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An Appraisal Of The Effects Of The First Year Of Bombing In North Vietnam

25X1

JCS review completed.

The Central Intelligence Agency

The Defense Intelligence Agency

ARMY and DIA review(s) completed.

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FOREWORD

This report presents an analysis of the Rolling Thunder air offensive against North Vietnam in 1965. The main body of the report is a joint analysis by the Central Intelligence Agency and the Defense Intelligence Agency. It estimates the physical damage and human casualties resulting from the 1965 air campaign and analyzes the countermeasures adopted by North Vietnam. The appendix to the report presents a detailed analysis by the Defense Intelligence Agency of the US and South Vietnamese air operations employed to obtain these effects. The graphics in the report were prepared by the Central Intelligence Agency.

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AN APPRAISAL OF THE EFFECTS OF THE FIRST YEAR OF BOMBING IN NORTH VIETNAM*

Summary

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.

The US and South Vietnamese air campaign against North Vietnam has been a carefully controlled means of gradual escalation to achieve strictly limited objectives. Consequently, the program has operated under a set of firmly defined ground rules which 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.

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.

* Covering the period from 2 March through 31 December 1965.

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

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.

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.

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. In September, Egyptian journalists were told that total casualties were 75,000, including 40,000 killed and 35,000 wounded. No procedures devised in this report for the purpose of estimating casualties can support a figure of this magnitude.

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 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.

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.

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 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.

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. 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.

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.

I. Physical Damage

The cost of reconstruction or repair of the economic and military facilities in North Vietnam which were attacked in 1965 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 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 A-1 through A-4. For locations of JCS targets, see the map, Figure A-5.

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 A-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 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 four to six months will be

Table A-1

Electric Powerplants Attacked Under the Rolling Thunder Program

25X1

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 $)
	Thanh Hoa	5,000	3	4 Apr 27 Jul 29 Jul 30 Jul 31 Jul 4 Aug	100	3	25X5 1,100
	Ben Thuy	8,000	5	4 Jun 4 Jun	100	5	1,000
	Co Dinh	1,500	1	8 Jun 10 Jun	100	1	400
	Nam Dinh	7,500	4	28 Jul 29 Jul 2 Aug 3 Aug	100	4	2,000
	Ben Thach	1,000	0.5	21 Aug 22 Aug 23 Aug	100	0.5	300
	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.

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 military/economic target. Since then, three other petroleum storage facilities have been bombed and the Vinh facility has been restruck (see Table A-2).

Pre-strike, major bulk petroleum storage capacity was 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 A-2

Petroleum Storage Facilities Attacked Under the Rolling Thunder Program

25X1

25X1

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 $)
[redacted]	Phu Van	1,000	Negl.	6 May	100	Negl.	19
	Phu Qui	10,000	5	18 May	80	4	151
	Vinh	18,000	9	a/ 24 May 26 May 11 Sep 15 Sep			25X5
				6 Oct	89	7	300
	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 pre-strike national storage capacity was 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 nine 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 A-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 A-3

Manufacturing Facilities Attacked Under the Rolling Thunder Program

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 $)
25X1						25X1
	Lang Chi Explosives Plant	100	24 Jul 7 Aug 8 Aug	71	71	370
	Nam Dinh Textile Mill	70 to 75 cotton spinning, 50 cotton weaving	28 Jul	5	3	800
	Total					1,170

25X5

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 December 1965. 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 A-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 A-4

Railroad Yards Attacked Under the Rolling Thunder Program

Target Number	Name	Dates of Attack (1965)	Damage	Cost of Restoration (Thousand US $)
25X1	Vinh Classification Yard N.W.	26 May 27 May 1 Jun	Main line interdicted in four places; four sidings interdicted	25X5
	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. [redacted] Yen Bai Ordnance Depot.

25X1

25X5

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 A-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

Table A-5

Maritime Ports Attacked Under the Rolling Thunder Program

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 $)
[redacted]	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
	Ham Rong	782.5	1	14 Jul 16 Jul 18 Jul	15	0.2	190
	Total						660

25X1 25X1 25X5

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.

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 halted 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:

	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 A-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 A-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 $)
25X1	Dong Hoi	53.0 (inactive)	6	6	30 Mar 6 Jun 1 Jul 17 Sep 22 Sep 23 Sep	50 25X5
	Vinh	10.0 (inactive)	6	6	8 May 30 Jun 1 Jul	43
	Na San	45.0 (inactive)	4	4	25 Jun 23 Sep 24 Oct	144
	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.

25X1

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 A-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 A-8).*

* Text continued on p. 28.

Table A-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 $)
[redacted]	Quang Khe Naval Base	15.0	47.0	7	2 Mar 28 May 21 Sep 24 Sep 27 Sep 28 Sep	130
	Phuc Loi	10.0	78.0	8	20 May 12 Sep	660
Total				15		790

25X1

25X5

25X1

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 A-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 $)
	Dong Hoi Barracks NW	2,500	0.6	7 Feb 24 Jul 27 Jul	82	0.5	550
	Chop Le Barracks NW	1,200	0.3	8 Feb 11 Feb 7 Jun 9 Jun 10 Jun	36 (inactive)	0.3	110
	Hon Gio Military Barracks		N.A.	14 Mar	N.A.	N.A.	20
	Vu Con Barracks Supply	500	0.1	21 Mar 23 May	71 (inactive)	0.1	90
	Vinh Linh Barracks Cent. NE	1,500	0.3	4 May 5 July 22 Sep 24 Sep 27 Sep	39 (inactive)	0.3	40
	Vinh Linh Barracks NW, Xom Cho	1,200	0.3	4 May 5 Jul	87 (inactive)	0.3	260
	Xom Trang Hoa Barracks and Supply Depot	1,350	0.3	8 May	66 (inactive)	0.3	500
	Vinh Linh Barracks East, Line Cong.	1,000	0.2	9 May	90 (inactive)	0.2	225
	Hoan Lao Barracks	2,500	0.6	19 May 22 Sep 25 Sep	80 (inactive)	0.6	550
	Phu Le Barracks/ Supply Depot	1,200	0.3	21 May	48 (inactive)	0.3	200
	Quang Suoi Barracks NE	2,500	0.6	22 May 23 Jul 26 Jul 29 Jul	32 (inactive)	0.6	200
	Phu Qui Barracks/ Supply Depot	3,000	0.7	23 May 19 Jun 20 Jun 21 Jun 22 Jun	55	0.4	700
	Mu Gia Pass Barracks	600	0.1	25 May	74 (inactive)	0.1	150
	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.

Table A-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 $)
25X1	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
	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
	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
	Muong Sen Camp	400	0.1	12 Jun	72 (inactive)	0.1	70
	Yen Phu NE	4,000	1.0	12 Jun 13 Jun 14 Jun 15 Jun 7 Sep	51 (inactive)	1.0	510
	Badon Barracks	670	0.2	14 Jun 17 Jun	30 (inactive)	0.2	50
	Sam Son Barracks West	1,200	0.3	16 Jun	22	0.1	70
	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

25X5

25X1

Table A-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 $)
[redacted]	Moc Chau Barracks	1,000	0.2	21 Jun 23 Jun 24 Jun	65 (inactive)	0.2	160
	Dong Hoi Barracks	3,000	0.7	21 Jun 7 Aug 9 Aug	77 (inactive)	0.7	575
	Thuan Chau Barracks/ Supply Depot	1,000	0.2	29 Jun 30 Jun 10 Aug 15 Aug 16 Aug	52	0.1	250
	Don Bai Dinh Military Camp	400	0.1	29 Jun	100	0.1	100
	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
	Thanh Hoa Barracks South	1,500	0.3	8 Jul 21 Aug	36 (inactive)	0.3	140
	Vinh Son Barracks South	3,500	0.8	14 Jul 18 Jul 19 Jul	52 (inactive)	0.8	450
	Dong Cao Thon Barracks	5,500	1.2	21 Jul 22 Jul	88 (inactive)	1.2	1,210
	Bai Thuong Barracks NE	2,300	0.6	28 Jul 31 Jul 2 Aug 5 Aug 22 Aug	56 (inactive)	0.6	400
	Vinh Barracks NNE	2,300	0.6	2 Aug 4 Aug 5 Aug	43	0.2	250
	Xom Trung Hoa Barracks	1,000	0.2	25 Aug 28 Aug 29 Aug	31	0.1	80
	Ha Tinh Barracks/ Supply Depot	900	0.2	5 Sep 6 Sep	35 (inactive)	0.2	150

25X5

25X1

25X1

Table A-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 $)
25X1	Vinh Barracks NW	4,000	1.0	7 Sep 8 Sep 9 Sep 10 Sep 14 Sep 15 Sep	53	0.5	550
	Xom Bang Barracks East	850	0.2	6 Sep 12 Sep 13 Sep	97 (inactive)	0.2	200
	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
	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
	Vinh Linh Barracks SW		0.1	9 Sep 10 Sep	94 (inactive)	0.1	100
	Xom Chang Barracks South		0.1	24 Sep 30 Sep	31 (inactive)	0.1	165
	Chuc A Barracks/ Support Area		0.3	6 Oct	56	0.2	250
	Phu Van Barracks SSE		0.5	24 Oct 25 Oct 26 Oct	88	0.5	440
	Quang Khe Barracks		0.2	23 Dec	N.A.	N.A.	Negl.
	Total					18	16,000

25X5
25X1

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. A

25X1 [redacted] post-strike photography indicates that 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 A-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

25X1 [redacted]

Table A-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 $)
25X1	Phu Van SE	55,440	0.5	19 Mar 26 May	86 (inactive)	0.5 25X5	372
	Vinh Son	84,480	0.8	19 Mar 20 Jun 22 Jun 24 Jun	47	0.4	144
	Thien Linh Dong South	124,080	1.2	30 Apr 13 Aug	58 (inactive)	1.2	495
	Dong Thanh Warehouse Area South	68,640	0.6	8 May 22 Jun	71 (inactive)	0.6	492
	Vinh Loc	50,000	0.5	20 Aug	79 (inactive)	0.5	236
	Dong Thanh Warehouse West	54,000	0.5	17 Aug 18 Aug 18 Nov	38	0.2	386
	Phu Duc	30,000	0.3	26 Aug	100	0.3 25X5	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
	Son La Army Barracks Vu Con Army Barracks Phu Le Army Barracks Ha Tinh Army Barracks Xom Trung Hoa Army Barracks		Vinh, Headquarters Military Region IV, Army Barracks Phu Qui Army Barracks Thuan Chau Barracks Chuc A Army Barracks

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.

25X1 25X1 25X1 25X5

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 A-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 $)
[redacted]	Xom Bang	5,000	4	2 Mar	75.0 (inactive)	4	260
	Phu Qui	9,000	8	15 Mar 30 Apr 22 May 4 Jun	62.0 (inactive)	8	300
	Phu Van	3,800	3	19 Mar 5 May 6 May	71 (inactive)	3	150
	Xom Rung	4,120	4	4 May 31 Jul	13 (inactive)	4	30
	Hoai An	8,236	7	30 May 31 May 1 Jun	61 (inactive)	7	240
	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
	Qui Hau	11,500	10	25 Jun 26 Jun 27 Jun 3 Jul 4 Jul 8 Jul	32 (inactive)	10	240
	Ban Phieng Hay	1,500	1	25 Jun 30 Jun	50 (inactive)	1	50
	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 25X5

* Footnotes follow on p. 32.

Table A-10

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

25X5

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 $)
25X1	Yen Bai		3	9 Jul 10 Jul 11 Jul 12 Jul 13 Jul 14 Jul 17 Jul	55	2	1,190
	Tai Xouan	7,700	7	24 Jul 18 Sep 21 Sep 23 Sep 26 Sep	32	2	330
	Bac Can	2,000	2	5 Sep 8 Sep 10 Sep 12 Sep 14 Sep 15 Sep	75 (inactive)	2	200
	Lang Het	6,750	6	5 Oct	4	0.2	20
Total						63	4,500

25X1

25X1

25X1

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

6. SAM Sites

From July through December, 27 of North Vietnam's 64 known surface-to-air (SAM) sites were struck.* It is believed that no more than 15 to 20 of these sites were operational at any one time. Most of the SAM sites are located within the greater Haiphong-Hanoi area and the remaining sites guard segments of the Hanoi-Vinh, Hanoi-Lao Cai and Hanoi-Dong Dang rail lines outside the delta region.

Sixteen of the 27 sites attacked were unoccupied or were staffed with dummy missiles. Eleven of the sites attacked contained SAM's and sustained considerable damage, as shown in the following tabulation:

	Destroyed	Damaged
SAM's	5	1
Sites	0	17
Radar vans	1	2
Missile transporters	10	2
Launchers	4	1
Support buildings	17	30

Damage to SAM facilities in North Vietnam is estimated to be at least $630,000.** Initially, SAM installations were designated as JCS targets only, but authority was given later for attacks by armed reconnaissance under strictly limited conditions. Approximately 200 missiles were fired in 1965 against allied targets. A total of 10 planes and 7 drones were lost to missiles during the Rolling Thunder program through 24 December.

7. Communications

North Vietnam has 35 large high-frequency (HF) radio stations only 5 of which are targeted under the Rolling Thunder program. Two of the targeted facilities, Chanh Hoa and Muong Sen, were struck on 19 May and 12 June 1965, respectively. Estimates of damage range from 20 percent physical destruction at Chanh Hoa to 80 percent at Muong Sen. The cost of restoring both facilities is estimated to be $50,000.

* Since the end of 1965 the SAM system has been extended to include 100 sites.

** This total includes cost estimates for SAM's, radar vans, missile transporters, and launchers damaged or destroyed. It is based on an average, reflecting the probability that neither the best nor the newest equipment has been furnished to North Vietnam. It has not been possible to assign a dollar value to the damage of launch sites or support buildings.

Although open wirelines have not been explicitly targeted for destruction, numerous breaks have occurred as a result of the bombing of railroads, bridges, and roads. When such breaks occur, the normal pattern of communications is shifted to HF radio. Thus far, breaks in the wirelines have been of little consequence when viewed against the total available telecommunications resources in North Vietnam. The cost of collateral damage to the communications system is estimated to be an additional $20,000. Most of the damage, both direct and collateral, has been inflicted in the southern portion of North Vietnam.

The most important fixed radio facilities in North Vietnam are located in the greater Hanoi area. Among these facilities are the radiobroadcast complex at Me Tri, the HF international transmitting center at Dia Mo, the international receiving station at Son Dong, and about 30 other sizable HF radio stations in the greater Hanoi area. These facilities serve the Armed Forces High Command, the Central Executive Committee of the Lao Dong Party, and various economic components within North Vietnam. Important wireline routes within the delta region radiate out from Hanoi to Haiphong and Thanh Hoa and to the Chinese and Laotian borders.

Destruction of broadcast facilities within the Hanoi area would severely curtail national broadcast services. The subsequent destruction of the international HF stations would temporarily eliminate the only direct communications link with the outside world. However, by making use of relay stations, international communications could, with some inconvenience, be restored in relatively short order. Irrespective of damage to fixed installations, a large number of small radio stations would remain. These small HF stations would probably prove to be adequate to accommodate essential political and military needs.

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. The Soviet-manufactured TRACKDISH radar has already been replaced by a KNIFEREST B of Chinese manufacture, and the others can readily be replaced by the Chinese. The Chinese are specifically manufacturing for the North Vietnamese at this time and are drawing upon a major capability in this field. Overall early warning capabilities in North Vietnam have not been affected by the Rolling Thunder activities -- there are more radars in the country now than at the outset of the program.

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 A-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 A-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 A-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.

Table A-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.

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. Sources available for such estimations range all the way from the self-serving -- and inflated -- North Vietnamese propaganda claims [redacted] 25X1

25X1 [redacted]

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. [redacted] 25X1

25X1 [redacted] journalists were told by Hanoi officials that total casualties -- presumably both military and civilian -- were 75,000. This figure was said to include 40,000 killed and 35,000 wounded.

25X1 [redacted]

25X1

Although a large volume of post-strike photography is available, only a relatively small sample has been used for casualty analysis, and that mainly to determine the nature of the targeted area before attack and for post-attack assessment. Actual casualties are seldom, if ever, visible in photography.

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.

C. Minimum Estimates of Casualties

25X1

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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,

25X1

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 and the Chinese Communists 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 A-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 A-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	25X1 ks
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	Including 36 MIG-15/17's flown in from China in 1964 after the Gulf of Tonkin incident, 8 MIG-15/17's flown in from China in 1965, and 8 Il-28's flown in from the USSR in 1965. MIG aircraft from the USSR were shipped by rail in crates.
			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 A-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

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

** Including 36 flown in from China in 1964 after the Gulf of Tonkin incident.

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 A-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. Eight Il-28 bombers from the USSR and 44 MIG-15/17 jet fighters from China were flown to North Vietnam as a result of airstrikes. In addition, the USSR sent 24 or 25 MIG-15/17's and 11 MIG-21's by rail. 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 A-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 A-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/		392	392
Other construction vehicles	8	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. [redacted] 25X1

25X1 [redacted] shortages of essential consumer goods, loss of property, and declines in income as a result of interruption of normal economic activity have created extremely difficult living conditions, particularly in the towns. 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

25X1 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

25X1 Some reports from Hanoi have indicated that as many as 300,000 have left the city. A Soviet reporter in Haiphong recently stated that "nearly all the children and

25X1

part of the adult population have been evacuated." Although other reports have not indicated resettlement evacuation of this magnitude, a one-third evacuation of major centers is considered possible.

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.

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

 the people had to leave the city during the day and that work was performed at night.

 the villagers were evacuated daily. 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.

Workers are expected to make up time lost from their job in air raid precautions. Local officials are instructed to incorporate into their air defense plans the steps necessary to maintain production.

4. Shelter

 widespread and continuing construction and improvement of air

raid shelters in North Vietnamese cities. 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 It must be concluded, therefore, that sufficient nearby shelter of some type is available to accommodate practically the entire population of cities and potential target areas, especially those that have already been subjected to airstrikes or overflights by US and South Vietnamese aircraft.

25X1 blast walls as being erected at building entrances in Hanoi, and the taping of windows has also been noted. Prefabricated concrete elements such as sewer pipes are now being used in improving simple excavated trenches in Hanoi and Haiphong.

5. Industry Relocation

There have been about a dozen reports of industry being evacuated from North Vietnamese cities, principally from Hanoi. A 25X1 some workers had left Hanoi together with their production equipment. In May a North Vietnamese official told Polish journalists that factories were being moved from cities and that some were even installed underground. A reporter from Eastern Europe indicated that some industry had been removed from Nam Dinh when he made reference to those "plants which have not yet been evacuated." individuals 25X1 who had been evacuated or were to evacuate with their factories. On 26 August 1965 the Deputy Chief of the Industrial Office of the Premier stated that a need existed to decentralize industrial production.

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

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

"After dark, vehicle traffic was extremely heavy with convoys moving south at intervals." Reduced lighting or blackout lights are used in this movement. Even in the Hanoi-Haiphong area, the relative absence of truck, boat, and rail traffic during the day and concluded that a substantial amount of traffic must be moving at night.

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 A-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 A-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. From intelligence information it was later

learned that in at least two of the agreements -- with Hungary and Rumania -- relatively small amounts of aid were involved: $11.1 million and $4.4 million, respectively. Moreover, both Soviet and Eastern European spokesmen, in responding to Chinese charges of tokenism, have attempted to justify the modest scale of their aid to North Vietnam.

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 from 20,000 to 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 A-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 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 A-15

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

25X1

	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 A-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 A-17

Estimated Communist Technical Assistance to North Vietnam
1965

	Military		Economic	
	Number	Cost (Million US $)	Number	Cost (Million US $)
Communist technicians in North Vietnam				
Communist China	20,000 to 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	200 (minimum)	2.0		
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

V. Political Effects of the Bombing

The bombing through 1965 apparently had 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.

Evidence on the effect of the bombing on the morale of the people suggests that the results have been mixed. 25X1 25X1 the bombing has strengthened popular support of the regime by engendering patriotic and nationalistic enthusiasm for resisting the attack. On the other hand, those who have had more direct experience with bombing cite personal hardships and anxieties caused by the raids. 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.

Hanoi's political relations with its allies were in some respects strengthened by the bombing. The attacks 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.

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 on the basis of photographic interpretation of the damage to the bombed facilities.

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 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

25X1

25X1 Destroyed and remaining capacities were evaluated with respect to known operational needs of the North Vietnamese military. Costs of reconstruction, priorities,

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

[redacted] 25X1

[redacted] Rough cost estimates were made for each of 25X1 the items reported destroyed or damaged.

D. Casualties*

Examination of photography has shown that 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

25X1 [redacted]

25X1 [redacted] The methodology for arriving at estimates of military casualties was provided by DIA.

[redacted] 25X1

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, and [redacted] 25X1

25X1 [redacted] 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. [redacted] 25X1

25X1 [redacted]

25X1 [redacted] From this method it was determined that an average of 1.3 casualties occurred per mission (averaging about 5 aircraft per mission). 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.

25X1 [redacted]

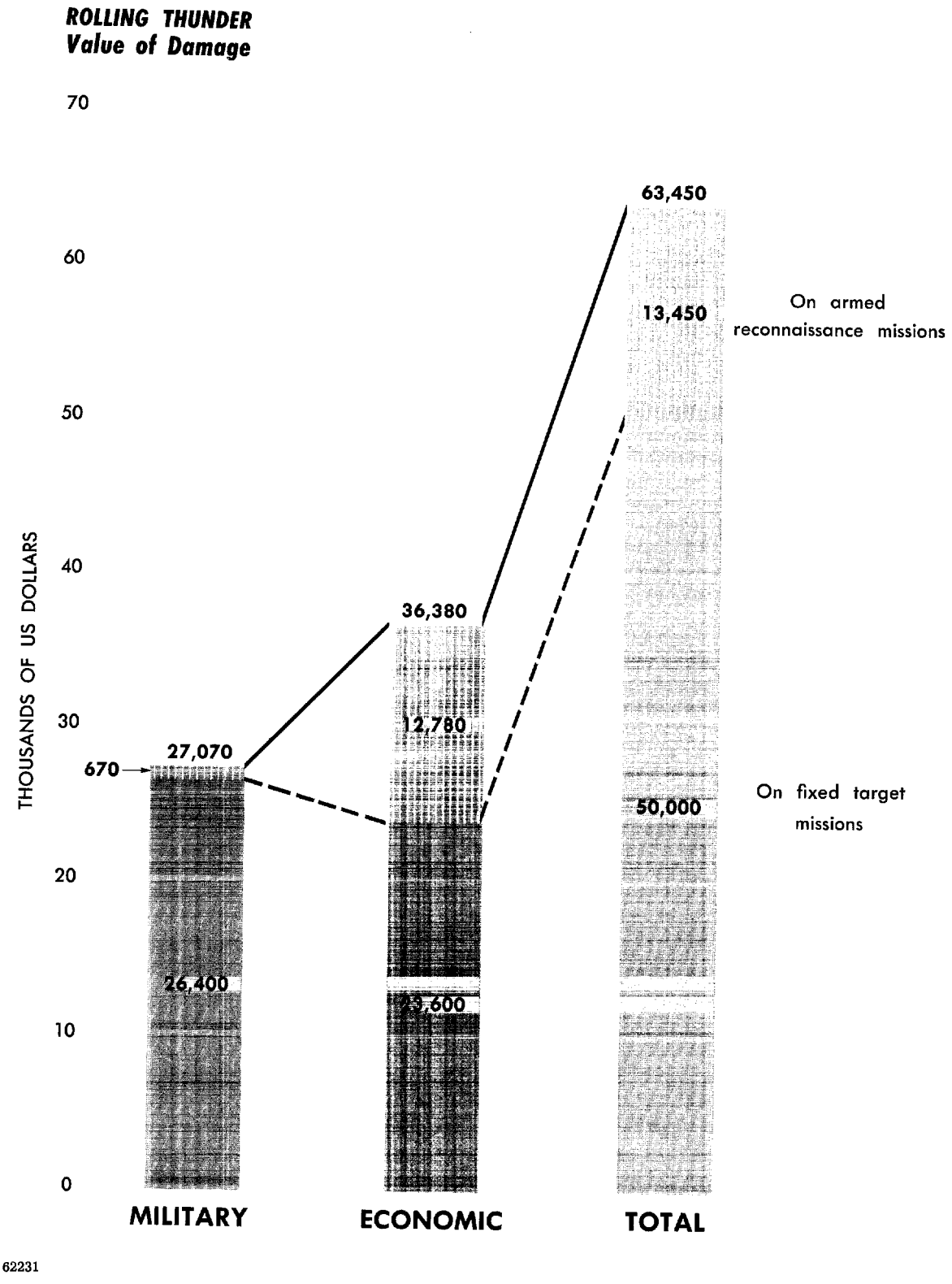
4. Military Casualties

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.

6/17/98

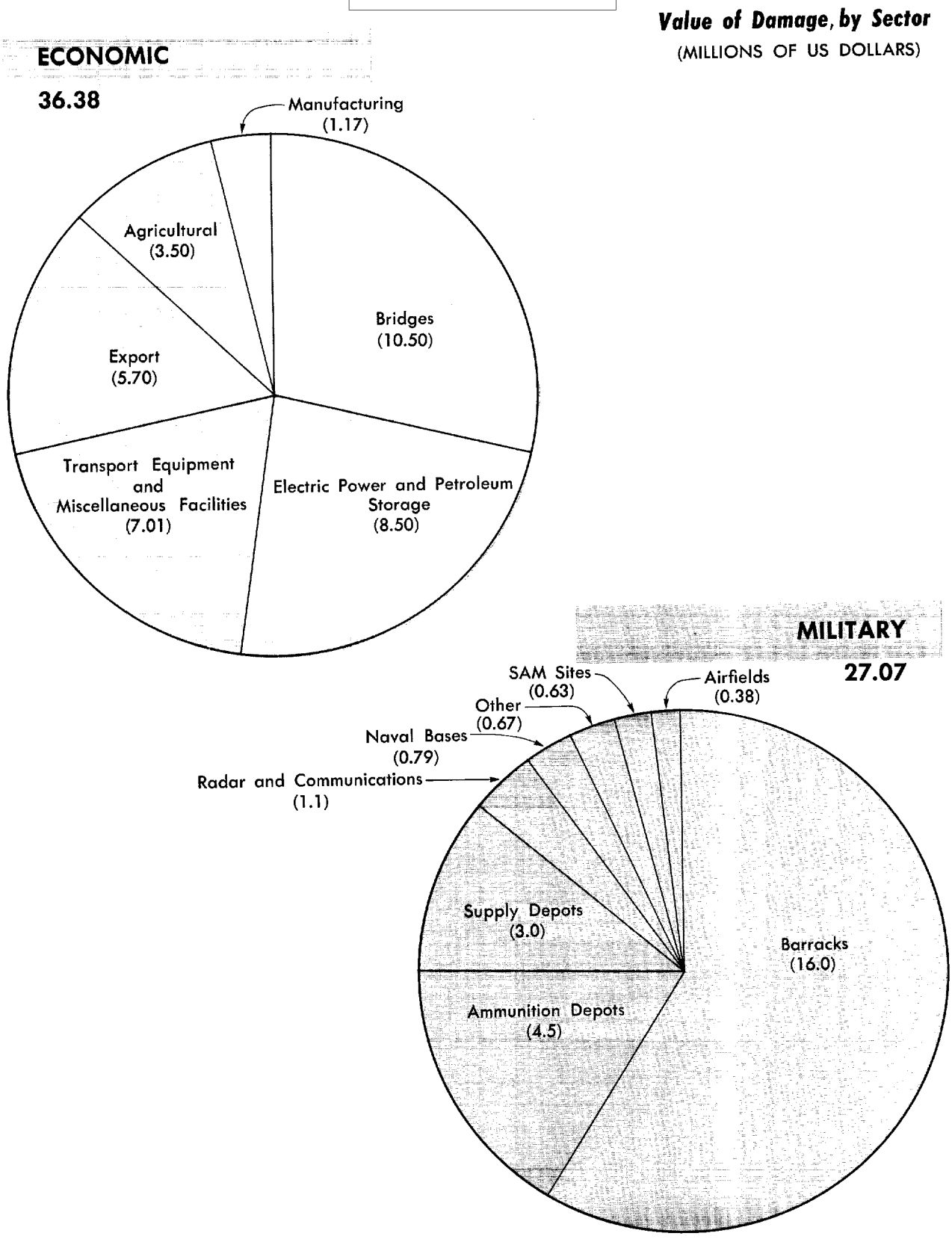
25X1



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

25X1

25X1



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

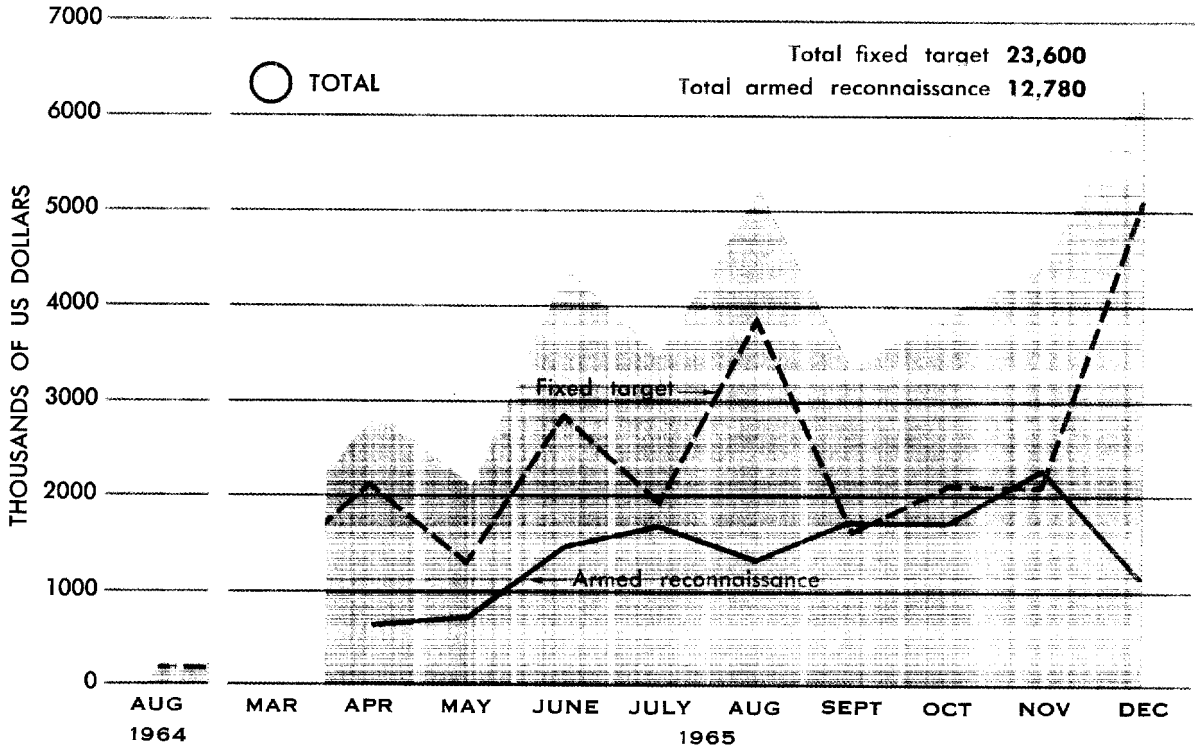
62232

25X1

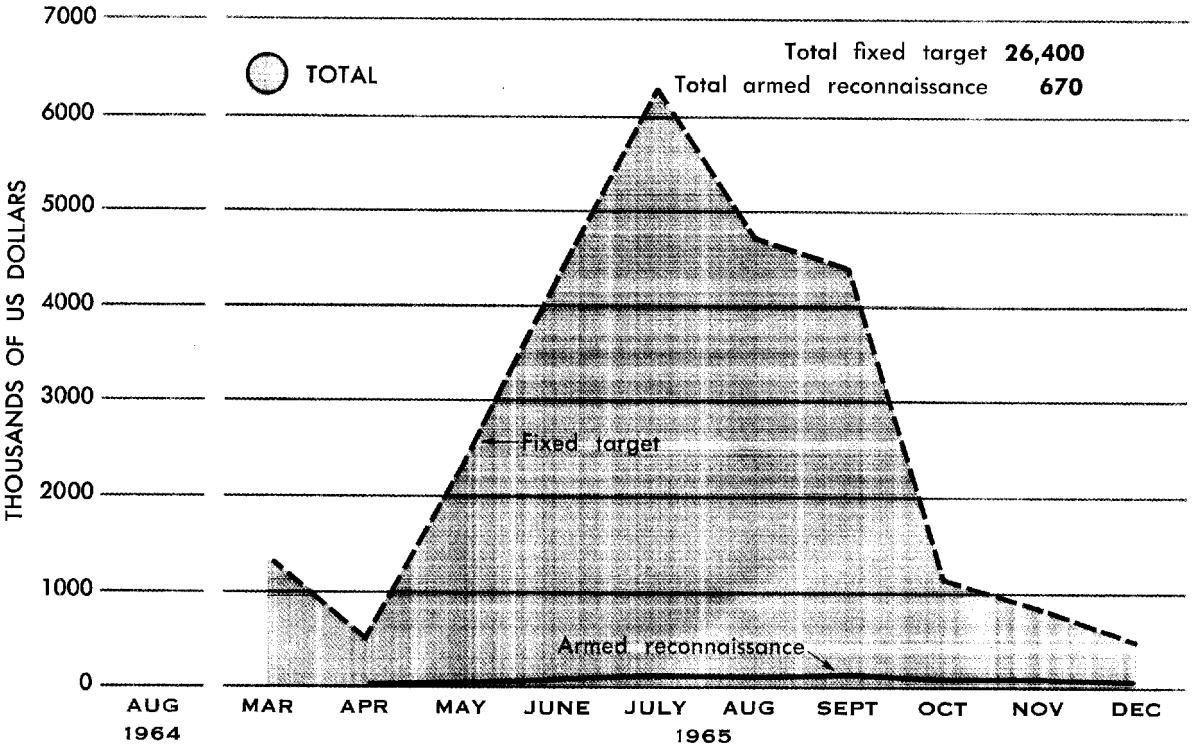
25X1

ROLLING THUNDER
Cost of Damage Inflicted

ECONOMIC DAMAGE (Including agricultural and export losses)



MILITARY DAMAGE

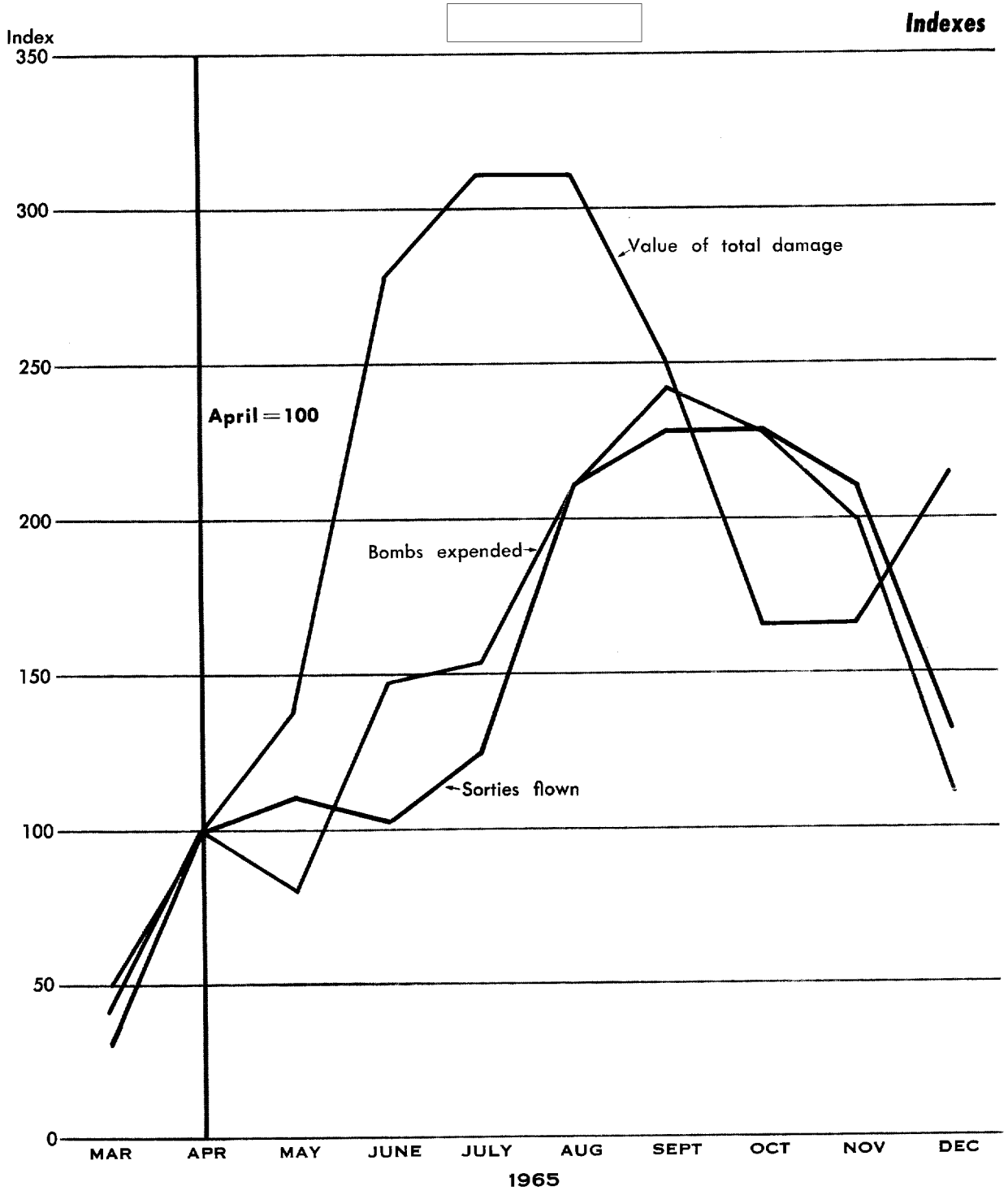


A-3 Total Cost to North Vietnam of Damage Inflicted During the Rolling Thunder Program

62233

25X1

25X1



A-4 Rolling Thunder: Indexes of Value of Damage, Sorties Flown, and Bombs Expended

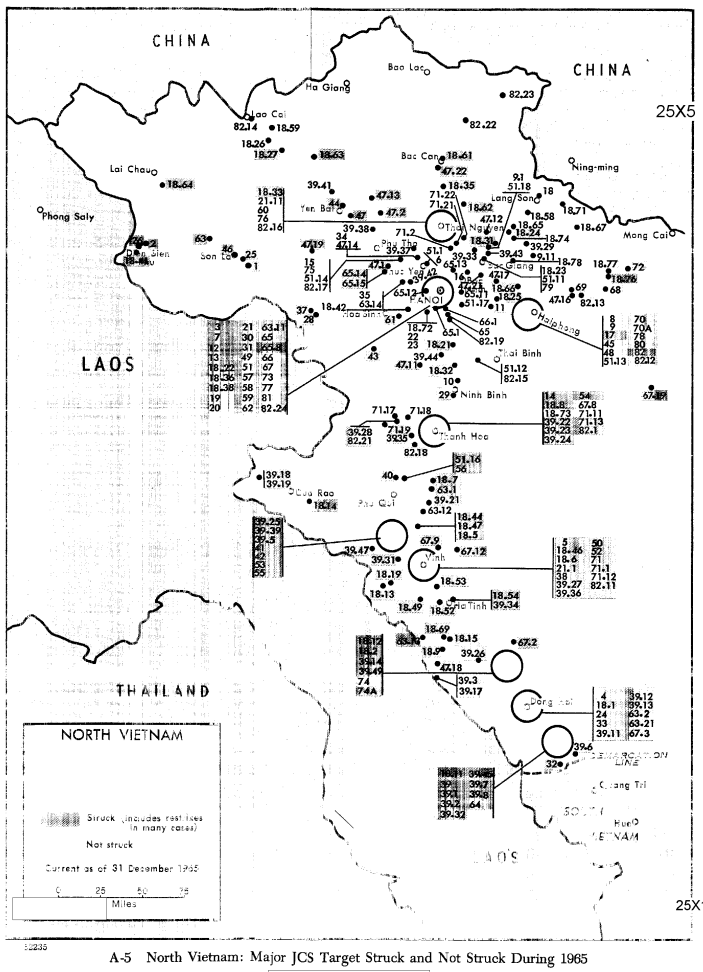
25X1

62234

JCS Target Numbers deleted from latest listing:

Target Number	Name	Coordinates
	Quang Khe Highway Ferry West over the Rao Nay	17 42 42 N 106 26 50 E
	Vinh Highway Ferry over the Song Ca	18 38 40 N 105 42 35 E
	Muong Sen Highway Ferry over the Nam Mo	19 24 04 N 104 08 34 E
	Cay Giau Railroad Bridge over the Khe Bi	21 47 10 N 104 48 55 E
	Thai Nguyen Railroad Station Yards and Shops	21 33 31 N 105 51 05 E
	Cua Tung Highway Bridge over the Song Ben Hai	17 00 03 N 107 03 21 E
	Phu Doan Highway Bridge and Ferry over the Song Chay	21 38 41 N 105 11 10 E
	Suoi Rut Highway Ferry over the Black River	20 46 20 N 105 05 00 E
	Ban Kai Highway Ferry over the Black River	21 13 08 N 104 19 48 E
	Huu Hung Highway Ferry over the Kien Giang	17 24 00 N 106 38 50 E
	Phu Qui Highway Ferry North over the Song Hieu	19 20 00 N 105 25 35 E
	Vinh Son Highway Ferry over the Song Ca	18 53 55 N 105 17 51 E
	Phu Thach Highway Ferry over the Song Ca	18 34 35 N 105 39 42 E
	Trai Hoi Highway Bridge over the Ngan Sau	18 21 37 N 105 37 00 E
	Ron Highway Ferry over the Song Ron	17 52 30 N 106 26 45 E
	Xuan Son Highway Ferry over the Song Troc	17 36 51 N 106 19 10 E
	Mi Le Highway Ferry over the Dai Giang	17 19 24 N 106 37 44 E
	Phu Qui Highway Ferry over the Son Hieu	19 19 15 N 105 25 45 E
	Phuong Dinh Railroad/Highway Bridge over the Lach Truong	19 51 02 N 105 48 22 E
	Bai Thuong Army Barracks Complex North	20 05 01 N 105 26 01 E
	Vit Thu Lu Army Barracks and Storage Area	17 01 10 N 106 38 40 E
	Vinh Army Barracks Central NE, and Headquarters Military Region IV	18 40 22 N 105 41 15 E
	Hoa Luat Nam Army Barracks	17 10 30 N 106 49 20 E
	Hon Gio Military Barracks Area, Ile du Tigre	17 09 34 N 107 20 05 E
	Quan Lan Army Barracks	18 54 48 N 105 25 10 E
	Xom Y Lanh Army Barracks	17 48 03 N 105 46 57 E
	Tuyen Quang Ammunition Storage Area, Tin Vu	21 46 10 N 105 11 12 E
	Hanoi Petroleum Products Storage Area, Bac Mai	20 59 55 N 105 50 45 E
	Cap Mui Ron Radar Site	18 07 00 N 106 25 25 E
	Ha Tinh Radar Site	18 19 20 N 105 55 05 E
	Quang Khe Radar Site	17 42 22 N 106 29 39 E
	Kim Cuongo Radar Site	18 32 10 N 105 11 25 E
	Bai Thuong Radar Site	19 52 00 N 105 21 00 E
	Anh Son Radar Site	18 55 00 N 105 17 00 E
	Vinh Radar Site	18 43 00 N 105 40 00 E
	Thanh Hoa Radar Site	19 48 00 N 105 47 00 E
	Xom Lom Radar Site	20 50 00 N 104 45 00 E
	Thai Nguyen Radar Site	21 36 00 N 105 50 00 E
	Trai Ngau Radar Site	21 27 00 N 105 39 00 E
	Son La Radar Site	21 19 00 N 103 55 00 E
	Do Son Radar Site	20 41 00 N 106 49 00 E
	Dien Bien Phu Radar Site	21 19 00 N 103 01 00 E
	Na San Airfield Radar Site	21 13 00 N 104 01 00 E
	Nam Dinh Radar Site	20 27 00 N 106 10 00 E
	Phuc Yen Radar Site	21 19 00 N 105 50 00 E
	Dong Hoi Radar Site	17 30 00 N 106 36 00 E
	Vinh Linh Radar Site	17 05 00 N 107 07 00 E
	Lang Mo Radar Site	17 10 00 N 106 22 00 E
	Cua Lo Radar Site	18 50 00 N 105 40 50 E
	Bai Thuong Dam on the Song Chu	19 53 34 N 105 22 51 E
	Vinh Son Dam on the Song Ca	18 54 30 N 105 18 00 E
	An Lac Check Dam, on the Kien Giang	17 15 00 N 106 44 50 E

25X1



25X5

25X1

A-5 North Vietnam: Major JCS Target Struck and Not Struck During 1965

25X1

APPENDIX

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 a carefully controlled means of gradual escalation to achieve strictly limited objectives. Consequently, the program has operated under a set of firmly defined ground rules.

The Rolling Thunder program over time has extended both the area and the frequency of air attacks in North Vietnam, but both the choice of targets and the areas to be bombed have been limited. 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.

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 in the northwest, a 25-nm buffer zone in the northeast, 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 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

* 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.

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 restrictions in the Rolling Thunder program included the mining of principal ports or attacks on major port facilities. Similar restrictions applied to attacks on major airfields in the northern areas of North Vietnam. There also were 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.) 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.

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. 76) 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

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* Data in this Appendix were derived from individual strike reports given in the Bomb Damage Assessment (BDA) and therefore may not agree in every case with data in the main text 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. 99.

*** 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. 81.

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 Recon-naissance	Total Sorties	Service: US Navy	Service: US Air Force	Service: South Vietnamese 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

Table B-4

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

25X1

25X1

Program	Sorties Flown			Percent Through		Ordnance Delivered	Percent Through	
	Strike and Flak Suppression	Support	Number	24 Dec 65	19 Feb 66	Tons	24 Dec 65	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. 87.

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. 84.

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. 91.

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				Service		
					US		
	Leaflet and Other	Fixed Target	Armed Recon-naissance	Total Sorties	Navy	Air Force	South Vietnamese 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

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

25X1

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

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:

Type of Aircraft	Service				Total	
	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 restrikes 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:

		Personnel	
Service	Aircraft	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.

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 Costs of Rolling Thunder
Compared with Costs of Damage to the 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.

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,

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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

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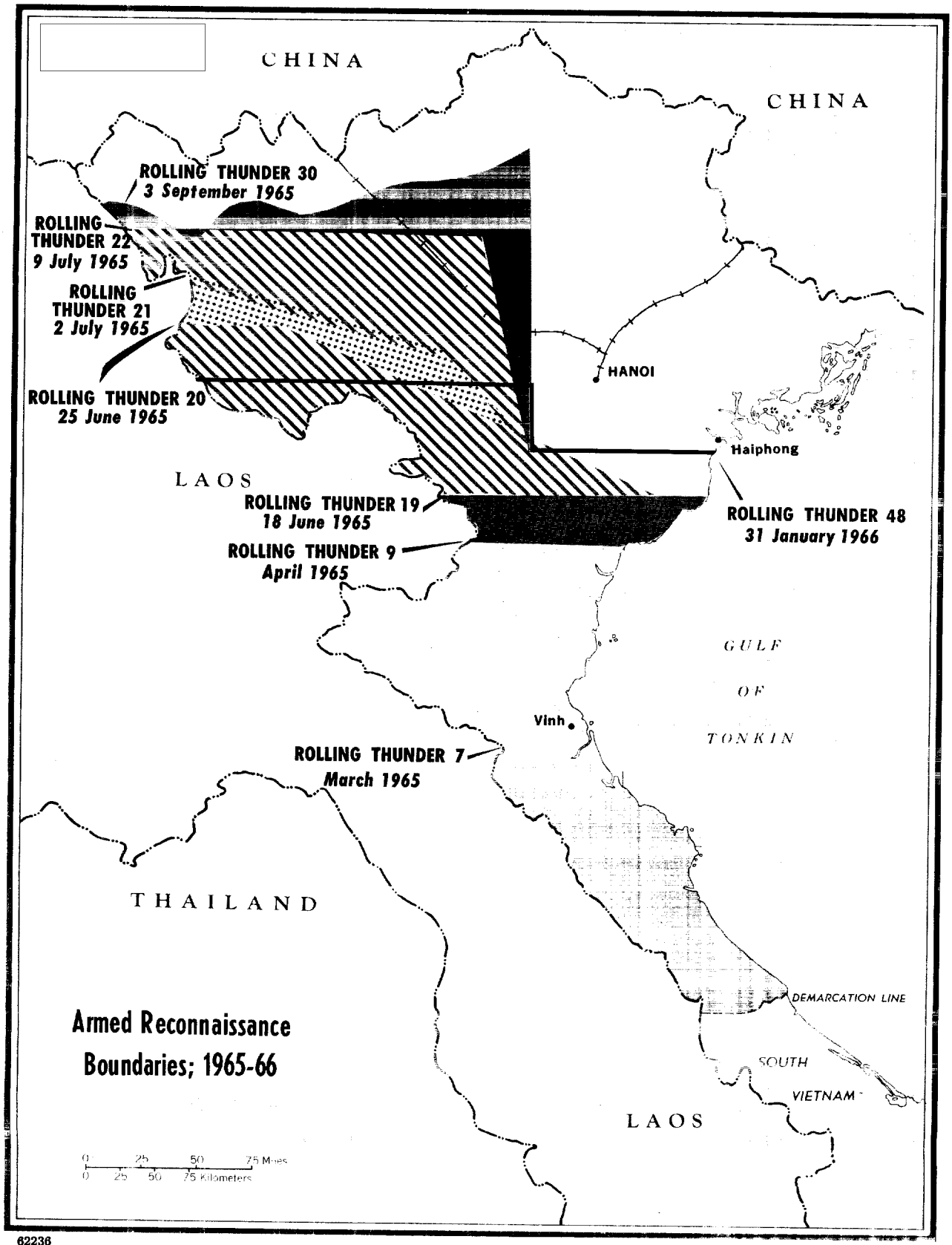

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B-1 Rolling Thunder: Armed Reconnaissance Boundaries

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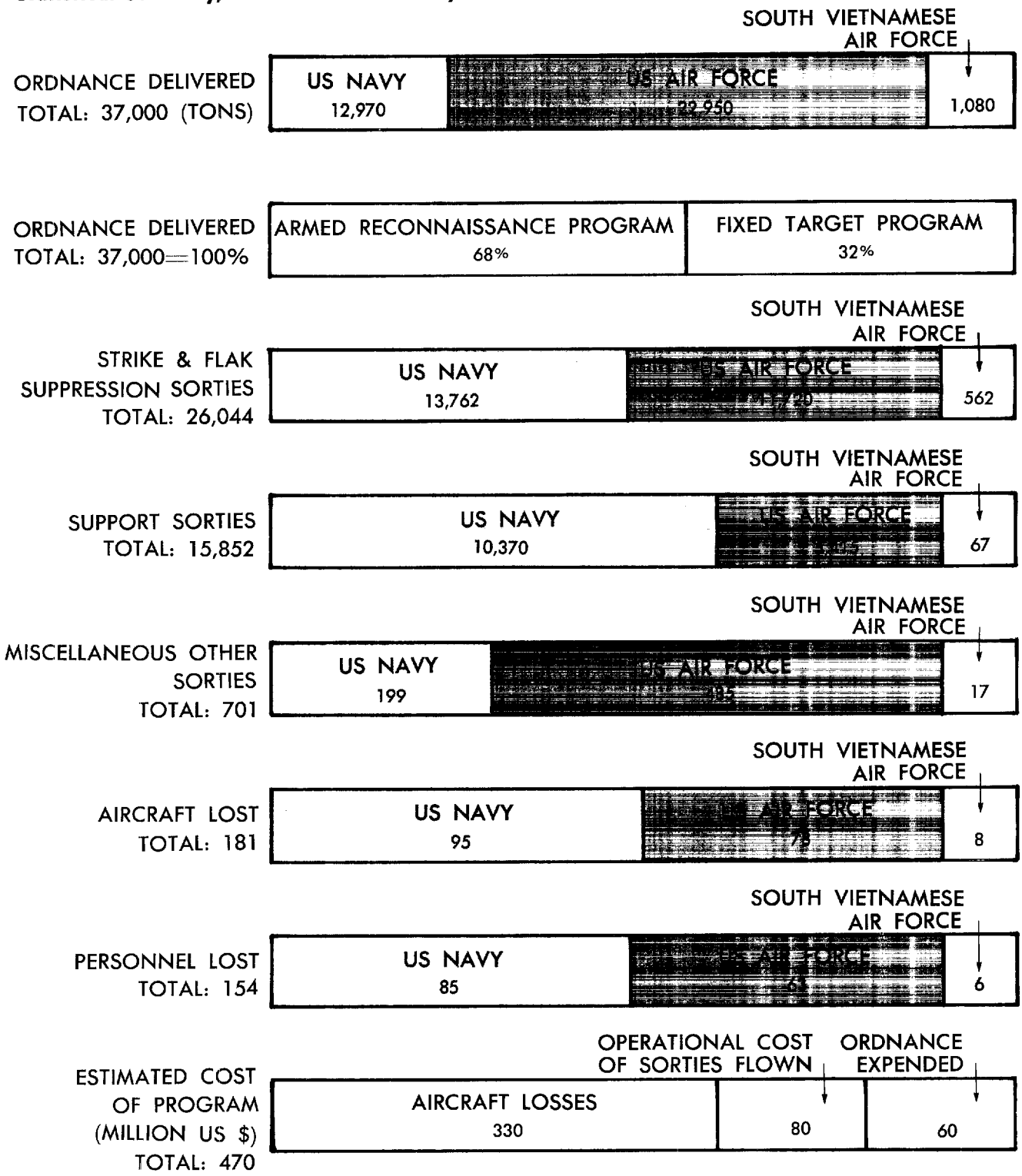
ROLLING THUNDER
Statistical Summary, 2 March 1965-19 February 1966



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

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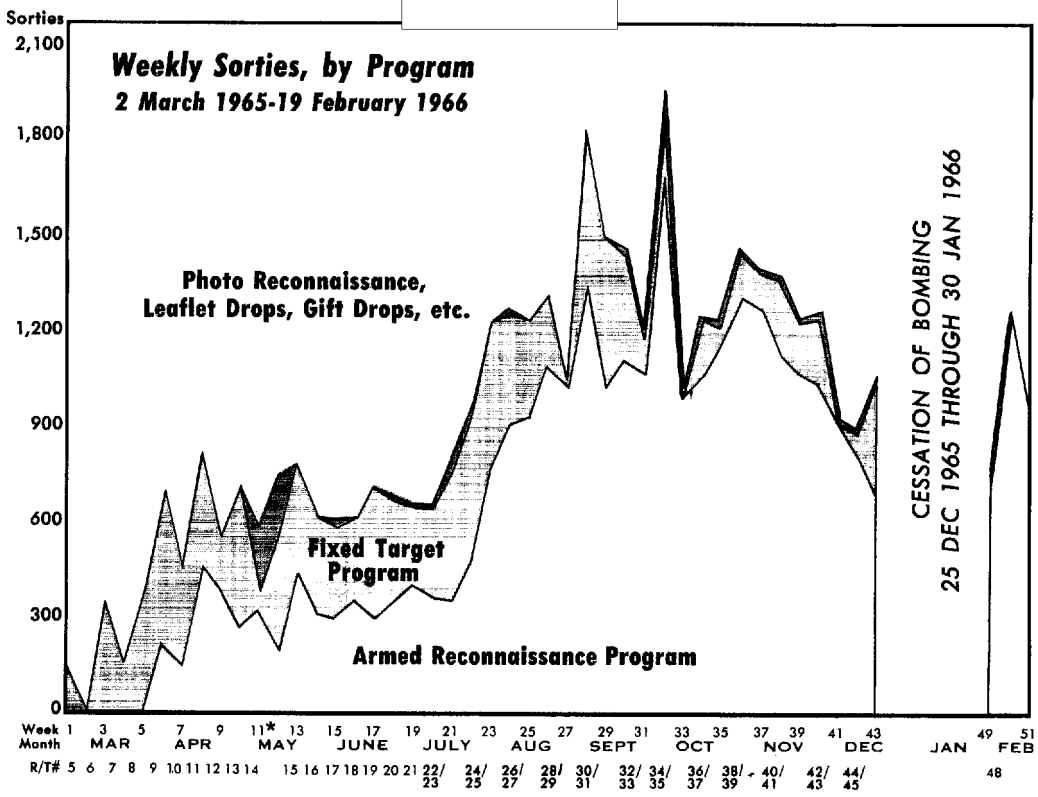

B-3 Rolling Thunder: Weekly Summary of Sorties, by Program
2 March 1965–19 February 1966

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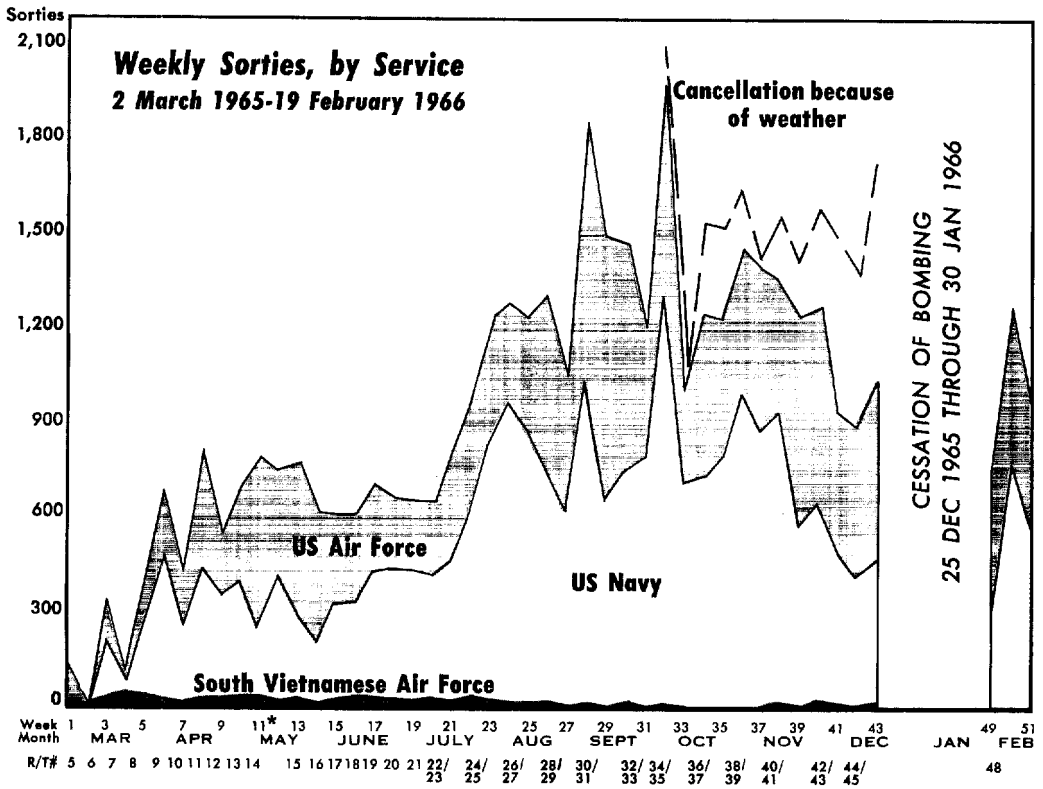
*Five day suspension of bombing



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

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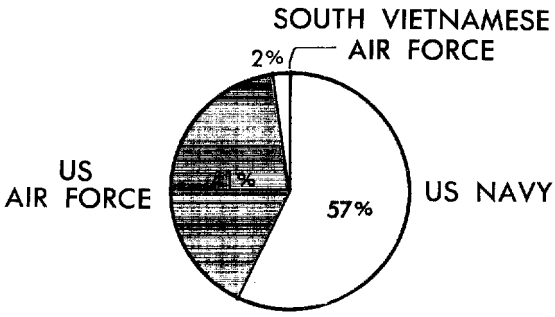
ROLLING THUNDER

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



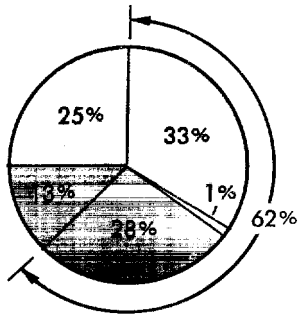
COMBAT SORTIES

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

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

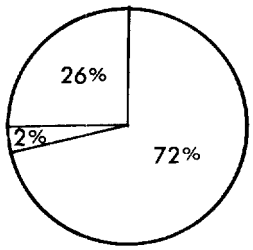
SUPPORT SORTIES: 15,852— 38%

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

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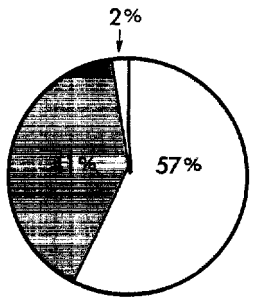
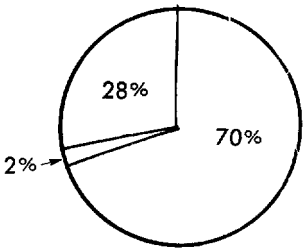
ROLLING THUNDER
Sorties Flown, 2 March 1965-24 December 1965

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



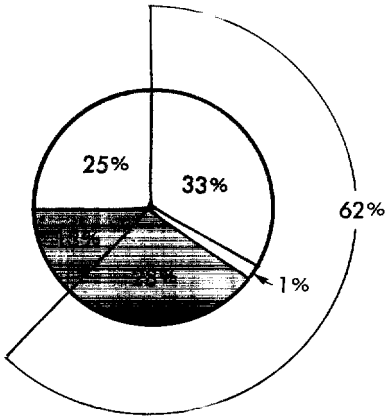
PROGRAM

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

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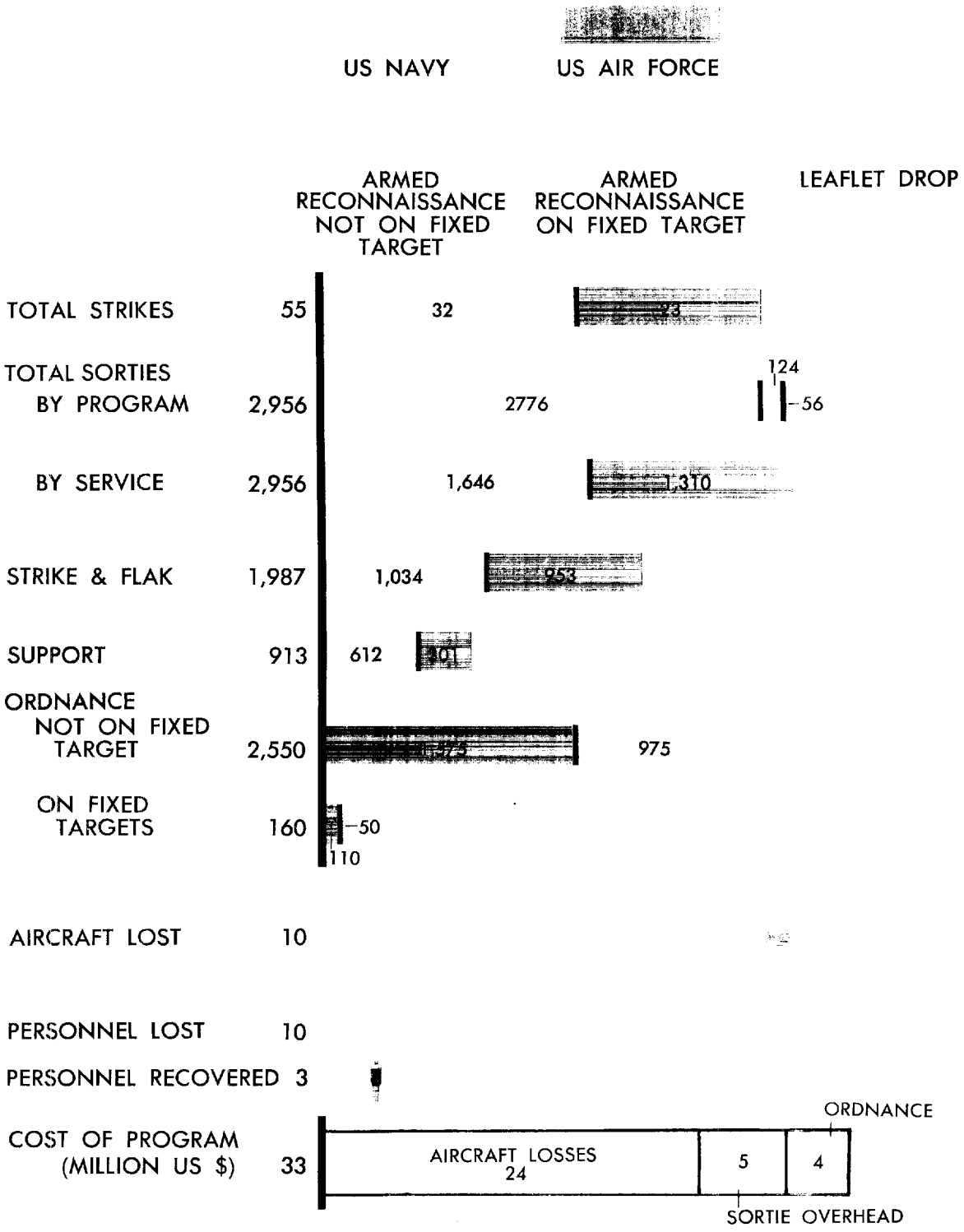
ROLLING THUNDER
Statistical Summary, 31 January-19 February 1966



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

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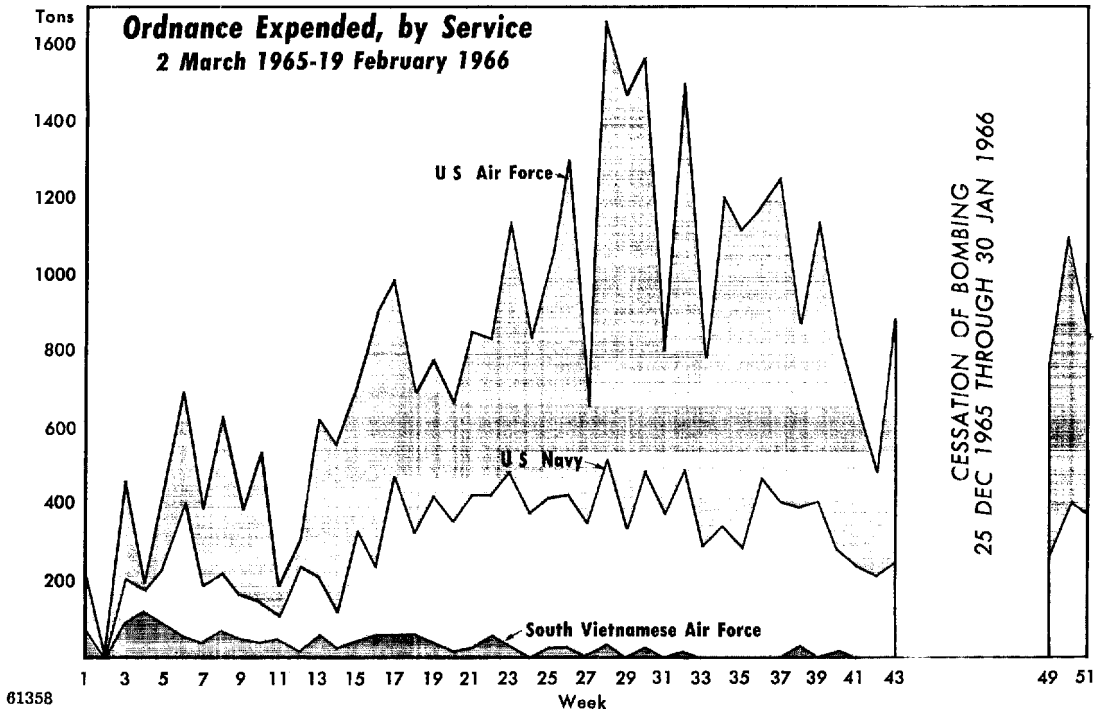
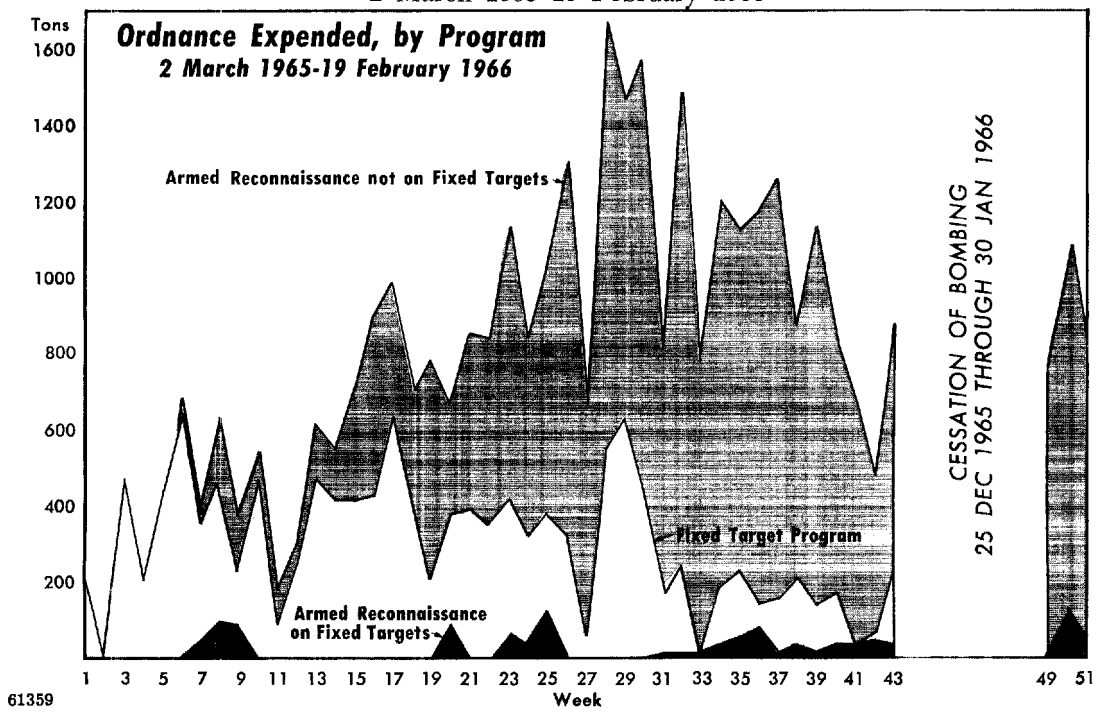


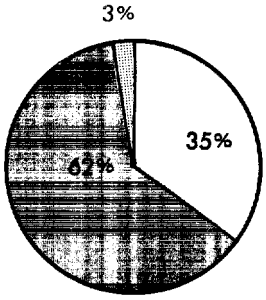
B-8 Rolling Thunder: Weekly Summary of Ordnance Expended, by Service
2 March 1965–19 February 1966



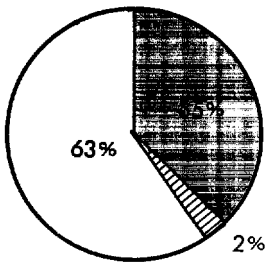
B-9 Rolling Thunder: Weekly Summary of Ordnance Expended, by Program
2 March 1965–19 February 1966

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



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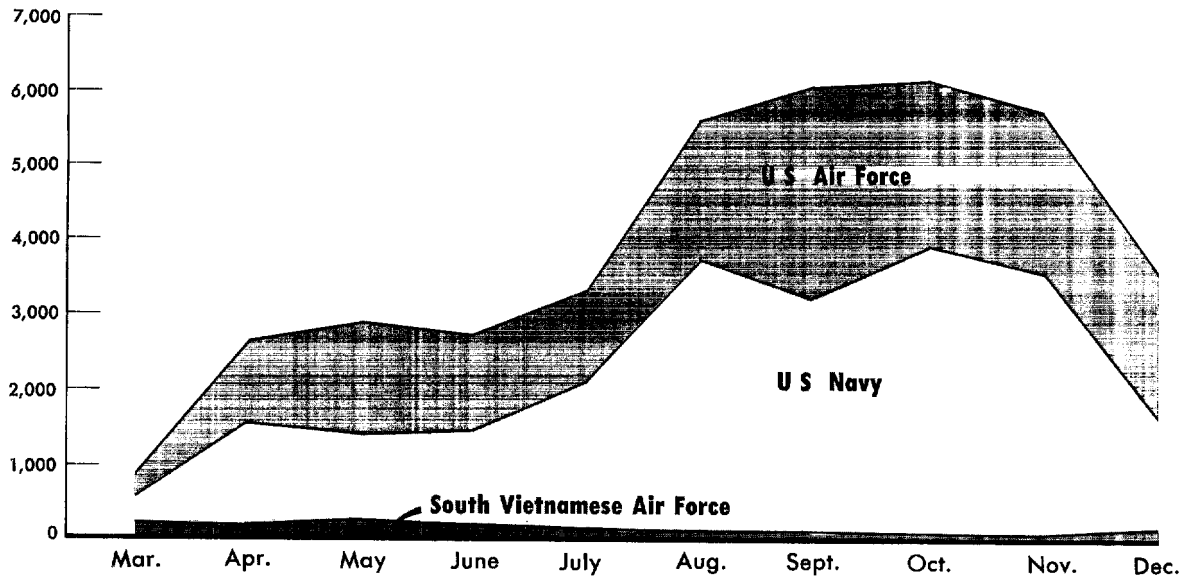

B-11 Rolling Thunder: Monthly Summary of Sorties, by Service, March–December 1965

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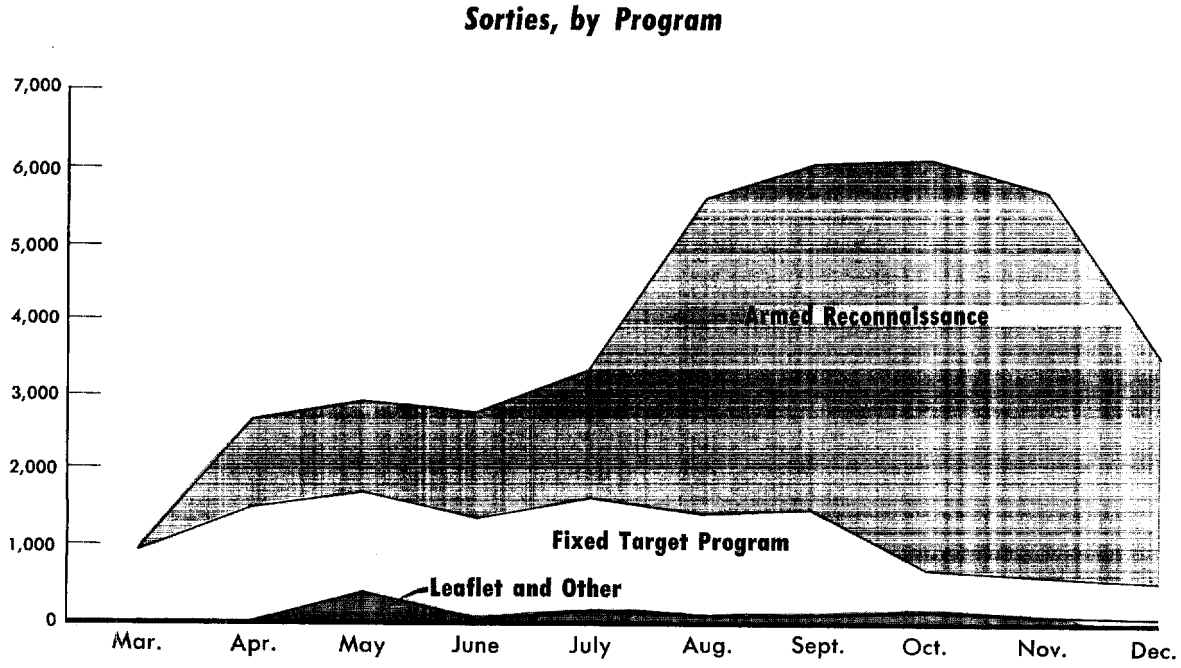

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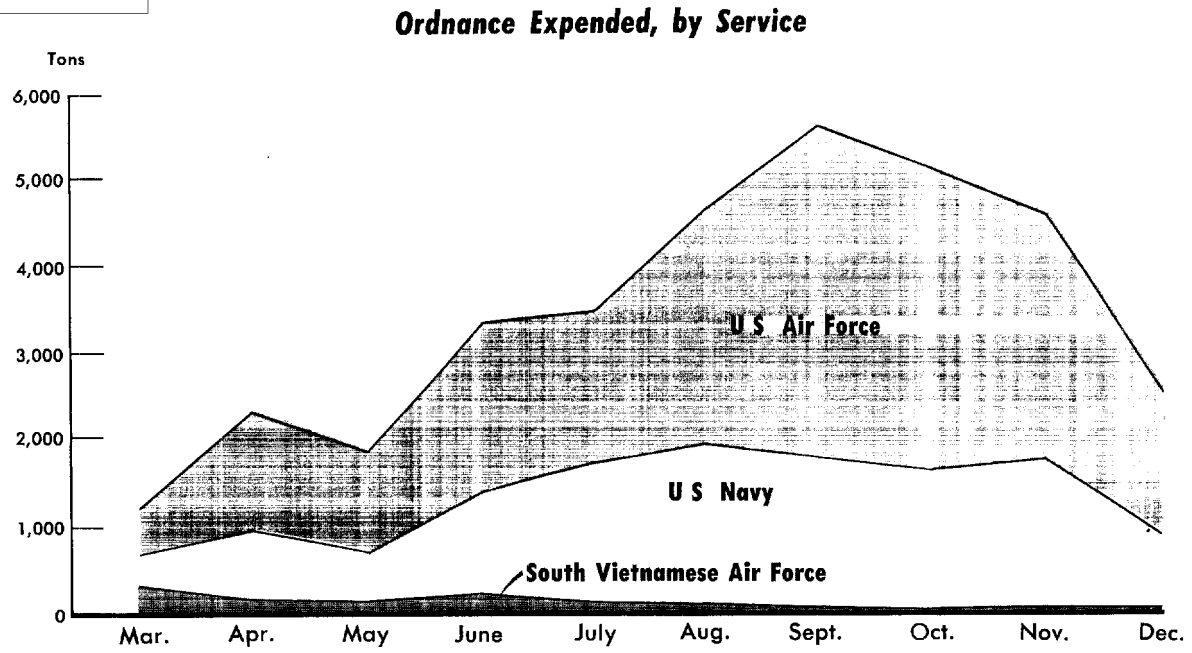
B-12 Rolling Thunder: Monthly Summary of Sorties, by Program, March–December 1965

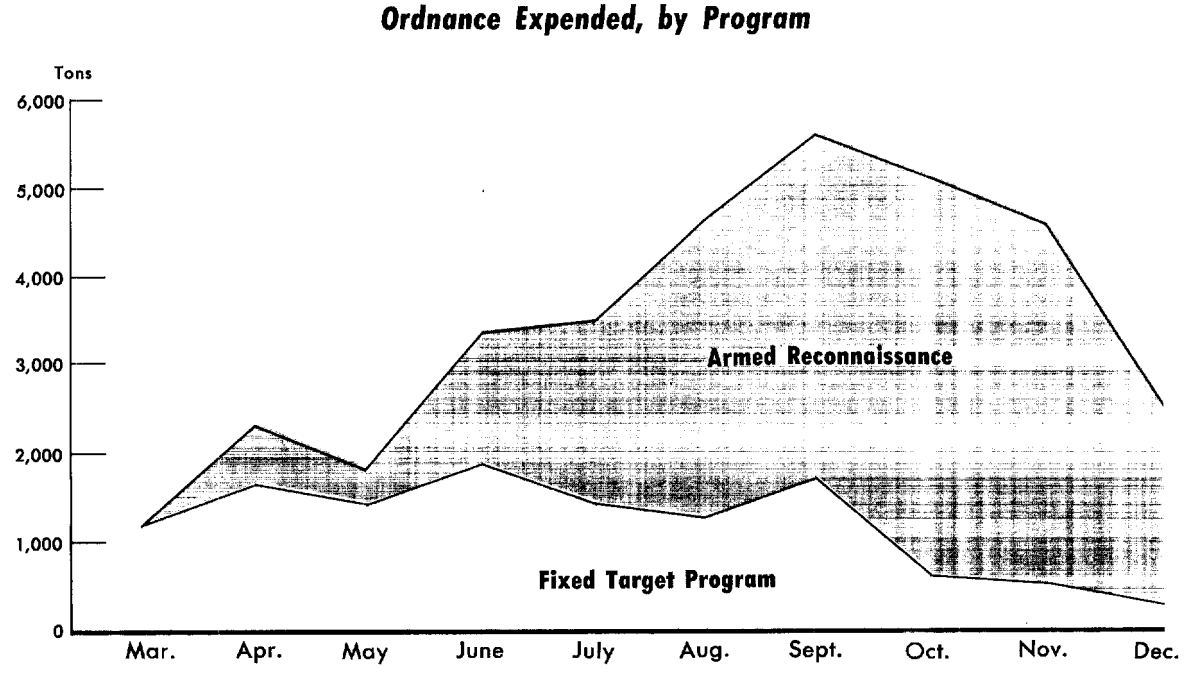
61362

25X1



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

61363 3-66 CIA



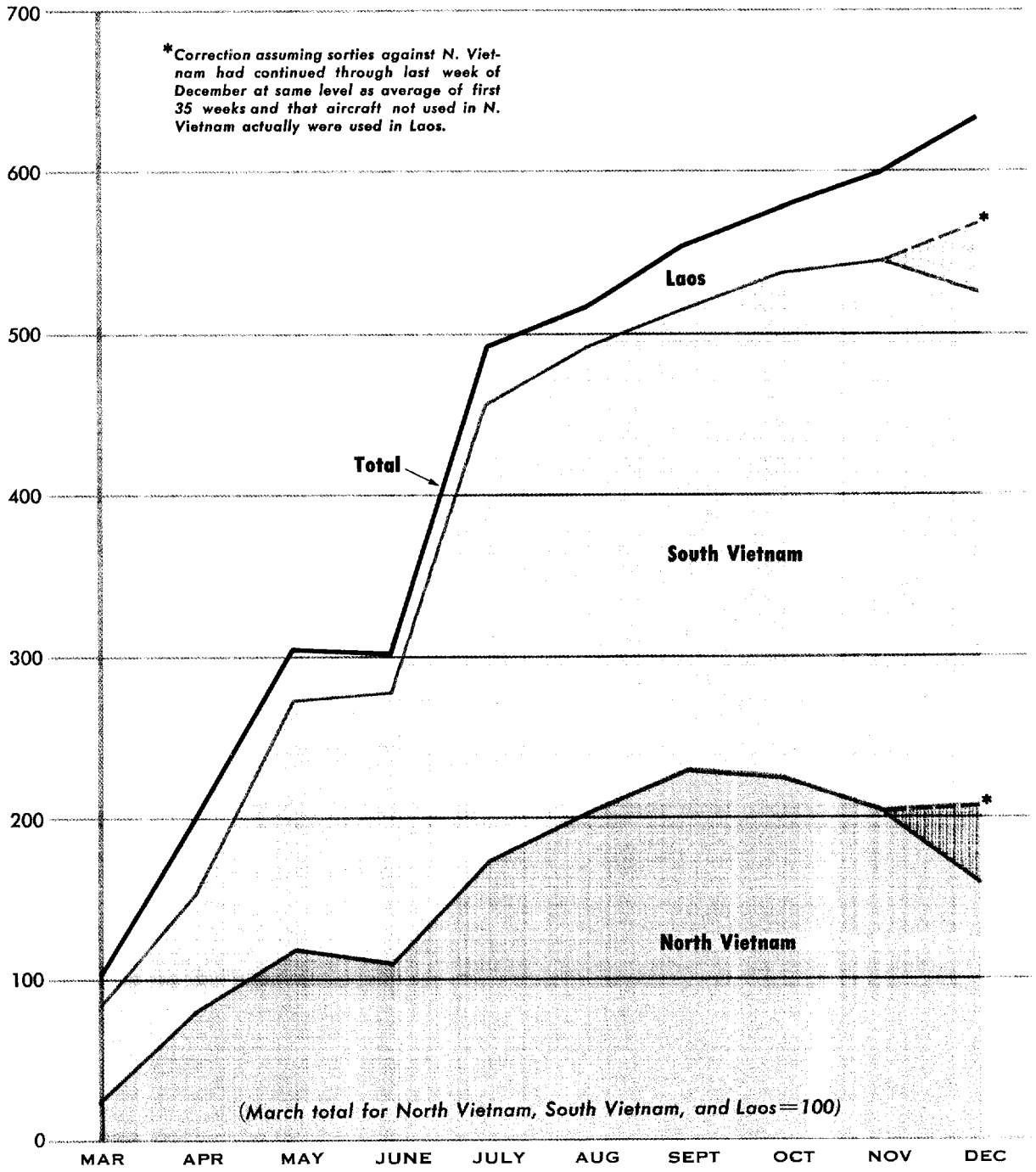
25X1

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

61364 3-66 CIA

25X1

Indexes of Sorties Flown in Southeast Asia



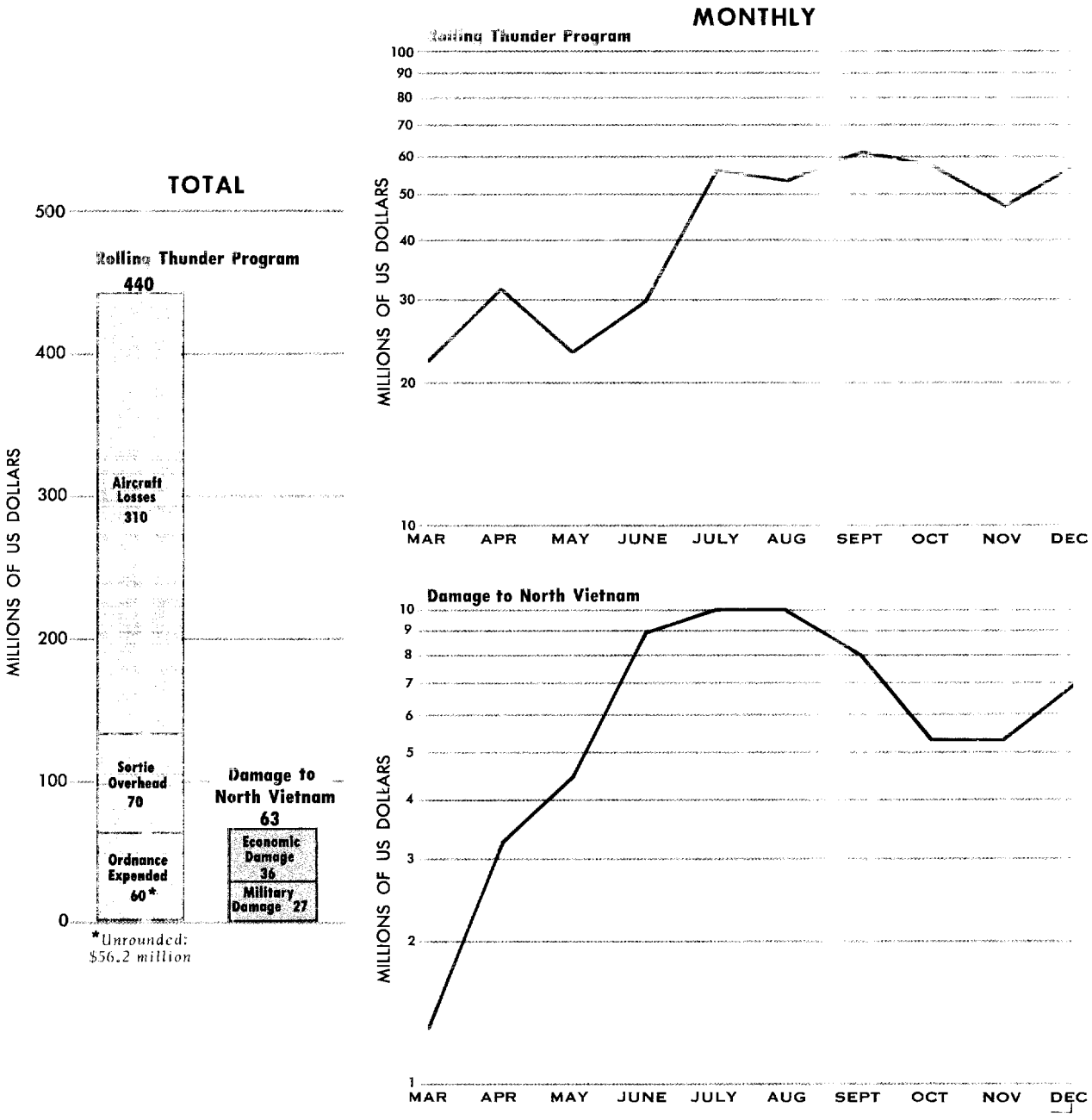
B-15 Indexes of Sorties Flown in Southeast Asia and the Relative Amount in Each Area March–December 1965

61365

25X1

25X1

Cost Related to the Cost of Damage



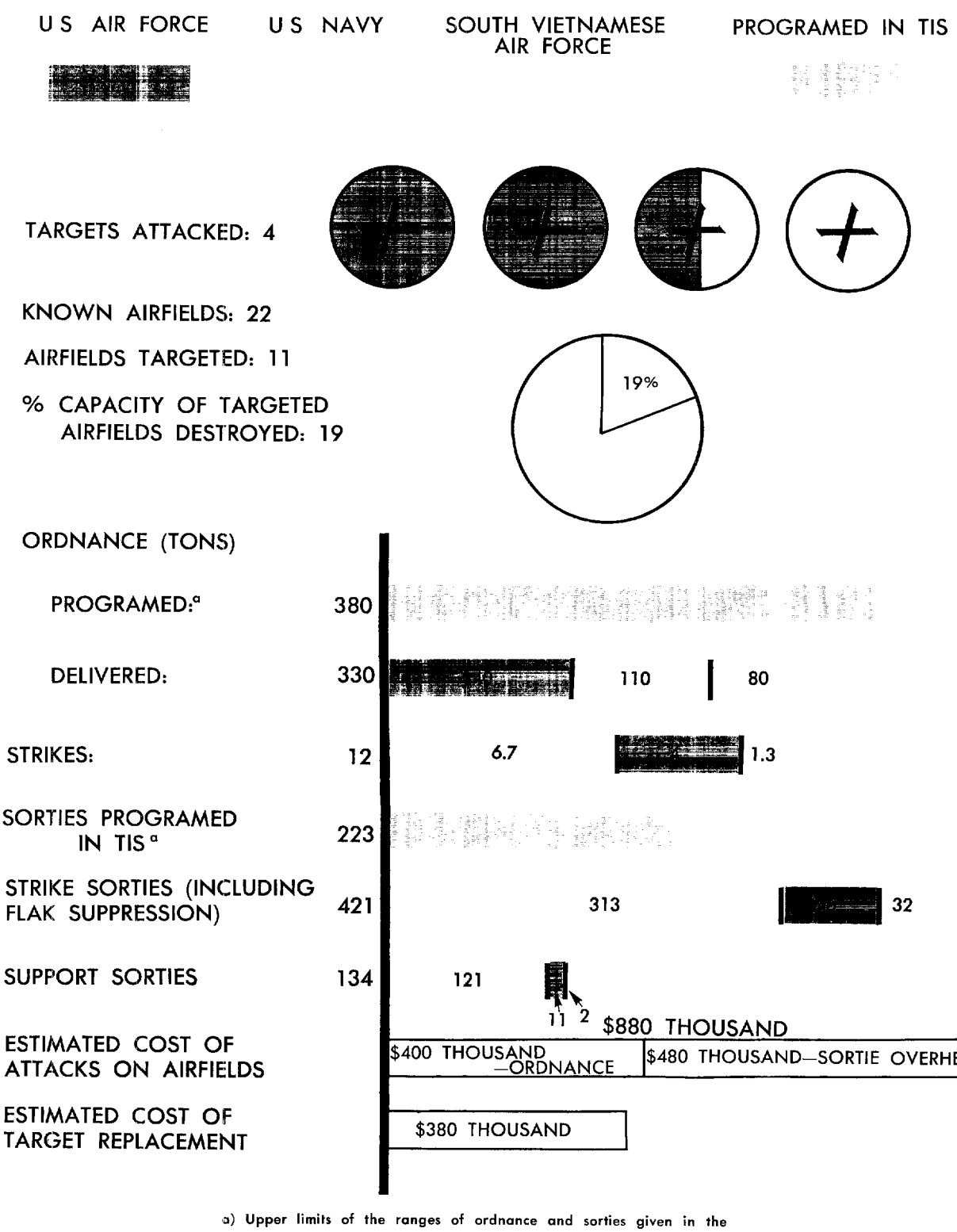
B-16, B-17 Estimated Cost of Rolling Thunder Related to the Cost of Damage to the Economy of North Vietnam
2 March–24 December 1965

61366

25X1

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.

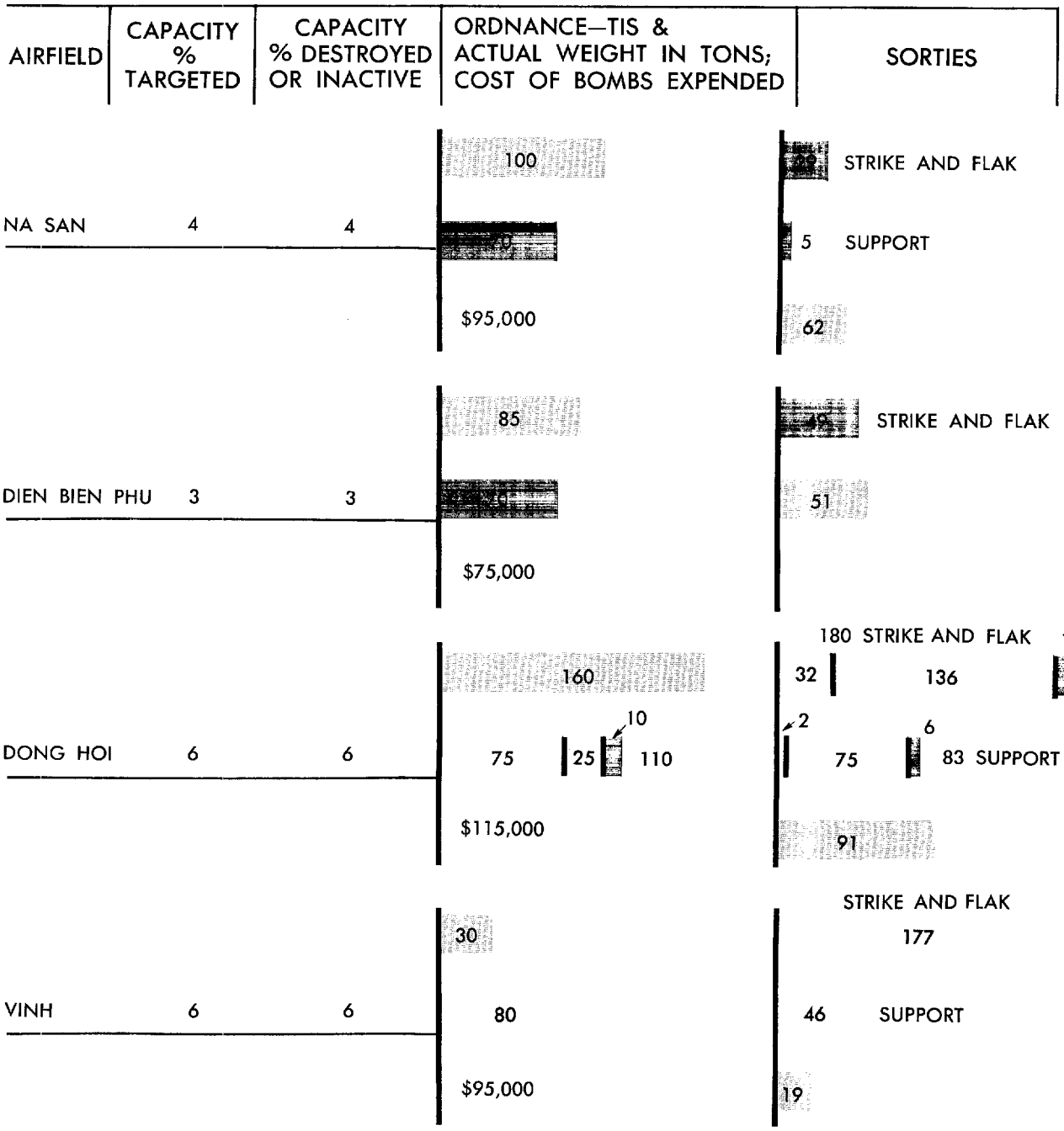
B-18 a Rolling Thunder: Statistical Summary of Attacks on Airfields, 2 March–24 December 1965

61369

25X1

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

US AIR FORCE US NAVY SOUTH VIETNAMESE AIR FORCE PROGRAMED IN TIS

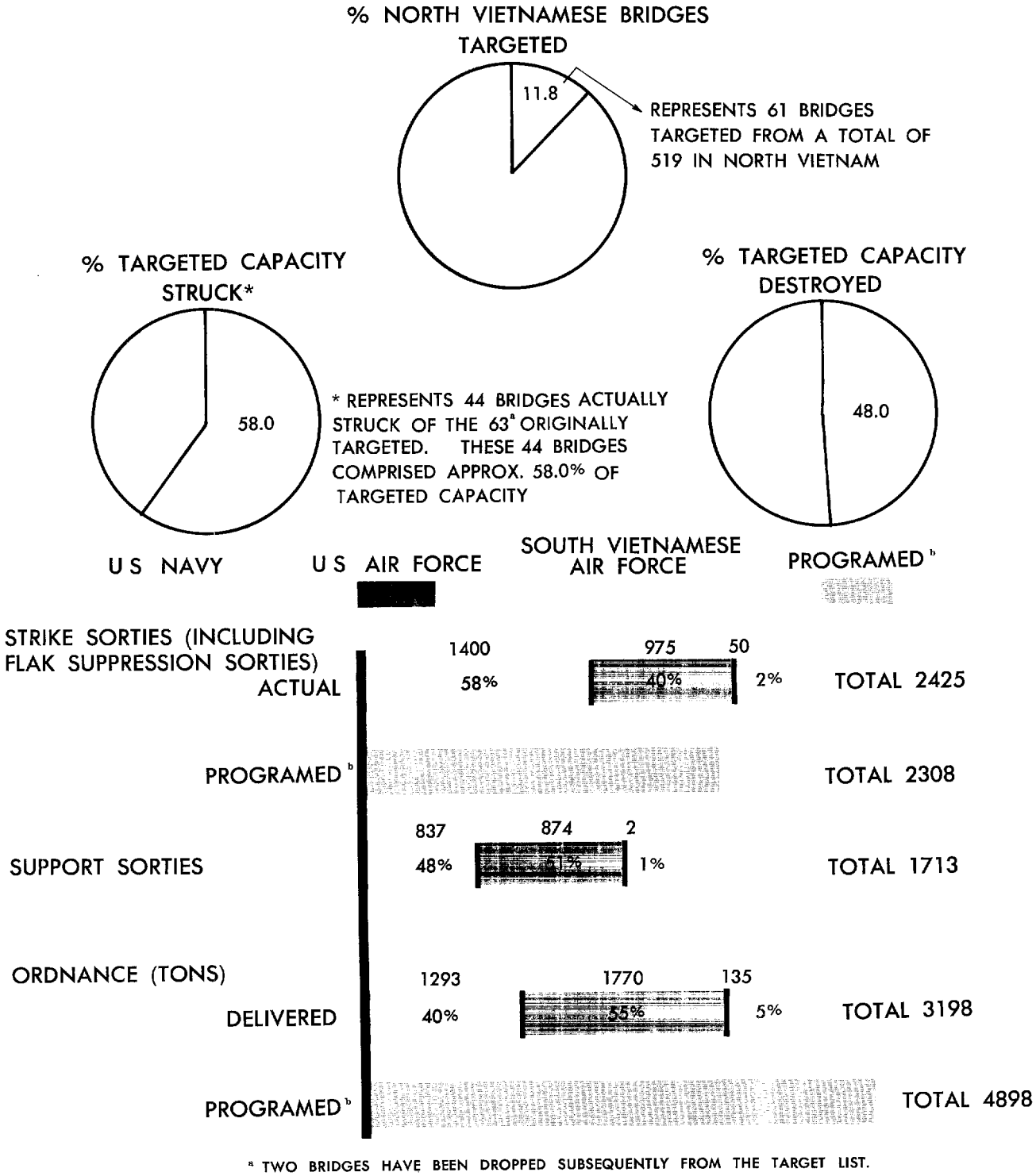


B-18 b Rolling Thunder: Statistical Summary of Attacks on Airfields, 2 March–24 December 1965

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

61370

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

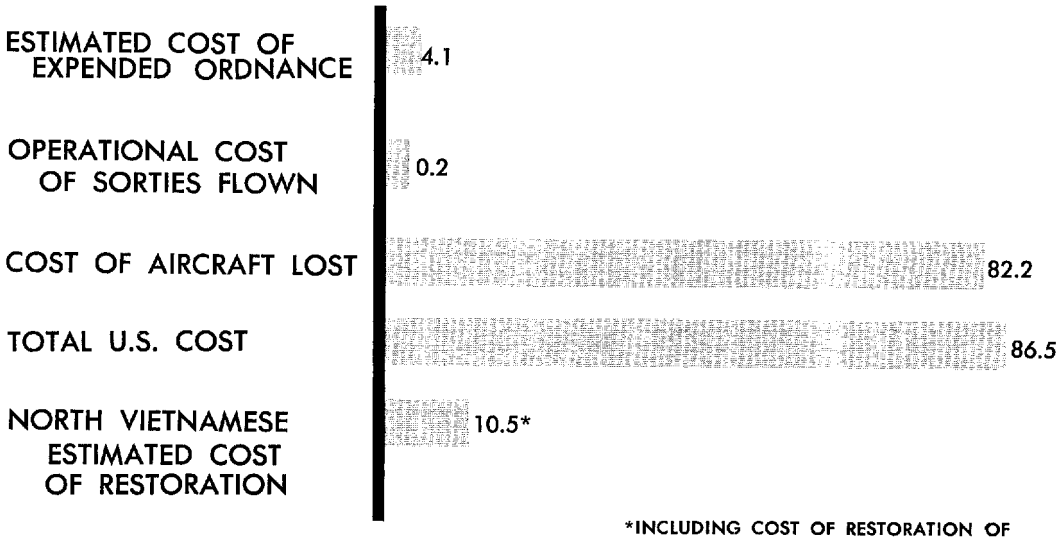
LOST

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.

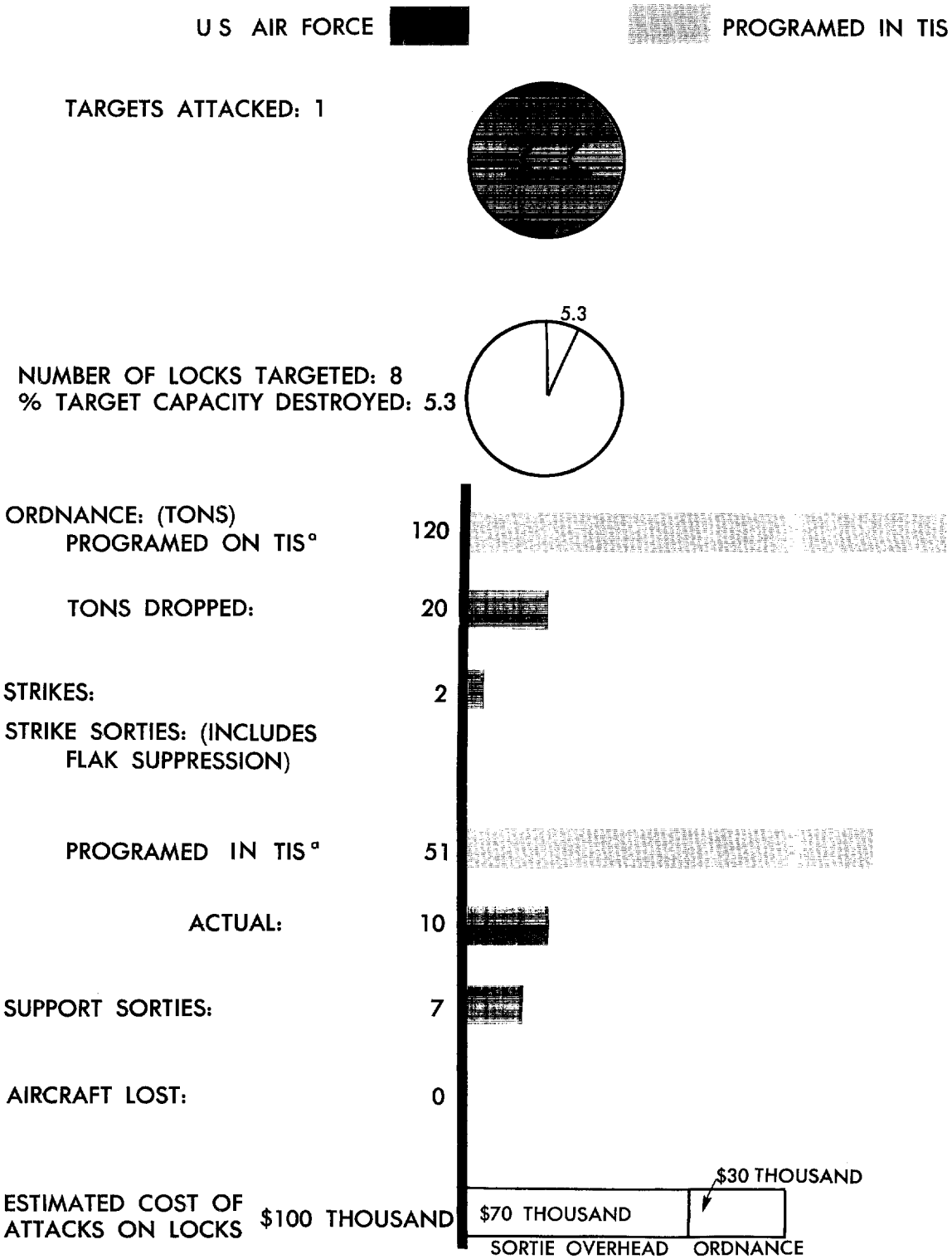
B-19b Rolling Thunder: Statistical Summary of Attacks on Bridges, 2 March–24 December 1965

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.

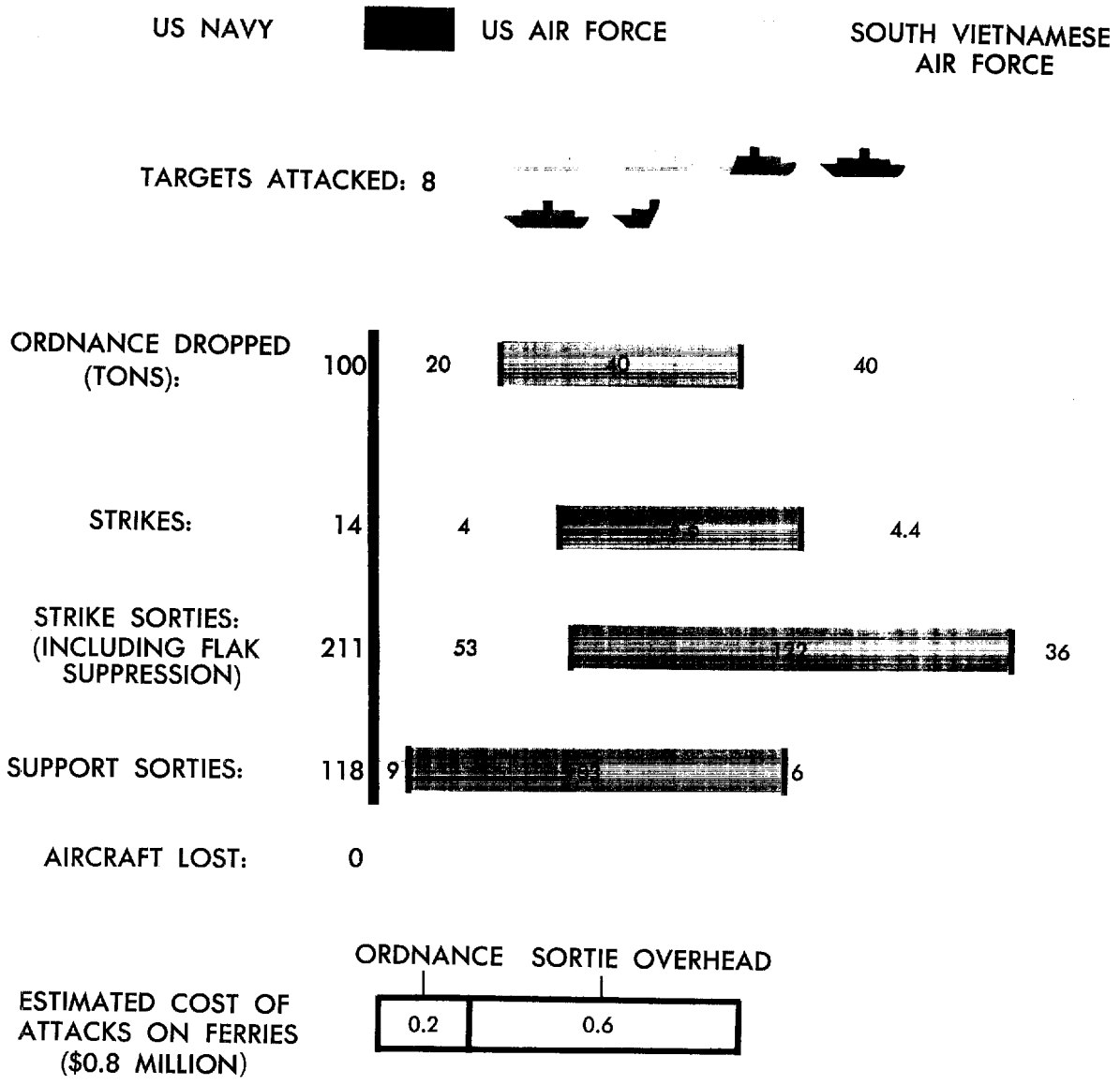
B-20 Rolling Thunder: Statistical Summary of Attacks on Locks, 2 March–24 December 1965

25X1

61371

[redacted] 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

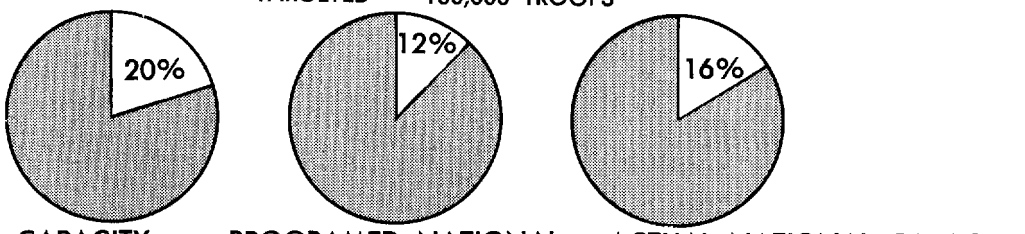
[redacted] 25X1

25X1

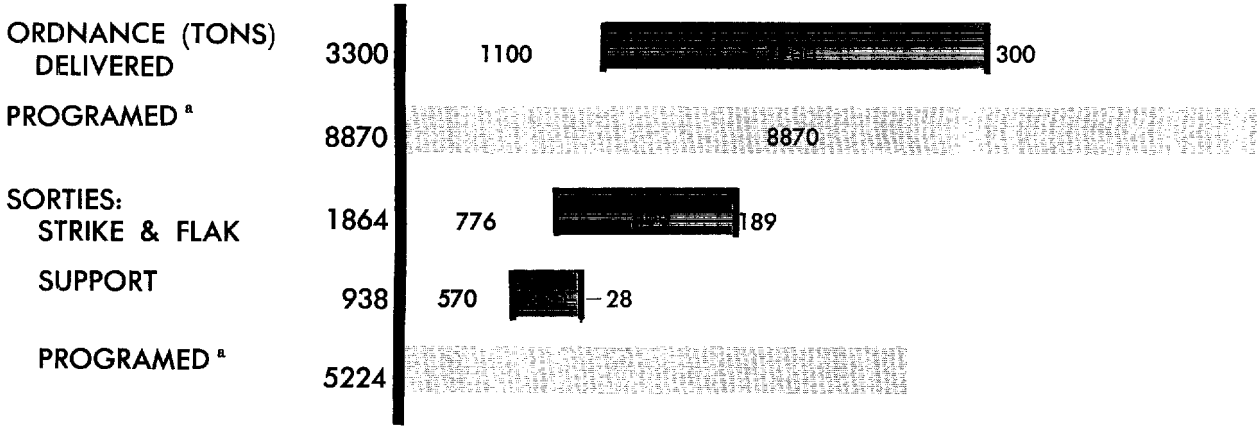
ROLLING THUNDER
Attacks on Barracks,* 2 March 1965-24 December 1965

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

TOTAL NATIONAL BARRACKS
CAPACITY 443,000 TROOPS
TARGETED 180,000 TROOPS



NATIONAL CAPACITY STRUCK | PROGRAMED NATIONAL CAPACITY DESTROYED | ACTUAL NATIONAL CAPACITY DESTROYED OR INACTIVE

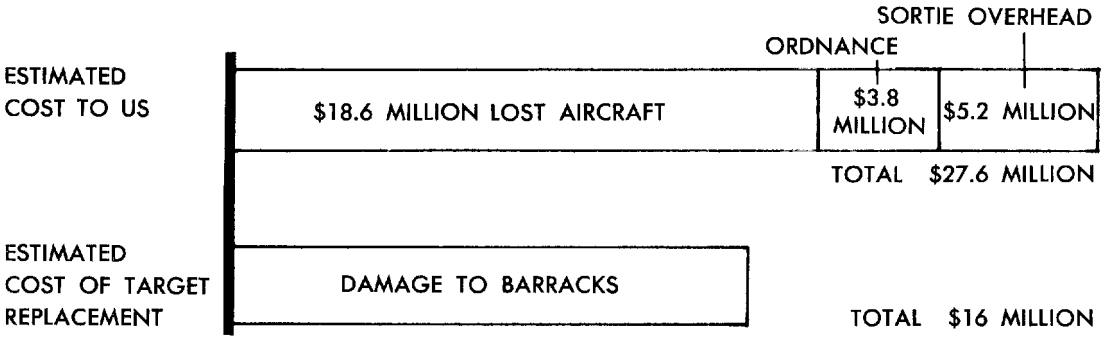


LOSSES:
AIRCRAFT: 7

PERSONNEL: 3 LOST, 4 RECOVERED

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

*EXCLUDING COMBINED BARRACKS/AMMUNITION DEPOTS AND BARRACKS/SUPPLY



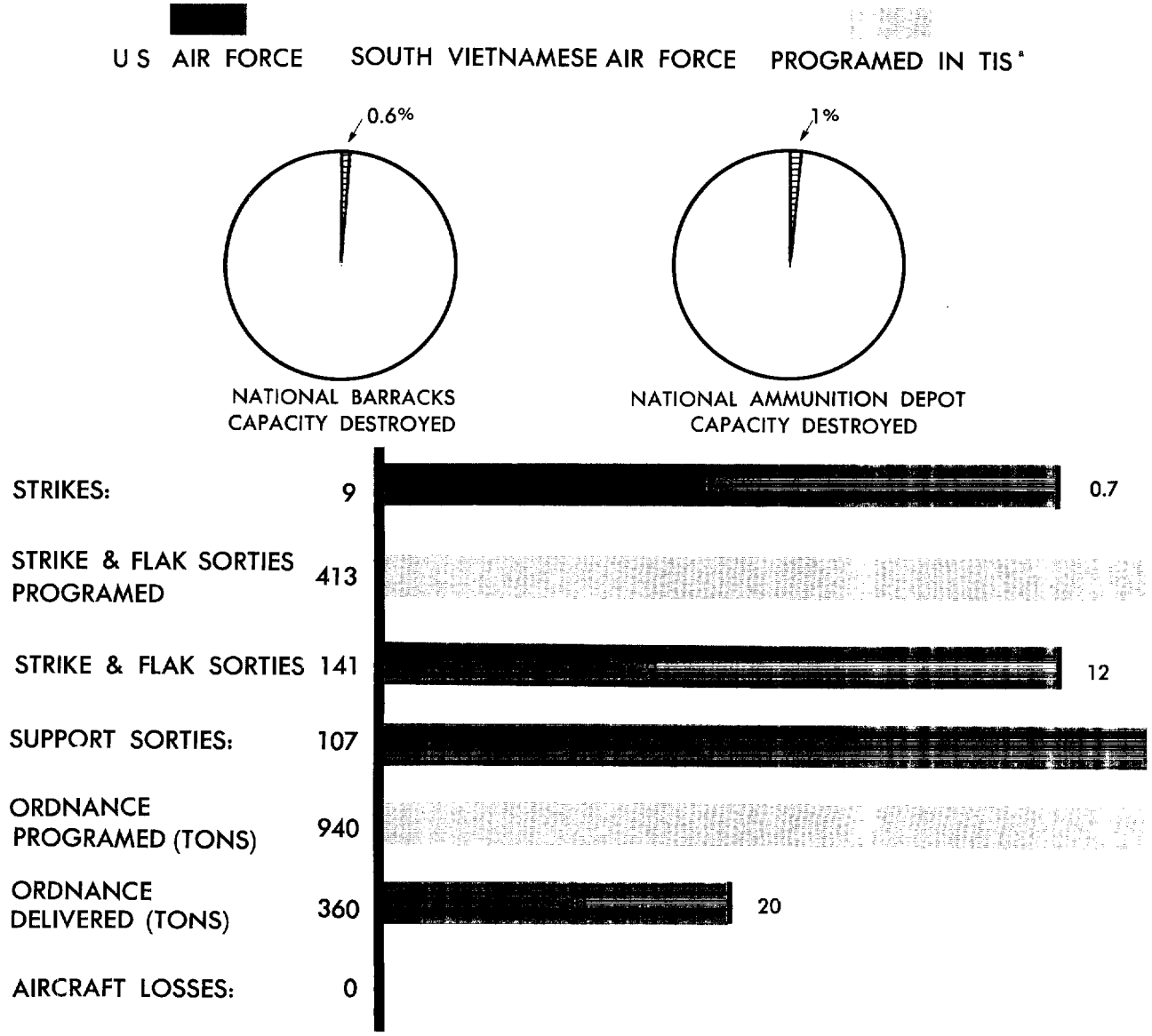
B-22 Rolling Thunder: Statistical Summary of Attacks on Barracks
2 March–24 December 1965

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

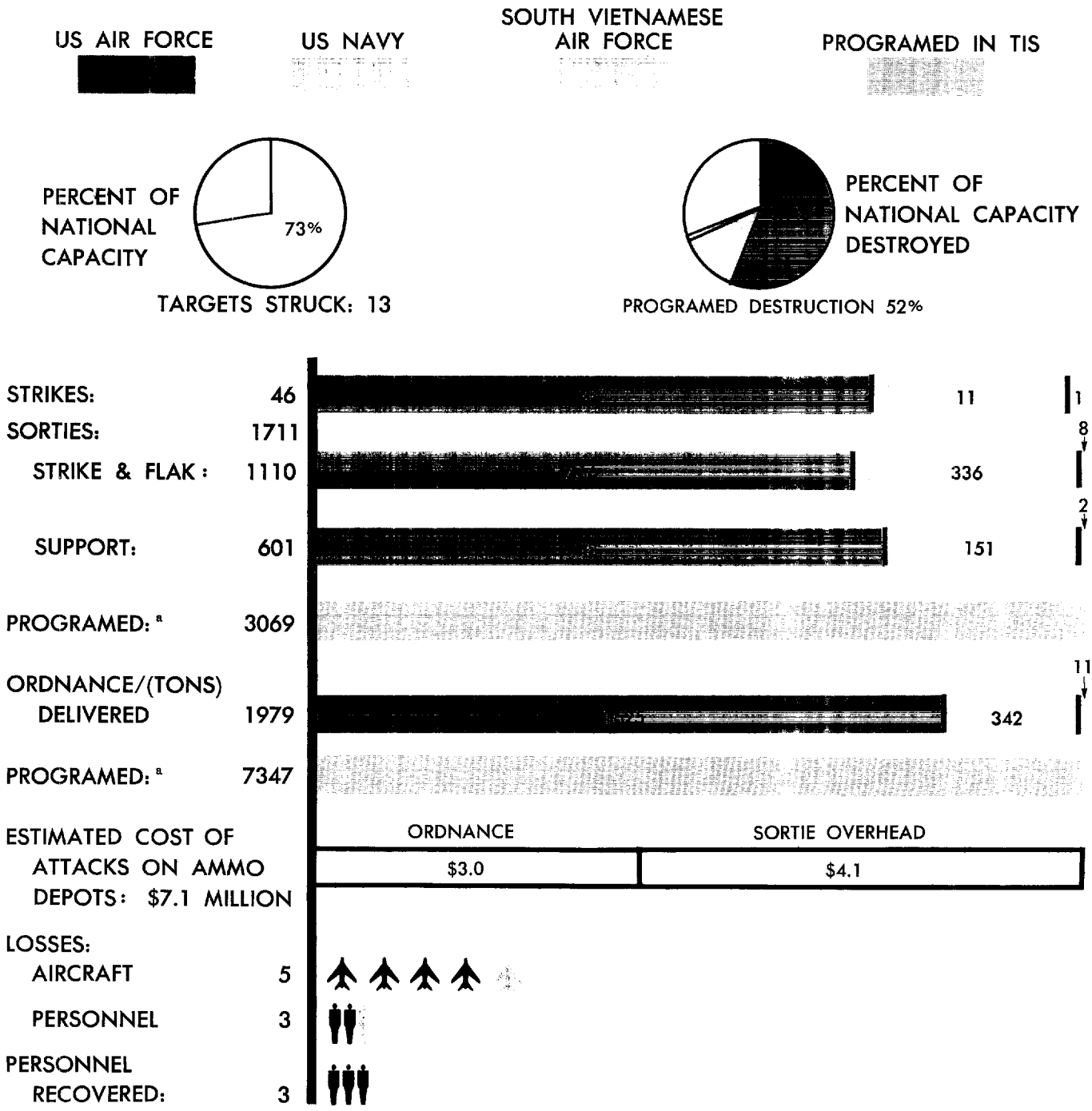
B-23 Rolling Thunder: Statistical Summary of Attacks on Combined Barracks and Ammunition Depots 2 March–24 December 1965

25X1

61374

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.

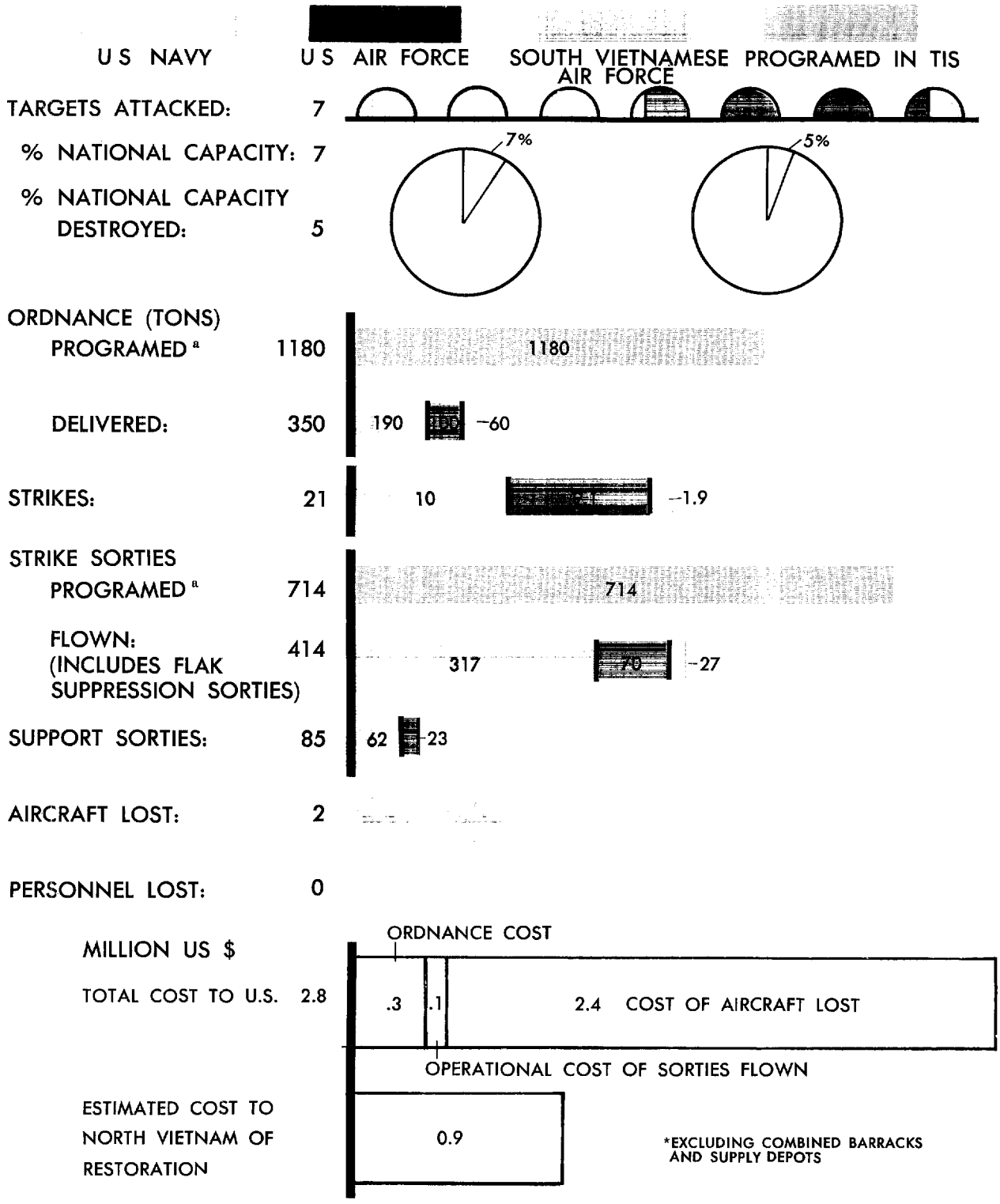
B-24 Rolling Thunder: Statistical Summary of Attacks on Ammunition Depots*
2 March–24 December 1965

61375

25X1

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.

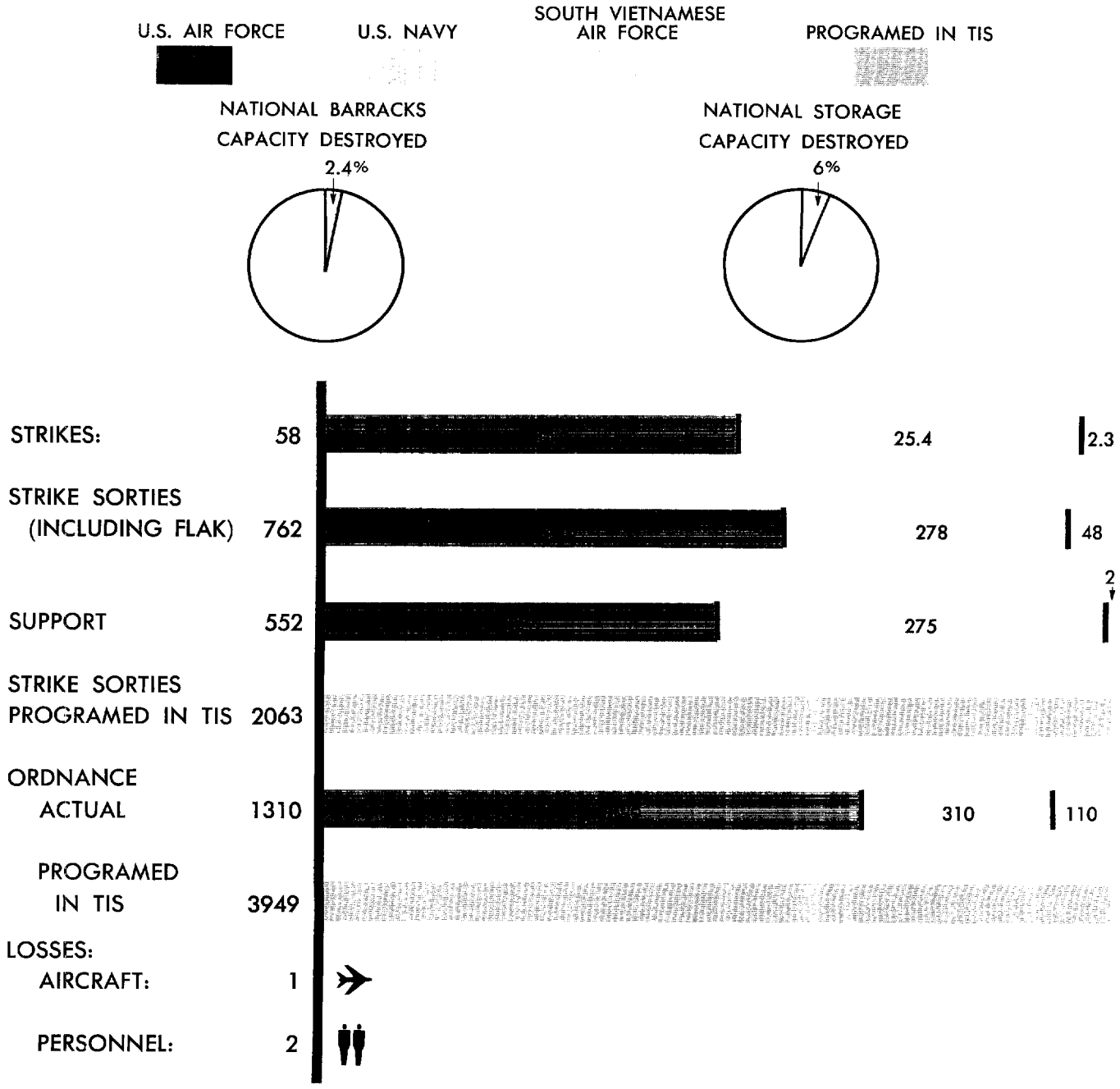
B-25 Rolling Thunder: Statistical Summary of Attacks on Supply Depots *
2 March–24 December 1965

61376

25X1

25X1

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

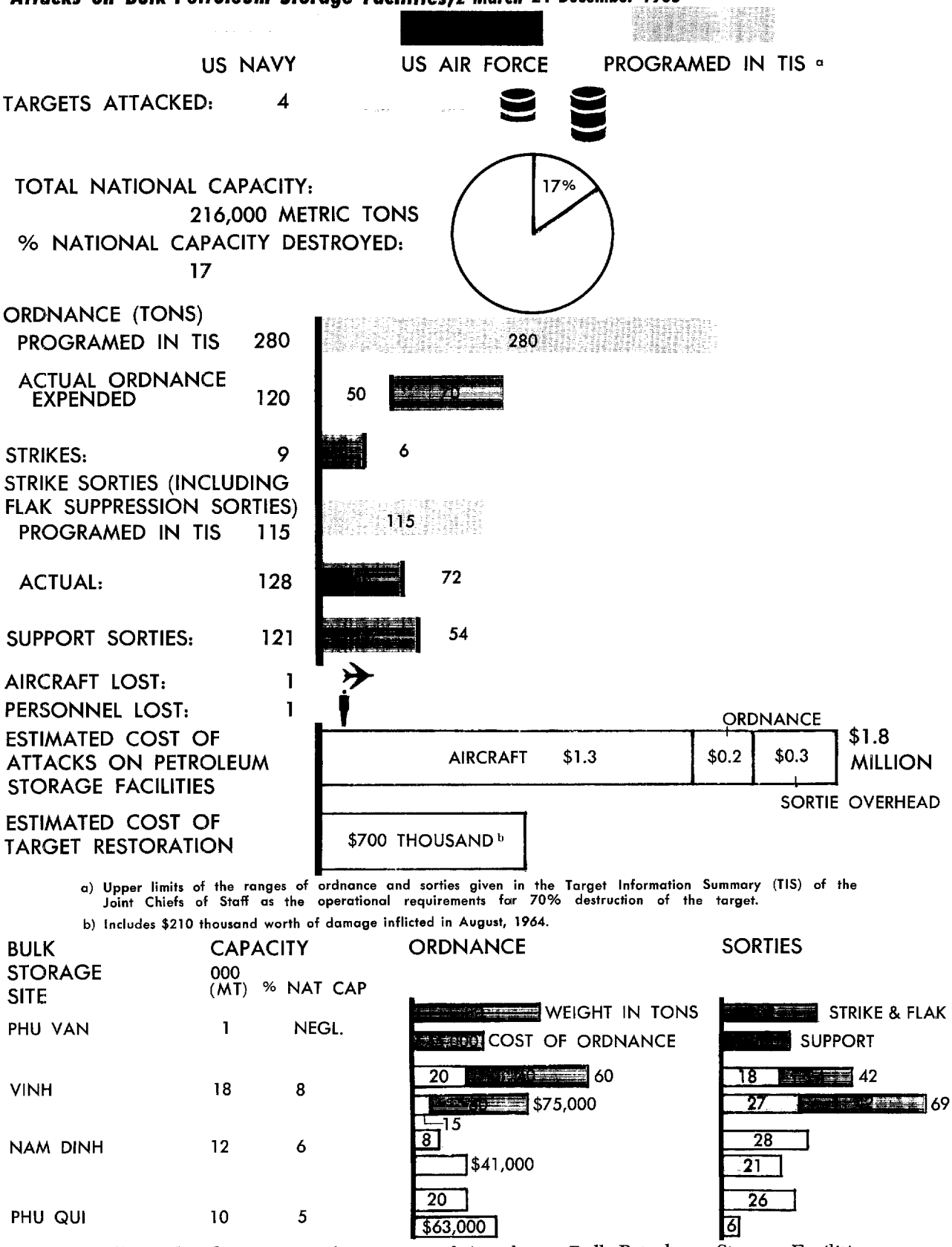


COST OF ORDNANCE DROPPED: $1.5 MILLION
COST OF AIRCRAFT LOST: $2.1 MILLION
OPERATIONAL COST OF SORTIES FLOWN: $1.1 MILLION

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

61377 25X1

ROLLING THUNDER
Attacks on Bulk Petroleum Storage Facilities, 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) Includes $210 thousand worth of damage inflicted in August, 1964.

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

[redacted]

25X1

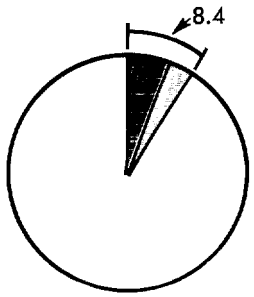
ROLLING THUNDER

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	[redacted]	[redacted]	[redacted]	[redacted]

% NATIONAL CARGO HANDLING CAPACITY

PROGRAMED FOR DESTRUCTION	ACTUALLY [b] DESTROYED
8.4	5.7



ORDNANCE (TONS)					
PROGRAMED IN TIS		[redacted]		1,860	
ACTUAL	390	320		55	15
STRIKES:	23	21	1.4	.6	
SORTIES					
PROGRAMED IN TIS [a]	868	[redacted]			
STRIKE & FLAK	315	263		28	
SUPPORT SORTIES	111	87	2	[redacted]	
AIRCRAFT LOST	3				
PERSONNEL LOST	3				

[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

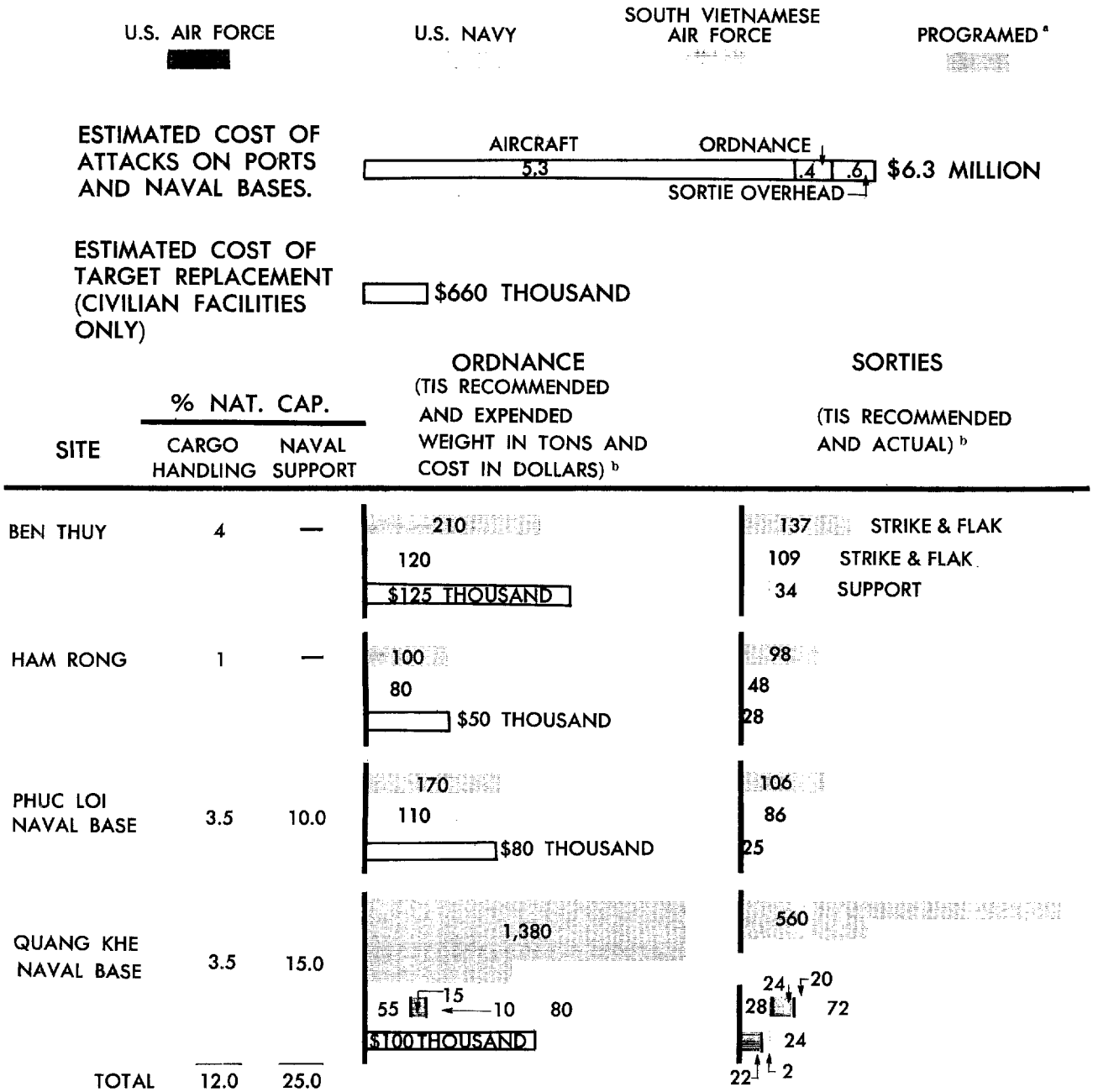
61379

[redacted]

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.

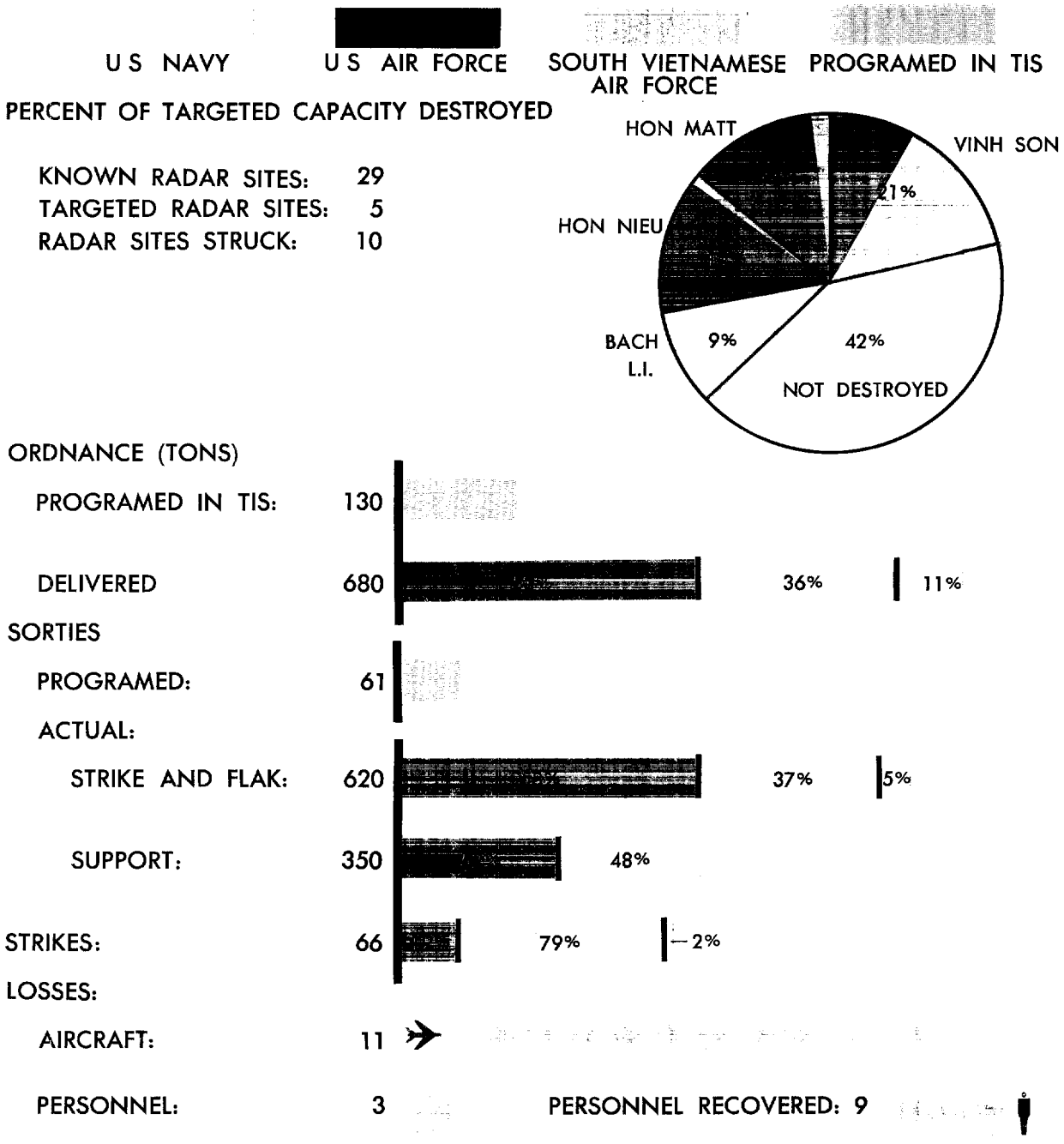
Figure B-28b Rolling Thunder: Statistical Summary of Attacks on Port Facilities and Naval Bases, 2 March–24 December 1965

61389

25X1

25X1

ROLLING THUNDER
Attacks on Radar Installations, 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.

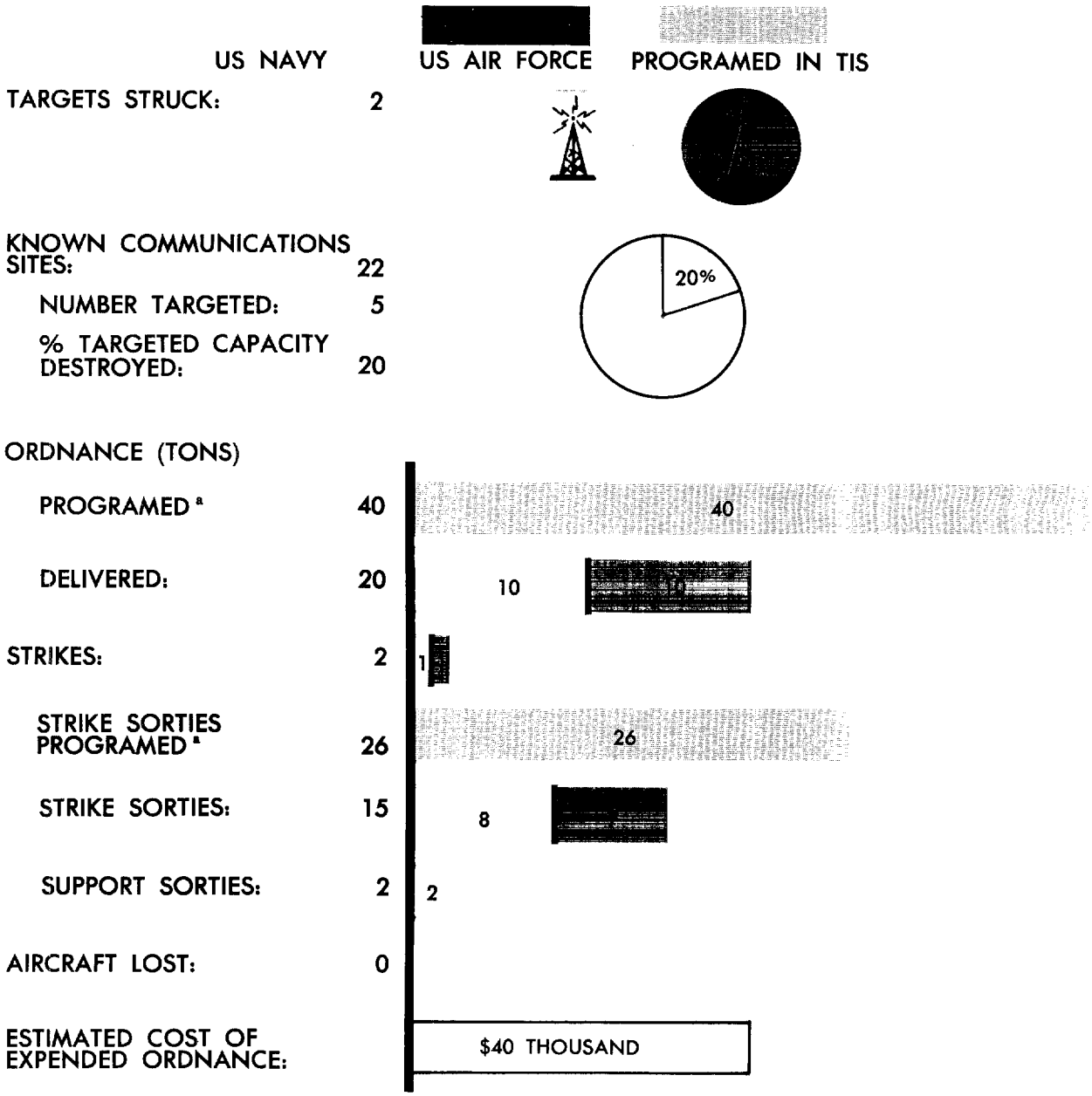
B-29 Rolling Thunder: Statistical Summary of Attacks on Radar Installations
2 March–24 December 1965

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

61381

25X1

25X1

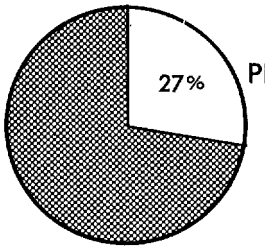
ROLLING THUNDER
Attacks on Electric Powerplants, 2 March 1965-24 December 1965

U S AIR FORCE U S NAVY PROGRAMED IN TIS

TARGETS ATTACKED: 6

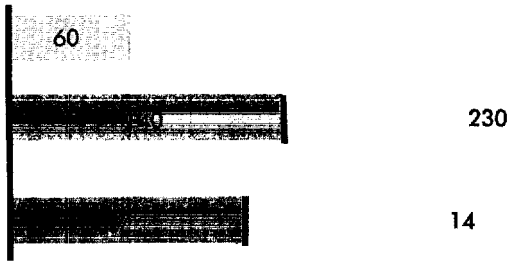
5 THERMAL 1 HYDRO

TOTAL NATIONAL CAPACITY: 175,000 KILOWATTS

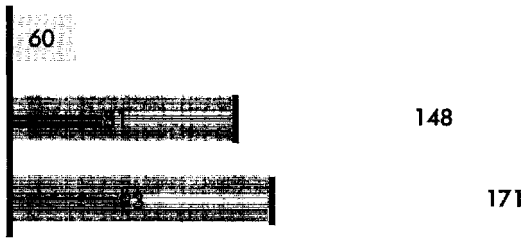


PERCENT NATIONAL CAPACITY DESTROYED: 27

ORDNANCE: (TONS)



STRIKE SORTIES (INCLUDING FLAK SUPPRESSION SORTIES)

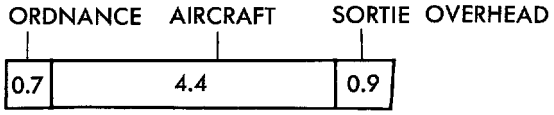


STRIKE AIRCRAFT LOST: 4

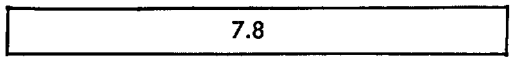
PERSONNEL LOST: 3

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

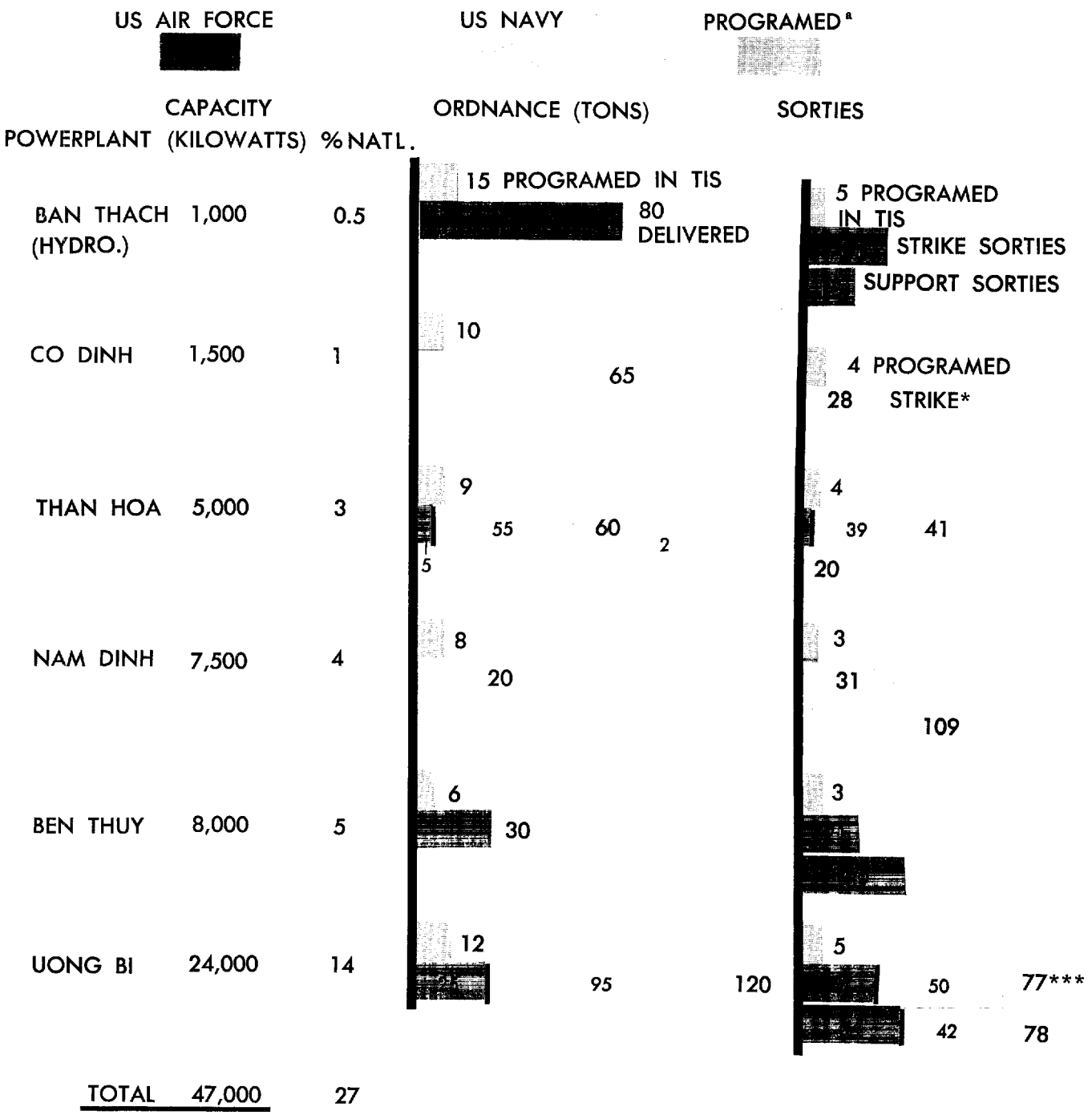
61382

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

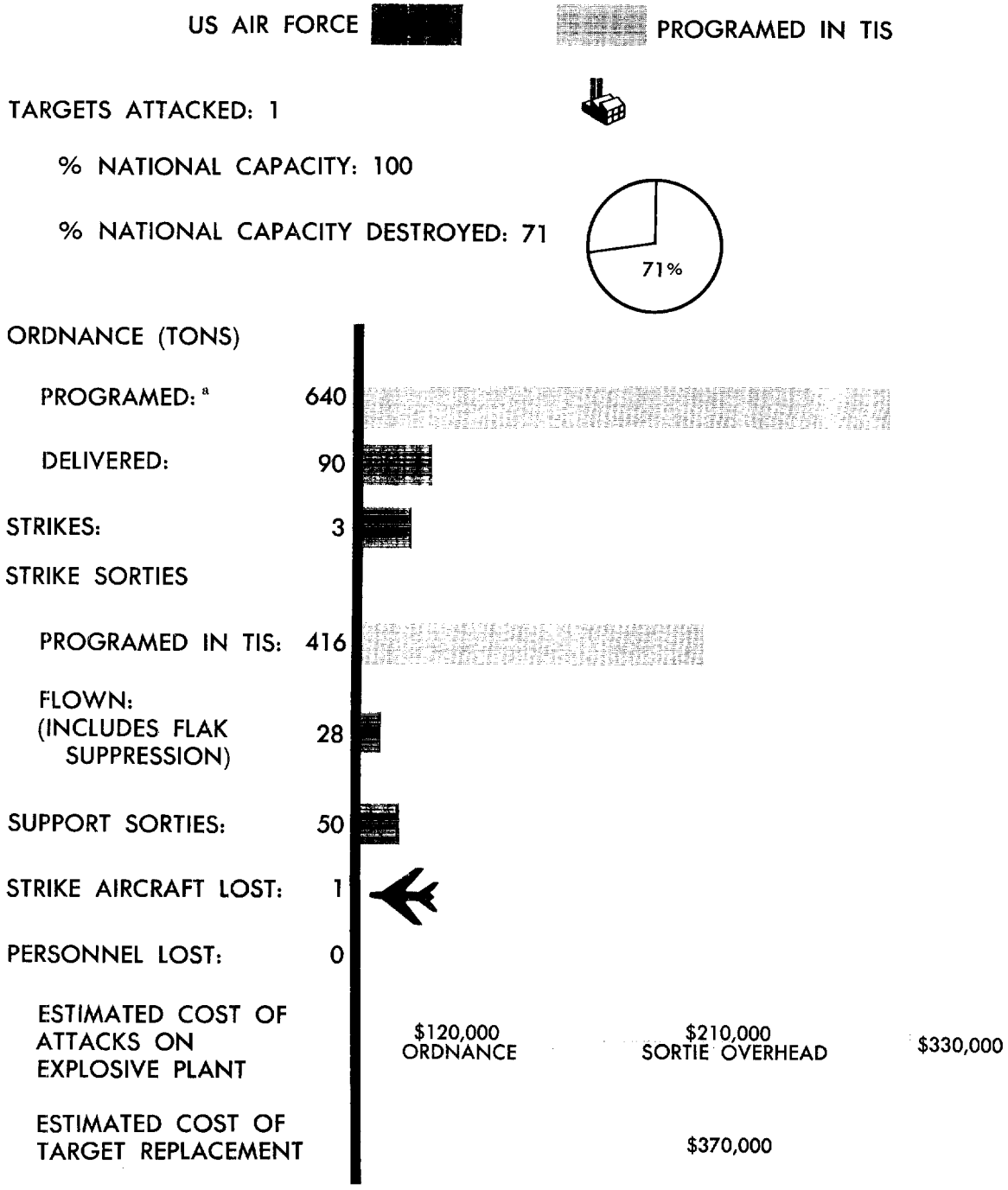
25X1

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