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DIRECTORATE OF
INTELLIGENCE

Intelligence Memorandum

An Assessment of the Rolling Thunder Program Through 30 September 1967

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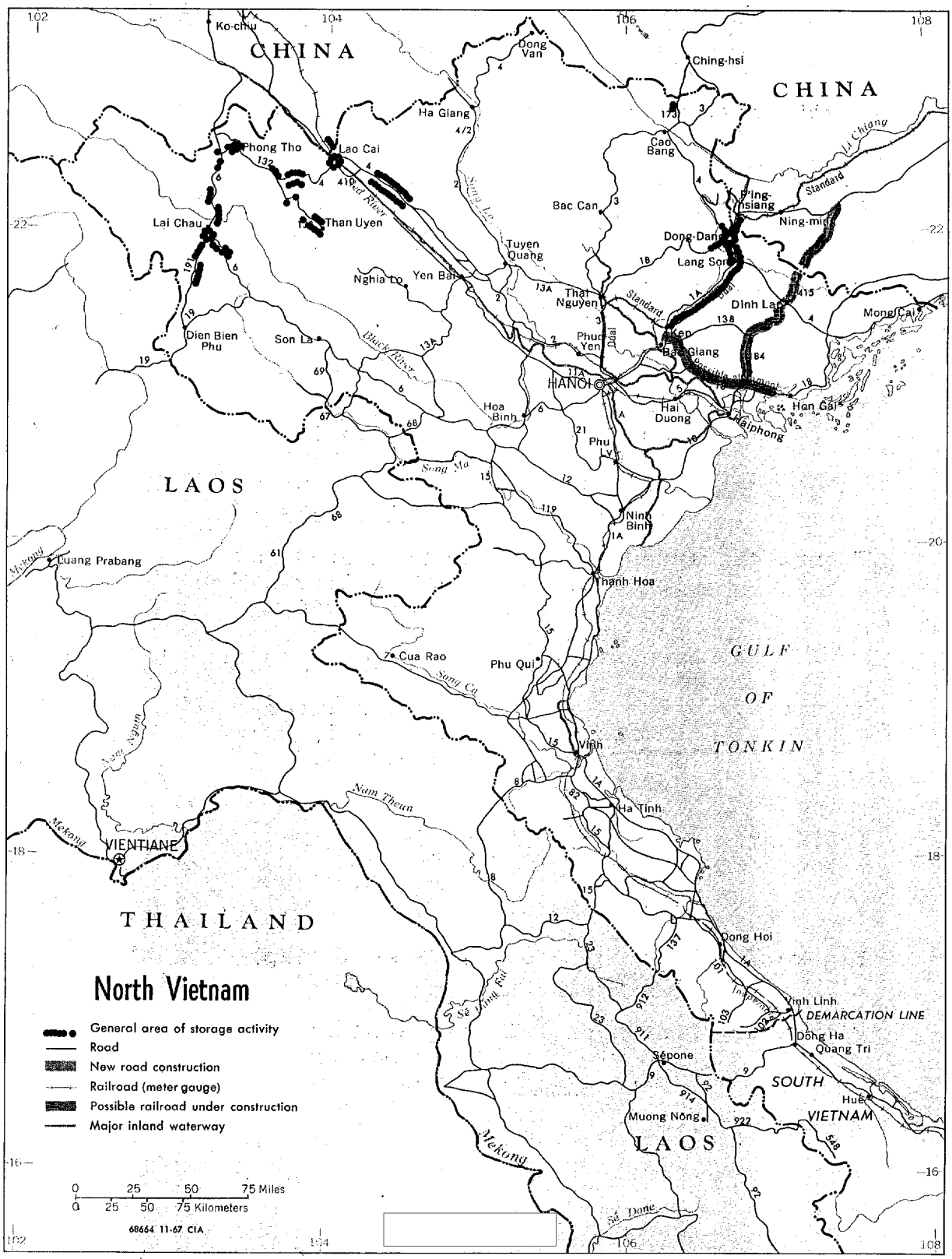

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CENTRAL INTELLIGENCE AGENCY
Directorate of Intelligence

INTELLIGENCE MEMORANDUM

AN ASSESSMENT OF THE ROLLING THUNDER PROGRAM THROUGH 30 SEPTEMBER 1967

Summary

Rolling Thunder operations have been increasingly successful in imposing a burden on North Vietnam. The costs of bomb damage, the neutralization of industry, the increased disruption of transport, and the rigors of daily living have combined to make support of the war more difficult and complex. Despite the achievements of the bombing program, however, no significant deterioration in North Vietnam's military capabilities or its determination to persist in the war can be detected.

During the first nine months of 1967 the air campaign against North Vietnam increased significantly in terms of sorties flown, ordnance dropped, and targets attacked. More sorties were flown over North Vietnam during the first nine months of 1967 -- 149,600 -- than during all of 1966. New industrial, transport, and military targets were effectively attacked for the first time. Intensified attacks against LOC's throughout the country -- including attacks against key and previously unstruck targets in the Hanoi, Haiphong, and the China border areas -- gave the Rolling Thunder program in 1967 its first opportunity to test the potential of a sustained and systematic air interdiction program.

Note: This memorandum was produced solely by CIA. It was prepared by the Office of Economic Research and coordinated with the Office of Current Intelligence and the Special Assistant for Vietnamese Affairs. The estimates and conclusions represent the best judgment of the Directorate of Intelligence as of 5 December 1967.

The cumulative effects of 32 months of punishing air attacks have caused widespread damage and disruption to virtually every part of the North Vietnamese economy. The Rolling Thunder program has been increasingly effective in 1967 in inflicting damage on military and economic targets. About one-half of the estimated $355 million total damage inflicted on North Vietnam since 1965 was inflicted in the first nine months of 1967 (see Figures 1 and 2).

Damage to industry accounted for the largest share of direct economic losses during the first half of 1967, while damage to transport equipment caused almost 70 percent of direct economic losses during the third quarter. Airstrikes against electric powerplants have reduced the country's capacity to about 20 percent of the prestrike level, and the main power network that serves Hanoi and Haiphong has been kept at an operating level of not more than 10 percent of its prestrike capacity. Direct bomb damage or a lack of electric power has crippled North Vietnam's small modern industry. A halt in cement and pig iron production and a decrease in coal-processing capacity have caused a major decline in the seaborne exports of bulk goods during the third quarter of 1967. The transport system has been disrupted, and large numbers of transport equipment and facilities have been destroyed. Furthermore, the North Vietnamese economy is undoubtedly hurting in ways that cannot be measured. The populace has had to shoulder countless new responsibilities, bear intense emotional stresses, and work harder for longer hours.

Costs of damage to military equipment and facilities during the first nine months of 1967 were almost three times as high as in 1966 (see Figure 2). However, damage to aircraft alone accounted for slightly more than 40 percent of this damage during 1967. Direct attacks on military target systems other than the air defense system have probably had only a negligible impact on the overall effectiveness of North Vietnam's military forces, which has been sustained and even increased by large infusions of military aid from the USSR and Communist China.

ECONOMIC DAMAGE

MILLION US DOLLARS

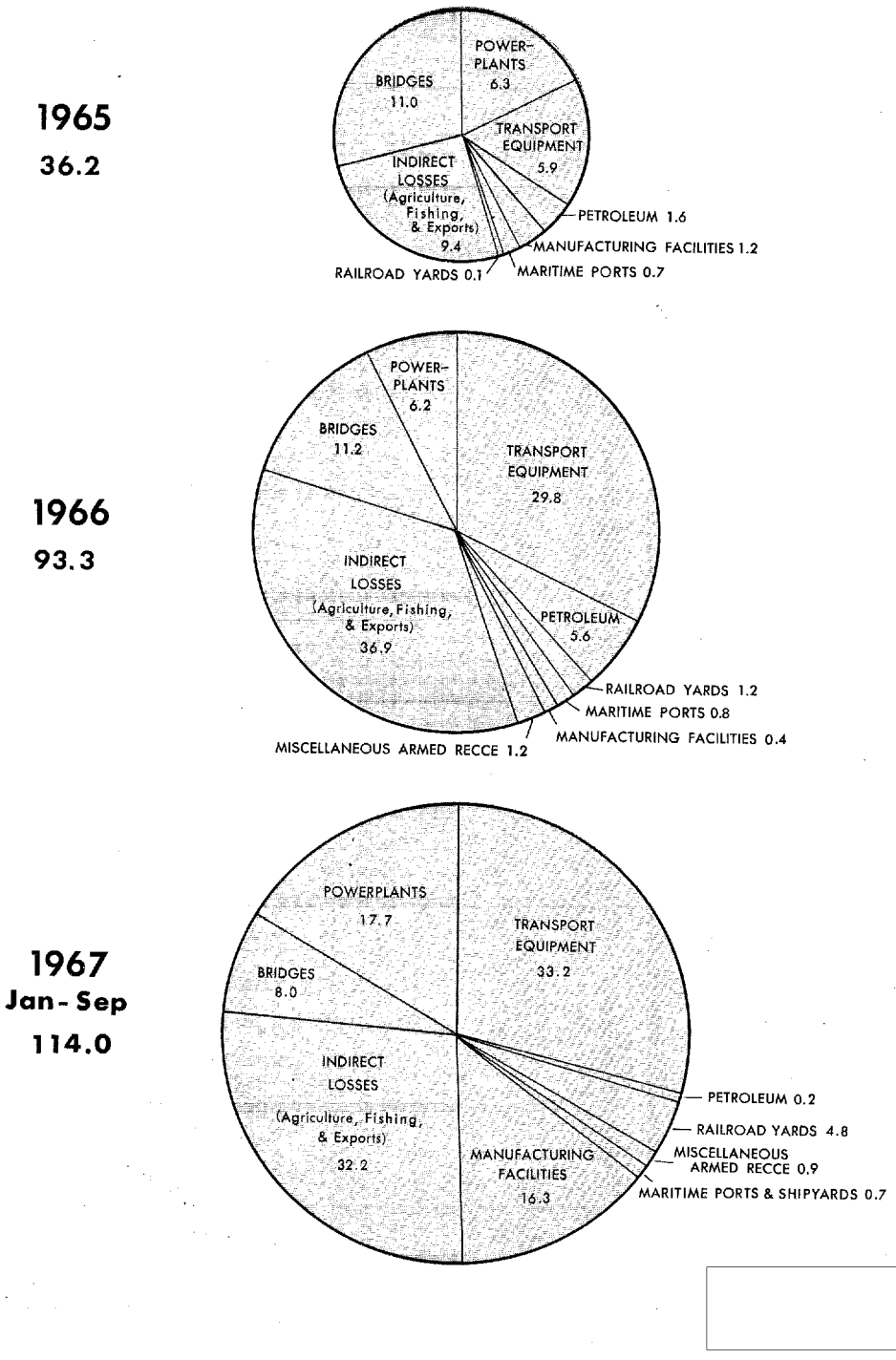

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Figure 1. Value of Economic Damage in North Vietnam, by Sector, 1965, 1966, and January-September 1967

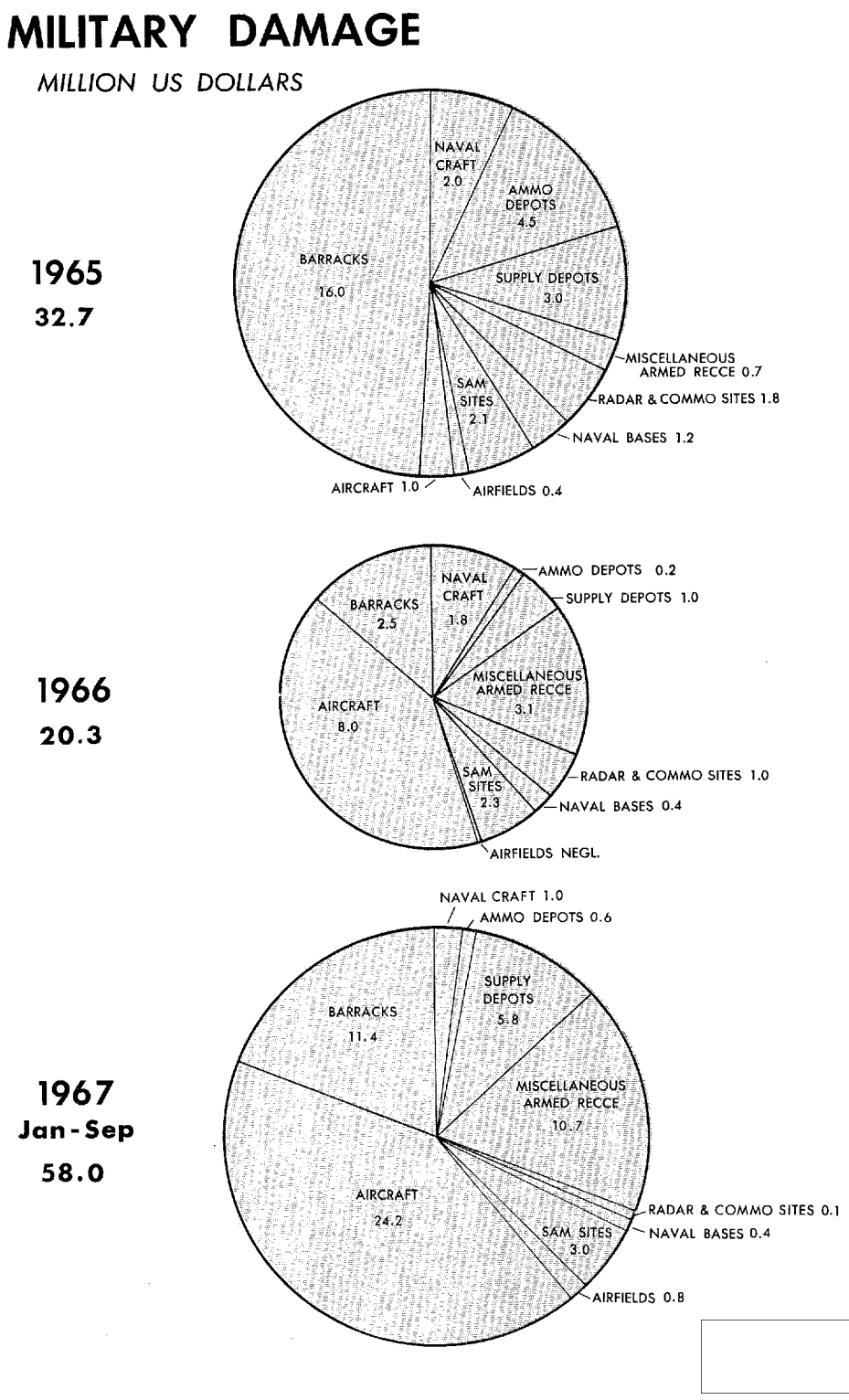

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Figure 2. Value of Military Damage in North Vietnam, by Sector, 1965, 1966, and January-September 1967

Despite the increased intensity of the air war, especially the increased attacks against LOC's (see Figures 3 and 4), there is still no evidence that the Rolling Thunder program is having a significant impact in limiting the North Vietnamese war effort in South Vietnam. The cost of moving men and supplies to South Vietnam has been raised, but the flow continues. Logistics problems have not placed a relevant ceiling on force structures or levels of combat. The movement of supplies in the northeast has been slowed, but all modes of transport -- rail, road, and waterway -- continue to be used. Neither Haiphong nor Hanoi has been isolated from other parts of the country. In spite of increased imports, there has been an overall net decline in the volume of goods that must be moved as a result of the cessation of modern industrial production. The inventory of freight cars has been maintained and its carrying capacity increased; the number of trucks has been maintained despite the high level of destruction. As a result of effective countermeasures, the North Vietnamese transport system presently has greater capacity than it did when the Rolling Thunder program began.

North Vietnamese success in countering the bombing program against the logistics system is explained by several factors. The density of the system remains low and its diversity so great that it is extremely difficult to neutralize. Transport requirements are low relative to capacity. North Vietnamese countermeasures have continued to improve -- abetted and strengthened by large infusions of materiel and equipment from their Communist allies, as well as Chinese manpower.

It is difficult to conceive of an interdiction campaign that would pinch off the flow of essential military supplies to forces in the South as long as combat requirements remained at anything like current levels. Political considerations aside, the combined interdiction of land and water routes, including the mining of the water approaches to the major ports and the bombing of ports and transshipment facilities, would be the most effective type of interdiction campaign. While the logistics problems would be further complicated, we believe the flow of essential supplies would continue. Under these conditions, the determining factor in shaping Hanoi's outlook toward the war probably would be the situation in South Vietnam itself.

Although the overall loss rates of US aircraft have steadily declined since 1965, disproportionately high losses of both aircraft and crews have resulted from the attacks against targets in Route Package VI, particularly in the immediate Hanoi and Haiphong areas. The overall 1967 combat loss rate of attack aircraft is 2.2 per 1,000 attack sorties. In comparison the loss rate for attacks against the Thai Nguyen Iron and Steel Plant was 28.6 per 1,000 sorties and against electric powerplants it was 18.2 per 1,000 sorties. Six aircraft were lost while attacking the Hanoi Electric Powerplant and the Hanoi Transformer Substation which play minor roles in the overall war effort. The recovery rate for pilots and crews downed in Route Package VI is no more than half the rate for the country as a whole. To date, the US air campaign in Route Package VI, particularly in the Hanoi-Haiphong area, involves a very high element of risk and high costs.

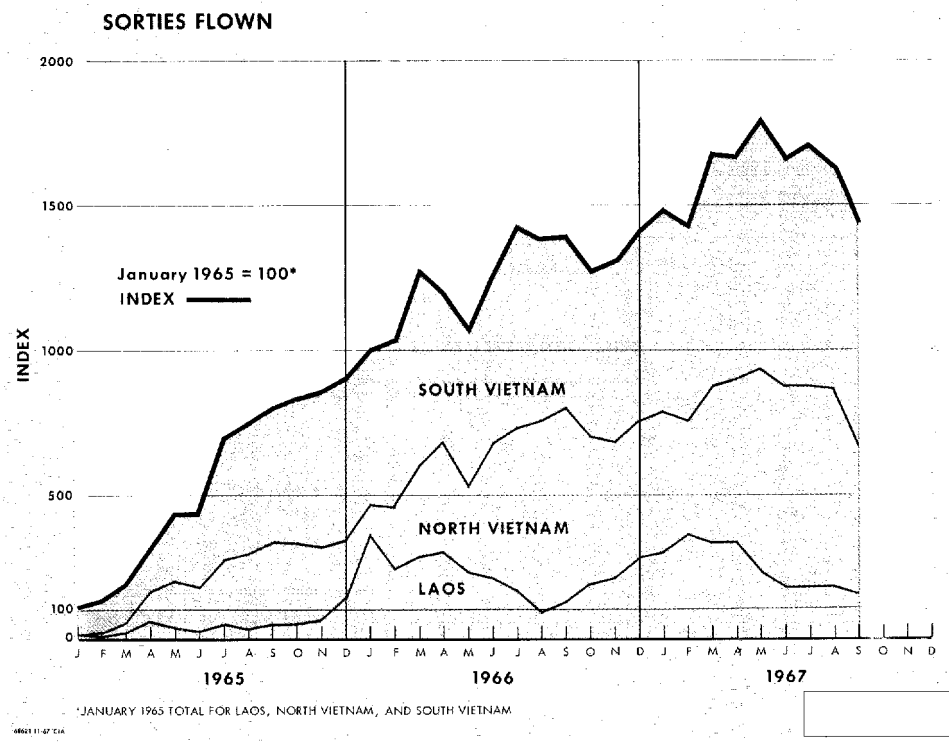

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Figure 3. Index of Sorties Flown in Southeast Asia and Relative Amounts in Each Area, 1965, 1966, and January-September 1967

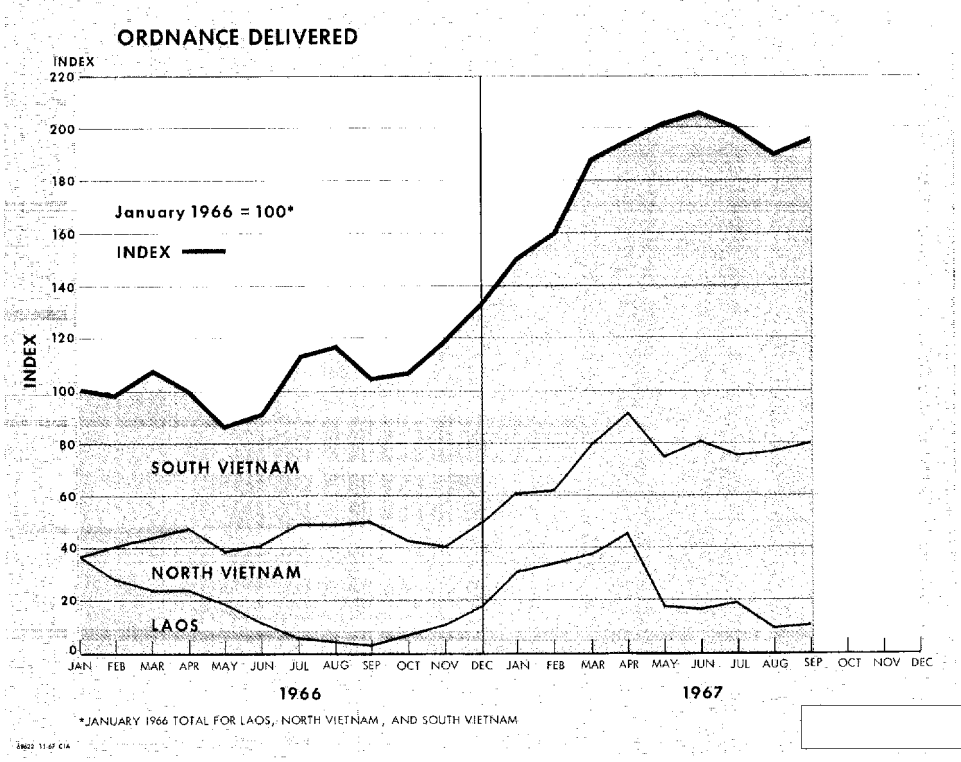

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Figure 4. Index of Ordnance Delivered in Southeast Asia and Relative Amounts in Each Area, 1966 and January-September 1967

I. Physical Effects

The Rolling Thunder program increased significantly in both scope and intensity during the first nine months of 1967. Emphasis on airstrikes against major industrial facilities, most of which had not been previously attacked, generally neutralized North Vietnam's limited modern industrial base in the first half of the year. During the third quarter the emphasis of attacks shifted from industrial targets to increased interdiction of the transport system, particularly key targets in the Hanoi and Haiphong areas and the Chinese buffer zone which were struck for the first time.

The cumulative measurable damage to the economy and military facilities and equipment through September 1967 is estimated at about $355 million (see Table 1). Nearly 70 percent of this damage was inflicted on economic targets -- primarily transport equipment, bridges, and electric powerplants -- but indirect losses from decreases in agricultural production and exports also occurred. A comparison of the cost of damage by time period follows:

	Million US $		
	1965	1966	Jan-Sep 1967
Economic	36.2	93.3	114.0
Military	32.7	20.3	58.0
Total	*68.9*	*113.6*	*172.0*

Although the amount of damage declined sharply during the third quarter of 1967 after the more lucrative targets -- manufacturing facilities and electric powerplants -- were heavily attacked, it remained well above the 1965 and 1966 levels (see Figure 5). The high rate of damage to transport equipment inflicted in the second quarter continued during the third quarter, and damage to military supplies and equipment by miscellaneous armed reconnaissance rose significantly. The decline in

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Value of Economic and Military Damage
Million US Dollars

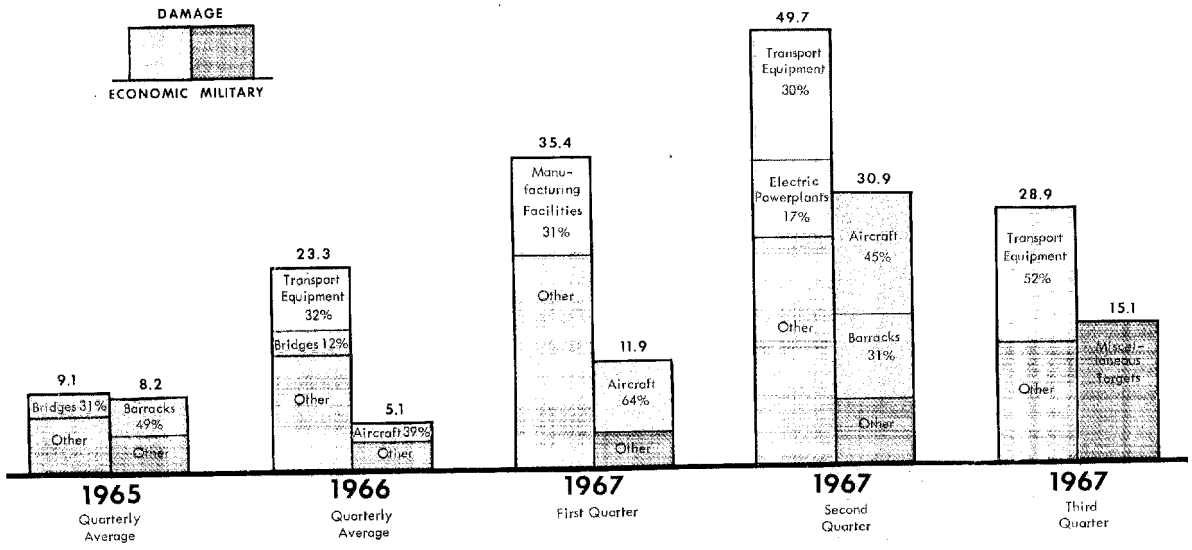

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Figure 5. North Vietnam, Value of Economic and Military Damage, by Quarter, 1965, 1966, and January-September 1967

cost of damage during the third quarter does not reflect the increased difficulties faced by the North Vietnamese in moving economic and military supplies because of major damage to the transport system.

A. Economic Damage

1. Introduction

The measurable cost to North Vietnam of direct damage to economic targets through September 1967 was $165 million, about 68 percent of the total direct and indirect economic cost and 47 percent of the combined economic and military cost. About one-half of the cumulative direct economic damage occurred during the first nine

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Table 1

Value of Economic and Military Damage Attributed to the Rolling Thunder Program
Cumulative 1965 Through September 1967

Economic	Million US $	Military	Million US $
Direct losses	165.0	Direct losses	110.9
Transportation equipment	68.9	Aircraft	33.2
Railroad/highway bridges	30.3	Barracks	30.0
Electric powerplants	30.2	Supply areas and depots	9.8
Manufacturing facilities	17.8	SAM sites	7.4
Petroleum	7.5 a/	Ammunition depots	5.3
Railroad yards and shops	6.1	Naval craft	4.8
Maritime ports and shipyards	2.1	Radar sites	2.6
Miscellaneous armed reconnaissance	2.1	Naval bases	1.9
Indirect losses	78.5	Airfields	1.2
Exports	29.5	Communications sites	0.2
Agriculture	39.5	Miscellaneous armed reconnaissance	14.5
Fishing	9.5		
Total, direct and indirect losses	243.5		

Total economic and military b/ 354.5

a. Midpoint of the range of about $7.2 million to $7.9 million.
b. Because of rounding, components do not add to the totals shown.

months of 1967. The tabulation below summarizes direct damage to economic targets:

	Million US $			
	1965	1966	Jan-Sep 1967	1965 - Sep 1967
Direct damage to economic facilities and equipment	26.8	56.5	81.7	165.0

The cost of direct damage rose rapidly from a quarterly average of $14.1 million in 1966 to $23.9 million in the first quarter of 1967 and $36.3 million in the second quarter. The increased damage in the first half of the year resulted from the heavy damage to modern manufacturing facilities and electric powerplants. After attacks on these facilities slackened, the cost of damage dropped sharply to $21.6 million in the third quarter. Damage to transport equipment remained at a high level, rising from $3.3 million in the first quarter to $14.9 million in the second quarter and $15.0 million in the third quarter.

2. Transportation

The high level of airstrikes against the transportation system of North Vietnam that has been under way since June 1967 has disrupted operations and caused substantial losses of equipment and facilities. The costs and difficulties of maintaining traffic movements have increased, but, with extensive countermeasures and foreign assistance, there is probably overall more surplus capacity available today than existed at the start of the Rolling Thunder program. North Vietnam is far better able to cope with air attacks against the transportation system today than in 1965.

At the same time, some requirements for transportation have been reduced. Airstrikes against electric power and industrial targets have reduced transport requirements for coal, other raw materials, and products. The gross decline in

traffic is estimated at about 1.5 million tons for the first half of 1967. Although this decline was partly offset by the increase in the volume of imports moved through Haiphong during the first half of 1967, the net decline in tons carried was about 1.2 million, an amount equal to 12 percent of the tons carried during a similar period in 1966. The following tabulation shows tons carried on the modern transportation system during the first half of 1967, compared with the totals in previous years:

	Million Tons Carried			
	1964	1965	1966	Jan-Jun 1967
Railroad	4.13	3.7	3.3	1.6
Highway	7.18	7.9	7.9	3.9
Inland water	7.01	7.7	8.5	3.2
Coastal water	0.37	0.4	0.5	0.2
Total	*18.69*	*19.7*	*20.2*	*8.9*

The decline in traffic will be even greater in the last half of 1967 unless some of the industrial plants resume production or imports increase substantially during the final quarter.

a. Railroads

The railroad system of North Vietnam has been subject to attack throughout the Rolling Thunder program. During 1965 and 1966 the principal emphasis of attack was on the railroad line leading south from Hanoi with only sporadic strikes against the Hanoi - Lao Cai and Hanoi - Dong Dang lines. Since June 1967 the bombing program has been enlarged to include intensive and repeated attacks against multiple targets on the vital railroad lines in the northern areas. In addition, railroad targets in previously restricted areas such as Hanoi, Haiphong, and the buffer zone along the northern border have come under repeated and heavy attacks.*

* *For a detailed discussion of the current transport situation in Hanoi and Haiphong, see Appendix A.*

Key railroad and combination railroad and highway bridges have been destroyed, important railroad yards have been damaged, and much railroad rolling stock has been damaged or destroyed. In many instances, damage to bridges has forced the North Vietnamese to employ less efficient and more time-consuming methods to move traffic, transshipping railroad freight to motor trucks and water craft where bypass bridges are not available.

Although major problems have been created by the recent heavy attacks against railroad targets in the Hanoi and Haiphong areas, countermeasures and alternate facilities have guaranteed the maintenance of substantial capacity for traffic movement.

Throughout the period of intensive strikes against the Hanoi - Dong Dang line, each bridge attacked had at least one serviceable bypass available. The railroad yards, though sometimes unserviceable immediately following strikes, had at least one track open for through service shortly afterward.

Attacks against the Kep - Thai Nguyen and Thai Nguyen - Hanoi lines have not significantly hindered the movement of traffic. Either adequate bypasses or quick repairs obviated adverse effects.

Constant bombing of the Hanoi-Vinh line has made the continuation of through service nearly impossible. The importance of this line is demonstrated by the fact that the North Vietnamese continue to use it to the extent possible. Substantial repair and construction efforts keep sections of the line open for shuttle train service between interdicted points.

Through service on North Vietnam's secondary railroad connection to Communist China, from Hanoi northwest to Lao Cai, has not been possible since June 1966, when the bridge at Viet Tri was destroyed. A railroad car ferry has been placed in service and apparently has been capable of carrying the relatively low level of traffic

moving through Viet Tri. A cable bridge that can accommodate motor trucks has also been constructed across the damaged spans of the Viet Tri Bridge to maintain the flow of traffic in the event that recent mining impairs use of the railroad ferry.

Thus, North Vietnam appears to be willing and capable, with foreign assistance, to maintain needed rail service. The more important the route, the greater expense and effort marshaled to move traffic and to increase route capacity. Measures taken to increase capacity include the conversion of much of the system to dual gauge and the establishment of multiple bypasses for interdicted points. Tracks capable of accommodating both North Vietnamese meter gauge and Chinese standard gauge rolling stock now extend from the Chinese border through Dong Dang to Kep. A standard gauge line was completed in 1966 from Kep to Thai Nguyen. From Thai Nguyen, dual gauge extends to the vicinity of Hanoi. Only a few kilometers of the line from Hanoi to Kep have not been converted to dual gauge. No steps have been taken to convert the Hanoi-Haiphong, the Hanoi - Lao Cai, and the Hanoi-Vinh lines to dual gauge, but higher capacity Chinese rolling stock can now operate over that portion of the system most used for overland imports from China and the USSR.

b. Highways

Airstrikes against the highway system in North Vietnam have had no sustained effects on truck operations. The majority of airstrikes have been concentrated in the region south of Thanh Hoa, with Routes 1A, 15, 7, and 101 receiving the heaviest damage. While these strikes have interrupted and slowed traffic, repair efforts and countermeasures have been effective in maintaining traffic.

Since June 1967 the air campaign against highways has been intensified and expanded to include highway bridges in previously restricted areas near Haiphong and the Chinese border, but these attacks have not stopped truck operations. In Haiphong the three highway bridges originally

targeted have been destroyed, but at least five highway pontoon bridges and six highway ferries are available and capable of moving about 4,800 trucks each way every 24 hours (see Appendix A). In the northeast buffer zone the highway bridges at Cao Bang, That Khe, and Chien Chang were attacked and destroyed, but bypasses were either available or under construction at these sites.

New road construction beginning north of Haiphong and extending to the China border may reflect North Vietnam's preoccupation with the possible closing of Haiphong port. Construction since July 1966 has included improvements to 84 kilometers of road in North Vietnam to the China border north of Dinh Lap. The Chinese, meanwhile, have rebuilt 56 kilometers of road on their side of the border. In July 1967, photography showed that a 5-kilometer gap remained between the road segments. Since there are numerous other border crossing roads in the northeast, this road is probably a contingency measure.

c. Waterways

Attacks against the waterway system in North Vietnam have not appreciably affected inland or coastal water transportation. Important transshipment areas such as Quang Khe, Dong Hoi, Vinh, and Thanh Hoa have been attacked several times, causing supplies to be off-loaded "over the beach" in many instances. An accidental attack in May 1967 rendered inoperative a canal lock on the Song Ca at Ben Thuy. However, the waterway system is flexible and continues to play an important role in moving supplies.

A mining program was begun in February 1967 to disrupt watercraft operations in five selected waterways south of 20 degrees north latitude and was extended in June to include all lines of communication in the country. Despite the use of a more sophisticated magnetic weapon (MK-36) which the North Vietnamese are not believed to be able to disarm, there is no evidence that mining has significantly disrupted inland waterway traffic.*

* *For a discussion of the MK-36 mining program, see Appendix B.*

d. Railroad Yards and Shops

Railroad yards and shops in 1967 have come under sharply increased bombing attacks that have disrupted activity and temporarily halted through rail service. During 1967 the heaviest strikes were concentrated on the Hanoi - Dong Dang line, especially at Vu Chua and Kep, and on the Hanoi-Vinh line. The estimated total cost of repairs to damaged rail yards for 1965 through September 1967 is $6.1 million (see Table 2). Photography reveals that most yards have had at least one serviceable track available most of the time and that near-normal operations have been maintained.

There are 27 major railroad yards* and related facilities in North Vietnam; four of these yards have railroad repair facilities (Hanoi, Gia Lam, Haiphong, and Thai Nguyen). Twenty-three targeted major yards have been attacked; yards at Hanoi, Haiphong, Dong Dang, and Lao Cai have not yet been authorized for attack. In addition to major yards, at least 30 secondary yards and numerous railroad sidings serve as small yards.

Air attacks on railroad yards and shops have increased dramatically since 1965. In 1967 the 23 major yards suffered 532 separate attacks, compared with 16 attacks in 1965 and 100 in 1966. Only six of the major yards, all on the Hanoi - Lao Cai and Hanoi-Vinh lines, were attacked in 1965. During 1966, 15 major yards, including three on the Hanoi - Dong Dang line and five on the Hanoi-Vinh line, were struck.

e. Maritime Ports and Shipyards

Four of the six targeted ports in North Vietnam have been hit by air attacks since 1965. Ham Rong, a minor facility, and Ben Thuy, having 4 percent of national capacity, were struck first in 1965. Restrikes on Ben Thuy in 1966 and 1967 have caused extensive damage to nearly all

** A major railroad yard is defined as one having four or more sidings and one passing track.*

storage space, and ships cannot be berthed because of sunken vessels. It is estimated that 85 percent of the cargo-handling capacity at Ben Thuy has been destroyed.

In 1966, coal-treatment facilities at the port of Cam Pha were struck, reducing coal-processing capacity an estimated 20 percent. Cam Pha was restruck in September 1967, and the loading area and the coal-treatment facilities were damaged. Although the port remains operational, damage to the port, coal-treatment facilities, and related power and transportation facilities has had the overall effect of decreasing coal exports to 1,100 tons in September and 6,500 tons in October 1967, compared with average monthly shipments for the first eight months of 1967 of 33,600 tons. The port facilities at Hon Gai, another coal-shipping port, were attacked for the first time in April and May 1967. The overall damage does not appear to have seriously affected the operational capability of the port, because coal shipments continue at previous levels.

Recent developments in and around the port of Hon Gai may presage the use of the port as a supplement for the more congested Haiphong port or as an alternate to Haiphong in case of attack or mining. Ships were seen in October proceeding to Hon Gai apparently to unload, after waiting two or three days at the outer anchorages of Haiphong. Photographs of Hon Gai port in late October showed one ship unloading at the wharf and three others grouped nearby in the anchorage. What may be the possible construction of a new rail route between Hon Gai and Kep has appeared in recent photographs. Such a rail line would significantly enhance North Vietnam's logistics capability by permitting the increased use of Hon Gai port.

In October 1967, three minor shipyards in Haiphong -- Haiphong Shipyard West, Thuong Ly, and Lach Tray -- were attacked. A fourth, Haiphong Shipyard No. 2, had been damaged in September as a result of strikes against the adjacent Haiphong Railroad/Highway Bridge. The cost of restoring these facilities is estimated at $900,000, of which nearly $400,000 resulted from damage in September. Because these yards perform only minor

repair functions, the damage inflicted does not significantly reduce North Vietnam's overall capacity to fabricate and repair barges, lighters, tugs, or coastal vessels. Of the ten shipyards in the port of Haiphong, the two most significant are Haiphong Shipyard No. 4 and the adjacent Naval Shipyard, neither of which has yet been struck. The total estimated cost through September of restoring the damaged ports and shipyards is $2.1 million (see Table 3).

f. Transport Equipment

Damage inflicted on transport equipment by airstrikes has increased significantly in 1967, compared with 1965 and 1966. Reported damage and destruction of watercraft reached record highs in May 1967, and losses of trucks in August 1967 exceeded the previous record high of August 1966. Damage and destruction of equipment is shown on Table 4.* The total cost to the North Vietnamese of replacing and repairing transport equipment from 1965 through September 1967 is estimated at $68.9 million. The cost of damage inflicted during January-September 1967 is $33.2 million, an increase of $8.7 million over the same period in 1966. An all-time high in monthly cost of damage to transport equipment was reached in June of this year.

Despite increasing damage to transport equipment, the system has not experienced any serious equipment problems. Truck imports have been sufficient to maintain the truck inventory at pre-bombing levels. In addition to trucks actually imported, trucks for use in North Vietnam are stored at P'ing-hsiang, China, and are available to replace losses and to meet fluctuating traffic needs. Known imports of railroad rolling stock have not equalled the reported** damage inflicted

** Data are based on pilot reports and have been adjusted downward to eliminate duplication whenever possible.*

*** Reported losses of railroad rolling stock have included many small makeshift cars used on the rail lines south of Hanoi which are not included in the inventory estimate of mainline freight cars.*

by bombing, but no problems resulting from shortages of rail equipment have been identified. Counts made from photography show more rolling stock than was estimated to be available in 1964. Moreover, Chinese railroad equipment can be made available in sufficient quantity to compensate for any shortages in the North Vietnamese inventory. More than 20,000 watercraft have been destroyed or damaged in North Vietnam since the bombing began, but again there are no apparent shortages.

g. Bridges

From June through September 1967, 112 strikes were carried out against 36 JCS-targeted bridges, compared with 125 attacks against 29 bridges from January through May 1967. Table 5 summarizes strikes against JCS-targeted bridges since the beginning of the Rolling Thunder program.

The total number of bridges and bypass bridges confirmed by available photography to have been damaged or destroyed by the Rolling Thunder program now stands at 461, including 329 highway, 91 railroad, and 41 combination railroad/highway structures.

The estimated cumulative cost of completely restoring the confirmed damaged or destroyed bridges to their original condition through September 1967 would be $24.7 million -- an increase of 30 percent since the end of 1966 and nearly two and one-half times that estimated for 1965.* At least $5.6 million have been spent already on temporary repairs to bridges through September 1967, of which an estimated $2.3 million were spent during the first nine months of 1967. Estimated cost of temporary repairs to the number of unrepaired bridges at the end of September 1967 is $1.6 million.

A survey of the 461 bridges showed that 420 bridges have had one or more "serious

* *The estimated cumulative costs for restoring bridges to their original condition as of the end of 1965 and 1966 were $10.1 million and $19.0 million, respectively.*

damage occurrences" (SDO's).* There have been a total of 709 SDO's since the beginning of the bombings in February 1965 through September 1967 (see Table 6). The number of SDO's by year and the average number of times each of the 420 bridges were interdicted are as follows:

Year	SDO's	Number of Bridges with SDO's	Average Number of Interdictions per Damaged Bridge
1965	218	177	1.23
1966	334	185	1.81
Jan-Sep 1967	157	58	2.71

While a specific bridge may be interdicted an increasing number of times, in most cases the crossing is bypassed in a variety of ways. Of the 230 bypass bridges observed in aerial photography, 62 have sustained 98 SDO's.

The North Vietnamese have effectively countered the bomb damage to JCS-targeted bridges by concentrating their effort on building a variety of bypasses in the vicinity of each target. Their program has been so successful that the average number of bypasses per bridge targeted by JCS has increased during the accelerated bombing program in 1967. The average has increased from almost 2.2 bypasses per bridge through May 1967 to more than 2.9 through September 1967, as shown in the following tabulation:

** A "serious damage occurrence" consists of initial hits and re-hits and is defined as damage sufficiently severe that a crossing is denied to users until a significant amount of repair has been performed -- requiring considerable time, materials, and labor. For example, serious damage would include a dropped span(s), a destroyed pier(s), or a destroyed abutment(s). Holes in a deck, cratered approaches, twisted superstructure, or a slight shifting of spans is not considered serious damage.*

Type of Bypass	Through May 1967	Through September 1967
Total number of damaged JCS-targeted bridges (confirmed by photography)	46	54
Total number of bypasses	*99*	*157*
Fords (including causeways and culverts)	18	26
Alternate bridges	26	36
Cable bridges	9	14
Ferries and pontoon bridges	46	81
Average bypasses per bridge	*2.2*	*2.9*

3. Other Economic Target Systems

a. Electric Power

Concerted airstrikes during February-June 1967 inflicted severe damage on the Hanoi-Haiphong main power network, and restrikes since June have effectively nullified repair efforts. An estimated 150,000 kilowatts (kw) of generating capacity, or about 80 percent of the national total, currently is out of operation. The total cost of damage inflicted on power facilities is estimated at $30.2 million.

The main power network centered on Hanoi and Haiphong received the brunt of air attacks against electric power facilities in 1967 (see Table 7). Of the 72 strikes on power facilities during the first nine months of 1967, 60 were directed against targets in the Hanoi-Haiphong network and 45 of these were carried out in the first half of the year. Damage to the nine powerplants and one key substation that make up the main network has reduced serviceable

capacity from 148,000 kw to between 10,000 and 15,000 kw, or roughly 7 to 10 percent of pre-strike capacity. At present, all but two of the facilities are known to be out of service. The Hanoi powerplant is limited to partial operation at 30 to 50 percent of its installed capacity, probably for the remainder of the year. Results are not yet known of a restrike against the Nam Dinh plant, which apparently had been put back into partial operation during September. Repairs in progress at the Viet Tri powerplant may soon permit partial operation.

Loss of the central generating plants has eliminated the source of supplementary power formerly received by Hanoi and Haiphong from the main power network. Hanoi is dependent on partially serviceable local power and on a number of diesel-generating stations. Haiphong is without a central power supply and must rely completely on diesel stations. The two cities apparently have a system of power rationing and experience intermittent power outages but essential services are being provided. With the use of diesel-generating equipment, minimal power supplies for high-priority consumers can be continued indefinitely, and important urban areas can be expected to maintain a limited power supply.

A possible decision to fragment the central power network and to forego extensive reconstruction of powerplants is suggested by the removal of transformers from a number of network substations and the lack of repair activity at many heavily damaged plants. There has been no evidence of attempts to repair powerplants at Haiphong, Bac Giang, Thanh Hoa, and the Dong Anh substation since May or June 1967, nor at Co Dinh since November 1966. The general severity of damage to these powerplants will deny even partial operation of power facilities for periods ranging from three months to one year after repair work is resumed. Complete restoration in most cases, if attempted, will require well over one year.

b. Petroleum Storage Facilities

By the end of September 1967, about 86 percent of the 128,000 tons of petroleum storage

capacity that had existed at the beginning of 1965 had been destroyed (see Table 8). No repairs have been undertaken. Seven JCS-targeted storage facilities with residual capacity of about 16,000 tons remained operational.

During the first nine months of 1967, 13 airstrikes against JCS-targeted petroleum storage facilities inflicted identified damage only on Do Son, where residual capacity of about 1 percent of North Vietnam's original capacity was destroyed. Damage to the Haiphong terminal as a result of attacks in 1967 was restricted to rail facilities and buildings in the terminal. No damage to tankage was observed.

The value of tankage, contents, and related facilities destroyed since 1965 at JCS-targeted sites is estimated at about $6.7 million to $7.4 million. In addition, an estimated 5,000 tons of storage capacity -- including contents -- at dispersed tank sites was destroyed during 1966 and 1967 with a value of about $0.5 million. Although the stockpile of 55-gallon drums also has been attacked since 1965, no adequate assessment of the damage inflicted can be made. Thus the measurable damage to all petroleum facilities and contents through September 1967 is estimated at about $7.2 million to $7.9 million.

Although the cost and difficulty of importing and distributing petroleum have been increased, the bombing has not effectively reduced North Vietnam's capability to maintain petroleum supplies primarily because of the development of dispersed bulk oil storage capacity before extensive attacks against JCS-targeted facilities began. By the end of September 1967, there were more than 100 dispersed petroleum storage tank sites in North Vietnam with a total estimated capacity of between 30,000 and 40,000 tons. The accumulation of 55-gallon drums has given increased flexibility in petroleum storage and distribution. The storage capacity represented by the drum inventory at the end of September 1967 probably was about 40,000 tons. In addition, there is an indeterminate

amount of "floating storage capacity" represented by oil barges, rail tank cars, tank trucks, and a small tanker now in use in North Vietnamese waters.

c. Manufacturing Facilities

North Vietnam's small modern manufacturing sector has been severely damaged by airstrikes, particularly during 1967. Most of the larger industrial plants have been virtually paralyzed by a combination of direct bomb damage and a shortage of electric power. Production has been halted at the Thai Nguyen Iron and Steel Complex, the Haiphong Cement Plant, the Lang Chi Explosives Plant, the Nam Dinh Textile Mill, and several newer chemicals plants. No attempts have been made to repair damage at the plants.

Bomb damage, in terms of costs of repair, to North Vietnamese manufacturing facilities from January through September 1967 is estimated to be $17.8 million. More than 90 percent of the total damage occurred during 1967, as shown in the following tabulation:

	Million US $			
	1965	1966	Jan-Sep 1967	Total a/
Thai Nguyen Iron and Steel Complex			10.0	10.0
Haiphong Cement Plant			3.0	3.0
Nam Dinh Textile Mill	0.8	0.2	1.3	2.4
Cam Pha Coal Treatment Plant		0.1	Negl.	0.1
Viet Tri Paper Mill		0.1	0.7	0.8
Lang Chi Explosives Plant	0.4		Negl.	0.4
Bac Giang Chemical Fertilizer Plant			0.4	0.4
Hon Gai Calcium Carbide Plant			0.2	0.2
Phu Tho Phosphate Fertilizer Plant			0.2	0.2
Haiphong Enamelware Plant			0.4	0.4
Total a/	*1.2*	*0.4*	*16.3*	*17.8*

a. Because of rounding, components may not add to the totals shown.

Damage to the steel and cement plants, inflicted in the first half of 1967, accounted for 56 percent and 17 percent, respectively, of the total cost of damage. No important strikes against manufacturing facilities were made in the third quarter of 1967. Table 9 shows details on manufacturing facilities attacked through September 1967.

The Thai Nguyen Iron and Steel Complex halted production as a result of damage to the coke plant, blast furnaces, steam plant, and open hearth building and rolling mill during March- May 1967. The Haiphong Cement Plant has been inactive since the strikes of April 1967. The plant had previously accounted for 95 percent of North Vietnamese cement production. Loss of cement production that had been more than adequate for domestic requirements has forced North Vietnam to import cement, mainly from Communist China.

Production at North Vietnam's major chemicals and explosives plants has been seriously disrupted. The Bac Giang Chemical Fertilizer Plant is not operational because of a loss of power, and some essential equipment may have received direct bomb damage. The Viet Tri Chemical Plant probably has cut back or suspended operations because of damage to the Viet Tri Powerplant in March 1967. The Phu Tho Phosphate Fertilizer Plant probably was inactive for most of the spring and summer of 1967 because of a power shortage. Although the plant received slight damage in recent airstrikes, photography indicates some continuing production activity. The Lang Chi Explosives Plant, inactive from bomb damage since August 1965, has been literally destroyed, having been hit in at least 12 separate airstrikes since June 1967. A minor chemical plant -- the Hon Gai Calcium Carbide Plant -- also has been heavily damaged by bombing. Output of fertilizer at the Haiphong Fertilizer Plant has been disrupted because equipment was dismantled and moved, apparently in anticipation of attacks on nearby important bridges. Processing of coal for export at Cam Pha and Hon Gai has been disrupted to an extent that coal exports were sharply reduced in 1967.

Three of North Vietnam's most important light industrial plants have been damaged extensively by bombing. The Nam Dinh Textile Mill sustained severe structural damage during several airstrikes against an adjacent powerplant. There

has been little damage to equipment, however, because much of the machinery was evacuated after the first accidental strike in June 1965. A recent decline in cloth rations may reflect the reduced output resulting from the dispersal of equipment. The Viet Tri Paper Mill and the Haiphong Enamelware Factory have also suffered damage during strikes at nearby facilities.

The small machine building industry has remained untouched by US airstrikes, except for possible damage to small shops located near targets. The capacity for machine building and metal processing has been enlarged since the beginning of the air war through imports of machinery and equipment now being installed in small shops throughout the country. Machine building shops are now engaged primarily in maintaining transport equipment and producing and maintaining the limited amount of equipment going to the agricultural sector. The main problem faced by machine building as a result of the air war has been the exacerbation of an already drastic shortage of technical cadre and the need to rely increasingly on the use of female workers.

Local industry is playing a more important role in the economy during 1967 because of the damage to modern industry. Small facilities contribute locally to the military effort mainly as repair facilities and as sources of a variety of consumer goods. Handicrafts and processed foods, primarily from local industry, have made up about half the value of exports in the past and in 1967 probably will account for most of the reduced value of exports. The regime has responded to stepped-up air attacks on industry during 1967 by increasing the pace of the dispersal of industry. Manufacturing operations that can be separated are being installed in separate locations. Problems in coordinating supplies and providing transportation have reduced the efficiency of the dispersed factories.

4. Indirect Effects

The Rolling Thunder program has also resulted in significant losses to the North Vietnamese economy that are indirectly related to the

bombing. These losses result from disruptions of normal economic activity, decreases in production, and a decline in foreign exchange earnings because of reduced exports. Losses that can be quantified -- decreases in the rice crop and the fish catch and the loss of exports -- are estimated at nearly $78.5 million through September 1967, or about one-third of total economic damage. Unquantifiable losses resulting from management problems and production inefficiencies, the costs of dispersing industry, production losses due to power shortages, reallocations of manpower, and civil defense measures including urban evacuation undoubtedly total in the tens of millions of dollars.

a. Agriculture and Fishing

Agriculture and fishing have been affected by bombing attacks even though they have never been targeted. Production has been adversely affected by the disruption of normal farming and fishing routines, manpower diversions to war-related tasks, and, in the case of agriculture, interruptions in the manufacture and distribution of fertilizer. A substantial but unknown portion of agricultural losses, however, may be due to adverse weather conditions rather than to bombing attacks. The cumulative loss of rice production (which includes the effects of adverse weather) and of the fish catch from early 1965 through September 1967 is estimated to be about $49 million as tabulated below:

	Million US $			
	1965	1966	Jan-Sep 1967	Total
Rice production	3.5	22.0	14.0	39.5
Fishing	1.7	3.3	4.5	9.5
Total	*5.2*	*25.3*	*18.5*	*49.0*

North Vietnamese claims that US aircraft have attacked dikes that control water levels in the Red River delta have been shown to be false. Aerial photography of dikes claimed by the North Vietnamese to have been attacked in June-August 1967 revealed only minor damage in most cases. All but three of the 24 dikes listed by the North Vietnamese were located and covered by photography. No damage could be found at nine of the located dikes. Only four may have been partly cut, and there was no evidence of significant flooding. In almost all cases where dikes showed some evidence of damage, military-associated targets were located nearby.

b. Export Losses

The cumulative measurable value of the reduction in seaborne exports attributable to the bombing from 1965 through September 1967 was about $29.5 million. Losses of seaborne exports in the first three quarters of 1967 were up nearly 60 percent from the comparable period in 1966. The significant increase in the loss of exports in 1967 reflects the stepped-up attacks on industrial facilities during the first half of the year. Export losses by quarter since 1965 are shown in the tabulation on the following page in million US dollars at f.o.b. prices.

B. Military Damage

The cost of damage to military targets systems through September 1967 is estimated at nearly $111 million, slightly less than one-third of the total cumulative damage from the Rolling Thunder program. Losses of aircraft and damage to barracks complexes comprised about 57 percent of the total military damage. The cost during the first nine months of 1967 was nearly three times that for all of 1966, primarily because of the high level of damage to aircraft and barracks in the second quarter. In addition, a high level of aircraft destruction in October added $8.8 million to the cost as well as reducing the effectiveness of jet fighters for air defense.

Damage inflicted on military targets, however, has had little significant impact on

	Apatite	Pig Iron a/	Cement	Coal	Total
1965 b/	3.3	0	0.9	0	4.2
2nd quarter	0.7	0	0.2	0	0.9
3rd quarter	1.0	0	0.3	0	1.4
4th quarter	1.6	0	0.4	0	1.9
1966 b/	6.1	0	0.7	4.7	11.6
1st quarter	1.6	0	0.2	0	1.8
2nd quarter	1.6	0	Negl.	1.5	3.1
3rd quarter	1.5	0	0.2	2.2	3.9
4th quarter	1.6	0	0.2	1.1	2.9
1967 b/	4.7	0.8	1.2	7.1	13.7
1st quarter	1.6	0	0.2	1.3	3.0
2nd quarter	1.6	0.2	0.5	2.7	4.9
3rd quarter	1.6	0.5	0.5	3.2	5.8
Total	*14.0*	*0.8*	*2.8*	*11.9*	*29.5*

a. Fluctuations in pig iron exports, due principally to changes in demand, were not measured until after US bombing of the Thai Nguyen metallurgical plant.
b. Because of rounding, components may not add to the totals shown.

North Vietnam's military capabilities. Jet fighters have never been a primary means of defense, and the loss of barracks capacity probably is less inconvenient now than it was at the end of 1965. Although the radar order of battle decreased in the third quarter of 1967, there is no evidence of a significant deterioration of North Vietnam's air alert capability. Attacks on SAM sites apparently have not reduced either the total number of active SAM battalions or the available firing sites, including the SAM threat in the southern part of the Panhandle. Furthermore, North Vietnam's Communist allies have more than offset the damage; the value of military aid rose from an estimated $270 million in 1965 to $455 million in 1966 and may exceed $650 million in 1967.

1. Barracks

The number of airstrikes against JCS-targeted barracks during the first nine months of 1967 was about three times that flown during all of 1966. The restoration cost of the damage inflicted by airstrikes in 1967 is estimated at more than $11.4 million compared with $2.5 million in 1966 and $16.0 million in 1965 (see Table 10). Most of the damage inflicted in 1967 resulted from strikes against 11 JCS-targeted barracks which had not previously been attacked. Of the total cost estimated for the period, nearly 85 percent resulted from strikes during the second quarter and about 12 percent during the third quarter.

The bombing attacks against JCS-targeted barracks alone resulted in a loss of capacity, either destroyed or inactive, for about 119,000 men -- nearly 27 percent of the pre-strike national capacity. The total loss of barracks capacity undoubtedly is causing much inconvenience, especially in the outlying areas of the country. Damage to barracks in these areas has not been repaired, and troops apparently are being quartered in makeshift shelters or in nearby villages. However, the North Vietnamese have had time to adjust to the loss of barracks in most areas, and the military housing problem probably causes less inconvenience now than at the end of 1965, when about two-thirds of the present cumulative losses had been inflicted.

2. Airfields

A series of airstrikes at Hoa Lac, Kien An, and Kep commencing in April 1967 increased the cumulative cost of damage through September 1967 to an estimated $1.2 million (see Table 11). About 26 percent of the national capacity of JCS-targeted airfields remained destroyed or inactive through September 1967 -- an increase of about 7 percentage points since March.

Despite the bombings, including initial strikes at Phuc Yen and Cat Bi in October, no important change in the general capability of

North Vietnam's major airfields has occurred since 1965. Photography taken in late October 1967 showed that, except for Cat Bi, all airfields struck in 1967 had been restored to the extent that at least limited fighter aircraft operations could be supported. At Phuc Yen the runway was probably repaired sufficiently to allow at least limited MIG operations within three days of being struck. The basic airfield and control apparatus have been gradually expanded to counter the Rolling Thunder program. Six airfields -- Hanoi/Gia Lam, Phuc Yen, Kep, Hoa Loc, Haiphong/Cat Bi, and Haiphong/Kien An -- are capable of supporting MIG operations, and an additional airfield under construction at Bai Thuong will be able to accommodate jet aircraft when it is completed.

3. SAM Sites

From July 1965 through September 1967, approximately 1,200 airstrikes were directed against SAM facilities in North Vietnam. Assessment of the effects of these airstrikes has been severely limited by a lack of post-strike photography. The strikes have caused frequent redeployment of equipment, which probably has reduced the efficiency of firing units and complicated logistics. The minimum value of firm damage to sites and support facilities is shown in the following tabulation:

Thousand US $

			1967			
SAM Facilities	1965	1966	Jan-Mar	Apr-Jun	Jul-Sep	Total a/
Firing sites	480	2,100	0	1,250	1,450	5,300
Support facilities	1,600	170	300	0	0	2,100
Total a/	*2,100*	*2,300*	*300*	*1,250*	*1,450*	*7,400*

a. Because of rounding, components may not add to the totals shown.

Attacks on SAM sites apparently have not reduced either the total number of active SAM battalions or the available firing sites. There are now about 30 to 35 active battalions, a slight increase from May 1967. Available to these battalions are about 226 prepared or pre-surveyed sites, a possible increase of about 50 sites over the number available in May.

4. Naval Bases

Air attacks against Port Wallut in August 1967 accounted for the only major strike at a naval facility since 1965. By the end of September 1967, about 30 percent of North Vietnam's naval base support facilities were destroyed or inactive, compared with about 15 percent at the end of 1965 and almost 20 percent at the end of 1966. The cumulative value of damage inflicted on naval bases is estimated at about $1.9 million (see Table 12). It is doubtful that the damage to the naval bases has seriously affected the operations of the small North Vietnamese navy because restorations can be effected quickly with indigenous materials.

5. Radar*

No strikes were scheduled against targeted radar sites from 1 June 1967 to mid-October 1967, yet the number of operational early warning and ground control intercept radars and radar sites dropped from 180 radars at 86 sites to 155 radars at 71 sites. The decline in the number of operating radars occurred primarily at the five JCS-targeted sites strategically located along the coast and may represent losses or damage resulting from miscellaneous armed reconnaissance attacks. It is also possible that some radars have been moved but not yet reactivated. The value of damage to radar from armed reconnaissance sorties is included in the appropriate section below. The cumulative cost to JCS-targeted radar sites is estimated at $2.6 million.

* *Excluding radar associated with SAM sites.*

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6. Communications

North Vietnam's telecommunications system has escaped major physical damage and continues to satisfy essential requirements of Party, military, and government subscribers. 25X1

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Confirmed physical damage to North Vietnam's telecommunications system thus far has been confined to the destruction or damage of six of 20 or so fixed radio centers, two of 50 telephone exchanges, and to segments of the nationwide open wireline network. Cumulative monetary damage to North Vietnamese telecommunications is estimated at approximately $240,000.

7. Supply and Ordnance Depots

Fourteen of the 29 JCS-targeted supply and ordnance depots were struck during January-September 1967, six for the first time. The most significant strikes were against Thai Nguyen in the first quarter, Ha Dong in the second quarter, and Van Dien in the second and third quarters. In addition, a number of important non-targeted supply areas and motor vehicle depots were attacked, the most significant of which were the Haiphong Warehouse Area West and the Kinh No Motor Vehicle Depot. All but three of the JCS-targeted supply and ordnance depots had been attacked by the end of September 1967, and one of these was inactive. The Hanoi Army Supply Depot South at Quinh Loi and the Hanoi Army Supply Depot North at Tay Ho -- representing 10 percent of the total national capacity -- were the only active unstruck depots.

The total cost of damage to facilities at both targeted and non-targeted supply centers during 1967 is estimated at about $5.8 million, compared with about $1.0 million in 1966 and $3.0 million in 1965. One-half of the targeted supply and ordnance depots were inactive. However, most of the larger depots had more than 50 percent of

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their capacity remaining and continued to be active, and the loss in capacity of JCS-targeted depots destroyed or inactive was only about 19 percent of the total national capacity. Although the total storage capacity lost has been small, valuable supplies and equipment have been destroyed, and the increased requirement to operate from a dispersed logistics base has complicated management problems and reduced operational efficiency.

Increased dependence on a dispersed logistics base is exemplified by the heavy concentrations of storage capacity noted at Dong Dang in the northeast, near Lao Cai and Lai Chau in the northwest, and north of Haiphong along the Tonkin Gulf. Significant improvements and expansion of storage capacity have been concentrated on the road and rail line from P'ing-hsiang, China, through Dong Dang to Kep. Excluding the sites at Dong Dang, there is an average of one storage site every 10 kilometers along the 93-kilometer stretch between Kep and the China border. Expansion at some sites has continued through the summer of 1967 (see the frontispiece).

8. Ammunition Depots

Ten ammunition depots were attacked during January-September 1967, five of which were struck for the first time. The most significant strikes were against Cam Ly and Hon Gai in the first quarter and against Haiphong/Kien An in the second quarter. Damage inflicted during the third quarter was relatively light. The total cost of restoration of facilities damaged during the first three quarters of 1967 is estimated at nearly $600,000, compared with about $200,000 in 1966 and $4.5 million in 1965.

All 18 JCS-targeted ammunition storage depots, with a total capacity of about 113,000 tons, had been attacked by the end of April 1967. Eleven were inactive by the end of September, with a loss of 77 percent of total capacity. This loss probably has resulted in temporary delays in the distribution of ammunition, but there is no evidence of prolonged shortages in the areas where

the depots are located. Most of the ammunition apparently was being stored in dispersed storage areas by the end of 1965, and airstrikes since that time probably have not significantly affected the overall storage of ammunition in the country.

9. Naval Craft

By the end of September 1967, destruction had been confirmed of 12 North Vietnamese naval craft* -- four *Swatow*-class gunboats in 1965; three PT boats and one SO-1 subchaser in 1966; and one *Shanghai*-class patrol boat and three PT boats in 1967. The total cost of these losses is estimated at $4.8 million. The small North Vietnamese navy currently is estimated to include 14 to 15 *Swatow*-class gunboats, three *Shanghai*-class patrol boats, 11 to 12 PT boats, two SO-1 subchasers, and four unidentified naval craft.

10. Aircraft

The North Vietnamese probably lost 24 MIG-21's and 70 MIG-17's through September 1967 from attacks by US aircraft.** The cost of all aircraft losses is estimated at $33.2 million. Only $2.6 million is attributed to losses during July-September 1967, representing a sharp decrease from record high losses of $14.0 million recorded in the preceding quarter. A high level of both air and ground losses during October 1967 probably accounted for an additional four MIG-21's, five MIG-17's, and five helicopters (two MI-6's and three MI-4's), equivalent to $8.8 million.***

Although MIG losses have been heavy, the North Vietnamese air force has taken an aggressive role in air defense when key targets have been attacked. The MIG inventory on 30 September 1967

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* *Excluding the 8 to 10 naval craft destroyed by the Pierce Arrow attacks in August 1964 following the Gulf of Tonkin incident.*

** *Including an estimated eight aircraft destroyed on the ground during rails on Kep and Hoa Lac during May 1967.*

*** *Including an estimated two MIG-21's destroyed on the ground at Phuc Yen and five helicopters destroyed on the ground near Haiphong.*

included 22 MIG-21's and 67 MIG-15/17's, of which 13 MIG-21's and 50 MIG-15/17's were being held in reserve in China. North Vietnam presumably could obtain additional MIG-17's and MIG-21's from China and the USSR, respectively.

C. Miscellaneous Targets of Armed Reconnaissance

A variety of miscellaneous targets -- principally LOC's associated and military facilities -- that are destroyed or damaged during armed reconnaissance missions do not fit into major target categories. Because of the nature of armed reconnaissance operations, it is difficult to evaluate the damage caused to such miscellaneous targets. Pilots tend to double count, to overestimate the effectiveness of the attack, and to describe targets imprecisely. The cost of damage, therefore, is an assumed level of damage to a typical target in each category. Within these limitations, the total cost of replacement or restoration of the miscellaneous targets destroyed or damaged by armed reconnaissance strikes is estimated at about $16.6 million, as shown in the following tabulation:

	Million US $					
			1967			
	1965	1966	Jan-Mar	Apr-Jun	Jul-Sep	Total
Economic facilities and equipment	Negl.	1.2	0.1	0.4	0.4	2.1
Military facilities and equipment	0.7	3.1	1.8	3.2	5.7	14.5
Total	*0.7*	*4.3*	*1.9*	*3.6*	*6.1*	*16.6*

A substantial portion of the increase in the level of damage and destruction to military facilities during July-September 1967 appears to be a result of increased airstrikes on non-targeted radar installations and on dispersed storage and supply areas.

Table 2

Major Railroad Yards and Shops Attacked Under the Rolling Thunder Program
1965, 1966, and January-September 1967

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Area of Yards	Number of Yards Attacked			Number of Attacks			Cost of Restoration (Thousand US $)			
	1965	1966	Jan-Sep 1967	1965	1966	Jan-Sep 1967	1965	1966	Jan-Sep 1967	Total
Hanoi area		2	2		4	28		820	3,100	3,920
Hanoi - Dong Dang		3	7		12	199		Negl.	365	365
Hanoi - Haiphong			2			13			35	35
Hanoi - Thai Nguyen - Kep		1	2		6	52		400	770	1,170
Hanoi - Lao Cai	3	4	5	5	11	78	70	N.A.	500	500
Hanoi - Vinh	3	5	5	11	67	162		N.A.	N.A.	70
Total	6	15	23	16	100	532	70	1,220	4,770	6,060

Table 3

Maritime Ports and Shipyards Attacked Under the Rolling Thunder Program
/ 1965, 1966, and January-September 1967

JCS Target Number	Name	Percent of Total Maritime Cargo-Handling Capacity	Dates of Attack	Percent of Target Capacity Destroyed	Percent of Total Capacity Destroyed	Cost of Restoration (Thousand US $)
1965						
[redacted]	Ben Thuy	4	5, 6, 8 Jun 9, 10, 11, 17, 19, 21 Jul	61	2.4	470
	Ham Rong	1	14, 16, 18 Jul	15	0.2	190
	Subtotal: 1965					660
1966						
[redacted]	Ben Thuy	4	1 Feb 8 Mar 30, 31 Oct 4, 9 Nov 6 Dec	85	3.4	590
	Cam Pha Port a/	16	24 Apr 8 Nov	21	3.4	160
	Subtotal: 1966					750
Jan-Sep 1967						
[redacted]	Ben Thuy	4	7, 9, 14, 23 Jan	85	3.4	N.A.
	Hon Gai a/	18	24, 25, 26 Apr 24, 25, 26 May	22	3.9	N.A.

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Table 3

Maritime Ports and Shipyards Attacked Under the Rolling Thunder Program
1965, 1966, and January-September 1967
(Continued)

JCS Target Number	Name	Percent of Total Maritime Cargo-Handling Capacity	Dates of Attack	Percent of Target Capacity Destroyed	Percent of Total Capacity Destroyed	Cost of Restoration (Thousand US $)
[redacted]	Cam Pha Port	16	10 Sep	N.A.	N.A.	370
	Haiphong Shipyard No. 2 SACRIC	b/	Sep			367
	Subtotal: Jan-Sep 1967					737
	Total: 1965-Sep 1967					2,147

a. Strikes were not conducted against port facilities but against related areas such as support facilities and coal-treatment facilities which affected port operations and resulted in export losses. The estimated cost at Cam Pha is the cost of damage to support facilities.
b. Shipyard performs minor repairs and contains several fabrication and repair shops.

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Table 4

Destruction and Damage of Transport Equipment
1965, 1966, and January-September 1967

	Locomotives	Railroad Cars	Trucks	Ferries	Barges	Other Watercraft
1965						
Destroyed	6	227	318	53	263	144
Damaged	6	592	487	56	487	210
1966						
Destroyed	10	1,101	1,935	67	2,520	867
Damaged	14	935	1,801	131	4,289	1,372
Jan-Sep 1967						
Destroyed	11	779	2,627	10	3,180	149
Damaged	22	1,268	1,629	10	5,942	298
Total						
Destroyed	27	2,107	4,880	130	5,963	1,160
Damaged	42	2,795	3,917	197	10,718	1,880

Table 5

Strikes Against JCS-Targeted Bridges
1965, 1966, and January-September 1967

	1965		1966 a/		January-May 1967 a/		June-September 1967 a/	
	Strikes	Bridges	Strikes	Bridges	Strikes	Bridges	Strikes	Bridges
Rail and rail/highway	67	14	110	16	57	12	64	16
Highway	77	30	76	23	68	17	48	20
Total	144	44	186	39	125	29	112	36

a. Including bridges struck initially before the time period.

Table 6

Bomb Damage Assessment of Bridges in North Vietnam a/
1965 - September 1967

	Bridges Damaged			Total Serious Damage Occurrences (Including Initial Hits and Re-hits)		
Type of Bridge	Total	Seriously	Moderately	Total	Original Bridge	Bypass Bridge
Total	461	420	41	709	611	98
Highway	329	292	37	447	421	26
Railroad	91	89	2	177	136	41
Combination railroad-highway	41	39	2	85	54	31

a. Damage to bridges confirmed by available photography.

Table 7

Electric Power Facilities Attacked Under the Rolling Thunder Program a/
1965, 1966, and January-September 1967

JCS Target Number	Name	Pre-Strike Target Capacity (Kilowatts)	Percent of Total Capacity b/	Dates of Attack	Cost of Restoration (Million US $) c/
1965					
[redacted]	Thanh Hoa	5,000	3	4 Apr 27, 29, 30, 31 Jul 4 Aug	0.2 0.9
	Ben Thuy	8,000	5	4, 4 Jun	1.0
	Co Dinh	1,500	1	8, 10 Jun	0.4
	Nam Dinh	7,500	4	28, 29 Jun 2, 3 Aug	0.5 1.5
	Ban Thach	1,000	0.5	21, 22, 23 Aug	0.3
	Uong Bi	24,000	14	15, 20, 22, 22 Dec	1.5
	Subtotal: 1965				6.3
1966					
[redacted]	Uong Bi	24,000	13	18, 28 Apr 11, 14, 17 Aug	0.1 4.3
	Thai Nguyen	24,000	13	6-8 Jul	0.8
	Viet Tri	16,000	9	Prior to 19 Jul	
	Ben Thuy	8,000	4	13, 15 Mar 23, 26, 26, 27, 28, 29 Oct	0.2

Table 7

Electric Power Facilities Attacked Under the Rolling Thunder Program a/
1965, 1966, and January-September 1967
(Continued)

JCS Target Number	Name	Pre-Strike Target Capacity (Kilowatts)	Percent of Total Capacity b/	Dates of Attack	Cost of Restoration (Million US $) c/
1966 (Continued)					
[redacted]	Thanh Hoa	5,000	3	22, 23, 23, 23 Sep	0.4
	Trinh Xuyen	N.A.	N.A.	1 Nov	
	Co Dinh	1,500	1	4 Nov	0.4
	Subtotal: 1966				6.2
Jan-Sep 1967					
[redacted]	Hon Gai	15,000	8	24,25 Feb 2, 10 Mar 20, 22 Apr	2.2
	Bac Giang	12,000	6	24, 26 Feb 11, 16, 24 Mar 5 Apr 10, 20, 22 May 16, 19 Jun 1 Aug	0.5 0.1 0.1
	Viet Tri	16,000	9	12,19 Mar	2.8
	Thai Nguyen	24,000	13	19, 23, 24 Mar 28 Jun 6, 7, 13, 22 Jul 2 Aug	1.5 0.1 0.5 0.7
	Haiphong West	10,000	5	20, 25 Apr 10, 20, 26 May	1.1 0.5

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Table 7

Electric Power Facilities Attacked Under the Rolling Thunder Program a/
1965, 1966, and January-September 1967
(Continued)

JCS Target Number	Name	Pre-Strike Target Capacity (Kilowatts)	Percent of Total Capacity b/	Dates of Attack	Cost of Restoration (Million US $) c/
Jan-Sep 1967 (Continued)					
	Haiphong East	7,000	4	20, 21 Apr 10 May	1.0 0.3
	Nam Dinh	7,500	4	22, 26 Jun 22 Aug 9 Sep	0.7
	Ben Thuy	8,000	4	29, 30 Jun 2, 23, 24, 25, 31 Jul 5, 15, 18, 19 Aug	 0.4 0.1
	Dong Anh Substation	N.A.	N.A.	25, 26, 30 Apr 4, 22 May	0.2 0.1
	Hanoi	32,500	17	19, 21 May 10 Jun 21 Aug	0.8 0.6
	Uong Bi	24,000	13	26 May 8, 11, 11 Jun 21, 25 Aug 2, 9, 13, 30 Sep	 2.3 0.4
	Thanh Hoa	5,000	3	12 Jun	0.7
	Subtotal: Jan-Sep 1967				17.7
	Total				30.2

a. Electric generating capacity out of operation in North Vietnam was 28 percent in 1965, 32 percent in 1966, and about 80 percent in September 1967. At present, all power facilities that have been struck are estimated to be out of service except the Hanoi plant, which is operating 30 percent to 50 percent of capacity, and the Nam Dinh plant, the status of which is not known.
b. Based on national installed capacity of 175,000 kw in 1965 and on 187,000 kw in 1966 and 1967.
c. Lack of an entry indicates either no damage or no information available to make estimate.

Table 8

Petroleum Storage Facilities Attacked Under the Rolling Thunder Program
1965, 1966, and January-September 1967

JCS Target Number	Name	Percent of Total Targeted Capacity	Dates of Attack	Percent of Target Capacity Destroyed	Percent of Total Targeted Capacity Destroyed	Cost of Restoration (Thousand US $)	Value of Petroleum Destroyed (Thousand US $)
1965							25X5
[redacted]	Phu Van	Negl.	6 May	100	Negl.	40	20
	Vinh a/	6	24, 26 May	34	2	120	70
			11, 15 Sep	34	2	120	70
			6 Oct	17	1	60	30
	Nam Dinh	9	2, 4 Jul	100	9	500	270
	Phu Qui	6	18 May	100	6	340	0
	Subtotal: 1965				20	1,180	460
1966							25X5
[redacted]	Haiphong	32	29 Jun	46	14	840	300 to 460
			7 Jul	32	10	600	190 to 310
			2 Aug	21	7	380	80 to 150
	Hanoi	24	29 Jun	100	24	1,380	490 to 760
	Vinh a/		30 Jul				
			7, 8 Aug				
			6 Sep				
			8, 11, 13, 27, 28, 29 Oct				
	Nguyen Khe	6	30 Jun	10	2	112	39 to 60
			19 Jul	22			
			17, 18, 22 Aug				
			4 Sep				
			8 Oct				

25X1

25X1

Table 8

Petroleum Storage Facilities Attacked Under the Rolling Thunder Program
1965, 1966, and January-September 1967
(Continued)

JCS Target Number	Name	Percent of Total Targeted Capacity	Dates of Attack	Percent of Target Capacity Destroyed	Percent of Total Targeted Capacity Destroyed	Cost of Restoration (Thousand US $)	Value of Petroleum Destroyed (Thousand US $)
1966 (Continued)							
[redacted]	Bac Giang	2	30 Jun 31 Jul 11 Aug 14 Sep	31	0.6	32	11 to 17
	Do Son	2	29 Jun 3 Jul 5, 8, 10, 14, 15, 17, 22 Aug 12, 22 Oct 1 Nov	50	1	64	16 to 35
	Viet Tri	1	30 Jun 19 Jul 14 Aug 5 Sep	97	1	0 2 0 0	0 1 to 2 0 0
	Duong Nham	3	1, 12, 23 Jul 17, 22 Aug 12 Sep	100	3	185	16 to 25 24 to 50
	Ha Gia	8	22 Nov 2, 3, 4, 5, 19, 30 Dec	22	2	99	0
	Can Thon	1	23 Nov 2 Dec 3 Dec	33	0.4	37	20

25X1 25X1 25X5

Table 8

Petroleum Storage Facilities Attacked Under the Rolling Thunder Program
1965, 1966, and January-September 1967
(Continued)

JCS Target Number	Name	Percent of Total Target Capacity	Dates of Attack	Percent of Target Capacity Destroyed	Percent of Total Targeted Capacity Destroyed	Cost of Restoration (Thousand US $)	Value of Petroleum Destroyed (Thousand US $)
1966 (Continued)							
[redacted]	Phu Qui b/		8 Aug 11 Oct				
	Subtotal: 1966				65	3,731	1,187 to 1,889
Jan-Mar 1967							
[redacted]	Vinh a/		7 Feb				
	Ha Gia c/		15 Feb				
	Do Son d/		5 Mar	50	1	64	35
	Subtotal: First Quarter of 1967				1	64	35
Apr-Jun 1967							
[redacted]	Vinh a/		13, 14, 15, 16 Apr				
	Haiphong e/		26 Apr, 2 May				
	Phu Qui b/		20 May, 12 Jun				
	Subtotal: Second Quarter of 1967				0	0	0
Jul-Sep 1967							
[redacted]	Nam Dinh b/		22 Aug, 9 Sep				
	Subtotal: Third Quarter of 1967				0	0	0
	Total: 1965, 1966 and First 9 months of 1967				86	4,975	1,682 to 2,384

25X1 25X1 25X5 25X5 25X5 25X5

Table 8

Petroleum Storage Facilities Attacked Under the Rolling Thunder Program
1965, 1966, and January-September 1967
(Continued)

25X1

25X1

a. The facility at Vinh was attacked in August 1964, prior to the Rolling Thunder program. Vinh was attacked ten times in 1966 and five times in 1967, but no destruction of storage capacity has been identified since 1965.
b. This facility was 100 percent destroyed in 1965 and apparently has been abandoned.
c. Ha Gia had been attacked in 1966; available photography indicates that the destroyed tankage did not contain petroleum at the time of the 1966 attack.
d. Do Son had been attacked in 1966; the facility is now 100 percent destroyed.
e. The facility at Haiphong had not been attacked since 2 August 1966. Photography of early 1967 revealed that storage tanks previously considered to be serviceable were being dismantled. For purposes of this table, the dismantled tanks and their contents are considered to have been destroyed in the attack of 2 August 1966. No damage to storage was observed after the attacks in 1966.

Table 9

Manufacturing Facilities Attacked Under the Rolling Thunder Program
1965, 1966, and January-September 1967

JCS Target Number	Name	Percent of Total Capacity	Dates of Attack	Percent of Target Capacity Destroyed	Percent of Total Capacity Destroyed or Inactive	Cost of Restoration (Thousand US $)
1965						
[redacted]	Lang Chi Explosives Plant	100	24 Jul 7, 8 Aug	71 (Inactive)	100	370
	Nam Dinh Textile Mill	Cotton spinning: 70 to 75			Spinning inactive: 60	
		Cotton weaving: 50	28 Jul	5	Weaving inactive: 40	800
	Subtotal: 1965					1,170
1966						
	Cam Pha Coal Treatment Plant	N.A.	24 Apr 8 Nov	N.A.	N.A.	75
	Viet Tri Paper Mill	80	Mid-Jul	N.A.	N.A.	100
	Nam Dinh Textile Mill	N.A.	Oct-Dec a/	N.A. b/	N.A. b/	250
	Subtotal: 1966					425

Table 9

Manufacturing Facilities Attacked Under the Rolling Thunder Program
1965, 1966, and January-September 1967
(Continued)

JCS Target Number	Name	Percent of Total Capacity	Dates of Attack	Percent of Target Capacity Destroyed	Percent of Total Capacity Destroyed or Inactive	Cost of Restoration (Thousand US $)
Jan-Sep 1967						
[redacted]	Thai Nguyen Iron and Steel Complex	95 c/	10, 11, 18, 21, 25, 26, 30 Mar	N.A. (Inactive)	95 c/	10,000
			7, 10, 18, 23 Apr			
			1, 4, 10, 27 May			
			21, 27 Jun			
	Haiphong Cement Plant	95	20, 25 Apr	70		
			7, 27 May	(Inactive)	95	3,050
	Lang Chi Explosives Plant	100	16, 23, 29 Jun 6, 8, 18, 20 Jul 1, 3, 18, 19, 20 Aug	80 (Inactive)	100	45
	Nam Dinh Textile Mill	N.A.	Mar, Jun, Jul	N.A. b/	N.A. b/	1,330
	Cam Pha Coal Treatment Plant	N.A.	Feb	N.A.	N.A.	Negl.
	Phu Tho Phosphate Fertilizer Plant	56 d/	Jul	3	N.A.	200
	Hon Gai Calcium Carbide Plant	N.A.	9, 12, 13 Mar 16, 17 Apr	75	N.A.	200
	Haiphong Enamelware Plant	N.A.	Apr	35	N.A.	360

25X1 25X1 25X5

Table 9

Manufacturing Facilities Attacked Under the Rolling Thunder Program
1965, 1966, and January-September 1967
(Continued)

JCS Target Number	Name	Percent of Total Capacity	Dates of Attack	Percent of Target Capacity Destroyed	Percent of Total Capacity Destroyed or Inactive	Cost of Restoration (Thousand US $)
[redacted]	Bac Giang Chemical Fertilizer Plant	37 d/	24, 25 Feb 11, 16 Mar 10, 20, 22 May 16, 19 Jun	3 (Inactive)	37	395
	Viet Tri Paper Mill	80	Mar	100	80	675
	Subtotal: Jan-Sep 1967					16,255
	Total					17,850

a. Two strikes within the period.
b. Relocation of much of the mill's equipment is believed to have permitted restoration of perhaps a significant share of national capacity.
c. Pig iron only. It is not possible to determine the plant's relative share of fabrication work.
d. Percent of chemical fertilizer capacity (excluding apatite and phosphate rock).

25X1
25X1
25X5

Table 10

Barracks Attacked Under the Rolling Thunder Program a/
January-September 1967

JCS Target Number	Name	Percent of Total Targeted Capacity	Dates of Attack	Percent of Target Capacity Destroyed as of			Cost of Restoration (Thousand US $)			
				End 1965	End 1966	1 Oct 1967	Jan-Mar 1967	Apr-Jun 1967	Jul-Sep 1967	Total
[redacted]	Xuan Mai Army Bks SSW	1.2	19 Apr (initial strike) 20 Apr	b/	b/	64	0	950	0	950
	Xuan Mai Army Bks NNW, Hoa Muc	0.3	5 Feb (initial strike)	b/	b/	13	220	0	0	220
	Son La Army Bks/Hq Mil Reg NW/Sup Dep	2.0	26 Mar; 2, 3, 8, 9, 14 Apr; 3, 7, 9 May	52	61	61	Negl.	Negl.	0	Negl.
	Ha Dong Army Bks/ Supply Depot	1.1	5 May (initial strike) 12, 14, 22 May	b/	b/	33	0	5,000	0	5,000
	Vu Con Army Bks/Supply Depot	0.1	27 Sep	71 (inactive)	71 (inactive)	71 (inactive)	0	0	Negl.	Negl.
	Dong Hoi Army Bks WNW	1.1	15, 19 Jun; 5, 7, 8 Jul	82 (inactive)	82 (inactive)	82 (inactive)	0	Negl.	Negl.	Negl.
	Vinh Yen Army Bks/Training Area N	0.7	13 May (initial strike) 25 May	b/	b/	19	0	1,300	0	1,300
	Son Tay Army Bks SW Tong	1.1	28 Jul (initial strike) 1 Aug	b/	b/	23 (inactive)	0	0	420	420

25X1 25X1 25X5

Table 10

Barracks Attacked Under the Rolling Thunder Program a/
January-September 1967
(Continued)

JCS Target Number	Name	Percent of Total Targeted Capacity	Dates of Attack	Percent of Target Capacity Destroyed as of			Cost of Restoration (Thousand US $)			
				End 1965	End 1966	1 Oct 1967	Jan-Mar 1967	Apr-Jun 1967	Jul-Sep 1967	Total
[redacted]	Chap Le Army Bks NW	0.3	24 Jan; 4, 10, 12, 13, 23, 24, 25, 28 Mar; 4, 9, 21, 27 Apr	36 (inactive)	36 (inactive)	90 (inactive)	Negl.	165	0	165
	Ben Quang Army Bks SW	0.5	29 Jan; 2 Feb; 5, 6, 7, 9, 12, 14, 20, 21, 21, 23, 25, 26 Mar; 2, 3, 4, 7, 13, 22, 25 Apr	66 (inactive)	96 (inactive)	96 (inactive)	Negl.	Negl.	0	Negl.
	Dong Hoi Army Bks Citadel	0.6	14, 22 Jul	77 (inactive)	77 (inactive)	77 (inactive)	0	0	Negl.	Negl.
	Phu Le Army Bks/ Supply Depot	0.3	6 Feb; 20 Jun; 11 Sep	48 (inactive)	48 (inactive)	48 (inactive)	Negl.	Negl.	Negl.	Negl.
	Muong Sen Mil Installation	0.1	1 Jul; 4 Aug	72 (inactive)	100 (inactive)	100 (inactive)	0	0	Negl.	Negl.
	Vinh Linh Army Bks Cent NE	0.3	25, 28 Jan; 1 Feb; 4, 6, 7, 10, 10, 11, 11, 16, 17, 19, 24 Mar; 4, 9, 10, 10 Apr; 31 Aug	39 (inactive)	52 (inactive)	52 (inactive)	Negl.	Negl.	Negl.	Negl.
	Thanh Hoa Army Bks S	0.3	24, 31 Jan; 2 Feb	36 (inactive)	36 (inactive)	36 (inactive)	Negl.	0	0	Negl.
	Vinh Army Bks NNE	0.6	31 Aug; 1 Sep	43	51 (inactive)	51 (inactive)	0	0	Negl.	Negl.

25X1

25X1

25X5

Table 10

Barracks Attacked Under the Rolling Thunder Program a/
January-September 1967
(Continued)

JCS Target Number	Name	Percent of Total Targeted Capacity	Dates of Attack	Percent of Target Capacity Destroyed as of			Cost of Restoration (Thousand US $)			
				End 1965	End 1966	1 Oct 1967	Jan-Mar 1967	Apr-Jun 1967	Jul-Sep 1967	Total
[redacted]	Kep Ha Army Bks	0.9	28 Aug (initial strike) 29 Aug; 3, 4, 9, 10, 25, 26, 30 Sep	b/	b/	5	0	0	320	320
	Mu Gia Pass Supply/ Staging Point	0.1	6, 31 Jan	74 (inactive)	74 (inactive)	74 (inactive)	Negl.	0	0	Negl.
	Xom Bang Army Bks E	0.2	7, 8, 9, 12, 17, 22, 24, 27 Mar; 7, 7 Apr	97 (inactive)	97 (inactive)	97 (inactive)	Negl.	Negl.	0	Negl.
	Trai Thou Army Bks	0.4	29 Jul (initial strike) 31 Jul	b/	b/	19	0	0	150	150
	Vinh Army Bks NW/ Supply Depot	0.9	29 Apr	53	93	93	0	Negl.	0	Negl.
	Son Dong Army Bks	1.1	28 Aug (initial strike)	b/	b/	7	0	0	300	300
	Kep Army Bks S	0.7	19 May (initial strike) 31 May; 29 Aug	b/	b/	6	0	385	Negl.	385
	Chi Ne Army Bks	0.7	1 Mar (initial strike) 24 Mar; 3 May	b/	b/	35	N.A.	1,550 c/	0	1,550
	Quang Khe Army Bks	0.2	21 Feb; 25 Apr; 11, 25, 31 May; 5 Jun	0	0	17	165	Negl.	0	165
	Vinh Linh Army Bks E, Lien Cong	0.2	7, 11, 11, 19, 24, 29, 29 Mar; 7, 11, 12 Apr	90 (inactive)	90 (inactive)	90 (inactive)	Negl.	Negl.	0	Negl.

25X1 25X1 25X5

Table 10

Barracks Attacked Under the Rolling Thunder Program a/
January-September 1967
(Continued)

JCS Target Number	Name	Percent of Total Targeted Capacity	Dates of Attack	Percent of Target Capacity Destroyed as of			Cost of Restoration (Thousand US $)			
				End 1965	End 1966	1 Oct 1967	Jan-Mar 1967	Apr-Jun 1967	Jul-Sep 1967	Total
	Vinh Linh Army Bks NW, Xom Cho	0.3	10, 19, 29, 30 Mar; 30 Apr	87 (inactive)	87 (inactive)	87 (inactive)	Negl.	Negl.	0	Negl.
	Vinh Hqs Military Region IV, Army Bks/ Supply Depot	0.8	1 Sep	37	37	37	0	0	Negl.	Negl.
	Van Dien Army Supply Depot	1.9	19 May (initial strike) 4, 10, 27 Jun; 21 Aug	b/	b/	45	0	340	175	515
	Subtotal						385	9,690	1,365	11,440
	Total: Jan-Sep 67						11,440			
	Total: 1966						2,545			
	Total: 1965						16,000			
	Grand total						29,985			

a. Cost of damage to non-JCS targeted barracks is given under "Miscellaneous Targets of Armed Reconnaissance."
b. Facility not struck.
c. Total damage inflicted, including that from strikes in March.

25X1 25X1 25X5

Table 11

Airfields Attacked Under the Rolling Thunder Program
1965, 1966, and January-September 1967

JCS Target Number	Name	Percent of Total Targeted Capacity	Dates of Attack	Percent of Target Capacity Destroyed	Percent of Total Targeted Capacity Destroyed	Cost of Restoration (Thousand US $)
1965						
[redacted]	Na San	4	25 Jun; 23 Sep; 24 Oct	45 (inactive)	4	144
	Dien Bien Phu	3	2, 8 Jul	94 (inactive)	3	143
	Dong Hoi	6	30 Mar; 6 Jun; 1 Jul; 17, 22, 23 Sep	53 (inactive)	6	50
	Vinh	6	8 May; 30 Jun; 1 Jul	10 (inactive)	6	43
	Subtotal: 1965				19	380
1966						
[redacted]	Dien Bien Phu	3	6, 11 Feb	94 (inactive)	3	2
	Dong Hoi	6	19 Nov	53 (inactive)	6	Negl.
	Subtotal: 1966				19 a/	2
Jan-Mar 1967						
[redacted]	Dong Hoi	6	29 Mar	67 (inactive)	6	13
	Subtotal: Jan-Mar 1967				19 a/	13

25X1 25X1 25X5 25X5 25X5

Table 11

Airfields Attacked Under the Rolling Thunder Program
1965, 1966, and January-September 1967
(Continued)

JCS Target Number	Name	Percent of Total Targeted Capacity	Dates of Attack	Percent of Target Capacity Destroyed	Percent of Total Targeted Capacity Destroyed	Cost of Restoration (Thousand US $)
Apr-Jun 1967						
b/	Hoa Lac	b/	24 Apr (initial strike), 28 Apr; 1, 3, 8, 19, 21, 26, 30 May; 29 Jun	N.A.	b/	306
[redacted]	Dong Hoi	6	16 May	67 (inactive)	6	Negl.
	Haiphong/Kien An	7	10 May (initial strike); 14, 25 May	N.A.	N.A.	4
	Kep	10	24 Apr (initial strike); 1, 7, 21, 21, 26, 31 May; 29 Jun	40	4	248
	Subtotal: Apr-Jun 1967				23 a/	558
Jul-Sep 1967						
b/	Hoa Lac	b/	12 Jul; 30 Aug	N.A.	b/	229
[redacted]	Na San	4	22 Jul	45 (inactive)	4	Negl.

25X1 25X1 25X5 25X5

Table 11

Airfields Attacked Under the Rolling Thunder Program
1965, 1966, and January-September 1967
(Continued)

25X1

25X1

JCS Target Number	Name	Percent of Total Targeted Capacity	Dates of Attack	Percent of Target Capacity Destroyed	Percent of Total Targeted Capacity Destroyed	Cost of Restoration (Thousand US $)
Jul-Sep 1967 (Continued)						
[redacted]	Vinh	6	31 Aug; 1 Sep	10 (inactive)	6	Negl.
	Haiphong/Kien An	7	12 Aug	N.A.	N.A.	N.A.
	Kep	10	4, 7 Jul; 3, 9, 30 Sep	45	4	17
	Kep Ha	3	21 Aug (initial strike), 24 Aug	17 (inactive)	3	33
	Subtotal: Jul-Sep 1967				26 a/	279
	Total				26	1,232

25X5

a. Including that capacity destroyed or inactive at airfields not attacked during the time period.
b. Not JCS-targeted.

Table 12

Naval Bases Attacked Under the Rolling Thunder Program
1965, 1966, and January-September 1967

JCS Target Number	Name	Percent of Naval Base Support Capacity	Dates of Attack a/	Percent of Base Utility Destroyed	Percent of Total Naval Base Support Capacity Destroyed or Inactive	Cost of Restoration (Thousand US $)
1965						
[redacted]	Phuc Loi	10	20 May; 12 Sep	78	8	815
	Quang Khe, Cuu Dinh	15	2 Mar; 28 May; 21, 24, 27, 28 Sep	47	7	400
	Subtotal: 1965				15	1,215
1966						
[redacted]	Hon Gai/Bai Chay Port Naval Complex	17	6 Aug; 28 Oct; 4 Nov	14	2	28
	Phuc Loi	10	4, 5 Apr	78 (inactive)	10	230
	Quang Khe, Cuu Dinh	15	26 Apr; 25 Nov	47	7	100
	Subtotal: 1966				19	358
Jan-Mar 1967						
[redacted]	Phuc Loi	10	15 Mar	78 (inactive)	10	1
	Quang Khe, Cuu Dinh	15	17, 28 Mar	47	7	1
	Subtotal: Jan-Mar 1967				19 b/	2

25X1 25X1 25X5 25X5 25X5

Table 12

Naval Bases Attacked Under the Rolling Thunder Program
1965, 1966, and January-September 1967
(Continued)

25X1 25X1

JCS Target Number	Name	Percent of Naval Base Support Capacity	Dates of Attack a/	Percent of Base Utility Destroyed	Percent of Total Naval Base Support Capacity Destroyed or Inactive	Cost of Restoration (Thousand US $)
Apr-Jun 1967						25X5
[redacted]	Phuc Loi	10	8 Jun	78 (inactive)	10	Negl.
	Quang Khe, Cuu Dinh	15	3 Apr; 22 Jun	47	7	Negl.
	Subtotal: Apr-Jun 1967				19 b/	Negl.
Jul-Sep 1967						25X5
[redacted]	Phuc Loi	10	7 Sep	78 (inactive)	10	Negl.
	Port Wallut	15	21 Aug (initial strike); 25 Aug	30	4.5	250
	Quang Khe, Cuu Dinh	15	19 Aug	90	13.5	100
	Subtotal: Jul-Sep 1967				30 b/	350
	Total				30	1,925

a. Dates of attack indicate only assigned strikes; in certain instances more attacks have been made against a specific target than is indicated below.
b. Including that capacity destroyed or inactive at naval base support facilities not attacked during the time period.

II. Air Operations

A. Scale of Attack

Over 40 percent of the more than one million sorties flown over South Vietnam, North Vietnam, and Laos since February 1965 were carried out during January-September 1967. The 412,500 sorties flown during the first nine months of 1967 exceeded those during January-September 1966 by about 30 percent and showed almost a three-fold increase over the same period in 1965. As shown in the tabulation below, about 1,500 sorties are being flown per day, of which about 550 are over North Vietnam.

	Average Sorties Per Day		
Area of Operation	1965	1966	Jan-Sep 1967
North Vietnam	152	405	548
Laos	44	212	234
South Vietnam	304	558	729
Total Southeast Asia	*500*	*1,175*	*1,511*

The distribution of sorties among targets in North Vietnam, Laos, and South Vietnam was about the same during the first nine months of 1967 as during 1966. The numbers of sorties and the percentage share of the total sorties for each country, by year, are shown in the following tabulation:

	1965		1966		Jan-Sep 1967	
Area of Operation	Number of Sorties	Percent of Total	Number of Sorties	Percent of Total	Number of Sorties	Percent of Total
North Vietnam	55,560	30	147,840	35	149,600	36
Laos	16,050	9	77,370	18	63,980	16
North Vietnam and Laos combined	71,610	39	225,210	53	213,580	52
South Vietnam	110,980	61	203,600	47	198,910	48
Total Southeast Asia	*182,690*	*100*	*428,810*	*100*	*412,490*	*100*

Through September 1967, attack sorties* made up 56 percent of total sorties in North Vietnam and 79 percent in South Vietnam, the same as in 1966, but in Laos attack sorties showed a substantial decline from 63 percent to 50 percent of total sorties. The decline in the share of attack sorties over Laos this year probably reflects the heavier attack against North Vietnam and the increased use of reconnaissance aircraft to detect infiltration and logistic movements at the same time that attack sorties were being limited by the southwest monsoons.

The air war in North Vietnam, as in virtually all of Southeast Asia, is almost totally a US undertaking. In 1967 the South Vietnamese Air Force has averaged only 13 sorties per month over North Vietnam, a negligible share of total sorties. Table 13 shows sorties over North Vietnam by nationality, 1965 through September 1967.

The relative share of total US sorties flown over North Vietnam through September 1967 by each military service remains the same as in 1966. The Air Force flew 53 percent of the total, the Navy 42 percent, and the Marine Corps 5 percent. Table 14 shows sorties by each US service for 1965 through September 1967.

B. Ordnance

Total ordnance delivered over Southeast Asia during the first nine months of 1967 amounted to approximately 645,400 tons, a one-third increase above the total for all of 1966 and more than three times the amount delivered in 1965. The increase results from an increase both in the number of sorties being flown and in the average load of ordnance delivered per sortie. A comparison of average ordnance loads delivered per attack sortie in 1966 and in January-September 1967 is shown in the following tabulation:

* *Attack sorties carry out strike and flak suppression missions. Support sorties make up the remainder and conduct photo and electronic reconnaissance, combat air patrol, search and rescue, electronic countermeasure, refueling, and forward air control missions.*

Area of Operation	Average Tons per Attack Sortie 1966	Jan-Sep 1967
North Vietnam	1.6	2.1
Laos	1.5	2.7
South Vietnam	1.8	2.4
Total Southeast Asia	*1.7*	*2.4*

Increased employment of B-52 aircraft over Southeast Asia is a major factor contributing to both the overall rise in ordnance delivered and the increased rate of ordnance delivered per attack sortie. Ordnance loads delivered per sortie by B-52's have averaged about 23 tons -- nearly 10 times the overall average. Since June 1965, when the first Arc Light (B-52) strikes were carried out against targets in South Vietnam, about 14,000 sorties by these aircraft have delivered more than 320,000 tons of ordnance against targets in all three countries. Somewhat more than one-half of this amount, about 180,000 tons, was delivered during the first nine months of 1967 and accounted for more than one-fourth of the total ordnance delivered during this period. As a result of the campaign against North Vietnamese units located near the DMZ, the number of B-52 sorties against North Vietnam during September exceeded B-52 sorties over South Vietnam and Laos combined for the first time since the beginning of the Arc Light program.

Ordnance delivered over North Vietnam during the first nine months of 1967 totaled approximately 175,200 tons, or 27 percent of the ordnance delivered by all air operations in Southeast Asia -- the same share as during 1966 (see Table 15). A comparison of the shares of ordnance delivered on each area in 1966 and 1967 is shown in the following tabulation:

Area of Operation	1966 Tons	1966 Percent	Jan-Sep 1967 Tons [a]	Jan-Sep 1967 Percent
North Vietnam	128,590	27	175,160	27
Laos	73,690	15	86,930	14
North Vietnam and Laos combined	202,280	42	262,090	41
South Vietnam	281,250	58	383,340	59
Total Southeast Asia	*483,530*	*100*	*645,430*	*100*

a. Tonnage for September is an estimate.

C. Distribution of Attacks in North Vietnam

The distribution of attacks against the six Route Packages during January-September 1967 saw some changes from 1966. Route Package I continued to be the primary target area in 1967 as in 1966. There was a significant increase in strikes against Route Package VI, which includes the industrial targets in the Hanoi and Haiphong areas and key LOC targets in the northeast. Thus during January-September 1967, Route Package VI received an average of 17 percent of attack sorties compared to about 7 percent in 1966. Table 16 shows distribution of attack sorties by Route Packages for 1966 and the first nine months of 1967.

Although beginning in March 1967, an intensified program was carried out against previously unstruck JCS-numbered industrial targets,* armed reconnaissance continues to dominate the Rolling Thunder program as it has since 1965. The following tabulation shows the percent of sorties

** In recent months a series of previously unstruck fixed targets have been attacked which are not JCS-numbered but are treated operationally as JCS-numbered targets. These include such targets as railroad and highway bridges, railroad yards and sidings, shipyards, and supply and storage areas in the Hanoi and Haiphong areas and the Chinese buffer zone. The inclusion of attacks against such targets with attacks against JCS-numbered targets would increase only slightly this share as a percent of the total.*

flown and ordnance delivered against JCS fixed targets in North Vietnam.

	Percent [a]		
	1965	1966	Jan-Sep 1967
Sorties	25	2	3
Ordnance (tons)	37	3	5

a. All sorties flown and ordnance delivered over North Vietnam equal 100 percent in each case.

Although the share of total sorties flown and ordnance delivered against JCS targets during 1967 is small, the effort is still substantially higher than during 1966. The 1967 quarterly average for sorties is more than twice that of 1966, whereas the average for ordnance delivered is more than three times that of 1966. The 1967 figures are still below those of 1965, however, as shown in the following tabulation:

	Quarterly Averages		1967		
	1965	1966	Jan-Mar	Apr-Jun	Jul-Sep
Sorties	3,470	655	980	2,320	1,570
Ordnance (tons)	3,200	890	2,070	3,720	2,830

The current year has seen a marked increase in the number of strikes carried out against previously unstruck JCS targets that included industrial installations, targets on lines of communications, and military facilities. Through September, 36 JCS targets were attacked for the first time. Almost half of these initial strikes were made during the second quarter of 1967. A third of the 36 targets are located within 10 nautical miles of Hanoi or Haiphong. The number of strikes, of sorties flown, and amount of ordnance delivered in initial strikes on JCS targets, by quarter, during 1967 are shown in the following tabulation:

Initial Strikes

1967	Total	Hanoi-Haiphong Area	Attack Sorties	Ordnance Delivered (Tons)
January-March	7	0	158	680
April-June	17	11	381	1,170
July-September	12	1	173	580
Total	*36*	*12*	*712*	*2,430*

D. Cost of Air Operations over North Vietnam

The direct operational cost to the United States of air operations over North Vietnam during January-September 1967 is estimated at about $1,250 million -- slightly more than that estimated for all of 1966. This amount includes the production cost of aircraft lost, valued at about $525 million; direct operational cost of sorties flown estimated at about $350 million; and ordnance costs of about $375 million. The following tabulation gives estimated costs during 1966 compared with those of January-September 1967.

	Million US $	
	1966	January-September 1967
Aircraft lost	605.6	525.2
Operational cost of sorties flown	330.4	349.4
Ordnance	311.5	373.5
Total	*1,247.5*	*1,248.1*

The measurable costs to North Vietnam for reconstruction or repair of bomb damaged facilities and for indirect losses attributed to the bombing during January-September 1967 are estimated to be $172 million. The trend of the cost of inflicting one dollar's worth of damage on North Vietnam is as follows:

Million US $

	Cost of Damage	Operational Cost	Operational Cost per Dollar of Damage
1965	68.9	460.0	6.68
1966	113.6	1,247.5	10.98
Jan-Sep 1967	172.0	1,248.1	7.26

The increase in cost per dollar of damage in 1966 was attributable primarily to the increasing costs of the accelerated air interdiction program that concentrated on low-yield target systems. The improved cost trend in 1967 reflects the increased number of attacks against significant economic targets in industry. Prospects for further improvement in cost effectiveness are dim, however, as the number of these significant targets is decreasing, a fact pointed up by the decline in cost of damage during the third quarter of 1967 compared with that of the second quarter.

Table 13

Sorties Against North Vietnam by Mission and Nationality a/
1965, 1966, and January-September 1967

Year and Month	By US Services			By South Vietnamese Air Force			Total		
	Attack Sorties b/	Support Sorties	Total Sorties	Attack Sorties b/	Support Sorties	Total Sorties	Attack Sorties b/	Support Sorties	Total Sorties
1965	25,270	29,570	54,840	610	110	720	25,880	29,680	55,560
1966	61,360	65,660	147,020	810	10	820	82,170	65,670	147,840
1967 (Jan-Sep)	84,310	65,170	149,480	120	0	120	84,430	65,170	149,600
January	6,580	7,160	13,740	0	0	0	6,580	7,160	13,740
February	5,470	5,620	11,090	0	0	0	5,470	5,620	11,090
March	8,490	6,880	15,370	10	0	10	8,500	6,880	15,380
April	8,960	7,150	16,110	0	0	0	8,960	7,150	16,110
May	11,310	8,630	19,940	20	0	20	11,330	8,630	19,960
June	11,460	8,160	19,620	10	0	10	11,470	8,160	19,630
July	11,290	8,240	19,530	20	0	20	11,310	8,240	19,550
August	11,850	7,360	19,210	40	0	40	11,890	7,360	19,250
September	8,900	5,970	14,870	20	0	20	8,920	5,970	14,890

a. Rounded to the nearest 10 sorties.
b. Attack sorties include strike and flak suppression sorties.

Table 14

Sorties Against North Vietnam by Program and by Service a/
1965, 1966, and January-September 1967

Year and Month	On Fixed Targets		On Armed Reconnaissance				Services			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Total on Fixed Targets (Col. 2 & 3)	By Fixed Target Strikes	By Armed Reconnaissance Strikes	Armed Reconnaissance Not on Fixed Targets	Total on Armed Reconnaissance (Col. 3 & 4)	Total (Col. 1 & 4)	United States Air Force	United States Navy	United States Marine	South Vietnamese Air Force
1965	13,890	11,060	2,830	41,670	44,500	55,560	24,620	29,220	1,000	720
1966	2,620	420	2,200	145,220	147,420	147,840	78,580	62,550	5,890	820
1967 (Jan-Sep)	4,870	910	3,960	144,730	148,690	149,600	79,050	62,500	7,930	120
January	200	0	200	13,540	13,740	13,740	7,500	5,750	400	0
February	200	80	120	10,890	11,010	11,090	5,590	4,860	640	0
March	580	170	410	14,800	15,210	15,380	7,680	6,790	900	10
April	750	350	400	15,360	15,760	16,110	7,760	7,470	880	0
May	830	110	720	19,130	19,850	19,960	9,710	9,340	890	20
June	740	0	740	18,890	19,630	19,630	10,710	8,140	770	10
July	480	50	430	19,070	19,500	19,550	10,410	8,070	1,050	20
August	710	150	560	18,540	19,100	19,250	10,770	7,190	1,250	40
September	380	0	380	14,510	14,890	14,890	8,920	4,890	1,060	20

a. Rounded to the nearest 10 sorties.

Table 15

Ordnance Delivered by Air on North Vietnam by Program a/
1965, 1966, and January-September 1967

Tons

Year and Month	On JCS Fixed Targets (1) Total on JCS Fixed Targets (Col. 2 & 3)	On JCS Fixed Targets (2) By Fixed Target Strikes	On JCS 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)
1965	12,800	11,960	840	21,500	22,340	34,300
1966	3,560	440	3,120	125,030	128,150	128,590
1967 (Jan-Sep)	8,620	1,510	7,110	166,540	173,650	175,160
January	450	0	450	11,050	11,500	11,500
February	430	200	230	10,000	10,230	10,430
March	1,190	340	850	14,690	15,540	15,880
April	1,360	460	900	16,390	17,290	17,750
May	1,260	160	1,100	20,330	21,430	21,590
June	1,100	0	1,100	23,090	24,190	24,190
July	920	110	810	20,750	21,560	21,670
August	1,190	240	950	24,540	25,490	25,730
September	720	0	720	25,700	26,420	26,420

a. Rounded to the nearest 10 tons.

Table 16

Distribution of Attack Sorties over North Vietnam by Route Package a/
1966, January-September 1967

Percent

Year and Month	Route Package I	II	III	IV	V	VI	Unknown
1966	37	15	13	9	4	7	15
1967							
January	44	6	15	21	4	10	0
February	63	7	9	12	3	6	0
March	59	10	12	8	4	8	0
April	49	11	13	7	5	13	0
May	39	13	18	11	3	16	0
June	36	13	17	11	4	19	0
July	38	9	7	9	4	33	0
August b/	48	7	10	8	2	22	0
September b/	58	8	6	8	3	17	0
Nine Month Average	47	10	12	10	3	17	0

a. North Vietnam is divided, for operation, into six geographic areas, known as Route Packages. Percentage data shown are approximate, due to the effects of multiple-route-package sorties and coastal sorties.
b. In addition, shares of 3 percent during August and 1 percent during September were flown in the Buffer Zone.

III. Air Losses

A. Introduction

The ratio of US air losses to the number of sorties has declined each year since the beginning of 1965, when US air involvement in Southeast Asia increased sharply. This trend has prevailed in South Vietnam, Laos, and North Vietnam, but the decline in North Vietnam has been more pronounced. Continued improvement in the loss rate in North Vietnam is particularly significant in view of the vast expansion of the North Vietnamese air defense system and the intensification of the US attack against heavily defended targets in the northeast. The decrease in the Rolling Thunder loss rate results primarily from improved electronic countermeasures and increased experience in evasion tactics. Even though loss rates are declining, the rates against specific targets such as industrial installations and particularly targets in the Hanoi and Haiphong areas are many times higher than the overall average.

B. Air Losses in Southeast Asia

US and South Vietnamese air losses over all of Southeast Asia since the introduction of US air advisory groups in 1962 through September 1967 total at least 2,860 helicopters and fixed-wing aircraft. About 540 of these losses -- 19 percent -- were aircraft of the Vietnamese Air Force or US aircraft flying non-combat associated missions. Of the remaining 2,320 losses, 93 percent have been downed since 1965. The following tabulation shows US losses by year through September 1967 of helicopters and fixed wing aircraft flying attack and support missions.

Year	Fixed Wing Aircraft	Helicopters	Total
1962	4	21	25
1963	11	34	45
1964	35	60	95
1965	305	170	475
1966	492	319	811
Jan-Sep 1967	410	459	869
Total	*1,257*	*1,063*	*2,320*

Total losses in the first nine months of 1967 exceeded those for any full previous year, primarily because of the heavy losses of helicopters over South Vietnam. About 60 percent of the fixed wing aircraft losses occurred over North Vietnam, about 30 percent over South Vietnam, and 10 percent over Laos.

C. Rolling Thunder Losses

1. Loss Trends

During the period 1965 - September 1967, US losses over North Vietnam, both operational and combat, totaled 772 fixed wing aircraft, with combat losses alone totaling 689 aircraft. Antiaircraft artillery (AAA) downed 579 US fixed-wing aircraft over North Vietnam, three-fourths of total US losses in the Rolling Thunder program in this period. The following tabulation shows the causes of downings of US aircraft over North Vietnam from 1965 through September 1967.

	Losses of Fixed Wing Aircraft	Percent
AAA	579	75
SAM	84	11
MIG	26	3
Total combat losses	689	89
Operational losses	83	11
Total	*772*	*100*

An increasing share of US aircraft lost over North Vietnam is attributable to the more sophisticated SAM and, to a lesser extent, MIG defenses, although AAA remains the primary cause of US air losses. The share of total losses caused by AAA decreased from 84 percent in 1965 to 76 percent in 1966 and 67 percent in 1967. Conversely, from 1965 to January-September 1967, losses attributable to SAM's as a share of total losses rose by 10 percentage points and losses from

MIG attacks rose by 4 percentage points. The following tabulation gives percentages of aircraft losses by cause during 1965, 1966, and January through September 1967:

Cause	Percent		
	1965	1966	Jan-Sep 1967
Antiaircraft artillery	84	76	67
SAM	6	10	16
MIG	1	3	5
Total combat	91	89	88
Operational	9	11	12
Total	*100*	*100*	*100*

The overall loss rate of US aircraft has decreased since the Rolling Thunder program began in 1965. During 1965, 187 US attack and support fixed-wing aircraft were lost because of both operational failure and combat causes while flying 54,840 Rolling Thunder sorties -- an overall loss rate of 3.4 aircraft per 1,000 sorties. During 1966 this overall rate decreased to 2.1 and in 1967 it decreased to 1.8.

During the period February 1965 - September 1967 about 79 percent of the combat-caused losses were sustained by aircraft carrying out attack missions and flying 54 percent of the Rolling Thunder sorties. The remaining 21 percent of the combat-caused losses were sustained during support missions by aircraft flying 46 percent of the sorties.* Table 17 shows the trends of the

** Causes of aircraft losses fall into two categories, operational losses caused by equipment failure and combat losses resulting from damage inflicted by the enemy's defenses. Aircraft downed by either of these causes may be flying one of two basic types of* [footnote continued on p. 74.]

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loss rate for the Rolling Thunder program for the period 1965 through September 1967.

2. Losses by Type of Target

The emphasis placed on armed reconnaissance and interdiction campaigns has meant that most US aircraft losses have been sustained in attacks against transport targets. US forces have reduced the combat loss rate of aircraft flying attack missions, and in the first nine months of 1967 this rate averaged only 2.2 aircraft per 1,000 attack sorties, compared with a rate of 5.1 during 1965. This improvement reflects both the changing nature of the Rolling Thunder program and the increased effectiveness of US pilots and the countermeasures available against the North Vietnamese air defense system.

The combat loss rate varies significantly, however, with the type and location of target taken under attack. Thus, attacks against key industrial facilities in the heavily defended Hanoi-Haiphong area have sustained the highest loss rates. During the first nine months of 1967, for example, the attack against North Vietnam's petroleum and electric power facilities and the Thai Nguyen Iron and Steel Plant, accounted for about 1 percent of all Rolling Thunder attack sorties, but the combat loss rate for these attacks soared to an average of 21.5 aircraft per 1,000 attack sorties. By contrast, a combat loss rate of less than one aircraft per 1,000 attack sorties was sustained by aircraft attempting to interdict nine of North Vietnam's primary infiltration routes into South Vietnam. Almost 60 percent of Rolling Thunder attack sorties were flown against these routes. Strikes against railroads accounted for 14 percent of the attack sorties and 25 percent of the combat losses -- a rate of four aircraft downed per 1,000 attack

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sorties -- attack sorties which carry out strike and flak-suppression missions, and support sorties, which conduct photo and electronic reconnaissance, combat air patrol, search and rescue, electronic countermeasure, refueling, and forward air control missions.

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Table 17

Sorties, Losses, and Loss Rates
for the Rolling Thunder Program
1965, 1966, January-September 1967

	Sorties	Losses	Combat Losses per 1,000 Sorties [a]
Combat losses			
Attack missions			
1965	25,270	129	5.1
1966	81,360	226	2.8
Jan-Sep 1967	84,310	186	2.2
Support missions			
1965	29,570	41	1.4
1966	65,660	56	0.9
Jan-Sep 1967	65,170	51	0.8
All missions			
1965	54,840	170	3.1
1966	147,020	282	1.9
Jan-Sep 1967	149,480	237	1.6

	Total Sorties	Combat and Operational Losses	Losses per 1,000 Sorties
Total losses [b]			
All missions			
1965	54,840	187	3.4
1966	147,020	315	2.1
Jan-Sep 1967	149,480	270	1.8

a. Previously reported loss rates of 6.7, 3.5, and 3.0 during 1965, 1966, and 1967, respectively, were based on attack sorties and combat-caused losses sustained by attack and support sorties. The rates used in this text are more comprehensive measures of comparing losses to attack and support sorties, both separately and combined. The decreasing trend is noted in all comparisons.
b. Combat and operational losses.

sorties. The following tabulation shows the variations in combat loss rates sustained by attack aircraft against representative target systems during January-September 1967.

	Attack Sorties		Losses		
Target Category	Total	Percent	Total	Percent	Rate a/
Electric power	550	0.7	10	5.4	18.2
Thai Nguyen Iron and Steel	280	0.3	8	4.3	28.6
POL b/	100	0.1	2	1.1	20.0
Industry total	930	1.1	20	10.8	21.5
Highways c/	49,000	58.1	31	16.7	0.6
Railroads	11,370	13.5	46	24.7	4.0
Land transport route total	60,370	71.6	77	41.4	1.3
All other	23,010	27.3	89	47.8	3.9
Total	*84,310*	*100.0*	*186*	*100.0*	*2.2*

a. Combat losses of attack aircraft per 1,000 attack sorties.
b. Numbers listed are for attacks against JCS POL targets only.
c. Numbers listed include attacks against 9 roads utilized by Hanoi as primary infiltration routes into South Vietnam. They total 1,200 miles in length -- about 70 percent as long as North Vietnam's 1,700 miles of principal highways.

3. Losses by Geographic Area

Analysis of Rolling Thunder sorties and losses, by Route Package, shows clearly the higher risk associated with attacks against the more lucrative industrial and transport targets in Route Package VI. During the first nine months of 1967, missions targeted against Route Package VI carried out 17 percent of total Rolling Thunder attack sorties but sustained 52 percent of the combat losses during attack and support sorties over

North Vietnam. Figure 6 shows shares of total attack sorties and combat losses of attack and support sorties over Route Package VI during January-September 1967. During this period the combat loss rate in Route Package VI was 8.5 attack and support aircraft downed per 1,000 attack sorties, a rate ranging from more than three to eight times that sustained in the other Route Package areas. The following tabulation gives loss rates and shares of sorties and losses, by Route Package, during January-September 1967.

	Route Package					
	I	II	III	IV	V	VI
Combat losses of attack and support aircraft per 1,000 attack sorties a/	1.4	1.0	2.3	2.1	2.4	8.5
Attack sorties (percent)	47	10	12	10	3	17
Combat losses of attack and support aircraft (percent)	23	3	10	8	3	52

a. Available data do not give breakdowns by Route Package either of combat losses of attack sorties alone or of attack plus support sorties. Therefore, the listed loss rates are ratios of attack sorties to combat losses of attack and support sorties. These loss rates are comparable only to the loss rates listed in the footnote to Table 17. However, ratios of attack sorties to combat losses of attack sorties would show little difference in the relative loss rates between Route Packages.

The disproportionately high loss rates in Route Package VI are attributable in large measure to the losses sustained while attacking targets close to Hanoi or Haiphong. The loss rate over these areas during April-September 1967 came to 19.5 combat losses of attack aircraft per 1,000

Shares of Attack Sorties and Combat Losses, 1967

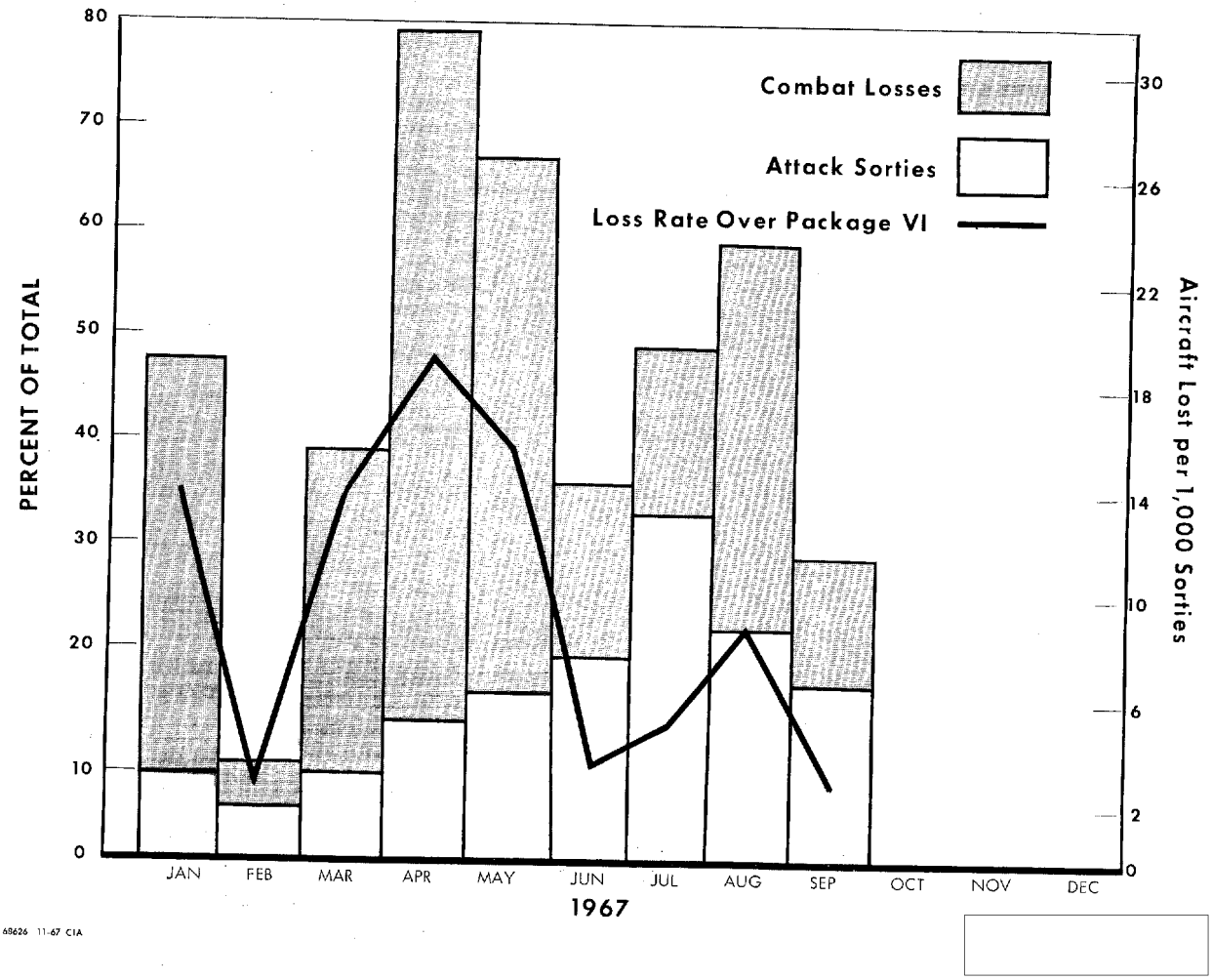

Figure 6. Shares of Attack Sorties and Combat Losses Over Route Package VI, January-September 1967

attack sorties. During April, May, and August, attacks over Hanoi and Haiphong accounted for more than one-fourth of the attack aircraft lost in combat under the Rolling Thunder program, although the targets taken under attack accounted for less than 3 percent of total attack sorties. Six of the ten aircraft losses in action against electric powerplants occurred on about 100 sorties that attacked the Hanoi Thermal Powerplant and the Hanoi Transformer Substation. The following tabulation gives sorties, losses, and loss rates recorded

during attacks within 10 nautical miles of Hanoi and Haiphong during April-September 1967.

	Hanoi/Haiphong Areas		
Month	Attack Sorties	Combat Losses	Loss Rate a/
Second quarter	800	21	26.2
April	313	11	35.1
May	389	9	23.1
June	98	1	10.2
Third quarter	685	8	11.7
July	91	0	0
August	372	7	18.8
September	222	1	4.5
Total	*1,485*	*29*	*19.5*

a. Combat losses of attack aircraft per 1,000 attack sorties.

D. North Vietnamese Claims

Since the first US attacks against North Vietnamese targets during August 1964, North Vietnam has claimed shooting down a total of 2,343 US aircraft through September 1967. The actual figure of 689 combat losses amounts to less than one-third of the claimed number. A breakdown by area given by the North Vietnamese during August 1967 for about 2,200 of the claimed downings shows a Route Package distribution similar to that indicated by US data. The largest difference is in Route Package VI, where Hanoi claims downing only 32 percent of the total number of aircraft lost since the start of the Rolling Thunder program (compared with an actual of 52 percent during January-September 1967) suggesting that air defense units in this Route Package make less exaggerated claims than those in the rest of the country. The following tabulation gives a breakdown, by Route Package, of claims by North Vietnam of downed US aircraft through August 1967.

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	Route Package						
	I	II	III	IV	V	VI	Total
Claimed aircraft downings	447	143	279	379	242	715	2,205
Percent	20	7	13	17	11	32	100
Percent based on US data, Jan-Sep 1967 a/	23	3	10	8	3	52	100

a. Combat losses of attack and support aircraft. Because of rounding, components may not add to the totals shown.

E. Personnel Losses

During the period August 1964 through 27 November 1967, 1,058 US Air Force, Navy, and Marine Corps personnel went down with aircraft disabled by hostile action over North Vietnam. One-third of the downed personnel -- 349 men -- were rescued by US search and rescue forces. Intelligence reports and reports based on observations by crews of aircraft accompanying downed Air Force and Navy sorties have established that at least 20 percent of the downed personnel have been captured and 10 percent were killed. More than one-third are carried as missing, 25X1

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25X1 The following tabulation shows the status of personnel in each service downed during August 1964 through 27 November 1967.

	Downed	Rescued	Captured	Killed	Missing
Air Force	636	203	92	29	312
Navy	395	135	113	80	67
Marine Corps	27	11	5	0	11
Total	*1,058*	*349*	*210*	*109*	*390*
Percent	100	33	20	10	37

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Heavy defenses around Hanoi and Haiphong severely limit search and rescue efforts in these areas. Only 16 percent of 141 personnel downed by enemy action in Route Package VI during the period January through September 1967 were rescued, compared with the overall share since August 1964 of 33 percent. Because of hostile surroundings, no search and rescue efforts were initiated for at least 20 percent of the 141 personnel downed by defenses in Route Package VI.

Appendix A

Transportation in the Hanoi and Haiphong Areas

I. The Hanoi Area

A. General

Attacks in the Hanoi area have resulted in the most significant damage against the North Vietnamese transportation system yet inflicted by the air campaign. The successful interdiction of the two key Hanoi bridges -- the Hanoi Railroad/Highway (Paul Doumer) Bridge over the Red River and the Hanoi Railroad/Highway Bridge over the Canal des Rapides -- has forced the North Vietnamese to rely on an elaborate series of rail and highway bypasses at each of the two bridges, increasing the time and labor needed to maintain traffic (see Figure 7). The total capacity of these bypasses is substantial, however, and if all are used at the same time the North Vietnamese can move a considerable volume of traffic.

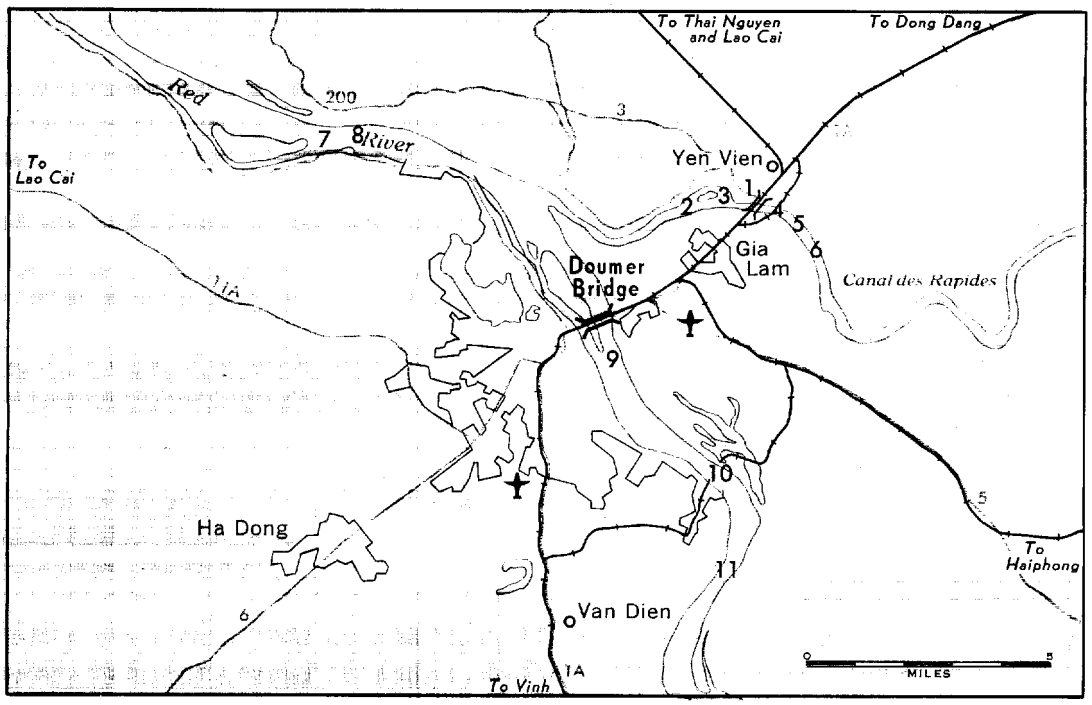
B. The Hanoi Transportation Network

The transportation network in the immediate Hanoi area -- from the center of Hanoi to the Yen Vien classification yard, 11 kilometers from Hanoi -- is a key connection for all traffic moving between Hanoi and China, south to Vinh, or east to Haiphong. This section contains two of North Vietnam's most important railroad/highway bridges and three of its largest railroad classification yards, Yen Vien, Gia Lam, and Hanoi. All rail and highway traffic between Hanoi and Haiphong, Dong Dang, Lao Cai, and Thai Nguyen must cross the mile-long Hanoi Railroad/Highway (Doumer) Bridge over the Red River. In addition, traffic from areas north of the Canal des Rapides must use the Hanoi Railroad/Highway Bridge over the Canal des Rapides to reach the yard at Gia Lam and the Doumer Bridge. The rail line from Haiphong to Hanoi joins the rail line into Hanoi at Gia Lam, south of the Canal des Rapides bridge.

C. Attacks on the Doumer and Canal des Rapides Bridges

The key Doumer Bridge was interdicted initially on 11 August by an attack that destroyed 250 feet of the bridge and effectively disrupted through rail and highway traffic between Hanoi and Haiphong, and between Hanoi and points north of the Canal des Rapides. It is possible that damage would have been much greater if the North Vietnamese had not built 29 additional supporting piers before the attack. The piers reduced the possibility that long bridge sections would be dropped. After 11 August traffic across the Red River was limited to the use of four highway ferry facilities, one highway pontoon bridge, and a series of three pairs of rail ferry slips. All of these were available before the attacks started. If all the highway and rail bypasses in place across the Red River on 11 August were in operation at one time, an estimated 5,000 to 5,500 tons each way per day could be moved, of which 1,300 tons could be handled by the rail ferries. Later photography revealed two other highway ferries about 11 kilometers northwest of the Doumer Bridge and an additional highway pontoon bridge 10 kilometers to the south. These additions represented increased capacity of about 3,100 tons. In addition, there are at least 34 highway ferries shown in photography between Hanoi and Phu Tho, about 100 kilometers from Hanoi, which could have been used as alternates. The Doumer Bridge was reopened to truck traffic on 9 September, less than 30 days after being interdicted. Limited rail traffic across the bridge was restored by at least 4 October. Collateral sources indicate the bridge probably could not support a locomotive because rail freight cars were shuttled across the repaired span.

The main bridge over the Canal des Rapides was damaged on 12 August, but through rail service was not seriously affected, because a previously constructed rail bypass bridge equal in capacity to the main bridge was available. On 22 August this bypass bridge was interdicted, thus disrupting the flow of traffic from Dong Dang, Thai Nguyen, and Lao Cai to the Red River and to Haiphong. After 22 August, traffic across the Canal des Rapides was temporarily forced to use either a highway



1 Original Canal des Rapides Bridge
2 Highway ferry and pontoon bridge
3 Highway cable bridge
4 Alternate rail/highway bridge
5 Probable rail/highway bridge (u/c)
6 Rail ferry
7 Highway ferry
8 Highway ferry
9 Three highway ferries
10 Rail ferry
11 Two highway pontoon bridges or one highway pontoon bridge and one highway ferry

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Figure 7. Hanoi Area Bypass System

ferry, a highway pontoon bridge, or a rail ferry. These bypasses could probably accommodate traffic of about 5,000 to 5,500 tons each way per day, of which about 1,800 tons could be moved by rail ferry. This capacity is compared to an estimated international traffic of 800 tons per day moving south from Dong Dang in August 1967. In October, the number of bypasses across the Canal des Rapides was increased to include one highway pontoon bridge, one highway ferry, a highway cable bridge, and a rail ferry. The concrete and steel railroad bypass bridge was interdicted and not available. The combined capacity of these bypasses is estimated at 5,600 tons each way per day. The Canal des Rapides Bridge was noted to be restored for both rail and truck traffic in 17 September photography.

The Doumer Bridge was attacked again on 25 October and two spans were destroyed. Through rail and highway traffic between Hanoi and Haiphong and Hanoi and points north of the Canal des Rapides was again effectively disrupted and dependent on the bypasses to the Doumer Bridge. However, photography of 17 November showed that this bridge had been restored for truck traffic. In the past, the bridge required about 30 days to repair for truck traffic and an additional 23 days for restoration of limited rail traffic.

The Canal des Rapides Bridge was reattacked on 28 October, and one span displaced, thus disrupting the flow of traffic to the Red River and Haiphong from Dong Dang, Thai Nguyen, and Lao Cai. Both rail and truck traffic from these areas were again forced to use the bypasses over the Canal des Rapides. However, photography of 17 November showed that this bridge was serviceable to truck traffic.

Rail traffic moving south from Dong Dang could be accommodated by the rail ferry over the Canal des Rapides. To enter Hanoi by rail, however, trains from Dong Dang would have to cross the Canal des Rapides, enter Gia Lam, and move east on the Haiphong line to the rail ferry bypass line, then ferry across the Red River and enter Hanoi from the south. This routing would interfere with traffic from Haiphong which also must use the Red River rail bypass to enter Hanoi. Thus it is

more likely that goods from Dong Dang are being transshipped at Gia Lam and moved into Hanoi by truck. The several highway bypasses over the Red River and the inland water system in the Delta area are more than adequate to handle the diverted traffic in the Hanoi area, should the restored bridge be interdicted again.

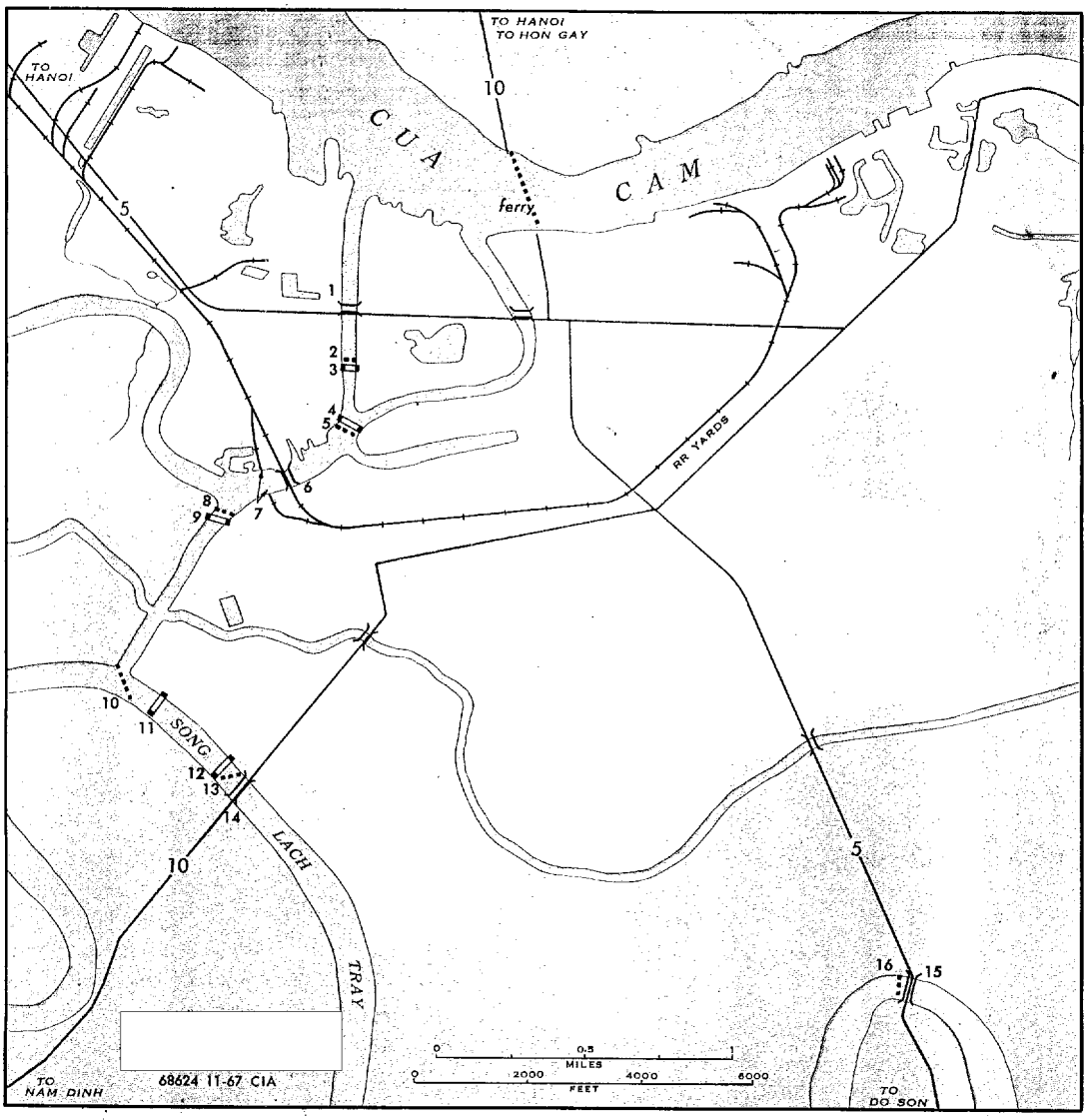
II. The Haiphong Area

A. General

The transportation system between Haiphong and the interior has been disrupted by recent air operations. Slight increases in cargo in some open storage areas and no increase in other areas are apparent in comparative photography of 4 and 18 October. This stockpiling may reflect North Vietnamese use of the area as a safe haven, protected from attack by its proximity to foreign ships and to heavily populated civilian residential areas. Photography showed an increased number of sampans and barges at the port. Although all the original targeted bridges in Haiphong have been damaged, at least ten recently constructed highway bypasses assure the movement of a considerable volume of traffic (see Figure 8).

B. Rail Transport

Rail traffic to and from Haiphong has been seriously affected by airstrikes during the past few months. Strikes were directed against the railroad/highway bridges and railroad yards at Hai Duong, Hai Duong East, and Ngoc Kuyet. Through rail traffic at these points was disrupted for short periods; however, the system of rail and highway bypasses was capable of maintaining the movement of traffic and supporting about 5,500 tons each way per day. The limiting capacity for through rail traffic was apparently the pontoon rail ferry at Hai Duong Bridge East. This ferry probably restricted through rail traffic to 1,000 tons each way per day. By transloading and using the highway bypasses at this point, however, the uninterdicted capacity of the line - 4,000 to 5,000 tons each way per day - could have been achieved. It is estimated that the line handled only 3,150 tons daily of international traffic in August 1967



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1 *HIGHWAY BRIDGE* 735' steel thru-truss
1 span and lift tower destroyed, 2 approach spans destroyed } 18 Sep 1967
30 Sep 1967-no change

2 *FERRY LANDING*-18 Oct 1967

3 *PONTOON BRIDGE*-30 Sep 1967

4 *PONTOON BRIDGE*-30 Sep 1967

5 *FERRY LANDING*-30 Sep 1967
1 ferry noted

6 *RAIL/HIGHWAY BRIDGE* 300' steel thru-truss
1 span dropped, 2 spans destroyed } 30 Sep 1967

7 *PROBABLE RAILROAD BRIDGE BYPASS*
under construction-2 Jul 1966
work continuing-18 Oct 1967

8 *FERRY LANDING*
2 ferries noted-30 Sep 1967

9 *PONTOON BRIDGE*-18 Oct 1967

10 *FERRY LANDING*-4 Oct 1967
1 ferry noted

11 *PONTOON BRIDGE*-4 Oct 1967

12 *PONTOON BRIDGE*-4 Oct 1967

13 *FERRY LANDING*
no ferry noted, 1 landing damaged } 4 Oct 1967

14 *HIGHWAY BRIDGE (SW)* 665' half thru-truss and deck
2 spans destroyed-4 Oct 1967

15 *HIGHWAY BRIDGE (SSE)* 520' steel thru-truss
4 spans dropped, 2 piers destroyed } 4 Sep 1967

16 *FERRY LANDING and POSSIBLE PONTOON SECTIONS*
no ferry noted-18 Oct 1967

Figure 8. Status of Haiphong Bridges, 4 September-18 October 1967

(2,900 tons westbound and 250 tons eastbound). In September the railroad/highway bridge and the railroad yard (west) at Haiphong were attacked. On 28 September the railroad/highway bridge was destroyed, effectively stopping through rail traffic out of Haiphong proper. No rail bypass is avaiable, but one is under construction. However, rail traffic can continue on the Hanoi-Haiphong line west of the interdicted bridge, and trucks can be employed to move goods to Haiphong Railroad Yard West near the bridge, where the material can be transshipped to trains.

C. Roads

The several major and numerous secondary roads serving Haiphong have been moderately damaged during the course of the Rolling Thunder program. The most important of these comprise Route 5, paralleling the rail line to Hanoi with a capacity of 5,000 tons each way per day, and Route 10, serving the areas north and south of Haiphong with a capacity of 1,000 tons each way per day. In addition, a number of secondary roads connect these routes and provide a flexible network for the movement of goods in the region south of Haiphong. In September, three vital highway bridges in Haiphong (Kien An Highway Bridge on Route 10 and Haiphong Highway Bridges South Southeast and North Northwest on Route 5) were destroyed. The loss of these key bridges undoubtedly disrupted the movement of goods out of the port by truck until effective countermeasures, such as highway pontoon bridges or highway ferries, were organized.

D. Water Routes

Two principal and numerous minor water routes connect Haiphong and Hanoi. The southern route via the Canal des Bambous and the Red River has the largest capacity and is used most intensively. The northern route consists of the Song Thai Binh and Canal des Rapides. Available photography of these waterways reveals large numbers of barges and sampans, representing a substantial carrying capacity. While attacks against watercraft in these areas have occurred occasionally during armed reconnaissance missions, no sustained air campaign was conducted against the

waterway system in the area until June 1967. At that time a mining program was extended from waterways south of 20 degrees north latitude to all the principal lines of communication in North Vietnam, particularly those between Hanoi and Haiphong. A new more sensitive magnetic-influenced mine for use on land routes as well as waterways was also introduced (see Appendix B).

E. Residual Transport Capacity

Five highway pontoon bridges and six highway ferries determine the remaining capacity of the Haiphong transportation system. Three of the highway ferries have been noted in operation. If all three highway ferries and all pontoon bridges leading out of Haiphong were in operation at one time, an estimated 14,200 tons each way per day could be moved, of which about 700 tons could be handled by the three ferries and 13,500 tons by the pontoon bridges. This volume represents nearly twice the uninterdicted capacity of the Hanoi-Haiphong railroad line and about two times the daily movement of traffic to Hanoi at the peak of imports during 1967. Photography of 18 October indicates that construction is proceeding on the rail bypass to the interdicted Haiphong Railroad/Highway Bridge. The completion of this rail bypass, first seen in the early stages of construction in July 1966, will eliminate some of the time-consuming and less efficient operations of moving goods out of the port by truck or watercraft.

Appendix B

The MK-36 Mining Program in North Vietnam

The concentration of the interdiction effort against rail and highway lines of communication in North Vietnam and the increasing disruption of land traffic operations forced the North Vietnamese to resort to greater use of the inland water system in 1965-66. This system for the most part had to cope only with armed reconnaissance attacks against barges and watercraft through 1966. In early 1967 a mining program was undertaken as part of an overall effort for more effective interdiction of inland water traffic.

I. The MK-50/MK-52 Mining Program

A modest mining program using conventional MK-50 and MK-52 mines was undertaken during the period 26 February - 21 May 1967 to disrupt inland water transport in the area south of 20 degrees north latitude. A total of 143 mines were placed in or near the mouth of five southern rivers. These waterways were the principal routes for waterborne traffic in the area south of the Red River and included the Song Ma, Song Ca, Cua Sot, Song Giang, and Kien Giang Rivers.

The program was not effective -- principally because the conventional acoustic- and magnetic-detonated mines being used were not suited for the area where they were employed. The mines require minimum depths of 12 or 18 feet to be armed, depths seldom found in these areas. Moreover, the North Vietnamese were able to mount simple and well-organized countermeasures that effectively neutralized the program.

II. The MK-36 Program

The development of a more sophisticated magnetic weapon, the MK-36, made it possible to undertake a more extensive mining program with a greater potential for interdicting all of the principal lines of communication in North Vietnam.

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The MK-36 weapon is a converted MK-82, 500-pound, low-drag bomb with a life span of about four months. It is armed on land or water impact and is effective in water up to depths of 60 feet. This device differs from the MK-50 and MK-52 mines because it does not require a minimum water depth for arming. It can be detonated by the magnetic influence of rifles at 10 to 15 feet or trucks at 40 to 60 feet. Its effective radius of destruction is believed to be 20 feet on land and 35 feet in water. Tests are still being conducted to determine the actual radii of destruction.

The MK-36 program is a three-phase operation with emphasis on the Haiphong area. Phase I is a plan to isolate the Hanoi-Haiphong area by seeding the most vulnerable points along the important transportation routes between the two cities. Selective seeding of the Lao Cai and Dong Dang railroad lines at priority areas is also part of Phase I as is the mining of key transport routes in the southern part of the country, particularly in the vicinity of Vinh, Cap Mui Ron, Quang Khe, and Dong Hoi. Phase II is designed to isolate Vinh and to seal off the major lines of communication south toward the DMZ and north toward the northeast sector. Phase III calls for the mining of all major land and waterway routes throughout the country and the use of the MK-36 to neutralize all countermeasures taken to reduce the effects of interdiction. Some parts of each phase of the MK-36 program have been implemented, but other parts, such as the attempted isolation of Vinh, have not been undertaken.

III. Implementation of the MK-36 Program Through 30 October

Use of the newly developed MK-36 weapon against transport targets in North Vietnam began on 20 June of this year. About 26,000 MK-36 weapons are required to implement the three phases of the program. Between 20 June and 30 October, nearly 4,300 MK-36 weapons have been placed in various rivers and estuaries, near highway ferries or fords, on roads, and near rail and highway bridges. About 50 percent of the weapons have been placed in the Hanoi - Haiphong area, with 666 weapons placed in the immediate vicinity of the port of

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Haiphong. The Haiphong Railroad/Highway Bridge, several ferry crossings near the three targeted highway bridges, and strategic stretches on the Cua Cam River also have been seeded, as shown in the following tabulation.

Location	Number of MK-36 Weapons
Haiphong Highway Bridge South Southeast	63
Haiphong Boat Yard at Lach Tray	62
Haiphong Railroad/Highway Bridge	56
Haiphong Highway Bridge and Pontoon Bypass	169
Loi Dong POL Transshipment Area	15
Cua Cam River	40
Kien An Highway Bridge	83
Kien An Ferry	16
Kien An Ferry Northeast	47
Kien Bai Highway Ferry	67
Vat Cach Ha Junction	48
Total	*666*

The major transportation routes connecting Hanoi and Haiphong have been seeded with 600 weapons. Devices have been placed at important ferry crossings along the Song Thai Binh River, which connects with the Canal des Rapides. Important ferries and bridges on the Hanoi-Haiphong railroad line and highway Route 5 have been heavily seeded, especially near Hai Duong. In the immediate Hanoi area, the MK-36 has been placed at the Hanoi Railroad/Highway (Doumer) Bridge over the Red River and the railroad ferry bypass three miles south of this bridge. In addition, the Kim Quan Highway Ferry south of the rail ferry bypass has been seeded.

In the area between Haiphong and 20 degrees north latitude, nearly 500 weapons (12 percent of the total) have been planted along Routes 6 and 10, along the Canal des Bambous, and at major ferries and highway bridges. These include the Tu-Y Highway Bridge and the Lang Lien and Noi Thang ferries.

A little less than half of the weapons have been placed south of 20 degrees north latitude. The five selected rivers (Song Ma, Song Ca, Cua Sot, Song Giang, and Kien Giang), which were attacked under the first mining program continue to be seeded. In addition, other key facilities such as the Ron Ferry Complex, the Vinh Son Highway Ferry (at the junction of Routes 7 and 15), the Song Kinh Highway Bridge, and Tho Ngoa Ferry and Highway Bridge have been seeded. More than 25 percent of weapons deployed in this area have been placed along the Ben Hai River in the DMZ.

The Red River near Phu Tho and the Viet Tri Railroad Ferry have recently been seeded with 260 weapons in accordance with Phase I for selective seeding of the Lao Cai railroad line.

In addition, the dropping of more than 100 weapons on the Kep Airfield and areas nearby illustrates the program's broad application to land areas as well.

IV. Effectivenss of the Program

Little evidence is available regarding the effectiveness of the MK-36 program. It seems clear, however, that the MK-36 program has had a greater impact on North Vietnamese logistic operations than the ineffective MK-50/MK-52 mining program. Photography has revealed that the ferry at Ben Thuy did not operate for two months after a seeding on 20 June, although other ferry sites were used and the movement of traffic continued. Photography also shows that MK-36's probably damaged the northern low-water ferry slip on the railroad bypass around Hanoi. This damage did not halt the movement of traffic, however, because the northern high-water ferry slip was in use.

Apart from these possibilities, photography supplies no evidence of disruption to traffic that can be attributed to the use of the MK-36 exclusively. In about 30 target areas searched for effects of the MK-36, only three areas in addition to those noted above showed significant change in traffic patterns. These were the Loi Dong Transshipment Area on the

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Cua Cam near Haiphong, the Haiphong Railway/Highway Bridge, and a segment of the Red River at Lang Tien Ca. In all of these cases, however, it is impossible to determine whether the change observed resulted from the MK-36 or from regular bombs, including delayed action bombs, that have been dropped in all target areas. In all other MK-36 target areas searched, there appeared to be little change in the low level of traffic observed during daylight hours.

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the MK-36 and the delayed action bombs, or both, are creating additional problems and some apprehension. For example, it is quite possible that repairs have been delayed on land routes out of Haiphong because of such weapons. There is no evidence that the North Vietnamese have yet developed a capability to disarm the MK-36, and there is some opinion that they will not be able to develop this capability. On the other hand, the MK-36 program is still just getting under way, and the North Vietnamese have shown over the past two and one-half years a considerable capability for developing simple and effective countermeasures to modern weaponry.

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