4.4 Aircraft Early Warning and Control

We can increase the effectiveness of the air defense system and enable prospective targets to take protective measures by furnishing early warning. Factors unique to Korea, however, make this difficult: The proximity of ROKAF and NKAF bases would limit the warning time for a North Korean surprise attack in any case. Kimpo, the northernmost ROKAF airbase, is only 6 minutes flying time from the DMZ and 13 minutes from the nearest NKAF airfield.

The present warning system can do several things for the Koreans. First, it can furnish early-warning of a mass attack, giving defense forces five minutes at least to scramble forces and for defenders to take cover and to man defense artillery. Warning against a massive attack could be improved by one to five minutes, at most, by positioning OTH radar in Okinawa.

The effectiveness of OTH for this type mission is open to question: Operational experience is not available. OTH is susceptible to false alarms. Although not sufficiently accurate to control friendly aircraft, if technical specifications are met it would be capable of performing selective scans of high interest areas such as NKAF airfields, in addition to providing general surveillance of airspace over North Korea and Southern Manchuria. At best, in terms of the ROK defense problem, the system might be able to detect NKAF aircraft shortly after take-off. In this event, we would still have to establish their intent to attack the ROK. OTH might also contribute to our ability to detect a NKAF pre-attack stand-down. However, it is difficult to envision such a stand-down going undetected given existing surveillance techniques such as air-to-ground radio monitors and ELINT collectors. Okinawa is the preferred location for an OTH covering North Korea, since the radar tracks head-on targets best and a NKAF attack would be directly toward an Okinawa radar. If Okinawa is unavailable for political reasons, Taiwan or Japan may be considered as alternative sites.

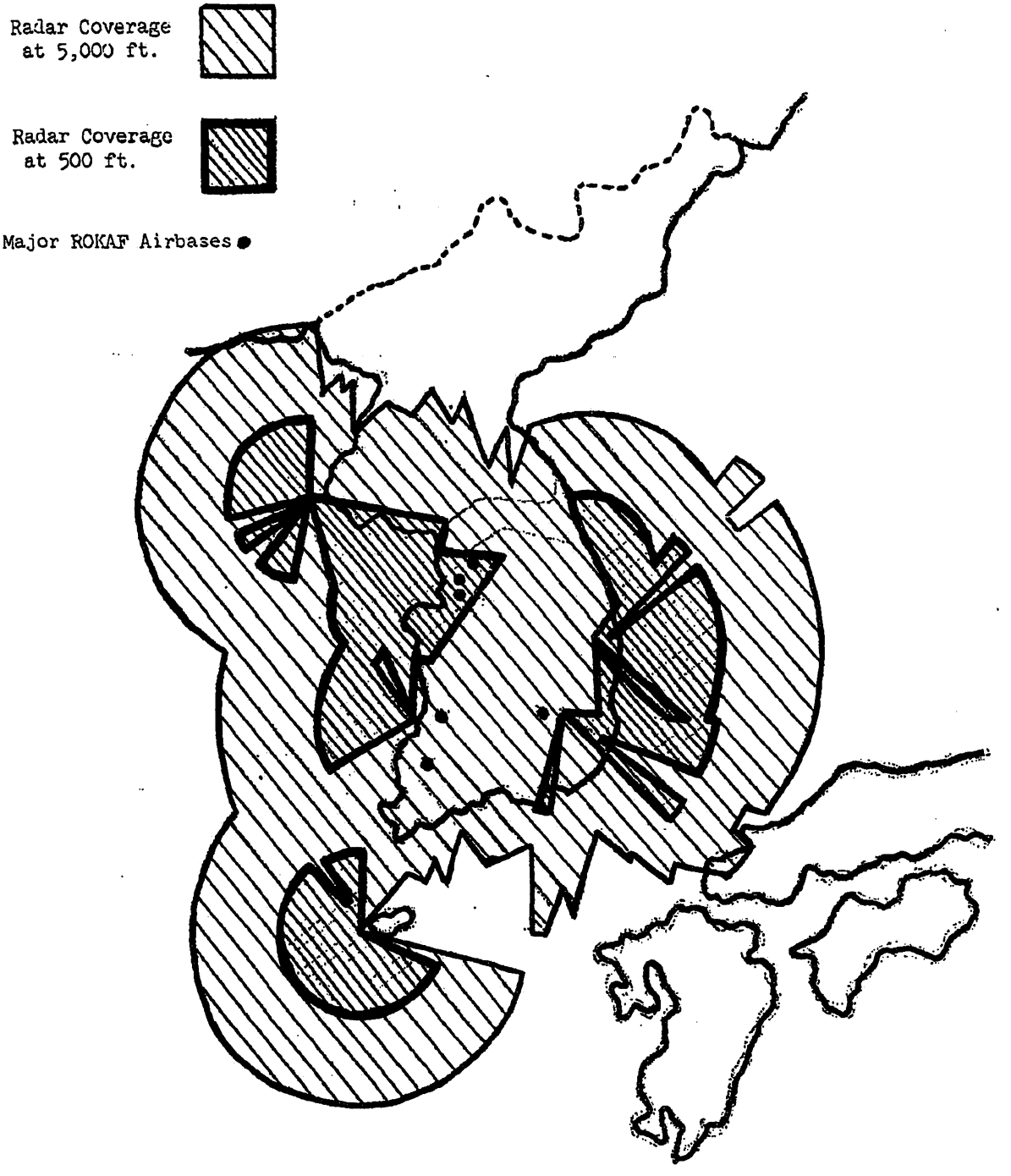
There are gaps in the present AC&W system. Due to the mountainous terrain in Korea, there is a low-level coverage problem, particularly north of Seoul (see Figure 4-2). There are also gaps in coverage of sea approach routes. Some current USA sites help fill these gaps: The HAWK radars can cover the DMZ, but their limited "look-down" capability does not alleviate the low-level coverage problem to any degree. Otherwise, there is no way to close these gaps completely.

The effectiveness of the system is also impaired by operational difficulties. The limited technical capability of the ROK personnel, at present training levels, means that reports are not always reliable. Moreover, even if effective sightings were obtained, communicating them to defense units could become a problem. For example, ineffective communications between the ROKN coastal watch and the Korean TACC minimizes the air defense contribution of the Navy radars.

Second, the present ROKAF early-warning system is also useful for controlled intercept of incoming attack aircraft.

FIGURE 4-2

ROKAF RADAR COVERAGE



Since this mission is more complicated than the first, the somewhat out-dated ROKAF AC&W system is not so effective as one might desire. At present, there are eight radars which are under the Joint ROKAF/USAF Tactical Air Control Center (TACC) at Osan which could be used to guide interceptors. This present control system and scope capacity should permit simultaneous control of about 95 individual interceptor aircraft, or up to 380 aircraft flying in flights of four.

The effectiveness of the AC&W system for this intercept mission is impaired by several factors. First, the warning times afforded by the present manual system (as low as 5 minutes as mentioned above) would not be adequate to allow interception of surprise attackers prior to their arrival over ROK targets. Improved communications could reduce the delay between detection, identification and alert, although the time lag between detection and identification should approach zero if large numbers of attackers cross the DMZ. Some increase in warning time might also be achieved by employing a semi-automatic AC&W system to reduce reaction time. The technical competence of ROK operations and the technical reliability of the system are important considerations in evaluating this means of extending warning time.

To introduce a semi-automatic AC&W system, either stepped-up US participation or intensified ROKAF training would be required, particularly in the maintenance area, to offset the limited technical proficiency heretofore demonstrated by poorly trained ROKAF personnel. Theoretically, more air defense interceptors could be controlled simultaneously with a semi-automatic AC&W system, but ground radar control in a "dog fight" environment is approximate at best, and an improved manual system would be fully capable of providing this level of assistance. Finally, forward deployment of a sophisticated AC&W system, where the sites are exposed to repeated air attack, could result in less rather than more control capability compared to the simpler but more resilient manual system.

ROKAF AC&W communications have suffered primarily from the low skill level of ROKAF maintenance personnel and a lack of available spares at outlying locations. Some improvement has been made recently through the delivery of critical spares by helicopter. Still, the Korean point-to-point communications system is only marginally capable of providing the necessary intersite communications required to meet an all-out air attack. COMUSKOREA and CINCPAC have recently completed an in-depth analysis of the US and MAP circuit requirements in Korea. The Defense Communications Agency (DCA) has since utilized this information to develop a comprehensive communications improvement program to meet US requirements. A description of the ROKAF communications system and circuit requirements appears in Annex III, Appendix H.

4.5 Alternative Air Defense Posture

Four alternative Korean ADA postures for defending both ground forces and key military installations are outlined below. The first represents a continuation of the present program with stress placed on area coverage missiles 70% of which are US-manned; the second expands air defense capability by maintaining present missiles and adding essential point defense guns, while the third and fourth de-emphasize area coverage by withdrawing some or all US units and replacing them with a lesser number of ROKA units equipped with improved HAWKs.

Alternative I

Continue the present FY 70-74 MAP emphasizing area coverage with ADA missiles (predominately US Army units) at costs (in millions) of: $34.9 US Military Department, $13.2 MAP and $8.6 ROK budget.

Alternative II

Improve ROKA point air defenses by providing 40mm DUSTER guns and additional .50 caliber machine guns; provide REDEYE missiles to the ROKA for use by ground forces (assuming this weapon is released for distribution to foreign nationals). Since this alternative maintains US ADA strength at the current level, it represents an increase in overall ROK air defenses of 17-3/4 to 25-3/4 M42/M55 automative weapons batteries (depending on the number of airbases defended) and 120 REDEYE teams (720 missiles). Compared to Alternative I, MAP costs would rise by an estimated $49.5 million while ROK budget costs would increase by about $23.7 for the five-year period; US Military Department costs would remain unchanged at $349.0 million.

Alternative III

Improve ROKA point air defenses as in Alternative II without providing REDEYE to ground forces. Withdraw all six US HERCULES batteries and eight of sixteen US HAWK batteries; US REDEYE and VULCAN/CHAPARRAL would remain for defense of US ground forces. To partially offset the withdrawal of US area coverage missiles, ROKA would be equipped with twelve batteries of improved HAWK by modifying eight existing ROKA HAWK batteries and four of the withdrawn US batteries. The remainder of withdrawn US batteries (6 HERCULES and 4 HAWK) would be placed in CONUS reserve. Alternative III represents an increase in point defenses (+17 3/4 to 25 3/4 gun batteries) and some net decrease in area coverage strength depending on the effectiveness of improved HAWK manned by ROKA relative to HERCULES and existing HAWK manned by the US (-6 US HERCULES, 8 US HAWK and 8 ROKA HAWK batteries vs. +12 ROKA improved HAWK batteries). Estimated cost changes over the present MAP are: -$181.2 million US Military Department, +89.3 MAP (net US reduction of $67.5 million allowing for CONUS reserve costs), and +$25.2 ROK budget.

Alternative IV

ROKA point air defenses are improved as in Alternatives II and III without provision of REDEYE to ground forces. All US area coverage missile units are withdrawn; US REDEYE and VULCAN/CHAPARRAL remain as long as US ground forces are not reduced. ROKA is provided with twenty batteries of improved HAWK (8 existing ROKA batteries modified and 12 US batteries modified and turned over to ROKA). ROKA HERCULES batteries are withdrawn and placed in CONUS reserve along with 6 US HERCULES and 4 US HAWK batteries. Net change in area coverage missile strength again depends on the efficiency of improved HAWK in ROKA hands (-6 US HERCULES, 16 US HAWK, 4 ROKA HERCULES, 8 ROKA HAWK vs. +20 ROKA improved HAWK). Compared to the present MAP, US costs would decrease by $121.1 million (-$280.5 US Military Department, +$124.9 MAP and +$34.5 CONUS reserve) while ROK budget costs would rise by $29.0 million.

Strengths and costs associated with each alternative are summarized in Table 4-11.

Inclusion of over-the-horizon radar (OTH) with any of the alternative forces would increase air defense costs by about $25.7 million (in US Military Department account), while a semiautomatic AC&W system would add another $49.5 million to MAP costs. Both systems are expensive and technically complex and uncertain. US operation and maintenance would be required in each case in view of observed limitations on ROKAF technical competence and the overseas location of OTH. For these reasons, neither appears worthwhile for Korean air defenses at this time, except perhaps in conjunction with the high-value aircraft inventories contained in Alternative D, Section 2. If ROKAF technical proficiency improves, and OTH reliability is operationally demonstrated, the feasibility of employing this system at some later date should be re-examined.

TABLE X-11

FY 70-74 US/ROKA AIR DEFENSE ALTERNATIVES OF KOREA
(Costs in Millions $ US)

	US				ROKA					Total ADA in Korea (FY 70-74)	Withdrawn ADA Places in CONUS Reserve	Total Costs (FY70-74)
ALTERNATIVE I (Current MAP)	HAWK	HERCULES	REDEYE 1/	VULCAN/ CHAPARRAL 1/	HAWK	HERCULES	REDEYE	STINGER (M-42/M-55)	Improved HAWK			
Number of Batteries	16	6	105(teams)	4	8	4	0	0	0	38 (+105 REDEYE)	0	
Number of Missiles on Launchers (Weapons for VULCAN and HAWK)	288	54	105	64/256	144	36	-	-	-			
US Military Dept Costs	$198.5	$82.0	$27.0	$41.5	-	-	-	-	-	$349.0	-	
US MAP Costs 2/	-	-	-	-	$10.2	$3.0	-	-	-	13.2	-	
ROK Budget Costs	-	-	-	-	$6.2	$2.4	-	-	-	8.6 / $370.8	-	$370.8 ($60.2 US)
ALTERNATIVE II (ROKA Improved with guns and REDEYE; US Forces remain at current level)												
Number of Batteries	16	6	105(teams)	4	8	4	105(teams)	17 3/4 3/	0	55 3/4 (+22a REDEYE)	0	
Number of Missiles on Launchers (Weapons for VULCAN and CHAPARRAL)	288	54	105	64/256	144	36	105	284/192	-			
US Military Dept Costs	$198.5	$82.0	$27.0	$41.5	-	-	-	-	-	$349.0	-	
US MAP Costs 2/	-	-	-	-	$19.2	$3.0	$5.1	$31.1	-	62.7	-	
ROK Budget Costs	-	-	-	-	$5.9	$2.4	$1.6	$22.1	-	32.3 / $444.0	-	$444.0 ($11.7 US)
ALTERNATIVE III (ROKA Improved with guns and "Improved HAWK;" US HERCULES withdrawn and US HAWK Reduced to two Battalions)												
Number of Batteries	8	0	105(teams)	4	0	4	0	17 3/4	12	45 3/4 (+105 REDEYE)	10 4/	
Number of Missiles on Launchers (Weapons for VULCAN and HAWK)	144	-	105	64/256	-	36	-	284/192	216 5/			
US Military Dept Costs	$99.3	-	$27.0	$41.5	-	-	-	-	-	$167.8	$24.6	
US MAP Costs 2/	-	-	-	-	-	$3.0	-	$14.1	$12.4	$169.5	-	
ROK Budget Costs	-	-	-	-	-	$2.4	-	$22.1	$9.3	33.8 / $370.1	- / $24.4	$394.5 ($94.7 US)
ALTERNATIVE IV (ROKA Improved with guns and "Improved HAWK;" ROKA HERCULES phased-out; US HERCULES and HAWK withdrawn)												
Number of Batteries	0	0	105(teams)	-	0	8	0	17 3/4 3/	20 7/	41 3/4 (+105 REDEYE)	14 6/	
Number of Missiles on Launchers (Weapons for VULCAN and HAWK)	-	-	105	64/256	-	-	-	284/192	360			
US Military Dept Costs	-	-	$27.0	$41.5	-	-	-	-		$68.5	$14.1	
US MAP Costs 2/	-	-	-	-	-	-	-	$14.1	$9.3	$138.1	-	
ROK Budget Costs	-	-	-	-	-	-	-	$22.1	$15.5	$37.6 / $244.2	- / $34.1	$278.3 ($41.1 US)

1/ Committed to direct defense of US ground forces; withdrawal contingent on US ground force reduction.
2/ 18.8% of US active duty costs.
3/ One M-55 deployed with every two M-42s. Two M-42s per HAWK site; four per NIKE site; forty at principal ports; sixteen per major airbase. Five battalions assumed (ROKAF Force 11c E) in Table could increase to as many as fifteen under ROKAF force 11c D thereby raising required gun batteries to 23 3/4 (160 M-42s and 190 M-55s) and associated costs to $59.0 million MAP and $22.9 million ROK budget.
4/ Six HERCULES batteries and four HAWK batteries.
5/ Eight ROKA HAWK batteries modified and equipped with improved HAWK; four US HAWK batteries modified for improved HAWK and turned over to ROKA.
6/ Ten HERCULES batteries and four HAWK batteries.
7/ Eight ROKA HAWK batteries modified and equipped with improved HAWK; twelve US HAWK batteries modified for improved HAWK and turned over to ROKA.
8/ Provision of REDEYE to the ROKA is contingent upon the release of this weapon for distribution to foreign nationals.
9/ Includes investment and operating costs; US Military Department and ROK budget costs are for operations only.

SECTION 5: AIRFIELD CONSTRUCTION

5.1 Summary

Past construction in Korea has fluctuated with the level of North-South tensions. Better balance might be achieved at less cost by adhering to a continuous, comprehensive program. Such a program is now being developed by a JCS study group to include contingency requirements for US air augmentation.

Considerable returns might be realized at relatively small costs by emphasizing hardening of aircraft, POL and munitions facilities at existing airbases. Depending on the ROKAF alternative force, 150% aircraft sheltering for tactical jets could cost from $8 to $21 million, and hardened POL storage another $10-12 million. Some effort in this direction is included in the $48.0 million FY 68 supplemental construction program for Korea. Construction costs under each ROKAF alternative are summarized below.

TABLE 5-1

COST OF CONSTRUCTION IN KOREA (FY 1970 - FY 1974)
(Million $ US)

Basic Requirements	Alt A (JSOP)	Alt B	Alt C	Alt D	Alt E (MAP 74)
Basic Airfield Improvements	$ 41.6	$ 41.6	$ 41.6	41.6	$ 41.6
New Operating Bases (MOB)	159.0	106.0	53.0	212.0	--
Upgrade Existing Facilities	--	14.8	14.8	14.8	--
New Dispersal Bases (DOB)	--	25.6	25.6	25.6	--
Extension to Kangnung	--	.5	.5	.5	--
ALOC (Army Costs)	8.2	8.2	8.2	8.2	--
Aircraft Hardening 1/	8.3 2/	12.5	13.5	16.6	8.4 2/
POL Hardening 1/	--	2.8	2.5	3.9	1.4
Less: Cost of Personnel Chargeable to MAP	-1.3	-1.3	-.8	-2.2	--
Sub-Total US Military Construction Costs	($215.8)	($210.7)	($158.9)	($325.0)	($51.4)
MAP Costs	1.3	3.2	2.5	8.1	0.6
Sub-Total US Costs	($217.1)	($213.9)	($161.4)	($333.1)	($52.0)
ROKAF Budget Costs	31.9	41.3	37.2	45.7	29.4
Sub-Total Basic Requirements	($249.0)	($255.2)	($198.6)	($378.8)	($81.4)
Contingency Requirement					
POL Hardening for US Deployment	10.8 2/	8.4	8.7	8.8	8.5 2/
TOTAL Construction Costs	$259.8	$263.6	$205.3	$387.6	$89.9
Military Construction	(226.6)	(219.1)	(167.6)	(343.8)	(59.9)
MAP	(1.3)	(3.2)	(2.5)	(8.1)	(0.6)
ROKAF Budget	(31.9)	(41.3)	(37.2)	(45.7)	(29.4)

1/ Sensitive to specific basing posture (presently uncertain), estimates derived from an assumed posture following JCS study guidelines.
2/ Not included in present program.

5.2 Past Programs

In the past, improvements to ROK facilities have accelerated in response to periods of serious tensions such as the post-Pueblo crisis situation. Following the Pueblo incident, the Air Force developed a $46.1 million emergency construction program as a supplement to the $3.4 million FY 68 Military Construction Program. USAF construction in Korea averaged $1.8 million annually for the three fiscal years prior to 1968 -- largely to repair existing facilities. The emergency FY 68 MCP-Supplemental was designed to bring the airbases at Kunsan, Kwangju, Osan, Suwon, and Taegu up to minimum US standards.

An adequate ROK facility improvement program has not been maintained within MAP. Consequently, the Pueblo crisis found the six jet-capable Korean airfields deficient in hardstand facilities and lacking the basic "hardening" measures necessary to protect aircraft against air strikes and guerrilla attacks. Only 30 full aircraft revetments existed in all of South Korea, and fuel was stored in highly vulnerable above-ground tanks; ammunition storage facilities were similarly vulnerable.

US and ROKAF construction now planned or underway is summarized below.

TABLE 5-2

AIR FORCE CONSTRUCTION IN KOREA
(Millions of $US)

	MCP FY 1967	FY 1968 MCP	FY 1968 Supplemental	MCP FY 1969	MCP FY 1970	FY 1970 PACAF Proposal
Air Force	$ .9	$3.4	$46.1	$1.5[1/]	--	$52.2
MAP[2/]	.8	1.1	--	--	--	--
MASF	--	--	.6[3/]	--	--	--
ROKAF[4/]	.7	.7	--	2.2	$3.7	--
TOTAL	$2.4	$51.9		$3.7	$3.7	N/A

1/ Includes $805,000 in TABVEE POL hardening requirements.
2/ Does not include MAP program amounts for construction supplies.
3/ CIGCOREP package: $120,000 for Blue Fortune expansion, $389.419 for security fencing, $5,970 for watch towers and $79,042 for lighting.
4/ Programmed on calendar year basis. Amounts were converted to fiscal year basis by means of the formula: $FY2 = \frac{CY1 + CY2}{2}$

The FY 68 MCP-Supplemental has not provided a balanced and orderly construction package. A thorough analysis of POL storage requirements would have disclosed the advantages of dispersing POL storage capacity by constructing a greater number of 10,000 barrel tanks rather than the 40,000-50,000 tanks now under construction at Kunsan, Kwangju, Osan, and Taegu.* Aside from 33 two-sided revetments at Kimpo, no other revetments or shelter programs were planned for the USAF/ROKAF dispersal bases in South Korea.

The emergency reprogramming of sizable "rush" construction activity to Korea creates a "sellers market" because of the limited number of contractors available. For instance, the USAF construction index of .7 for Korea in AFP 88-16 quickly became outdated as USAF construction costs jumped to more than twice their pre-January 1968 levels. In terms of construction values within the ROKAF Won Budget, about 170% inflation was experienced in 1968. ROKAF construction costs are expected to increase by another 156% in 1969. The US could have achieved a better-balanced construction posture, at approximately one-half of the FY 1968 cost, by pursuing a more orderly and gradual program prior to the Pueblo crisis.

The major USAF FY 1968 MCP-Supplemental Program for Korea is summarized in Table 5-3 below:

TABLE 5-3

SUPPLEMENTAL FY 68 MILITARY CONSTRUCTION IN KOREA (USAF)

Purpose of Facility	Cost (Million $ US)
Aircraft Shelters	$ 9.9
Operations	14.1
Maintenance	1.7
Supply	3.1
Medical	.6
Administrative	.6
Cantonment	8.6
Utilities	5.7
Design	1.7
TOTAL	$ 46.0

* The Joint Working Group Report on US Tactical Air Warfare Requirements and Force Effectiveness in the Korean Theatre (pp. 7-1 and 7-2), for instance, demonstrated that the smaller tank facilities would require more than four times the number of NKAF air sorties to destroy as would the large 40,000-50,000 barrel tanks under construction.

After completion of POL hardening outlined in the FY 69 TABVEE program, e entire PACAF construction proposal for Korea in FY 70 (totaling $52.2 illion) was deleted from the FY 70 Construction Program Request to Congress. he deleted PACAF proposals are itemized in Table 5-4 below.

TABLE 5-4

PACAF PROPOSED FY 70 MILITARY CONSTRUCTION PROGRAM

Runways, taxiway improvements	$ 6.175
Alert pads and facilities	3.368
Fuel storage (hardened)	2.580
Ammunition storage	2.968
Aprons	3.368
Operational facilities	2.279
Lighting	.700
Utilities	2.616
Shelters and hangars	5.596
Communications facilities	5.435
Maintenance and shop facilities	4.440
Logistics facilities	4.890
Personnel quarters and facilities	7.596
Boundary fencing	.480
TOTAL	$52.191 Million

The proposed FY 70 PACAF construction package would have extended the air base hardening program to Kangnung, Pusan, Kimhae, and Kimpo. However, the bulk of the program would have been applied toward improving basic USAF deployment facilities at Osan, Kunsan, Taegu, Suwon, and Kwangju as summarized below:

Base	Cost ($ Millions)
Kang Nung	$ 3.410
Kimhae	2.990
Kimpo	.768
Kunsan	8.324
Kwangju	5.491
Osan	11.026
Pusan	3.453
Suwon	3.768
Taegu	12.961

5. Construction Cost Parameters in Korea

In light of rapidly escalating Korean construction costs, it was necessary to revise cost factors for future construction activity. New estimates for Korean construction costs are:

Twelve inch concrete for runways, runway extensions, aprons, and taxiways	$13,533 + 17.99 (Square Yard)
Two inch asphaltic concrete for runway overruns	$13,533 + $3.50 (Square Yard)
Hardened POL storage facilities	$13,705 + $11.93 (Barrel of Capacity)
Warehouse Facilities	$35,455 + $10.08 (Square Foot)
Maintenance Shops	$23,580 + $19.31 (Square Foot)
Office Space	$36,045 + $16.85 (Square Foot)
Dormitory Facilities	$1,000 (man)
Office Quarters	$4,865 + $1,913 (man)
Dining Facilities	$288 (man)
Ammunition Storage (Igloo)	$132,917 + $20.65 (Square Foot)

In terms of personnel support facilities, the derived cost multiplier for US personnel can be summarized as follows:

Cost = (No. of Assigned Personnel) ($1,000 for dormitory facilities +
$ 228 for dining facilities +
$ 50.40 per hundred gallons water capacity per day +
$ 395 electric capacity per day +
$ 21.70 per hundred gallons sewer capacity per day)

Therefore: Cost for US Personnel = (Number) (Multiplier of $1817)

For ROKAF personnel, the 6146th AFAG has advised that the cost of facilities construction is considerably less per airman. Based on construction materiels provided within the MAP Program rather than through the Won Budget, the AFAG estimated cost was $300 per man. In this study, cost estimates for personnel facilities reflect the cost of materiels within the MAP Program and the erection cost within the ROKAF Real Estate and Construction Account. The MAP construction materiel multiplier for ROKAF personnel is as follows:

Cost = (No. of Assigned ROKAF Personnel) ($150 for dormitory and dining facilities + $240 for electricity + $76 for water capacity + $22 for sewer capacity)

Therefore: Cost for ROKAF Personnel = (Number) (Multiplier of $488)

5.4 Construction Concept for Alternative Force Structures

In addition to pricing the Air Force construction requirement for Korea developed by the November 1968 Complex Review, this study presents illustrative construction packages keyed to the alternative ROKAF force structures. Each of these packages provides two additional 9,000 foot jet capable airfields. No account is taken of the runway capability of the new Seoul-Pusan highway (this possibility should be examined further).

The two new airfield facilities might be at Chinju/Sachon and at Sangju. The latter facility could also relieve ALOC pressure against Taegu. Sachon is now depicted as a special air warfare center in many of the proposed PACAF and COMUSK basing postures.

Following an analysis and costing of the alternative construction packages, the study will investigate the costs and requirements for base hardening. A summary of the alternative construction packages is as follows:

Alternative A (JSOP): Three new main operating bases, costing $159.0 million, might be considered with the JSOP force. Improvements to ALOC fields would cost another $8.2 million.

Alternative B: Alternative B envisions two new main operating bases (MOBs), upgrading of Kimhae and Sachon, and two new "bare base" facilities (DOBs). In all the alternatives, DOBs would be selected for future possible upgrading to fully operational facilities. Alternative B construction would cost approximately $256.8 million for the FY 1970-74 period.

Alternative C: In addition to upgrading Kimhae and Sachon, Alternative C reflects the addition of one new airfield facility and two "bare bases" for dispersal deployment. The Alternative C construction package is estimated to cost approximately $199.4 million for the FY 1970-74 period.

Alternative D: This is the maximum ROKAF force alternative for the FY 1970-74 period and reflects the construction of four new main operating bases in Korea in addition to upgrading of Kimhae and Sachon. Two bare base facilities would also be constructed under this alternative. The expected cost for Alternative E construction is estimated at $377.1 million for the FY 1970-74 period.

Alternative E (MAP 74): The force posture of the presently projected military assistance program through 1974 might still require additional airfields to provide maximum dispersion and the ability to accommodate augmenting forces. The expected airfield construction costs would be $167.2 million for three new MOBs.

5.5 USAF Construction in Korea

At the request of JCS, COMUSKOREA conducted an intensive construction requirements review for US forces in Korea. This study, completed in November 1968*, was "based upon the current authorized strengths and current missions of US forces." Contingency requirements were not included except for "hard-core, long lead-time" facilities which should be in place prior to a contingency. The estimated costs of the Air Force facilities recommended by COMUSKOREA are summarized in Tables 5-5 and 5-6 on the following page.

* COMUSKOREA, Construction Requirements, Republic of Korea (Complex Review), dated 1 November 1968.

TABLE 5-5

USAF CONSTRUCTION NEEDS IN KOREA BY LOCATION[1/]
(Thousand $ US)

Kimpo	$ 2,844.4
Osan	8,406.9
Kangnung	1,769.4
Suwon	5,784.8
Kimhae	1,353.9
Pusan	1,816.1
Kunsan	5,364.0
Kwangju	5,549.9
Taegu	8,730.8
TOTAL	$41,620.2
POL Storage at Various Bases	10,817.7
TOTAL (with POL Storage)	$52,437.9

1/ As stated by COMUSKOREA

TABLE 5-6

USAF CONSTRUCTION NEEDS IN KOREA BY TYPE OF FACILITY[1/]
(Thousand $ US)

Airfield Pavements	$ 9,338.6
Land Operations Buildings	4,500.8
Maintenance Facilities	7,017.0
Ammo Storage	1,493.5
Cold Storage	2,883.8
Covered Storage	1,298.5
Open Storage	61.2
Administrative, Office & Hospital Facilities	2,519.6
Community Facilities	10,714.3
Troop Housing	145.8
Electricity	1,197.7
Sewerage	449.4
TOTAL	$41,620.2
POL Storage at Various Bases	10,817.7
TOTAL (with POL Storage)	$52,437.9

1/ As stated by COMUSKOREA

Several problems were not resolved by the COMUSKOREA Complex Review: Two new airfield facilities were omitted from airfield requirements, POL hardening/storage was highly concentrated, and provision was not made for additional aircraft sheltering.

5.6 Costs of Various Packages in Korea

New ROKAF Operational Base

The cost of a new operational base is estimated by COMUSKOREA at $80-$90 million. The most recent ROKAF facility was built at Kwangju between 1962 and 1967 and cost $27.5 million. At present day prices, a new facility comparable to Kwangju would cost an estimated $36.3 million as shown in Table 5-7. This study uses a preliminary cost estimate of $53 million for each new ROKAF jet-operational base to allow for added facilities recommended by COMUSKOREA but not included in initial Kwangju base construction.

TABLE 5-7

COST OF "PACKAGE" ROKAF OPERATIONAL FACILITY COMPARABLE TO KWANGJU
(Exclusive of POL Storage, Acft Shelters, & AA Defense)

Site Aquisition, Grading, and Drainage		$ 5,510,900
Crushed Stone/Gravel Base for Runway and Aprons		1,195,000
Concrete (12"):		
Runway - 9,000 ft. x 150 ft.	= 150,000 SY	
Taxiway - 8,000 ft. x 175 ft.	= 66,650	
Apron/Hardstands (48 F-5s and support a/c)	= 60,200 1/	
Dispersal Parking:		
Aprons	= 16,800	
Taxiways	= 92,400	
	386,050 SY	
Cost of 12" Concrete Facilities (13,533 + (17.99) (386,050)		6,945,000
Overruns of 2" Asphaltic Concrete ($3.50) (33,300 SY)		116,500
Land Operation Buildings (49,500 SF)		1,086,400
Maintenance Facilities (86,661 SF)		1,508,300
Ammo Storage (65,000 SF)		1,554,907
Open Storage (20,000 SF)		70,000
Cold Storage (21,000 CF)		672,000
Covered Storage (33,000 SF)		368,095
Administrative/Dispensary Facilities (31,000 SF)		666,530
Community Facilities (120,000 SF)		2,634,765
Personnel (84 Tactical + 476 Maintenance + 310 Support Personnel) x $488		425,600
Roads (15 miles 3" concrete 8" base)		1,374,700
Fencing (50,000 ft.)		465,000
Central Heating and Distribution		3,031,800
Electrical Parts and Distribution (basic)		2,154,000
Lighting, Approach		461,000
Runway, Lighting, Edge		412,500
Taxiway, Lighting		375,000
Communications Facilities		1,798,200
Other Base Support Facilities		3,430,000
TOTAL		$ 36,256,197

1/ Based on AFM-86-4, pp. 42-43.

Bare Bases in Korea

The "bare base" concept includes essential runway, apron, and taxiway facilities together with a basic water supply. The USAF would then provide its own communications, logistics and operational support when occupying the base with augmentation aircraft. Based on a potential to deploy up to two squadrons of F-4s at a bare base facility, the cost for constructing each "bare base" installation in Korea is shown below:

TABLE 5-8

COST OF "BARE BASE" DEPLOYMENT FACILITY (DOB)

Site Acquisition, Grading and Drainage		$5,510,900
Crushed Stone/Gravel Base for Runways, Taxiways & Aprons		806,100
Concrete (12")		
Runway: 9,000 ft x 150 ft = 150,000 SY of 12" concrete		
Taxiways: 7,000 ft x 75 ft = 58,325 SY of 12" concrete		
Aprons: 1/ = 41,600 SY of 12" concrete		
Cost of 12" concrete: $13,533 + $17.99 (249,925)		5,049,400
Runway Overruns: 2,000 ft x 150 ft of 2" asphaltic concrete = 33,300 SY		
Cost of 2" asphaltic concrete: 2/ $3.50 (33,300)		115,500
Water System:		
Well/Treatment Facility	$60,000	
Water Mains, 6,000 ft	49,000	
Storage Tanks	5,500	114,500
Roads (Gravel Untreated) 5 miles		115,200
Minimum Base Cost		$11,711,600

1/ Computed for forty-eight F-4 aircraft utilizing standards in AFM-86-4K for aircraft parked at 45° to apron logitudinal axis:

Width = [1.414 (wing span of 38.4' + 10')] + [Bloc dimension of 47.3] = 115.7 ft.

Length = [(Bloc dimension of 47.3') (24 aircraft per row) + 90 (24 aircraft per row - 1)] = 3205.1

Total Approximate Apron Area 41,600 SY

2/ Assumes addition to previous base construction program above.

In addition to the essential "bare base" facilities shown in Table 5-7, revetments, POL hardening (both discussed in Section 3), and dispersal parking could also be provided at each DOB. These passive defensive measures can greatly reduce aircraft losses from strafing attacks and insurgency efforts. The cost for dispersal parking for forty-eight F-4 aircraft is summarized as follows:

Dispersal Aprons	18,700 SY	
Dispersal Taxiways	37,500 SY	
	56,200 SY	$975,100
Cost = * $17.99 (56,200)		
Crushed Stone/Gravel Base for Aprons & Taxiways		137,400
Sub-total		1,112,500
TOTAL Bare Base Facility		12,824,100

Upgrading of Existing ROKAF Facilities

Probably the cheapest method for providing additional jet capable airfields is by expanding existing facilities with 6,000 - 7,000' runways and upgrading other shorter airfields to replace the expanded facilities in their previous role. Several of the alternatives reflect the expansion of Kimhae to a 9,000 foot fully operational facility. Kimhae would continue to be used for T-28 and T-38/F-5B flying training. Sachon is an example of an existing facility which could be extended to 7,000 feet to serve as the central special air warfare facility. Extension of the Kangnung runway (7,380 feet) to 8,000 feet might also be considered. Alternative D also reflects the extension of Pohang to 9,000 feet with the small airfield at Taejon being extended to replace Pohang. **

In all of these upgradings, the least expensive elements are the actual runway and apron facilities. Upgrading ROKAF airbases must also include additional maintenance and support facilities to accommodate the dispersed ROKAF units. The facilities cited above are also used in the cost estimates shown in Table 5-9 on the following page, although the actual costs of upgrading depend on the particular bases chosen and may differ from what has been assumed here.

* Assumes addition to previous base construction program above.

** The special airfields selected for improvement here are illustrative in the sense that actual facilities would be determined jointly by the US and ROK Governments.

TABLE 5-9

COST OF UPGRADING EXISTING FACILITIES TO MOB STANDARDS

Extension of Kimhae and Sachon	
Land Acquisition, Grading & Drainage	$ 3,670,000
Concrete Requirements	
Kimhae Runway: 2,000 ft x 150 ft = 33,300 SY	
Sachon Runway: 3,000 ft x 150 ft = 50,000 SY	
Additional Taxiways: 6,000 x 75 = 50,000 SY	
Additional Aprons = 58,000 SY	
191,300 SY	
Cost of 12" Concrete Facilities: $27,066 + ($17.99 (191,300 SY)	3,468,500
Cost of 2" Overlay and Overruns = 250,000 SY: $3.50 (250,000 SY)	875,000
Crushed Stone/Gravel Base for Additional Runways, Taxiways & Aprons	640,100
Maintenance, land operations, storage and other support facilities (including troop facilities for 950 ROKAF personnel)	6,185,000
Sub-Total	$14,838,600
Extension of Pohang and Taejon	
Land Acquisition, Grading & Drainage	$ 3,895,000
Concrete Requirements	
Pohang Runway: 2,500 ft x 150 ft = 41,650 SY	
Taejon Runway: 3,100 ft x 150 ft = 51,650 SY	
Additional Taxiways: 6,000 ft x 75 ft = 50,000 SY	
Additional Aprons = 70,000 SY	
213,300 SY	
Cost of 12" Concrete Facilities: $27,066 + $17.99 (213,300 SY)	3,864,300
Cost of 2" Overlay and Overruns: $ 3.50 (196,650 SY)	688,300
Crushed Stone/Gravel Base for Additional Runways, Taxiways & Aprons	738,900
Maintenance, land operations, storage and other support facilities (including troop facilities for 1,023 ROKAF personnel)	6,793,000
Sub-total	$18,979,500
Extension of Kangnung	
Concrete Requirements	
Runway: 620 ft x 150 ft. = 10,350 SY	
Taxiway: 660 ft x 75 ft = 5,500 SY	
15,850 SY	
Cost of Runways: $13,533 + ($17.99) (15,850 SY)	$ 298,700
Cost of 2" Overrun: ($3.50) (16,650 SY)	58,400
Crushed Stone/Gravel Base	95,500
Sub-total	$ 452,600

5.7 ALOC

Three ALOC facilities with minimal airfield support elements, also included in the alternatives, are estimated to cost:

Grading and Drainage		$3,700,000
Concrete		
Runways (3): (3,500 ft) (80 ft) =	93,333 SY	
Taxiways (3): (2,200 ft) (40 ft) =	26,667 SY	
Aprons for C-119Ks	60,000 SY	
	180,000 SY	
Cost of Concrete: (3) ($13,533) + ($17.99) (180,000 SY)		3,278,800
Land Operations Facilities (2,400 SF)		148,600
Maintenance Facilities (60,000 SF)		1,053,500
TOTAL		$8,180,900

5.8 Base Hardening

As previously stated, prior to the Pueblo incident there were few hardened aircraft sites in Korea. POL storage at airfields and port terminals was exposed and vulnerable. Since then, 170 revetments and 170 shelters have been programmed by the USAF. An additional 22 revetments were provided by MAP and eight more were financed from the ROKAF Won Budget. TAB VEE vulnerability analysis, confirmed by our recent experience in SEA, points to shelters as the best way to protect aircraft from air or insurgent attacks.* Further hardening of ROKAF airbases to provide protection for aircraft and vital facilities could be considered.

Airfield Shelters and Revetments

To estimate the potential returns from additional shelters and revetments, two hypothetical attacks (by forty-eight and seventy-two MIG-21 aircraft) were modeled against a forward "pre-January 1968 configured" ROKAF airfield basing forty-eight aircraft. Several alternative facility improvements were made to the standard base. The critical criterion for evaluating the hardening was damage sustained (capability to take-off) as a function of dollar expenditures for airfield improvements. The North Koreans were assumed to employ optimum weapons and munitions, i.e., 30mm strafing against dispersed aircraft, 51mm rockets and RBK-500 bomblets against undispersed or reveted aircraft.** The NKAF would utilize air-to-ground missiles and 550-lb. bombs for attacks against sheltered targets. The MIG-21s were assumed to be armed with two 550-lb. bombs and/or 30mm guns. An assumed five-minutes of warning time was available to the ROKAF. The results of the simulation are portrayed in Figure 5-1.

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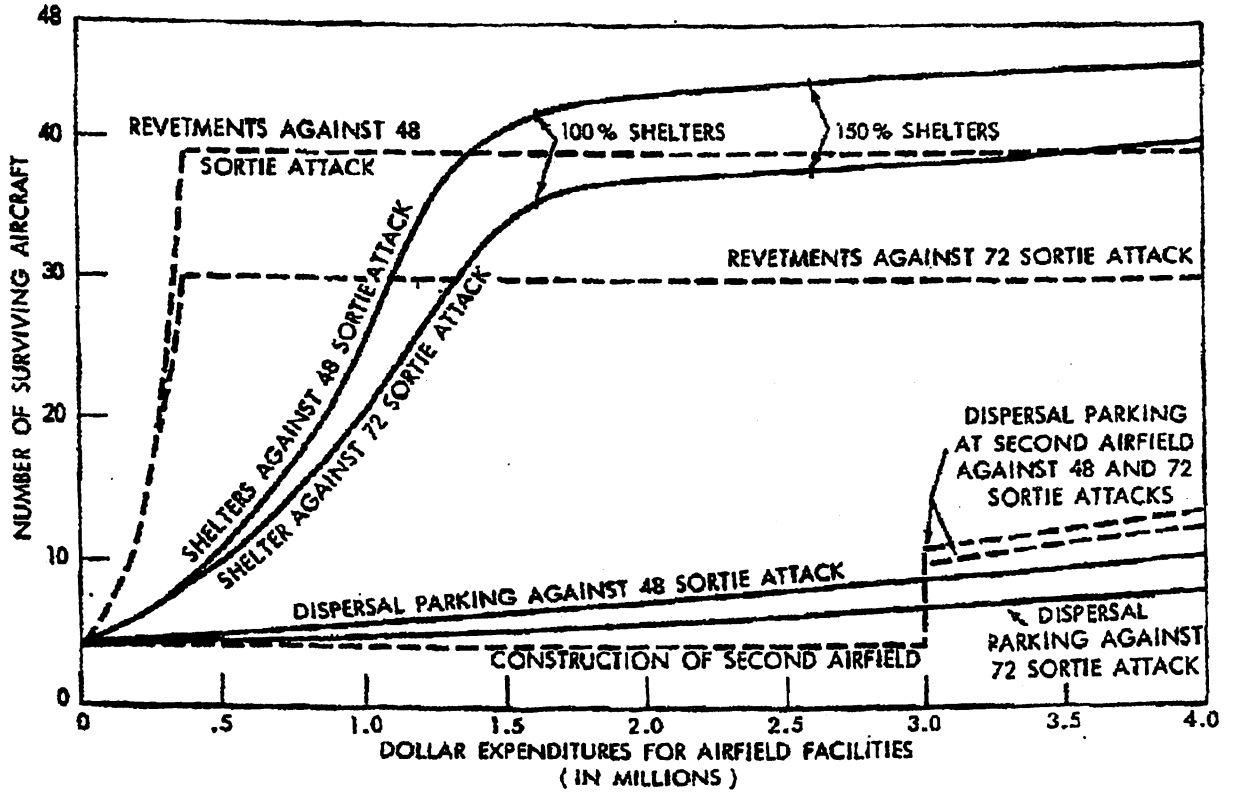
* Theater Air Base Vulnerability Study (TAB VEE), dated December 15, 1965.
** This CBU weapon is assumed to be available in 1974 from the Soviet Union.

FIGURE 5-1

NUMBER OF UNDAMAGED ROKAF AIRCRAFT FOLLOWING FORTY-EIGHT AND SEVENTY-TWO MIG-21 SORTIE ATTACK



As indicated in Figure 5-1, all aircraft can be expected to receive some take-off limiting damage. Dispersal alone, even with a second base available, does not provide substantial returns in terms of surviving combat-ready ROKAF aircraft per dollar expended to improve facilities. Additional airfields could reduce the basing density at existing airfields, compound the enemy's targeting problem, and provide alternate landing sites. However, dispersal alone, without hardening, did not provide substantial returns in our simulation model.

The single pass kill probability for a MIG-21 with two 57mm rocket pods on an F-5 in the open was considered to be .45 for the purposes of this excursion (not considering degradation due to ground fire). Without any hardening, up to 75% of the 48 ROKAF aircraft in the simulations could be destroyed by only forty-eight attack sorties; 87% could be destroyed by a seventy-two sortie attack.

Aircraft revetments and shelters are not expensive. The cost of a 16-foot high and 6'11" wide steel revetment is about $7,650, including transportation and erection costs. Revetments for a UE squadron of twenty-four aircraft would cost about $183,600.

The existence of shelters results in far fewer damaged aircraft and significantly fewer destroyed aircraft. With a five minute warning, 10-15% of the ROKAF non-alert forces would be caught outside of their shelters and these aircraft might be destroyed. In the simulation, an attack by forty-eight MIGs against a sheltered base configuration left forty-two of the ROKAF force undamaged (including four airborne aircraft). Against a 72 MIG-21 sortie attack, thrity-six of the ROKAF force avoided damage.* Shelter steel skeletons are priced at $14,919. Transportation and erection costs (including the pouring of 18 to 32 inches of concrete) are estimated to cost another $22,400 per shelter. Shelters for one UE squadron of twenty-four aircraft would cost about $896,000.

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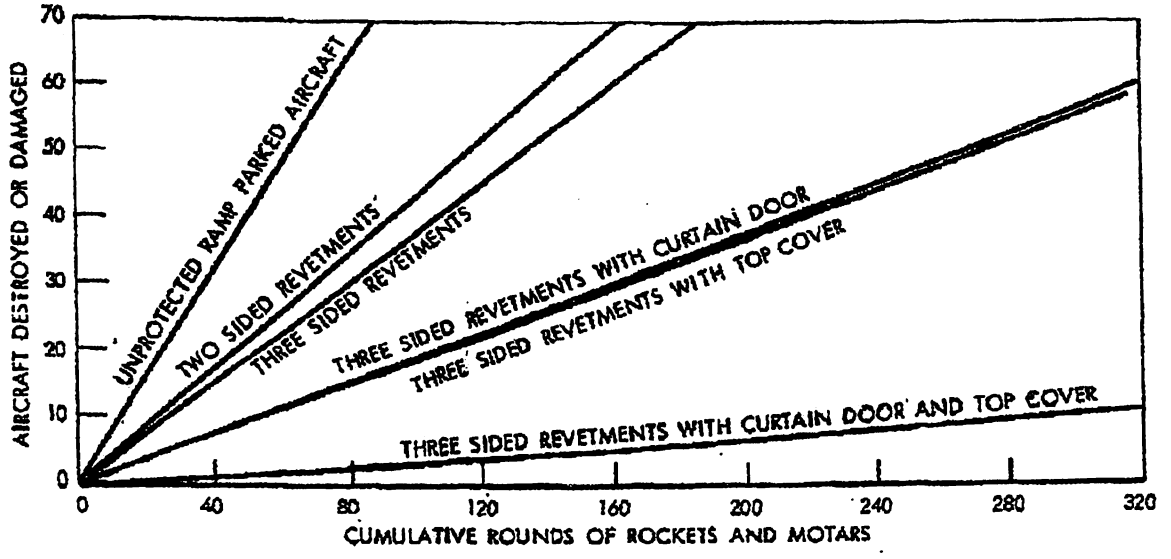
* The simulation suggests that construction of additional shelters beyond 100% of the tactical force also might be cost-effective. Since attacking aircraft cannot distinguish shelters containing tactical aircraft from those containing support aircraft, or those that are vacant, they might attack all shelters. As portrayed in Figure 5-3, forty-four ROKAF aircraft can be expected to survive the 48-sortie attack when the base is provided with 150% sheltering. In other words, one might argue that two additional undamaged combat-ready F-5 aircraft are retained for the post-attack fleet by expending an added $.9 million on shelters, whereas to procure two additional flyaway F-5s would cost $1.9 million: Unfortunately, this cost comparison depends on the .45 kill probability, a highly questionable parameter.

In relation to the returns provided by shelters and revetments from insurgent attacks against airfields, the expected number of aircraft damaged or destroyed as a function of the cumulative number of rounds fired, based on late January to March 1968 experience in South Vietnam, is shown in Figure 5-2 below:

FIGURE 5-2

EXPECTED NUMBER OF AIRCRAFT DESTROYED AND RECEIVING MAJOR DAMAGE IN VIETNAM FROM ATTACKS AGAINST AIRFIELDS



In light of the high returns from aircraft hardening, it might pay to construct sheltering for an augmentation of USAF aircraft. Without this added hardening, an early USAF deployment would be highly vulnerable to attack while receiving initial support and maintenance.

* Msg fr CINCPACAF 290511Z mar 69, Subject: Hardened Aircraft Shelters.

The costs of providing 100% reveting for non-tactical aircraft and 150% sheltering for tactical jets, under each alternative ROKAF force structure, are shown in Table 5-10 below:

TABLE 5-10

AIRCRAFT HARDENING FOR ALTERNATIVE ROKAF FORCES 4/

	Alt A (JSOP)	Alt B	Alt C	Alt D	Alt E (MAP 74)
Additional Hardening Proposed					
Shelters 1/	222	312	342	528	226
Revetments 2/	0	112	96	122	0
Estimated Cost of New Hardening (Million $US) 3/	8.28	12.50	13.49	20.62	8.43

1/ With existing 170 shelters, will provide 150% sheltering for tactical and air defense jets (including 48 USAF aircraft programmed for Korea).
2/ Includes 96 revetments at two new DOBs under Alts, B, C, D and E, plus any new construction necessary to provide 100% reveting for non-tactical jet aircraft (using all 243 revetments existing revetments).
3/ At $37,300 per shelter; $7650 per revetment.
4/ Additional hardening requirements are sensitive to specific basing posture (uncertain at this time). Assumed posture follows JCS study guidelines (see Section 3-3).

Hardened POL Storage

POL now stored above ground in large unhardened tanks is also vulnerable to air attack. The cost for POL hardening is small in relation to its return. Some new facilities are being constructed with four feet of earth overlay which greatly reduces the probability that a tank will be destroyed, assuming the NKAF pilot could identify the specific tank location. There are also advantages to storing POL in smaller (10,000 barrel) underground tanks rather than the 40,000-50,000 barrel tanks now

being built above ground. If this were done, the sorties necessary to achieve equivalent destruction might increase by a factor of nearly four. The costing information available in the FY 68 Supplemental Program the FY 69 TABVEE Program, and the FY PACAF proposal suggests that the construction of dispersed 10,000 barrel facilities would cost 11% more than large 40,000 barrel tanks for equal total capacity.

The costs of hardening ROKAF POL storage for each alternative force is shown in Table 5-12 on the next page. The ROKAF fuel consumption estimates shown in the table assume 30% aircraft attrition during the initial forty-five days of hostilities; the table is based on the following fuel consumption data:

Aircraft	Gallons Consumed per Sortie	Assumed 3-Day Surge Sortie Rate	Assumed 42-Day Sustained Sortie Rate
A-37	457	3.0	2.0
F-5	700	1.7	1.1
F-5-21	790	1.7	1.1
F-4	2,154	1.6	0.6
F-102	1,175	1.7	0.9

Current doctrine envisions USAF augmentation forces operating from non-hardened POL storage facilities; bladders and above ground tanks. Construction of additional hardened POL storage facilities to meet USAF deployment requirements during the initial 45 days would cost about $8-9 million more (equivalent to the flyaway cost of 3 F-4Es). JP-4 requirements of a USAF (TACCP) augmentation are summarized in Table 5-11 below. * POL hardening costs appear in Table 5-12 on the next page.

TABLE 5-11

FUEL REQUIREMENTS OF USAF TACCP AUGMENTATION

Aircraft	Squadrons	Fuel Consumption (in thousands of gallons)
D+5 Days to D+45 Days		
F-4E	6	14,036
A-7D	4	4,652
F-111C/D	3	11,970
RF-4C	2	4,055
D+20 Days to D+45 Days		
F-4E	7	10,769
A-7D	3	2,299
TOTAL		47,781

* See appendix - USAF Augmentation.