietnam in order to minimize civilian casualties, it is to North Vietnam's interest to assert otherwise. Thus its propaganda media give the impression that the air offensive is a vicious and unrestrained assault on the civilian population, hospitals, schools, and other nonmilitary objectives. While there have been few North Vietnamese official statements giving precise casualty figures for specific incidents, the North Vietnamese press and radiobroadcasts and formal protests by the North Vietnamese Army to the International Control Commission imply that casualties are inordinately high.

25X1

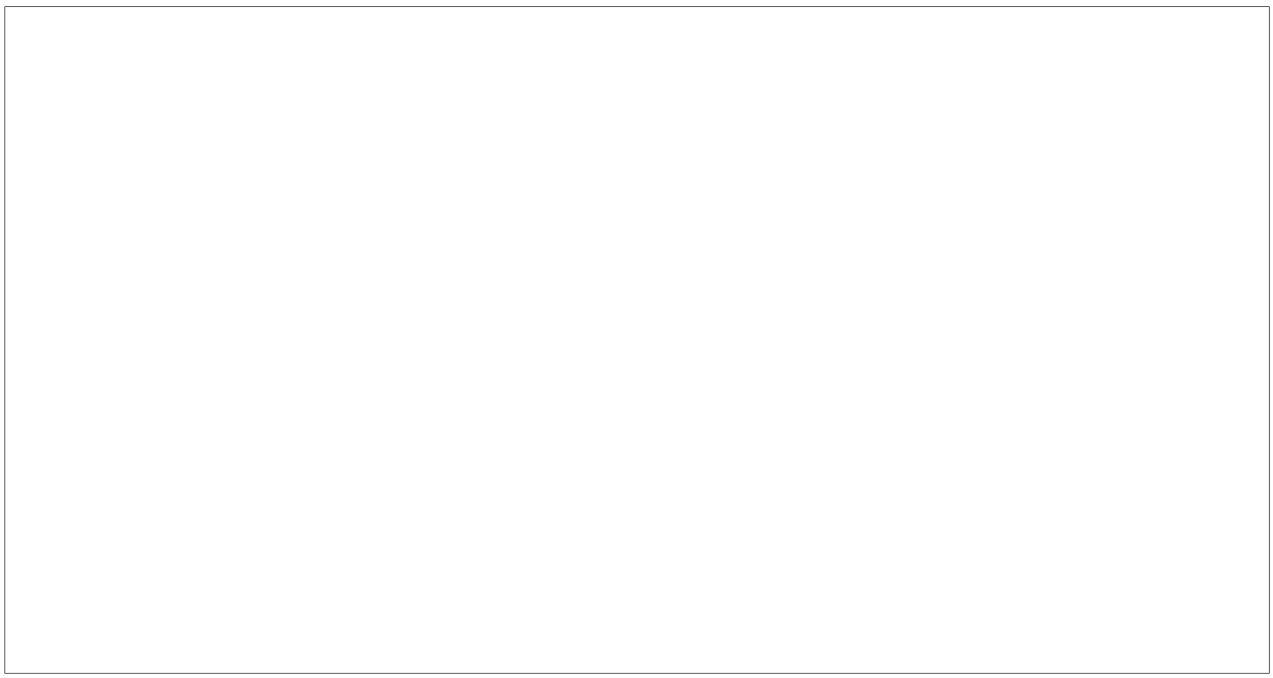
25X1

25X1



Finally, documented German experience with Allied bombing during World War II (covering the year 1943) averaging one wounded for each eight buildings severely damaged or destroyed and one killed for each 25 buildings severely damaged or destroyed has provided a useful assessment guideline. These data show the effectiveness of even improvised shelters.

25X1



25X1

25X1

D. Estimates of Casualties from Attacks on Fixed Targets

It is estimated that strikes against fixed targets, including armed reconnaissance strikes against JCS targets, resulted in 1,700 to 2,400 civilian casualties during the period 7 February to 24 December 1965. Of these, approximately 5 to 10 percent resulted from strikes against targets located in urban areas. For the same period, it is estimated that military casualties have been within the range of 3,800 to 4,700. Probably not more than 55 military casualties and 30 civilian casualties occurred in the last two months of the program prior to the Christmas cessation, reflecting the shift in emphasis to armed reconnaissance and the fact that many fixed targets struck during that period were abandoned. Furthermore, none of the targets struck during November-December was near heavily populated areas (see the tabulation in E, below).

About 470 strikes were made against 157 fixed targets in a little more than 100 localities. Approximately three-quarters of the strikes were made against targets in 55 urban areas, which ranged in size from Nam Dinh with a population of 90,000 to Ha Tinh, 5,000. The remaining strikes were made against nearly 65 targets in about 45 rural areas. About 10 targets were located in uninhabited areas for which no civilian casualties could be expected. Of the total, about one-fourth were economic targets located in urban areas.

During the last two months covered by this report, all targets struck -- 16 in number -- were considered to be located in rural areas, although two, the Uong Bi thermal powerplant and the Hanoi SAM support facility, are associated with urban areas -- though not geographically within the boundaries of the cities.

E. Estimates of Casualties from Armed Reconnaissance Missions

Since the inception of the armed reconnaissance strikes through 24 December, approximately 17,000 sorties were flown against trucks, boats, barracks, and lines-of-communication targets such as bridges,

railroads, and ferry facilities. Civilian casualties from this activity are estimated to range between 3,500 and 4,500 killed or wounded, whereas military casualties are numbered at 2,600 to 3,200. It is of interest that, although civilian casualties resulting from strikes on fixed targets have been a negligible factor in the total during the last two months, as shown in the tabulation below,* the number of killed or wounded from armed reconnaissance is relatively high, reflecting the increase in this type of activity. There was an estimated monthly total of 325 to 410 civilian casualties from armed reconnaissance through 28 October and some 450 to 600 casualties per month during the final two months covered by this report. Similarly there were 225 to 275 military casualties through October and 400 to 500 per month in the November-December period.

	Number	
Type of Casualty	February-October	November-December
Fixed targets		
Military	3,800 to 4,600	55
Civilian	1,700 to 2,400	30
Armed reconnaissance		
Military	1,800 to 2,200	800 to 1,000
Civilian	2,600 to 3,300	900 to 1,200

F. Estimated Total Casualties

The estimated total casualties resulting both from airstrikes against fixed targets and from armed reconnaissance missions is in the range of 11,700 to 14,800 persons, probably divided about equally between killed and wounded. Of these, between 5,200 and 6,900 represent civilian casualties. This estimate cannot be endorsed as one of precision or finality, however, even though it seems reasonably consistent with the information available.

The impact of some 3,000 civilian deaths out of the total number of civilian casualties cannot be great in the total picture of life in North Vietnam, where some 350,000 persons probably died in 1965 alone. Even the accidental death rate in North Vietnam overshadows the civilian casualty losses. At the rate of 3 to 5 percent of all deaths, accidents probably accounted for from 10,500 to 17,500 deaths in 1965. Relating these casualties to those inflicted by the Viet Cong on the civilian population of South Vietnam, it is observed that 1,870 South Vietnamese

* Because of rounding, the data shown in the tabulation do not necessarily agree with data given elsewhere in this report.

civilians were killed during 1965 and some additional 12,700 were kidnapped with unknown fate. The importance of the military casualties is likewise difficult to measure except in relative terms. The approximately 6,500 to 7,900 casualties represent only a small percentage of the estimated total North Vietnamese armed force of 265,000 troops and of the military casualties of the South Vietnamese armed forces during 1965 of approximately 34,000 killed and wounded.

III. North Vietnamese Countermeasures

A. Reconstruction and Repair

From the beginning of bombing attacks in February 1965, the North Vietnamese [redacted] have demonstrated a remarkable ability to restore and rebuild damaged or destroyed bridges, to improvise substitute stream crossings, and otherwise to maintain the transportation routes (see Table C-13). Despite shortages of technical and engineering manpower, administrative inefficiencies, and shortages of some types of construction materials and equipment, they have been able both to restore most of the damaged transportation routes and to improve and extend their supply net. Their pattern of engineering operations and techniques closely parallels that used by the Communist forces during the Korean War and demonstrates a phenomenal speed in replacing or repairing destroyed and damaged bridges, as shown in the following tabulation:

Type of Reconstruction	Length	Average Work Time (Hours)
Railroad bridges	60 to 90 feet	48 to 72
Highway bridges	20-foot spans	20 to 24
Approaches (earth)	50 to 100 feet	4 to 6
Bypasses	per mile	20 to 30
Underwater crossings (ford)	per 100 feet	8 to 10

Simplicity of construction, improvisation, and mass use of labor make it possible to surmount quickly the inconveniences created by the bombing. Available intelligence data indicate that bomb damage to supply routes has neither stopped nor curtailed the flow of military supplies, in part because current military logistics needs are not taxing the existing system. Moreover, Communist potential for recuperability, in terms of the means for restoration and repair, maintenance, and construction of new supply routes could be at least doubled and probably tripled.

On the other hand, recuperability from damage suffered by electric powerplants has been quite slow because of the shortage of technicians and the nonavailability of spare parts. Some machinery could be put back into operation by cannibalizing other damaged equipment for needed replacement parts. In most cases, however, it will be necessary to import both parts and new replacement equipment. Shortages of electric power probably have been partly compensated for by strict rationing regulations and the introduction of small portable generating units, by the spreading out of work shifts, and by more intensive utilization of existing generating capacity. It is believed that none of the powerplants damaged by airstrikes has yet been put back into service. Petroleum (POL) bulk storage installations which have been damaged have been

Table C-13

Estimated North Vietnamese Imports by Land and the Increase in Imports Resulting from the Rolling Thunder Program
1965

	Total Imports (Metric Tons)	Increase in Imports Resulting from Bombing			
		Volume (Metric Tons)	Number and Type	Source	Remarks
Total	310,000	110,000			
Military	100,000	90,000			Including (other than that noted below) large shipments of various types of artillery, tanks, mortars, small arms, other weapons, and ammunition.
Of which:					
SAM equipment	9,600 to 14,600	9,600 to 14,600	15 to 20 active sites	USSR	Including fire battalions and support battalions.
AAA equipment	4,600 to 5,600	4,600 to 5,600	1,000 to 1,200 weapons	USSR and China	
Aircraft	420	420	8 Il-28	USSR	
			11 MIG-21	USSR	
			24 to 25 MIG-15/17	USSR	
			44 MIG-15/17	China	
Radar	420	420	67 a/	70 percent from China 30 percent from the USSR	Probably as important as the increased quantity of radars is the shift to more sophisticated equipment. Some older types of radars have actually been retired.
Economic	210,000	20,000			Including (other than that noted below) increased shipments primarily of construction supplies such as bridge steel, rails, and asphalt; boats and barges; bicycles and parts; truck parts; medical supplies; and probably some increased shipments of food, textiles, and radio equipment.
Of which:					
Coke and coking coal	160,000	0		China	Although coal imports increased in 1965, the increase resulted from the opening of the second blast furnace at the Thai Nguyen Iron and Steel Complex, not from the bombing.

Table C-13
(Continued)

	Total Imports (Metric Tons)	Increase in Imports Resulting from Bombing: Volume (Metric Tons)	Number and Type	Source	Remarks
Economic (Continued)					
Petroleum products	6,800 b/	1,700	Jet fuel and some aviation gas	USSR	Jets were first brought in after the Gulf of Tonkin incident. Imports of aviation gas probably also increased.
Trucks	5,500 b/	5,400	1,330 cargo trucks; 8 crane trucks	China China	Probably almost all trucks imported from China were a result of the bombing.
Railroad rolling stock	1,000 b/	900	4 locomotives; 64 freight cars	China	Including 2 locomotives sent from Rumania by sea.

a. Excluding radars included as part of the SAM equipment.
b. Reported shipments. The actual total probably is larger.

neither repaired nor replaced. It is possible that the Communists have no intention of restoring the damaged POL storage facilities and have chosen to protect their oil supplies and provide for more flexible distribution through dispersion and concealment. They have developed new bulk storage capacity by the installation of small tanks at various locations and probably have established stockpiles of POL in drums and cans. It is estimated that the capacity represented by these expedients is small compared with the capacity lost by bombing.

B. Development of Alternative Transportation Routes

In many areas which have been bombed intensely during the Rolling Thunder operations the North Vietnamese are developing alternative transportation routes and other transportation means which are providing greater flexibility and capacity for movement of military supplies southward from North Vietnam to South Vietnam. Initial destruction of the land routes in the early part of 1965 forced the North Vietnamese to rely, to a greater extent, on coastal shipping and the use of inland waterways. In many places, inland waterways parallel existing roads and serve as alternate transportation routes. The most far-reaching effort, however, in terms of inputs, has been the construction of over 300 kilometers of roads and several bypasses around traffic chokepoints. In so doing, there has been an intense effort to take advantage of natural cover and to conceal these new routes and bypasses by camouflage. In addition to the use of waterways and new roads, the transportation system includes a restored portion of rail line parallel with route 15 south of Vinh. Bombing has also resulted in a more intensive use of the many foot trails, particularly in the area around the Demilitarized Zone. Frequently a new road is simply a foot trail which has been expanded to carry truck traffic. In addition, the Communists have expanded and improved the road net comprising that part of the supply route which passes through Laos to South Vietnam.

The principal effort to construct and maintain alternate routes in North Vietnam has been in the area southward from Thanh Hoa. The North Vietnamese are developing these inland north-south roads to provide a choice of routes south through Mu Gia Pass, where route 15 crosses the Laotian border and continues as route 12. At Mu Gia Pass there are now two bypass roads around the chokepoint and a third under construction to insure the uninterrupted movement of supplies. A new road under construction from route 911 will provide a new transport connection between North Vietnam and Laos. The North Vietnamese are continuing to improve route 12 in Laos and to develop bypass roads at chokepoints in their determination to keep this major border crossing open to provide another supply route to South Vietnam. The following roads and a segment of railroad were constructed or improved during 1965 in Military Region IV (south of Thanh Hoa) in North Vietnam:

Route	Length (Kilometer)	Possible Alternate for Sections of Route
101 west from Dong Hoi (17 29 N 106 36 E)	35	1A
701, 704, and 116 between Thanh Hoa and Vinh (improvement)	82	1A
15 northwest from Vinh (improvement)	60	1A
74 (improvement)	84	15 and 1A
83, 831, 832	81	15 and 1A
Railroad segment south from Vinh	70	15
Total length of alternate routes	412	

The continued expansion of this road net in southern North Vietnam would further increase its capacity to keep military supplies moving south. In addition, the construction of routes 911, 922, 96, 165 and improvements to route 16 in Laos during 1965 offer a choice of routes to South Vietnam on the southernmost segment of the supply line from Hanoi. The effort to build additional routes in Laos has been equally as intense as the effort in southern North Vietnam.

The manpower and materials committed to restoring roads and stream crossings destroyed by bombings has been sufficient to provide the necessary resources for development of alternative routes. An estimated 70,000 to 100,000 workers have been organized into work camps and smaller elements such as mechanized units or bridge units. Despite these large numbers, shortages of technically experienced road and bridge builders exist. To alleviate this shortage, groups of 200 workers have been sent to Hanoi and possibly China for training in the operation and maintenance of construction equipment. About 60,000 youths from the Hanoi-Haiphong area were drafted for construction in southern North Vietnam during 1965 to meet the needs for construction labor, and a new, broader program is currently under way throughout the country to draft even more young people into the program. They have caused complaints because of their inexperience, but they have effectively filled the need for mass labor to repair bomb damage. Although the greater share of this labor is employed in restoration of existing roads and the building of bypasses, about 21,000 workers are involved in the construction of new roads.

Although there are shortages of construction equipment, recent information indicates some additions to existing inventories through imports from the USSR. The North Vietnamese method of construction using mass labor, however, tends to offset the shortage of equipment. It is estimated that 3,000 North Vietnamese are responsible for each 25-kilometer segment of new road construction, or about 120 workers per kilometer. They have completed 116 kilometers of new roads and 226

kilometers of improvements to existing roads in approximately 7 months for an overall average completion of 1.6 kilometers per day. The rate of road construction on individual projects varies according to the priority placed upon it.

C. Increased Flow of Supplies from other Communist Countries

In 1965, primarily as a reaction to allied bombing, North Vietnamese imports of military and military-related economic goods from other Communist countries increased 170,000 tons over the 1964 level.* Military equipment and supplies, mainly for defense purposes, made up more than half of this increase, as shown in the following tabulation:

	Increase Above 1964	
	Volume	Unit
Increase in total imports	170,000	Metric tons
Military	90,000	Metric tons
Of which:		
SAM sites	15 to 20	Equipment for sites
Antiaircraft artillery	1,000 to 1,200	Units
Aircraft	8	Il-28 bombers
	11	MIG-21 jet fighters
	68 to 69**	MIG-15/17 jet fighters
Radar (not included with SAM equipment)	67	Units
Economic	80,000	Metric tons
Of which:		
Petroleum	26,300	Metric tons
Motor vehicles	3,890	Units
Rails and rail joints	6,980	Metric tons
Suction dredges	58	Units
Pontoon bridges	200	Metric tons

25X1

* For an appraisal of the dollar cost of the increased military and economic aid to North Vietnam, see section IV.

The increase in imports of economic goods resulting from the bombing, almost all of which was military related, began as early as April from China. Imports of similar goods from the USSR, however, occurred mainly during the latter half of 1965. Imports of cargo trucks, other transport equipment, and petroleum rose sharply over the 1964 level. In spite of air attacks, North Vietnam's truck inventory reached 13,000 to 15,000 military and civilian trucks by the end of 1965, an increase of about 3,000 trucks during the year. Large imports of construction equipment and supplies, including bridge steel, pontoon bridges, rails, and small dredges, aided the North Vietnamese in not only maintaining but also increasing the flow of supplies to the southern part of North Vietnam as the year progressed.

1. Increased Imports by Land Transport

Allied air attacks were indirectly responsible for an estimated 110,000 tons out of the total increase (about 160,000 tons) in North Vietnamese imports by land in 1965 (see Table C-13). North Vietnam countered the air attacks by importing by land transportation an estimated 90,000 tons of military equipment and supplies, which apparently moved almost entirely overland, and 20,000 tons of military-related economic goods. Only about 20,000 of the 90,000 tons of military goods can be quantified by type. Equipment for the 15 to 20 active SAM sites currently deployed in North Vietnam made up the largest volume of identified imports of military goods. An estimated 1,000 to 1,200 antiaircraft artillery weapons out of a current total in North Vietnam of about 2,240 also were imported because of the bombing, as were almost 70 of the 160 radars not included with SAM equipment.

25X1

The approximately 70,000 tons of military goods that cannot be quantified by type included large imports of artillery, tanks, mortars, small arms, and ammunition.

Increased imports of economic goods resulting from air attacks included at least 1,330 cargo trucks from China transported overland out of a total of at least 3,310 cargo trucks* imported from all Communist countries by land and sea in 1965 (see Table C-14). China also supplied 8 crane trucks out of a total of 510 dump trucks and other construction vehicles imported in 1965 by the North Vietnamese. Increased shipments of construction supplies such as bridge steel (including girders), rails, and asphalt; boats and barges; truck parts; bicycles and parts; and medical supplies were noted but cannot be quantified. In addition, at least 4 locomotives and 64 freight cars were imported. China probably also has allowed the North Vietnamese to use some of its meter-gauge rolling stock normally used for Chinese transit traffic in order to counter the destruction of North Vietnamese rolling stock.

* Excluding dump trucks and other specialized cargo trucks.

Table C-14

Estimated North Vietnamese Imports of Motor Vehicles a/
1965

Type	By Land	By Sea b/	Total
General cargo trucks	1,331	1,981	3,312
Dump trucks c/	8	392	392
Other construction vehicles		113	121
Bulldozers		43	43
Scrapers		44	44
Graders		6	6
Excavators		6	6
Automotive cranes	8	6	14
Truck workshops		8	8
Other vehicles	30	165	195
Tank trucks		2	2
Ambulances		38	38
Refrigerator trucks	30		30
Truck tractors		8	8
Jeeps		103	103
Buses		5	5
Automobiles		9	9
Total	1,369	2,651	4,020

a. Reported shipments either received or en route. The actual totals probably are larger.
b. From the USSR and Eastern Europe.
c. Although most of these trucks are related to economic aid projects, they could be used for construction projects resulting from the bombing.

2. Increased Imports by Sea Transport

Much of the 13-percent increase in North Vietnamese seaborne imports from Communist countries in 1965 over the 1964 level can be attributed to allied bombing. All of the 17-percent increase in imports of petroleum from Communist countries and much of the 14-percent increase in general cargoes can be attributed to the bombing.

The most striking increase in the category of general cargo is that for motor vehicles. Communist ships carried 2,650 motor vehicles

of all types to North Vietnam in 1965, compared with about 100 in 1964. All of these vehicles originated in Communist countries, and most were suitable for military or construction use. Another significant increase occurred in Soviet shipments of railroad rails and rail joints, presumably for rebuilding bomb-damaged rail lines. In 1964, only 52 tons of rails were shipped to North Vietnam from Communist countries. The following tabulation shows the increases described above:

Commodity	Unit	Increase in 1965 Above 1964	Percent Increase in 1965 Above 1964
Increase in total seaborne imports	Metric tons	59,600	13
Of which:			
Petroleum	Metric tons	24,300	17
Motor vehicles	Units	2,550	2,550
Railroad rails and rail joints	Metric tons	6,732	12,900
Pontoon bridges	Metric tons	200	a/
Suction dredges	Units	58	a/

a. Few or no imports in 1964.

D. Adjustments in Civilian Living Standards

Civilian living standards in North Vietnam, which are barely above subsistence even in normal times, have generally declined as a result of allied airstrikes, but the impact of bombing has varied widely despite some sacrifice in the standard of living by almost every segment of the civilian population. The regime has demanded extra work, largely without compensation, of almost every able-bodied person and has postponed some benefits, such as vacations at "health camps," which were previously awarded to a small number of outstanding workers. Moreover, higher rice procurement quotas in 1965 have probably reduced food availabilities in rural areas, while urban residents have had to bear the disruptions caused by evacuation and by reduction of some urban services. Families living in target areas and those with a high ratio of dependents to wage-earning members have suffered far greater hardships than other civilians, and the regime has apparently made little effort to provide assistance to those civilians feeling the greatest effects of the bombing. For the most part, however, adequate levels of consumption have been maintained, largely because of the relatively unimpaired functioning of the subsistence sector of the economy, which supports about 85 percent of North Vietnam's population.

The greatest decline in living standards has been in the southern part of the country, where extensive bombing has severely disrupted the distribution system and economic activity in the urban areas as well as destroying some civilian property and where the influx of large numbers of workers to repair bomb damage has strained local supplies of food and other consumer goods.

The primarily rural nature of the southern provinces has permitted continued functioning of the subsistence sector, but rural families in the southern provinces have probably suffered some decline in living standards as they have had to provide assistance to urban relatives and have probably had some soldiers and repair workers billeted in their homes.

Inhabitants of other parts of the country have been most affected by strains on incomes, by physical dislocations, and by the reduced quality of many consumer goods and services, although distribution and production difficulties as well as stockpile requirements have probably intensified normally tight supplies of consumer goods. Incomes of many urban and rural families have undoubtedly fallen because of a diversion of working members to low-paying or uncompensated defense and reconstruction tasks and as a result of the elimination of pay for overtime work in industry. Moreover, evacuation of dependents from urban areas has involved a sharp reduction in living standards for city dwellers forced to live under more primitive conditions in the countryside. The maintenance of separate households has imposed considerable financial burdens on some families. Little information is available on the extent of evacuation, and apparently many of those who left subsequently returned to the cities. However, several hundred thousand urban residents may have moved to rural areas. Those remaining in the urban areas have been forced to accept a less desirable diet -- part of the rice previously included in food rations has been replaced by less popular secondary foods, such as manioc and sweet potatoes -- and they have probably been deprived of at least some electricity for home use because of the destruction of two large powerplants that were included in the power grid linking North Vietnam's major cities. In addition, dispersal of some schools, hospitals, and industrial facilities from urban areas has probably resulted in reductions in the quality of health and educational services and in the quality of many consumer goods.

E. Other Actions to Minimize the Effects of Air Attack

The North Vietnamese authorities have taken steps to reduce casualties and damage in North Vietnam. North Vietnamese civil defense has probably supplemented US restraint in target selection to hold civilian casualties at a relatively low level.

Measures taken to reduce casualties in North Vietnam include the thinning out (or strategic evacuation) of cities and some supplementary population dispersal during daylight hours, when air attack is considered more likely. In addition, the North Vietnamese rely for defense on the extensive preparation and use of foxholes, trenches, and air raid shelters. In some cases the hours of school, work, and marketing have been adjusted to avoid large concentrations of people during the day.

1. Civil Defense

Civil defense is controlled nationally by a Directorate of Peoples Antiaircraft Defense in the Ministry of Defense and at the province and town level by local civil defense committees. The latter coordinate the militia, fire departments, and the civilian "self-defense" units which are organized and trained for medical aid, firefighting, shelter supervision, and rescue and repair activities. The organization of mobile medical units and stationary first aid points has been reported.

The organization of civil defense at important factories and transportation worksites includes a combat group armed with machineguns and rifles to fire at attacking planes as well as the conventional first aid, firefighting, and rescue units. Shelters for workers have been prepared. In some cases these are linked by communicating trenches. 25X1

[redacted] Areas of dispersed storage have been seen in recent weeks along North Vietnamese transportation routes.

2. Resettlement Evacuation

Since early 1965, some North Vietnamese civilians have been evacuated to northern areas from Hanoi, Haiphong, and the southern coastal towns. Others have been evacuated on a resettlement basis to areas not far from their home city. Old people, women, children, and the unemployed are the most frequently identified evacuees. Nearly all schools and university faculties have left the central Hanoi area, and similar precautions have been taken for schools in other urban centers. Elements of the central government have left Hanoi to set up at points not more than 50 miles distant. Local government offices in other cities or towns have apparently relocated to nearby rural areas or are prepared to move quickly when necessary.

The government has assisted evacuees in the organization of movement and by reducing transportation fares, but the principal costs are borne by individuals or families. The exact extent of resettlement remains unknown.

25X1 [redacted]

[redacted] 25X1

25X1

25X1

3. Changes in Work Hours and Dispersal

Frequent air alerts during daylight hours have apparently altered the routine of North Vietnamese cities. In and around Hanoi, government offices, schools, and some ships have shifted their work to the early morning and the evening hours. Thus work and school go on from about 0400 to 0900 and from about 1700 to 2100 hours. Similarly, schools in a number of other localities have shifted to morning or evening sessions, or both. Market places have been reported as being open only at night in several cities south of Hanoi.

25X1

25X1 the population of some cities is partially dispersed, the people retreating to the countryside during the day and returning at night.

25X1

25X1 A Prague newspaper carried an article stating that practically the entire population of Nam Dinh leaves home for nearby villages during the day.

It is unlikely that the entire population of larger urban areas is dispersed during daylight. There is sufficient evidence to support a belief that a dispersal program exists for substantial groups of the population, particularly children, older people, and those engaged in the services sector of the economy such as transportation and the wholesale and retail trades. The nature of the dispersal program for workers in industry is less well defined. In some industries the nature of the production process would preclude midday shutdowns. In sanctuary areas, such as Hanoi and Haiphong, there is no need to shut down. It seems probable, however, that factory operations are halted for long periods in target cities such as Vinh and Nam Dinh. It is equally probable that, although the entire labor force is not sent to the country during daylight hours, the regime does attempt to avoid the daytime concentration of workers in facilities that are likely to be the target of air attack and, in addition, to provide nearby shelters for the work force.

25X1

4. Shelter

25X1

25X1

25X1

25X1

The existence of foxholes and trench shelters is apparent in photography of such target areas as Vinh, Nam Dinh, and Dong Hoi. It appears that every family must have its own foxholes or trench shelters; others are dug at frequent intervals along city streets. During 1965, many trenches have been roofed with timber or other available materials and covered with earth. In Hanoi, some trench shelters have been lined with brick and roofed with masonry. More elaborate concrete shelters have been seen at government buildings and hotels.

25X1

25X1

Prefabricated concrete elements such as sewer pipes are now being used in improving simple excavated trenches in Hanoi and Haiphong.

5. Industry Relocation

25X1

The amount of industry moved from North Vietnamese cities is unknown. What has been accomplished is probably limited to small factories and cooperatives with easily moved machines and relatively few employees.

6. Transport Movement

The North Vietnamese have used camouflage, movement by night with reduced lighting, and dispersal to reduce transport vulnerability. Camouflage efforts have included painting vehicles and railroad cars in dull colors and with irregular patterns. In addition, camouflage nets and foliage are used to break the outlines of motor vehicles, trailers, and boats. Reporting during the past year indicates that a great deal

25X1

25X1

of road movement, including both civilian vehicles and military convoys, has taken place during the hours of darkness.

25X1

25X1

25X1

IV. Costs to Communist China and the USSR of Additional Support to North Vietnam

In 1965 the levels of military and economic assistance provided to North Vietnam by Communist China and the USSR increased sharply and are believed to have totaled somewhere in the range of $250 million to $400 million. After a two-year lull, economic aid, believed to be on the order of $100 million to $150 million, was extended to North Vietnam in 1965. Military aid, which previously had been supplied on a very small scale, reached an estimated level of $150 million to $200 million in 1965. Technical aid grew to a value estimated at $10 million to $25 million.

This increased assistance to North Vietnam appears to be largely in response to the intensified allied air offensive. By far the largest part of the military equipment (by value) delivered in 1965 represented SAM sites, antiaircraft artillery, and related air defense equipment, most of which was supplied by the USSR. Communist economic and technical assistance to North Vietnam in 1965 consisted in large part of equipment and personnel needed to restore and maintain power, transport, and communications.

In spite of the increased costs to Communist China and the USSR of assisting North Vietnam, these costs in 1965 -- both direct and indirect -- were small in terms of Chinese and Soviet capabilities to extend military and economic aid. In 1965, for example, the USSR supplied the less developed countries of the Free World with more than twice as much military equipment (by value) as it supplied to North Vietnam in the same period. Similarly, Soviet economic aid extended to the less developed countries in 1965 was about twice the amount that the USSR is believed to have extended to North Vietnam. China, which supplied some 40 MIG-15/17 fighters to North Vietnam following the Tonkin Gulf incident in 1964, is believed to have provided only small quantities of military aid in 1965. China's economic aid also seems to have been on a relatively modest scale in 1965; indeed, its most significant contribution appears to have been the thousands of Chinese support personnel assigned to duty in North Vietnam. Assistance from the Eastern European Communist countries has been limited thus far to token supplies of small arms, medicines, and a few industrial specialists.

A. Costs of Soviet and Chinese Military Aid

In 1965 the USSR became by far the major source of weapons to North Vietnam, supplying somewhere between 70 and 95 percent (by value) of the total estimated military equipment received (see Table C-15). More than four-fifths of the Soviet deliveries consisted of air defense equipment, including operational SAM sites, antiaircraft artillery, and radar, which together reached an estimated value of roughly $115 million.

Other large deliveries of military goods in 1965 included some 50-odd jet aircraft, of which more than 40 were supplied by the USSR and the remainder by Communist China. The USSR and China together are estimated to have delivered more than 4,000 trucks to North Vietnam in 1965, most of which are believed to have been used in military or defense-related transport (for example, hauling construction crews and supplies for repair of bridges and highways).

In addition, China and the Communist countries of Eastern Europe supplied North Vietnam with machineguns, small arms, and ammunition probably valued at around a few million dollars in 1965. The chief contribution of the Eastern European countries in 1965 was the sharply increased supply of medicines and medical equipment, estimated to have been on the order of a couple of million dollars. China also engaged in repairing North Vietnamese gunboats and in naval patrol activity in North Vietnamese waters during 1965, but the costs of these activities, although believed to be only a few million dollars, cannot be reliably estimated.

An additional aspect of the costs of 1965 military aid is the terms under which it was extended. The Chinese have specified that some of their military assistance is in the form of grants; it seems likely that this also is true of some Soviet deliveries. The value of Chinese and Soviet military aid together is twice the value of North Vietnam's exports to the entire Communist world in any recent year. It therefore would be unrealistic, to say the least, to expect North Vietnam to be economically capable of repaying so large a debt.

B. Costs of Communist Economic Aid

New extensions of economic aid to North Vietnam increased rapidly in 1965, following a virtual cessation in new economic aid agreements during 1962-64. The economic aid extended in 1965, thought to have been somewhere on the order of $100 million to $150 million, was nevertheless well below that extended in several of the years prior to 1962 (see Table C-16). This total was also well below -- less than one-fifth -- the value of Communist economic aid to the less developed countries of the Free World in 1965.

The 1965 aid, unlike that of any previous year, involved commitments not only by China and the USSR but also by all the other Communist countries. This broader participation of the Communist camp in economic aid to North Vietnam reflects the growing pressure on these countries to give tangible proof of their support to North Vietnam's military effort against the United States. The token character of their response, however, is suggested by Communist propaganda concerning the 1965 aid agreements. In no single case was the value of the aid extended made public.

Although relatively little information is available on the composition of the 1965 aid, the evidence at hand suggests that it may have consisted in large part of supplies of materials and equipment made necessary by the war, such as medical supplies and equipment to restore transport, power, and other economic capacity. The North Vietnamese, after successfully concluding a series of economic aid agreements with almost every Communist country in mid-1965, were compelled to send out another aid-seeking mission at the end of the year.

In addition to extending material aid, most of which was in the form of grants, several additional categories of economic aid costs were sustained by Communist China, the USSR, and the Eastern European Communist countries in their 1965 aid to North Vietnam. The most important was the dispatch of technical, advisory, and other special personnel to North Vietnam (see C, below). Additional costs were incurred by a number of Communist countries in the form of public donations to North Vietnam, amounting to no more than several million dollars in 1965, and in the postponement of certain North Vietnamese debt obligations.

Between February 1965 and January 1966, three Communist countries -- the USSR, Hungary, and Rumania -- agreed to a deferment of debt repayments by North Vietnam. Although details are lacking, it is likely that the agreements cover the 1966 installments on North Vietnam's long-term debts to these three countries. It is difficult to assess, however, the extent to which this should be counted a real loss, in terms of imports foregone in 1966, for despite North Vietnam's indebtedness to the Communist countries (estimated to be around $500 million at the beginning of 1966), North Vietnam has consistently run an import surplus in its trade with these countries. In view of North Vietnam's chronic difficulty in repaying earlier debts, its creditors would have been optimistic, indeed, to expect repayments to be made under the conditions likely to exist in 1966.

C. Costs to the Communist Countries of Technical Assistance*

In 1965 the number of personnel from the USSR, Eastern Europe, and Communist China, particularly the latter, in North Vietnam increased rapidly over previous levels. It is estimated that some 30,000 Chinese special troops were sent into the northern regions of North

* Technical assistance is used here to cover only the personnel sent to North Vietnam or the North Vietnamese personnel trained in Communist countries. Other technical services are not included.

Vietnam where they were associated mainly with maintaining and repairing North Vietnamese transport and communications to the north. A rapid influx of Soviet technicians accompanied the introduction of the SAM sites in mid-1965, although some of the Soviet technicians in North Vietnam were engaged in jet aircraft training and maintenance. The Eastern European Communist countries furnished a much smaller number of personnel, most of whom apparently were medical or industrial specialists. The total value of technical assistance to North Vietnam in 1965, as shown in Table C-17, is estimated to have been roughly between $10 million and $25 million.

D. Costs to North Vietnam Associated with Trade and Aid

In addition to the costs of Communist aid to North Vietnam, the country itself bore certain costs associated with its foreign trade and its aid receipts in 1965. Export earnings, particularly those from the Free World, appear to have declined in 1965, probably reflecting in large part the disruption of normal economic activity brought about by the allied air offensive. Although data on North Vietnam's 1965 trade are fragmentary, it seems likely that total exports may have declined by as much as 10 percent -- that is, by around $10 million -- in 1965. Identified seaborne exports to the Free World alone of coal, cement, and apatite -- three of North Vietnam's leading exchange earners -- declined sharply in 1965, representing a loss of some $5 million to $6 million.

North Vietnam also bore additional costs associated with the more than 30,000 military personnel believed to have served in the country in 1965. Assuming that food represented virtually all of such costs to North Vietnam, it is estimated that these costs amounted to slightly more than $1 million.

Table C-15

Estimated Soviet and Chinese Deliveries of Military Equipment
to North Vietnam
1965

	USSR		Communist China		Total	
	Quantity	Value (Million US $)	Quantity	Value (Million US $)	Quantity	Value (Million US $)
SAM sites (operational)	15 to 20	80.0			15 to 20	80.0
Antiaircraft guns	1,000 to 1,200	30.0	N.A.	N.A.	1,000 to 1,200	30.0
Aircraft	44	15.0	8	1.0	52	16.0
Il-28 bombers	8	2.8			8	2.8
MIG-15/17's	25 a/	3.2	8	1.0	33	4.2
MIG-21's	11	8.8			11	8.8
Trucks and other vehicles	2,650 b/	10.0 b/	1,370	5.0	4,020	15.0
Radar		5.0		5.0		10.0
Medicines		2.0 b/	Negl.	Negl.		2.0
Jet fuel	1,531 metric tons	0.1			1,531 metric tons	0.1
Minimum estimated total		142.0		11.0		150 to 200 c/

a. Based on reported delivery of 24 or 25 aircraft.
b. Imported from the USSR and Eastern Europe, together.
c. The estimated total value of military deliveries also includes small arms provided by Communist China and Eastern Europe and medical supplies provided by Eastern Europe. Although the value of these deliveries cannot be reliably estimated, it is known to be small, probably amounting to only a few million dollars.

Table C-16

Communist Economic Aid Extended to North Vietnam a/
1955-65

Million US $

	1955	1956	1957	1958	1959	1960	1961	1962	1963-64	1965	1955-65
Communist China	200.0	b/	b/	b/	100.0	b/	157.0	b/	b/	N.A. c/	457.0
USSR	100.0	7.5	11.8	20.7	25.0	200.0	3.9	N.A.	b/	N.A. d/	368.9
Eastern Europe	50.2	8.3	7.0	b/	2.5	Negl.	62.5	b/	b/	N.A. e/	130.5
Total	350.2	15.8	18.8	20.7	127.5	200.0	223.4	N.A.	b/	100 to 150 f/	1,056.4 to 1,106.4 f/

a. In addition, insignificant amounts of aid have been extended by Albania, Mongolia, and North Korea.
b. No extensions are known to exist, although some may have taken place.
c. New aid includes a grant in July and a credit in December; values are not available.
d. New aid includes a grant in February, a credit in July, and a grant and credit in December; values are not available.
e. All Eastern European Communist countries made available new assistance; although values are not available, the amounts are believed to be small.
f. Total extensions for 1965 have been estimated; however, a regional breakdown is not available.

Table C-17

Estimated Communist Technical Assistance to North Vietnam
1965

25X1

25X1

	Military		Economic	
	Number	Cost (Million US $)	Number	Cost (Million US $)
Communist technicians in North Vietnam				
Communist China	30,000	2.0	200 to 500	2.0 to 4.0
USSR	1,000 to 1,500	5.0	500 to 1,000	4.0 to 8.0
Eastern Europe	100 to 200	0.5	50 to 100	0.5
North Vietnamese pilot trainees in the USSR	50	0.5		
North Vietnamese trainees in Communist China	N.A.	N.A.	N.A.	N.A.
Estimated total		5.0 to 10.0		5.0 to 15.0

25X1

V. Political Effects of the Bombing

The bombing has not had a major effect in shaping Hanoi's decision on whether or not to continue the war in Vietnam. There is evidence that some of the policymakers in Hanoi are concerned over the long-range effect of the bombings on the North Vietnamese economy. Continuation of the air attacks would probably sharpen the apprehensions of this group and might also cut into the morale and staying power of the more hard-line elements in the North Vietnamese leadership. Nevertheless, the regime probably continues to base such decisions mainly on the course of the fighting in the South and is willing to suffer even stepped-up bombing so long as prospects of winning in the South appear to be reasonably good. If the Viet Cong began to show significant weakness in the South, however, the effect of the bombing would play a larger part in Hanoi's decisions on how to handle the conflict. 25X1

Evidence on the effect of the bombing on the morale of the people suggests that the results have been mixed.

25X1

Because the airstrikes have been directed away from urban areas, morale has probably been damaged less by direct bombing than by the indirect effects of evacuation of urban population, splitting of families, and the inconveniences of air raid drills.

If bombing were directed at urban centers, there would be a sharper drop in morale. But even in this event, popular morale would not be expected to collapse or the regime to respond to morale problems by making major shifts in its policies.

Hanoi's political relations with its allies have in some respects been strengthened by the bombing. The attacks have had the effect of encouraging greater material and political support from the Soviet Union than might otherwise have been the case. While this Soviet aid has complicated Hanoi's relationship with Peking, it has reduced North Vietnam's dependence on China and thereby has given Hanoi more room for maneuver in its own behalf.

25X1

25X1

VI. Discussion of Sources and Methodology

A. Economic Targets

The inventory of physical damage in the North Vietnamese economic sector was assessed in several ways, depending on the availability of pre-strike and post-strike information on the specific target systems. In the case of powerplants, petroleum storage facilities, manufacturing plants, and JCS bridges, assessments of damage were made by industry specialists

25X1

The damage inflicted on facilities was recorded in two ways: (1) the cost in US dollars of restoration of the damaged facility and (2) the damage to the facility expressed in terms of a reduction in national capacity. Such factors as the actual utilization of capacity and its meaning to the economy must be viewed when using the latter measure as a bomb damage indicator. Target descriptions in the 94 Target List, reductions in national capacity found in the DRV Target Study Analysis, and the Bomb Damage Assessment Book (BDA) recording damage inflicted on all targets during the air war, as well as aerial photography used in the evaluation.

25X1

Damage and loss to rail yards, maritime ports, locks, agriculture, and exports were handled in a somewhat different manner. In addition to the above-mentioned sources, the assessment of damage to rail yards was based on pilot reports recorded in the BDA and yard descriptions in the North Vietnam Rail NIS. Ports were evaluated by combining CIA/DIA cost of damage estimates, BDA information, and descriptions in the 94 Target List. Damage to the single lock attacked was assessed by evaluating the pre-strike descriptions found in the 94 Target List with the BDA description of damage. Agricultural loss was estimated on the basis of a projected crop loss due to irrigation difficulties. Export losses were calculated for apatite and cement. By comparing figures of known North Vietnamese exports,

25X1

25X1

and BDA information, it was possible to attribute the loss in export exchange to the air war. Costs were calculated by multiplying going world prices of cement and apatite by the net reduction in the 1965 exports of these two commodities.

B. Military Targets

By using CIA and DIA construction cost data, the 94 Target List, the DRV Target Study Analysis, and the BDA, it was possible to elaborate on the statistical information used by DIA to represent the damage inflicted on military targets in North Vietnam. Destroyed and remaining capacities were evaluated with respect to known operational needs of the North Vietnamese military. Costs of reconstruction, priorities,

25X1

logistics, and the locations of struck targets were given consideration. Particular emphasis was given to the importance and location of targets not yet struck.

C. Armed Reconnaissance

Armed reconnaissance damage was based primarily on pilot reports entered in the BDA, CIA/ORR weekly indications reports, and the DIA contribution to this report. Rough cost estimates were made for each of the items reported destroyed or damaged.

D. Casualties

in the localities with less population there has been relatively more damage to civilian-associated housing and activities. In addition, the smaller localities are believed to have received less perfect warning of airstrikes and have less well-established civilian defense measures than a locality of the size of Nam Dinh. Furthermore, in the smaller localities civilian housing is less well constructed.

To take these considerations into account, the populations of Urban Area X as well as all other urban areas subjected to attack have been divided into the population of Nam Dinh to obtain the necessary weight:

Population of Nam Dinh: 90,000 divided by population of X (10,000) equals 9.

The calculations have then been completed as follows:

3 times 9 equals 27 minimum casualties.

5 times 9 equals 45 probable casualties.

1. Civilian Casualties in Urban Areas

The city of Nam Dinh was used as a case study for the purposes of constructing a methodology for calculating casualties in urban areas. As a consequence of six airstrikes, the casualties estimated for this city are a minimum of 30 and probably 45. The population of

Nam Dinh is 90,000. Therfore, the estimates of casualties ranged from 1 per 18,000 in population to 1 per 12,000 in population. In applying these findings to other urban areas, only two variables have been used. The first is the number of strikes and the second is the population of the various localities. Thus:

Urban area - X

Number of strikes - 6

Population - 10,000

6 times 10,000 equals 60,000

60,000 divided by 18,000 equals 3 casualties

60,000 divided by 12,000 equals 5 casualties

2. Civilian Casualties in Rural Areas

Most of the civilian casualties inflicted on North Vietnam by assigned strikes in rural areas appear to have been caused by collateral bombing -- bombs falling off target and hitting adjacent villages. In an effort to quantify the number of casualties under these conditions, sample villages in rural areas adjacent to JCS targets were studied. The number of buildings in each village was determined by a visual observation from photoanalysis. In turn, the amount of physical damage to each village was observed following attack. To derive casualty estimates from the physical damage in the villages, three variables were considered: (1) JCS pre-strike estimates of casualties against a specific target, (2) German experience with Allied bombing in 1943

The final average figure arrived at was one casualty for every four buildings destroyed or damaged in rural areas. In this report this ratio was applied to each JCS target area after a visual check of photography to determine the number and size of villages in the immediate vicinity (within 0.3 mile) of the target.

3. Civilian Casualties from Armed Reconnaissance

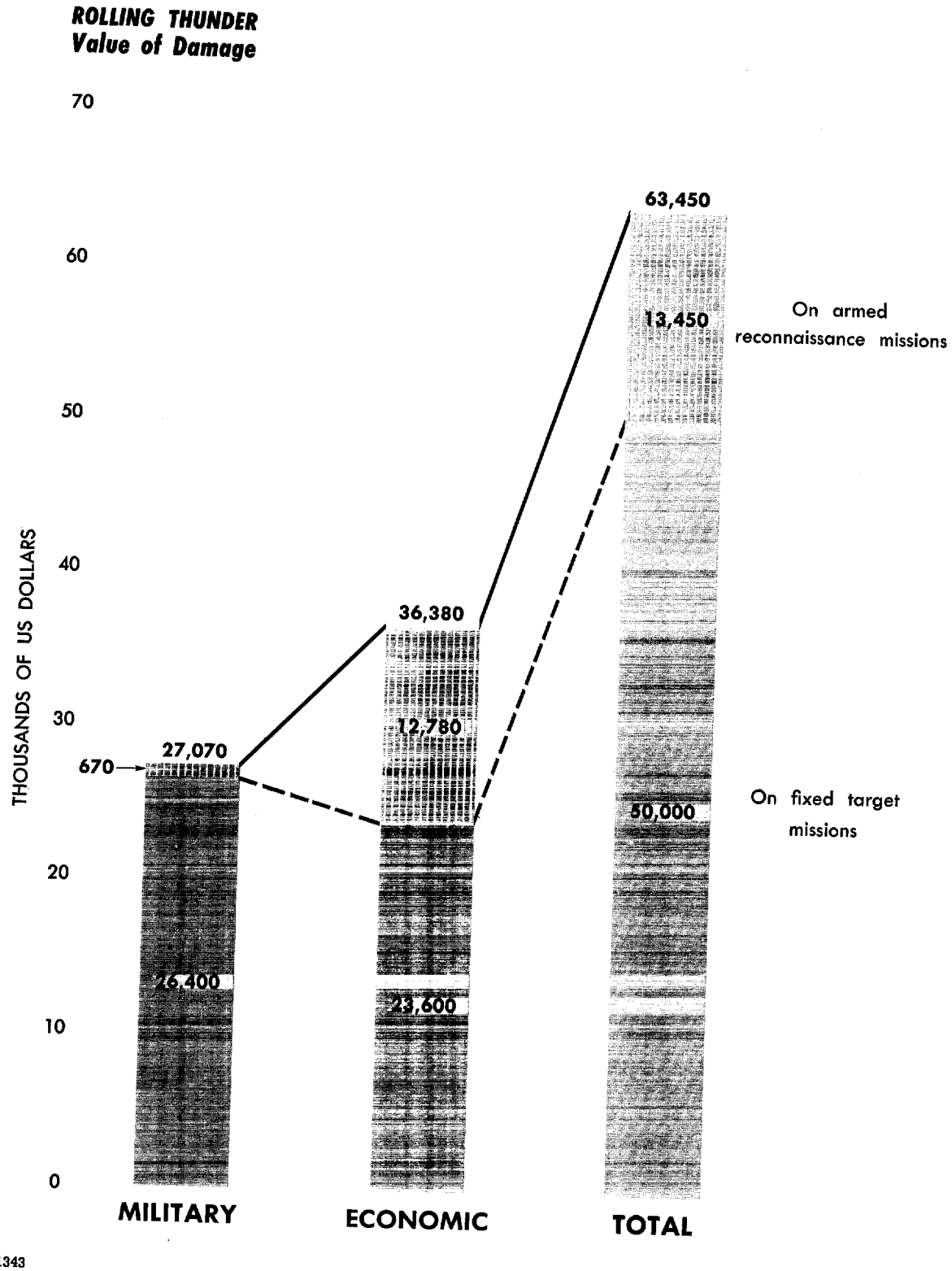
Two methods were used for determining casualties from armed reconnaissance. The first relates the average civilian population density in the areas under attack to weapons effectiveness.

Analysis of armed reconnaissance casualties using both methods gave a considerable range with the first method yielding the "low" estimate and the second the "high" estimate.

4. Military Casualties

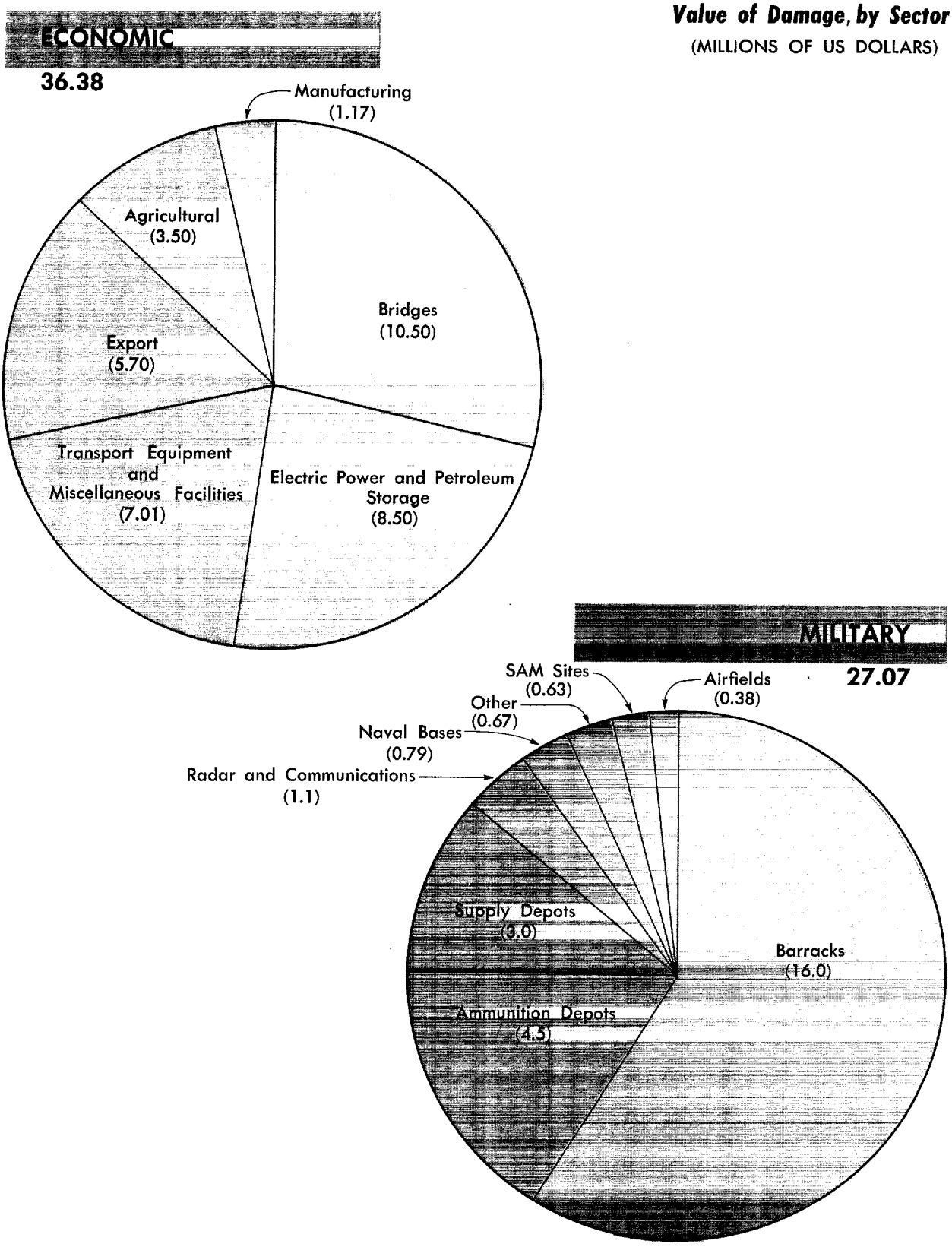
In estimating military casualties resulting from strikes against fixed targets the following factors were assumed: personnel are in a warned condition; barracks areas are occupied only on the date of the first strike; personnel are considered to be under hazard within the targeted area and an adjacent area defined as encompassing three CEP's (for purposes of this study, 600 feet in all directions from the outside perimeter of the target). Total casualties are estimated on the basis of pre-attack demographic studies of the target and the damage probability of the tonnage of ordnance actually dropped at the target adjusted by a standard formula to determine probable on-target hits. In this report the figures on total casualties derived by this methodology have been rounded and given as a range of plus or minus 10 percent.

Estimates of military casualties resulting from the armed reconnaissance program are achieved by applying uniform factors to the number of targets reported by pilots to have been damaged and destroyed. Thus for each truck or boat reported damaged or destroyed one casualty was assigned; for each locomotive or railroad car damaged or destroyed, 0.01 casualty was assigned; for each barracks, supply warehouse, or other building, 0.1 casualty was assigned; and for each antiaircraft, 0.3 casualty was assigned. While the casualty factors appear to be based on reasonable assumptions the armed reconnaissance estimates will be overstated to the extent that pilot reports often are exaggerated and overlapping. Since no alternative source of information is presently available for measuring the effectiveness of armed reconnaissance, an attempt was made to accommodate the bias by rounding total casualty figures derived by this methodology and applying a range of plus or minus 10 percent.



C-1 Value of Damage Inflicted on North Vietnam During the Rolling Thunder Program

Value of Damage, by Sector
(MILLIONS OF US DOLLARS)

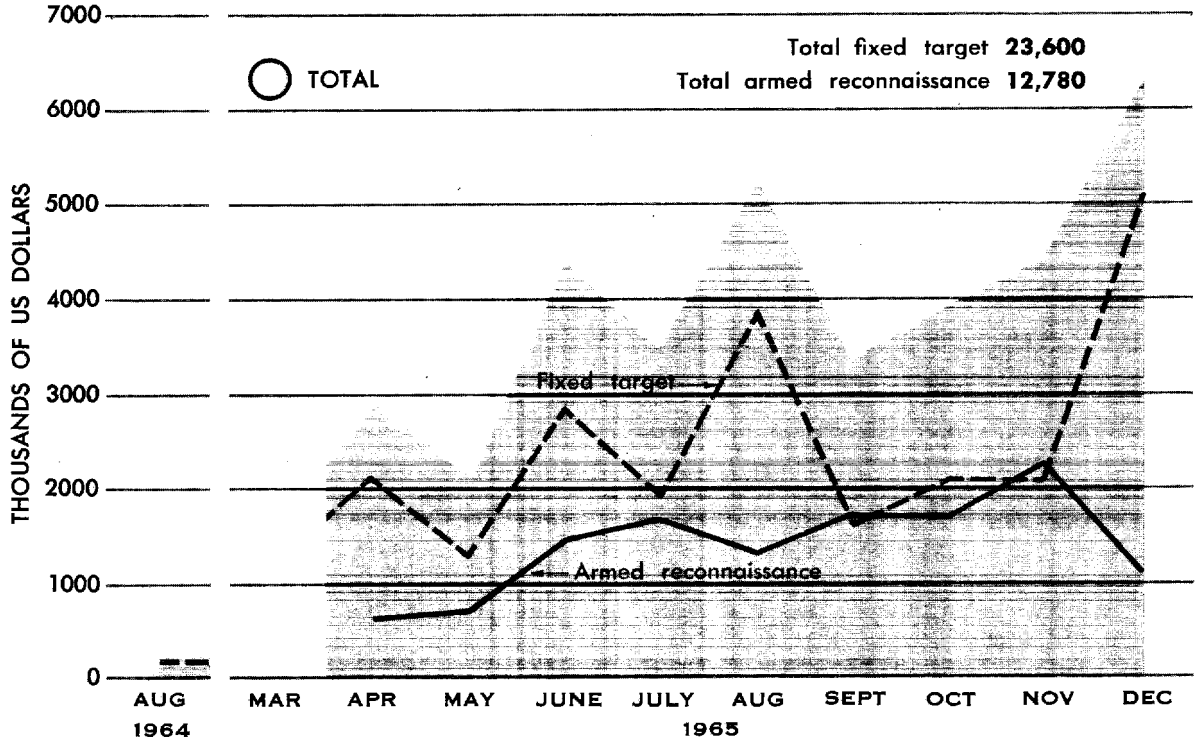


C-2 Value of Damage, by Sector, Inflicted on North Vietnam During the Rolling Thunder Program

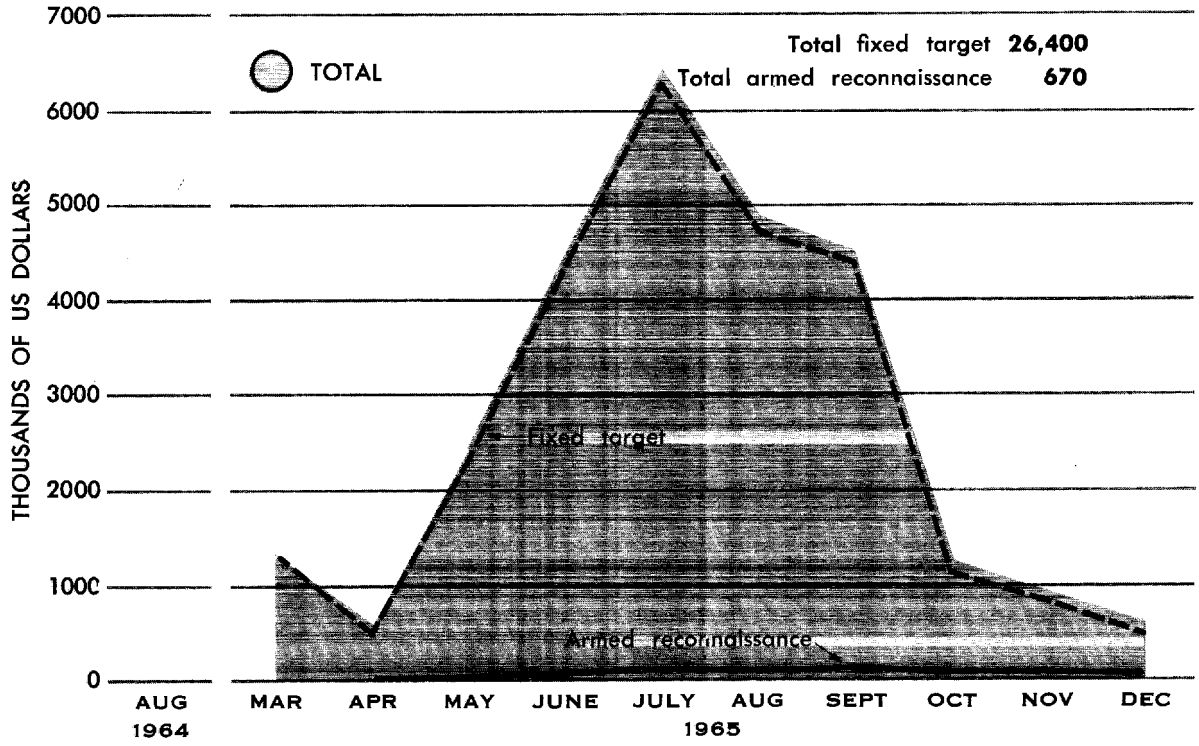
61344

ROLLING THUNDER
Cost of Damage Inflicted

ECONOMIC DAMAGE (Including agricultural and export losses)

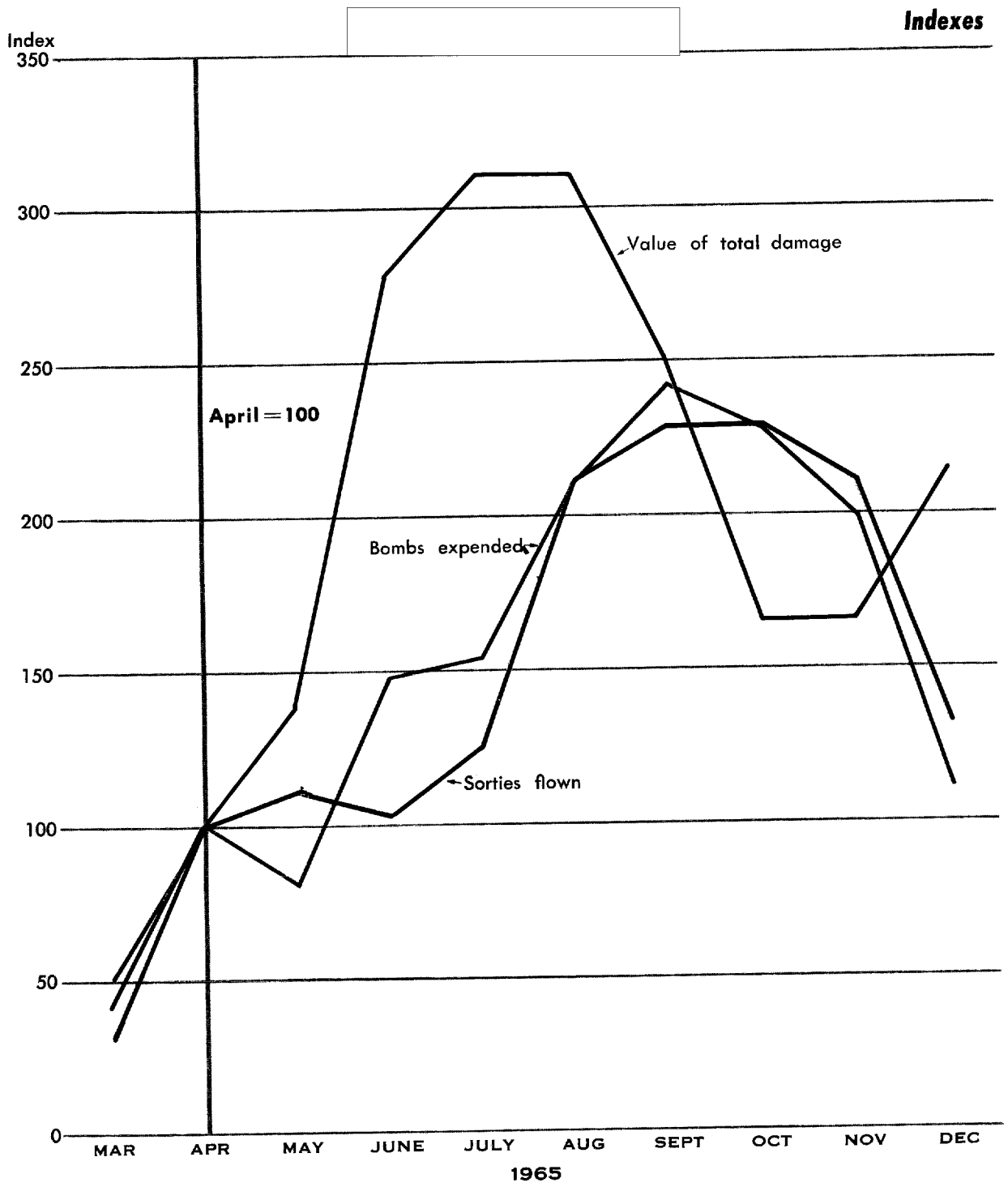


MILITARY DAMAGE



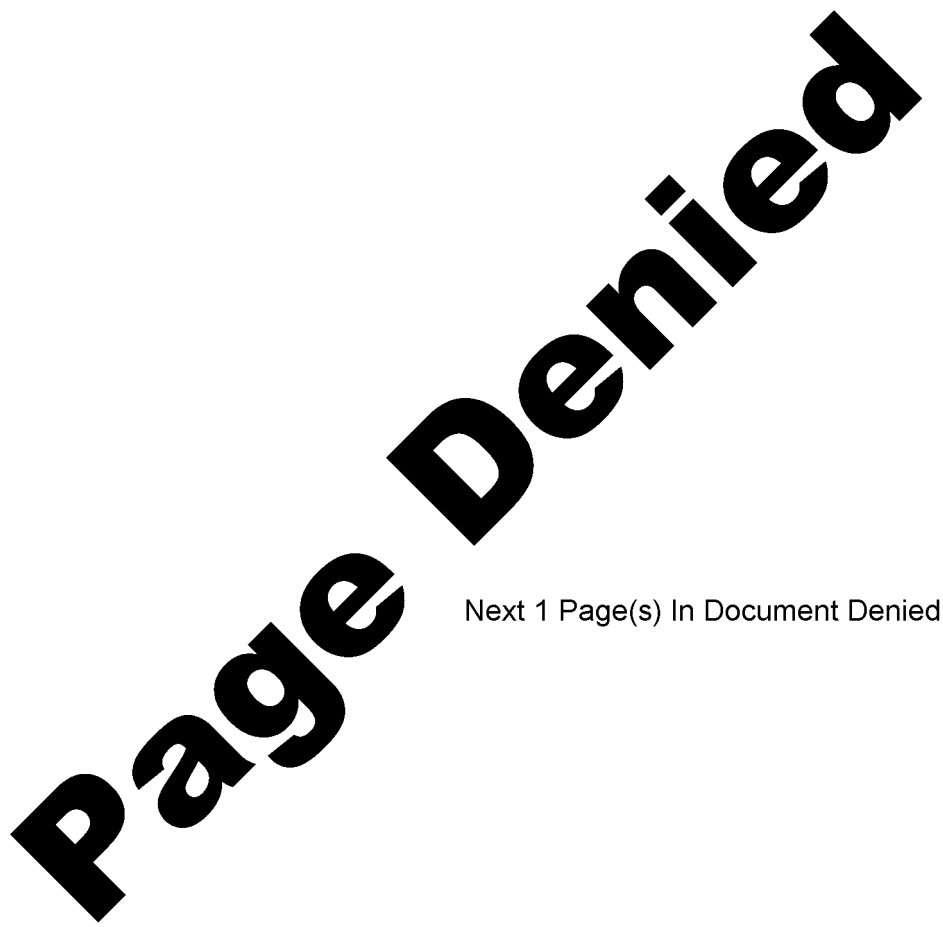
C-3, C-4, C-5 Total Cost to North Vietnam of Damage Inflicted During the Rolling Thunder Program

61345



C-6 Rolling Thunder: Indexes of Value of Damage, Sorties Flown, and Bombs Expended

61348



Next 1 Page(s) In Document Denied

Appendix D

APPENDIX D

POTENTIAL OF AIR ATTACKS AS A WEAPON TO ACHIEVE ROLLING THUNDER OBJECTIVES

I. Military Significance of North Vietnam

The military significance of North Vietnam is measurable in terms of three basic functions which it performs in support of the military activities in South Vietnam. It serves (1) as a logistic base for the stockage and movement of supplies into South Vietnam, (2) as a source of manpower, and (3) as a control center for the direction of insurgency.

A. The Logistic Base

The North Vietnamese economy, which is basically one of subsistence agriculture, has only a small modern industrial sector concentrated in a few urban centers, including Hanoi, Haiphong, Nam Dinh, Viet Tri, and Thai Nguyen. The country imports little food even in poor agricultural years and depends largely on domestic production to feed its population of about 18 million persons. More than 80 percent of the labor force is engaged in agriculture, which in 1964 accounted for almost one-half of the gross national product (GNP). North Vietnam produces only minor items of military equipment -- grenades, mines, mortars, and ammunition for small arms -- and must import all of its heavy military equipment and most of its small arms, ammunition, and medical supplies from Communist countries.

The capabilities of North Vietnam's armed forces have not been affected significantly by attacks on economic and military facilities in North Vietnam. Although the movement of personnel, equipment, and supplies has been hampered by damaged transportation facilities, the Viet Cong and North Vietnamese forces place little direct reliance on the North Vietnamese economy for material. Within South Vietnam the Viet Cong have developed an effective logistic system which is able to procure from internal sources almost all of their requirements for supplies. The major items of critical material supply -- arms and ammunition, technical equipment, medical supplies -- are all items which North Vietnam itself does not produce. The main role of North Vietnam in obtaining these supplies is as an importer from third countries, usually Communist, and as a forwarder to South Vietnam through a well-developed supply system. North Vietnam has established and controls the following principal supply routes: (1) a land corridor through Laos; (2) a sea route from points in North Vietnam to points in the southern and coastal parts of South Vietnam; and (3) a route from Cambodia using both land and inland water routes to South Vietnam or on occasion resorting to sea infiltration. The overwhelming share of these supplies is funneled through North Vietnam or transported along the roads and trails in Laos.

B. Manpower

A major aspect of North Vietnam's military significance to the fighting in the south is its capacity both to train and to supply insurgent Viet Cong personnel for later infiltration into South Vietnam and to provide substantial increments of its own population to serve in South Vietnam or in indirect support functions.

North Vietnam has a population of over 18 million. Most of the labor force is engaged in agriculture and is seasonally underemployed, but because of the difficulty in shifting manpower to meet the requirements for the large number of new tasks resulting from bombing, labor supplies are tight. The regime views the manpower situation as "critical," and a large-scale mobilization of manpower has reportedly been under way in North Vietnam during 1965.

The country has about 4 million males of draft age, almost all of whom have been put in the regular armed forces, paramilitary organizations, or labor repair and maintenance battalions. In addition to these manpower resources, about 175,000 males reach draft age each year, of which at least 100,000 will be physically fit for military duty. With these resources the North Vietnamese should be able to sustain and probably increase the approximately 20,000-man rate of infiltration into South Vietnam maintained during 1965.

It is estimated that as many as 23, but probably only 12, of the 38 army infantry regiments in North Vietnam would be used to train infiltrees. These 12 units, operating on a four-month training cycle, could train and infiltrate the equivalent of nine North Vietnamese battalions each month during 1966, or a total of approximately 54,000 men for the year. This estimate of North Vietnamese capability to infiltrate forces into South Vietnam is a gross rate only. The net additions to be made to the Communist forces in South Vietnam will depend, in addition to decisions on the rate of infiltration, on the capability of the Viet Cong to train new and replacement troops and the casualty rates inflicted on Viet Cong and North Vietnamese forces during the year. On the basis of present projections, North Vietnam would account for more than 56 percent of the forces to be added to combined Viet Cong and North Vietnamese strength in 1966.

In addition to its ability to train and infiltrate significant numbers of North Vietnamese forces for service in South Vietnam, North Vietnam has also demonstrated a capacity to mobilize large numbers of personnel for activities involved in supporting the insurgency in the South. The diversion of manpower to tasks associated with dispersal programs, emergency repair, and construction and maintenance of lines of communication throughout North Vietnam may require the full-time services of 200,000 workers (equivalent to about 10 percent of the nonagricultural labor force) and the part-time impressment of another 100,000. An additional 150,000 persons are also obligated, on a part-time basis, to serve

in various aspects of civil defense which take them away from their normal pursuits. These levies represent a significant share of the labor force and an admitted cost to North Vietnam in supporting the war in the South. This problem does not yet seem to have reached a critical point.

C. Control Center for Insurgency

The function of North Vietnam as the control center for Viet Cong insurgency is well documented in intelligence materials. These materials confirm that North Vietnam is playing a vital role as a center from which the Viet Cong obtains vital support in the form of manpower, training, organization, and supplies. The Party and government leaders of North Vietnam also function as the source of political direction and, indeed, inspiration for the Viet Cong leaders.

The major instrument of political control and direction of the Viet Cong insurgency is the Lao Dong Party, specifically the Committee for the Supervision of the South which is attached to the Party's Central Committee. The Communist Party of North Vietnam has in effect as its southern branch, the People's Revolutionary Party of South Vietnam. This organization is responsible for providing funds for the Viet Cong war effort and of providing most of the essential nonmilitary goods for the Viet Cong organization. It also controls a wide array of Party, front, and military elements which implement the principal tasks of supporting the insurgency.

Although the North Vietnamese Communist Party and government have avoided any direct and overt ties with the National Liberation Front (NLF), the linkage is close and clear. Hanoi maintains control over the NLF through the Communist leaders in South Vietnam to whom North Vietnam issues overall guidance. This control channel runs from both the Reunification Department of the Central Committee and the Reunification Commission of the North Vietnamese Council of Ministers, both of which are headed by Nguyen Van Vinh. The North Vietnamese military command is also highly integrated into the hierarchy which directs the insurgency in the South.

II. The Logistics Target System

A. Interdiction Efforts During 1965

About 2,700 strike and flak suppression sorties carrying approximately 3,400 tons of ordnance were flown against JCS-designated fixed targets on LOC's in North Vietnam during 1965. All but about 5 percent of the total sorties and tonnage on the logistic target system were directed against 44 railroad, highway, and combination railroad and highway bridge targets selected from among the 63 JCS-targeted bridges.* The remaining JCS targets attacked on the LOC's included one railroad yard of the five targeted and two ports and one waterway lock of the total of 16 waterways targets as follows: 6 ports, 8 locks, and 2 mineable areas. The accompanying map showing JCS targets, divided by those attacked and not attacked, indicates that most of the JCS targets attacked on the LOC's were located south of Ninh Binh. Relatively few were located on the railroads and roads north and east of Hanoi.

In addition to scheduled strikes against JCS-designated targets, armed reconnaissance was planned to be a very significant part of the program for interdicting the LOC's. Within the areas of North Vietnam that are authorized for armed reconnaissance, not only JCS targets but also all other transport facilities, including roads and rail lines, ferries, fords, port facilities, transport equipment, and landing beaches, are targets. Coastal and inland water craft are considered to be targets only if they can be identified as possibly carrying military cargo.

B. Effect of the Interdiction Efforts

In general terms, it can be concluded that these interdiction efforts made it more difficult and expensive for North Vietnam to continue operating at somewhere near its normal economic level and to support the war in South Vietnam and Laos. Performance by the modern transport system during 1965 probably was not reduced below the level achieved in 1964. Performance would have considerably exceeded the 1964 level had it not been for the comparative success of attacks on the railroad line to Lao Cai. On the other railroad lines and roads the amount of interdiction, in terms of number and type of target and frequency of attack, was not enough to reduce the capacity of the routes below the level of traffic normally moved. It was believed during the planning stages for Rolling Thunder that destruction of bridges would reduce the capacity of the LOC's in the southern part of the country by about two-thirds and by even more in the north. Experience now indicates that the North Vietnamese have sufficient

* Two bridges have been deleted from the 63 targeted and 44 attacked, but all the data available for the bridges are analyzed in this Appendix.

recuperability that the reduction of route capacity by two-thirds is sustained only for a very short period of time if at all. The North Vietnamese are using a sufficient number of engineers and laborers to maintain routes in the southern part of the country at roughly two-thirds of their original capacity and at the same time to increase the number of routes and bypasses, thus making the network less vulnerable to attacks. Furthermore, the reduction actually achieved has not lowered the capacity to anywhere near the low level of traffic that normally moves on these routes. These conclusions are borne out by an analysis of specific routes and areas.*

The relative success in interdicting the Hanoi - Lao Cai rail line is explained by several factors. The Hanoi - Lao Cai line is used normally at two-thirds of capacity, a moderately heavy rate of utilization. At this rate of utilization this line becomes a rather attractive interdiction target, particularly in the absence of alternative means of transportation. There was no road paralleling the interdicted portions of the railroad, and the Red River which parallels the line at a distance of several miles has only limited navigability. Thus alternative modes of transport were not available over which the normal rail traffic could be moved and over which supplies to repair the rail bridges could be moved. Interdiction of through traffic was maintained by making fairly frequent attacks on a number of small bridges and one major JCS-designated bridge. The interdiction would have been even more successful in stopping all traffic were it not for the rapidity with which bridges were repaired, even though the line was being restruck. The Lang Bun bridge, a two-span 150-foot steel bridge, was restored in late September or early October in 20 days or less, and after the second strike in October it was rebuilt in less than 11 days. In some instances the minor bridges on this line, ranging in length from 30 to 90 feet, were restored to service in less than eight days. The JCS estimate of the effort required to sustain interdiction of this rail line was placed at six strikes per month, each with 25 strike and 25 support sorties, or a total of 300 sorties. Data are not available at present to determine how many sorties were flown over this line, but it was apparently considerably less than the recommended number. Even if strikes had occurred once every five days, it is believed that bridges could have been returned to service, based on the demonstrated ability of the Communists to repair or replace damaged railroad bridges of up to 90 feet in length in 48 to 72 hours.

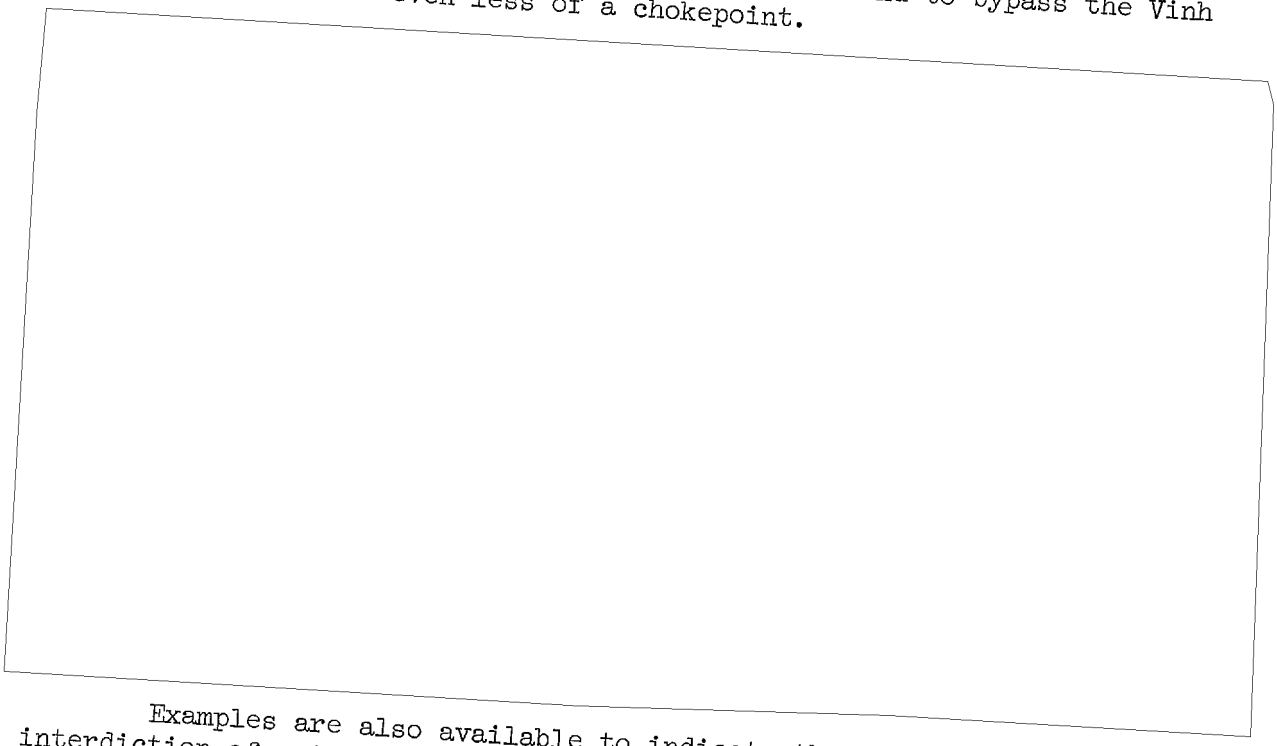
In the area south of Thanh Hoa the North Vietnamese have put forth great effort to maintain their existing routes. A comparison of the estimated capacities based on photography of 26 segments of route in January 1966 with capacities as of April 1965 indicates that on 15 segments the route capacity was maintained at the same level, on nine segments the capacity was reduced, and on two segments the capacity had actually increased. Two of the segments for which capacity is believed to have remained the same were sections of route 1A just north and south of Vinh, routes that have been heavily bombed.

* For transportation routes in Vietnam and Laos, see the map in Appendix A.

On most of the nine segments with reductions in capacity, the reduction amounted to 25 percent or less. Segments that had a reduction of more than 25 percent in capacity were routes 1A just south of Thanh Hoa (reduced from 3,800 tons to 1,350 tons each way per day*) and a portion of route 8 (reduced from 1,100 tons to 700 tons each way per day). In these instances it is quite obvious that the North Vietnamese did not need to use the road at even these reduced capacities. Increases in capacity occurred on route 1A from Ha Tinh south to the Demilitarized Zone (from 750 tons to 850 tons each way per day) and on route 103 near the Demilitarized Zone (from 50 to 150 tons each way per day), even though both of these routes have been heavily bombed because they are used as routes for men and supplies moving to the trail network for infiltration around the Demilitarized Zone.

The North Vietnamese construction of new and improvement of alternate routes has also been significant in maintaining the southward flow of supplies in spite of route interdiction. During 1965, more than 400 kilometers of alternate land routes and bypasses in Military Region IV were constructed. Improvement of the inland waterways in the area has also increased the flexibility of the network and increased capacity through certain areas. For example, the improvement of route 74 to serve as an alternate to route 1A and to bypass the Vinh area will make Vinh even less of a chokepoint.

25X1



Examples are also available to indicate the extent to which interdiction of rail and water routes in the south was not sustained.

* Only dry season capacities are used in this section.

The prime examples of this situation are JCS target 14, the Thanh Hoa railroad/highway bridge, and target 18.8, the Dong Phuong Thuong railroad/highway bridge, both located in the Thanh Hoa area. Target 14 was first struck on 3 April with the recommended tonnage and was severely damaged. Comparatively light restrikes were made twice in May, once each month in June and July, and twice in September with no significant new damage. At the end of September the bridge was serviceable for rail and truck traffic. Target 18.8 was destroyed on 3 April also. Small amounts of ordnance were dropped on the target in May and June, causing further damage. A new bypass bridge under construction upstream was noted in photography in early September. The old bridge was restruck in September but not the new bridge. By early November the new bridge was completed and operational. The demonstrated speed with which the North Vietnamese can replace or repair destroyed or damaged bridges requires that restrikes be scheduled frequently, as often as once every three days, against bridges under repair or against alternate facilities under construction. Even this action will not prevent the nighttime construction and use of fords and ferries at the bridge site.

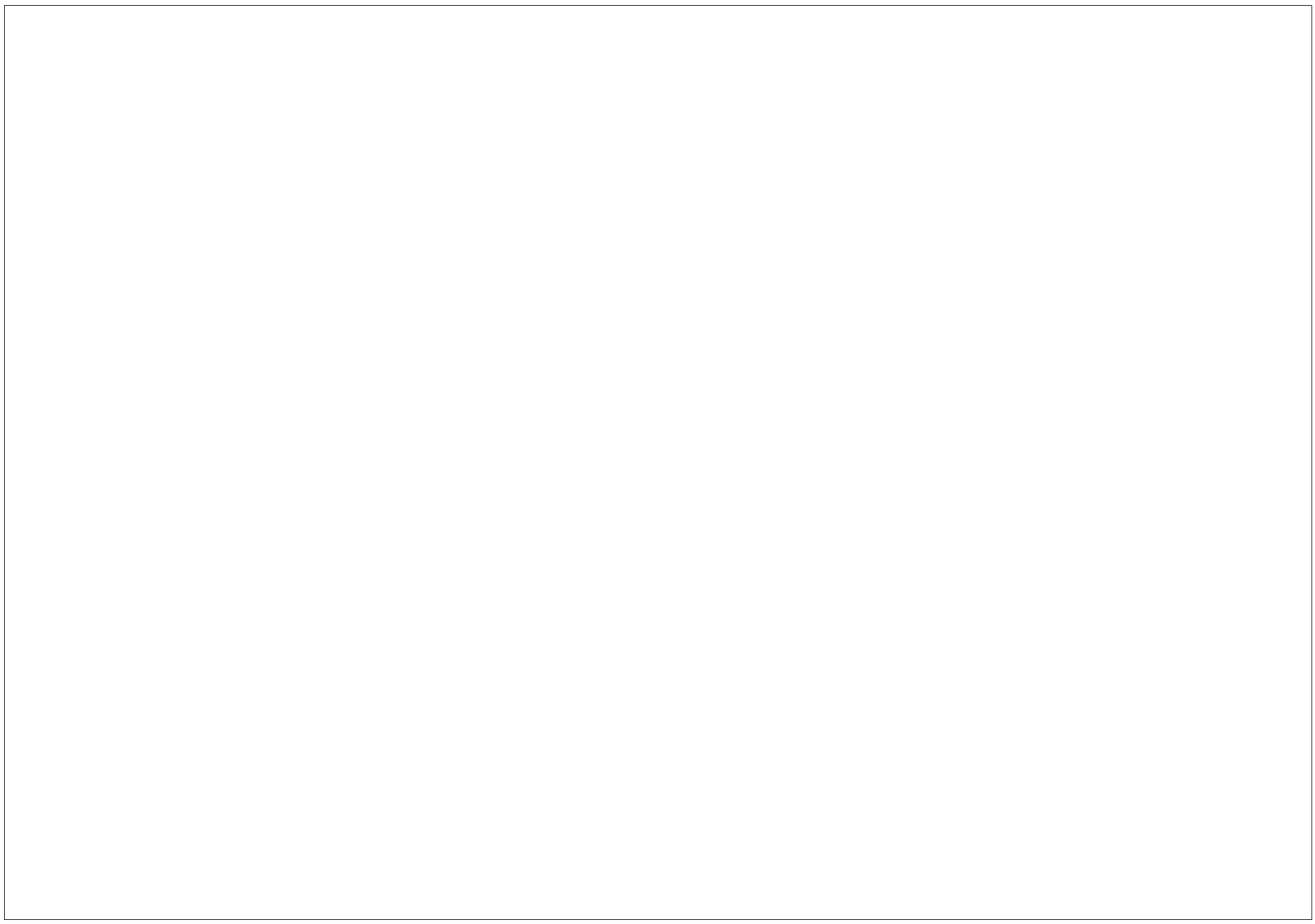
The initial strike in June 1965 on the port of Ben Thuy was reported to have destroyed 50 percent of the maritime traffic capability of the port, estimated to have been more than 700 tons per day. A number of restrikes were carried out in June and July, resulting in additional damage to warehouses and piers.

C. Effort Required to Further Reduce the Capacity of the LOC's

The experience of US bombing in other countries indicates the probable success to be expected from interdiction of transport systems and the effort required. The lessons learned from the bombing of Germany and Japan during World War II and of North Korea during the Korean War are summarized below.

25X1

25X1



3. North Korea

The war in Vietnam is teaching the same lessons learned during the Korean War. One of these lessons is that it is very difficult to prevent by aerial bombing the movement of military supplies. In North Korea, it appeared that the movement of large amounts of supplies required by the Chinese Communist and North Korean troops -- estimated at from 2,400 to 3,000 tons a day -- could be prevented by aerial bombing. However, the enemy not only continued to move the minimum amount required for his daily resupply but in addition moved in another 800 tons a day to build up stockpiles. The daily supplies estimated to be needed by the Viet Cong and North Vietnamese now fighting in South Vietnam are less than one-half of one percent of those required by the Chinese Communists and North Koreans during the Korean War -- about 12 tons a day moving to South Vietnam, compared with about 2,400 to 3,000 tons required in the earlier war. It appears that a much greater aerial bombing effort would be required to stop the present movement of supplies, a trickle compared with the large flow that moved during the Korean War. Yet the number of sorties flown over North Vietnam in the Vietnamese War through December 1965 was less

25X1

than one-third of the number flown during a comparable period in the Korean War. The total ordnance dropped on North Vietnam in 1965 was also only one-third that dropped on interdiction targets in Korea during Operation Strangle alone. In both wars the Communists have shown a remarkable ability to improvise repairs, build bypass lines, mass workers to maintain and repair essential supply lines, and move supplies in the dark.

D. Recent Experience in Laos

Even more applicable to the present problem is the experience gained from recent bombing over Laos. During the period of the bombing lull in North Vietnam, attacks on targets and routes in Laos were increased over earlier levels, amounting to about 9,000 sorties, some 8,000 of which were flown over the Panhandle area south of Nape Pass. These sorties each dropped an average of two tons of ordnance. The majority of the sorties over the Panhandle were directed over the main supply routes to South Vietnam, route 12 and its bypass from Mu Gia Pass and connecting routes to the south -- 23, 911, 92, 922, 96, and 165. Nevertheless, the level of truck traffic moving south on routes 23 and 911 averaged 29 trucks per day -- twice the average of 15 trucks per day moving south in this area during the same period one year earlier. On 28 December 1965, as many as 115 trucks moved south on route 911 in one day, indicating that the average level of truck traffic probably could have been much higher if the Communists had wanted to move more supplies south.

The trucks generally travel at night to avoid detection. The aircraft have revealed comparatively few trucks on the road by dropping flares.

25X1

It is quite possible that the bombs have been expended on suspected targets rather than identified targets. The improved earth surfaces of the roads are easily repaired if cratered, and during the dry season truck traffic can ford most streams when the bridges are destroyed. Construction material is readily available from the forest beside the road to make whatever repairs are necessary. During the rainy season, flying conditions are poor, and traffic can move in the daytime under cloud cover. Some of the traffic is moved by inland waterway rather than by truck in the rainy season. During the coming rainy season, road conditions will undoubtedly be poor, but it is probable that sufficient improvements in the routes have been made to provide an all-season route through the Panhandle.

The Laotian experience resembles that in the southern part of North Vietnam in that the volume of traffic needed to be moved is only a small volume of military traffic. If the routes in these areas had to support a civilian economy as the German transport system did, they could be carrying traffic of sufficient volume to show some interdiction results from airstrikes. Only when the routes are being used at near-capacity levels can attacks that damage bridges, crater roadbeds, and force traffic to move at night be effective. It is hardly conceivable that conventional air interdiction of the land routes in North Vietnam and Laos could be so numerous, widespread, and repeated that the North Vietnamese would decide that the effort required to move supplies by land to South Vietnam was not possible.

E. The Requirement for Successful Interdiction

Analysts who have examined this problem say that it is impossible to decide what might be required to interdict given transport routes to produce a specific reduction in capacity. The experience of 1965 in attempting to sustain interdiction against a rudimentary transport system moving only small amounts of supplies would indicate that the extreme difficulty in obtaining reductions in capacity to desired levels would require an inordinately high level of sorties and ordnance expenditure. Although continued attacks against traffic moving in the southern areas of North Vietnam and Laos would be justified, the optimum return would probably be realized by concentrating, in combination with attacks on other target systems, the interdiction program on the logistic target systems in the northern part of the country.

A logistic target system that is proposed in an intensified allied air offensive to interdict land transport in northern North Vietnam includes attacks on 29 major bridges and the four principal railroad yards and shops. The initial strikes against these targets would require an estimated 1,760 strike and support sorties and 1,500 tons of ordnance. A precise restrike effort required to keep these targets interdicted has not been calculated, but it would include armed reconnaissance on a 24-hour basis and a combined, sustained effort of over 3,000 sorties a month against land transport targets. An interdiction program only against the two rail connections to China -- the Hanoi-Lao Cai and Hanoi-Dong Dang lines -- would require an estimated 750 strike and support sorties monthly. This program, if effectively inplemented, should stop through traffic on major routes. More intensive attacks would be necessary to halt the use of these routes for shuttle service, and this objective may not be completely feasible. Attacks on these 33 land transport targets, the major portion of which are located on the more heavily used transport routes of the country, would be much more effective in reducing the flow of supplies than attacking minor bridges in the south and in other outlying areas. From the standpoint of target identification, this program would be more easily carried out than attacks on the more obscure, smaller, and diverse transport targets in the south.

A major interdiction attack against logistic targets would achieve optimum results if it were combined with the mining of the three major ports. The mining program would require initially 104 sorties and 190 tons of ordnance. The closing of the ports to oceangoing traffic would throw almost all of North Vietnam's import traffic onto the rail connections to China. The Hanoi-Dong Dang line would then be operating at or close to full capacity. If other essential import requirements were generated by attacks on industrial facilities, such as the Haiphong cement plant, import traffic requirements would then exceed the capacity of the rail line. With only limited highway capacity available, interdiction of northern transport lines would then have a more immediate and direct impact. The flow of military supplies into North Vietnam and onward to South Vietnam would be slowed up and made more costly. Some economic imports would probably have to be foregone. In summary, the North Vietnamese regime would by this program be brought under far stronger pressure from air attacks than that obtained by the pattern of airstrikes in 1965.

It appears that air interdiction with the weapons available and at the level of sorties flown in 1965 will place no real restraint on the level of Communist activity in South Vietnam until their requirements for resupply are much higher than now estimated. It is concluded that to stop the flow of supplies by land from North Vietnam to South Vietnam, allied forces must physically occupy the Panhandle of Laos and completely control a belt across the northern part of South Vietnam. Even then the North Vietnamese would not be at the end of their options and could undertake alternative means of resupply such as sea infiltration or increased use of routes through Cambodia.

F. Some Probable Limits to Resupply

There should be some multiple of the level of air attacks, however, that would increase the cost to the regime and place an upper limit on the level of support that it would be willing to maintain. In order to maintain the supply lines and support the logistic effort in 1965, it is estimated that at least 200,000 full-time laborers and 100,000 part-time workers were required. This number is equivalent to about 20 percent of the industrial labor force. Most of these workers probably come from the agricultural sector, but even their diversion could have an unfavorable impact on agricultural production, particularly in a country where food is in short supply. If this diversion of labor has to increase substantially additional quantities of food would have to be imported to make up for production foregone. This not only would cause increased internal distribution problems but also would aggravate the entire import program, particularly if the major ports were closed by mining and the rail connections to China were subjected to heavy interdiction.

One of the key determinants in the effectiveness of the interdiction effort is the level of supplies required by the Communist forces in South Vietnam. As these requirements increase, the interdiction efforts have a greater chance of success. As allied offensive operations increase in South Vietnam, the Communists will be forced to fight more and will thus use supplies at a higher rate. This will also be true if they on their own initiative try to step up the pace of the fighting. At the same time, if sweep operations uncover and destroy stockpiles of weapons and ammunition the Communist forces will be forced to depend to a larger extent on the flow of supplies from external sources. If the operations in South Vietnam could impose a total dependence on external sources for supply, the daily external logistic requirement would be six times the present level. This requirement could be satisfied through the existing supply network. If, however, the Communist forces build up to the force levels projected for the end of 1966, fight at intensive levels of combat, and are completely dependent on external sources, the North Vietnamese would be hard pressed to meet total requirements through land routes alone.

III. The "Will of the Regime as a Target System"

In North Vietnam, three main factors appear to affect the determination of the regime to continue to support the war in South Vietnam: (1) the course of the war itself in the South; (2) the degree of political and material support rendered the regime by its two main allies, the USSR and Communist China; and (3) the economic, social, and political consequences within North Vietnam itself of supporting the war in South Vietnam. The effort required in supporting the war in South Vietnam draws very little on the physical resources of North Vietnam. The neutralization of given target systems within North Vietnam does, however, exact an increasing cost as the price to be paid for supporting the insurgency. This Appendix examines the various target systems within North Vietnam, with the exception of lines of communication, ranks them in a rough order of their importance to the military effort, presents a judgment on the feasibility or desirability of subjecting them to air attack, and evaluates the probable impact of recommended attacks. Estimates of the forces and ordnance required are presented only for those target systems which it is believed currently offer defensible and fruitful choices in attaining the objectives of the Rolling Thunder program.

A. The Military Supply Target System

Even assuming that the field commanders will have the authority to neutralize all military target systems which prevent control of North Vietnam's airspace, there remain valid military supply and military/economic target systems. The destruction of these targets would compound the adjustment problems which the North Vietnamese have had to face in countering the attacks from the 1965 Rolling Thunder program.

In the North Vietnamese military supply system there are 15 troop barracks, 5 ammunition depots, and 6 supply and ordnance depots designated as fixed targets by the JCS which have not been attacked (see Table D-1). These facilities primarily support North Vietnamese military activity in the North; nevertheless, a number of these facilities also serve as training areas for Viet Cong forces and are supply points for North Vietnamese and Viet Cong forces operating in South Vietnam.

The effectiveness of the postulated attack on these facilities will depend on the extent to which they are in fact in active use. The Hanoi regime appears to have abandoned or dispersed some facilities of this type into the countryside where they will be less vulnerable to air attacks. The dispersion of troops and the abandonment of barracks has been quite widespread. Because construction of temporary storage facilities for ammunition and ordnance may be more difficult in North Vietnam's tropical climate, the extent of their dispersion is less certain and probably less widespread.

Table D-1
Military Supply Target System

JCS Target Number	Name	Estimated Sorties			Ordnance Requirement (Tons)
		Strike	Support	Total	
Barracks					
22	Xuan Mai SSW	44	24	68	99.0
23	Xuan Mai NNW	28	24	52	63.0
31	Ha Dong Barracks/Supply Depot	100	32	132	225.0
34	Vinh Yen North	46	20	66	103.5
35	Son Tay SW	34	20	54	76.5
39.29	Kep Ha NE	64	28	92	144.0
39.33	Trai Thon	24	16	40	54.0
39.37	Vinh Yen NNE	26	20	46	58.5
39.38	Phu Tho NW	18	16	34	40.5
39.41	Ngoc Thai	18	16	34	40.5
39.42	Son Dong SSE	54	16	70	121.5
39.43	Kep South	20	16	36	45.0
39.44	Chi Ne	18	16	34	40.5
39.46	Bien Son NNE	132	20	152	297.0
39.51	Nom Son	8	8	16	18.0
Ammunition depots					
45	Haiphong	76	28	104	114.0
47.14	Vinh Yen	32	20	52	48.0
47.16	Hon Gai Explosives Storage	28	12	40	42.0
47.17	Cam Ly	24	20	44	36.0
47.21	Bac Giang	20	16	36	45.0
Supply/ordnance depots					
58	Hanoi South	28	24	52	21.0
59	Hanoi North	30	20	50	22.5
60	Thai Nguyen North	14	20	34	10.5
62	Van Dien	16	20	36	12.0
63.11	Van Dien Vehicle Depot	58	32	90	43.5
63.14	Son Tay	34	24	58	25.5
Total		994	528	1,522	1,846.5

On balance, destruction of these targets would impede the flow of material in the military supply system and would disrupt military training programs in North Vietnam, but it does not appear likely to decisively cripple the military effort of the regime. The effects would be even more disruptive if other recommended attacks against military/economic targets and lines of communication were carried out. These added attacks would greatly complicate but still not eliminate the flow of essential military supplies into North Vietnam and their eventual distribution to military consumers.

B. The Military/Economic Target System

The economic targets in North Vietnam's modern industrial base which have a direct bearing on the regime's ability to support the war in the South are the major bulk petroleum storage facilities and the Haiphong cement plant (see Table D-2). The petroleum storage installations are vital to maintaining supply and distribution activities within North Vietnam and through Laos, to the mobility of North Vietnamese military forces, and to distribution and transport services for the civilian economy. The Haiphong cement plant as the sole producer in North Vietnam provides a major input to both normal construction activity and the intensive reconstruction and repair programs necessitated by Rolling Thunder attacks.

1. Petroleum Storage Facilities

Previous airstrikes against bulk petroleum facilities destroyed or rendered useless four storage facilities which represented about 37,000 tons of bulk storage capacity. The estimated expansion of airstrikes against eight major storage terminals would deprive the regime of an additional 165,000 tons of capacity. There would remain only 4,000 tons of residual capacity in two of the four bombed sites and some 10,000 tons of storage dispersed in a variety of untargeted locations, including some 2,200 tons in small buried tanks at seven newly identified dispersed storage facilities. Thus the planned attacks would eliminate the principal bulk petroleum terminals in North Vietnam and would preclude the delivery of petroleum supplies in bulk by tankers. About 90 percent of North Vietnam's imports of petroleum currently are delivered by tanker.

A minimum of 440 sorties, comprising 280 strike and 160 support aircraft, will probably be required to destroy the eight major facilities. Losses resulting from the air defenses protecting these targets are estimated at about 3 percent, or 13 aircraft. The ordnance requirement for these targets is estimated to be about 850 tons.

In 1965 the total supply of petroleum, all imported, was about 175,000 tons. Although coal is the principal source of primary energy, this amount of petroleum probably represents North Vietnam's minimum essential needs. In relation to normal monthly rates of consumption, North Vietnam's storage capacity represents almost a year's

Table D-2

Military/Economic Target System

JCS Target Number	Name	Capacity (Metric Tons)	Estimated Sorties			Ordnance Requirement (Tons)
			Strike	Support	Total	
Petroleum storage facilities a/						
48	Haiphong	72,000	58	24	82	196.0
49	Hanoi (Thanh Am)	34,000	36	24	60	121.5
51.1	Phuc Yen	14,000	50	24	74	169.0
51.17	Duong Nham	14,000	38	20	58	85.5
51	Nguyen Khe	13,000	40	20	60	135.0
51.13	Do Son	8,000	22	12	34	49.5
51.11	Bac Giang (Phu Lang Thuong)	6,000	20	16	36	45.0
51.14	Viet Tri	4,000	20	20	40	45.0
Total		165,000	284	160	444	846.5
Cement plant	Haiphong	700,000 to 800,000	4	16	20	13.5

a. Previous strikes at four facilities have eliminated almost 37,000 tons of capacity.

25X1

25X1

supply. Therefore, if the attack is to obtain optimum effect, it is imperative that it be carried out almost simultaneously on all petroleum storage targets. Simultaneous attack insures the most certain way of eliminating the cushion represented by excess storage capacity and stocks and thus creating a critical shortage of supplies to meet essential requirements. The loss of petroleum storage facilities -- and their contents -- would have an immediate effect on the economy. The effect on normal industrial production activities would be slight because most of the industrial enterprises in North Vietnam rely on coal or electricity for energy. Consumption of petroleum by individual civil consumers is negligible. The major effect in the civilian economy would be in transportation. Civilian motorized transportation would come to a quick halt if imports of petroleum were interdicted continuously. The transport of food, raw materials, and finished goods would be curtailed drastically. Relief would be found only to the extent that priority transport and distribution problems could be handled by primitive means of transport or through use of existing stockpiles.

A sustained loss of petroleum storage facilities coupled with an inability to import even minimum operating requirements would have its greatest effect on military operations. North Vietnamese military forces account for about 60 percent of total petroleum consumption, or a monthly average of about 8,500 tons. North Vietnam with Chinese cooperation would probably be able to maintain petroleum imports at almost normal levels even after the intensified attacks discussed in this Appendix. Therefore, the supply of essential imports of petroleum for military requirements would appear to be almost certain.

Nevertheless, the attack would compound the difficulties of maintaining the flow of civilian and military imports on the land transport connections with Communist China. The difficulties would be increased as attacks on other target systems increased the traffic flows in these land and coastal water transport routes.

2. Haiphong Cement Plant

An attack on the Haiphong cement plant would neutralize North Vietnam's only producer of cement and create a major impediment to reconstruction and repair programs at least in the short run. Over the longer term, cement could be imported from Communist China. The import requirement could be in the order of 700,000 to 800,000 tons a year and would require a doubling of the present volume of all seaborne imports. If the cement and all seaborne imports had to be carried on the rail line from China, the total traffic volume would be in excess of the normal capacities of the Hanoi-Dong Dang rail line and the highway connections to China and would be far in excess of their capacity under conditions of interdiction.

C. The Modern Industrial Target System

The modern industrial target system of North Vietnam consists of those major facilities which cumulatively represent Hanoi's hopes for economic development and growth. However, excluding those military and military-related industrial facilities and the fertilizer plants which contribute directly and solely to agricultural output, the bulk of the modern industrial facilities contribute in only a minor way to the maintenance of the war effort.

Hence, modern industry has been called a "hostage target system" in the sense that, while its destruction could well have a considerable psychological impact on the Hanoi leadership, its output is not essential for the continuation of the insurgency in the South and is only indirectly related to the maintenance of military defense in the North.

Such an attack is often postulated on the ground that by depriving Hanoi of almost all of its modern economy and the major hallmarks of its economic progress the regime will be persuaded to enter into negotiations to end the war. This outcome is uncertain and probably unlikely. North Vietnam's modern industrial economy makes almost no direct or significant contribution to the war effort which is sustained materially almost exclusively by supplies from other Communist countries. Since North Vietnam is essentially a subsistence economy, the industrial sector also makes only a limited contribution to economic activity. The loss of industrial production would have almost no impact on the great mass of this agrarian society. The small element of the population directly affected would hardly be sufficient, or disposed, to persuade the regime to stop the war. For these reasons an attack on the modern industrial base of itself would not be likely to attain US objectives.

The experience of the Korean War also supports this judgment. Korea in 1950 was a country with a population considerably smaller and an industrial base much larger than that of North Vietnam in 1965. Most of Korea's modern industry was destroyed in the first three months of the war. One year later, hydroelectric plants were attacked to increase pressures on the regime. Attacks in the spring of 1953 against irrigation dams brought further pressure on the Korean economy. This carefully phased program failed to force the enemy to accept UN truce proposals. In both North Korea and North Vietnam it is clear that the modern industrial base is too small to serve as a testing ground for the "hostage" concept of industrial destruction as a means of deterring aggression.

Attacks on modern industrial facilities, however, would become potentially more promising when and as the effect of other actions -- the war in the South and the results of other Rolling Thunder programs -- gave a cumulative indication of effective pressure upon the regime. At this time an extension of the Rolling Thunder program to attacks on these facilities could add significantly to the psychological pressures influencing the regime's attitude toward negotiations.

There are three categories of plants which fall within the general classification of modern industrial facilities. These are the electric powerplants, the newly constructed heavy industry facilities, and a variety of factories which produce civilian-type goods for the most part. Because these plants are only indirectly related to the military effort, none of them is recommended for priority consideration as targets at this time. They are discussed briefly below.

1. Electric Power

The electric power facilities which would be the object of the postulated attacks are the thermal powerplants at Hanoi, Thai Nguyen, and Hon Gai, and the Dong Anh transformer substation which feeds power from three sources to the city of Hanoi. In addition, the thermal powerplants at Viet Tri, Haiphong city, the Haiphong cement plant, and Lao Cai would also become inoperable (see Table D-3). Destruction of these facilities, including those destroyed so far, would raise the total loss of power-generating capacity to 160,000 kilowatts, or 91 percent of national capacity. These strikes would bring modern industry in the affected areas to a virtual halt and would severely disrupt the highly electrified operations at the port of Cam Pha.

Among the major industrial installations that would probably be shut down are the Hanoi machine building plant; the Hanoi rubber products plant; the Nam Dinh textile plant; the March 8 textile plant; the Thai Nguyen iron and steel plant and iron ore mines; the Hon Gai coal mines; the paper mill, chemical combine, and sugar refinery at Viet Tri; the Haiphong cement plant and phosphate plant; and the Lao Cai apatite mines.

If the attacks on the electric power facilities were effectively executed, the North Vietnamese would be hard pressed to restore power to the degree necessary to resume industrial production. Destruction of the targeted power facilities would also deny to agriculture an estimated 30 to 40 percent of the power supply now used in agriculture. The country lacks both the capability to manufacture the required equipment and the technical skills necessary to reconstruct the powerplants.

2. Heavy Industry

As noted earlier, successful air attacks on the 8 remaining electric power facilities in North Vietnam would eliminate the power sources for 13 major industrial facilities and, as a result, would bring most modern industrial activity in North Vietnam to a halt. Nevertheless, physical destruction of heavy industrial plant facilities could have considerable psychological impact on the regime. Both the time and resources required for reconstruction of these facilities -- in addition to the requirements for replacing damaged electric power facilities -- would further set back North Vietnamese

Table D-3

Modern Industrial Target System

JCS Target Number	Name	Capacity (Kilowatts)
Electric power facilities a/		
81	Hanoi Thermal Powerplant	32,500
82.16	Thai Nguyen Thermal Powerplant	24,000
82.13	Hon Gai Thermal Powerplant	15,000
82.24	Dong Anh Transformer Substation	
82.17	Viet Tri Thermal Powerplant	16,000
82.12	Haiphong Cement Plant Thermal Powerplant	12,000
80	Haiphong Thermal Powerplant	6,000
82.14	Lao Cai Thermal Powerplant	8,000
Total		113,500
Heavy industry		
77	Hanoi Machine Building Plant	
76	Thai Nguyen Iron and Steel Plant b/	
75	Viet Tri Chemical Combine b/	
	Tran Hung Dao Machinery Plant b/	
Light industry		
	Nam Dinh Textile Plant b/	
	Viet Tri Paper Mill b/	
	March 8 Textile Mill b/	
	Sao Vang Rubber Products Plant in Hanoi b/	

a. Previous strikes at 6 plants have eliminated more than 45,000 kilowatts of capacity.
b. This target would cease operations as the result of destruction of electric power facilities.

plans for eventual industrialization. In this case, the following industrial targets would be subject to attack.

a. Hanoi Machine Building Plant

This modern plant, which was a key Soviet aid project, is highly prized by the North Vietnamese as a symbol of advanced technology.

b. Thai Nguyen Iron and Steel Plant

This 100,000-ton steel mill, which is being built with Chinese aid, is the most expensive foreign aid project to be built in North Vietnam. The plant is already producing pig iron and was expected to be producing crude steel and some rolled products by the end of 1965.

c. Viet Tri Chemical Combine

This new plant, built by the Chinese and East Germans, is the center of the industrial chemicals industry in North Vietnam.

d. Tran Hung Dao Machinery Plant

This plant is the second largest machinery and equipment producer in North Vietnam.

3. Light Industry

The following are the major light industry targets of North Vietnam:

a. March 8 Textile Mill

This plant, which has the capacity to produce 30 million meters of cotton fabric annually, was built with Chinese aid and began operation in 1964.

b. Sao Vang Rubber Products Plant in Hanoi

This Chinese-built plant is the sole producer of rubber products. Output includes "large" automobile tires (1965 plan: 23,000 units) of 8 types, including truck tires. It also produces some 30 products for the communications industry as well as bicycle tires, inner tubes, recap tires, and shoe products.

c. Nam Dinh Textile Plant

This plant -- the largest producer of cotton fabric in North Vietnam -- was reconstructed in 1956 and subsequently expanded with Chinese Communist aid.

d. Viet Tri Paper Mill

This plant was built with Chinese aid and has a capacity of 20,000 metric tons. The plant began initial operation in 1961.

Approved For Release 2008/10/16 : CIA-RDP80T01629R000300080014-9

E. The Agricultural Target System

The agricultural target system that has been considered falls into two categories (see Table D-5). The first is the industrial

facilities which directly support agricultural output and which consist primarily of fertilizer plants and one sugar refinery. The other segment of the target system that has been considered is the breaching of the levee system on the Red River delta. The potential vulnerability of North Vietnamese crops to direct attack by chemical agents or plant pathogens has not been considered.

Table D-5

Agricultural Target System

JCS Target Number	Name
	Lam Thao Superphosphate Fertilizer Plant
79	Ha Bac Nitrogenous Fertilizer Plant (Bac Giang)
78	Haiphong Phosphate Plant
	Viet Tri Sugar Refinery
	Van Diem Sugar Mill

The North Vietnamese economy is basically one of subsistence agriculture. The country imports little food even in poor agricultural years and depends largely on domestic food production to feed its population. More than 80 percent of the labor force is engaged in agriculture, which in 1964 accounted for almost one-half of the gross national product (GNP). The bulk of this population lives on food produced, processed, and stored locally. A relatively small shortfall in agricultural production resulting from air attacks could aggravate an already tight food situation in view of the increased food requirements generated by the expanded war effort.

1. Industrial Plants

Neutralization of industrial (largely fertilizer) plants affecting the food supply in North Vietnam would not add significantly to North Vietnam's problem in feeding its population. Damage to the targeted fertilizer plants would result in a maximum reduction in annual output of rice -- totaling 4.5 million to 4.7 million tons in recent years -- of 50,000 tons. In addition, North Vietnam would be deprived of the 225,000-ton increase in annual production of rice which would result from the additions to total capacity for production of chemical fertilizer that are scheduled to go into operation during 1966. Destruction of the sugar refinery would have a negligible

effect on the food supply. Domestic production of sugar, equalling about 2 kilograms per capita annually, provides only an average of 21 calories in the daily North Vietnamese diet, and currently unused capacity at smaller, untargeted facilities could be used to compensate for the loss of the large plant.

2. The Red River Delta Levees

Another segment of the potential agricultural target is the levee system in the Red River delta. In order to inflict maximum damage to the rice crop -- the staple food in North Vietnam -- these levees would have to be breached at some point in the period mid-July to mid-August when the Red River is at its height. During this period, the level of the Red River -- contained by an extensive system of levees -- is considerably above the level of the surrounding plain. Also during this period, the newly transplanted fall rice seedlings, which normally produce about two-thirds of the annual rice harvest, are most vulnerable to damage.

The areas most vulnerable to flooding if the primary levees of this system were breached are the Ha Dong area southwest of the Red River and the Ha Bac area northeast of the river. A secondary system of levees in these areas has tended to confine the damage from major floods in the past to roughly 200,000 hectares,* or almost one-quarter of the total area. Breaching of the secondary levees could substantially increase the acreage flooded. If only the main levees were breached, it is estimated that the crop loss would be on the order of several hundred thousand tons of rice -- or less than 10 percent of the average annual harvest in recent years. If the secondary levees were also effectively breached, the decrease in rice production could reach three-quarters of a million tons.

Successful breaching of these levees would also affect the one and one-half million people in this area, which includes the city of Hanoi. Furthermore, most of the industrial, commercial, and military activity in Hanoi and its suburbs would be temporarily halted until the water receded.

Four factors -- the short time when the attacks on the levees must be executed, the need for great precision in bombing a small target, possible North Vietnamese countermeasures, and the probable adverse public reaction in the West -- detract from "levee busting." As regards the timing of the attacks, they must be mounted within the one-month period from mid-July to mid-August when the river is highest -- above 33 feet -- and the fall rice crop is most vulnerable to flood damage. Within this time period, the attack should follow an unusually high flood stage (the historic highs of the river in flood at Hanoi have been just under 39 feet) because the heights of the primary levees run from 42 to 49 feet.

* One hectare is equal to 2.471 acres.

As for the factor of precision in bombing, the objective is to create a series of overlapping craters across the entire crown of the levee (a distance of approximately 80 feet when the river is at the 33-foot stage) the lips of which are below the water level in the river. If achieved, the scouring action of water rushing through the breach would rapidly deepen and widen the break. A suggested means of creating the series of overlapping craters is with trains of 1,000-pound general-purpose bombs consisting of 11 bombs each which penetrate about 10 feet in average soil and produce craters about 37 feet in diameter. The following tabulation shows three assurance levels of cutting the levee when the river is at the 33-foot level:

Percent Assurance	Number of Trains	Number of 1,000-Pound General-Purpose Bombs	Tonnage
50	5	55	27.5
70	6	66	33.0
85	8	88	44.0

These assurance levels apply only to one breach; from two to four separate and almost simultaneous breaches are probably required to achieve the type and extent of flood damage discussed above. Breaching the levees at one point requires heavy bomb loads and accurate delivery; breaching them at multiple points at the same time is likely to be even more difficult. The existence of heavy antiaircraft defenses in the same general area that the levees can be most effectively attacked further compounds the difficulty.

As regards countermeasures, the North Vietnamese are well aware of the importance of the levee system to life in the Red River delta, and the regime has maintained and strengthened the system over the years. The existence of a secondary system of levees, which are not here considered as targets for air attack, tends to limit the effects of breaching the primary system. Well before the initiation of US air attacks in 1965, discussions within the North Vietnamese regime of the importance of the levee system highlighted the success of the Viet Minh in countering the effects of French destruction of levees and dams and suggests that past experience has in part prepared the regime for such an eventuality. One obvious method of countering the effects of a breach in the levees in the target area is to deliberately breach a number of the levees upstream and divert the water into less important agricultural areas. Defensive breaching of this type could rapidly drop the level of flood water at Hanoi by as much as six feet. A specific illustration of the sensitivity of the North Vietnamese regime to possible attacks on levees was contained in a recent report which mentioned the collection of barrage materials in the Hanoi area to fill breaches in the levees.

Loss of life, homes, and places of work would be exceedingly disruptive to the social order in the affected areas in the short run but over the long run, the effect on rice availabilities would probably be the hardest problem for the regime. The loss of several hundred thousand tons of rice, particularly in a year of below-average harvests, would force the regime to seek outside sources of supply. Communist China, which in an average year produces 75 million to 85 million tons of rice, could provide the necessary amount. Under conditions of continuing air interdiction of the land links between North Vietnam and Communist China, transport of such supplies could be difficult. The factors of timing, bombing difficulty, and North Vietnamese countermeasures all argue against attempting to breach the levees; similarly, the regime would be quick to exploit the political advantage provided by such attacks.

F. The Manpower Target System

North Vietnam is an essentially agrarian society with less than 15 percent of the population living in urban areas. Of the more than two million urban population, 928,000 are concentrated in the eight largest cities and their populations are as follows:

	Population
Hanoi	475,000
Haiphong	210,000
Nam Dinh	90,000
Vinh	46,000
Thanh Hoa	35,000
Thai Nguyen	28,000
Viet Tri	26,000
Dong Hoi	18,000

Area bombing attacks of the type mounted against Japan in World War II could be mounted against these cities. Civilian casualties in Japan were about 600,000 (excluding those from atomic weapons), or a ratio of about 4 casualties per ton of bombs. Most of the tonnage was dropped on urban areas in Japan. Several factors suggest that such attacks against North Vietnamese cities would not necessarily result in as high a proportion of casualties as those resulting from the attacks against Japan. Unlike the very high proportion of wooden structures in Japanese cities, brick and masonry construction is a common feature of North Vietnamese cities. Traditional Asian methods of construction with wood and fibres tend to be seen chiefly on the outskirts of the larger cities of North Vietnam and do not predominate except in the smaller towns and villages. Because of their construction, North Vietnamese cities do not appear to be as vulnerable to incendiary attack

and fire damage as were Japanese cities. Furthermore, differences in the layout of North Vietnamese cities further decrease their vulnerability to bombing damage. For example, the system of wide boulevards which compartment the city of Hanoi and the network of canals which runs through Haiphong city constitute fairly effective firebreaks. Other examples of differences in urban layout are Thai Nguyen, in which the two main built-up areas are separated from one another by a few miles of rice fields and scattered dwellings, and Viet Tri, in which several built-up areas are dispersed along the banks above the junction of two rivers.

There are also good indications that the regime's civil defense program is more effective than the Japanese program in World War II. Partial evacuation of the larger North Vietnamese cities has already been undertaken as was the case in Japan prior to the attacks in the spring of 1945. However, the early warning system of North Vietnam and its shelter programs in the cities appear to be better conceived and, during the attacks of 1965, better carried out than was the case in Japan. Finally, the regime has made it clear to the North Vietnamese people that they must expect air attacks -- at least some of the casualties in Japan are credited to the government-sponsored belief that serious bombing attacks could never occur.

For these reasons, it is believed that casualties (the total of killed and wounded) in attacked areas of North Vietnamese cities are likely to be less than was the case in Japan.

Under conditions of continuing industrial activity, bombing attacks on urban areas would probably have the greatest effect on North Vietnam's limited supply of skilled manpower. Approximately 85 percent, or about 255,000, of North Vietnam's supply of skilled manpower lives and works in the eight cities considered as targets. Roughly 150,000 of this total is concentrated in two cities -- Hanoi, about 105,000, and Haiphong, 45,000. Qualitatively, the manpower loss to the regime from these air attacks would be most severe in the Hanoi-Haiphong area since the concentration of the more advanced industrial facilities in this area means that the most highly skilled among the labor force are likely to become casualties.

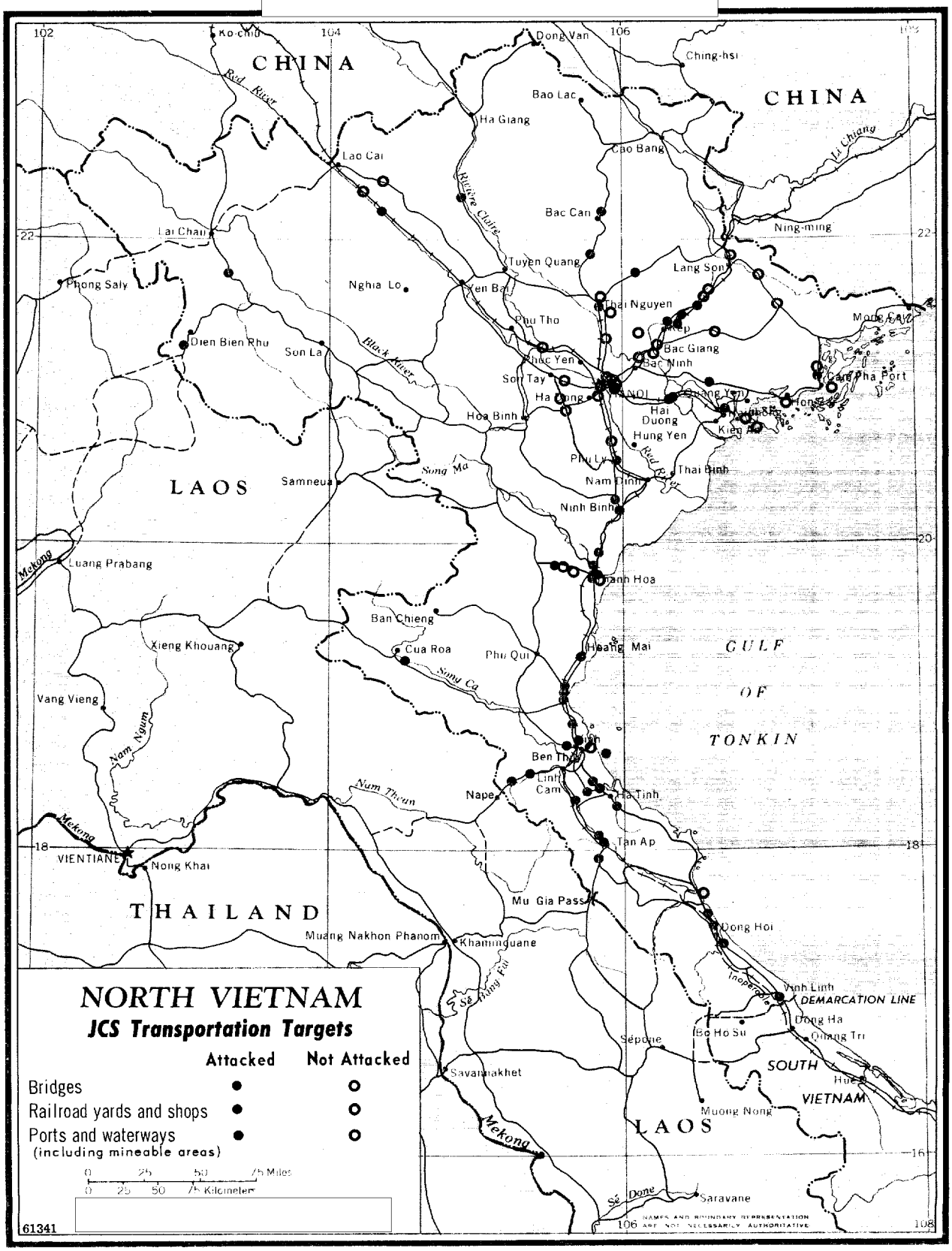
Extensive physical damage would also result from these attacks and a large proportion of surviving urban population would evacuate to near-by rural areas. In the short run, the organizational effort necessary to reallocate most of the urban labor force in addition to implementing further defense measures and the necessary adjustments in the agricultural labor force would strain the limited management capabilities of North Vietnam's cadre force. Much of the manpower made available to the regime would be wasted through irrational assignments, and many urban workers would probably be left to their own devices long enough to scatter into sparsely populated areas where an

inadequate control system would make it almost impossible to channel them into essential jobs. The existence of the fairly efficient and resilient communications system and a reasonably well-disciplined Vietnamese Workers Party apparatus of around 900,000 members would be prime assets in the regime's attempts to solve this problem. Nevertheless, the morale of the nonagricultural labor force would probably decline with a consequent lowering of its potential productivity due to numerous casualties, transfers from normal jobs, separation from families, and the probable demand for further amounts of uncompensated labor.

Medical services in North Vietnam are inadequate to meet the nation's normal public health needs. These services, therefore, can provide only minimum emergency care and treatment of additional civilian casualties. The small numbers of civilian medical and paramedical personnel (estimated to include 1,400 physicians, 2,300 doctors' assistants, and 8,000 nurses in 1965), most of whom are poorly trained, are unable to cope with the high incidence of nutritional, infectious, and parasitic diseases. They presumably have been hard pressed to service the relatively few war casualties sustained thus far. The civilian and military hospitals (only 25,000 beds), convalescent homes, and village medical stations are, with few exceptions, poorly equipped and chronically overcrowded. Moreover, with the exception of several important combat-related items, medicines are in short supply. The exceptions are mainly penicillin, blood plasma, and sulfa drugs, large stocks of which have been accumulated as a result of greatly increased imports during the past year. The stockpile of penicillin is estimated to be sufficient, according to US experience, to meet the needs of more than 800,000 troops in active combat for one year.

It has not been possible in the time available to arrive at an estimate of the bomb tonnage required to bring the eight leading cities of North Vietnam under air attack. Nor was an estimate made of the probable level of casualties. Clearly, heavy attack on these cities would result both in severe physical damage as well as widespread casualties, particularly if the attacks were concentrated in time. The major reason for giving skilled manpower a lower target priority at this time is that of the probable adverse effects of such attack on Western opinion while a large number of industrial and military targets remained intact. The manpower attack is one which, by its very nature, is attractive as a "last ditch" effort, after other target systems have been generally neutralized and the regime nevertheless continues to press on with the conflict.

25X1



D-1 North Vietnam: JCS Transportation Targets Attacked and Not Attacked

25X1

Appendix E

Approved For Release 2008/10/16 : CIA-RDP80T01629R000300080014-9

APPENDIX E

THE EFFECTIVENESS OF AIR ATTACKS IN OTHER WARS

The United States has engaged in three previous wars in which air power has played a major role as a means of conducting offensive warfare.

25X1

The air war against Korea is most similar to the air war being conducted in North Vietnam. For this reason the Korean War is examined in considerable detail to evaluate the attempts to interdict North Korea's transport system and to evaluate the lessons this experience may have for the Rolling Thunder program.

25X1

Approved For Release 2008/10/16 : CIA-RDP80T01629R000300080014-9

III. The Air War Against North Korea

A. Introduction

The lessons learned in one war against an adversary using strategy and tactics appropriate to the time and place cannot often be applied with success to another war fought under different conditions. Improved weapons alone can negate the lessons of an earlier war. Furthermore, each war is unique in its total setting -- the political and economic realities of a North Vietnam are not those of a North Korea any more than the tropical setting of the former is equal to the harsh climate of the latter.

This appendix reviews the environment of the two wars and places particular emphasis on the attempts by US aviation forces to interdict the transportation system and to destroy the heavy industry of North Korea. In spite of the differences between North Korea and North Vietnam, these aspects of US operations in North Korea are relevant to current US air operations in North Vietnam.

B. Similarities and Differences of Environment

Numerous similarities exist between the present war in Vietnam and the Korean War. Each conflict involves a divided country. Communist China looms over the northern border of both North Korea and North Vietnam as a major supplier of war materiel and as a participant or potential participant. Many contrasts exist also. The topographic and climatic setting of the military actions in South Vietnam are unlike those fought in Korea. Instead of the guerrilla and infiltration tactics characteristic of today's war in South Vietnam, the Korean War eventually involved large-scale land armies.

Other contrasts can help put the two conflicts in perspective. North Korea occupies an area of about 47,000 square miles and in 1953 had a population of 9 million; North Vietnam has an area of 61,000 square miles and a population of 18 million.

C. Interdiction in North Korea

1. Introduction

In the summer of 1951 as talks about a truce began and the fighting lulled, the US Eighth Army calculated that enemy forces in Korea were stockpiling daily 800 tons of supplies behind their lines. It was feared that the enemy would "reach a degree of preparedness previously unparalleled in the Korean War." To interfere with this buildup, the Far East Air Force (FEAF) planned Operation Strangle, a comprehensive interdiction campaign against North Korea's railroads and highways.

Operation Strangle had two principal objectives: (1) the knocking out of the North Korean rail system by maintaining continuing rail cuts at numerous points and by destroying rolling stock and equipment, and (2) the disrupting of rail services so that the North Korean and Chinese Communist forces would have to use the highways, which could be brought under effective attack, to transport most of their military supplies.

Postmortems on Operation Strangle have claimed that the codename was an unfortunate choice because it implied more than had been intended. Nevertheless, that name mirrors initial Air Force optimism about the probable effectiveness of an interdiction program. For example, one official statement at the beginning of Operation Strangle claimed:

> The Fifth Air Force and attached units in conjunction with US Naval Air units and FEAF Bomber Command have the capability of destroying the enemy's rail system in North Korea, and of hindering his highway transportation system to such an extent that he will not be capable of opposing the US Eighth Army effectively.

Starting in August 1951 and extending over the next 11 months, 81,600 interdiction and armed reconnaissance sorties were flown by the USAF, and more than 104,000 tons of bombs were dropped during the interdiction and armed reconnaissance sorties.* By contrast, in a similar time period (February-December 1965) in North Vietnam, 27,900 sorties were flown and 34,300 tons of bombs, napalm, and rockets were expended against fixed and armed reconnaissance targets. During Operation Strangle an average of almost 10,000 tons of bombs were dropped monthly. The peak month for Rolling Thunder occurred in December 1965 when 5,500 tons of bombs, napalm, and rockets were expended. A summary comparison of air operations in the Korean War and in North Vietnam (Rolling Thunder) is presented in Table E-2.

Operation Strangle was not, however, the first US attempt at interdiction in Korea. In the first year of the Korean War the Air Force had flown 70,000 interdiction and armed reconnaissance sorties out of a total of 140,000 combat sorties, but the fluid military situation had required that major emphasis be given to close support of combat troops.

* Because of its unfortunate codename there was considerable controversy (during the Korean War) about the timespan covered by Operation Strangle. The time limits used in the official Air Force history are used in this Appendix. Thus Operation Strangle (later Operation Saturate) began in August 1951 and continued through June 1952.

2. Railroad Interdiction -- Operation Strangle

For the first three months, Operation Strangle was successful. Major rail lines were disrupted, and fighter-bombers destroyed railroad track faster than the enemy could rebuild it. By early October 1951, rail movements ceased, even on the double-tracked line from the capital of P'yongyang south to Sariwon just north of the battle zone. By November 1951, virtually all direct major rail routes to Manchuria had been severed, although limited serviceability existed by shunting traffic inland and then back to either coastal or other interior rail lines. Interdiction and armed reconnaissance accounted for over 60 percent of all combat sorties from the start of Operation Strangle through the end of 1951. The numbers of sorties flown and bomb tonnages expended reached a peak in October, when 9,700 interdiction and armed reconnaissance sorties were flown and more than 10,000 tons of bombs were dropped. In the first two months of Operation Strangle, interdiction and reconnaissance targets claimed more than 90 percent of the total weight of bombs dropped.

These attacks reached a peak of destructiveness in September through November 1951. In September, Air Force pilots alone claimed the destruction of 38 locomotives, 558 freight cars, 5,400 vehicles, and about 1,400 buildings. Rail lines were severed about 15,000 times.*

Immense damage was done to the transportation system of North Korea, even when allowance is made for the exaggerated claims of destruction. The first intense blows did not knock out the system, however, and in the following months the serviceability of the North Korean transport system improved materially. Tonnages being moved on the railroads and highways were only a small fraction of peacetime "capacity," but the supplies getting through were more than sufficient

* The official USAF Historical Study of Air Operations in the Korean War recognizes that pilot's claims of vehicles destroyed were greatly exaggerated, the results of night attacks being especially hard to evaluate or check. In September 1951 the Fifth Air Force issued a directive permitting night intruders to claim enemy vehicles destroyed only when the vehicles were seen to burn or explode. Yet even this requirement probably did not prevent multiple claims. For example, North Korean truck drivers carried oily rags which were lighted when they were under attack to feign destruction and be spared further attack. Eventually, claims of locomotive "kills" were only allowed when attacks were made using 500-pound bombs or larger and after which the locomotive was observed to be derailed or in at least three separate parts.

Table E-2

Comparison of Air Operations in Korea and North Vietnam

	Korean War [a]		North Vietnam
	Entire War June 1950 - July 1953	Operation Strangle August 1951 - June 1952	Rolling Thunder February - December 1965
Sorties			
Total	710,886	214,485	N.A.
Total combat [b]	461,554	144,724	N.A.
Total interdiction and armed reconnaissance [c]	220,168	81,613	27,932 [d]
Total combat expenditures			
Bombs (tons)	386,037	118,207	N.A.
Napalm (tons)	32,357	4,313	N.A.
Rockets (rounds)	313,600	50,707	N.A.
Expenditures for interdiction and armed reconnaissance			
Bombs (tons)	218,448	104,115	34,261
Napalm (tons)	3,815	2,192	
Rockets (rounds)	97,885	30,492	
Damage [e]			
Bridges			
Destroyed	1,153	223	161
Damaged	3,049	763	432

Table E-2

Comparison of Air Operations in Korea and North Vietnam
(Continued)

	Korean War [a]		North Vietnam
	Entire War June 1950 - July 1953	Operation Strangle August 1951 - June 1952	Rolling Thunder February - December 1965
Damage (Continued)			
Tunnels			
Destroyed	65	41	N.A.
Damaged	939	257	N.A.
Locomotives			
Destroyed	963	272	6
Damaged	1,171	345	6
Freight cars			
Destroyed	10,407	3,638	227
Damaged	22,674	7,069	592
Railroad cuts	28,621	24,251	N.A.
Trucks and other vehicles			
Destroyed	82,920	33,210	483
Damaged	33,131	14,768	565
Buildings			
Destroyed	118,231	9,109	1,837 [f]
Damaged	88,461	17,382	2,266 [f]

Table E-2
(Continued)

	Korean War [a]		North Vietnam
	Entire War June 1950 - July 1953	Operation Strangle August 1951 - June 1952	Rolling Thunder February - December 1965
Damage (Continued)			
Oil storage tanks			
Destroyed	16	0	N.A.
Damaged	3	0	N.A.
Barges and boats			
Destroyed	593	225	460
Damaged	821	284	753
Aircraft			
Average inventory			
Bombers, light	192 [g]	150 [h]	
Bombers, medium	118 [g]	103 [h]	
Fighters	1,511 [g]	982 [h]	
Operational losses [i]			
B-26	168	57	
B-29	57	24	
F-51	300	98	
F-80	277	67	
F-82	11	2	
F-84	249	121	
F-86	184	66	

Table E-2

Comparison of Air Operations In Korea and North Vietnam
(Continued)

25X1

25X1

a. Excluding sorties flown by the US Navy and Marines and by other friendly forces. During the Korean War, Navy and Marine aircraft flew 275,912 combat sorties: 204,995 offensive, 44,160 defensive, and 26,757 reconnaissance. Ordnance expenditures were 178,399 tons of bombs and 274,189 rounds of rockets. Navy aircraft were heavily engaged in Operation Strangle, but no specific data, comparable to USAF statistics, are available.
b. Including close support, strategic, counter-air-offensive, counter-air-defensive, reconnaissance, and interdiction and armed reconnaissance, but excluding combat support sorties such as rescue, cargo, and tactical control.
c. A mission with the primary purpose of penetrating enemy lines and destroying or damaging traffic, communications, and movement significant to the enemy's military operation in a given area.
d. Including 6,928 sorties against fixed targets and 17,129 armed reconnaissance sorties.
e. In addition, Navy and Marine aircraft destroyed during the Korean War: 2,005 bridges, 391 locomotives, 5,896 freight cars, 7,437 vehicles, and 44,828 buildings.
f. Barracks, warehouses, and miscellaneous buildings.
g. Peak average inventory, April-June 1953.
h. Average inventory, July-September 1951.
i. In addition, 564 Navy and Marine aircraft were lost to enemy action between 25 June 1950 and 27 July 1953.

to support the Communist armies in the field. The North Koreans and Chinese developed an increasing capability to repair damage from air attacks and to get both rail and highway traffic moving again. Repairs were being made so rapidly that by late December 1951 the Fifth Air Force recognized that "the enemy had broken our railroad blockade of P'yongyang and ... [has] won the use of all key rail arteries."

In February 1952, Operation Strangle (renamed Operation Saturate) was modified to reflect the lessons of the previous six months. Railroad interdiction was still emphasized, but attacks were concentrated against specific pre-targeted segments of the rail line. The change in air operations, and its successes and failures, can be seen in a description of one attack made against the rail line between Chongju and Sinanju. In a leadoff attack in late March 1952, 307 fighter-bombers dropped 530 1,000-pound bombs and 84 500-pound bombs. The following day, 160 fighters dropped 322 1,000-pound bombs. During the night, B-26's dropped 42 500-pound bombs on what had already become a major gap in the rail line. However, the ability of the North Koreans to repair rail damage had further improved; within six days the roadbed was almost completely rebuilt and the tracks were replaced. The 48-hour attack and the expenditure of 450 tons of bombs had interdicted the rail line for 6 to 7 days but had required the commitment of almost the entire fighter-bomber force. At the same time other rail lines had remained open.

In April 1952 a penetrating staff study by the Air Force recognized that in spite of the vast damage inflicted the interdiction operation had not achieved its objectives and that such operations were becoming more costly in terms of casualties to air crews and aircraft lost and damaged. Furthermore, some of the most modern US weaponry was being effectively countered by hordes of unskilled labor and minimum amounts of easily attainable materials.

Policy changes which emerged from the staff study emphasized the need to inflict maximum damage on the enemy and to minimize US losses, and included some shifts in targets. Thus, while locomotives, motor vehicles, and other transportation targets were still rated as prime targets, equal or greater emphasis was given to radar, guns, supply depots, mines, powerplants, and military schools. In effect, the new targeting took account of economic principles. From attempts to physically cut the rail and highway systems the attack moved to inflict maximum damage upon the enemy's limited stock of military and transport capital in North Korea, capital which could not be replaced by the labor of unskilled peasants. Nevertheless, the new attack policy, announced in July 1952, admitted that "obstruction of enemy supply movement in Korea cannot prevent the enemy from gradually building up his stockpile." Although the Air Force continued to bomb selected bridges and rail targets during the remaining year of the war, Operations Strangle and Saturate were at an end.

3. Evaluation of Operation Strangle

a. Introduction

Operation Strangle and Operation Saturate failed to achieve their objectives not only because there was an insufficient number of aircraft to maintain an adequate number of rail cuts but also because enemy countermeasures were more successful than had been estimated. Communist antiaircraft defenses increased markedly, and the Communists showed an increasing ability to improvise repairs, to build bypass lines, and to mass peasant labor to maintain and repair essential supply lines.

The decline in returns from Operation Strangle can be seen from an analysis of bombs expended and damage achieved. During July 1951, the month before Operation Strangle got under way, approximately 6,600 tons of bombs had been dropped on interdiction targets in North Korea. Bombs expended increased sharply in August to 8,300 tons. From August to September, bombs expended increased by about 2,000 tons, or one-fourth, and the estimated value of destruction increased by about three times. After November, however, there was a steady trend of diminishing returns from the bombing attacks despite a fairly steady expenditure of bombs at an average rate of 9,800 tons per month. As shown in Figure E-3, the index of value of damage per ton of bombs declined from a peak of 100 in September 1951 to 39 in January 1952 and a low of about 26 in April and June.

b. Railroad Interdiction

During 1950-53 the North Korean rail system consisted of about 2,300 miles of line, largely standard gauge, and included approximately 1,800 bridges and 400 tunnels. During the initial stages of Operation Strangle the Air Force engaged in a multiprong attack against bridges, rolling stock, tunnels, roadbeds, and rails. Tunnels, used extensively to protect trains and supplies in daytime attacks, proved in most instances to be impossible to destroy. Bridges were difficult targets, but were destroyed consistently.

After the interdiction campaign had been under way for several months the enemy showed a rapidly increasing capability to restore damaged bridges. Construction materials were being stockpiled near key bridges even before US attacks. Simple bypass bridges were built frequently in from 2 to 4 days. Rail cuts were repaired in from 2 to 6 hours. Priority was placed on getting a bridge back in partial operation so that some supplies could begin to flow again although traffic might remain far below capacity levels.

The North Koreans and Chinese stationed railroad construction troops along all main supply routes which were under attack. Units of 50 troops were located at all major rail stations,

and crews of 10 men were located every 4 miles along the route. In addition, rail walkers spotted damage to the rail or roadbed. Nearby inhabitants were recruited for common labor, and sometimes as many as 1,000 persons were used to repair a damaged section. At dark, experienced railroad construction crews would move in and make the actual repairs to the rail line. Furthermore, in portage-like operations, rail service was maintained on very short stretches of usable track -- as short as 11 miles -- and freight was unloaded, carried around rail cuts or damaged bridges, and then reloaded on another train.

c. Highway Interdiction

The road network in North Korea, originally developed by the Japanese, had always been of secondary importance to the railroads. Trucks had been used typically for short hauls and served as links between industrial and commercial centers and the major railroads. North Korea's principal highways roughly followed the major rail routes from Manchuria southward. Altogether about 10,000 miles of highways existed, at best surfaced with gravel or crushed stone.

Although the major interdiction effort of Operation Strangle was against the North Korean rail system, attacks against trucks were also pressed, especially night attacks led by B-26's. On one occasion, an Air Force wing reportedly sighted 3,800 motor vehicles and attacked 2,600 vehicles in one day. The Air Force claimed that 6,400 trucks were destroyed in October 1951 alone. Highway bridges were also attacked but proved to be more difficult to interdict effectively than rail bridges. Bypasses were sometimes built at a considerable distance from the original bridge and were thus not easily sighted; fords were built and used during much of the year.

Truck traffic was uncommon during the daylight hours and at night was hard to locate and to attack effectively. The results of night attacks against motor vehicles as well as rolling stock were especially difficult to assess. Trucks usually traveled in convoys of 15 to 20 vehicles, ordinarily under blackout conditions. The mileage norm for trucks per night was about 60 miles. For example, a round trip from the Manchurian border to the battle zone required about 10 nights' travel.

d. Night Operations

Even before Operation Strangle began, the North Koreans had started to move virtually all rail and road traffic at night. The B-26 bomber was used extensively as a night intruder to harass trucks and trains along major enemy supply routes. During Operation Strangle, 1,500 to 2,000 sorties were flown monthly by B-26 bombers, about 90 percent of them at night. The heavier B-29 bombers were used to attack targets at night.

In the absence of bright moonlight, B-26 attacks achieved only limited success, and numerous experiments were conducted with flares to light the targets. Infrared detection systems were used on a limited scale to locate targets such as locomotives, tanks, vehicles, and industrial locations. The results of these innovations were limited, however.

In 1952, as Operation Strangle disrupted railroad lines, the North Koreans and Chinese made more intensive use of trucks to transport supplies to the front. In the fall and winter months, sightings of vehicles declined, and the B-26 night attacks were shifted to rail cutting and to harassing North Korean night repair activities.

The major lessons from US night-intruder operations during the Korean War were the following: (1) aircraft, especially the B-26 that had been designed for day operations, had only limited success at night in detecting, identifying, and attacking moving targets; (2) air crews required careful selection and special training for night operations; and (3) a strong need existed for a family of "denial" weapons that would successfully interdict rail lines and highways for periods that would eliminate the need for essentially inefficient night operations. Night operations were hampered throughout by the inadequacy of night photography to provide adequate assessment of bomb damage.

e. The Wa-dong Chokepoint

The Korean War offers an excellent example of the difficulty of successfully interdicting a transportation chokepoint by large-scale aerial bombing. In the winter of 1952, while Operation Saturate was getting under way, target specialists located what appeared to be a vital chokepoint near the village of Wa-dong in central Korea about 20 miles north of the 39th parallel. Here a major east-west railroad passed over a highway from Wonsan on the east coast to the capital at P'yongyang. About 100 yards further to the west the railroad entered a short tunnel. The railroad and highway did not follow identical alignments across North Korea but came together only at Wa-dong. Adjacent hills rising to about 300 feet above the valley floor would have made Wa-dong stand out as an ideal chokepoint to even the most unimaginative target analyst. The North Koreans had used both the lateral highway and the railroad to shuttle supplies between the east and west coastal railroads, thus substantially increasing the flexibility of the badly damaged rail system. The objective of the attacks was to block all rail and vehicle movement in the area. Due to the area's rough terrain, bypassing the chokepoint would have proved very costly.

For 44 days, from 26 January to 11 March 1952, 77 B-29 and 126 B-26 sorties saturated the target of about 18 acres with

3,928 500-pound general-purpose bombs, one bomb for every 22 square yards of target. Bomb assessment reports for 24 days of the 44-day attack period showed the following results:

Railroad	
Serviceable	10 days
Unserviceable	8 days
Status unknown	6 days
Total	24 days

Highway	
Serviceable	15 days
Unserviceable	4 days
Status unknown	5 days
Total	24 days

Bomb assessment reports also revealed that the total effort had resulted in only 18 actual rail cuts and 15 highway cuts. The effort at best resulted in the railroad being interdicted for 8 days and the highway for 4 days. Except for temporary disruptions the North Koreans had suffered very little damage. The bombs had done little more than churn up the countryside; landslides that had been hoped for did not occur.

Evaluations made of the Wa-dong experience during the Korean War led to the conclusion that it is a fallacy to assume that there is an "area target" for traffic interdiction, and the Far East Air Forces recommended that airpower be concentrated on pinpoint bombing against definite targets in preference to area bombing in any future interdiction attacks.

D. Strategic Bombing

1. Early Bombing

North Korea's modern industry, which was developed by the Japanese, was considerably greater in total capacity and range of output in 1950 than North Vietnam's industry in 1965. During the initial months of the Korean War the B-29's available in the war theater were engaged in close tactical support of the hard-pressed US and South Korean forces. Attacks on industrial targets in North Korea were not feasible until mid-July 1950. In the next three months the FEAF Bomber Command dropped 10,400 tons of bombs, with excellent results, on the major targets listed below in Table E-3.

Table E-3

Strategic Targets Attacked in North Korea
1950

Location	Target	Bomb Tonnage	Percent of Target Destroyed or Damaged
Wonsan	Dock area	244	50
	Locomotive shops	372	70
	Railroad yards	477	70
	Chosen oil refinery	327	95
Hungnam	Bogun Chemical Plant	695	70
	Chosen Nitrogen Fertilizer Company	563	85
	Chosen Nitrogen Explosives Company	500	85
P'yongyang	Arsenal	99	70
	Kan-Ni	500	15
	Shunting yards	356	30
	Railway shops and yards	584	70
Chongjin	Harbor and submarine base	249	5
	Mitsubishi	132	30
Chongjin	Iron works	203	20
	Railroad yards and shops	1,063	55
Rashin	Oil storage	49	Negl.
	Dock area	218	Negl.
	Railroad shops and yards	110	Negl.
Chinnampo	Marshaling yards	121	80
	Port and subbase	5	Negl.
	Mining and smelter	248	35
	Chosen Riken Metals Co.	284	70
Changjingang Reservoir	Pujon Hydroelectric Plant No. 1	39	10
Hamhung	Railway shops and yards	547	70
Haeju	Chosen Nitrogen Explosives Company	568	10
	Railway shops and yards	104	70

Table E-3

Strategic Targets Attacked in North Korea
1950
(Continued)

Location	Target	Bomb Tonnage	Percent of Target Destroyed or Damaged
Kyomipo	Iron works	252	40
	Marshaling yard	23	Negl.
Kowon	Railway shops and yards	102	10
Songjin	Steel works	326	90
	Magnesite Chemical Industry	183	30
	Railway shops and yards	280	60
Yangdok	Railway shops and yards	75	85
Namgungni	Storage area	58	80
Munpyongni	Rising Sun Oil Storage	2	a/
Chongju	Railway shops and yards	170	10
Kilchu	Marshaling yards	99	50
Sunchon	Chemical industry and marshaling yard	138	30
Sariwon	Marshaling yard	81	50
Total		10,446	

a. No bomb damage assessment.

Of 20 strategic targets designated by the JCS, 18 had been destroyed or severely damaged by late September.

In September 1950, plans were under way to destroy the modern complex of hydroelectric generating plants that had been built by the Japanese. On 26 September, 17 B-29's attacked and inflicted minor damage on the Pujon Hydroelectric Plant, which had an installed capacity of 128,000 kilowatts. The same day, however, the JCS suspended attacks on strategic targets.

By late September the Commander of FEAF was able to claim, "Practically all of the major military targets strategically important to the enemy forces and to their war potential have now been neutralized." In a few weeks, North Korea's modern industry had been destroyed. Although such destruction obviously inflicted "punishment" on North Korea's leadership, the military effect of the strategic bombing was of little consequence. Military equipment and ammunition continued to flow into North Korea from China and the USSR.

2. Later Strategic Bombing Efforts

a. Hydroelectric Power

It was not until June 1952 that the hydroelectric installations previously regarded as "politically sensitive" targets were again considered as legitimate targets. Over a 3-day period in June 1952, 730 fighter-bomber sorties by the Fifth Air Force, supported by sorties from a Navy Task Force, were flown against the power complexes, including the Sui-ho Generating Plant on the Yalu River. Post-strike evaluation of the bombing attack indicated that 90 percent of North Korea's electric power capacity had been knocked out. For more than two weeks there was almost a complete blackout in North Korea until small thermal plants and undamaged hydroelectric plants restored a small portion of North Korea's pre-attack capacity. Although the small, dispersed "war-industries" in North Korea obviously suffered from the loss of electric power, the extent of the damage to industry in Manchuria, which received much of its electric power from North Korea, was difficult to assess.

Attacks against the hydroelectric installations came much too late in the Korean War to have much impact on the outcome or to do serious damage to North Korea's war effort. The attacks were designed primarily to exert continued air pressure on the North Koreans and Chinese to accept UN truce proposals.

b. Irrigation Dams

In the spring of 1953, only slow progress was being made at the Panmunjom truce talks. Air Force targets specialists seeking additional means of increasing air pressure against the

Communists recognized the importance of the irrigation dams to Korean rice production. There followed a large-scale and highly successful attack against a 2,300-foot earth and stone dam about 20 miles north of P'yongyang. Along with severe damage to a major rail line, the floodwaters also damaged 5 square miles of prime rice crops.

Other Korean dams were attacked by US fighter-bombers and B-29's, ostensibly to interdict transportation lines. These later attacks were less successful because the North Koreans, as in other circumstances, improvised countermeasures. For example, by rapidly lowering the water level the North Koreans made it much more difficult to destroy or seriously damage the dams.

E. Lessons from the Korean War

1. Introduction

The 27,900 sorties flown and the 34,300 tons of bombs, napalm, and rockets expended under the Rolling Thunder program from February through December 1965 are less than one-third the 81,600 sorties flown and the 104,000 tons of bombs dropped by the Air Force during the interdiction and armed reconnaissance sorties in the 11 months of Operation Strangle. In addition, during the Korean War Navy and Marine aircraft operating from carriers probably also dropped about one-third as much tonnage as was dropped by the Air Force on interdiction targets.

Even allowing for exaggerated damage claims, it is clear that there were far more lucrative targets in North Korea than are being located and destroyed presently in North Vietnam. Destruction claimed in the 11 months of Operation Strangle in Korea compared with that claimed for Rolling Thunder in Vietnam through December 1965 is shown in the following tabulation:

	Operation Strangle	Rolling Thunder
Locomotives	272	6
Freight cars	3,638	227
Vehicles	33,210	483
Bridges	223	161
Buildings	9,109	1,837
Barges and boats	225	460

The greater destruction achieved in Korea compared with North Vietnam is not solely a function of the number of sorties and the tonnage of bombs dropped. The Rolling Thunder program has had to operate under an extremely restrictive policy which sharply limits both the areas in which it can operate and the targets it can attack.

North Korea's railroads and highways had to supply almost 1 million troops, 600,000 of whom were at the front. North Korea had almost 2,300 miles of rail lines and 10,000 miles of highways, compared with North Vietnam's meager 485 miles of rail lines and 5,800 miles of highways. North Korea had a much larger park of both rolling stock and trucks. In addition, although the population of North Vietnam substantially exceeds North Korea's, there was more modern and semimodern industry in North Korea than is found in North Vietnam.

2. Failure of the Interdiction Campaign

At the time Operation Strangle was under way, it was estimated that each Chinese division required 50 tons of supplies per day.* With 60 divisions at the front, approximately 3,000 tons of supplies had to be moved from Manchuria to the battlefront each day.

Peacetime capacity of the double-tracked line in western Korea from Sinuiju to P'yongyang was estimated to have a capacity of from 6,000 to 9,000 tons per day. After maximum interdiction efforts, it was conservatively estimated that only 500 to 1,500 tons per day were getting through to the battle zone. The capacity of the east coast rail line, 5,000 tons per day in peacetime, was reduced to less than 500 tons per day. Thus railroads were still able to transport about one-half of the daily requirements. In addition, the North Koreans and Chinese also relied heavily on trucks and on peasants carrying supplies strapped to A-frames and even bicycles for moving supplies to the front. A staff study completed in April 1952 by two Air Force officers concluded that after seven months of maximum US effort the Communists still were more than meeting minimum supply requirements. The study concluded that the accepted figure for the enemy's minimum supply requirements was 2,700 tons per day under existing conditions but that more than this amount was being received. The staff study also stated that over and above daily requirements the enemy had been able to stockpile approximately 100,000 tons, or a 37-day supply, during the seven months of the rail interdiction program.

Another logistics study from the Korean War illustrates how difficult it is to prevent what was called "seeping resupply." During three months in the winter of 1951-52 the Chinese and North Koreans were firing 15,000 mortar shells per month, or 500 shells a day. Each shell weighed 10 pounds; thus it was possible for a peasant to carry five of them on an A-frame. One hundred peasants arriving at the front from supply depots in the rear could supply all the enemy's daily needs for mortar ammunition. One truck a day could replenish the supply depots.

* About 48 percent food; 22 percent clothing, weapons, and equipage; 10 percent POL; and 20 percent ammunition.

Operation Strangle clearly did great damage to the transport system of North Korea and conceivably prevented Communist China from mounting additional large-scale offensives in Korea. At the same time, it is also clear that the Chinese and North Korean troops received sufficient logistic support to contain the offensive pressures exerted by the Eighth Army. In short, the defensive capabilities of the Chinese and North Koreans showed no sign of collapsing as a result of the interdiction campaign, and indeed the enemy was able to mount sharp battalion-size attacks on occasion.

The air interdiction campaign failed to deny Communist forces the supplies they needed to contain the US Army because the North Koreans and Chinese were able to take effective countermeasures. One major lesson that emerged from the Korean War was that US planners underestimated the effectiveness of the enemy countermeasures. The North Koreans and Chinese showed increasing rapidity in rebuilding damaged rail and road bridges and other key installations. Chokepoints, often given exaggerated importance, were frequently bypassed without undue enemy effort. Darkness shrouded most of the enemy's movements from effective attack. A major lesson of the Korean War was the clearly demonstrated need for the development of a family of weapons that could successfully interdict night railroad and highway traffic.

3. Air Pressure Tactics and Psychological Warfare

It is difficult to judge the overall effect of US interdiction and strategic bombing on the will of the political leadership and the morale of the civilian population of North Korea. There are numerous examples, however, of the North Koreans and Chinese responding with effective countermeasures to each new phase of air operations against North Korea. The North Koreans were able to devise effective means to counteract the program of massive rail interdiction. The North Korean response to the bombing of irrigation dams also illustrates the tenacity and cleverness with which the Communists met new phases of US air operations.

Claims by some historians that air operations were almost solely responsible for the North Koreans and Chinese initially coming to the conference table and finally signing a truce agreement cannot be substantiated.* The Chinese and North Koreans came to the conference table mainly because their total losses accruing from the war had become greater than their total gains, all military, political, and economic factors considered, including losses from air attacks. US airpower played an important role in convincing the Communists to come to terms, but the evidence does not support the view that airstrikes were the decisive factor.

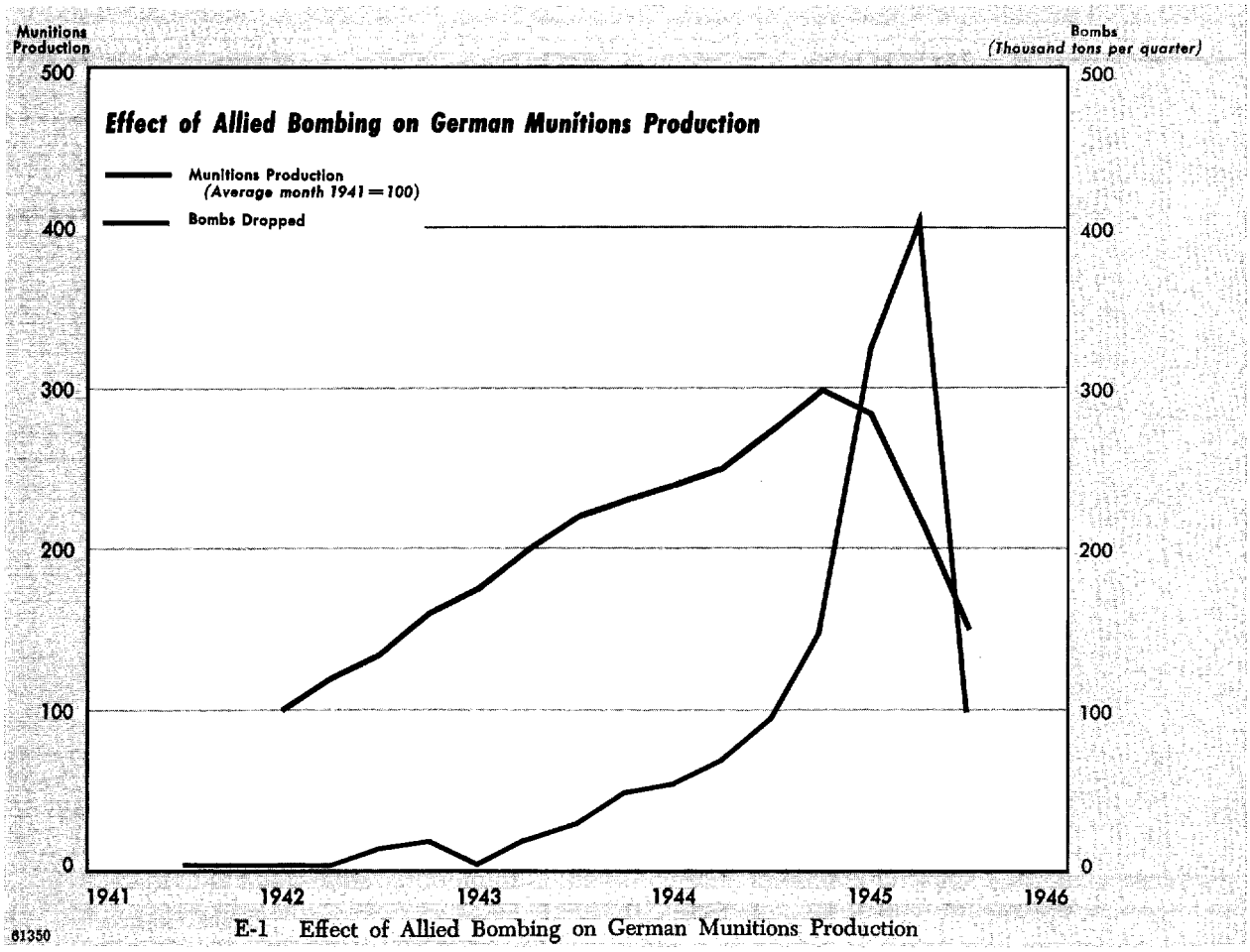
* One Air Force historian, for example, in discussing FEAF operations in Korea in mid-1952, wrote,"the destructive force of FEAF's airpower had broken the stalemate."

Because of a host of factors, including the unique nature of UN "police action" in Korea and the uncertain position of US officials about the advantages and disadvantages of psychological air warfare, the psychological warfare phase of US operations in North Korea was little understood and only intermittently applied.

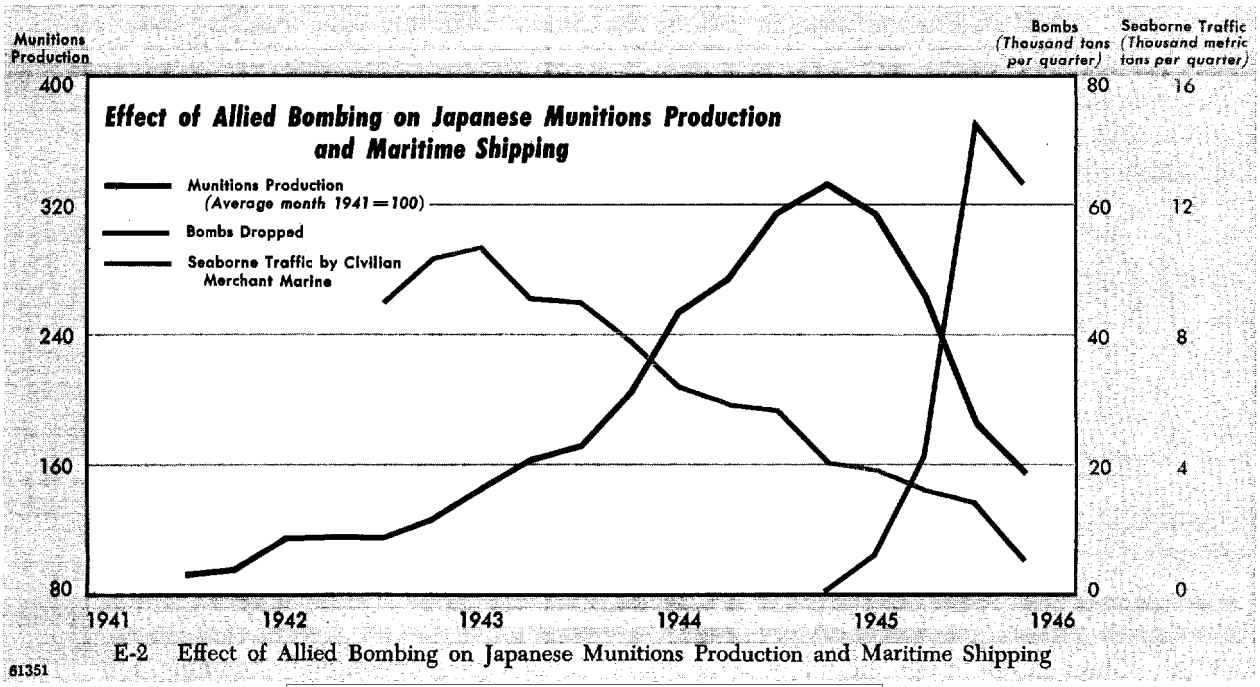
4. Lessons for Vietnam

The lessons from the Korean War indicate that it will prove difficult to cut off supplies flowing from North Vietnam to South Vietnam. The total daily tonnages needed by the Viet Cong and North Vietnamese regulars engaged in South Vietnam are far less per man than was the case in Korea, largely because most food and clothing supplies are obtained locally in the South. Relatively small numbers of trucks, carts, and human bearers can maintain more than the enemy's minimum requirements unless the Vietnamese war is sharply escalated. Furthermore, the experiences of the Korean War suggest that as long as they continue to receive support from China and the USSR the North Vietnamese are likely to show an increasing capability to improvise countermeasures to circumvent a continuing US air interdiction. The Korean War suggests also that diminishing returns can be expected from continuing air interdiction. At the same time, the increasing effectiveness of conventional antiaircraft weapons and air defense missiles raises the cost of continuing the campaign. The rebuilding of bridges, the building of bypasses, and the other countermeasures in evidence in North Vietnam in no way suggest a less determined enemy than was encountered in Korea. The primitiveness of North Vietnam -- the lack of potentially decisive military and industrial targets -- will make it difficult if not impossible for airpower alone to extract a prohibitive price for North Vietnamese intransigence. Only the application of large numbers of new interdiction weapons which are more effective than those that were available in the Korean War would tip the scales in favor of successful, long-term interdiction.

The bombing of "strategic" industrial targets in North Vietnam, based on the experience of the Korean War, would probably have little effect on the course of the war. Communist leaders in North Vietnam would almost certainly prefer not to lose the rudimentary modern industry that has been established in recent years. However, the much larger and more diversified industry of North Korea was destroyed in the first three months of the Korean War and neither deterred China from entering the war nor seriously impeded the North Korean military effort. Furthermore, Soviet and Chinese assistance was used to rebuild the damaged plants in North Korea after the war. In North Korea there was not sufficient industry to provide a critical test of the hostage concept of industrial destruction as a means of deterring aggression. In North Vietnam there is even less reason to believe that the loss of a small modern industry would alter the course of the war or make the Communists more prone to negotiate.

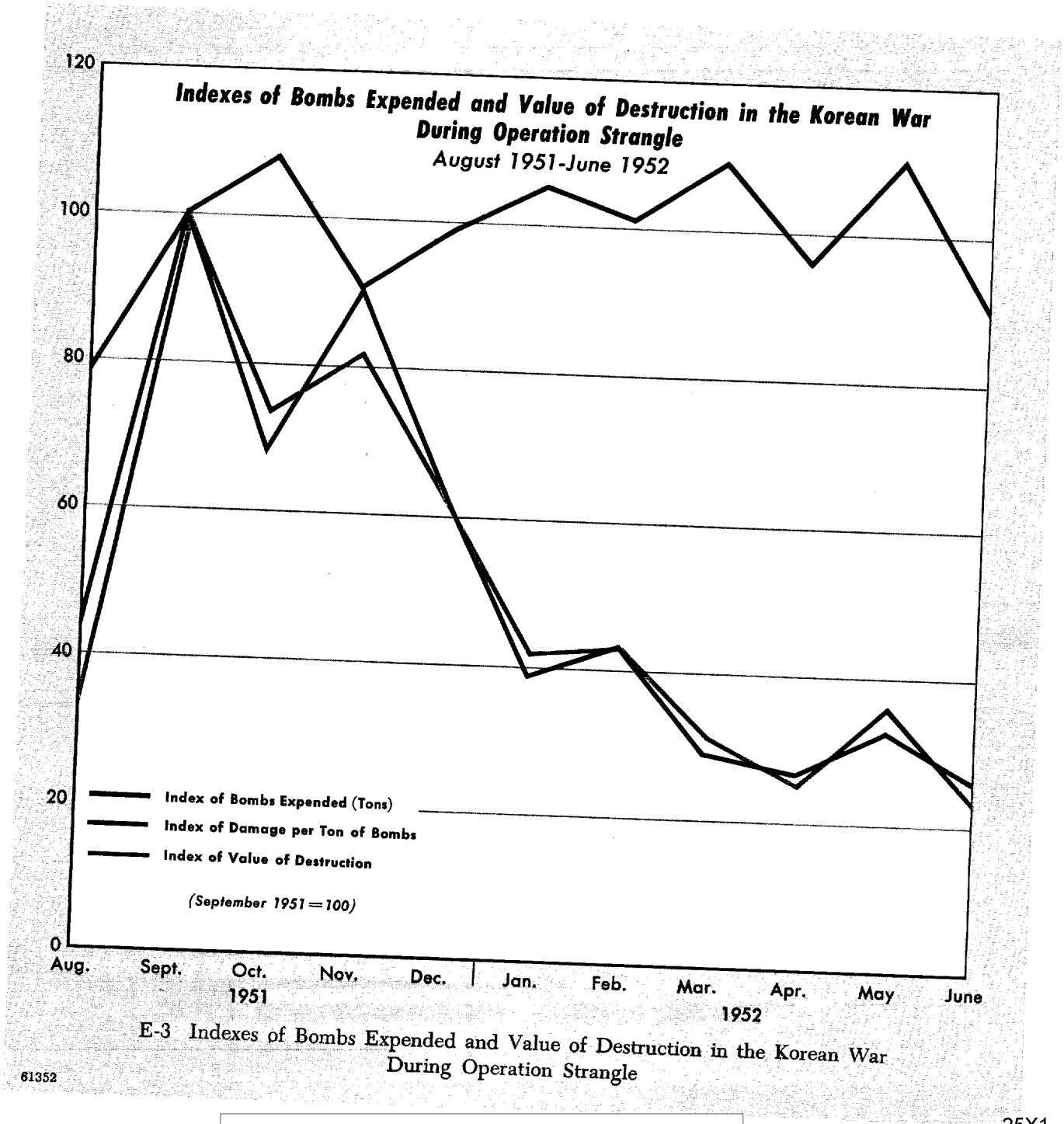


E-1 Effect of Allied Bombing on German Munitions Production



E-2 Effect of Allied Bombing on Japanese Munitions Production and Maritime Shipping

25X1



E-3 Indexes of Bombs Expended and Value of Destruction in the Korean War During Operation Strangle

25X1

25X1

25X1