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DEPARTMENT OF THE AIR FORCE
WASHINGTON

OFFICE OF THE SECRETARY

MAR 21 1961

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MEMORANDUM FOR THE SECRETARY OF DEFENSE

OFFICE OF THE SECRETARY OF DEFENS

SUBJECT: (U) Project No. 13 (Comparison of Proposed B-70 Force With Alternatives)

1. ~~(SECRET)~~ In response to your March 8, 1961, memorandum requesting a comparison of the operating plans, costs and total effectiveness of the proposed B-70 force with alternative forces, this memorandum and its inclosures:

a. Describe briefly the individual and combined operating plans of the missiles and aircraft which could comprise our strategic force in the late 1960's,

b. Discuss the B-70 force requirement,

c. Discuss in detail the cost effectiveness of a force with B-70's and alternatives - on the basis of a composite force analysis as well as on the less valid pure force basis, and

d. Discuss factors other than cost which influence total force effectiveness.

2. ~~(SECRET)~~ OPERATING PLANS. The expected individual weapon system and combined force operating plans in the late 1960's are as follows:

a. B-70.

(1) Although there will be only a few home bases for the entire B-70 force, the alert aircraft will be widely dispersed - three to five aircraft per alert base. Initially, two-thirds of the operational force will be on alert. As operational experience is gained, this fraction may exceed three-fourths. In this alert posture, the entire alert force could be launched in less than four minutes with crews in the cockpits and in less than six minutes with crews in alert shelters. Launch would be made on tactical warning and under positive control.

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(2) The B-70 will be capable of carrying multiple and varied weapons, including two class "B" or eight class "D" or sixteen 250 KT guided bombs or combinations thereof. Advanced sensor equipment will permit detection of the most difficult targets. Because the B-70 will have the highest yield to accuracy ratio of any system, it will be applied against the hard, the imprecisely located and the mobile targets. It will also be used to provide back-up for high priority targets programmed to be struck by ballistic missiles. Other capabilities will include inflight retargeting, missile and bomb damage assessment with immediate reporting to the SAC command/control post, and reconnaissance strike. The majority of the strikes will be able to recover within the United States.

b. B-52 with GAM-87's.

(1) The B-52 force will be dispersed to 39 bases with 53 percent of the force on ground alert, capable of launching in less than fifteen minutes. Twenty-three squadrons will be equipped with GAM-87's by April 1967; the balance will carry GAM-77's. Weapon load capabilities include four GAM-87's or two GAM-77's and one class "B" to four class "D" weapons.

(2) The air-to-surface missiles will be launched, as soon as range to target permits, against precisely located soft complex targets and air defense systems. Bombs will be delivered at low altitude and are suitable for both hard and soft targets. A limited damage assessment capability can be achieved during withdrawal at high altitude.

c. TITAN II. The TITAN II force will be deployed in individual silos dispersed and [redacted] Each missile will be on twenty-four hour alert, capable of being launched within [redacted] from receipt of execution order. Generally it will be utilized on [redacted] It also is capable of delivering a [redacted]

[redacted]

or Sec of Def, subj: (U) Project No. 13 (Comparison of Proposed rce With Alternatives) (Continued)

d. MINUTEMAN - Hard. The MINUTEMAN (H) force will be ually dispersed in [redacted] hardened silos. There will be five control centers, hardened to [redacted] for each group of 50 These missiles, maintained on twenty-four hour alert, will ble of being launched within thirty seconds after receipt of ion order. They will be employed against the general range of gic targets, except for the very hard, the imprecisely located e mobile targets. Some will be employed against enemy missile rcraft defense systems.

e. MINUTEMAN - Mobile. Missile trains will be deployed ously along the entire U.S. rail network. The trains will random along a number of routes and establish a condition of gic alert at pre-selected launch sites for varying periods. imately seventy percent of the missiles will be on strategic t all times, capable of being launched within one minute. irected, those on the move can proceed to the nearest pre- ted launchmark and launch their missiles within approximately ur and twenty minutes. Targets for this force will be similar se of the hardened MINUTEMAN.

f. POLARIS. The POLARIS force will be in one of four l readiness conditions. Condition one: On station with every- required to fire the missile functioning at maximum power. This maintained for approximately one hour. Condition two: On , but requiring fifteen minutes preparation before the first can be launched. Condition three: Enroute to the launch area. ion four: In port with its tender. Sixty-two percent of the 6 submarine force is programmed to be at sea in varying ions of readiness. After 60 days submerged in the on-station the submarine will return to its tender stationed overseas.

[redacted]

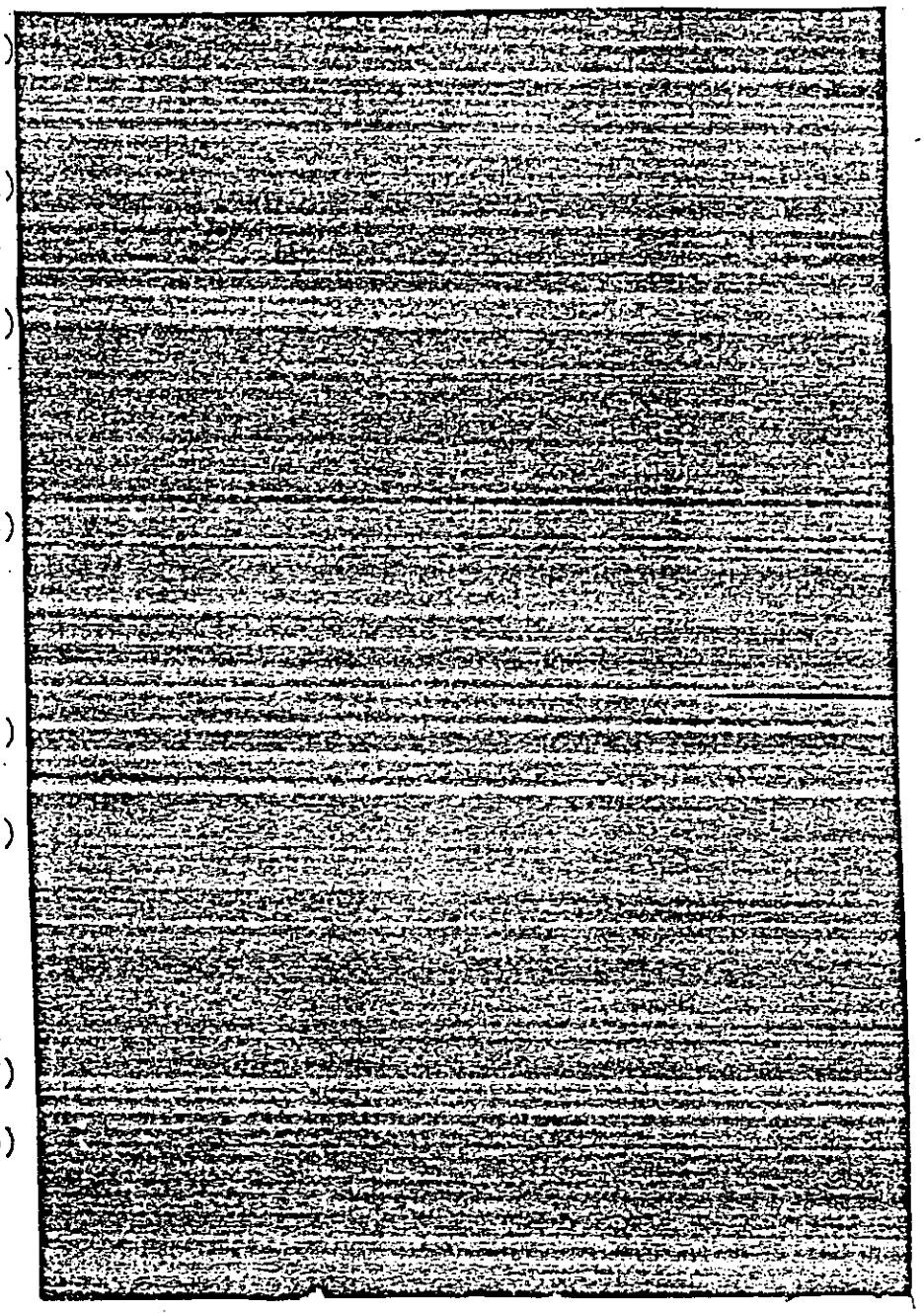
fectiveness of this force in a residual role will depend on its siveness to command/control and target damage assessment ed during and after the initial strike.

. (S) STRATEGIC FORCE APPLICATION.

a. In the late 1960's the total strategic force will be dispersed and maintained in a high state of readiness. As ly envisioned, this force will retaliate in the following cial manner:

[redacted]

(1)
(2)
(3)
(4)
(5)
(6)
(7)
(8)



b. The manned systems, primarily the B-70's, will provide essential data for programming the residual missiles and aircraft in the continued prosecution of the war.

4. ~~(SECRET)~~ B-70 FORCE REQUIREMENTS. Ultimate B-70 force levels have not been established and will depend upon many factors. For planning purposes, however, estimates have been made of the number of B-70's required to complement our future strategic force in its task of countering the threat. Our studies and war games have indicated that a force of about 225 B-70's will be needed to meet this requirement.

5. ~~(SECRET)~~ COST EFFECTIVENESS CONSIDERATIONS.

a. One measure of the ultimate effectiveness of a weapon system can be stated in terms of enemy targets destroyed - either in the initial exchange or during the follow-on exploitation. Generally, this is extended to measure achievement in terms of cost effectiveness. Comparisons between systems, or forces, are often made on the basis of targets destroyed for a given investment. The usual practice has been to compare weapon systems by considering each system and its environment essentially in isolation.

b. This is unfortunate. The true measure of system worth can be found only by considering the over-all military capability that results when all component weapon systems are integrated into a composite strategic force. Only in this context can integrated force effects be considered in proper perspective. Important examples include interference effects, such as occur when interceptors and surface-to-air missile systems attempt to operate in the same air space, and complementary effects, such as occur when ICBM's degrade enemy air defenses through direct attack or as a fall-out effect of the attack on primary targets and more bombers survive to deliver their more effective weapons.

c. An integrated strategic force cost effectiveness study, relating to the problem of establishing the required size of B-70 force in relation to the total strategic force in the 1970 time period, was completed in November 1960 by the Air Force. The broad objective of the study was to determine, for a fixed cost, the composition of the most effective U.S. strategic force in 1969.

d. Within the limitations imposed by two different budget level for both the U.S. and the USSR, the capabilities of a large number of equal-cost strategic forces to survive an initial Soviet attack and to carry out an effective counter-attack were examined. A facet of the stud worthy of note at this point is the manner of treatment of Soviet defense forces. These forces were specifically tailored to counter the particula U.S. force being analyzed. The detailed inputs, procedures, results, and findings of this study are attached as Inclosure 1. The principal findings can be summarized as follows:

(1) Among the eight equal-cost composite forces studied under the current budget levels for both sides, the force with B-70's (12 squadrons) equalled or exceeded the level of target damage achieved by any alternative. Under this criterion, the force with MINUTEMEN provided nearly equal achievement; the force with B-52's was third. Ranking the forces on the basis of both target destruction and bomber survival, a secondary but nevertheless important consideration in view of the importance of residual forces, the order becomes B-70, B-52 and MINUTEMAN.

(2) Among the five equal-cost, high budget forces studied, the greatest target destruction was achieved by a force containing both B-70's and added MINUTEMEN. This force also provided the highest number of surviving bombers.

(3) Among the thirteen composite forces studied in 34 campaigns, the forces which showed the best strike effectiveness contained the B-70.

e. Inclosure 2 discusses briefly the results of the recent evaluation of strategic offensive weapon systems by the Weapon Systems Evaluation Group. Despite assumptions and an analytical treatment which underestimate the capability of the B-70, WSEG concludes that the B-70 would be able to penetrate even a sophisticated, high cost Soviet defense with "medium to high confidence". WSEG is now revising downward their B-70 cost estimates. If these costs are introduced into the cost effectiveness analysis which WSEG made, it is believed that the results would show that B-70 system would be preferred in all cases except against soft targets (on the order of three psi) and even here the difference would not be so marked as to rule the B-70 out of competition.

f. A simple cost effectiveness exercise comparing equal-cost (initial investment plus five years operating cost) pure forces as to the number of point targets of 10 psi and 100 psi hardness which each can destroy is contained in Inclosure 3. The results indicate a clear superiority for the B-70 force against 100 psi targets. The B-52 force ranked second with approximately half as many kills. Against 10 psi targets, the fixed MINUTEMAN force ranked first, the B-70 second and the B-52 third. TITAN, mobile MINUTEMAN and POLARIS ranked lower.

6. ~~(SECRET)~~ OTHER BOMBER FORCE CAPABILITIES. The ability to stroy precisely located, soft-to-hard primary targets is a major quirement which every weapon system in the strategic force should et. However, additional capabilities are required of one or more the systems if the total target destruction capability required to hieve national objective is to be realized and if other missions the force are to be accomplished. Important targets may be precisely located or mobile. Damage assessment is important to aluate current success and to establish future plans of action he residual force application). Manned bombers are particularly ited to perform these missions.

7. ~~(SECRET)~~ One of the major objectives in the development ogram for the B-70 is to improve the capability of the strategic rce to perform all of its missions effectively. This program will ovide a weapon system capable of quick reaction, air and ground. vanced detection and communication equipment will permit immediate flight reporting of detailed missile and bomb damage assessment. is equipment will provide excellent reconnaissance-strike capability. e system will be adaptable to wide, random dispersal and recovery d to future concepts of hardening. The B-70 will be superior in ery one of these respects to the B-52.

8. ~~(SECRET)~~ Further, it should be noted that in the late 1960's, e time the B-70 would become operational, the B-52 will have been in e inventory for some twelve years and will have achieved its ximum growth potential. This growth was significant in every portant aspect - maintainability, range, penetration capability, d weapon delivery. Of course, much of this growth was required to intain pace with new developments in air defense. There is every ason to believe that the B-70 weapon system will enjoy a similar owth, thereby improving its capability relative to the B-52 and well as improving the over-all capability of the strategic force perform its missions effectively.

9. ~~(SECRET)~~ SUMMARY.

a. The operational plans of the weapon systems which mprise our strategic force are designed to exploit the peculiar apabilities of each system. The operating plan of the strategic rce coordinates and integrates these systems to capitalize on the teractive, mutually enhancing effects through which a mixed bomber-issile force can achieve a joint effect that exceeds the sum of eir separate effects.

b. Ultimate B-70 force levels cannot be established at this time. ɔent exercises and war games indicate that a force of some 225 B-70's ɛ required to meet anticipated commitments.

c. Based on cost effectiveness considerations by both the r Force and WSEG, it appears that a strategic force with B-70's is mpetitive with or exceeds the achievement of any other force in the counter- tack role. As a result, its additional capabilities in such roles as mage assessment, reconnaissance-strike, residual force become essentially -cost dividends. The capability of the initial configuration of the 70 to serve in these roles will be significantly greater than the B-52. s greater growth potential will increase this margin with time in ventory.

Eugene M. Zuckert

Incls
1. Evaluation of Strategic Force Compositions
2. WSEG on the B-70
3. Cost Comparison

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An Evaluation of Some Feasible 1969 U.S. Strategic Force Compositions

INTRODUCTION

Predicted improvements in the reliability, yield, and accuracy of ICBM's, in the performance of bombers as represented by the B-70, and in the effectiveness of future air defense systems raise difficult questions in connection with the composition of future strategic forces. Recent considerations of the importance of residual forces to seek out and destroy enemy capability remaining after the initial nuclear exchange, indicate the importance of strike reconnaissance, probably requiring manned systems, and raise the question of maintaining a mixed bomber-missile force even if a pure missile force proved to be superior to the mixed force in the initial exchange. Unfortunately, the residual force role of the strategic force is not spelled out clearly enough to permit quantitative analysis at this time. However, techniques have been developed whereby the initial exchange can be war gamed. The results, when considered in their proper context, can provide an important ingredient to the over-all considerations required to establish the composition of a strategic force which can meet all of the requirements laid on it.

This report is the result of a study directed to the problem of establishing the required size of the B-70 force in relation to the total strategic posture projected for the 1970 time period. In attempting to provide the required information, a more important question was considered, i.e., for a given cost, what is the composition of the most effectiv U.S. strategic force in the counterattack role? Actually, the results of the cost effectiveness study which was performed provide a better answer to this question than to the original problem, but it does appear that our strategic force will be better balanced with some 200 B-70's and additional missiles than with some 400 B-70's and no additional missiles.

The study compares the capabilities of several possible future strategic forces to survive a Soviet intercontinental ballistic missile (ICBM) attack on the U.S. under conditions of 15 minutes' tactical warning and to carry out a counterattack campaign against the Soviet Union. The measures of effectiveness developed are target complexes and point targets destroyed and bomber survival. Two budget levels are considered for both the U.S. and the USSR. The time period is 1969.

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S. STRATEGIC FORCES

The various force compositions studied were constructed combining various equal-cost, alternative add-on forces th a reference force which includes those weapon systems d numbers to which we now appear to be committed from a ocurement standpoint. The composition of this reference rce for the odd-numbered years through 1969 is given in ble 1.

In developing the equal-cost, alternative systems to be ded to the reference force, two constant budget levels for e period FY 61 through FY 70 were considered. The first proximated our present budget in the strategic area. Under is budget, it was assumed that the reference force could be ilt up and supported and that, in addition, eight billion llars would be available for additional procurement and pport during this period. The equal cost alternative sys- ms which could be added to the reference force under this dget are given in Table 2. An additional reason for the uality of the B-70 and B-52H buys is that the B-52H's hieve an earlier operational date than the B-70's and hence crue higher operating costs in the time period. The OMEDARY is a long endurance, chemically powered aircraft rrying missiles on an airborne alert.

A high budget situation was studied which was 1.6 llion dollars per year above the current budget in the rategic area. Half of this amount was assumed for weapon stem procurement, making a total of 16 billion dollars ailable for this purpose. The remaining eight billion llars under this budget was assumed to be required for the velopment of more advanced systems than those studied here. ble 3 shows the high budget, equal cost alternatives studied.

The weapon loads assumed for each delivery system are own in Table 4.

The operational plan assumed provided that all missiles rviving the initial Soviet ICBM attack be launched immed- tely. The B-52 force was dispersed to strategic wing level, th one-third on ground alert and able to launch within 15 nutes. A high ground alert posture, achieved through seven- y, 24-hour maintenance and a crew-to-aircraft ratio of four one, was assumed for the B-70. Through these means, it pears that 70 per cent of the force could be maintained on round alert. By proper planning and aircraft configuration, was assumed that, from the aircraft in the air on pro-

y training missions, another five per cent of the
could be added to the available striking force. By
ng crews for aircraft in maintenance, it was
ed that 50 per cent of the aircraft in maintenance
aunch within 15 minutes.

UNION FORCES

rious compositions for the strategic and air defense
of the Soviet Union were developed under two budget
equivalent to those studied for the U.S. Cost in-
on supplied by The RAND Corporation on the Soviet
ic and air defense forces estimated by ACS/Intelligence
9, together with the RAND estimate that Soviet GNP
ed by six per cent from 1958 to 1959, indicated that
ion dollars was a reasonable estimate of the FY 1961
for such forces. It was also assumed that this budget
ncrease at the average rate of four per cent per year
e period FY 1961-1970. The high budget studied as-
20 per cent increase in the current budget. The
ng budgets for the first and last years of the cost
in billions of dollars were as follows:

	FY 1961	FY 1970
Current Budget	14	21
High Budget	17	26

ailable intelligence information regarding the cap-
es of present and future Soviet weapon systems was
t the compositions of their strategic and air defense
were specifically tailored from the weapon systems
in Table 5 to counter the particular US force being

•

is important characteristic of the study is illustrated
in Table 6, which indicates the five major components
alternative equal-cost Soviet forces considered. For
, note the substantial M.3 fighter and improved surface-
missile programs when the B-70 is included in the force,
plete cancellation of these programs in favor of bigger
ICBM's, AICBM systems and lower performance fighters
TEMEN are added instead of B-70's. The M.2 fighter buy
eased because of its capability against B-52's penetrat-
either high or low altitudes.

[redacted]

FORCE SURVIVAL

The Soviet attack involved an initial salvo of the imum possible number of ICBM's. One hundred of these e directed against the air defense system. Fifty were ected against military control centers, and the balance e directed against SAC bomber bases and ICBM sites. The ective of the attack was to minimize the capability of surviving forces to damage the Soviet Union. To achieve s objective, bomber bases, Atlas and Titan Sites were geted with higher priority than were Minuteman Sites. ber bases with a sizeable number of non-alert bombers aining, each capable of carrying bombs having a total ld of many megatons, constituted essential and relatively t targets. Atlas and Titan Sites were relatively high ority targets because of their large yield warheads. uteman sites carried a lower priority because, being d, a considerable effort was required to destroy a single sile which carried a relatively small warhead. The ob- tive was achieved by assigning sufficient missiles to h base or site such that the product of the damage ential and the survival probability of every base or e is equal.

The ICBM attack was followed by manned bomber and sub- ine-launched missile attacks. The results of these acks were not analyzed. All alert bombers were launched ore the arrival of the ICBM attack and all the missiles ch survived this attack were launched before the arrival the follow-on manned bombers. Submarine launched siles were not directed against ICBM sites.

US Force survival are given in Table 7 for four of the es studied. The number of B-70's surviving includes the craft on alert plus those in maintenance which were able launch within the 15-minute warning time. The large bers of MINUTEMEN surviving results from the limited ber of missiles available to the Soviets and the criterion d for target assignment as discussed earlier.

US COUNTERATTACK

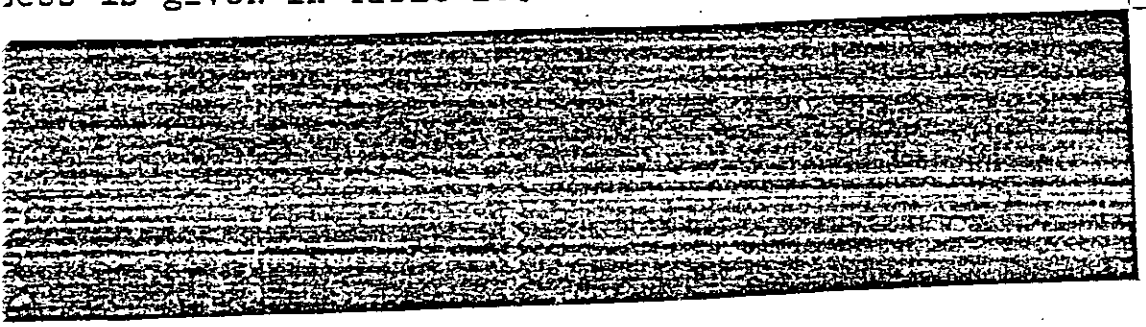
The effectiveness of the various US strategic forces was died in terms of an attack on Western Russia. Out of a t of 250 strategic target complexes in the Soviet Union China as furnished by ACS/Intelligence, 116 were located

ion attacked. In addition, between 200 and 220
ets of the categories shown in Table 8 were in
, the number varying according to the extent to
defense bases were targeted. Many surface-to-air
tes in the region were also targeted, with the number
nsiderably from case to case. The target complexes
tions of points of military and industrial values
that a single weapon can do damage to more than
point. For analysis purposes, an aggregated
rget complex as established by AFCIN was used.
targets included all value points of the
listed in Table 8 which appear in the Target
tory for the area under attack and which are not
any of the 116 complexes.

range missiles, light bomber bases, their military
and other types of targets of particular concern to
US tactical forces were not targeted and the attack
orces was not analyzed. Thus the possible com-
effects of this attack on the penetration capability
ic bombers was not considered. Possible contributions
aris weapon system in this connection were disregarded
a matter of fact, Polaris may serve its most effec-
as a member of the residual force.

dering that 41 of the first 50 target complexes
by priority and the majority of the important point
e in the area considered, it was estimated that
ely 60 per cent of the target system, in terms
was involved. As a result, 60 per cent of the US
ack effort was directed to this area.

t assignments were based on considerations of the
apabilities of each available weapon system and
n given in Table 9 was evolved. In the high
ference force plus B-70 and MINUTEMAN case, for
feasible assignment which tends to maximize force
ess is given in Table 10.



The attack sequences and the interactions considered in e analysis of the counterattack are worthy of note. First the sequence of attacks was the ICBM attack on both defenses d prime targets. The consequences calculated included target struction, direct defense destruction by blast and defense gradation due to fallout. Hand computation methods were ed. B-70's, when a component of the force, comprised the cond element of the attack, lagging the ICBM attack by proximately three hours. The B-52 force arrived approxi-tely nine hours after the ICBM attack. Generally, these ements attacked primary targets only but they did make in-rect contributions, through both blast and fallout, to the gradation of the defenses for follow-on elements. The nsequences of the manned bomber attacks were calculated sing a highly aggregated penetration model which was pro-rammed for the IBM 709 and 7090 computers. In addition to rget destruction and defense degradation calculations, mber weapons delivered and bomber survival were computed.

The penetration model used in the study divides space to geographical zones and time into periods. An individual r battle is fought in each zone for each time period. The rticipants in each battle are drawn from the survivors of rlier battles. The model is an expected value model.

SULTS

Among the eight equal-cost composite forces studied under e current budget level for both sides, Table 11 shows that e force with B-70's equalled or exceeded the level of target mage achieved by any alternative. By this criterion, the INUTEMAN case provided nearly equal achievement; the B-52H se was third. In considering the significance of the results, is important to keep in mind that the values shown are not solute measures of effectiveness. The relative standings, e real, however, and, for lower value of effectiveness, the fferences would increase in significance.

The primary objective of the force is, of course, target struction. However, bomber survival for residual force rposes is becoming an increasingly important consideration. t is thus of interest to rank the various cases in terms of mber survival as well as in terms of targets destroyed. On plying the fractional survival numbers of Table 11 to the rtion of the alert force used to attack the western part

riet Union, it is found that the B-70 case ranks first
al of 93 survivors, 46 being B-70's (0.56 survival)
ng B-52's (0.54 survival). The B-52H case ranks
h 75 surviving B-52's (0.64 survival), and the
third with 53 surviving B-52's (0.61 survival).
nd that these are the numbers of bombers surviving
wal from Soviet territory. Before they can become
components of the residual force, they must return
. Many, if not most of them, will require a post-
ging base to accomplish this. The probabilities
bases will survive or, given survival, that the
ill, in fact, effect their return to the US may be
l.

; the five equal-cost, high budget forces studied,
st target destruction was achieved by a force con-
th B-70's and added MINUTEMEN, as shown in Table 12.
ction effect which may be achieved by a mixed and
balanced bomber-missile force is clearly illustrated
n 24 squadrons of B-70's were added, the missile force
ll that it was virtually eliminated by the Soviet
tack. Soviet defenses suffered no damage prior to
l of the bombers and overall US force achievement
ed, particularly with regard to bombers surviving.
truction remained reasonably high because of the
omb carrying capability of the bombers. When a
'0's and missiles was added, both target destruction
" survival increased significantly.

ng the forces according to bombers surviving to the
point, the combination buy of B-70's and MINUTEMAN
irst with 106 survivors, compared with only 57
in the pure B-70 buy.

riving the results shown previously, the bombers
ed to carry ECM equipment of moderate effectiveness.
deliberate attempt was made not to over-estimate
of combat conditions, including such factors as
mmunication links, radars and control centers
ly or deliberately destroyed, psychological effects
el, etc., on the real as contrasted with the
l capabilities of the defenses. In this connection,
be noted that the effect of fallout were treated
and specifically. It played an important role in
2 penetration but not B-70 penetration, principally
the difference in RECL arrival times. The absolute
ECM and combat effectiveness are impossible to predict

:he situation in World War II, we will be unable
)efenses and develop specific counters if short-
liscovered. For these reasons, the sensitivity
:s to these assumptions was tested. The results
: for the B-70 case were based on a defense de-
:tor of 0.8, covering ECM effects and combat
: 0.8 value of the degradation factor corresponds
; in which ECM achieves a moderate level of
;. Both higher and lower values of the degradation
studied. The results are given in Table 13 for
)udget, strategic force with B-70's. Note that
/al depended much more strongly on the particular
:de than did target damage. A comparison of the
:he 0.8 and 0.4 factors shows that, even though
l was reduced by nearly 60 per cent, the
; of the force was reduced only 16 per cent.
)r this is, of course, the multiple bomb
:bility of the manned bomber. In this study,
:rried eight bombs. Only in exceptional cases
destroyed with a full load of bombs. Many
l of their bombs. This fact is illustrated
by the 0.4 case in the table. Only one-fourth
; survived but one-half of the bombs carried by
:re delivered.

factor contributing to the high effectiveness
:he bomber forces was the employment of MINUTEMAN
busting role. Both air defense bases and in-
face-to-air missile sites were targeted. In fact,
:e cases studied, all MINUTEMEN were targeted
)ses. The effect of not targeting defenses with
; studied in the current budget B-70 case for
:gradation factors. The results are indicated
Again, bomber survival depends more strongly
:ing of defenses than does force effectiveness.
: that assigning MINUTEMEN to SAM's can provide
:urance against the eventuality that our estimate
:iveness of ECM and/or combat degradation factor
)s error.

3 different composite forces studied in 34 campaigns,
)ich showed the best strike effectiveness contained
)is fact is doubly important. The additional un-
)abilities of the bomber, such as flexibility of

operation, reconnaissance, destruction of poorly located or mobile targets, restrike, and residual force, would improve further the achievement of the primary objectives of the strategic force.

Only two B-70 buys were studied, 12 squadrons and 24 squadrons. As a result, the question regarding optimum force size cannot be answered specifically. However, it appears that a total buy greater than 12 squadrons might be desirable - with 12 squadrons on 75 per cent ground plus air alert it was not feasible to assign B-70's to pertinent targets in the entire area studied. Residual force considerations may further increase the total number of B-70's required. On the other hand, the results of the high budget comparisons clearly indicate that, at the level studied, a combination buy of additional missiles and fewer than 24 squadrons of B-70's provided the greatest force effectiveness.

As by-products of the study, the payoffs to be derived from using missiles in a defense busting role and carrying multiple weapons on bombers were clearly indicated.

TABLE 1

US REFERENCE FORCE

Sq. U. E.	No. of Squadrons - End FY			
	63	65	67	69
15	42	42	36	29
11	64	16	0	0
9	4	4	4	0
28	14	14	14	14
23	29	29	13	6
46	0	10	23	23
20	20	6	0	0
20	16	19	17	14
10	22	25	21	16
30	1	0	0	0
10	7	7	5	0
13	6	6	6	6
10	6	6	6	6
10	3	8	8	8
50	2	13	13	10
30	0	5	5	5
15	0	3	0	0
23	3	0	1	1
15	0	1	1	1
12	0	1	1	1

TABLE 2

US Strategic Force Equal Cost* Choices - Current Budget

Weapon System	Sq. U. E.	No. of Sq.
B-70	15	12
B-52H **	15	12
SM-68	10	34
SM-80 Fixed	50	37
B-52 ** + SM-68	15 10	6 15
B-52H ** + SM-80 Fixed	15 50	6 16
SM-68 + SM-80 Fixed	10 50	15 17
DROMEDARY	10	33

* Cost = RDT and E + Proc. + O and M (FY 61-70) = $ 8 billion

** Including additional KC-135's and GAM 87's and improved ECM equipment for entire force.

TABLE 3

gic Force Equal Cost* Choices - High Budget

Sq. U. E.	No. of Sq.
15	24 **
10	66
15	12
10	34
15	12
50	37
15	12
10	33

* Cost = RDT and E + Proc. + O and M (FY 61-70) = $16 billion

** Assumes establishment of 2nd production line to meet 1969 availability.

SECRET

TABLE 4

US Strategic Force Weapon Loads

No. of Bombs or Warheads/Carrier	Warhead Yield-MT	CEP (nm)
8	[redacted]	[redacted]
[redacted]		
4		
1		
1		
1		
1		
1		
6		

-87)

[redacted]

TABLE 5

SOVIET WEAPON SYSTEMS

on System	To Counter
	ICBM
Improved	B-70
	B-52 (high)
	B-52 (low)
Fighter	B-70
Fighter	B-52 (high or low)

's and manned bombers as counterforce weapons
r performance fighters
-aircraft guns

TABLE 6

SOVIET UNION STRATEGIC AND AIR DEFENSE FORCE

NUMBER OF:

US Force-Reference Plus	ICBM's	SA-5 Sites	SA-2 Imp Sites	M.3 Fighters	M.2 Fighters
CURRENT BUDGET					
B-70	2000	25	320	600	700
B-52H	2500	50	0	0	2800
SM-68	2150	120	0	0	2000
SM-80	2150	120	0	0	2000
B-52H + SM-68	2650	100	0	0	2400
B-52H + SM-80	2650	100	0	0	2400
SM-68 + SM-80	2150	120	0	0	2000
DROMEDARY	2000	120	0	0	2000
HIGH BUDGET					
B-70	3000	120	520	600	700
B-70 + SM-68	2500	150	320	600	700
B-70 + SM-80	2500	150	320	600	700
SM-68	3000	180	0	0	2000
B-70 + DROMEDARY	3000	150	400	600	700

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TABLE 8

TARGET SYSTEMS

mplexes

Military and Industrial Values

ints

Weapon Storage and Production

Bomber Bases, Main and Staging

Interceptor Bases

ICBM Controls

Military Controls

TABLE 9

TARGET ASSIGNMENTS

MINUTEMAN	Defense Busting
	Complex Destruction
ATLAS, TITAN	Complex Destruction
B-70, B-52	Hard Targets
	Weapon Storage Sites
	Control Centers
	Soft Targets
	Bomber Bases
	Weapon Production
	Poorly Located Targets
	Complex Destruction

[redacted]

TABLE 10

GET ASSIGNMENTS - HIGH BUDGET B-70 + MM Case

	No. of Aircraft/Missiles Assigned			
	B-70	B-52	MM	ATLAS, TITAN
16)	48	63	85	22
s				
	18	15		
	3	3	48	
cated (70)	17	6		
Bases (34)			102	
96)			1212	

[redacted]

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TABLE 11

ITACK OUTCOMES - CURRENT US AND SOVIET BUDGETS

ce	Fraction of Target Complexes Destroyed	Fraction of Point Targets Destroyed	B-70 Survival	B-52 Survival
q.	[redacted]	[redacted]	.56	[redacted]
Sq.			-	
Sq.			-	
Sq.			-	
33 Sq.			-	
. +) q.)			-	
. +) q.)			-	
q. +) q.)			-	

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TABLE 12

US ATTACK OUTCOMES

(High US and Soviet Budgets)

al Cost Reference ce Plus	Fraction of Target Complexes Destroyed	Fraction of Point Targets Destroyed	B-70 Survival	B-52 Survival
), 24 Sq.	[redacted]	[redacted]	.18	[redacted]
58, 66 Sq.			-	
, 12 Sq. +) 58, 34 Sq.)			.35	
, 12 Sq. +) 0, 37 Sq.)			.54	
, 12 Sq. +) edary, 33 Sq.)			.27	

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TABLE 13

EFFECT OF COMBAT DEGRADATION PLUS B-70 ECM FACTOR

(Current Budget Force with B-70's)

Defense Degradation Factors	Fraction of Target Complexes Destroyed	Fraction of Point Targets Destroyed	B-70 Survival	B-70 Bombs Delivered
[redacted]			.25	.51
			.47	.68
			.59	.75
			.85	.92

TOTAL COMPLEXES TARGETED = 116

TOTAL POINTS TARGETED = 210

[redacted]

TABLE 14

EFFECT OF TARGETING SAM DEFENSES

(Current Budget Force with B-70's)

SAM Defenses	Fraction of Target Complexes Destroyed	Fraction of Point Targets Destroyed	B-70 Survival	Defense Degradation Factor
Not targeted	[redacted]	[redacted]	.03	.4
Targeted			.25	.4
Not targeted			.20	.8
Targeted			.59	.8

TOTAL NUMBER OF COMPLEXES = 116

TOTAL NUMBER OF POINT TARGETS = 210

[redacted]

[redacted]

WSEG on the B-70

WSEG Report No. 50, "Evaluation of Strategic Offensive Weapon Systems," was published in December 1960. The time considered is 1964 - 1967, and the B-70 is studied as a weapon system which could begin to enter the inventory toward the end of the period.

The WSEG study appears to have some rather serious limitations. The most important of these are discussed below.

WSEG used single idealized US weapon systems in its calculations rather than a mixture of US systems. This use of "pure" rather than "mixed" forces seriously underestimates probable effectiveness of individual weapon systems, which in a mixed force both contribute to and benefit from the accomplishments of other systems. For example, in a mixed force, the B-70 benefits substantially from the preceding ICBM attack and, in turn, materially assists subsequent, and lower performance, manned bombers to penetrate. This complementary characteristic of a mixed force has been shown very clearly in other studies of US Strategic Force Composition.

WSEG's pessimistic assumption that Soviet defenses and command and control systems are undegraded at the time of penetration is, by their own admission, unrealistic. It underestimates the ability of bombers to penetrate. This is particularly unfair to the B-70 which would benefit more than lower performance bombers from degradation of defenses because of the vulnerability of the netted system which is required to counter it.

Despite assumptions and an analytical treatment which we believe underestimate the capability of the B-70, the WSEG study concludes that it should have a penetration advantage over all programmed US bombers. WSEG postulates two possible levels of Soviet defenses - one rather moderate, the other quite sophisticated and involving a large investment - and estimates B-70 performance against each. Against the lesser defense system, the B-70 is a high confidence system, and against the sophisticated defense it is considered to be of medium to high confidence.

Essentially, then, WSEG's reservations about the desirability of the B-70 are not based upon doubts as to its ability to do the job, but rather, primarily, upon a cost effectiveness comparison between it and equal cost forces of missiles. One of the assumptions made in computing effectiveness is that survivability is neglected. All of the missiles are launched under this assumption but only 1/3 or 2/3 of the B-70's launch. Thus, survivability does not appear to have been ignored in the bomber calculations. The costs preferred

[redacted]

and used by WSEG for the B-70 were higher than the detailed costing information supplied by the Air Force.

Using the original WSEG costs, the B-70 is not attractive from a cost effectiveness point of view, except against targets of 100 or more psi hardness. On the other hand, using the Air Force costs supplied to WSEG, the B-70 proves to be competitive with fixed ballistic missiles in all cases, with an advantage which increases with target hardness. Its advantage over mobile missile systems of Minuteman or Polaris yield and accuracy (and costs) is much more pronounced. Using Air Force costs, the B-70 is shown to be more effective than other manned bombers.

In view of the importance assigned to this cost effectiveness comparison, it is very pertinent that WSEG is in the process of revising their costs downward. Using these revised costs and interpolating linearly between the original WSEG and Air Force costs presented in the WSEG study, the B-70 appears to be preferred in all cases except against quite soft targets (on the order of 3 psi), and even here the difference is not so marked as to rule the B-70 out of competition.

A COST EFFECTIVENESS COMPARISON OF PURE STRATEGIC FORCES

Pure force cost comparisons are admittedly of limited value since they ignore significant complementary, interference and enhancement effects which occur in real life when a mixed force of strategic weapon systems engages a mixed force of defensive weapon systems. These effects influence strongly and differently the ground survival and penetration capabilities of the various systems. However, if care is exercised in establishing the input values and if the inherent limitations of the exercise are kept in mind, a pure force cost comparison can indicate the relative merits of competing systems in severely restricted situations. Note the word relative. It is essential to view the results in terms of relative standing only. The results of such a restricted comparison cannot pretend to represent absolute capabilities under any realistic condition.

The cost effectiveness comparison reported here is based on the capability of alternative equal-cost, pure forces to destroy 10 psi and 100 psi point targets. Using the initial investment plus five years' annual operating cost of an operational force of 200 B-70's as a base, (225 total buy), the numbers of missiles or B-52's with GAM-87's which could be procured and supported for five years for the same cost were determined. The results are given in Table 1.

It is important to note that research and development costs were not considered. They were omitted on the assumption that the decision has been made to complete this phase for each of the systems compared whether it is eventually procured or not. The sensitivity of the results to this assumption is discussed briefly later.

Table 2 contains the assumptions made regarding certain pertinent characteristics and capabilities of the systems as well as the results of the comparison. The survival factors are based on the predicted minimum alert capabilities of the bombers, the fraction of Polaris submarines on station, and an estimate of the capability of the other missiles to survive the initial Soviet ICBM attack. With regard to reliability and CEP, the same value as were utilized in WSEG 50 have been applied.

Substantial uncertainties are associated with the penetrability factors assumed. The important point to be borne in mind when evaluating these assumptions is that the B-70's are carrying eight bombs and that the B-52's are carrying four bombs. Bombers that survive the penetration will deliver all their bombs. Only in exceptional cases will bombers be killed before they have delivered any of their bombs. Results of analyses indicate that, on the average, a dead bomber will deliver half its weapons before it is killed. Further, this factor appears to be relatively independent of the actual attrition rate achieved by the defense. Thus, the factor of 0.75 assumed for the B-70 represents, in fact, a bomber survival factor of the

order of 0.50. The penetrability factors assumed for the missiles are low if the Soviets do not develop an ABM capability but probably are high, particularly for POLARIS and MINUTEMAN, if they do achieve an effective missile defense.

The results are based on an attack by the entire force against point targets having a hardness of 10 psi or 100 psi. The computation is based on the number of weapons of the specified yield and accuracy required to provide a probability of 0.85 of destroying the given target. The total number of targets damaged by the force is then given by:

$$N_t = D_{0.85} P_s P_r P_p F W, \text{ where}$$

N_t = total number of targets destroyed

$D_{0.85}$ = number of weapons required to achieve 0.85 probability of damage

P_s = probability of survival

P_r = reliability factor

P_p = conditional probability that weapon is delivered

F = total force size

W = number of weapons/warheads carried by each bomber/missile.

Against 100 psi targets, the B-70 force shows a substantial margin of superiority over the B-52 and even a greater margin over any missile. [redacted]

Against 10 psi targets, the B-70 force appears to be slightly more effective than the B-52 force; both are significantly less effective than the fixed MINUTEMAN force but significantly more effective than any other missile force.

The above equation shows that the number of targets damaged varies with every input in direct proportion. Thus, doubling or halving any factor, doubles or halves the number of targets killed. This greatly simplifies sensitivity considerations.

If research and development costs are added, the B-70 force would still have a significant advantage against 100 psi (and harder) targets and it would still be competitive with the B-52 force against 10 psi targets. The rank of the missile forces would not change.

[redacted]

EQUAL COST FORCE CAPABILITY

Weapon System	Op'nl Day	No. of Weapons/ System	Yield (MT)	CEP (NM)	Survival	Relia-bility	Penetra-bility	No. Targets Damaged (Pd = 0.85) 10 PSI	100 PSI
B-70	200	8							
TITAN II	325	1							
MINUTEMAN (Fixed)	1632	1							
MINUTEMAN (Mobile)	979	1							
POLARIS (SSBN)	39	16							
B-52/Bomb	272	4							
/GAM-87		4							

EQUAL COST STRATEGIC WEAPON SYSTEMS

Cost In Millions *

Weapon System	Op'nl Force Size	Initial Invest	5 Yr Opns	Weapons Per Vehicle	Total Weapons
B-70	200	4,849.0	3,012.0	8	1600
TITAN II	325	4,667.0	3,194.0	1	325
MINUTEMAN (Fixed)	1632	3,737.0	4,112.6	1	1632
MINUTEMAN (Mobile)	979	3,338.4	4,513.2	1	979
** POLARIS (SSBN)	39	5,967.0	1,091.5	16	624
B-52/GAM-87	272	3,835.2	3,971.2	8	2176

* Excluding RDT&E

** POLARIS Cost Source WSEG 50