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THE SOTAS-SCOUT-AAH/HELLFIRE SYSTEM.(U)
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Prepared for:

Battlefield Systems Integration Directorate
US Army Materiel Development and Readiness Command
5001 Eisenhower Avenue
Alexandria, Virginia 22333

In Response to:

Contract No. DAAG39-77-M-0487

December 1976

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The increased performance capability and associated change in survivability resulting from the increase in performance was investigated for scout type helicopters. Three terrains, coded for the computer, were used in the study. Scout helicopters were employed to search, identify and designate targets for an Advanced Attack Helicopter with HELLFIRE missiles. The scout helicopter

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20. Abstract (Continued)

performance was investigated at different altitudes for several single and multiple pop-up positions in each terrain.

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TABLES

THE SOTAS-SCOUT-AAH/HELLFIRE SYSTEM

INTRODUCTION

The General Research Corporation, under contract to the Battlefield Systems Integration Directorate, has examined selected alternative concepts for employing scout and attack type helicopters to complement the SOTAS providing a relatively closed circuit target acquisition/engagement system. The particular emphasis of this investigation is focused on the amount of coverage which may be offered by the scout under varied conditions and the associated survivability of the scout when employed cooperatively with the AAH/HELLFIRE. The interface required from SOTAS through the DTOC is not addressed but is expected to be considered during the early testing and fielding of the SOTAS.

DISCUSSION

The SOTAS will provide surveillance of the area from the FEBA to about 40 kilometers beyond the FEBA. Moving targets in this area will be detected to a high order of accuracy within very short time periods. Mean detection times will be on the order of 10 seconds. The SOTAS may be quite limited, however, in its ability to find the numerous stationary targets within a few thousand meters of the FEBA. Particularly in the case of a discontinuous FEBA the SOTAS system may be severely taxed to find, identify and hand-off targets over the greatly extended frontages. Additionally the SOTAS cannot provide the laser designation of the targets for HELLFIRE from its expected position of employment 15 to 20 kilometers behind the FEBA; therefore, target hand-off to some weapon response and designation will be required. Early hand-off to scout helicopters could reduce the SOTAS workload. The AAH with HELLFIRE could also accept the early hand-off, however, the AAH should not be limited to following the progress of a single target until within HELLFIRE range. In fact the AAH need never be exposed if scouts can designate for it using the cooperative, indirect firing mode.

It is clear that a scout helicopter with a laser designator and target acquisition system can enhance the ground forces armor defeating potential by:

(1) reducing the SOTAS workload
(2) locating targets in the proximity of the FEBA
(3) identifying targets where the FEBA location is not clear
(4) designating targets for the AAH.

It is not so clear, however, how the scout helicopter can best be used to provide the ground coverage needed; whether the coverage is adequate; or if the scout can survive while performing the acquisition and designation functions under various terrain and threat conditions.

APPROACH

The thrust of the investigation was directed towards examining scout helicopter performance and survivability for several alternative conditions of employment. Using varied terrains, several selected pop-up positions for the helicopter and different altitudes of pop-up, the fractional portion of the terrain that was in line of sight of the helicopter from each position was determined. In addition the expected survival of the scout in each of the observing positions, in each terrain at the varied altitudes was calculated. Combinations of the positions in each of the terrains were then examined to determine how much more coverage might result from multiple observing points, a capability ideally suited for the aerial scouts mobility.

BASE DATA

Terrain

Three terrains were selected for the experiment that had already been coded for the CARMONETTE model and used on other studies. These terrains identified in Figs. 1, 2 and 3 will be referenced throughout the remainder of this report as A, B and C. These three terrains were

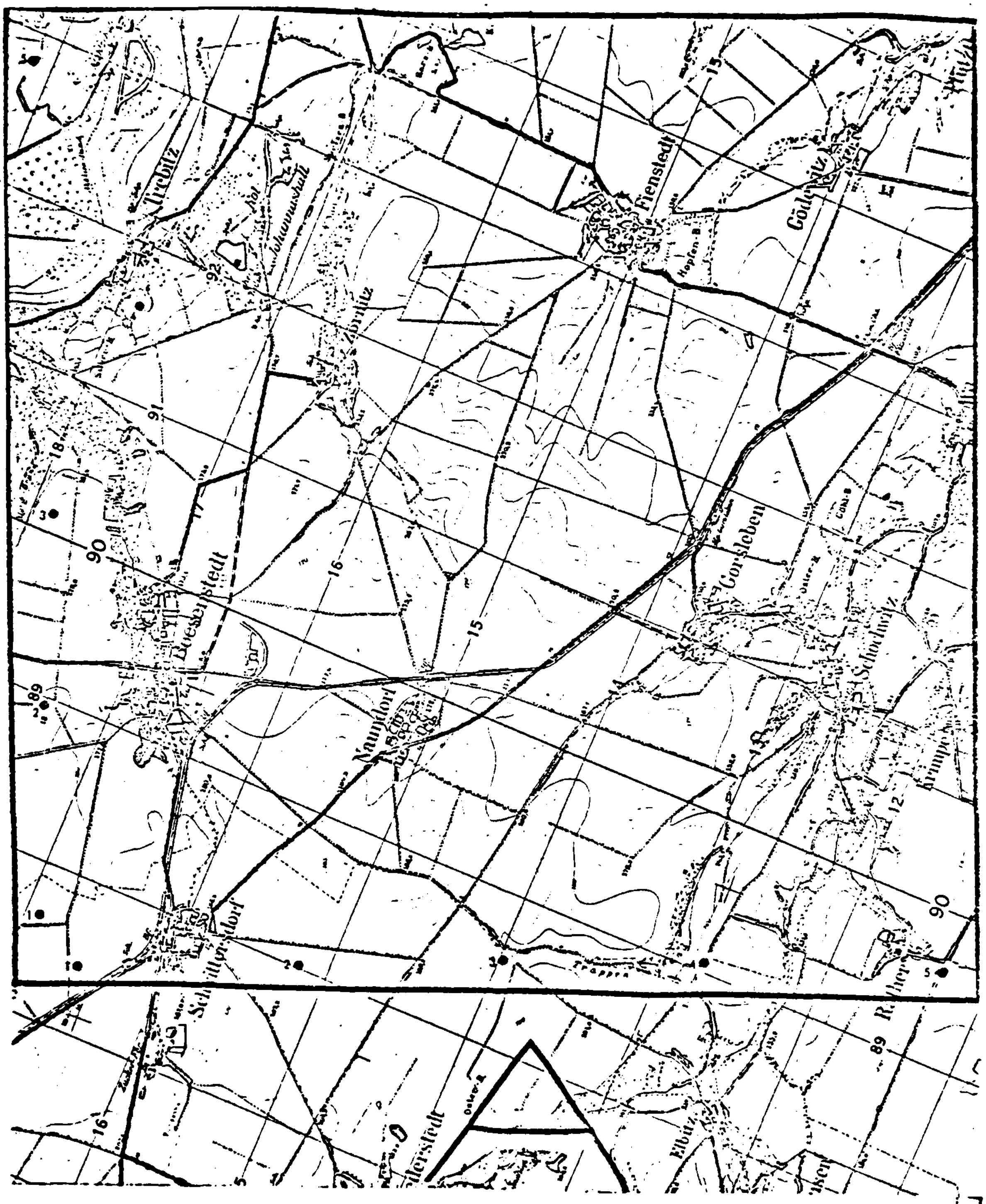

Fig. 1 — Open Terrain

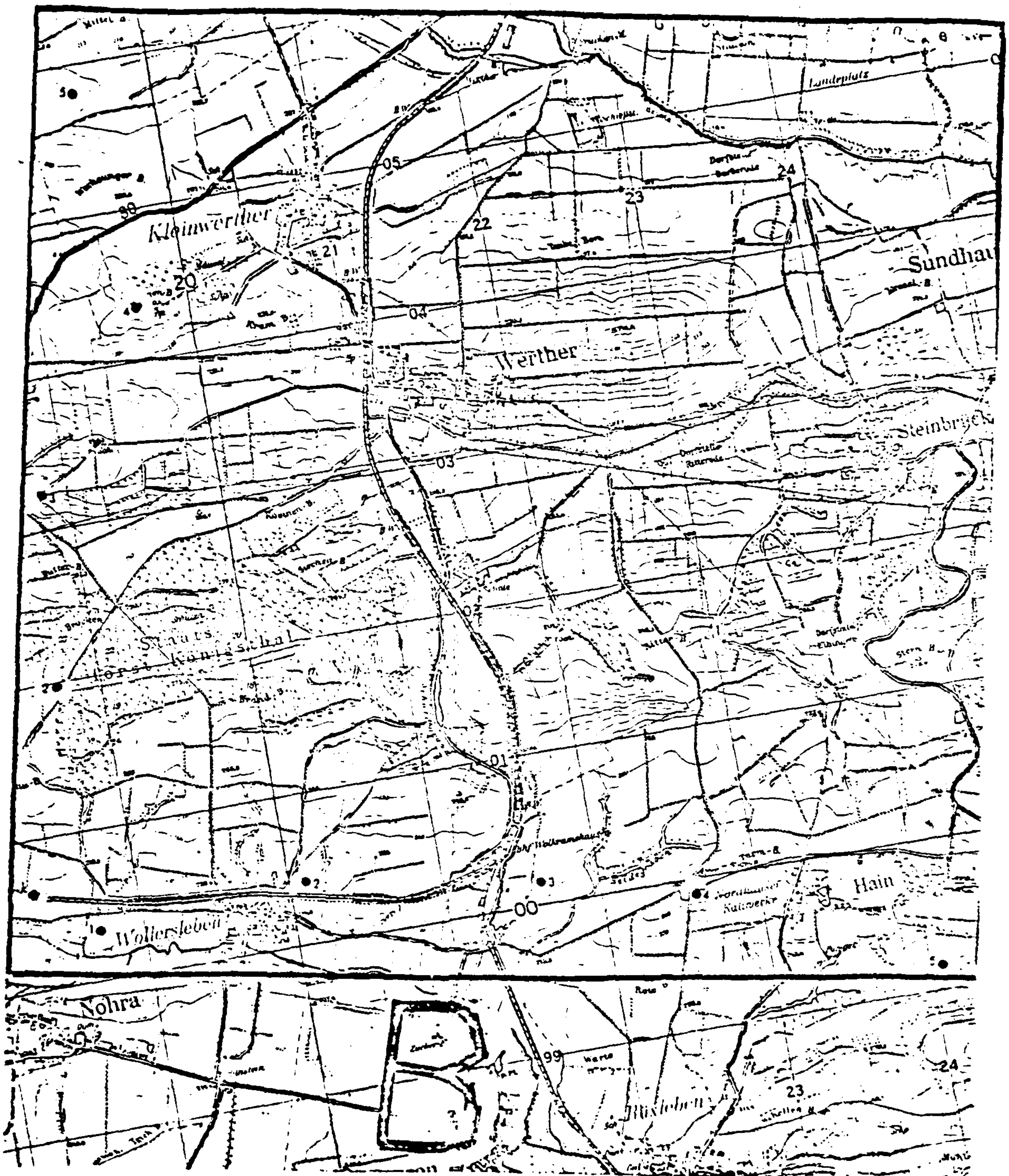

Fig. 2 — Medium Terrain

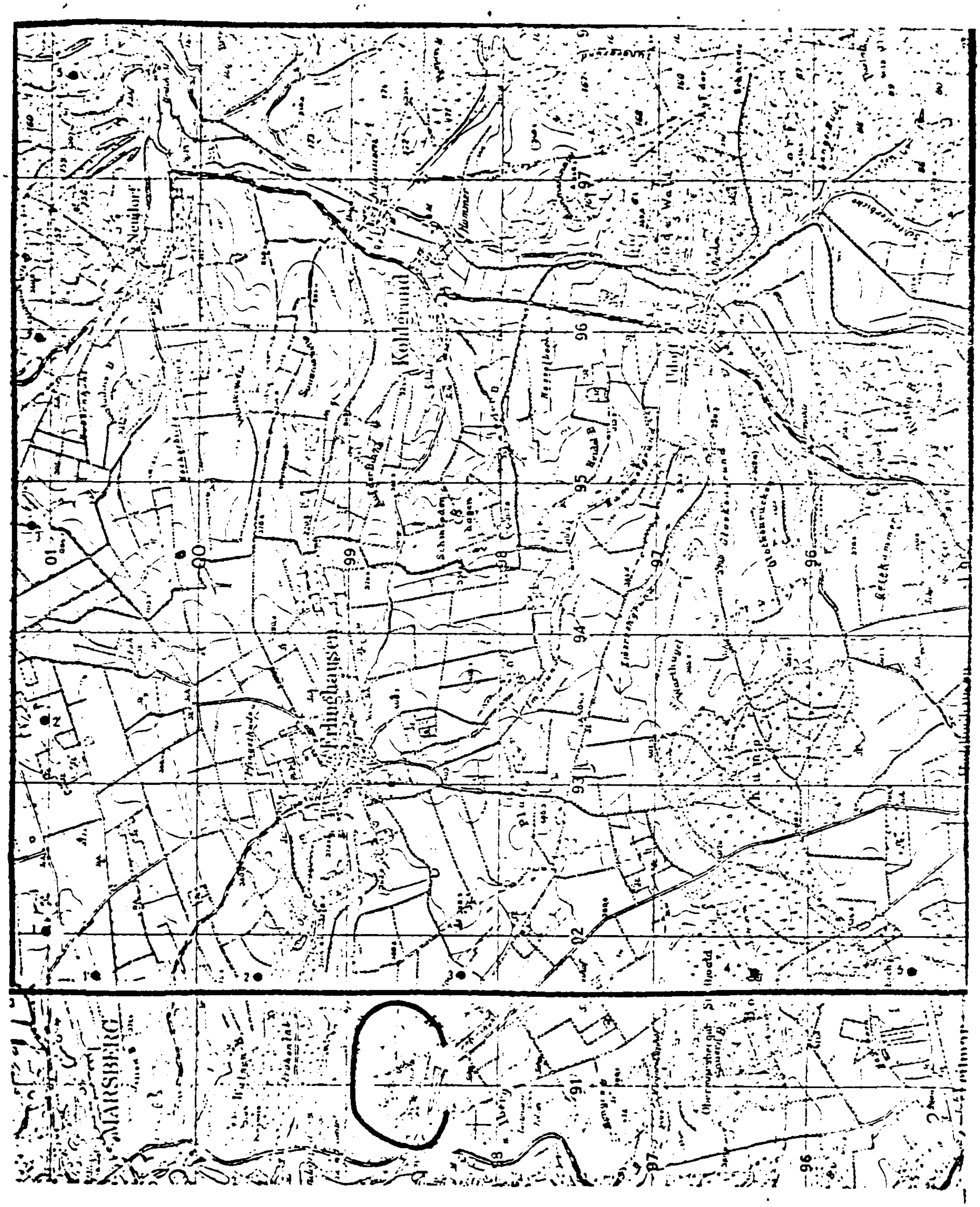

Fig. 3 — Closed Terrain

selected for the earlier studies as representative portions of European terrain varying from open to closed terrain. Terrain A is located about 15 kilometers to the northwest of Halle A. D. Saale in East Germany; terrain B is just south of Nordhausen in East Germany; and terrain C is located about 40 kilometers west by north of Kassel in West Germany. The area of the terrain enclosed by the solid black line on each Figure includes 6.3 x 6.4 square kilometers and was coded for each 100 meter square to reflect altitude, vegetation, potential concealment, and trafficability. For the experiment done for this study only the altitude and tree heights in every 100 meter square were used.

Observer Positions

Five observer positions were selected from an examination of the maps along the bottom of each coded area and along the left edge. Those located along the bottom were assumed to be searching up the map as displayed and are referred to hereafter as looking in the Y direction. Specifically those 5 numbered positions on the bottom of Fig. 1 are identified as searching terrain AY; those on the left of the map are identified as searching terrain AX.

A scout helicopter was placed in each of the positions shown in Figs. 1, 2 and 3, and the terrain within line of sight of each position determined for three pop-up altitudes: 16 feet, 100 feet and 200 feet.

To keep the experiment simple it was assumed that a FEBA existed on each of the terrains located two kilometers forward of the edge from which the scouts were located. It was also assumed that the aerial scouts would be able to navigate at nape of the earth out of line of sight to preselected observation points with an initial orientation to the target area by SOTAS. This gave the scouts located along the bottom edge an area to search in the Y direction of 6.3 kilometers by 4.4 kilometers. The scouts located on the left edge of the terrains searched an area in the X direction of 6.4 x 4.3 square kilometers.

Threat to the Scout

Three 23mm quad air defense guns were assumed to be located and uniformly distributed in the area being searched by the scout. It was further assumed that the number of 23mm quads that could see the scout was directly proportional to the amount of terrain visible to the scout. For example if the scout could see 0.20 of the terrain, 0.20 x 3 or 0.6 of the 23mm quads could engage the scout.

The performance characteristics of the 23mm quads were extracted from previous GRC studies. Those of greatest importance in the engagement sequence are summarized below.

a. Detection time - mean time of 3 seconds using the on-board radar

b. Accuracy of fire - 3.13 mils using the optical sight with range information from the radar

c. Dispersion - 5 mils at ranges less than 2500 meters and 10 mils at ranges over 2500 meters (note the projectile speed becomes subsonic at ranges of about 2500 meters)

d. Projectile Path

Range (m)	Time of Flight (sec)	Velocity (m/sec)
1000	1.3	612
2000	3.5	366
3000	6.8	260
4000	11.0	200
5000	17.0	130

e. Delay time - from acquisition to fire is 8 seconds

f. Rate of fire - Average rate of 20 rounds per second

g. Effect - The scout vulnerable area was assumed to be 1.32 square meters. (This is the vulnerable area of the OH-58).

Scout and AAH Performance

It was assumed that the scout, similar to the OH-58, would be able to employ the ALLD/TADS to designate targets for an AAH with HELLFIRE. In the experiment the scout would pop-up to the desired altitude, search for a target, designate the target for the AAH until HELLFIRE impact and then seek protective masking. This is a "worst case" condition for Scout survivability. The AAH with HELLFIRE was assumed to be located in a fully defiladed position and fired in the indirect fire mode. Key parameters influencing engagement outcomes are listed below.

a. Detection time - Times extracted from CDEC test results of 43.5 and 43.6 field experiments were used. Median detection times of interest are 15 seconds at 3000 meters, 17 seconds at 4000 meters and 19 seconds at 5000 meters.

b. Climb and Decend Rate - 720 feet per minut

c. Delay Time - The time from scout designation of the target to the AAH firing of HELLFIRE was assumed to be 5 seconds.

d. HELLFIRE Profile

Range (m)	Time of Flight (sec)	Velocity (m/sec)
1000	2.5	335
2000	5.4	287
3000	9.2	247
4000	13.9	213
5000	18.0	189

e. Maximum Search Time - The maximum time allowed for the scout to search for a target was four times the median time to detect (yielding a probability of detection of .9375). If a target was not found in this time the scout would seek full masking and abort the search from tnat position.

INVESTIGATION RESULTS

Terrain Coverage

Graphical printouts showing an "X" in all areas visible to each of the observer positions from each of the three altitudes were prepared. In addition all possible combinations of 2, 3, 4 and 5 observers on a common side (i.e., the bottom or left edge of map) were calculated and printed out. These printouts are not included in this report but are available at GRC in McLean, Virginia. Rather than include the graphical presentations the percent of the terrain covered should be more meaningful. Table 1 summarizes the fractional amount of the terrain, beyond the assumed FEBA, that can be observed by a single scout at each of 5 positions for the three different altitudes.

Table 1
FRACTIONAL AMOUNT OF TERRAIN WITHIN LINE OF SIGHT AT EACH POSITION

	POSITION NUMBER				
	1	2	3	4	5
TERRAIN AY, ALTITUDE = 16 FT	.0004	.0278	.0548	.0528	.1353
TERRAIN AY, ALTITUDE = 100 FT	.1607	.3774	.4155	.3516	.4639
TERRAIN AY, ALTITUDE = 200 FT	.4536	.5381	.5444	.5139	.5488
TERRAIN AX, ALTITUDE = 16 FT	0.0000	.0043	0.0000	0.0000	.0379
TERRAIN AX, ALTITUDE = 100 FT	.1785	.3281	.2391	.1613	.0629
TERRAIN AX, ALTITUDE = 200 FT	.4840	.5773	.5594	.5688	.3652
TERRAIN BY, ALTITUDE = 16 FT	0.0000	0.0000	.0139	.0206	.0473
TERRAIN BY, ALTITUDE = 100 FT	0.0000	.0008	.0980	.2183	.1726
TERRAIN BY, ALTITUDE = 200 FT	.0028	.0810	.2798	.3679	.3437
TERRAIN BX, ALTITUDE = 16 FT	.0430	0.0000	.2691	.1176	.2770
TERRAIN BX, ALTITUDE = 100 FT	.1477	.2090	.4184	.5547	.4629
TERRAIN BX, ALTITUDE = 200 FT	.2043	.4988	.6555	.6410	.5754
TERRAIN CY, ALTITUDE = 16 FT	.0004	.0004	.0004	0.0000	.0135
TERRAIN CY, ALTITUDE = 100 FT	.0357	.0230	.0377	.0226	.0611
TERRAIN CY, ALTITUDE = 200 FT	.0996	.0802	.1270	.0802	.2012
TERRAIN CX, ALTITUDE = 16 FT	.0363	.0008	.0348	.2250	.1684
TERRAIN CX, ALTITUDE = 100 FT	.1035	.0398	.1320	.2902	.2082
TERRAIN CX, ALTITUDE = 200 FT	.1801	.1629	.2562	.3609	.2445

The combinations of terrain in view of each set of five positions, shown in Table 1, were calculated for each altitude to determine what added coverage might result from multiple positions. The averages of these calculations are presented in Table 2. The fractional coverage shown under one position (e.g., .0542 for terrain AY at 16 feet altitude) is the average of the five positions shown on the first line of Table 1. The fractional coverage shown under 2 positions (e.g., .1026 for terrain AY at 16 feet altitude) was determined by overlaying all paired combinations (e.g., 1-2, 1-3, 1-4, 1-5, 2-3, 2-4, 2-5, 3-4, 3-5, 4-5) of positions, determining the coverage for each pair and then averaging the coverage. This continues to where under 5 positions, the fractional amount of terrain in view is shown if all five of the positions were occupied.

The output data contained in Table 2 is shown graphically in Figs. 4, 5 and 6 for all terrains for 16 feet, 100 feet and 200 feet altitudes of observation.

Figure 7 shows the average increase in coverage (averaged over all terrains) that results from increasing altitude and increasing the number of observation locations. One might conclude from this that if located 2 kilometers behind the FEBA and observing to about 4 kilometers behind the FEBA over a 6 kilometers front that 5 observers (or 5 different vantage points) from a 16 foot altitude render the same coverage as one position at 100 feet altitude. Also that one position at 200 feet altitude can see as much as 3 positions at 100 feet altitude.

Comparative Scout Losses

Tables 3-8, inclusive show the expected scout helicopter attrition for each terrain at three altitudes and five launch ranges. The scout was assumed to pop-up at the rate of 720 feet per minute to the desired altitude, search for any suitable target, designate for the AAH until HELLFIRE impact and seek protective masking. The AAH position was assumed to be in full defilade 3000 to 5000 meters from the selected target.

The losses which might result from each of the five positions selected for the scouts are shown in the tables. In addition the average of the

Table 2
AVERAGE AMOUNT OF TERRAIN IN LINE OF SIGHT
FROM MULTIPLE VANTAGE POINTS

	NUMBER OF POSITIONS				
	1	2	3	4	5
TERRAIN AY, ALTITUDE = 16 FT	.0542	.1026	.1455	.1833	.2163
TERRAIN AY, ALTITUDE = 100 FT	.3538	.4577	.4992	.5249	.5437
TERRAIN AY, ALTITUDE = 200 FT	.5198	.5825	.6112	.6288	.6405
TERRAIN AX, ALTITUDE = 16 FT	.0084	.0169	.0253	.0337	.0422
TERRAIN AX, ALTITUDE = 100 FT	.1940	.2965	.3518	.3845	.4074
TERRAIN AX, ALTITUDE = 200 FT	.5109	.6097	.6475	.6680	.6812
TERRAIN BY, ALTITUDE = 16 FT	.0164	.0314	.0449	.0571	.0579
TERRAIN BY, ALTITUDE = 100 FT	.0979	.1701	.2224	.2606	.2905
TERRAIN BY, ALTITUDE = 200 FT	.2150	.3373	.4038	.4398	.4611
TERRAIN BX, ALTITUDE = 16 FT	.1413	.2605	.3586	.4365	.4953
TERRAIN BX, ALTITUDE = 100 FT	.3585	.5648	.6807	.7416	.7742
TERRAIN BX, ALTITUDE = 200 FT	.5150	.7131	.7955	.8315	.8477
TERRAIN CY, ALTITUDE = 16 FT	.0029	.0056	.0083	.0109	.0135
TERRAIN CY, ALTITUDE = 100 FT	.0360	.0540	.0664	.0767	.0857
TERRAIN CY, ALTITUDE = 200 FT	.1176	.1739	.2151	.2487	.2774
TERRAIN CX, ALTITUDE = 16 FT	.0930	.1720	.2375	.2902	.3305
TERRAIN CX, ALTITUDE = 100 FT	.1548	.2637	.3416	.3970	.4363
TERRAIN CX, ALTITUDE = 200 FT	.2409	.3691	.4429	.4875	.5148

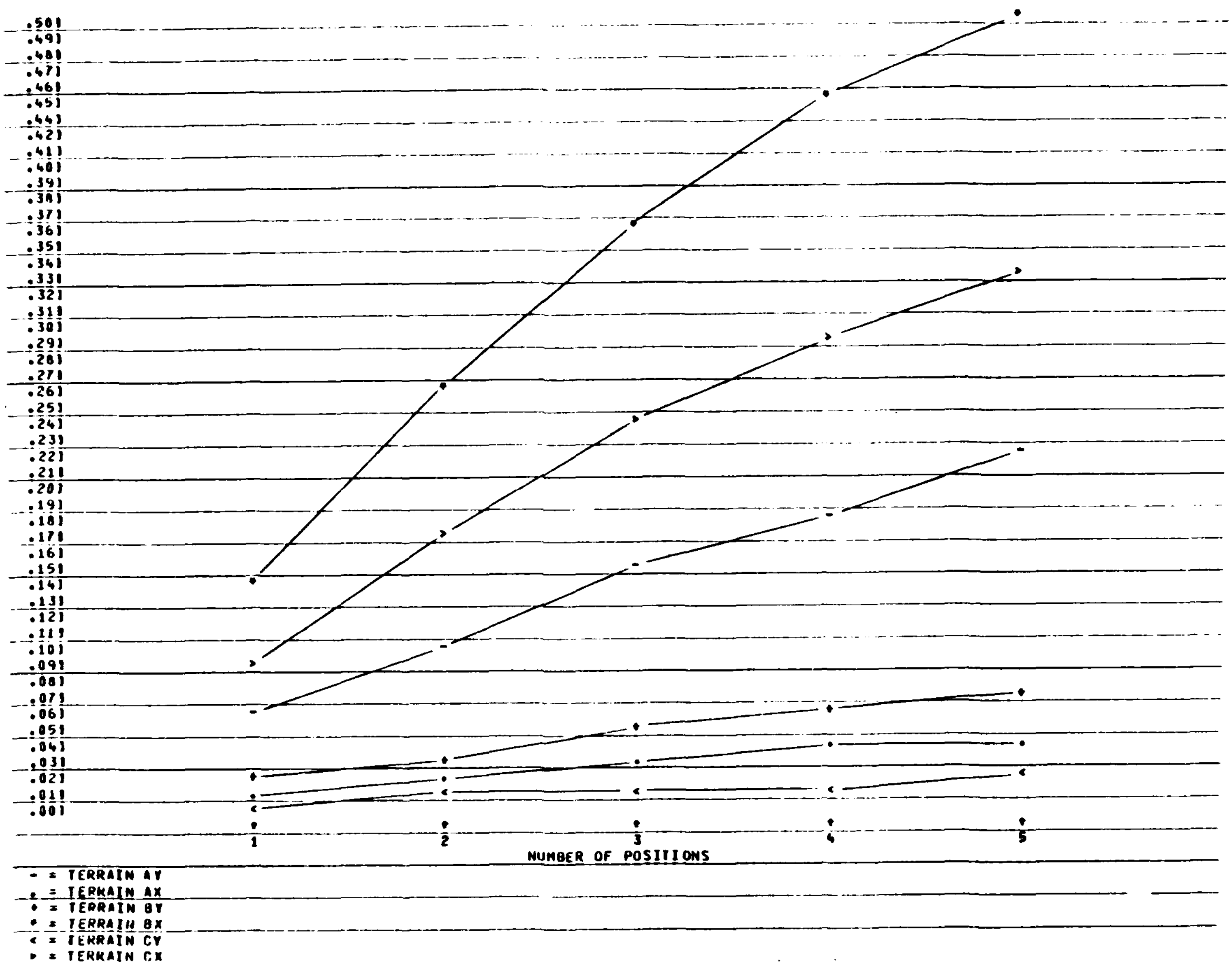

Fig. 4 — Increase in Coverage for Multiple Observation Positions at 16 Ft. Altitude

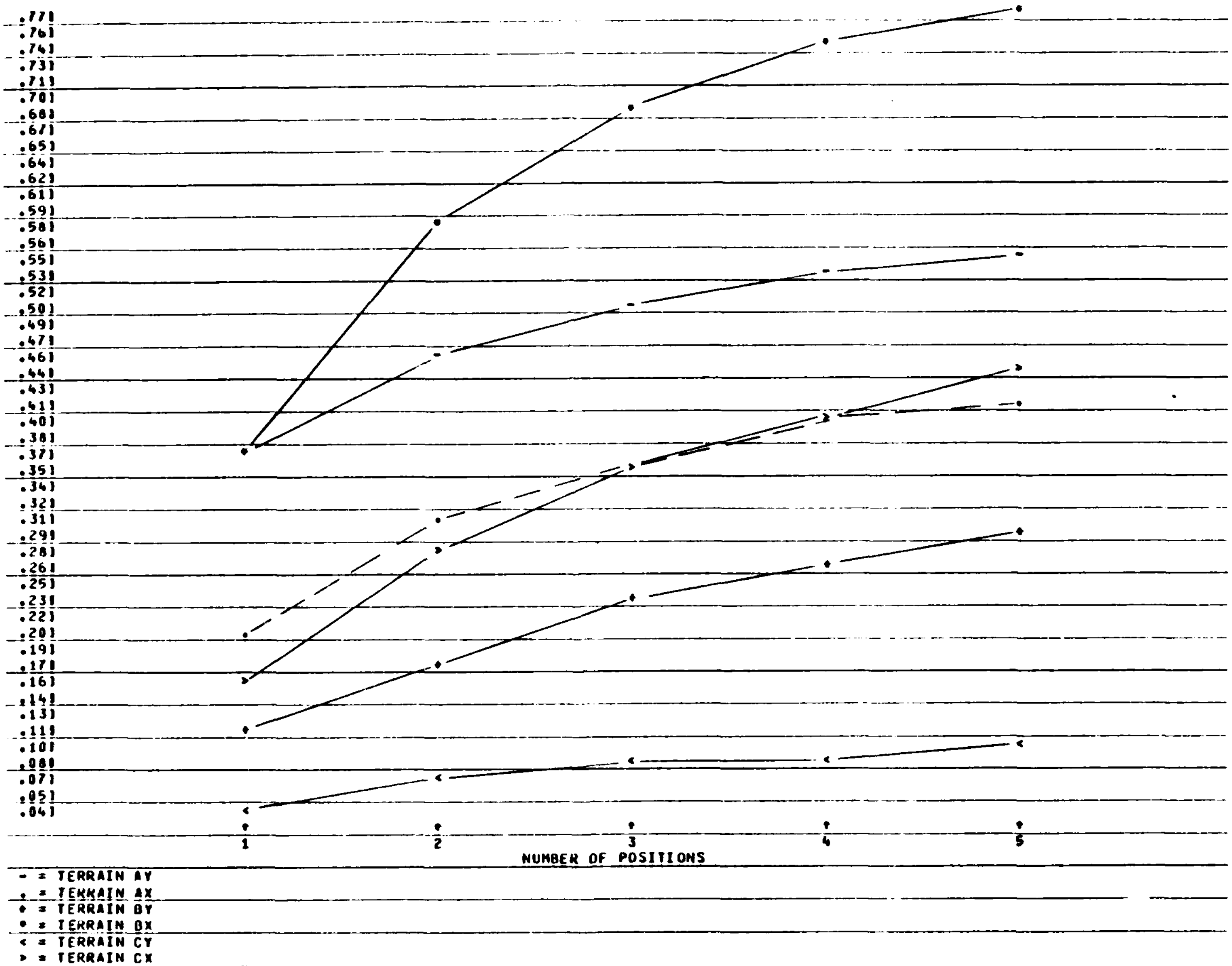

Fig. 5 — Increased Coverage for Multiple Observation Positions at 100 Ft. Altitude

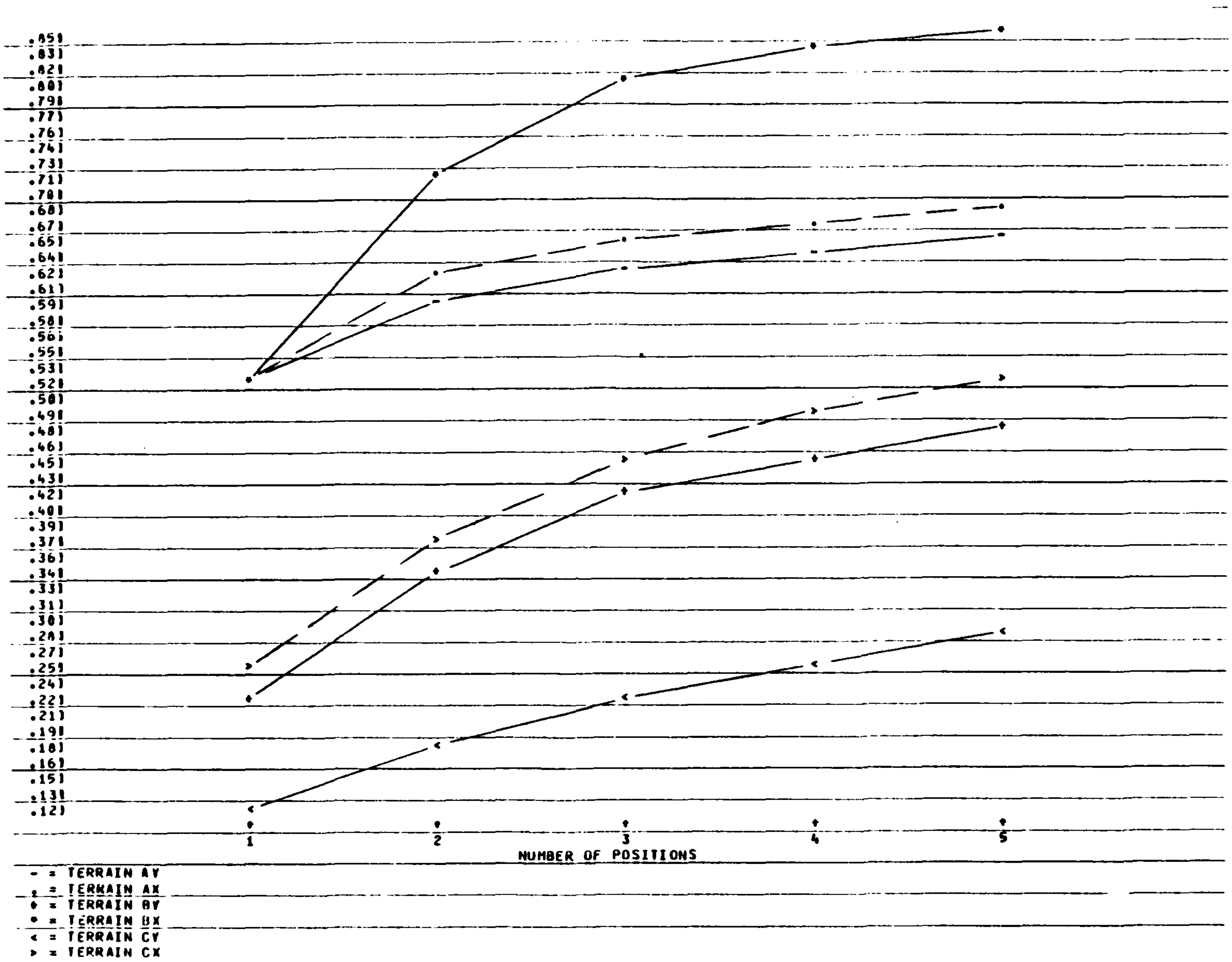

Fig. 6 — Increased Coverage for Multiple Observation Positions at 200 Ft. Altitude

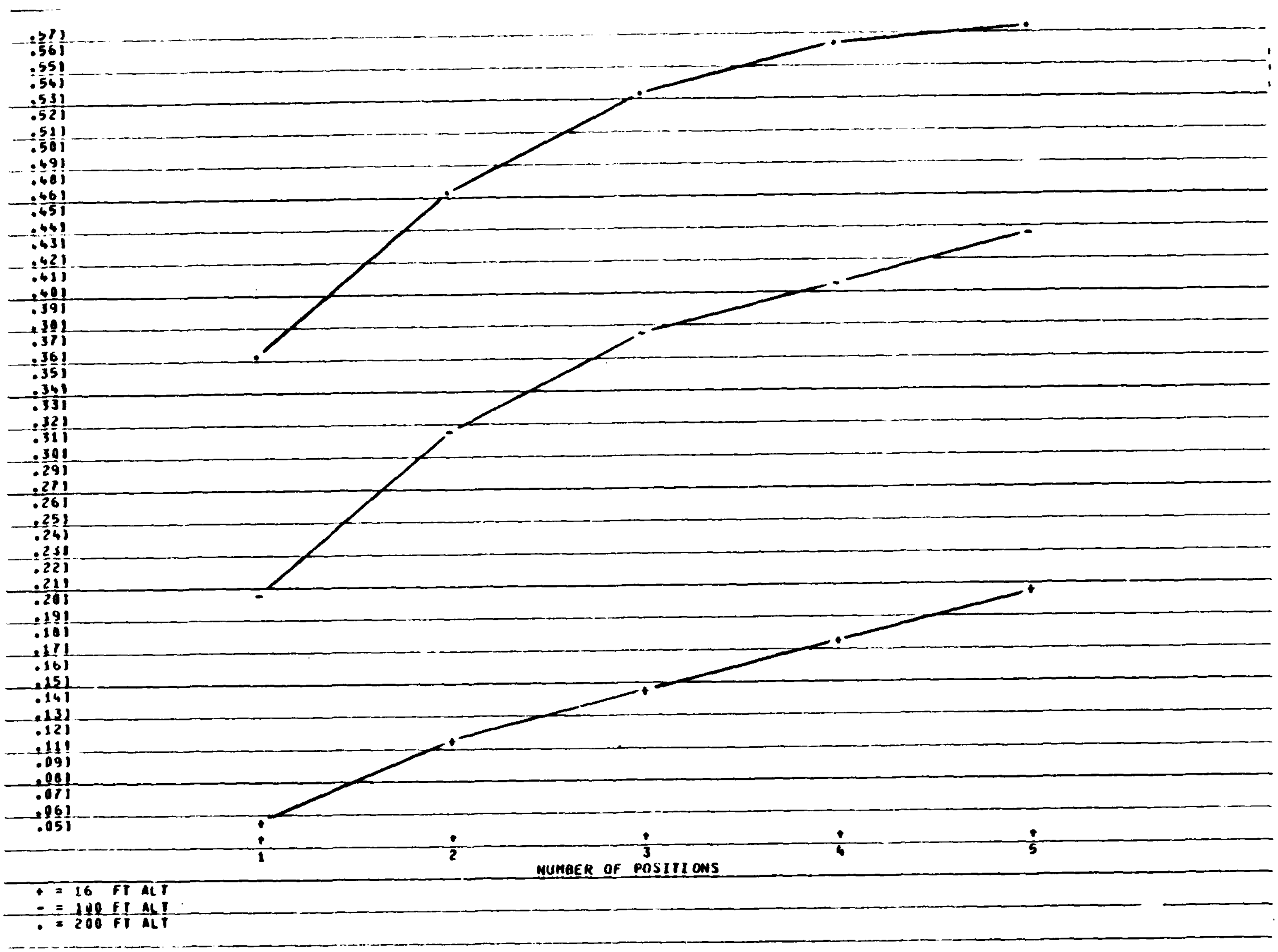

Fig. 7 — Change in Coverage for Increases in Altitudes and Number of Positions

Table 3

PROBABLE SCOUT ATTRITION IN TERRAIN AY

TERRAIN	SEARCH ALTITUDE	LAUNCH RANGE(M)	PSN 1	PSN 2	PSN 3	PSN 4	PSN 5	AVG
AY	16 FT	3000	0.00	0.00	0.00	0.00	.01	.00
AY	16 FT	3500	0.00	0.00	0.00	0.00	.01	.00
AY	16 FT	4000	0.00	0.00	.01	.01	.01	.01
AY	16 FT	4500	0.00	0.00	.01	.01	.02	.01
AY	16 FT	5000	0.00	0.00	.01	.01	.02	.01
AY	100 FT	3000	.02	.04	.04	.04	.05	.04
AY	100 FT	3500	.02	.04	.05	.04	.05	.04
AY	100 FT	4000	.02	.05	.05	.05	.06	.05
AY	100 FT	4500	.02	.05	.06	.05	.07	.05
AY	100 FT	5000	.03	.06	.06	.05	.07	.05
AY	200 FT	3000	.06	.08	.08	.07	.08	.07
AY	200 FT	3500	.07	.08	.08	.08	.08	.08
AY	200 FT	4000	.08	.09	.09	.09	.09	.09
AY	200 FT	4500	.08	.10	.10	.09	.10	.09
AY	200 FT	5000	.09	.10	.10	.10	.10	.10

Table 4

PROBABLE SCOUT ATTRITION IN
TERRAIN AX

TERRAIN	SEARCH ALTITUDE	LAUNCH RANGE(M)	PSN 1	PSN 2	PSN 3	PSN 4	PSN 5	AVG
AX	16 FT	3000	0.00	0.00	0.00	0.00	0.00	0.00
AX	16 FT	3500	0.00	0.00	0.00	0.00	0.00	0.00
AX	16 FT	4000	0.00	0.00	0.00	0.00	0.00	0.00
AX	16 FT	4500	0.00	0.00	0.00	0.00	0.00	0.00
AX	16 FT	5000	0.00	0.00	0.00	0.00	0.00	0.00
AX	100 FT	3000	.02	.03	.03	.02	.01	.02
AX	100 FT	3500	.02	.04	.03	.02	.01	.02
AX	100 FT	4000	.02	.04	.03	.02	.01	.02
AX	100 FT	4500	.03	.05	.03	.02	.01	.03
AX	100 FT	5000	.03	.05	.04	.03	.01	.03
AX	200 FT	3000	.07	.08	.08	.08	.05	.07
AX	200 FT	3500	.07	.09	.08	.09	.06	.08
AX	200 FT	4000	.08	.10	.09	.09	.06	.08
AX	200 FT	4500	.09	.10	.10	.10	.07	.09
AX	200 FT	5000	.09	.11	.11	.11	.07	.10

Table 5

PROBABLE SCOUT ATTRITION IN TERRAIN BY

TERRAIN	SEARCH ALTITUDE	LAUNCH RANGE(M)	PSN 1	PSN 2	PSN 3	PSN 4	PSN 5	AVG
RY	16 FT	3000	0.00	0.00	0.00	0.00	0.00	0.00
RY	16 FT	3500	0.00	0.00	0.00	0.00	0.00	0.00
RY	16 FT	4000	0.00	0.00	0.00	0.00	.01	.00
RY	16 FT	4500	0.00	0.00	0.00	0.00	.01	.00
RY	16 FT	5000	0.00	0.00	0.00	0.00	.01	.00
RY	100 FT	3000	0.00	0.00	.01	.02	.02	.01
RY	100 FT	3500	0.00	0.00	.01	.03	.02	.01
RY	100 FT	4000	0.00	0.00	.01	.03	.02	.01
RY	100 FT	4500	0.00	0.00	.01	.03	.02	.01
RY	100 FT	5000	0.00	0.00	.02	.03	.03	.02
RY	200 FT	3000	0.00	.01	.04	.05	.05	.03
RY	200 FT	3500	0.00	.01	.04	.06	.05	.03
RY	200 FT	4000	0.00	.01	.05	.06	.06	.04
RY	200 FT	4500	0.00	.01	.05	.07	.06	.04
RY	200 FT	5000	0.00	.02	.05	.07	.07	.04

Table 6

PROBABLE SCOUT ATTRITION IN TERRAIN BX

TERRAIN	SEARCH ALTITUDE	LAUNCH RANGE(M)	PSN 1	PSN 2	PSN 3	PSN 4	PSN 5	AVG
BX	16 FT	3000	0.00	0.00	.02	.01	.02	.01
BX	16 FT	3500	0.00	0.00	.02	.01	.02	.01
BX	16 FT	4000	0.00	0.00	.03	.01	.03	.01
BX	16 FT	4500	.01	0.00	.03	.01	.03	.02
BX	16 FT	5000	.01	0.00	.03	.02	.04	.02
BX	100 FT	3000	.02	.02	.04	.06	.05	.04
BX	100 FT	3500	.02	.02	.05	.06	.05	.04
BX	100 FT	4000	.02	.03	.05	.07	.06	.05
BX	100 FT	4500	.02	.03	.06	.08	.07	.05
BX	100 FT	5000	.02	.03	.06	.08	.07	.05
BX	200 FT	3000	.03	.07	.09	.09	.08	.07
BX	200 FT	3500	.03	.08	.10	.10	.09	.08
BX	200 FT	4000	.03	.08	.11	.11	.10	.09
BX	200 FT	4500	.04	.09	.12	.11	.10	.09
BX	200 FT	5000	.04	.09	.12	.12	.11	.10

Table 7

PROBABLE SCOUT ATTRITION IN TERRAIN CY

TERRAIN	SEARCH ALTITUDE	LAUNCH RANGE(M)	PSN 1	PSN 2	PSN 3	PSN 4	PSN 5	AVG
CY	16 FT	3000	0.00	0.00	0.00	0.00	0.00	0.00
CY	16 FT	3500	0.00	0.00	0.00	0.00	0.00	0.00
CY	16 FT	4000	0.00	0.00	0.00	0.00	0.00	0.00
CY	16 FT	4500	0.00	0.00	0.00	0.00	0.00	0.00
CY	16 FT	5000	0.00	0.00	0.00	0.00	0.00	0.00
CY	100 FT	3000	0.00	0.00	0.00	0.00	.01	.00
CY	100 FT	3500	0.00	0.00	0.00	0.00	.01	.00
CY	100 FT	4000	0.00	0.00	.01	0.00	.01	.00
CY	100 FT	4500	.01	0.00	.01	0.00	.01	.01
CY	100 FT	5000	.01	0.00	.01	0.00	.01	.01
CY	200 FT	3000	.01	.01	.02	.01	.03	.02
CY	200 FT	3500	.02	.01	.02	.01	.03	.02
CY	200 FT	4000	.02	.01	.02	.01	.03	.02
CY	200 FT	4500	.02	.01	.02	.01	.04	.02
CY	200 FT	5000	.02	.02	.02	.02	.04	.02

Table 8

PROBABLE SCOUT ATTRITION IN TERRAIN CX

TERRAIN	SEARCH ALTITUDE	LAUNCH RANGE(M)	PSN 1	PSN 2	PSN 3	PSN 4	PSN 5	AVG
CX	16 FT	3000	0.00	0.00	0.00	.02	.01	.01
CX	16 FT	3500	0.00	0.00	0.00	.02	.02	.01
CX	16 FT	4000	0.00	0.00	0.00	.02	.02	.01
CX	16 FT	4500	0.00	0.00	0.00	.03	.02	.01
CX	16 FT	5000	0.00	0.00	0.00	.03	.02	.01
CX	100 FT	3000	.01	0.00	.01	.03	.02	.01
CX	100 FT	3500	.01	0.00	.02	.03	.02	.02
CX	100 FT	4000	.01	.01	.02	.04	.03	.02
CX	100 FT	4500	.02	.01	.02	.04	.03	.02
CX	100 FT	5000	.02	.01	.02	.04	.03	.02
CX	200 FT	3000	.03	.02	.04	.05	.04	.04
CX	200 FT	3500	.03	.03	.04	.06	.04	.04
CX	200 FT	4000	.03	.03	.04	.06	.04	.04
CX	200 FT	4500	.03	.03	.05	.07	.04	.04
CX	200 FT	5000	.04	.03	.05	.07	.05	.05

expected losses from the five positions is shown as representative of the terrain in each of the tables. These results clearly show, as would be expected, that the losses are more severe at the higher altitude. The increased losses at higher altitudes result from principally two causes: (1) the increased exposure time caused by the time required to ascend and decend and (2) the increased exposure to the air defense weapons. The obvious conclusion follows that the more terrain in line-of-sight of the scout the higher the attrition; i.e., go high to see but stay low to survive.

Figure 8 plots the average scout losses as a function of launch range for each of the terrains. The data points in this figure average the three altitudes used in each terrain. This figure shows the spread in losses that might result from observing in different kinds of terrain. Yet the obvious conclusion cited above still pertains. A comparison of this figure with Figs. 4, 5 and 6 clearly shows as performance capability goes down so does attrition.

The three terrain types A, B and C, are considered to be representative of open to closed terrain in Germany. To construct an average European terrain the expected losses in all terrains at each altitude were averaged. The range of losses contributing to these averages may be seen in Tables 3 through 8. Figure 9 is a graphical plot of the attrition that might result in this average terrain for increases in altitude.

Figure 10 combines the averaged terrain data with average attrition losses for illustrative purposes. The average scout losses in averaged terrain are plotted against the average amount of terrain that can be observed. If large coverage of the terrain is required the increase in altitude and number of vantage points of observation becomes necessary. If, on the other hand, the SOTAS can provide the scout with specific information as to where to search, large coverage may not be necessary. The mission of the scout then becomes very important. If intelligence gathering over a wide area is paramount, the higher altitude and consequently higher attrition will prevail. If locating a target is the primary emphasis, in a target rich environment, in an area indicated by

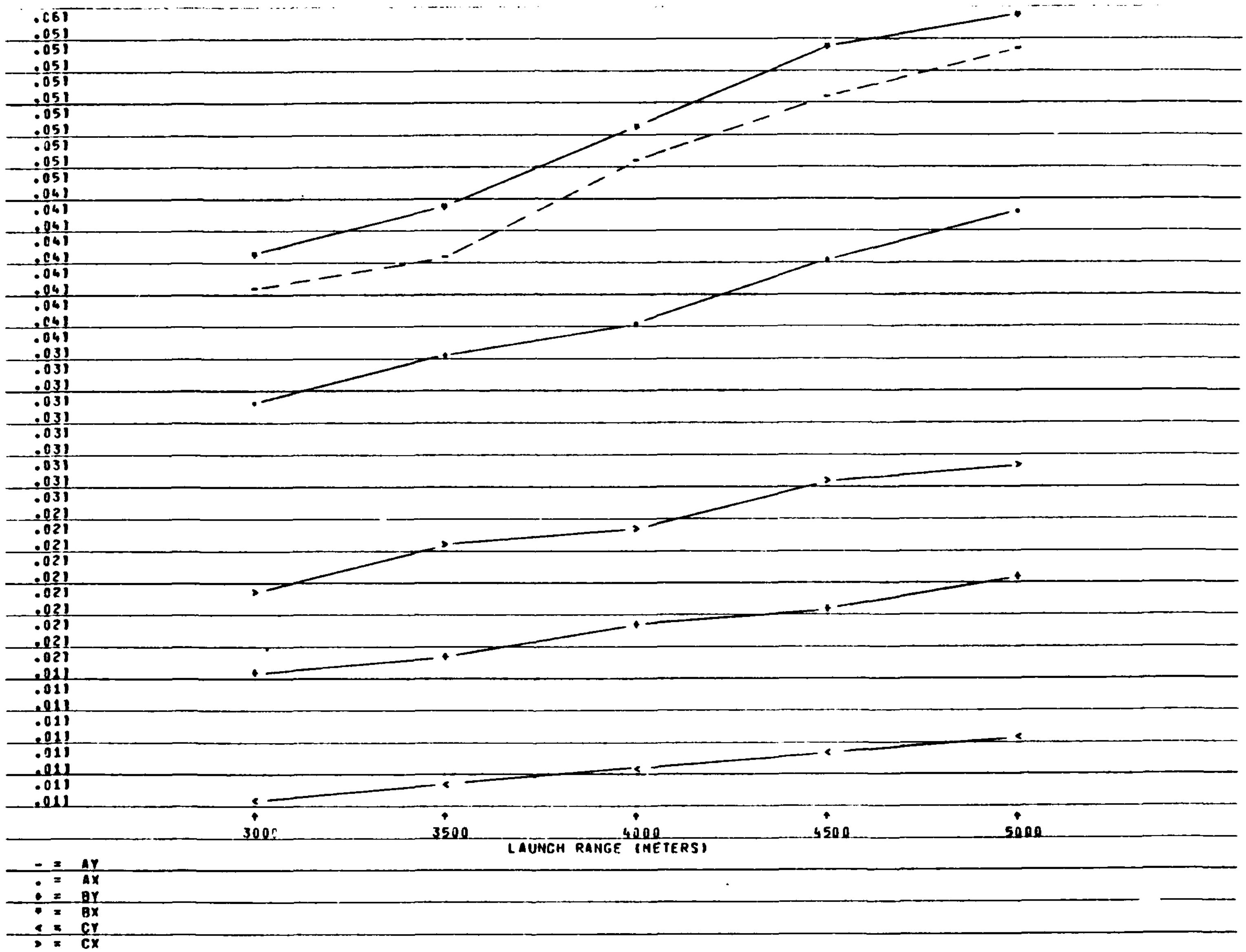

Fig. 8 — Average Scout Losses at an Average Altitude

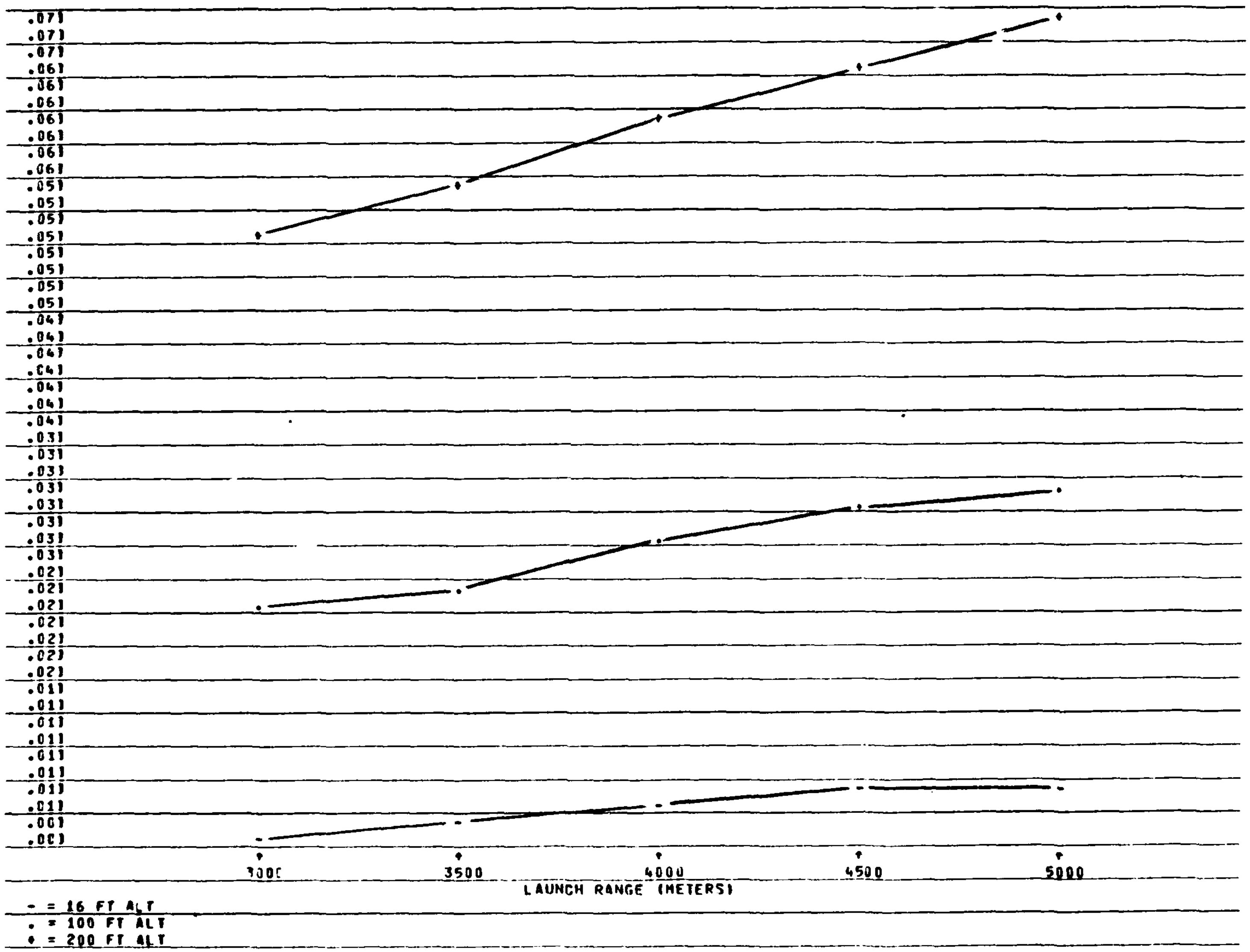

Fig. 9 — Average Attrition in Average Terrain

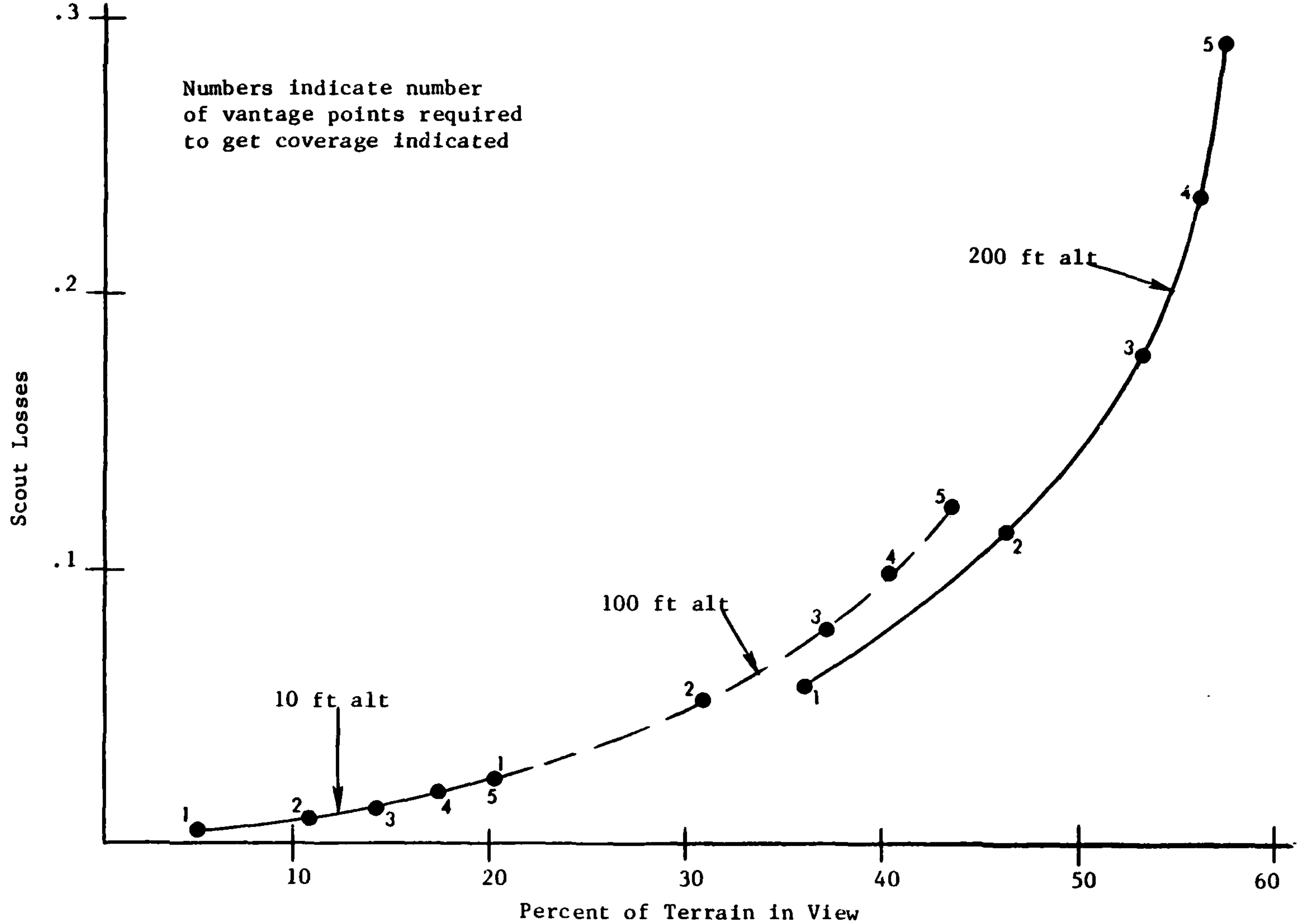

Fig. 10 — Average Scout Losses to Obtain Coverage

SOTAS and with orientation by SOTAS, the low altitude large stand-off range, and low attrition will prevail.

WEATHER

In all of the simulations conducted line-of-sight from the scout position to the terrain being searched for targets was the primary consideration. The percentage of terrain coverage that might be attained by single or multiple Scout positions in degraded weather conditions was not addressed. Early morning ground fog, reduced visibility ranges, low ceilings as well as other meteorological phenomena like wind, rain and snow may reduce the amount of coverage further depending in part upon the capability of the observation system. Coupled with this degradation in the Scouts performance due to weather the attrition caused by the 23mm quad would fall providing the duty cycle (exposure time) of the scout remained constant. This results because in limited visibility conditions the 23mm quad must be fired in the radar mode which is less accurate than in the optical mode with range information (ROR).

In the 1970 USAEUR-Seventh Army Air Cavalry Troop evaluation it was observed that during the testing period no discernible effects of weather were noticed on the aerial scout acquisition and engagement performance. This observation resulted, in part, from allowing stand-off ranges considerably smaller (1/2 mile) than those considered in this paper. However, included with the Air Cavalry Troop evaluation was an examination which assembled weather data gathered over a 10 year period from 16 locations in Europe (10 in W. Ger., 3 in E. Ger., and 3 in Czech). The results showed that favorable conditions (3 miles visibility and 500 ft. ceiling) existed about 80% of the time varying from 58% in November-December to 92% in July-August.

An Air Force study, SABER ARMOR, reported that conditions along the East-West German border (Grafenwohr) had ceilings over 2500 feet and 3 miles visibility 95% of the time in the summer and 72% of the time in the winter.

The above percentages are reasonably comparable. Coupled with these percentages, however, is the day/night variations between summer and winter. If positive identification is necessary by observation, the summer time capability may be better since there are about 16 hours of daylight as contrasted with about 8 hours in the winter time.

CONCLUSIONS AND INFERENCES

Clearly increasing the number of observers, or number of points from which observations are made, will increase the area of coverage. Also increasing the altitude of the observing points will increase the coverage. This study has determined the general order of magnitude of these increases for several terrains. As a summary of all of the data Figs. 11 and 12 are presented. An average of the data points of all the terrains was used to develop the curves shown in order to illustrate quantitatively the trade-offs between increasing observers and increasing altitude.

An increase in the area within line-of-sight of a scout helicopter located 2000 meters behind the FEBA can be obtained by increasing the altitude of the observer or increasing the number of positions from which the observation is made or a combination of both. An observer at 16-feet altitude on the average will see about 5.5 percent of the terrain. Two observers at different vantage points, at 16-feet altitude increase the amount of coverage to 11 percent. Clearly there is very little if any overlap in coverage of the area beyond the FEBA for two widely separated observation positions. This from an efficiency point of view appears to be good because adding another observation point doubles the percentage of coverage. On the other hand if the same terrain is not visible to two widely separated observers there can be no mutual support between observers and each must operate completely independent of the other. It requires 5 observers to increase the coverage to 20 percent if the altitude of 16-feet is adhered to. One observer at 100-feet altitude can also see 20 percent of terrain. Two observers increase this to 30 percent and four observers will increase the coverage to 40 percent. One observer at 200-feet altitude can also get about 40 percent (36 percent) coverage.

Average scout helicopter losses will increase for these average terrains with altitude. The losses at 16-feet altitude will be about one-half of 1 percent. At 100-feet altitude these losses will increase

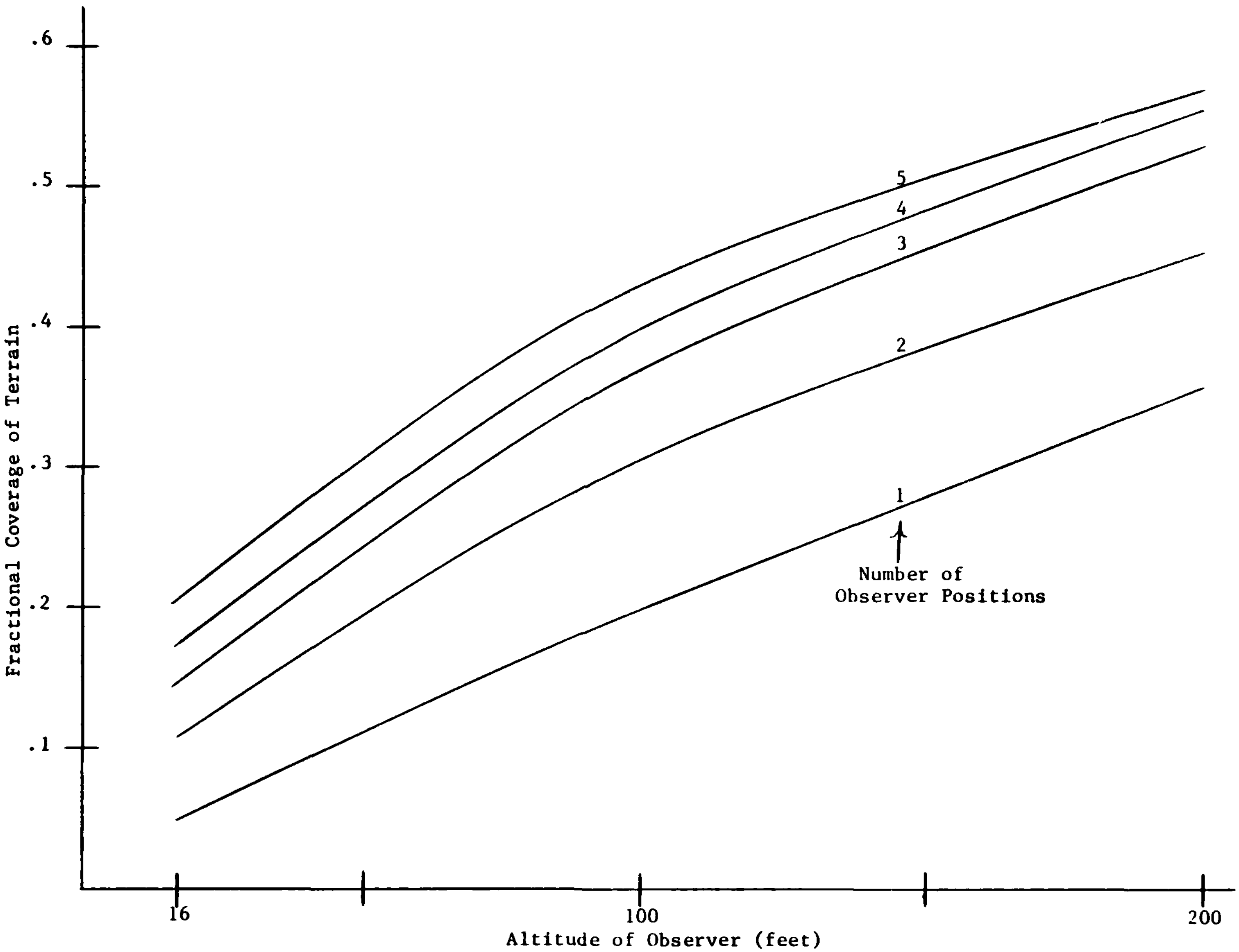

Fig. 11 — Coverage Versus Altitude

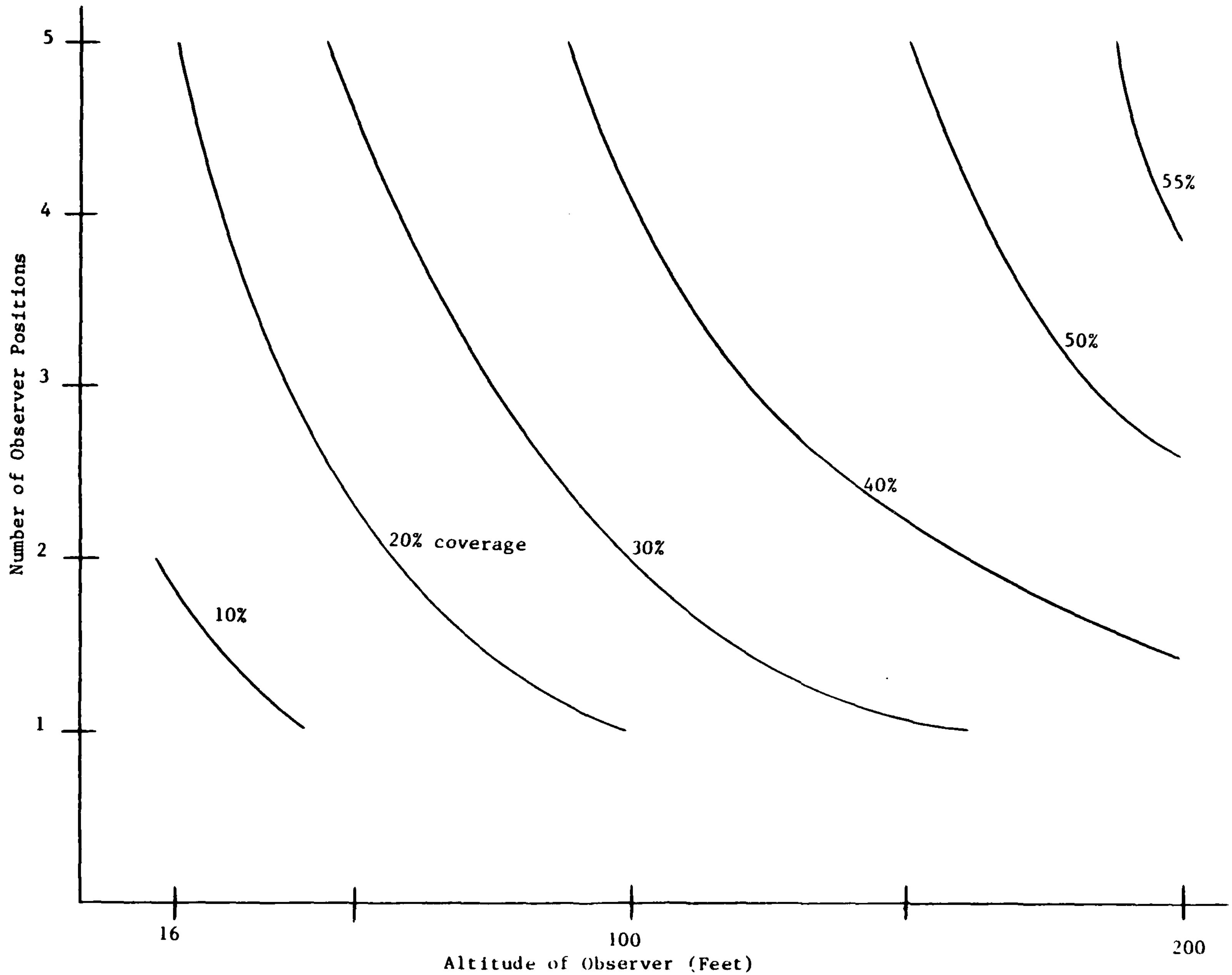

Fig. 12 — Number of Observers Versus Altitude

to about 3 percent and at 200-feet altitude about 6 percent. It was also shown that a one to two percent increase in expected scout helicopter losses results when the HELLFIRE is fired from the AAH at its maximum range (5000 meters) from the target.

In a target rich environment it appears that the scout helicopter will be able to find a target from low altitudes and survive while remaining in line-of-sight of the target to designate for a stand-off AAH firing HELLFIRE. On the other hand, if a specific type of target is sought it appears that a larger portion of the enemy must be under surveillance, thereby requiring higher altitudes for the scout and possibly multiple positions.

For the representative terrains in the air defense environment described and with the duty cycle postulated (i.e., pop-up, search, find and designate) it does appear that an observation platform, like the scout, that can be moved rapidly to several positions can survive and provide coverage of the close-in and stationary targets not identifiable or even detectable by SOTAS. In addition the scout with the ALLD/TADS when provided specific target information from a SOTAS type system can <u>identify</u> and designate targets near the FEBA for engagement by a cooperative AAH with HELLFIRE and survive.

LME