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DEPARTMENT OF THE AIR FORCE
WASHINGTON

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OFFICE OF THE UNDER SECRETARY

2 APR 1965

Memorandum for Members, New Search and Surveillance System Steering Group

Enclosed is the final report of the Task Force on Future Satellite Photographic System (Search and Surveillance). It is requested that you review the report prior to the next Steering Group meeting.

The next meeting of the Steering Group is scheduled for 0900-1300, 15 April 1965, Room 4E869, Pentagon.

Henry C. Howard
Lt Colonel, USAF
Executive Secretary, Steering Group

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FINAL REPORT OF WORKING GROUP ON FUTURE SATELLITE PHOTOGRAPHIC SYSTEM

1. Summary of Working Group activities convened 30 November 1964

In working sessions: 30 November - 7 December 1964;
11 - 15 January 1965

Reports to Steering Committee: 8 December 64; 25 January 1965

Outside Briefings to Working Group: 2, 7 December 1964;
11 - 15 January 1965

Outside Briefings to Steering Committee: 9 December 1964;
25, 26 January 1965

2. Requirements Definition:

The final report of the Task I Group, to define the needs of the Intelligence community, is included as Tab A. A summary tabulation of these needs appears as a matrix in that report. Further elaboration of satellite photographic reconnaissance requirements must originate with the using agencies.

3. System Design Criteria and Characteristics:

Available information on hardware capabilities, state-of-the-art limitations and forecasts, operational plans and concepts, and current system designs was gathered and assimilated by the TASK II Working Group. Matching these considerations to the requirements, reported by the Task I Group, resulted in System Operational Characteristics as defined in Tab B. A suggested Candidate System Evaluation Criteria is included in Tab C.

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4. It is recommended that the tabs be forwarded to SAFSP for system definition (by completion of development plan) and eventual contractual implementation of the most favorable system design.

5. The effort of the working group is considered complete. Questionable areas requiring further investigation may be handled on an ad hoc basis if desired by the Steering Committee.

Henry C. Howard
Lt Colonel, USAF
Chairman, Task Group

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SUBJECT: (S) Review of Intelligence Requirements for Search and Surveillance Satellite Reconnaissance

1. Background: In response to direction contained in reference a, (under Task I) a study was initiated to review the specific requirements for information from satellites for the time period 1968 and beyond. In accordance with the terms of reference, these informational needs were examined relative to several environmental conditions, ranging from the present world situation, defined as cold war, through the various escalating steps, to a general war environment. As a related, but separate problem, the requirements for geodesy, mapping and charting from satellites were reviewed. In this latter instance, particular attention was devoted to those expressed mapping and charting requirements which might be simultaneously fulfilled by a satellite configured primarily for search or surveillance intelligence gathering missions.

The analysis considered those particular elements of sensor capability necessary to provide information needed for making decisions pertinent to each of the various environmental conditions. These systems parameters include: quality and quantity of photography, responsiveness, and repetition rates. These, and other pertinent terms, are defined in the Glossary attached as Tab A.

2. Scope: In the conduct of this analysis, the "needs" group worked initially with source material which originated as early as 1961 (surprisingly pertinent and close to subsequent expressions) and as late as January 1965. Material of "all source" security category was included in the evaluation, and requirements ranged from strategic targeting needs to requirements for

general war after execution of the Single Integrated Operations Plan (SIOP). This report, including the data shown under Tab B, constitutes a review and summary of the latest and most authoritative information now available on information needs for future reconnaissance satellite systems. Except as otherwise specifically noted, all requirements apply to those which can be met by photographic sensors from satellites. Exceptions are generally contained in the "All Weather Requirements" category, and they are stated primarily as a guide in considering development of other sensors (i.e., radar, I.R., etc.)

In reviewing the stated requirements, those contained in the narrative of this report and shown on the attached (Tab B) are those "needed" to identify the primary elements of information peculiar to each of the environments. The Needs Task Group relied heavily on COMOR - D - 13/29 for the requirements concerning Cold War, Crises Management, and Limited War environments. However, the assumption was made by the group that the COMOR stated requirements for Crises management were almost identical to those for Limited War, which were not specifically stated.

After careful review by the Task Group and revalidation by SAC on 11 December 1964 the General War requirements of the Strategic Air Command (reference) were substantially accepted by the Task Group for the Strike Effectiveness and Post Attack missions -- although the PAR statement was modified (in terminology only) for clarity by the Group.

Concerning Self Recon, the Task Group assumed (and this assumption is supported by the few stated requirements regarding this environment) that the problems and informational needs of Self Recon and Strike Effectiveness are identical -- the principle difference being which side is dropping

the bomb.

3. Discussion: The following is a narrative summation of the data contained in Tab B. It concentrates on the problem of search and surveillance by photographic satellites, and only lightly touches on the problem of all - weather sensor requirements. The latter is necessary since the details supporting stated requirements are primarily photo-derived.

A. Cold War: A need exists to search, semi-annually, the entire Sino/Soviet bloc and other select areas of the world at a resolution sufficient to detect and identify activities associated with a threat against the U.S. Resolutions of 3 to 5 feet are considered necessary for such search. Areawise, the requirement encompasses approximately twelve million square miles, exclusive of the "other areas." All inclusive, the search requirement can be expected to average about fourteen million square miles on a semi-annual basis. All weather capability is desirable.

In the Cold War environment, the majority of our surveillance requirements "demand a 3 to 5 foot ground resolution." (COMOR - D - 13/29, pp. 3 & 4) Coverage of approximately thirty-five hundred objectives per annum is required with a variable frequency of coverage for each of the several categories of targets (See Tab B).

B. Crisis Management: Both search and surveillance informational needs require ground resolutions which will "permit the identification of objects at least five feet on a side" (COMOR - D - 13/29, p. 6). Stated response times are less than in a cold war situation: ranging from "real time response within ten hours" (Ibid.) to "having processed film at readout facility within 48-72 hours." (Secretary of Defense statement). Areas or objectives to be covered range from "equivalent to KH-4" (COMOR-D-13/29 pp. 1 & 6) to "max number of indicator targets achievable during one day (Secretary of Defense statement).

C. Limited War: No stated requirements for this environment were found to exist. However, after review of the requirements for information during a Limited War ("short of employment of strategic nuclear weapons") the Needs Task Group assumed that as a first approximation the system parameters for Limited War should be the same as those used in a Crisis Management situation.

D. General War: In a general war condition both the Strike Effectiveness Assessment and Self Recon mission requirements are very similar. /While this study is concerned with satellite recon, it must be recognized that, as a practical matter, the majority, if not all, domestic BDA (self recon) could be met with surviving aircraft./ For S. E. A. the Strategic Air Command "needs" to know: (1) location of a strike and (2) its relation to the target -- to compute status of the target. A ground resolution of 150 feet will provide a capability to assess the strike effectiveness of approximately 90% of programmed weapons.

S. E. A. requires coverage of all nuclear threat targets and, while these SIOP targets are spread throughout the Sino/Soviet land mass, approximately 75% of the initial stage SIOP targets are located west of 75° east longitude; target density east of 75° east longitude is relatively light; however, a number of priority targets are located in this area -- creating a need for coverage of the entire Sino/Soviet area.

Real time response is the goal; however, pending realization of this capability, information acquired within E + 4-6,12,2028, and 36 hours is required -- simply stated a valid requirement exists for strike effectiveness results as quickly as the maximum state of the art will provide.

The above comments on S. E. A. also apply, in general, to Self Reconnaissance. Qualitative requirements are the same -- as applied to the U.S. and to friendly forces/installations. Repetition rates desired will, of course, be those necessary to provide trans-and post-attack coverage on a continuing basis. Real time readout is desirable, or the minimum delay that the maximum state of the art can provide.

E. Post-Attack Recon: This mission involves two functions: (1) Search: locating residual military forces, and (2) determining the posture and potential of these forces.

Qualitatively, the resolution requirements for PAR must provide essentially the same information needed under Cold War conditions -- in fact, PAR in one sense may be looked upon as a transition from General War back to the Crisis Management and Cold War situations.

Resolutions of 3-5 feet are required for all surveillance (not including technical intelligence requirements) and for much of the search mission -- although in this latter instance, resolutions of about 10 feet would provide useful information.

F. Geodesy, Mapping and Charting: These requirements are presented, not as a primary part of Task I, but solely to assist sensor developers in assessing those Geodesy, Mapping and Charting requirements which might simultaneously be met, without compromise to the primary mission, by intelligence gathering (Search/Surveillance) satellites. (See Tab B) It should be noted that DIA is currently reviewing these requirements in detail.

G. Summary Findings: The matrix attached as Tab B shows the statement

and source of each expression of "needs" for various environmental conditions. To facilitate evaluation of data, the Task Force has summarized its findings as follows:

a. Qualitatively, ground resolutions of 3-5 feet are required for the search/surveillance mission under Cold War, Crisis Management, Limited War, and for the Post-Attack Recon mission in a General War Environment. Ground resolutions as gross as 150 feet are considered adequate for Strike Effectiveness Assessment and for the majority of the Self Reconnaissance effort in a General War Environment. However, COMOR has stated a requirement for "an all-weather photographic sensing capability which would permit the recognition of low contract objects five to eight feet on a side" (COMOR-D-13/29, p. 7).

b. Under all environmental conditions considered, quantitative (area or objective) requirements dictate the use of a system combining broad coverage with resolutions of 3-5 feet required to meet simultaneously area search and surveillance (exclusive of technical intelligence) requirements for coverage of specific targets.

c. Responsiveness is relatively unimportant in the Cold War but becomes increasingly important during Limited War, Crisis Management and General War environments. Achievement of a near real time reaction time for use under all conditions is highly desirable. In the interim, the responsiveness requirement is for the minimum delay that the maximum state of the art will provide.

d. An all weather capability is needed under all environments with the requirements for Strike Effectiveness Assessment almost dictating an all-weather and day-night capability.

References:

a. Operating Plan for Study of Search/Surveillance Satellite Reconnaissance, October 1964. (BYE 23586-64)

b. Long Range Requirements for Satellite Image Forming Sensors, 14 December 1964 (COMOR-D-13/29).

c. Statement of Requirements for Strategic War Reconnaissance - SAC Report TK-01840-3, dated 3 July 1963 and JCSM 862-64, subject; Strategic Reconnaissance, dated 20 October 1964.

1. [illegible]: Near static or relative situation existing between power which is not normal relations.

2. [illegible]: Other types of satellite-acquired information used to complement data collected by a photographic reconnaissance system.

3. Crisis Management: Period of international tension requiring reconnaissance information on potentially hostile capabilities to serve as the basis for decision making required to: terminate the threat; gain a military or political advantage or to otherwise achieve a given national objective.

4. General War: Situation requiring initiation of the SIOP (Single Integrated Operations Plan).

5. Limited War: Largest war possible short of employment of strategic nuclear weapons.

6. Post-Attack Reconnaissance: Reconnaissance to detect the residual forces still capable of military operation.

7. Quality: Dimension of smallest object which must be recognized.

8. Quantity: Number of targets or total area to be photographed.

9. Repetition Rate: Frequency of repeat coverage required.

10. Response Time: From receipt of specific collection requirement by (S) NRO to availability of initial report.

11. Search: A systematic reconnaissance of a defined area, for previously unknown information to permit an estimate of a potential enemy's overall strength.

12. Self-Reconnaissance: Selective search of the United States to assess damage.

13. Strike Effectiveness Assessment: Reconnaissance to permit early computation of bomb damage.

14. Surveillance: Periodic coverage of previously known, individual targets and small suspect areas to permit a definitive analysis of changes in their status and capability.

15. Vulnerability: Survivability of a collection capability to hostile intercept or interference.

[illegible]
[illegible]

TAB A

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ENVIRONMENT	MISSIONS	QUALITY	QUANTITY	RESPONSE TIMES
Cold War	Search	(1) 3-5 Feet.*	(1) Entire area of Sino-Soviet Bloc and selected areas of other parts of the world.	See repetition rates.
	Surveillance	(1) Same.*	(1) 3552 objectives.	See repetition rates.
Crisis Management	Search Surveillance	(1) Same as Cold War.*a	(2) B. Maximum number of indicator targets acheivable during one days operation.	(1) A. Within 10 hours. *c (2) B. Permit delivery of processed film to readout facility within 48-72 hours of request.
Limited War	Search Surveillance	(4) Same as Cold War.	(4) Same as Crisis Management.	(4) Same as Crisis Management.
General War	Strike Effectiveness Self Recon	(1) 5-8 feet (3) 150 feet	(3) 100% of all nuclear threat targets	(1) Minimum 24 hours (3) Maximum state of the art: 4-6-12-24-48 hours
	Post Attack Recon	(4) Same as Cold War.	(3) A.Dependent Upon: a. Availability of collateral information. b. Adequacy of reconnaissance in pre-hostility period. c. The attack option executed. d. The success of strikes executed. (4) B.Should be similar to Crisis Management	(4) Maximum state of the art: (3) 12-24 hours.

* See Remarks Column

COMOR (1) SAC (3)

Secretary of Defense (2) Task Force (4)

ENVIRONMENT	MISSIONS	REPETITION RATES	ALL WEATHER REQUIREMENTS	*REMARKS
Cold War	Search	(1) Semi-annually	(1) Some areas, due to darkness and cloud-cover, will require all-weather sensor coverage which can permit identification of targets 3-5 feet on a side.	(1) Permit detection & identification of activities associated with a strategic threat against U.S. & defense weapons systems.
	Surveillance	(1) Every 2 Months: 223 Objectives-CIA 0 " 3 Months: 1858 " " 166 " 6 Months: 446 " " 1921 " 12 Months: 1025 " " 1465 Total 3552 3552	(1) Some objectives, due to darkness and cloud-cover will require all-weather sensor coverage to satisfy repetition rates.	(1) It should be noted that sometimes one-foot ground resolution is essential to identify properly an object under surveillance.
Crisis Management	Search	(2) Repeat twice within 48 hours	(4) Same as Cold War.	(1) a. Resolution equivalent to KH-7. (1) b. Continuous stereoscopic ground coverage equivalent to KH-4. (1) c. Real time desired
	Surveillance	(4) Dependent upon tempo and duration of crisis		
Limited War	Search Surveillance	(4) Same as Crisis Management	(4) Same as Cold War	
General War	Strike Effectiveness Self Recon	(3) E + 4 - 6, 12, 20, 28, 36 hours	(3) All weather capability of major concern.	
	Post Attack Recon	(3) Dependent upon results & levels of initial missions and input of collateral intelligence could be as often as every 4-6 hours.	(4) Same as Cold War	

* See Remarks Column
COMOR (1) SAC (3)
Secretary of Defense (2) Task Force (4)

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	QUALITY	QUANTITY	RESPONSE TIMES	REPETITION RATES
Geodesy*	(1) Position accuracy of 450 feet horizontal and vertical control, with 90% assurance.	(1) World-Wide	See repetition rates.	
Mapping and Charting*	(1) 10 feet. (1) Frame camera aprox. 100'	(1) 38,000,000 sq. mile area coverage	See repetition rates.	(1) 1965 20,000,000 sq miles 1966 14,000,000 sq miles 1967 thru 1971 4,000,000 sq miles/year

* DIA is re-examining requirements for mapping, charting, and geodesy.

* See Remarks Column

COMOR (1) SAC (3)
Secretary of Defense (2) Task Force (4)

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GROUND RESOLUTION REQUIREMENT

The following graphs were prepared from data contained in COMOR-D-13/19, Subject: "Ground Resolution Comparison," dated 5 August 1964. This document provides a general indication of intelligence information obtainable relative to ground resolution. The EEI were provided by intelligence analysts and NPIC made judgments concerning the degree they could be answered at 10 feet, 3 feet, and 9 inches ground resolution. These degrees were stated in terms of "yes," "partially," "?," and "no." The group gave a value of 1.0 to each EEI and values of 1.0, 0.3, 0.1, 0.0, respectively, to the stated degrees

Example

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Information Sought	10 Feet	3 Feet	9 Inches	0"
1. Identify weapon	partially (0.3)	partially (0.3)	partially (0.3)	(0.1)
2. Identify support	partially (0.3)	? (0.1)	?. (0.1)	(0.5)
3. Locate nuclear storage	partially (0.3)	Yes (0.7)		
Totals	(0.9)	(1.1)	(0.4)	(0.6)

Therefore 30% of EEI answered at 10 feet, 36% additional or a total of 66% EEI at 3 feet, and 13% additional or a total of 79% EEI at 9 inches. The remaining 21% of the EEI would probably require something other than photography to provide the answer.

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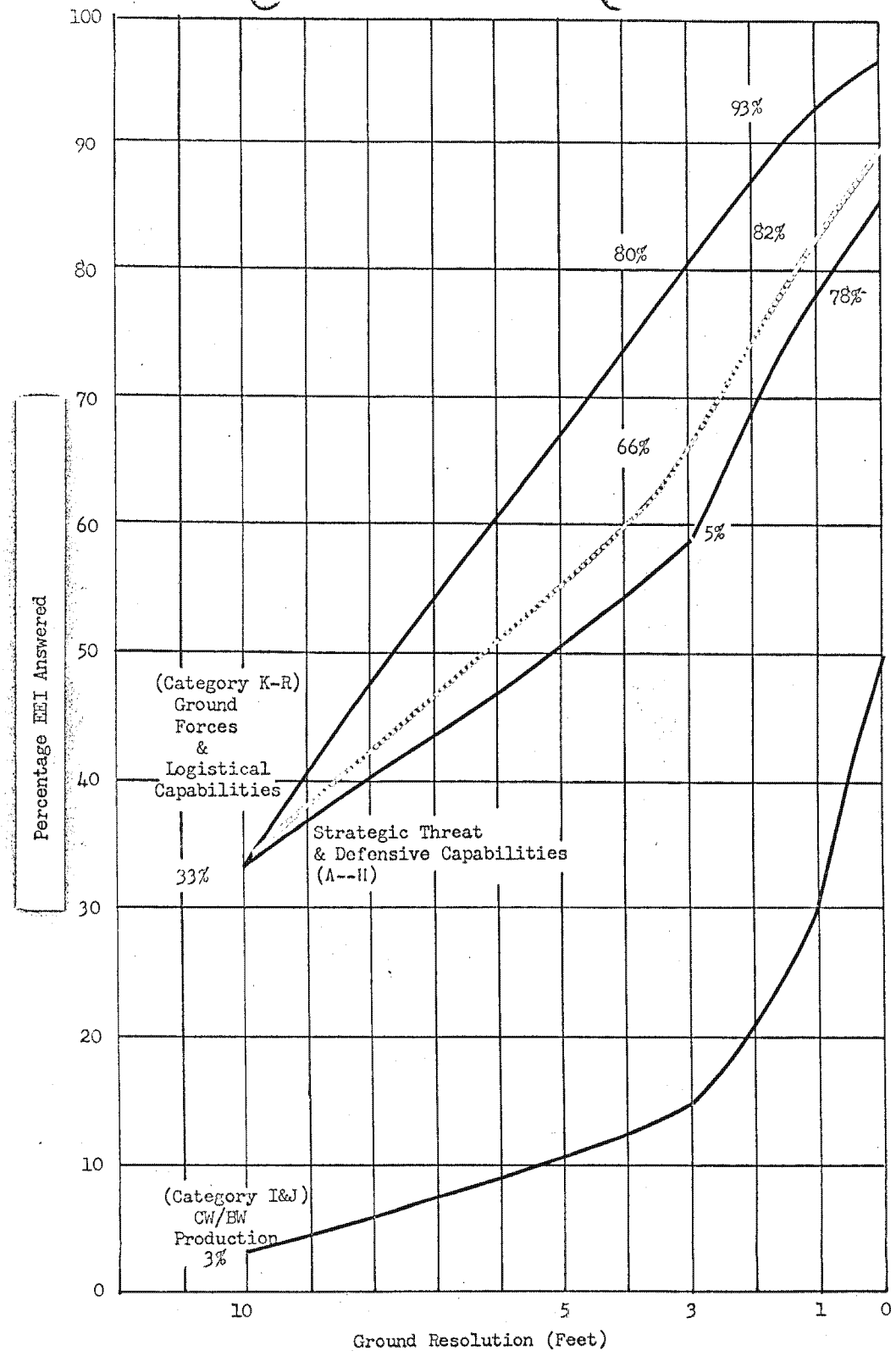
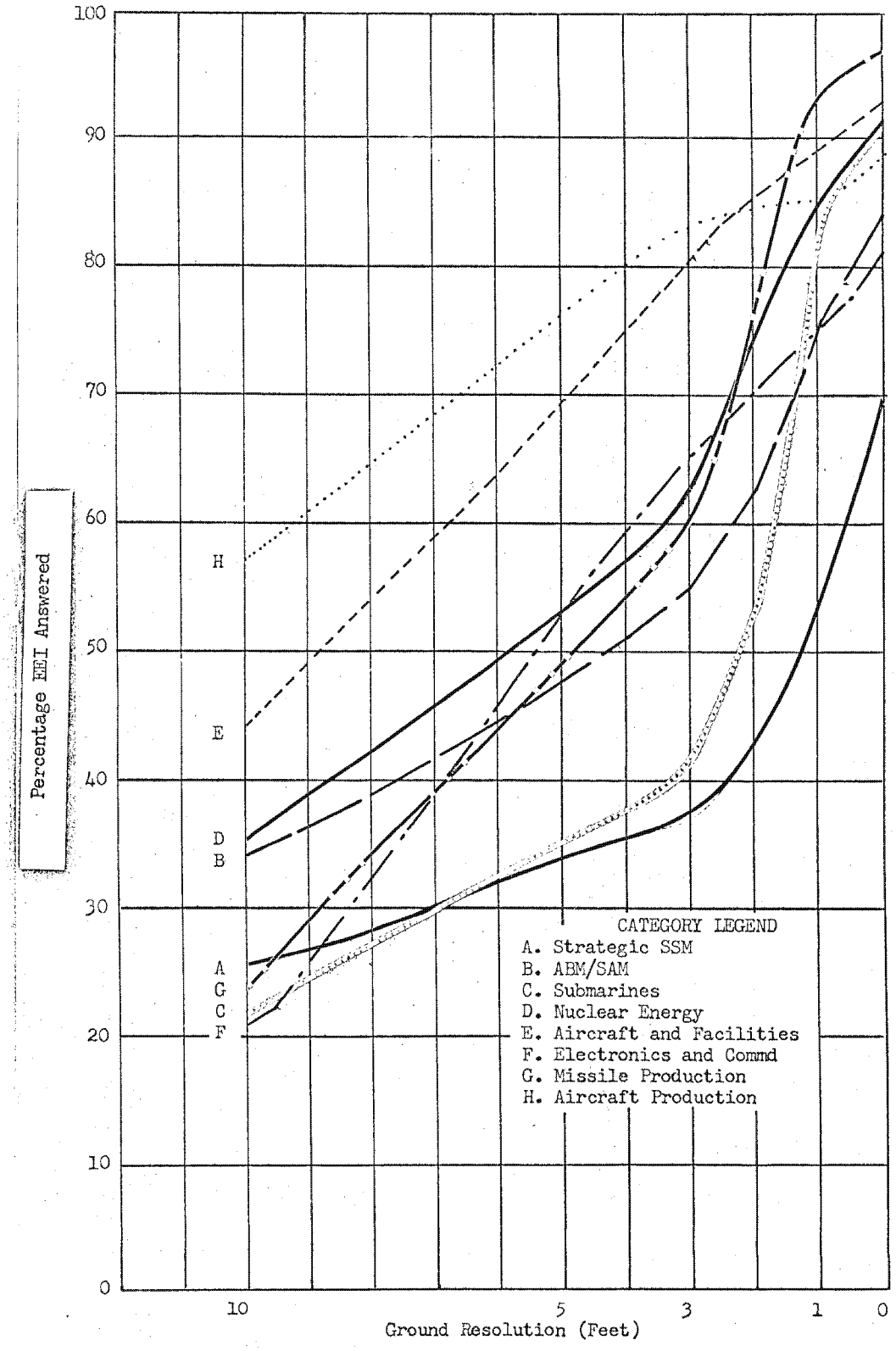
TAB C

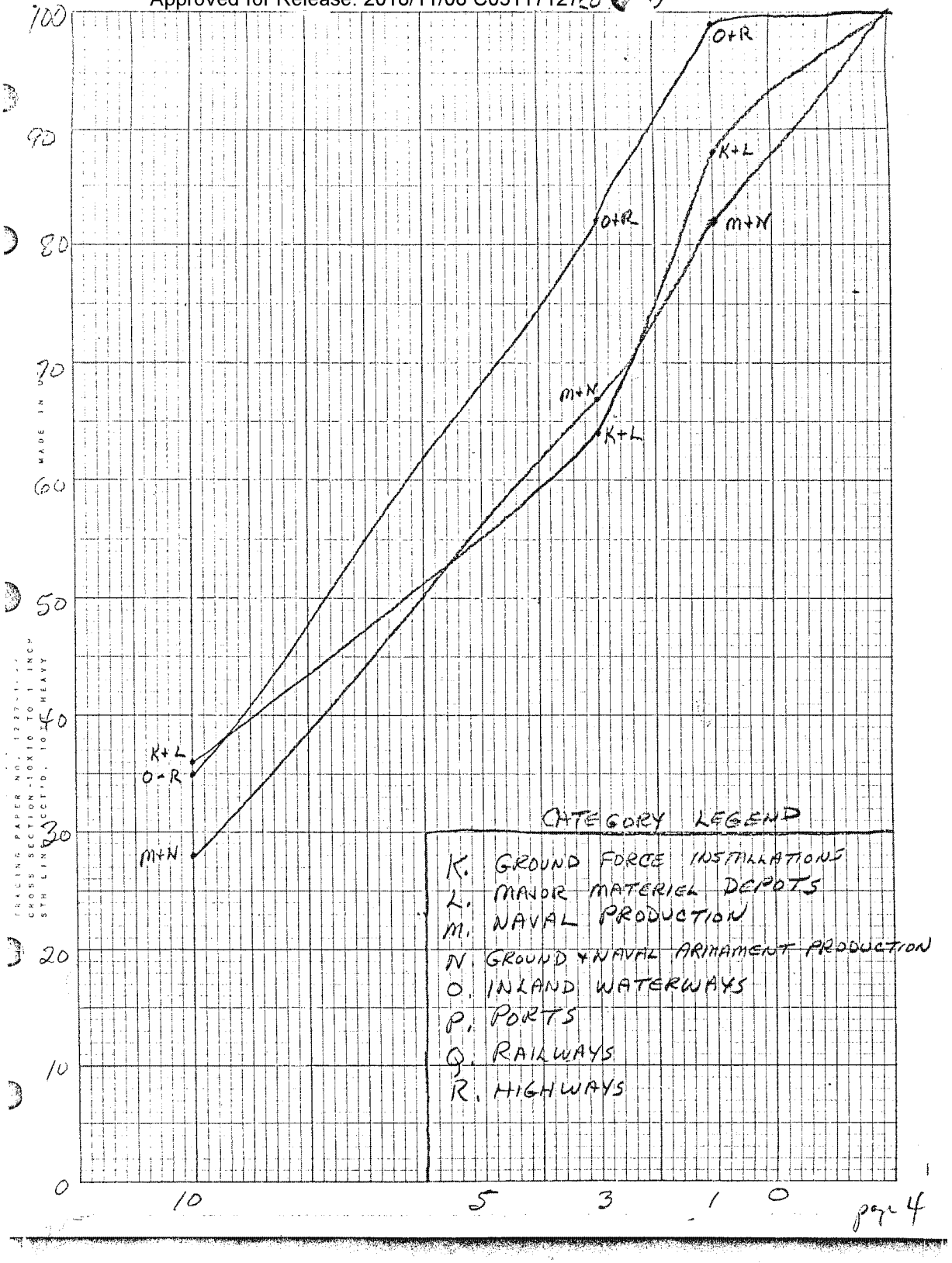


COMOR -D--13/19 EEI ANSWERED RELATIVE TO GROUND RESOLUTION



COMOR -D--13/19 STATEGIC THREAT AND DEFENSIVE CAPABILITIES EEI ANSWERED RELATIVE TO GROUND RESOLUTION

(QUANTITATIVE ANSWERED RELATIVE TO ...)



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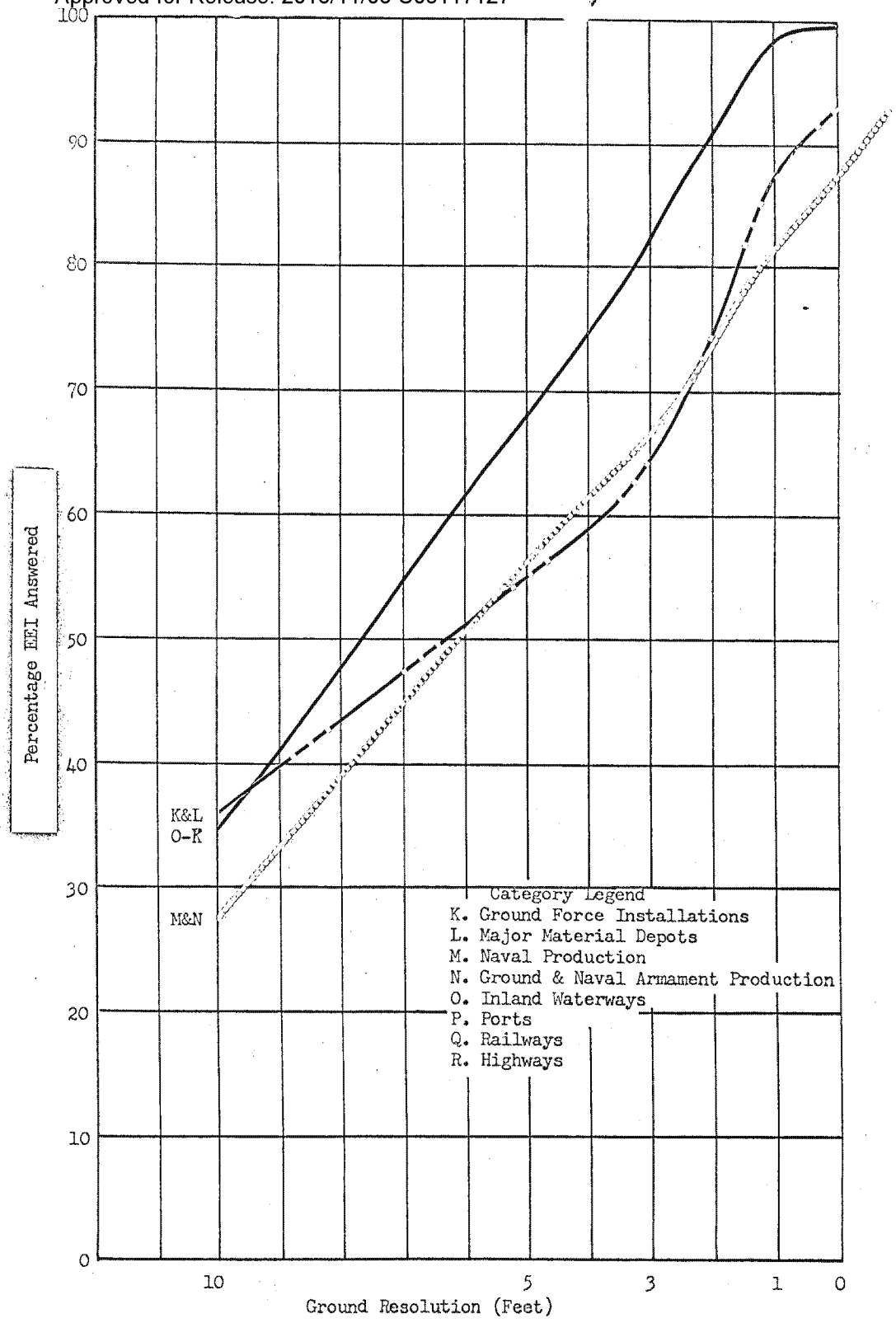
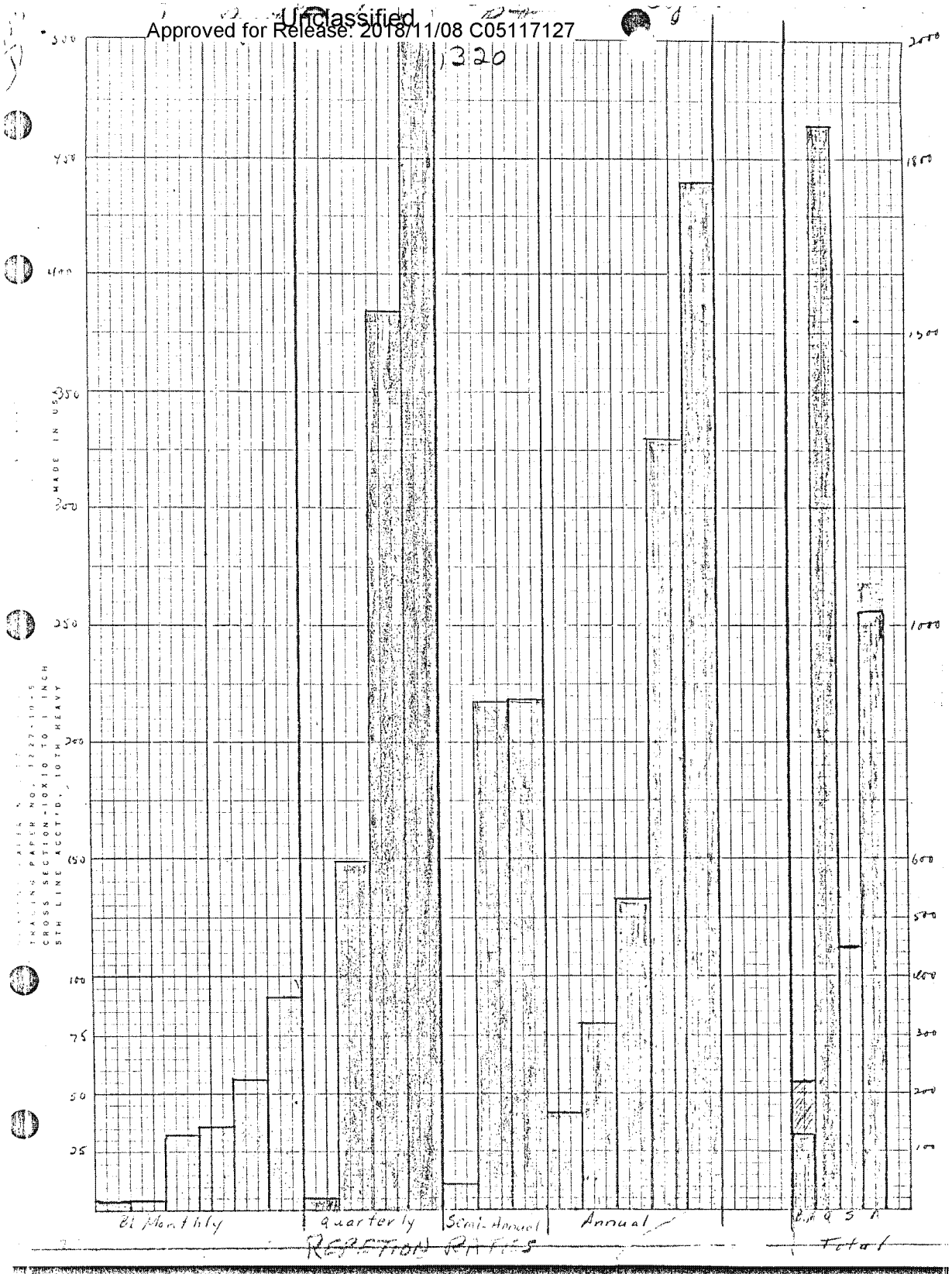
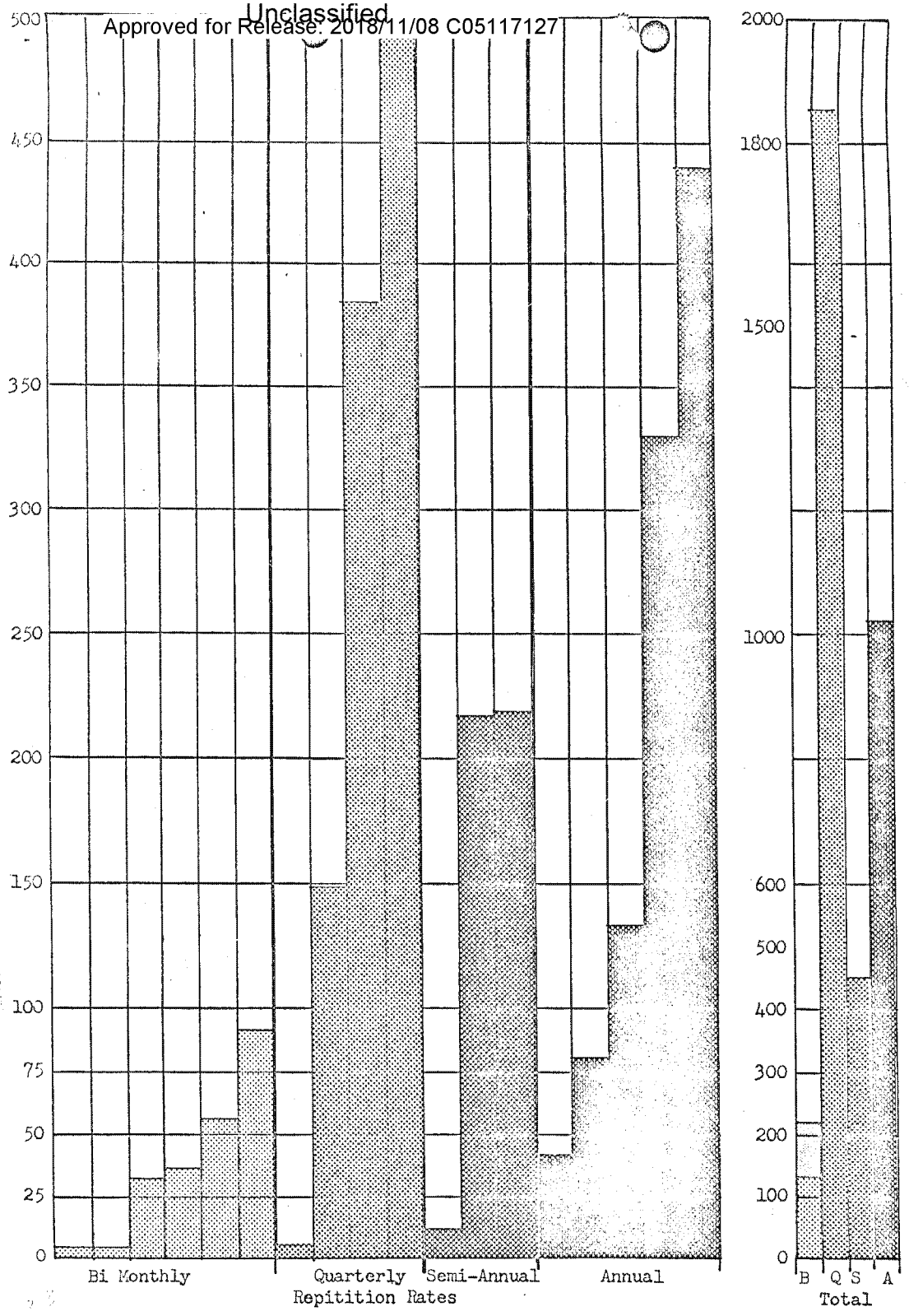


COMOR -D-13/19 GROUND FORCES AND LOGISTICAL CAPABILITIES EEI ANSWERED RELATIVE TO GROUND RESOLUTION





COMOR-D-13/29 SURVEILLANCE OBJECTIVES RELATIVE TO REPITITION RATES

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PROGRAM CHARACTERISTICS FOR A FUTURE SEARCH/SURVEILLANCE SATELLITE RECONNAISSANCE SYSTEM

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PROGRAM CHARACTERISTICS FOR A FUTURE SEARCH/SURVEILLANCE SATELLITE RECONNAISSANCE SYSTEM

I. PURPOSE: This document defines the mission and the operational and technical characteristics of a new search and surveillance satellite system to be developed by the National Reconnaissance Office for operational use commencing in late CY 1967 or early 1968.

II. MISSION AND GENERAL SITUATION:

A. A continued requirement will exist for the United States to acquire satellite photographic reconnaissance as a primary source of information on the status, capability and intent (threat) posed by potentially hostile nations to the peace of the free world.

B. These search and surveillance activities will be conducted in an environment similar to the current world situation; ranging from a "normal" or cold war, through a crisis management situation.

C. The primary mission of this system is to conduct search and surveillance satellite photographic reconnaissance of any designated part of the earth's surface during the time period 1968 and beyond. Priority to be given to photography of built-up areas of the USSR and China.

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III. REQUIREMENTS: The new system will be designed to provide an optimum capability for fulfilling the national search and surveillance objectives specified, for the time period by the Committee on Overhead Reconnaissance of the United States Intelligence Board. These requirements are:

A. Systematic search of 12 million square nautical miles of defined areas of the globe, semi-annually, to detect activities associated with a threat against the United States. In meeting this requirement, the new system will be capable of providing a ground resolution of not less than 5 feet at nadir; degradation at the edge of the format should not exceed a factor of two -- this latter figure to be independent of atmospheric limitations.

B. Periodic surveillance of previously known specific objective targets at a ground resolution sufficient to detect and analyze changes in the status or capability of a target. To meet this requirement, the system will be capable of providing photography with a ground resolution of not less than 3 feet at nadir. (Note: Repetitive coverage of certain types of targets and target complexes at even higher resolutions is vitally important to permit a definitive analysis of changes in their status.) Numerically, coverage of some 4,000 specific targets is required.

Frequency of coverage requires photography of approximately 300 targets every two months, 1,900 quarterly, 1,500 semi-annually and 700 annually. Primary targets are distributed throughout the Sino-Soviet land mass. (Note: An up-to-date location of these targets is maintained both by the ~~(S)~~ NRO Satellite Operations Center and by the Satellite Test Center). The majority (in excess of 90%) of those specific objective targets encompasses areas of 5 miles square or less -- the largest single objective target covers an area of about 50 miles square.

C. During periods of crisis, a satellite reconnaissance capability is required which will provide photography of any selected area of the world. Crisis management targets will be similar in character and require about the same ground resolution (i.e., 3-5 ft) as those identified under search and surveillance. However, to prove effective, the satellite reconnaissance capability used for crisis management must be flexible; capable of prolonged "standby" periods prior to launch; rapid response (within 24 hours) after the decision to launch is received; and elapsed time between recovery and readout must be minimized. Symmetrical stereo photography at convergent angles between 20 and 30 degrees is required for all of the above.

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IV. COROLLARY REQUIREMENTS:

A. The satisfaction of USIB technical intelligence requirements, which are also of vital national importance, will be considered in design of the new system when such requirements can be accomplished in conjunction with, without compromise to, and as a bonus to, the conduct of the primary search and surveillance mission.

B. In addition to the requirements for search and surveillance and technical intelligence stated above, requirements exist for satellite photographic coverage during general war environments and for mapping, charting and geodesy from satellites. Certain of the requirements in this category can probably be simultaneously fulfilled by a satellite system configured primarily for search and surveillance. To the extent possible, the maximum number of these ancillary requirements, which can be fulfilled without significant compromise to the primary mission capability, should be considered in the development of the new search and surveillance system (see Attachment #1). It should be recognized that these ancillary requirements which cannot be met without compromise to the primary search and surveillance mission may be sufficient in both number and importance to warrant programming of another (different) satellite reconnaissance system designed particularly to fulfill those additional requirements.

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C. Principal considerations influencing the design and development of this new system are to be applied to fulfillment of the primary mission. However, in developing the primary mission system, it may be possible to incorporate features which, without compromising the search and surveillance mission, provide a capability for simultaneously satisfying other than primary mission aims. Where possible and practicable, it is in the national interest to incorporate as many of the following features, peculiar to the individually stated requirement (i.e., strike effectiveness assessment, post attack reconnaissance, self reconnaissance, and mapping, charting and geodesy as indicated in Attachment #1) into the new search/surveillance system when the feature can be incorporated without significant compromise to the primary search/surveillance mission. In addition to requirements identified on Attachment #1, the following additional features, applicable to the environment/situation indicated below are essential in fulfilling these secondary objectives:

1. GENERAL WAR (SEA, PAR, SELF RECON):

a. Hard launching facilities and survivable command/control and recovery facilities.

b. Wide flexibility in orbit selection options.

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c. System survivability in a hostile operating environment.

d. Alternative airborne command and control backup.

e. Rapid processing (airborne, etc.) and rapid readout of results.

f. System for general war use should be directly responsive to the operational control of the Joint Chiefs of Staff.

2. MAPPING, CHARTING AND GEODESY: This requirement will be met by use of an auxiliary payload designed specifically for the function; the sensor will be designed to operate both in conjunction with and independent of the primary mission sensor. Twice yearly, the search and surveillance system will be programmed to fly at higher (i.e., 300 NM) than nominal altitudes in order to fulfill specific MC and G area coverage requirements.

D. As previously mentioned, the stated requirements of user agencies influences to a very large extent, the design and development of new satellite systems. In addition, experience gained through operational activity provides an excellent source of proven technological characteristics for future systems -- where appropriate, such proven technological parameters (gained through (TS) NRP experience) have been identified for incorporation into this new system.

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V. OPERATIONAL ENVIRONMENT:

A. Hostile:

1. While there is no direct evidence to indicate that the USSR is developing an anti-satellite capability, it is almost certain to be evaluating the feasibility of such a system. We know that the Soviets are capable of detecting and tracking U. S. satellites. Our knowledge of their technological stature indicates that the USSR could develop a limited anti-satellite capability within a few months after making a decision. This limited system, at least in the initial development stages, would probably make use of their existing satellite surveillance and tracking radars, off-the-shelf ballistic missiles and (to compensate for range/azimuth tracking inaccuracies) would probably employ a nuclear warhead.

2. An operational non-nuclear anti-satellite capability, requiring more precise target intercept accuracy, and an exoatmospheric maneuver capability, could probably be developed by the Soviets within two years after first flight tests.

3. Communist China has recently achieved some degree of success with nuclear devices and could probably also develop a space booster within the next few years. Due to disparity in technological capabilities, the Chinese probably could not develop an anti-satellite capability as quickly as could the Soviets.

4. The Communist Chinese are, of course, well aware of aircraft reconnaissance overflight of their territory -- they have destroyed some of these airplanes -- they have protested violation of their airspace by these flights on many occasions. In addition to aircraft overflights, the Chinese probably have some knowledge of U. S. satellite reconnaissance flights (i. e., speculative stories in the press, announcement of advance knowledge of the nuclear energy test [redacted] etc.). Thus, the Communist Chinese may have an equal, if not greater, incentive to develop an anti-satellite capability for use against U. S. reconnaissance satellites than do the Soviets.

5. While it appears that the USSR and the Communist Chinese have an adequate incentive to interfere with U. S. satellite vehicles, they are likely to weigh the consequences prior to initiating such action:

a. The initial intercept effort would probably require use of a nuclear device -- and, since it is doubtful that such an action could be conducted covertly, the pressure of anticipated world opinion (i. e., contamination of the atmosphere, resumption of nuclear "testing," interference with the peaceful passage of another nation's satellite in free outer space, etc.) could well inhibit initiation of such action.

b. At one time the Soviets were vehement in declaring, in the U. N. and elsewhere, their opposition to the conduct of U. S. satellite

reconnaissance "espionage" flights; however, in recent years they have voiced little or no positive opposition. The probable cause is the existence of a similar Soviet reconnaissance program which they do not wish to subject to attack by focusing attention on the U. S. program. The Chinese suffer no such restraint.

6. It should be realized that, despite rationalization to the contrary, either the USSR or Communist China may at some future time deliberately make a decision, based on a political desire to increase East-West tensions, to attack a U. S. satellite during peacetime.

7. In a general war situation, there is no reason to believe that the USSR would not attempt to employ an anti-satellite system against U. S. reconnaissance satellites. An estimate of Soviet detection and tracking capabilities during 1968-71 has been forwarded by separate correspondence.

8. While no extraordinary effort will be devoted to the development of anti-satellite defensive protection for the new search and surveillance system, the initial system design should include precautionary features such as: "passive" operation over area of interest, secure "activate-deactivate" and recovery command sequences, orbital adjust for nodal period changes (500 feet per second total), etc. Other reasonable provisions, for incorporation in the design for later modifications,

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should include consideration of features such as: Radiation shielding, shielding against pellet attack, use of decoys, electronics countermeasures (ECM), etc., for employment when and if needed.

B. FRIENDLY:

1. The new search and surveillance system is to become an integral asset of the ~~(TS)~~ National Reconnaissance Program. All missions will be conducted by the ~~(S)~~ National Reconnaissance Office.

2. When the new search and surveillance system becomes operational, it will replace the CORONA program.

3. The system will be employed primarily in a near peacetime (cold war) environment and, when required, in a crisis management situation. Optimum use of existing launching and on-orbit control assets (with minimal modification where indicated) is desired, and the new system will be as nearly compatible with existing command and control assets as is practicable. If advantages accrue, development of a launching facility at the Eastern Test Range will be considered. Established recovery assets (with minimal modification if required) will be utilized -- the primary recovery zone will be the Hawaiian recovery area with no compromise to primary search and surveillance system capability in order to establish a contingency land recovery capability.

4. Existing photographic processing and data processing support facilities (with equipment updated to the 68-71 time period plus other modifications as indicated) will be used in exploitation of photography acquired with the new system.

VI. DEVELOPMENT CONCEPT:

A. The United States possesses a competence in satellite system technology which should permit development of a new search and surveillance reconnaissance system with a minimum amount of new or additional research.

B. The new search and surveillance system is to be designed and developed to accomplish the primary mission objective; plus the maximum number of those other functions (previously identified as secondary missions or military requirements) which can be incorporated simultaneously into the design concept without significant compromise to the primary mission. Development plans will consider and specifically identify each "secondary mission" requirement and provide a listing of those requirements which:

1. Can be incorporated without compromise to the basic mission;
2. Indicate those features which can be included but which will result in some degree of compromise to the basic system.

(To permit weighing of trade-offs involved, comments will include information on degree of non-compatibility with basic system);

3. Use the primary search and surveillance system as a base or "building block," identify those requirements (under 2. above) which could be incorporated through future modification to the basic system -- include estimate of time phasing required to accomplish such modifications. The "building block" concept should be separated into two categories: (1) environmental or operating conditions such as: rapid response, launching from hardened sites, inertial guidance, land recoverable vehicles, vehicle survivability on-orbit, survivable command and control, etc.; and (2) systems characteristics, peculiar to the secondary mission, such as: [redacted] This modification may require interchanging the entire payload section.

VII. OPERATIONAL AND TECHNICAL CHARACTERISTICS:

A. General System:

1. Satellite vehicle nominal flight altitudes will range between 80 and 200 nautical miles and require a capability to remain active on

orbit for periods of about 12 days for normal search and surveillance missions. An additional requirement exists to be capable of flying at about 300 miles to fulfill semi-annual requirements peculiar to mapping, charting and geodesy.

2. [redacted]

3. The system is to:

a. Be launched at the rate of approximately one-per-month;

b. Provide for launch of a backup payload within three days after a system failure; and

c. Be counted down to, and held at, R-1 for periods of one month during a crisis -- during this R-1 period the vehicle will be configured with a multiple recovery front end.

4. Orbital adjust capability (period adjust only) is required; first, to provide a capability for 12-days active duration on-orbit at lower altitudes, and secondly, to serve as a countermeasure tactic against interception attempts.

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5. System will incorporate all fail-safe features considered feasible, practicable, and necessary to prevent catastrophic failure

and to meet systems reliability objectives. These systems design goals are defined as follows:

a. Overall System:

Required: Reliability to provide a minimum of 80% successful results (acceptable photographs recovered) at 90% confidence level.

Desired: Reliability of 90% at 90% confidence level for same conditions outlined above.

b. Sensor System: Reliability design goal of 90% successful operation at 90% confidence level.

6. The design should minimize requirement for field adjustment or maintenance of the system prior to flight.

7. For adjustment/maintenance which is deemed necessary to prepare the system for launching (in a normal, backup, and crisis situation) emphasis is to be placed on ease of accessibility, inspection, maintenance, or replacement of components.

8. The system should be compatible with the requirement for rapid changes, i.e., 24 hours, in ascent and orbital programs to meet normal, prolonged standby, and rapid response conditions.

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B. Boosters: The boosters that are to be considered for application against the requirements are (1) T-IIIX/AGENA; (2) T-IIIX/Solid Strap-On; and (3) T-IIIX/AGENA/Solid Strap-On.

C. Spacecraft:

1. The spacecraft is to be of conventional construction with particular emphasis placed on accessibility, ease of maintenance and inspection, and adaptability to a maximum satisfaction of the search and surveillance and military missions with minimum degradation to the search and surveillance system. A less capable backup is to be included for the command subsystem, stabilization subsystem, and recovery control subsystem (not recovery vehicle). Particular attention is necessary to assure minimum electrical connections and radio frequency interference in order to assure maximum use for the most missions and ancillary payloads, and provide for high reliability. The command programmer is to be capable of receiving commands for orbital operations, and changes as required, while on the launching site as well as while on orbit.

2. Spacecraft should be designed to optimize use of any space (cubage), not necessary for initial equipment installations, as a "built in" capability for future addition of other equipments or capabilities. Under this "built in" concept, space that is superfluous to initial mission

requirements would be configured with "brackets" (standardized to the extent practicable), which would be utilized to accommodate other compatible capabilities (i.e., extra batteries and/or gas, [redacted] ECM, SIGINT, passenger payloads, etc.). In developing this "built in" design, priority and importance of effort will be assigned in the following order: (1) those systems which extend the lifetime on orbit of the spacecraft; (2) systems contributing to the survivability of the spacecraft; and (3) the capability to carry passenger ("piggyback") payloads.

D. Recovery Vehicle:

1. A multiple capsule recovery capability is required. The search and surveillance mission capability shall provide for dual (two) recoveries per flight. A further requirement exists (during crisis management situations) for a capability providing one recovery per day with minimum of 100 frames of stereo photography per recovery for at least 4-8 recoveries.

2. The recovery vehicle must be designed to permit removal of portions of subsystems or film payload when weight reduction is required to provide increased orbital flexibility or to permit the substitution of survival aids.

3. Aerial recovery (with sea surface ship back-up) will continue

as the primary means of recovering satellite reconnaissance payloads during this time period:

a. If individual recoverable payloads will be compatible with existing (air catch) recovery systems, sizes of individual recoverable payloads will be optimized to permit safe and effective handling aboard the recovery aircraft.

b. Crisis management and emergency recovery situations require establishment of a night recovery capability.

E. Payload:

1. Primary Cameras:

a. Primary payload shall consist of two panoramic cameras capable of producing complete symmetrical convergent stereo coverage with a 20-30 degree convergent angle. The semi-field angles and focal length shall be selected so that the image width will not exceed 9" and is to be centered on the film which is not to exceed 9-1/2" in width.

b. Panning angles shall be variable in the following increments with selection and change of angle by: 20 degrees, 35 degrees, and approximately 45 degrees half angles and the resulting frame lengths shall be capable of being correspondingly adjusted during a camera operate cycle.

c. Selection and change of the panning angles will be by vehicle programmer and provisions for adjusting the programmer by command from the ground.

d. The primary cameras shall be capable of operations with 10% forward overlap in the altitude range from 80 to 200 nautical miles. Minimum number of camera cycles per camera operation is to provide 50 nautical miles advance coverage along orbit path. Maximum number of camera cycles per camera operation shall be 200. The minimum time between camera off and camera operate shall not exceed minimum operate time. In order to optimize the full stereo coverage and film utilization, differential start and stop of the two cameras is to be provided. Film capacity for primary cameras is to be based on the assumption that 50% of all recovered photography will be obscured by clouds.

e. In addition to search and surveillance, the product of the primary cameras will also be used for providing planimetric detail in support of mapping and charting. Provisions for photogrametric application and calibrations are to be included where appropriate. In addition, the system may be employed for a primary collection for mapping, charting and geodesy and would operate at altitudes from 250-350 nautical miles with 10% forward overlap.

f. The camera film shall be time coded with a millisecond clock alongside but external to the format. In addition, a light pulse will be recorded as close to the slit as possible for each S/I camera cycle.

2. Film: The primary camera film will be thinbase type 4404 or equivalent with an EI=6 and quantity sufficient to satisfy the primary mission requirements. Provisions for ultra-thin base material will be considered during development and to be used as an item of growth potential. During systems development, consideration will be given to possible (future) conversion to and use of ultra-thin base film.

3. Mapping and Charting Camera:

a. A dual camera system is to be incorporated as a part of the search and surveillance system. One vertically oriented camera will photograph the terrain (index) and the second camera will be oriented to photograph stars (stellar). Accuracy must permit the preparation of medium and large scale maps, vehicle attitude determination to 15 sec of arc, and assist in the accurate determination of empheris. The search and surveillance photography and the stellar and index (SI) frame photography shall permit identification and delineation of physical and cultural features with respect to control points and production of required contours and related relief data.

b. The angle between the stellar and the index camera is to be sufficient to obtain a rich field of stars (6th magnitude), for the full year and orbital conditions expected, but not less than 105 degrees $\pm$ 15 secs. The complete SI camera weight should be approximately 50 pounds.

c. This camera must be capable of being operated either simultaneously with, or independently of, the primary search and surveillance system.

d. Calibration of the complete SI camera system is mandatory. This calibration is to include inner orientation, relative orientation between stellar and index cameras, and relative orientation between SI and the search and surveillance cameras. When employed in synchronization with the primary search and surveillance system, the (SI) camera(s) shall actuate during the first and last exposure of the primary camera system, and every fifth or sixth exposure intervening. When employed independently, the SI camera(s) shall be programmable to provide 57% overlap for continuous operation for periods up to 30 minutes.

e. The Index Camera (frame type) shall:

(1) Provide 90^{o} by 90^{o} coverage with 3" focal length (distortion - microns: 25 radial, 5 tangential).

(2) Provide AWAR of 80 l/mm at 2:1 contrast (mil standard - 150A) dynamic or better.

(3) Provide a film capacity of 4000 exposures or better of 5" film.

(4) Contain a reseau grid with 1 cm squares and line width of 5 microns; 4 fiducials uniquely marked to indicate flight direction and right or left.

(5) Provide time marks on the film with a millisec clock with 29 bit time word with a data head that is machine readable.

f. The Stellar Camera shall:

(1) Provide a 60^{o} circular format with 3" focal length (distortion - reasonable and calibratable).

(2) Provide film capacity of 4000 exposures or better of 70 mm film.

(3) Contain a reseau grid with 1 cm square and line width of 5 microns; four fiducials uniquely marked to indicate flight direction and right or left.

(4) Provide time marks on the film with a millisecond clock and with 29 bit time word with a data head that is machine readable.

4. Multiple Sensors: System will incorporate provisions for carrying the P-11 type subsatellite. Additional auxiliary sensors (IR, SIGINT, other) are desired only if they enhance the search and surveillance mission. All auxiliary sensors will be located and configured so that failure of an auxiliary system will not affect the primary sensor system.

F. Ground Facilities:

1. Since hostile threat against a cold war search and surveillance satellite launching facility is not a primary consideration, the existing non-hardened Western Test Range (WTR) facilities will be utilized as the primary launching location for the new search and surveillance system. Should future requirements dictate, the need for establishing an alternative launching facility on the East Coast (Eastern Test Range) will be considered.

2. The new search and surveillance system must be compatible with the Satellite Test Center and its command and control network, without major modification.

3. Target selection and film expenditure decisions will remain a Washington responsibility.

VIII. DEVELOPMENT PLANS:

A separate development plan is required for each separate payload/spacecraft/booster system. The plans are to be orally presented as well as submitted in writing.

Adequate backup information, analysis, and/or data from feasibility demonstrations must be available to support critical technology areas and review of trade-offs to allow a system selection.

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SUGGESTED SYSTEM

EVALUATION CRITERIA

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MAJOR PARAMETERS

I. System

(1) Facilities

(a) Launch Pads (Special AGE)

(b) Control Center

(c) Tracking Stations (accuracy requirements)

(d) Recovery Equipments and Procedures

(2) Development Risks

(a) Critical Operating Areas

(b) Deviation from Existing Know-How

(c) Simplicity

(1) Ease of Maintenance

(2) Checkout and Alignment Provisions

(3) Interface

(a) Power

(b) Thermal

(c) Mechanical

(4) Factory to Pad

(5) Variable Mission Capability

(a) World wide

(b) Crisis Management

(c) Range of Orbital

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(1) Life

(2) Inclination

(3) Altitude

(c) N-S, S-N, Day-Nite,

(c) Multiple RV

(3) Growth

II. Orbit Selection

(1) Describe Nominal Orbit

(a) Days for mission, Life

(b) Altitudes

(c) Inclination

(d) Off-Nominal Capability

III. Booster

(1) Type (Incl. necessary mods.)

(2) Guidance Type

(a) 2 σ Injection Accuracies

(3-position and vel. coordinates)

(3) 3 σ Injection Wt. Capability

($70^{\circ} < i < 145^{\circ}$; 100 NM cir. & 80 NM perigee)

IV Orbit Vehicle

(1) Profile Drwng (incl fairings and adaptors)

(2) Ascent and injection events

(3) Subsystem description

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(a) Power (duty cycle)

(b) Detailed wt statement

(c) Accuracies (attitude control, dead bands, mag & rates gyro's, gas type and consumption)

(d) Special (momentum balance)

(4) TT&C

(a) Modulation

(b) Real and stored commands required

(c) Programmer type and operation

(d) Description of environmental control

(e) Description of ground-space & space ground link

(5) Recovery

(a) Profile Drawing (shape, film path, cassettes)

(b) Description of recovery events

(d) Detailed Wt statement

(d) Description of major components

(e) Multiple recovery (incl film mgmt and transfer techniques)

V. Photo - Optical

(1) Profile drawing of camera systems

(2) Characteristics (incl assumptions - contrast ratio, sun angle, film speed, transmissivity, and MTF)

(a) Resolution (0^{o} - Max Pan angle, 2 σ smear analysis, and altitude)

(b) Stereo angle

(c) Physical (aperture, focal length, field of view, pan angle limits and variability, cycle time, film type and format, film capacity)

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(d) Operational (start up time, settling time, intermittent, variable scan angle)

(e) Mechanical (IMC technique, film velocity incl variations, film skew angle with variations, lateral motions incl velocity - amplitude - how done)

(3) Thermal analysis

(4) Focus (control equipment)

(5) Film Handling

(a) Supply to RV - transport showing bends and twists

(b) Number of emulsion contacts

(c) Schedule of acceleration

(d) Management and transfer techniques to RVs

(e) Static electricity

(f) Film - optical synchronization

(6) Detailed Weight Statement

(7) Power consumption