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8 OCT 1969

TECHNICAL MEMORANDUM NO [redacted]

SUBJECT : Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various CORONA Configurations with Five Missions Per Year

PREPARED BY: [redacted]

REFERENCE : (1) [redacted] 14 Aug, 1969, Memorandum for Chairman, COMIREX: Projected CORONA Satisfaction of USIB Requirements, FY 1970 and 1971, by [redacted] NRO/DDSO.

I. SUMMARY AND CONCLUSIONS

1. This memorandum describes the results of a study of the sensitivity of requirement fulfillment level to variations in the size of the areas to be covered photographically in both annual and semi-annual periods. The objective of the study was to determine what gains, in terms of increased Accomplishment Level,[1] could be achieved by reducing the size of the area to be covered on a semi-annual basis. A secondary objective, but considered with equal emphasis, was to measure the costs of changing the Semi-annual Search Area size. Of course, since the number of missions was held constant at five CORONA J-3 missions

[1] Accomplishment Level - percent of designated search area covered by unique cloud-free photography within the required period (six to twelve months).

flown per year, the costs from a fiscal point of view remained constant. But, the sum of the total unique cloud free photographic coverage obtained for annual and semi-annual purposes is reduced as the size of the Semi-annual Area decreases. Thus cost is defined, fo the purposes of this paper, to be the loss in photographic coverage.

2. The way area coverage requirements are stated has a significant impact on the Accomplishment Level achieved. Therefore, the effects of reducing the size of the Semi-annua. Area are investigated from different points-of-view with regard to the specification of requirements. Three different points-of-view evaluated in this study are stated as follows: (a) Equal Accomplishmen: Levels are to be goals against both Semi-annual and Annual Areas, (b) Emphasis on the Semi-annual Accomplishment Level, (c) Those Accomplishment Levels against Annual and Semi-annual Search Areas are to be selected which maximize the sum of the total unique cloud free coverage of the two areas.

3. This memorandum provides a measure of the effect of specified Accomplishment Levels on one type of requirement area, Annual or Semi-annual, with the expected Accomplishment Level against the other type requirement area. The Accomplishment Levels which maximize the total unique cloud-free imagery were derived and are reported in this memorandum.

SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

4. Several factors influence the area photographed and, consequently, influence the Accomplishment Levels achieved; launch rate, film type and perigee altitude are particularly significant. The effects of different film types and perigee altitudes are of great interest because these are features of the CORONA system which can be chosen to define various configurations. For this study, four specific options with respect to the factors mentioned above, are reflected in this evaluation and they are defined in Table 1.

TABLE 1: CORONA J-3 CONFIGURATIONS

Film Type	Perigee Altitude[2] (n.m.)	Average Altitude Over Target (n.m.)	Coverage Available Per Flight ($\times 10^6$ n.m.^{2})
Ultra Thin Base (UTB)	100.0	107.1	13.5
Ultra Thin Base (UTB)	85.0	89.3	9.5
Standard Thin Base (STB)	100.0	107.1	9.2
Standard Thin Base (STB)	85.0	89.3	6.3

[2]The values given for perigee altitude actually do not have the precision indicated and should be thought of as nominal values.

SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

5. The results of the study show that regardless of which CORONA configuration is used, when five missions are flown per year, a reduction of as much as 50% in the size of the Semi-annual Search Area allows an increase of approximately 10% in Accomplishment Level. These increases in Accomplishment Level are based on the assumption that the authors of the requirements will specify that equal Accomplishment Levels are to be achieved against both Semi-annual and Annual objectives. It is shown that increases of this magnitude could be obtained with the appropriate choice of perigee altitude and/or film type without reducing the Semi-annual Search Area size.

6. There are specific Accomplishment Levels which maximize the sum of the total unique cloud free Annual and Semi-annual photographic coverage. If the authors of photographic requirements specify Accomplishment Levels which maximize this sum, increases in Accomplishment Level of approximately 12% against the Semi-annual Area and 15% against the Annual Area are achieved when the current Semi-annual Area decreases by 50%. The absolute values of Accomplishment Level achieved

along with the maximum values of the total unique cloud free photographic coverage acquired using this approach are summarized in Table 2.

TABLE 2: The Relationship Between Accomplishment Level and Maximized Total Unique Cloud-Free Photographic Coverage of Annual and Semi-Annual Areas

Film Type/ Perigee Altitude	Size of Semi-Annual Search Area			
	6.8×10^6 n.m.^{2}		3.4×10^6 n.m.^{2}	
	Maximum Total Net Coverage ($\times 10^6$nm^2)	SAAL*/AAL* %	Maximum Total Net Coverage ($\times 10^6$nm^2)	SAAL*/ AAL** %
UTB/100	14.2	88/80	12.5	95/98
UTB/85	11.1	68/69	10.1	76/80
STB/100	11.1	68/69	10.1	76/80
STB/85	9.0	56/52	8.5	65/66

* Semi-annual Accomplishment Level.
** Annual Accomplishment Level

7. The photographic requirements could place principal emphasis on increased Accomplishment Level against the Semi-annual Area. With this approach, the authors of the requirements would specify that no coverage against the Annual Area is to be

SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

obtained unless some acceptable Accomplishment Level, for example 80%, is obtained against the Semi-annual Area. If this level of coverage against the Semi-annual Area were obtained the remaining capability would be applied against the Annual Area. Table 3 summarizes the Accomplishment Level and the associated sum of the total unique cloud free Annual and Semi-annual photographic coverage. It will be noted that the Semi-annual requirement, 80%, is achieved by the UTB/100 configuration and the Accomplishment Level against the Annual Area is 97% with the current Semi-annual Search Area size. But, no coverage is obtained against the Annual Area with the other configurations with the current Semi-annual Area size. When the Semi-annual Search Area size is reduced by 50%, the 80% Accomplishment Level is fulfilled and accomplishment levels against the Annual Area are achieved. However, note that with the UTB/100 configuration the only improvement achieved by decreasing the Semi-annual Area by 50% is a one percent increase in Accomplishment Level agains the Annual Area. Also note that the values of coverage obtained are less than corresponding values in Table 2. Further presentation of data pertinent to the point-of-view discussed above will be found with Figures 5 and 6 of the study results.

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SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

TABLE 3: The Relationship Between Accomplishment Level and Total Unique Cloud-Free Photographic Coverage of Annual and Semi-Annual Areas--Semi-Annual Emphasis

Film Type/ Perigee Altitude	Size of Semi-Annual Search Area			
	6.8×10^6 n.m.^{2}		3.4×10^6 n.m.^{2}	
	Total Net Coverage ($\times 10^6$ nm^2)	SAAL*/AAL* (%)	Total Net Coverage ($\times 10^6$ nm^2)	SAAL*/AAL** (%)
UTB/100	13.3	80/97	11.6	80/98
UTB/85	10.6	75/0	1[illegible].0	80/75
STB/100	10.6	75/0	10.0	80/75
STB/85	8.6	62/0	[illegible].0	80/40

* Semi-annual Accomplishment Level.
** Annual Accomplishment Level.

8. When the size of the Semi-annual Area is decreased the increases in Accomplishment Level are achieved through a greater concentration of effort on the reduced area. This leads to an increase in redundant coverage. As the size of the Semi-annual Area decreases the size of the Annual Area increases causing a lower Accomplishment Level against the Annual Area for the previously applied level of effort. Thus, more effort is applied

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to the Annual Area in an attempt to pull its Accomplishment Level up. For these reasons, Accomplishment Level does not increase as high nor as fast as one may have anticipated for reduction in the Semi-annual Search Area size.

9. For all CORONA configurations at five missions per year except STB/85, a reduction in the size of the current Semi-annual Search Area will cause a reduction in the sum of the total area covered with unique cloud free photography for annual and semi-annual purposes. For STB/35 at five missions per year it appears that there could be minor advantages from a total net coverage point-of-view, in resizing the Semi-annual Area to approximately 6×10^6 n.m.^{2}.

10. When the photographic coverage available reaches a critically low level, five missions per year with STB/85 there is a specific Semi-annual Search Area size which maximizes the sum of the total unique cloud free Semi-Annual and Annual photographic coverage. Of course, it is necessary to prescribe Accomplishment Levels as goals which are appropriate to these maxima. This condition will exist and be more pronounced for all configurations if the missions flown should drop as low as four per year.

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SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

II. ASSUMPTIONS SUPPORTING DATA AND CONSTRAINTS

1. In this study it was assumed that the search requirements against which the CORONA system will be used in the future will be similar in structure to current requirements. Furthermore, it was assumed that the manner in which the CORONA system will be operated in the future will remain consistent with procedures and operations of the past.

2. The Army Map Service coverage accomplishment data was used to correlate the Annual and Semi-annual search Accomplishment Level with the Total Gross Coverage[3] for all six and twelve month periods ending in CY1963. Then, the Mission Gross Coverage[4] was correlated with data on the Total Area Photographed[5] for annual and semi-annual purposes from the files of the Satellite Operations Center (SOC). The supporting statistics and analytical technique discussed above are detailed in the Appendix.

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[3] Total Gross Coverage - the total of the individual mission, semi-annual or annual, area search gross coverage in square nautical miles.

[4] Mission Gross Coverage - the unique cloud free photography per mission in square nautical miles.

[5] Total Area Photographed - the total area, in square nautical miles, photographed within the search area for semi-annual or annual purposes. Includes cloud covered and redundant photography.

SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

3. The specified quantities or limitation on film utilization against requirements for coverage against High Priority Areas (HPA), non-Sino-Soviet areas, and Mapping, Charting, and Geodesy (MC&G) which have been used by the SOC in similar studies were used in this study. These constraints, presented in Table 4: Specified Film Utilization, may vary according to current intelligence objectives; but, they are usually specified according to the gross coverage available per mission.

TABLE 4: SPECIFIED FILM UTILIZATION
(Reference 1)

Film Type/Perigee Altitude	HPA Usage Per Mission[6] ($\times 10^6$ n.m.^{2})	Non-Bloc Annual Usage[7] ($\times 10^6$ n.m.^{2})	MC&G Annual Usage[8] ($\times 10^6$ n.m.^{2})
UTB/100	2.70	5.0	2.0
UTB/85	1.90	5.0	2.0
STB/100	1.84	5.0	2.0
STB/85	1.26	2.0	2.0

[6] Mission coverage capability to be used for High Priority Areas per mission.

[7] The area outside the Soviet Union, Communist Bloc countries, and China which must be photographed to assure the required level of cloud-free coverage.

[8] Coverage expended for Mapping, Charting, and Geodesy.

SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

III. ANALYTICAL APPROACH

1. With the foregoing assumptions, the historical coverage data provides a basis from which to project the accomplishment of future missions.

2. With the correlated data discussed above one is in a position to choose an Accomplishment Level and determine the Total Gross Coverage required to achieve this goal. Dividing this Total Gross Coverage by the number of missions to be flown during the requirement period (6 or 12 months) defines the required Mission Gross Coverage from which the total area that must be photographed per mission can be determined for a particular requirement. If one then subtracts this area to be photographed for this requirement from the amount of coverage available on a particular CORONA configuration, the remainder is the coverage available - on a particular mission - for other requirements. Since one of the goals of this study was to measure the effects of changing periodic search area size, the correlation of Accomplishment Level to Total Gross Coverage was normalized to the search area size. It is then possible to multiply this percent total gross coverage by

SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

a particular search area size and determine the Total Gross Coverage required to achieve the specified Accomplishment Level. A numerical example demonstrating the procedure discussed above and a more detailed explanation of each aspect of this method will be found in the Appendix.

IV. RESULTS

1. Figure 1 presents the Accomplishment Level vs. Size of Semi-annual Search Area. It was assumed, to produce Figure 1, that the objective of the user would be to achieve the same Accomplishment Level on both the annual and semi-annual area. Thus, the scale entitled "Accomplishment Level" represents the individual Accomplishment Level achieved against each requirement. It is pointed out that there are two scales on the abscissa: one scale for the size of each type of search area It will be noted that as the size of the Semi-annual Search Area increases the size of the Annual Area decreases.

2. The Accomplishment Levels in several specific cases are presented numerically in Table 5.

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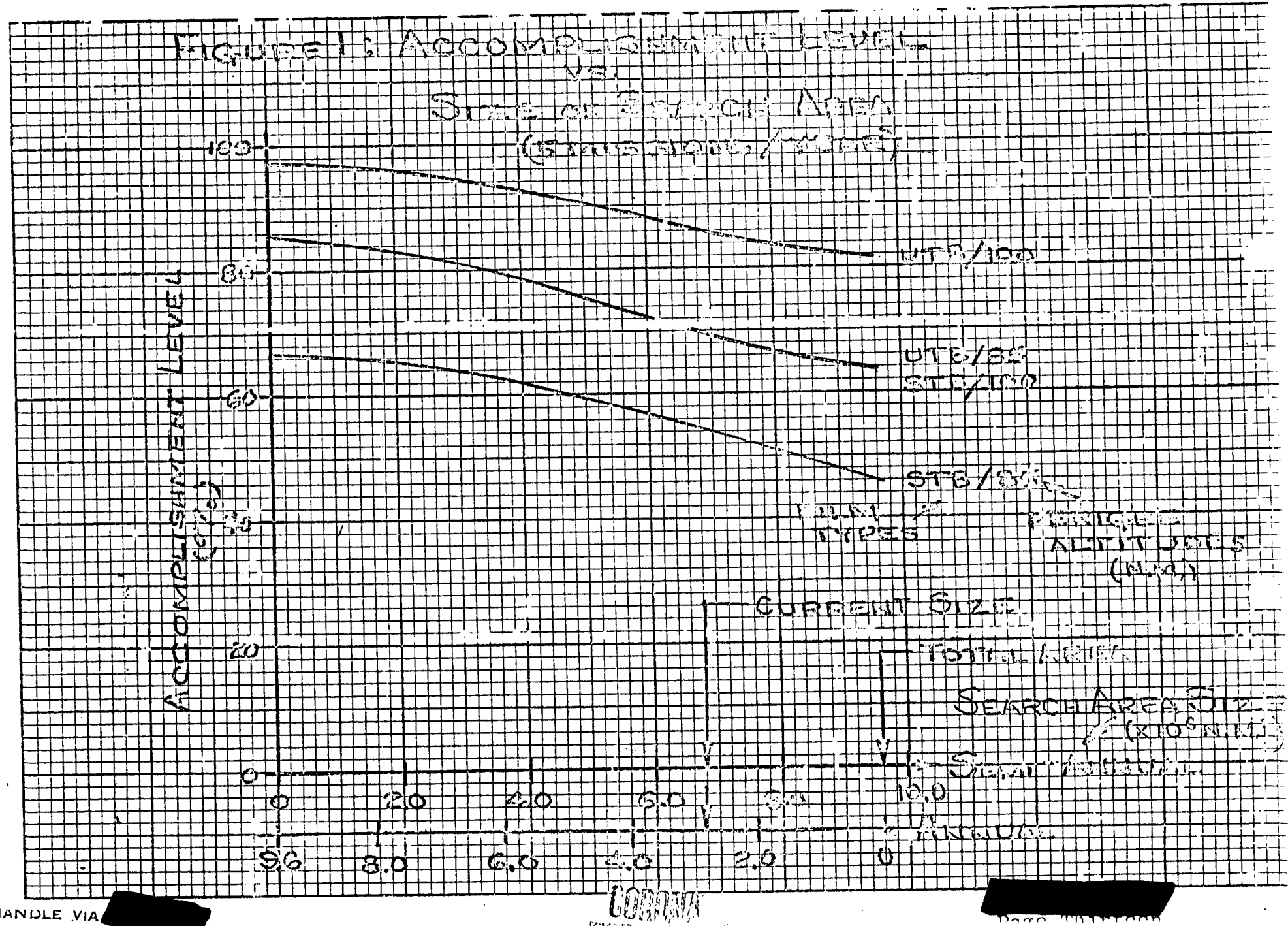

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SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

TABLE 5: ACCOMPLISHMENT LEVEL (%) VS. SIZE OF SEMI-ANNUAL AREA WITH FIVE MISSION/YEAR (EQUAL ACCOMPLISHED FOR SEMI-ANNUAL AND ANNUAL AREA)

Size of Area ($\times 10^6$ n.m.^{2})		Accomplishment Levels (%)		
		Film Type/Perigee Altitude		
Annual	Semi-Annual	UTB/100	STB/100[9] UTB/85	STB/85
0	9.6	80	63	45
2.8	6.8	86	69	54
3.4	6.2	87	71	56
4.8	4.8	91	76	60
6.2	3.4	93	80	63
6.8	2.8	94	81	64
9.6	0	97	85	67

3. The sensitivity of Accomplishment Level to a reduction from the entire area being semi-annually required to it being annually required is described numerically in Table 6. This is considered to be an extreme change - 100% annual to 100% semi-annual. It is presented because it provides bounds on the largest gains which can be realized

9 As will be noted in Table 1, STB/100 and UTB/85 have virtually the same film available per mission. Consequently, the results obtained using these two configuration are so nearly equivalent that an attempt to distinguish difference is not considered justified.

SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

by reducing the Semi-annual Area. It provides insight as to the changes in Accomplishment Level which could be realized by lengthening the requirement period. Table 6 shows a considerable improvement in Accomplishment Level; but, Table 5, Table 6, and Figure 1 all indicate the same absolute improvement may be obtained with either film type by increasing the perigee altitude from 85 to 100 nautical miles.

TABLE 6: ACCOMPLISHMENT LEVEL SENSITIVITY TO COVERAGE PERIOD

(Five Missions/Year)

Film Type/ Perigee Altitude	Accomplishment Level	Accomplishment Level	Change in Accomplishment for Shift from 100% Required Semi-Annually to 100% Required Annually	
	100% Semi-Annual	100% Annual	Absolute Change	Percent Change
UTB/100	80	97	17%	20%
UTB/85 } STB/100 }	63	85	22%	35%
STB/85	45	67	22%	49%

SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

4. Table 7 presents the change in Accomplishment Level for several possible reductions in the size of the current Semi-annual Search Area. Again, it is clear from these data that the average Accomplishment Level can be increased by decreasing the Semi-annual Area. These data again demonstrate that equivalent improvement in Accomplishment Level may be obtained by increasing perigee altitude.

SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

TABLE 7: INCREASE IN ACCOMPLISHMENT LEVEL FOR REDUCTIONS IN SIZE OF CURRENT SEMI-ANNUAL AREA (6.8×10^6 n.m.^{2})

(Five Mission/Year)

Reduction from Current Size	100%		50%		25%		10%		0%
New Size of Semi-Annual Search Area ($\times 10^6$ n.m.^{2})	0		3.4		5.1		6.1		6.8
Film Type/ Perigee Altitude	Absolute Change (%)	Percent Change (%)	Abso. Chg. (%)	Per. Chg. (%)	Abso. Chg. (%)	Per. Chg. (%)	Abso. Chg. (%)	Per. Chg. (%)	Accomplishment Level (%)
UTB/100	+11.0	12.8	+7.0	8.2	+4.0	4.7	+2.0	2.3	86
UTB/85									
STB/100	+16.0	23.0	+11.0	15.6	+6.0	8.6	+2.5	3.6	70
STB/85	+13.0	24	+ 9.0	16.6	+5.0	9.3	+2.0	3.7	54

SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

5. To decrease the size of the Semi-annual Search Area or to increase perigee altitude on a particular mission in the interest of increasing Accomplishment Level may be false economy. To increase perigee altitude will certainly increase the average ground resolved distance over the area photographed and to decrease the Semi-annual Search Area size may reduce the total quantity of photography useful for semi-annual and annual purposes. While average photographic resolution as a function of perigee altitude is the subject of other studies currently in progress and outside the scope of this report, the resulting effect of changing search area size on photographic yield is the subject of the remaining portion of this report.

6. Photographic yield could be defined in a number of ways. However, regardless of exactly how yield may be defined all definitions would probably fall into two categories: one category dealing in some measure with what was or could be learned from the photography and the other category describing the quantity of photography acquired and useful for some one or several purposes. This study cannot speculate as to the value of information contained

in photography. But, the effects of changing search area sizes on the quantity of useful photography taken for semi-annual purposes has been investigated and the results will be reported. Furthermore, this quantitative measure of photographic yield has been studied from two points of view. One view is that the proper specification of quantity is in terms of net coverage useful for annual or semi-annual purposes. Where net coverage is defined as the total of the unique photography covering a particular search area. This is an especially useful definition of yield and it is the manner in which search requirements are specified.

7. Another quantitative view of photographic yield is based simply on the accumulated gross coverage. With this view, regardless of whether coverage is redundant, that is coverage of the same area in a period less than the requirement frequency, it is countable toward gross coverage. Gross coverage is a useful measure because a comparison between gross and net provides an indication of the level of redundancy.

8. The objective was to measure the effects of reducing the size of the Semi-annual Area by observing changes in

performance achieved with a specific launch rate. Thus, it is necessary to accumulate the measures of performance over some period of time. But, there are two different search jobs to be done: Cover part of an area annually and part of another area semi-annually. It is clear that performance of each job contributes to both types of yield - net coverage and gross coverage. So, it would be useful to allow the measure of yield to reflect the performance of both jobs. Therefore, the following concepts and definition will be used as a means to describe the yield of some number of photographic missions:

(a) Total Net Photographic Yield - The total area photographed with unique, cloud-free photography for annual and semi-annual search purposes during some specific period of time.[11]

(b) Total Gross Photographic Yield - The total area photographed with cloud-free photography for annual and semi-annual purposes in some period of time.

[11] This definition of Total Net Photographic Yield allows counting of the coverage of the same area twice if the area is contained in the Semi-annual Area and the coverages are greater than six months apart.

9. The Total Net Photographic Yield (TNPY) is computed according to the following equation: TNPY= [Semi-Annual Accomplishment x Size of Semi-Annual Area x Frequency during Period] + [Annual Accomplishment x Size of Annual Area x Frequency during Period]. In this study, since we are concerned with a certain number of launches per year, 12 months was used as the period over which to accumulate yield. Therefore, semi-annual frequency during the period equals 2.0 and annual frequency during the period equals 1.0.

10. The Total Gross Photographic Yield (TGPY) is computed based on the coverage allocated for Semi-annual Area, Annual Area and HPA coverage. HPA cloud-free coverage is counted in total gross because it contributes to the Semi-annual total gross coverage.

11. The relationship between Net Photographic Yield and Semi-Annual Search Accomplishment Level is presented in Figure 2. The curve entitled Total is the Total Net Photographic Yield as it was defined above and it is intended to illustrate that this total is the sum of the net yield from coverage of the Annual and Semi-annual Areas. Furthermore, Figure 2 demonstrates that there is a certain Semi-Annual Accomplishment Level, 68% in the case presented, which maximizes the Total Net Photographic Yield.

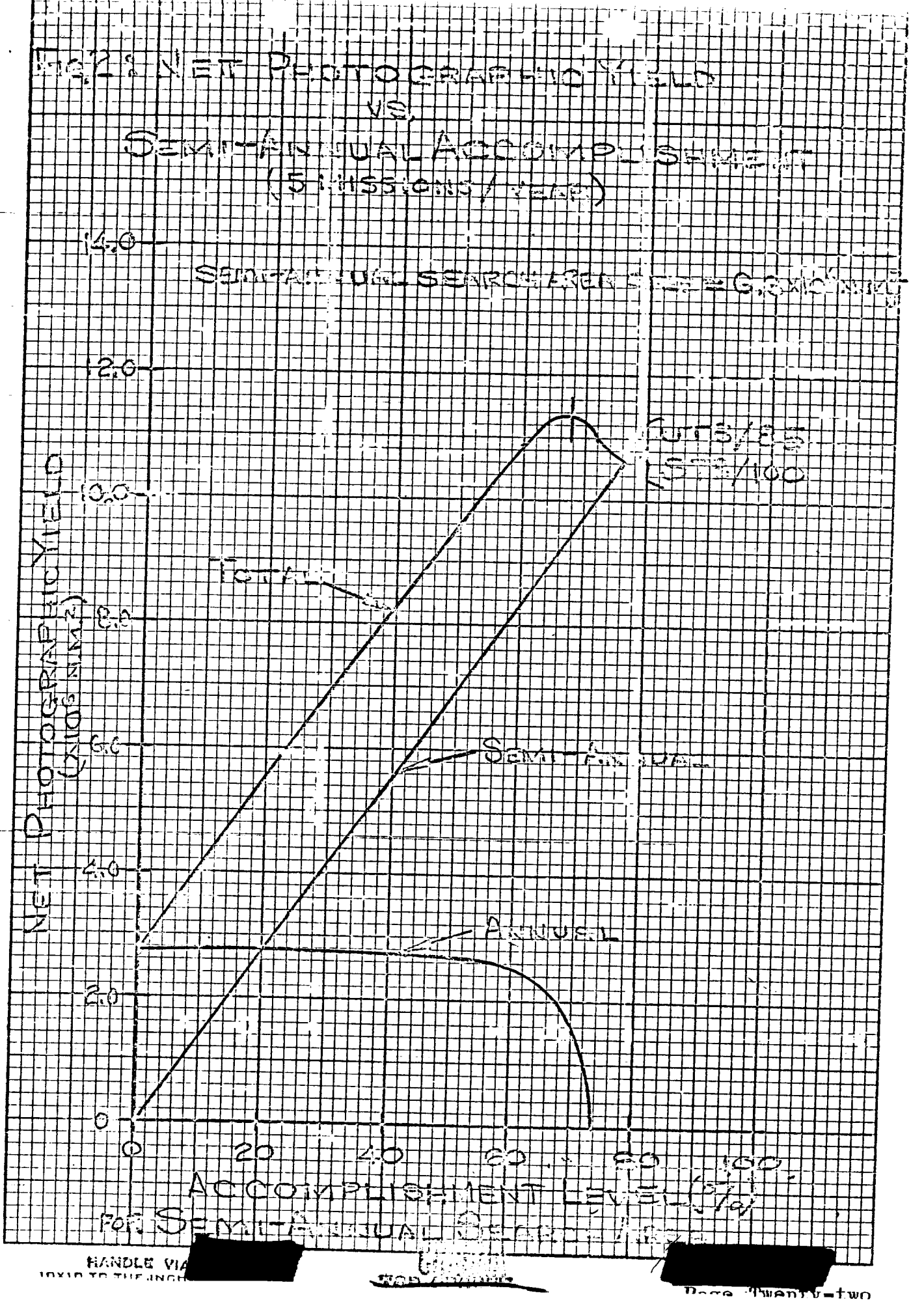
FIG. 2 NET PHOTOGRAPHIC YIELD
VS.
SEMI-ANNUAL ACCOMPLISHMENT
(5 Installations/Year)
4.0
2.0
0.0
NET PHOTOGRAPHIC YIELD
(Units/Man)
6.0
4.0
2.0
0
0
20
40
60
80
100
ACCOMPLISHMENT LEVEL (%)
For SEMI-ANNUAL
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Page Twenty-two

SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

12. Figure 3 presents the Total Net Photographic Yield as a function of Semi-Annual Accomplishment Level for the current Semi-annual Search Area; and, Figure 4 presents the same information for a search area of 3.4×10^6 n.m.^{2} (one half the current size). A comparison of these results, Table 8, shows that the Total Net Photographic Yield is actually reduced by reducing the size of the Semi-annual Search Area.

TABLE 8: MAXIMUM TOTAL NET PHOTOGRAPHIC YIELD VS. SIZE OF SEMI-ANNUAL AREA FOR FIVE MISSIONS PER YEAR

Film Type/ Perigee Altitude	Semi-Annual Search Sizes ($\times 10^6$ n.m.^{2}) 6.8	3.4	Δ Yield
UTB/100	14.0	12.5	-1.5
UTB/85 } STB/100 }	11.1	10.1	-1.0
STB/85	9.0	8.5	- .5

13. These data indicate a reduction of between 10.7% to 5.5% in Total Net Photographic Yield, depending on film type and perigee altitude, for the indicated reduction in Semi-annual search Area Size.

FEDERAL NET OUTLAYS

SEMI-ANNUAL ACCOMPLISHMENT

(6 MONTHS ENDED)

40.0

30.0

20.0

10.0

0.0

4.0

2.0

0

PROJECTED NET OUTLAYS (BILLIONS OF DOLLARS)

OUTLAYS

SEMI-ANNUAL SEASONALLY ADJUSTED ± 0.8

0

20

40

60

80

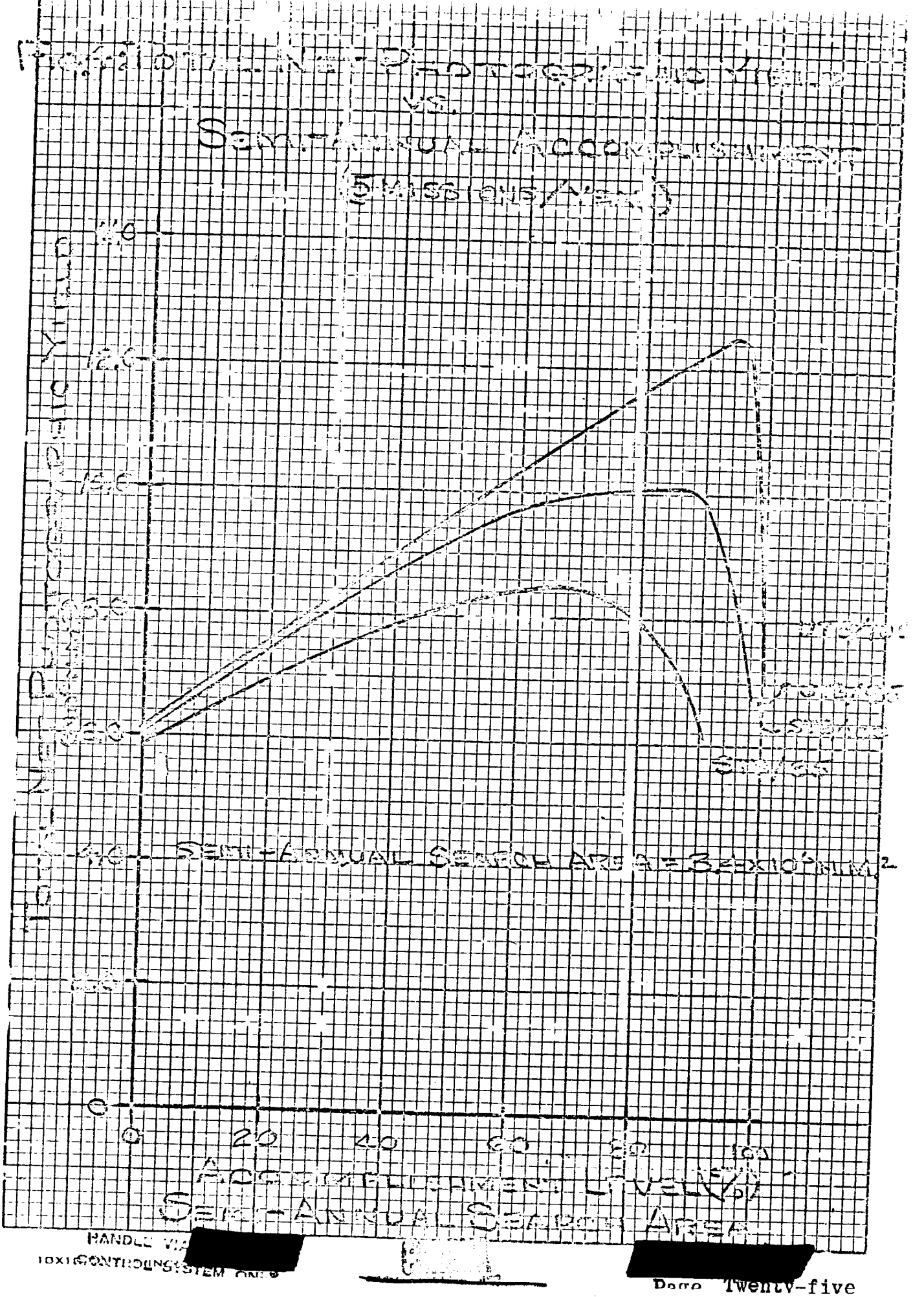
100

ACCOMPLISHMENT LEVEL (%)

SEMI-ANNUAL SEASONAL AREA

[redacted]

[redacted]


SEMI-ANNUAL SEARCH AREA B = 3.6 X 10⁶ NM²
0
20
40
60
80
100
SEMI-ANNUAL SEARCH AREA

SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

14. The relationship between Annual and Semi-Annual Accomplishment Level for the current Semi-annual Area is presented in Figure 5. Figure 6 presents the same relationship for the same number of flights. but the Semi-annual Search Area is reduced by 50%. The Accomplishment Levels which maximize the Total Net Photographic Yield are presented numerically in Table 9.

TABLE 9: ACCOMPLISHMENT LEVELS FOR MAXIMUM TOTAL NET PHOTOGRAPHIC YIELD

Film Type/ Perigee Altitude	SEMI-ANNUAL SEARCH AREAS			
	6.8×10^6 n.m.^{2}		3.4×10^6 n.m.^{2}	
	Accomplishment Level		Accomplishment Level	
	Semi-Annual	Annual	Semi-Annual	Annual
UTB/100	88	80	95	98
UTB/85 } STB/100 }	68	69	76	80
STB/85	56	52	65	66

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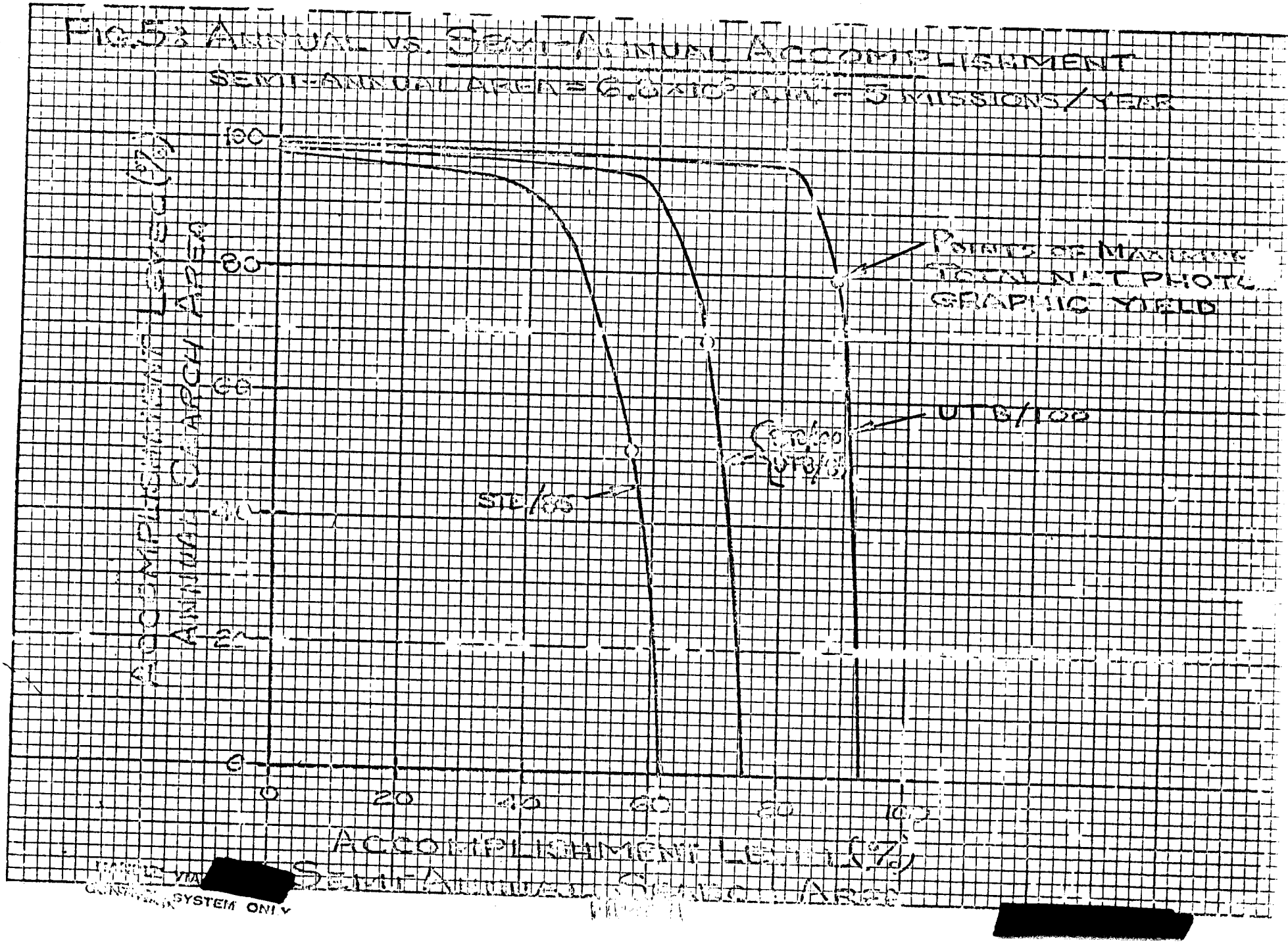
SEMI-ANNUAL AREA = 6.3 X 10³ NMI²
5 MISSIONS/YEAR
100
80
60
40
20
0
0
20
40
60
80
100
ACCOMPLISHMENT LEVEL (%)
ANNUAL PHOTOGRAPHIC AREA
SE/65
UT6/102
SEMI-ANNUAL SPACE LIFT
SYSTEM ONLY

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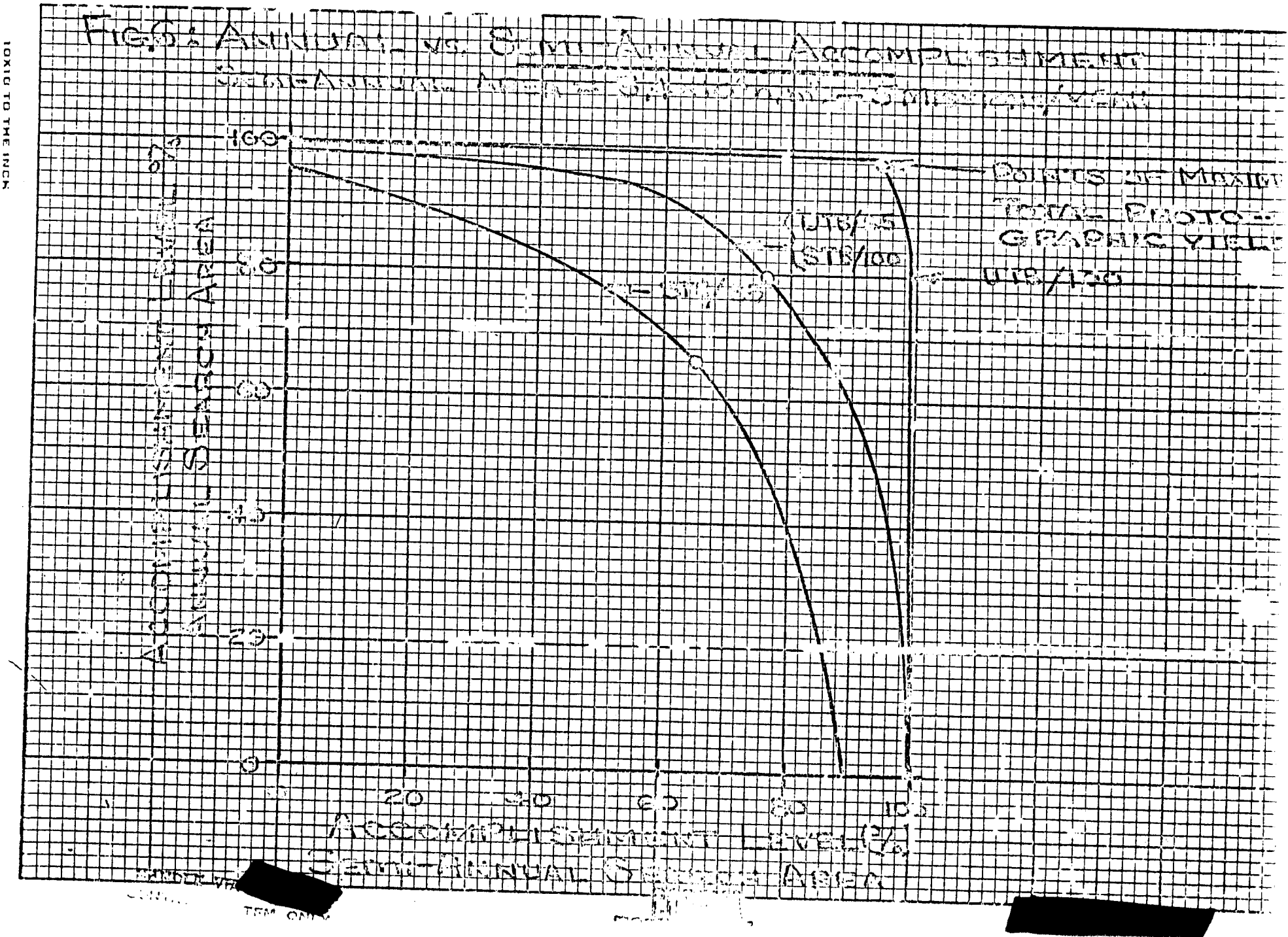

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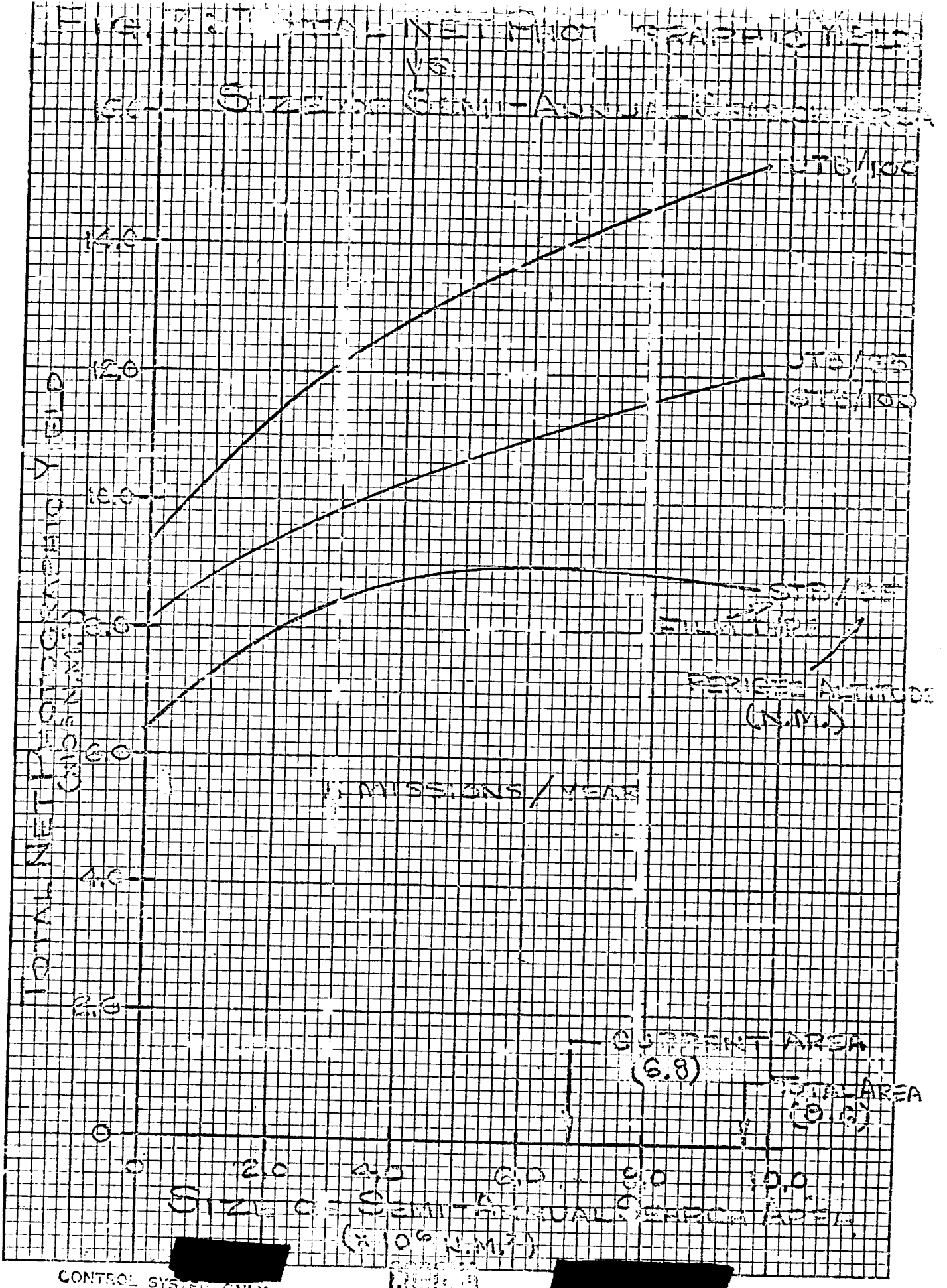
SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

15. The information contained in Figures 1, 5, and 6 may now be used to determine the relationship between Total Net Photographic Yield and the size of the Semi-annual Search Area. This relationship, shown in Figure 7, was obtained based on the assumption that Accomplishment Levels for both semi-annual and annual search objectives would be chosen so as to maximize the Total Net Photographic Yield for the particular sizes of Annual and Semi-annual Area.

16. Figure 7 clearly shows that in the cases of UTB/100, UTB/85 and STB/100 the Total Net Photographic Yield will increase as the size of search area increases. It appears that with STB/85, the TNPY increases until the size of the Semi-annual Area is approximately 6×10^6 n.m.^{2} and then decreases. Indicating that there is a particular Semi-annual Search Area size which maximizes the total net coverage for the STB/85 configuration. It is anticipated that this condition will exist and be more pronounced for all configurations if fewer than five missions are flown per year.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CONTROL SYSTEM ONLY
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SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

17. Figure 1, shown earlier, may now be modified to describe the Accomplishment Levels which maximize the Total Net Photographic Yield as a function of search area size. This information is presented in Figure 8.

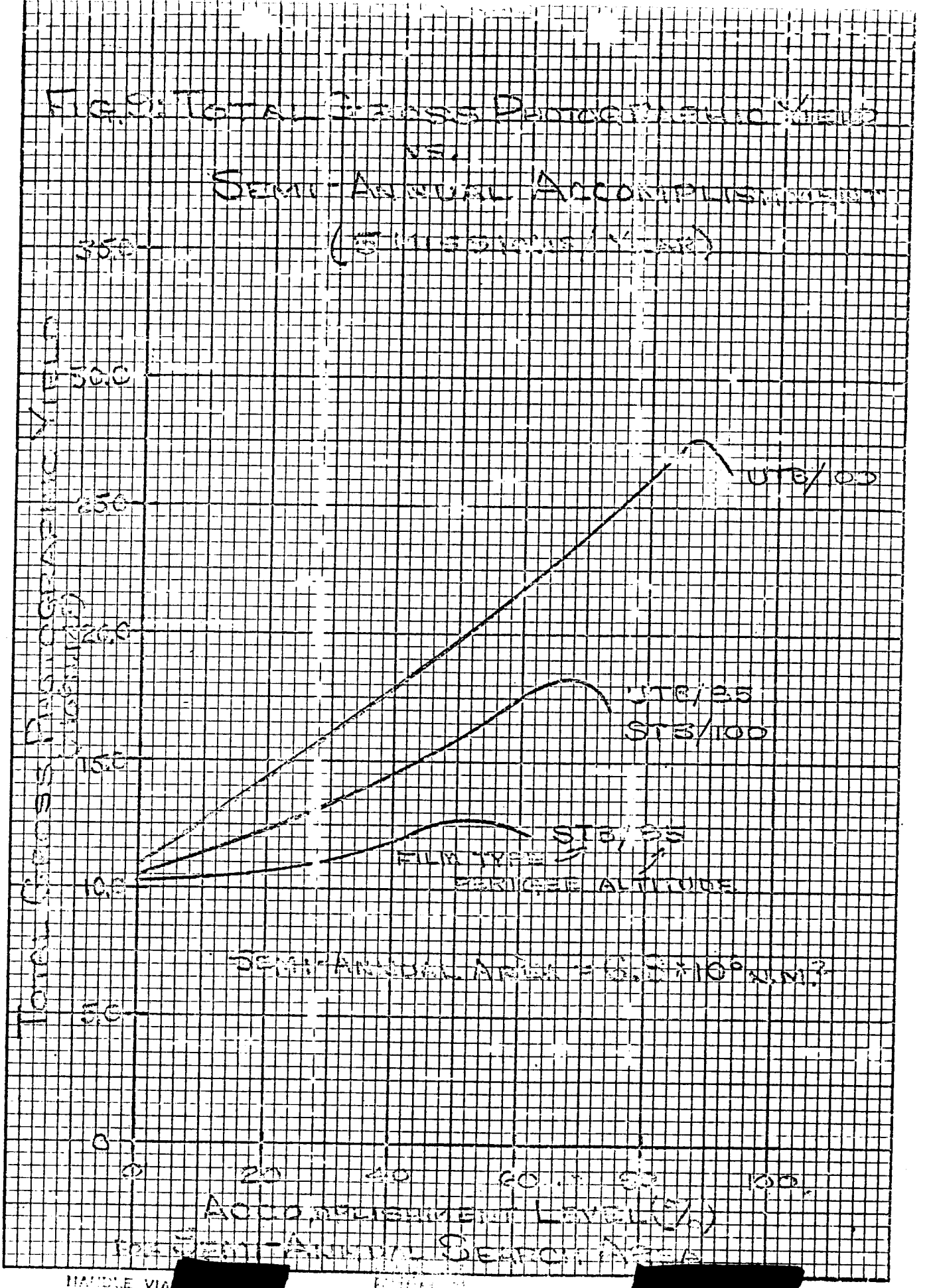
STEADY-STATE ANALYSIS
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460
480
500
520
540
560
580
600
620
640
660
680
700
720
740
760
780

SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

18. The effects of Accomplishment Level and Semi-annual Search Area size on the Total Gross Photographic Yield are presented in Figures 9, 10, and 11.

19. Figure 9 and 10 presents Total Gross Photographic Yield as a function of Semi-annual Accomplishment Level for the current Semi-annual Search Area and for one 50% smaller. Characteristically, the same observation as pertained to Total Net Photographic Yield may be made. There are specific Accomplishment Levels which maximize the TGPY. It will be observed that these values of Semi-annual Accomplishment Level which maximize the gross yield are virtually the same as the values which maximize the Total Net Photographic Yield.

20. The data from Figure 9 and 10 may be combined with data from Table 4 and information in the Appendix to produce Figure 11 which is the Total Gross Photographic Yield as a function of Semi-annual Search Area size. These functions, for the various configurations, show that the Total Gross Photographic Yield will gradually decrease as the size of the Semi-annual Area increases. The Total Gross Photographic Yield decreases because, as shown in Figure 18 of the Appendix, coverage against annual objectives is more efficiently conducted than coverage against semi-annual objectives.


FILM TYPE
SEMI-ANNUAL AREA = 6.4 x 10⁶ N.M.²
ACCUMULATED LEVELS (%)
SEMI-ANNUAL OBSERVATIONS

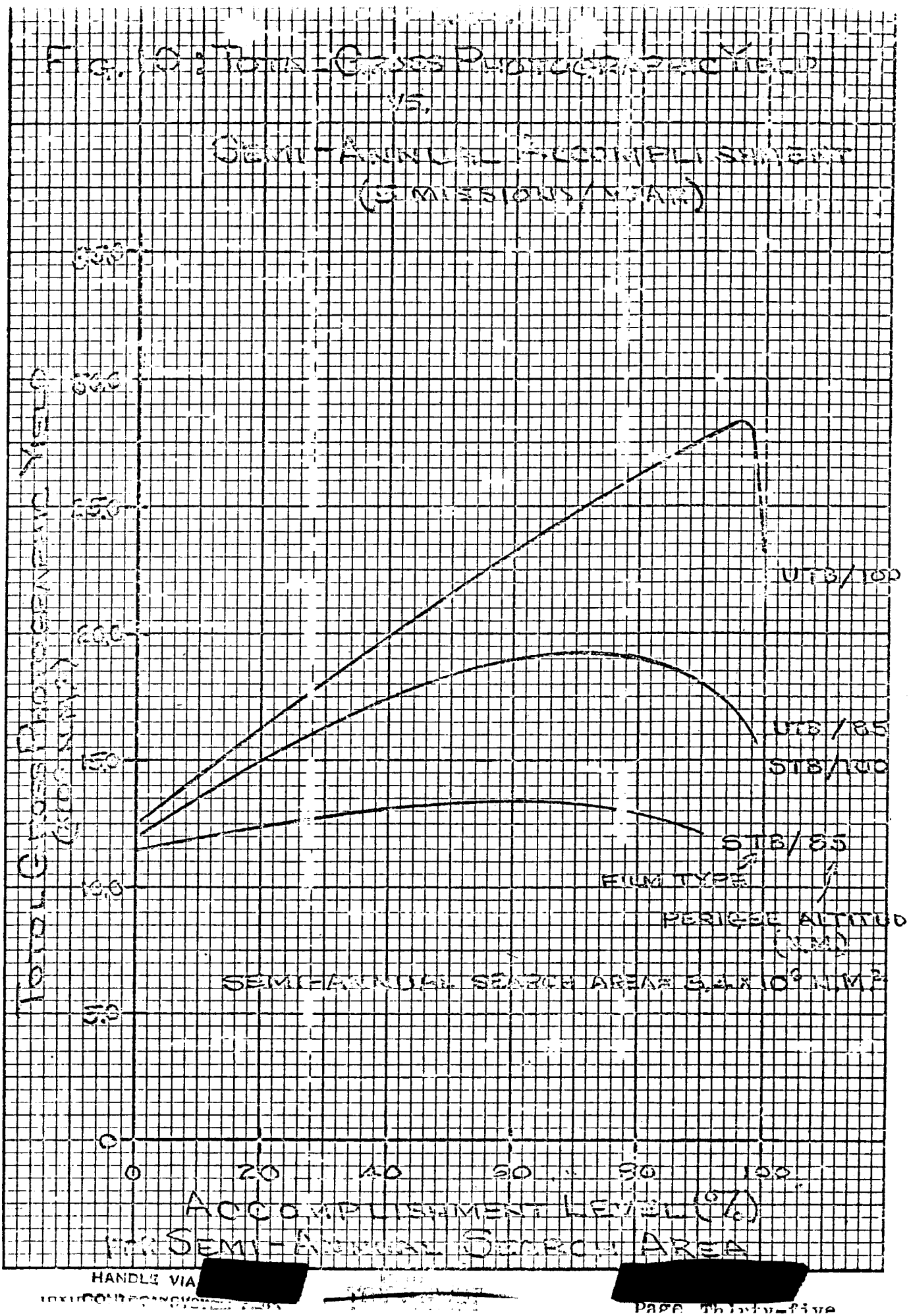
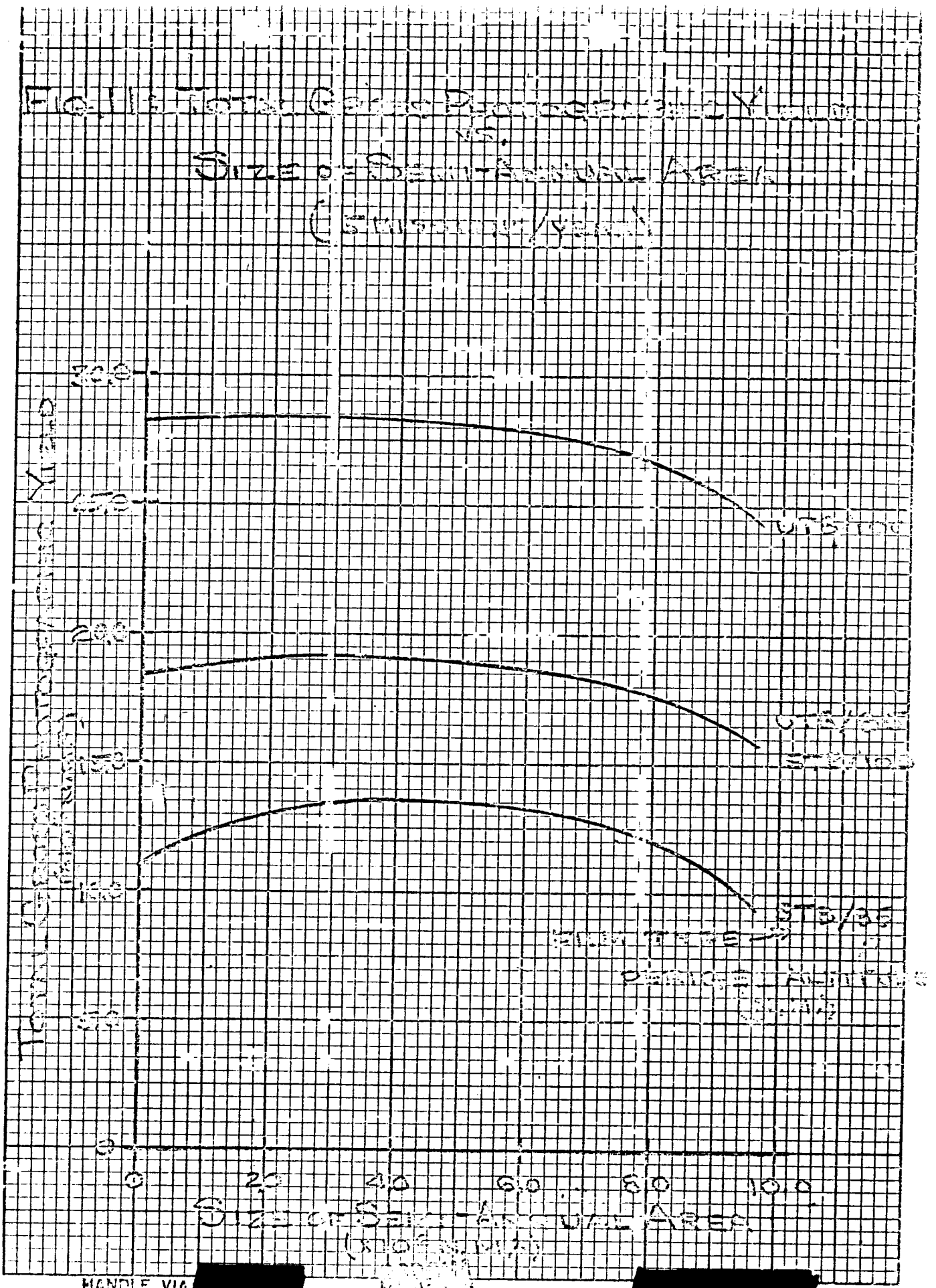


FIG. 2-2 TOTAL CROSS PROBABILITY VS.
SEMI-ANNUAL ACCOMPLISHMENT
(3 MISSIONS/YEAR)
CUMULATIVE PROBABILITY (%)
UTB/TOP
UTB/85
STB/100
STB/85
FILM TYPE
PERIGEE ALTITUDE
(NMI)
SEMI-ANNUAL SEARCH AREA 5.4 X 10⁶ NMI²
ACCOMPLISHMENT LEVEL (%)
SEMI-ANNUAL SEARCH AREA
HANDLE VIA



HANDLE VIA [redacted]
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SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishemnt Goals for Various Corona Configurations with Five Missions Per Year

21. Total Net Photographic Yield and Total Gross Photographic Yield may now be used to determine how redundancy is influenced by changes in the size of the Semi-annual Area. This relationship, Redundancy vs. Size of Semi-annual Area is presented in Figure 12. Here redundancy is defined by the following equation: Redundancy = (Gross - Net)/Gross. It can be seen that redundancy increases sharply as the size of the Semi-annual Search Area decreases regardless of which CORONA configuration is employed. Therefore, it should be clear that the increases in Accomplishment Level shown in Figures 1 and 8 are achieved through allowing a greater concentration of photographic activity with resulting increase of redundant coverage.

[redacted]

HANDLE VIA [redacted]
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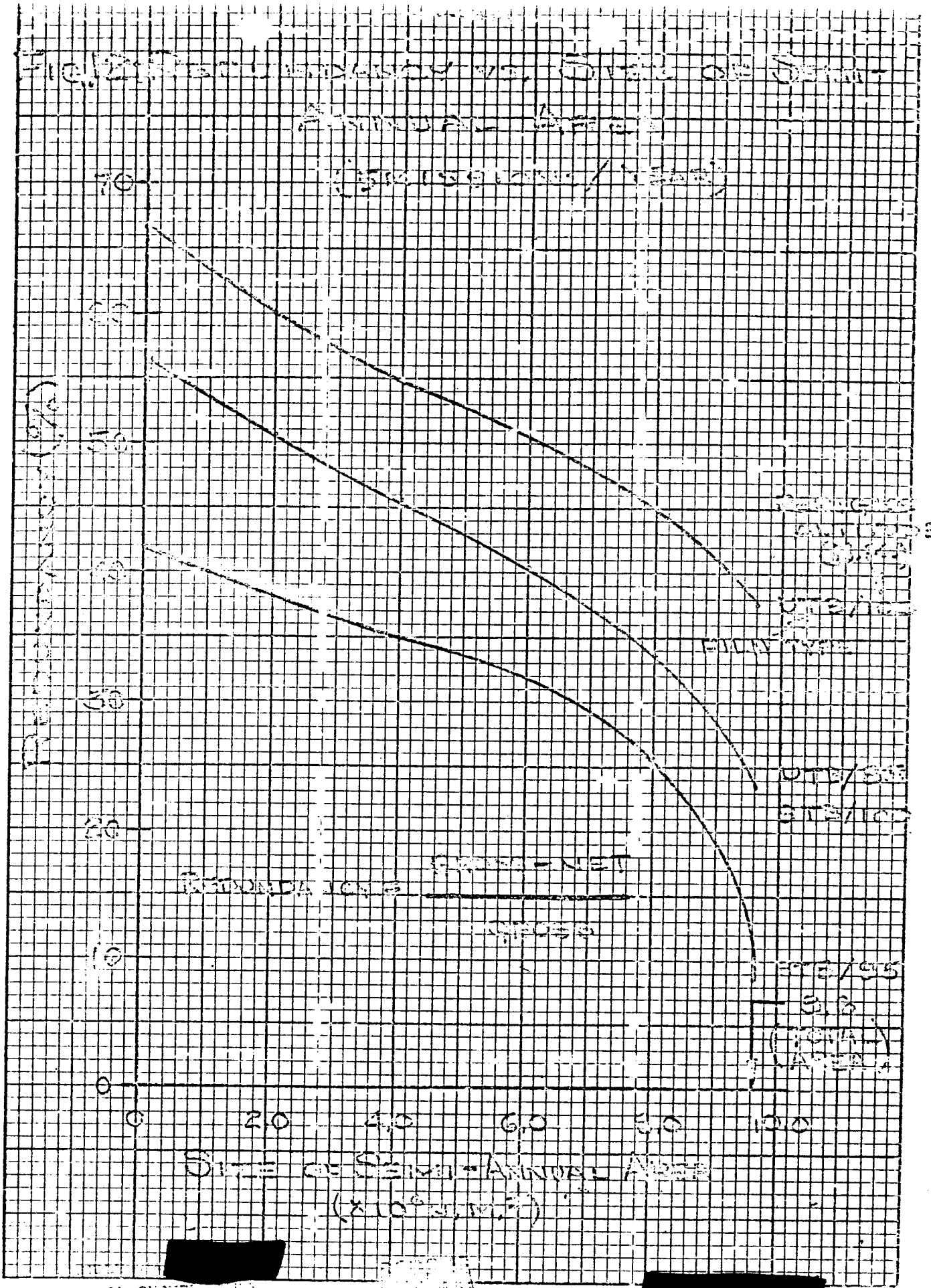
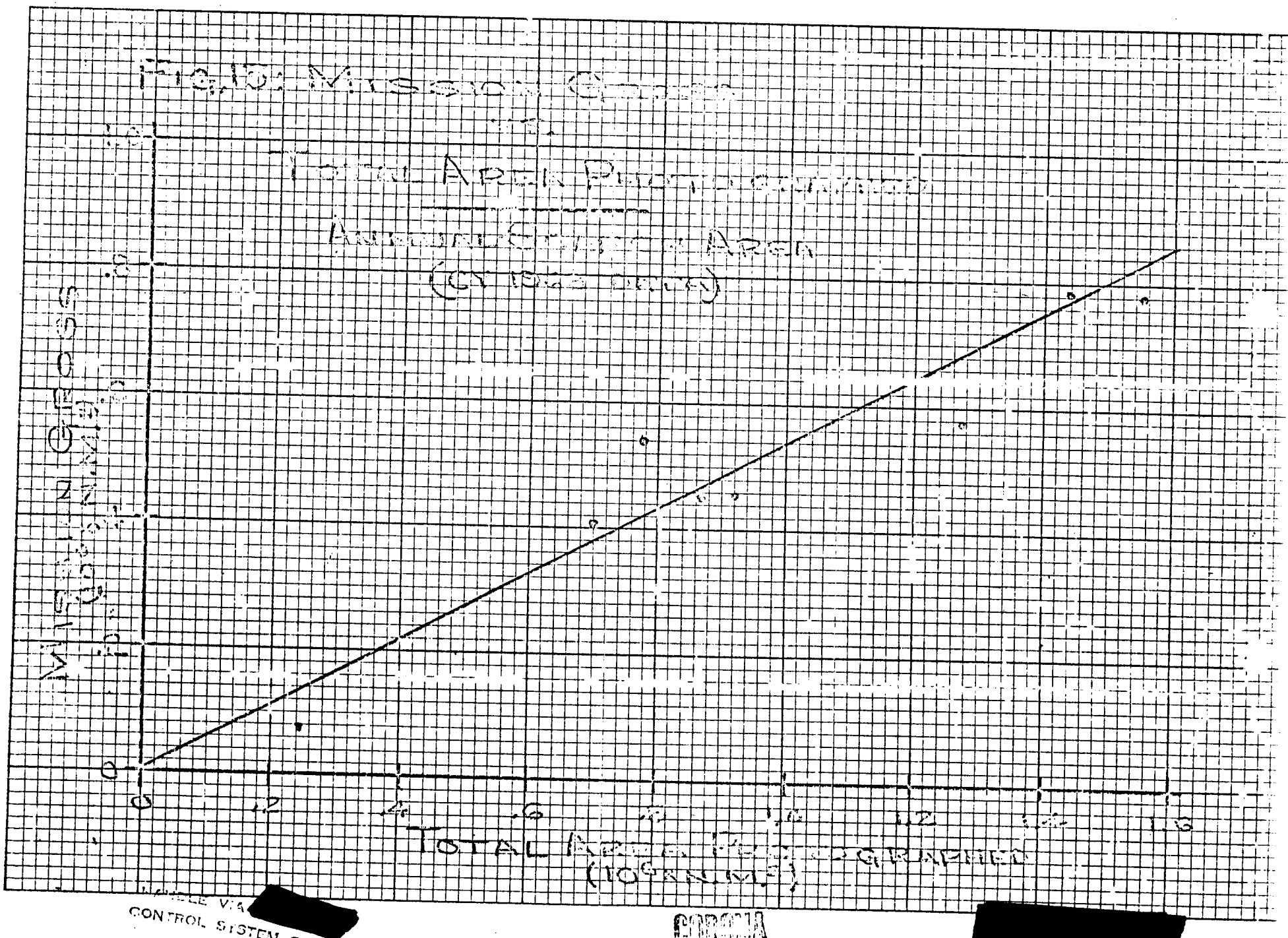
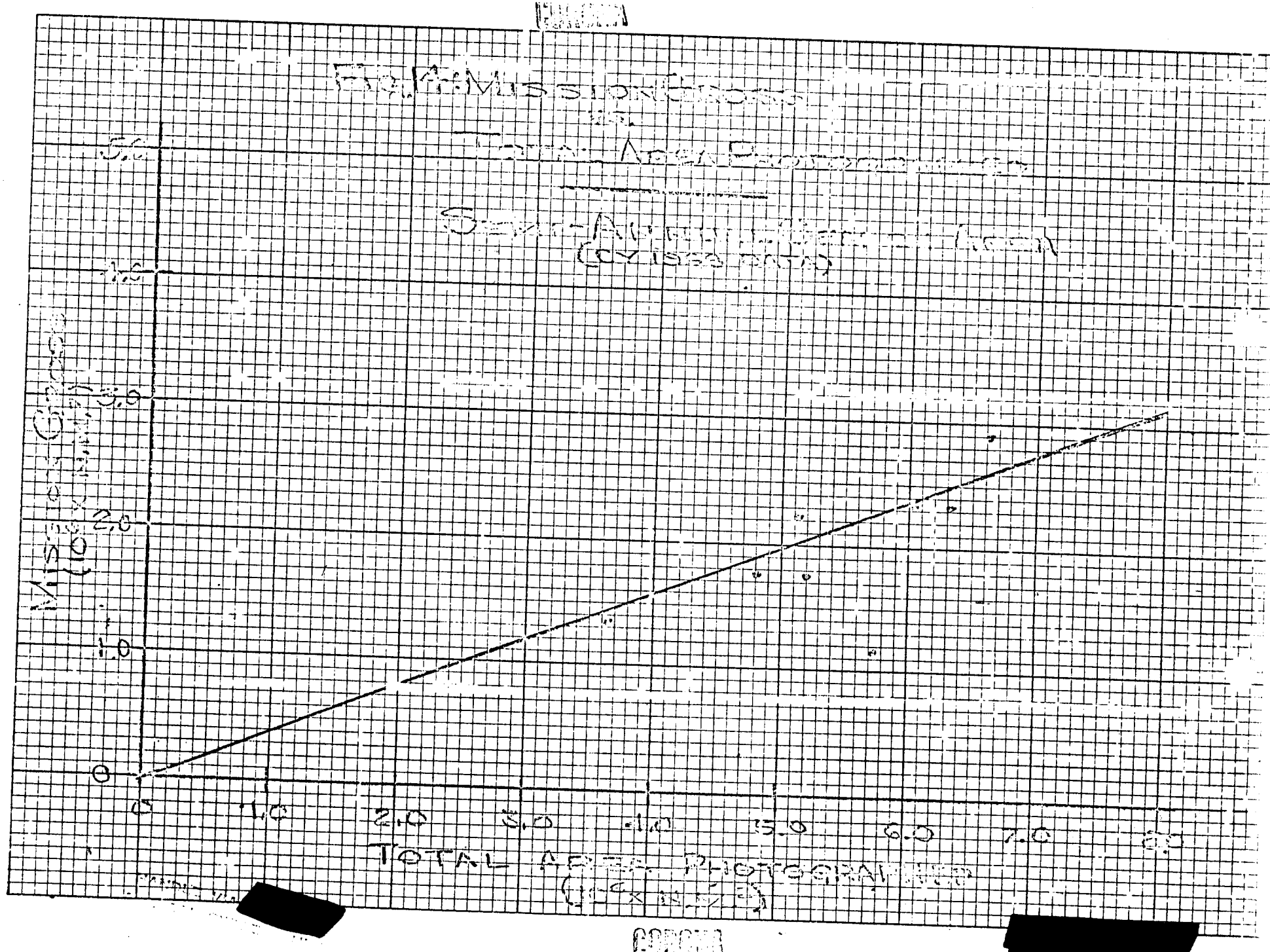
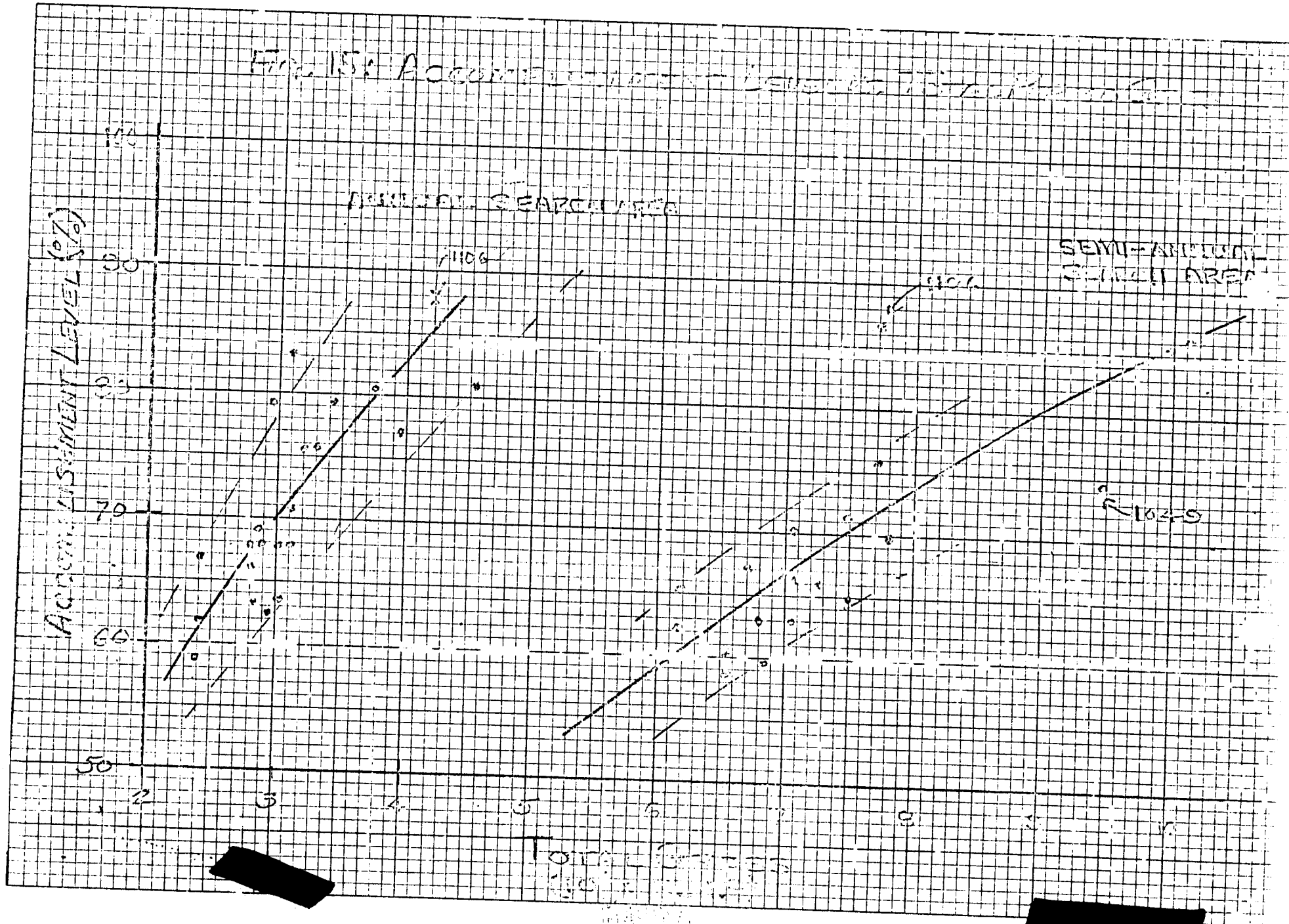

0
20
40
60
80
100
10X10 TO THE INCH

APPENDIX





Page Forty-one


ACCURATE ASSESSMENT LEVEL (%)
70
60
50
SEMI-ARTIFICIAL
SEMI-ARE
R162-S

SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various CORONA Configurations with Five Missions Per Year

VI. DISCUSSION OF FIGURES 16, 17 and 18

1. A given CORONA J3 configuration provides a certain coverage capability: for example, the coverage capability of one flight with STB/100 is 9.2×10^6 n.m.^{2}. This coverage capability may be used for the following purposes: HPA targets, Non-Bloc target, Mapping, Charting, and Geodesy, and for coverage of Semi-annual and Annual Search Areas. Figures 16, 17 and 18 allow one to determine Accomplishment Level for a given expenditure of film (equivalent to area photographed). Additionally, these figures provide the means by which coverage against the Semi-annual Search Area may be adjusted to reflect the fact that coverage against HPA's contributes positively to the Semi-annual Accomplishment Level. The manner in which these figures are used is demonstrated with the following example:

Conditions:

1. 5 missions/year
2. STB/100 configuration
3. Semi-Annual Area= 6.8×10^6 n.m.^{2}
4. Annual Area = 2.8×10^6 n.m.^{2}

SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various CORONA Configurations with Five Missions Per Year

Specified Film Utilization:

NON-BLOC= 1.0×10^6 n.m.^{2}/mission

MC&G= $.4 \times 10^6$ n.m.^{2}/mission

HPA= $\frac{1/84 \times 10^6}{3.24 \times 10^6}$ n.m.^{2}/mission
n.m.^{2}/mission

Coverage Available for Annual and Semi-Annual Requirements/mission ($\times 10^6$ n.m.^{2}):

$$6.8 - 3.24 = 3.56$$

2. First, for purposes of this example, assume that we desire 75% Accomplishment Level against the Annual Area; enter Figure 18 at the appropriate value, point A on the schematic.[1] Determine the Percent Total Gross, point B, then proceed to Figure 17 and determine the Mission Gross Coverage required according to the appropriate area size and missions flown during the requirement period, point C. Enter Figure 16 at point C and determine the Total Area Photographed for annual purposes per mission. Now, subtract this amount of coverage for the amount available to determine the coverage available to use against the Semi-annual Area:

$$3.56 \times 10^6 \text{ n.m.}^2 - 1.5 \times 10^6 \text{ n.m.}^2 = 2.06 \times 10^6 \text{ n.m.}^2$$

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[1] Schematic shown on page 47

SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various Corona Configurations with Five Missions Per Year

3. To determine Accomplishment Level against the Semi-annual Area this quantity, 2.06×10^6 n.m.^{2}, must be adjusted for the fact that HPA coverage contributes to Semi-annual Accomplishment Level. Therefore enter Figure 16 with the quantity of film used for HPA targets (1.84×10^6 n.m.^{2}), point E in the schematic, and determine the Mission Gross Coverage, point F. In a manner similar to that discussed above, determine the percent total gross, point G and then determine the equivalent percentage total gross for semi-annual purposes, point H. Using point H, determine the equivalent Total Area Photographed ($.55 \times 10^6$ n.m.^{2}) at point J. Now, the actual amount of capability applied to semi-annual is 2.06×10^6 n.m.^{2} + $.55 \times 10^6$ n.m.^{2} = 2.61×10^6 n.m.^{2} and to determine the Accomplishment Level against the Semi-annual Area one enters Figure 14 at this value, point K and proceeds to point P on Figure 12 (40%).

4. With the exception of the "HPA curve", on Figure 18, the information in Figure 16, 17, and 18 is contained in Figure 13, 14, and 15 or was derived analytically. Data for the "HPA curve" was obtained through conversation with SOC personnel. Specifically it was indicated that efficiency against HPA targets was 69% of the efficiency on semi-annual

objectives when the Total Gross Coverage expended is 1.9×10^6 n.m.^{2}; and saturated, of course, when the Mission Gross Coverage expended for HPA is approximately 2.0×10^6 n.m.^{2} at a very high (15 to 20 x 10^6 n.m.^{2}) Total Area Photographed.

Use of Figures 16, 17 and 18 to determine accomplishment against annual and semi-annual requirements:

Figure 18

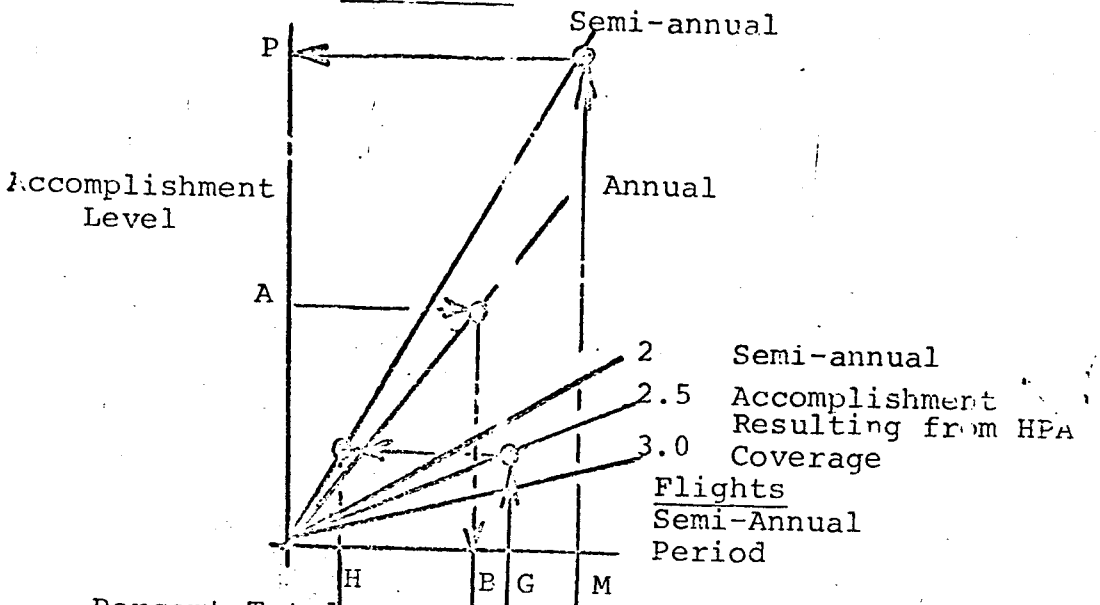
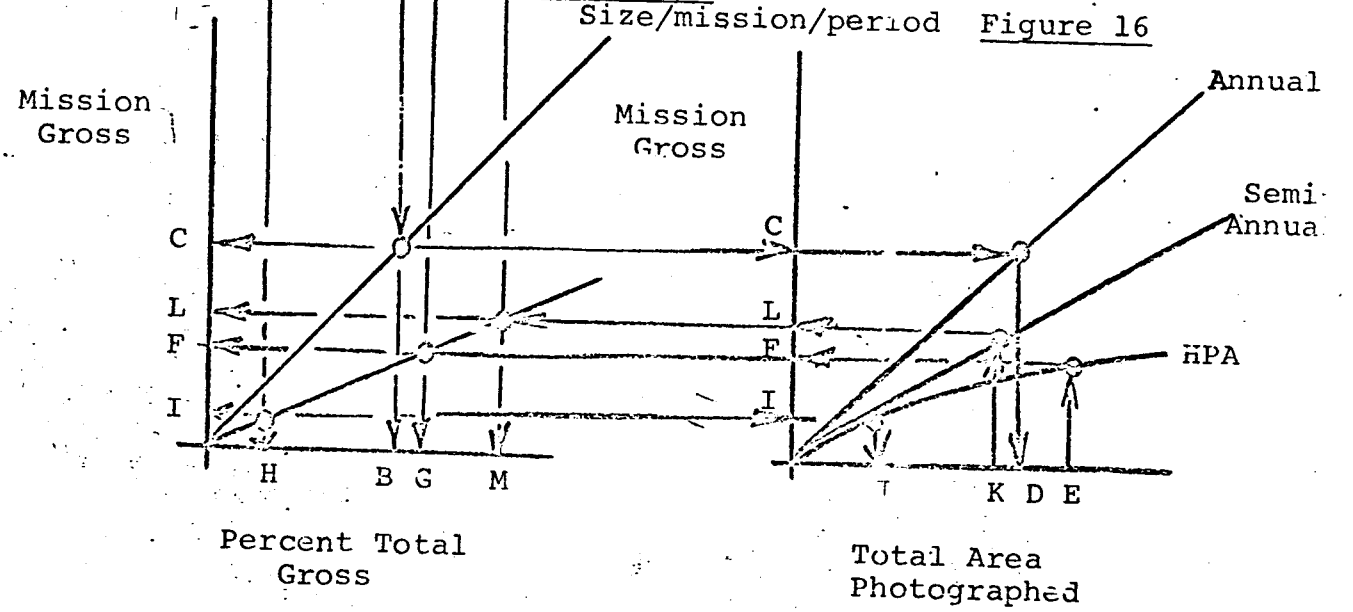


Figure 17
Size/mission/period

Figure 16



(No Scale)

HANDLE VIA [redacted] CONTROL SYSTEM ONLY

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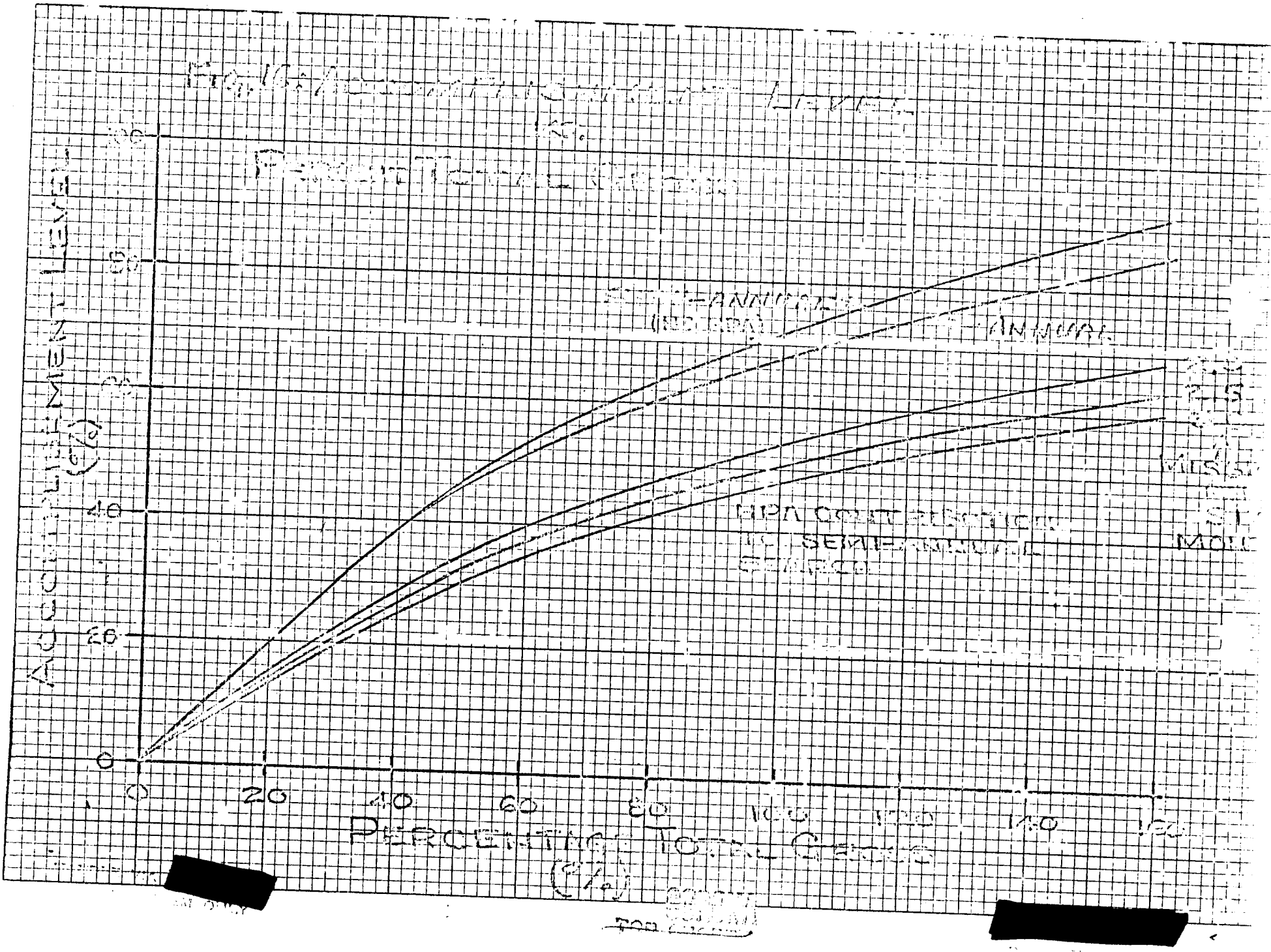
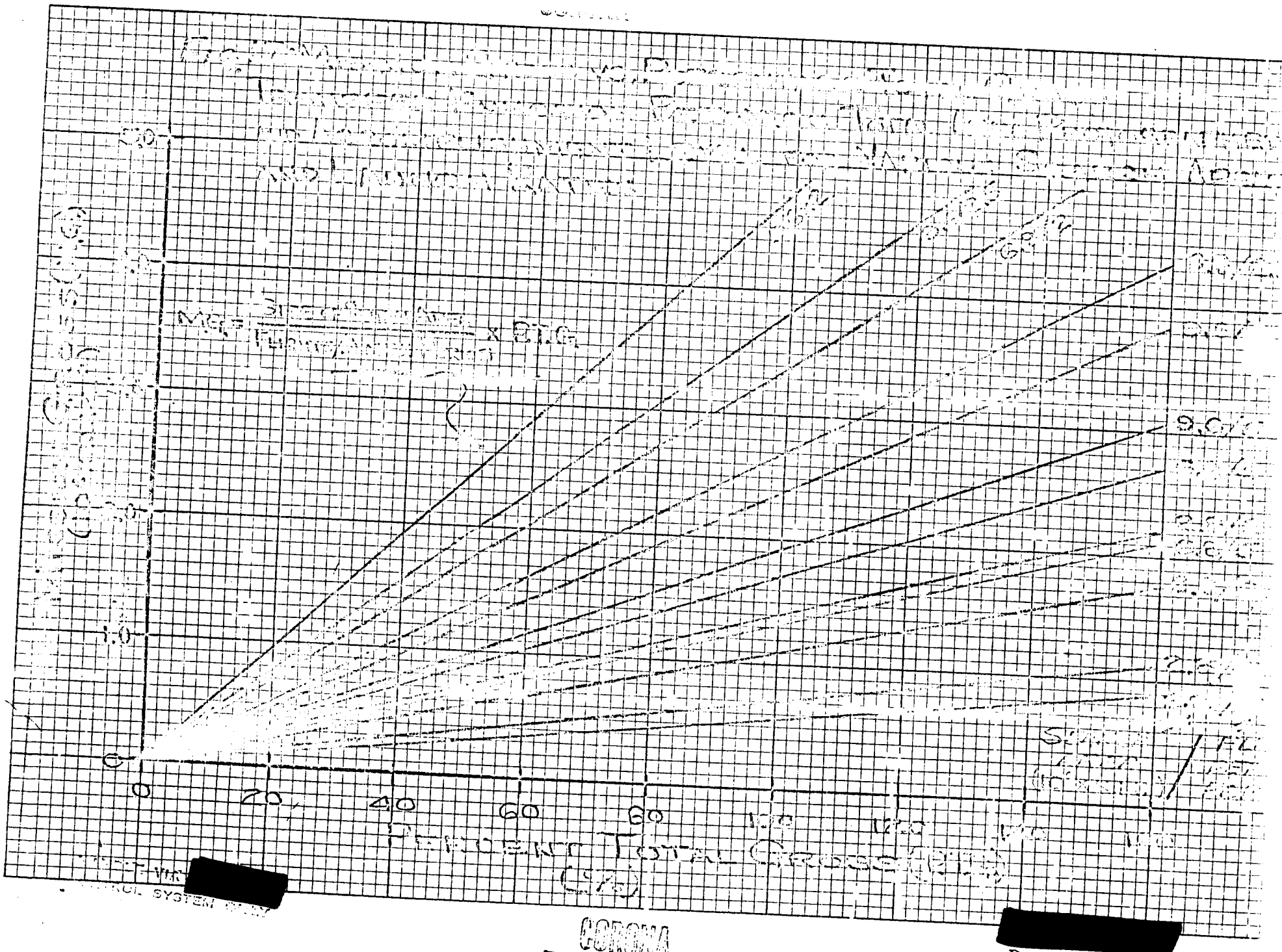
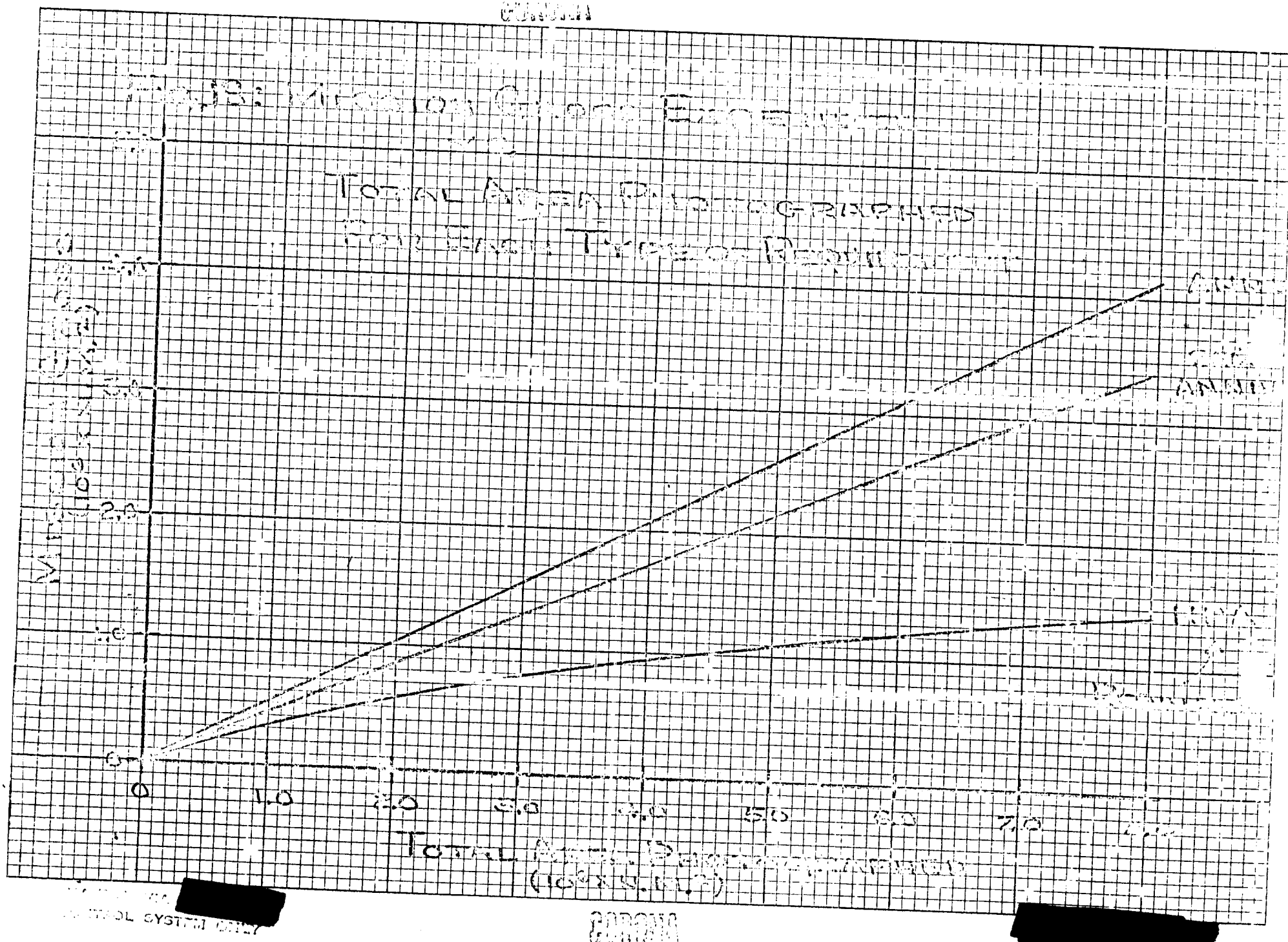

PERCENTAGE
0
20
40
60
80
100
PERCENTAGE (%)


20
40
60
80
1.0


Total Water Pumped
(100's Gal.)
0
1.0
2.0
5.0
7.0
Total Water Pumped (100's Gal.)

SUBJECT: Sensitivity of Search Accomplishment to Search Area Size and to Specific Accomplishment Goals for Various CORONA Configurations with Five Missions Per Year

Distribution:

[redacted]

[redacted]

CORONA