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REVIEW AND RECOMMENDATIONS OF USAF SATELLITE RECONNAISSANCE PROJECT SAMOS

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MEMORANDUM TO: Director of Defense Research and Engineering

SUBJECT: Review and Recommendations of USAF Satellite Reconnaissance Project SAMOS

14 JULY 60

I. GENERAL - Background Information

A. During the past several months, deliberations and studies concerning the various aspects of the SAMOS Program have been conducted by many groups and individuals. The national nature of this program, and the high importance that the many potential users place on the program, indicates that any review must consider the program as a whole in order to be most effective. Recently, there has been evidence of a revised doctrine of the SAMOS Program, obtained in informal discussions with members of the Office of the Secretary of the Air Force, and as seen in such directives as the Wilson letter to the BMD. However, in the meantime, national and international affairs have forced a new urgency, coupled with a frantic expectancy, for a project whose technology has been both overstated and underdone. Consequently, the Advisory Group has attempted to coordinate its various reviews of the current status of this work into the present Document.

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II. [redacted] Political Considerations

A. The universal applications of satellite reconnaissance have not been fully recognized. World-wide mapping, disaster and rescue surveys, geological search, weather analysis and warning, peace-time inspection and disarmament control, are all possible functions of satellites. The scientific results are, of course, also of very great importance, to mankind's best interests.

B. [redacted] approval to conduct operations is, and will continue to be, a serious problem. The situation must be such that the program will be acceptable politically — initially, on a U.S. National basis, and later, on an international basis. This includes favorable indoctrination of the public, operational and/or executive control by an organization capable of sponsoring both military and civilian peace time utilization of SAMOS, and of expeditiously and effectively exploiting the end results.

C. The U.S. cannot afford two R & D programs of this type; and the results of this program will be of priority interest not only to the USAF and the DOD but to the entire intelligence community and the nation.

Political approval to accomplish satellite reconnaissance will depend ultimately upon the degree that the conditions of universal application are met by the SAMOS system.

D. The military and civilian requirements are compatible — at least, from the R&D point of view — and a clearer relation will need to be established between the Department of State, NASA and the DOD as to the exploitation of R&D results.

E. Effective and expeditious exploitation of the SAMOS material requires that the data reduction be accomplished simultaneously by or in cooperation with all interested agencies utilizing reference material from all available sources and programs. Emphasis by the individual agencies should be consistent with their priority areas of interest and their respective assigned roles and missions. This indicates that existing facilities and agencies should be used, or that

Immediate action should be taken to prepare an adequate facility to accomplish this task if existing facilities are inadequate.

F. A new program organization and changes in organization should be pointed to the elimination of deficiencies as it pertains to the existing program and not to the initiation of new programs or establishment of new organizations. A new program with its inherent unknown and initial problems is not consistent with the national urgency attached to the program. Rather, a solution of existing and current problems, on a technical and management level, is recommended on an expedited basis in order to obtain an early intelligence product. The emphasis on new R&D organizations, new rocket developments, etc., that are not directly associated with the primary mission of the system will tend to dilute or degrade timely receipt of usable end products. Money and effort should be used to clean up, expedite, and improve the existing program; and greater effort should be placed on obtaining improved end results, qualitatively and quantitatively.

G. All of the above indicates that the program should be under the executive control of a national or joint organization that has an international growth potential.

H. Recommendations

(1) It is recommended that the DOD recommend to the NSC that executive responsibility for general guidance, operational plans and policies, and establishment of operational priority, in both the civilian and military applications of SAMOS, be placed either under the NSC or under an existing DOD office such as Office Secretary of Defense, Office of Special Operations.

(2) The USAF be given the task of

(a) managing the R&D program.

(b) operating the military part of the operational program either openly or under cover of a civilian mission.

(c) making available both the raw and the analyzed data to all US agencies designated by the Executive Office, whose

establishment is recommended under (1) above.

(3) The Executive Office, [redacted], should examine the possibility of accomplishing data reduction by a Joint Satellite Processing and Data Reduction Center, that could combine existing facilities, such as, the Satellite Tracking Center at Sunnyvale, California, The Reconnaissance Technical Squadron facilities at Westover AFB, the Lemo-Woolridge facilities at Denver, etc.

III. GENERAL - Requirements

A. Review

1. The official requirements for reconnaissance satellites have undergone a most important change in the last year. Before analysing the present (July 1960) situation, it is worth listing here for future discussion some of the interpretations presented by the USAF in official and unofficial briefings.

2. The use of satellites as warning devices was considered basic until just a few months ago. To give effective warning (assuming that this were possible), a large number of satellites (10 to 20) would be required to be in orbit at the same time, with practically instantaneous transmission of pictures required (Subsystem "g"), and accompanying large scale data handling effort on the ground. (Subsystem "I") (Ref. Annex A).

3. It is worth noting that the large expenditure in data processors is indeed correct according to the concurrency principle for a satellite reconnaissance system capable of giving warning.

4. The effect of weather, of orbit geometry, resolution, and economic factors have been forcefully emphasized by a number of technical groups and, as a consequence, the feasibility of the original scheme has been shown to be both problematic from a technical point of view, and almost impossible from an economical point of view.

5. The disappearance of the warning function as a fundamental part of the design basis is an event of recent occurrence. The necessary changes in the form of instructions by the BMD to the contractual set-up seems to have lagged the USAF accepted change in doctrine.

6. We should note here, before it is forgotten, that it is this erroneous concept that put emphasis on readout rather than recovery, that brought about a large expenditure on data processing devices, video links, digital computers and so on -- all of which may conceivably turn out to be useless.

7. Unless the change in doctrine is recognized by all responsible parties as a correction to a previous error, many of the mistakes of the past will be compounded rather than eliminated.

8. Another error, still present in the Project system, relates to the lack of proper dissemination of Project information. In the early parts of the program, a determined and unwarranted effort was made to reduce the flow of information on SAMOS to the intelligence community [illegible] improper use of the need-to-know security rules. The situation has improved, but insufficient appreciation is [illegible] given to the fact that SAMOS is a national rather than an Air Force project. The USAF, [illegible], owes to all interested intelligence agencies periodic and candid reports on its intentions, plans and achievements. As stated heretofore, the SAMOS capabilities go far beyond merely providing intelligence information; and this fact contributes further to the responsibility of the Air Force towards meeting information needs other than its own intelligence requirements.

B. The USIB July 1960 Document

On July 5, 1960, the USIB re-affirmed the requirements for SAMOS. An analysis of the document brings out the following facts:

(1) The requirement for satellite reconnaissance is important and continuous.

(2) No warning capability is expected; rather repeat coverage with intervals of one to six months if required, some targets may need to be re-examined at closer intervals.

(3) Optical resolutions (Subsystem "g") at 20, 5, 1 feet are required to be acceptable.

(4) Very flexible [illegible] devices (Subsystem "p") are desired with emphasis on R&D. The only detailed target requirements given at this time are

those calling for identification, localization and analysis of key electronic emitters used in anti-ballistic defense, missile telemetry and satellite links.

(5) From a visual or optical satellite two capabilities are needed. Paraphrasing the USIB notes, the following appear necessary:

(a) A quick solution of the surveillance problem is needed before 1962 to find missile bases under construction.

(b) A continuous operational capability aimed at the high priority targets, and both continuous surveillance and a directed reconnaissance (when the weather is suitable) are needed.

(6) ELINT collection (Subsystem "F") is not clearly wanted until better data are avilable on the capabilities of the system.

C. There will be a continuing requirement for photographic and ELINT coverage. As the state of the art permits and as the accuracy, types and numbers of weapons systems increase, the accuracies and detail required in the end products will become increasingly greater. ~~It is felt that this fact is now evident in the present program and is not provided for in existing technical development programs.~~ 2

[redacted]

[illegible] water suppression, [illegible]

[illegible] detection range [illegible]

resolution, all [illegible]

[illegible]

R&D program [illegible]

to obtain visual information [illegible] program with the [illegible] intelligence value.

U. The following sections of the report will be aimed at obtaining these results. In this introductory [illegible] concluded that the program suffers from original conceptual error and that this report is attempting to make maximum use of results already obtained.

V. [illegible] early [illegible] are [illegible] the means for achieving [illegible]. There is a chance that additional types of payload may become available by the end of 1961, but this is not considered as [illegible] as the [illegible] which is recommended here.

X. It is fundamental to [illegible] solved at all [illegible] it is felt that a solution can be [illegible] to meeting the R&D requirement for detection of [illegible]

F. The photographic readout aspects of the program appear to have been based on unrealistic warning capabilities and the claims pertaining to system capabilities were exaggerated. However readout is undoubtedly satisfactory for all the F applications excepting perhaps some advanced video recording capabilities.

G. Other problem areas in the readout system requiring technical studies to obtain the proper answers are:

(1) The "start-up" problem after computer failure and after down time for normal maintenance, particularly if a number of satellites are used simultaneously.

(2) The accuracy of the tracking information to properly program the camera. Specific problem areas are camera orientation, focusing, exposure control, image motion compensation, and camera on-off times.

(3) The possibility of jamming and the effects of a high density electronic environment (Vandenberg T & A station) on the quality of the transmitted picture.

(4) The possibility of intercept of a continuously orbiting reconnaissance vehicle and the restraining effects of a strong diplomatic protest.

V. GENERAL - Recovery

A. In contrast to assertions of last year that Discoverer recoveries were either "on hand or on order" it is necessary to conclude that the recovery efforts up to now have failed completely. Accordingly it is proposed that simplified payloads launchable by abundant and presumably reliable THOR vehicles be promptly devised for prolific studies of object recovery from orbits in space.

B. These experiments should involve both land and water recoveries. They ought to be characterised by simple but reasonably precise instrumentation to determine the physics and mechanics of the separate stages of recovery. Thus, for instance, deorbiting behavior should be clearly distinguished from pre-entry and re-entry activity. Without extensive technical information like this, orderly and continuous recovery of a useful product cannot seriously be anticipated.

C. We believe that one of the fundamental reasons why recovery has not been successful up to now, and if successful, unlikely to be continuously successful, is the process through which the Air Force has gone in achieving the desired result. We believe that the allotment for the blame cannot be easily made to one contractor or contracting agency. We do believe, however, that over and over, the influence on the research and development recovery program introduced by the necessity for some kind of useable take, has blocked the technical progress of the main contractor.

D. It is felt that the present prime contract responsibility is being well borne technically. However, the R & D demands are so urgent that additional assistance, probably on a test and engineering scale, is necessary. In this way such critical issues as parachute and other re-entry facilities can be developed without unbalanced effects on the development of the payload itself. It is felt that a contract situation must be created where the solution of re-entry problems is reasonably decoupled from modifications in the payload. For instance, the design

changes introduced four times in five weeks in parachute improvements appear to be mixed up with other problems of signalling retro-rocket activity, position control, and so forth; while there are inevitable connections among all these, critical stages must be separated. The rather subtle point is that technical development experience shows that components of a system invariably suffer in quality when they are developed in the system. Only after independent recovery components, including parachutes or other slow-down mechanisms, have succeeded should they be coupled into a specific SAMOS function. This situation would of course be different if anyone had ever recovered anything. As it is, the present regime resembles efforts to develop Faraday's capacitor for the first time during the construction of an all-electronic computer.

V WEATHER

A. Bad weather and darkness negate the possibility of obtaining photographic coverage utilizing either readout or recovery systems. As pertains to darkness the time of year and the latitude will determine when photographic coverage can be obtained. As pertains to weather the studies that have been conducted were based on statistical averages and can only be used for long range planning purposes. Based on these studies any conclusions made relative to the amount of coverage or the length of time to obtain total or specific area coverage under actual operational conditions are invalid. Weather is continually changing and there is no assurance that a continuously orbiting satellite will be in the right place at the right time. Large areas free of clouds, haze, and smoke occur infrequently (once or twice a month dependent on the season of the year), and persist for relatively short periods of time (approximately two to three days). The SAMOS readout system is not capable of fully exploiting large cloud free areas because of its narrow swath and because of its readout limitations. A recoverable panoramic package launched at the proper time and recovered at the end of 48 or 72 hours could fully exploit the good weather area. In addition, studies have indicated that a 70-mm panoramic camera recovered in 24 hours will show a gain of coverage of 6 to 18 times over the E-2 system, operating for the same length of time, because of readout limitations. In terms of information content the gain is between 260 and 850 depending on the width of the film used. In the case of areas that are cloud free only one or two days a year, the advantages of one recoverable package launched at the appropriate time as compared to a number of continuously orbiting readout packages are apparent. On the other hand, the loss of coverage during cloud free areas may result in a delay of months before the opportunity would exist again.

B. A comparison of the effects of weather and the number of days required to obtain coverage using various types of orbits and different swath widths is shown in Annex F.

VII. A. GENERAL PHOTOGRAPHIC

1. The spectacular publicity given to the SAMOS program, and the exaggerated claims as to capabilities have seriously jeopardized the utility of the system. ~~If this trend is allowed to continue, it may generate threats against the launching site, implicit or explicit. The resulting diplomatic restraints might prohibit satellite reconnaissance operations temporarily for long periods of time or permanently if the proper precautions are not taken.~~ It is strongly recommended that in the future all publicity releases be rigidly controlled.

2. Future studies and programs should consider the dispersal of launching sites, mobile launching sites and Polaris type launchings.

3. Education of the public, releases concerning program status on a delayed and pre-planned basis as well as releases concerning the current state of the art must be; thoroughly studied, agreed to and understood by appropriate Department of Defense and Department of State officials. The resulting plan must be approved at the Executive level and strictly adhered to by all lower echelons.

4. A problem of long standing and considered appropriate to the SAMOS program, particularly as pertains to the E-5, is: Design the configuration of the vehicle to accommodate the primary mission capability or design the primary mission capability to fit the vehicle, regardless of compromises.

5. It is felt that too much emphasis has been given to the capsule requirement and not enough to the payload requirement. As payloads become more sophisticated in order to meet the USIB requirements, the above problem if not resolved in favor of the primary mission

capability, may prevent or delay mission accomplishment.

6. Any follow-on or back-up program to the E-5 should represent significant improvements in coverage, resolution or scale, and be ready for R&D testing in mid CY-1961.

7. A continuous worry in the analysis of SAMOS has been the effect that the clamor for early intelligence take has had on the orderly conduct of the program. With a multitude of new techniques required, the interference with the research and development has had serious effects; specifically, the difference between research and development concepts and an operational concepts. Examples: Consider the case of an E1 payload sent in orbit for the first time. From the point of view of research and development this is a major stepping stone and information to be obtained from it is of the utmost importance. From the point of view of intelligence the 100' resolution is insufficient to make the results of particular significance. For this reason, one could state that 95% of the usefulness of the mission would be acquired if the lens and film of the camera were subjected to a winking light and did not view the terrain. In fact, the first E1 satellite will carry film exposed and developed, film exposed but not developed, and film to be exposed. Information obtained by the readout system on these films represents more than 90% of the information required from the research and development point of view. The fact that one could also look on the outside and get some incidental intelligence from the terrain below, appears to a research development minded organization an interesting but not overly important by-product of an outstanding R&D achievement.

VII. B. E-1 SYSTEM

1. The E-1 is a strip camera with a 6" focal length lens designed to operate at 260 statute miles. With the 70 mm format and 100 ll/mm AWAR (Av. weighted area resolution) it is reasonable to expect a basic ground resolution of 100'. To realize this 100' the IMC must be within 5% because of the long exposure time of 1/25 second. Since the orbit will be elliptical, this point should be studied carefully.

2. The E-1 system is less complex and much more workable than the E-2 system. Its design makes it a coverage tool (100 mi. wide strip). It is felt that it has limited "seeing" capability since after readout the recognition of objects will optimistically be limited to 300'. Strip cameras are not useful for mapping but approximate measurements of small objects detected are possible. Barring weather considerations, this satellite could cover Russia in about ten days. This is not a very meaningful statement, but weather and darkness play vitally important roles.

3. The quantitative aspects of the readout problem are not as critical in the E-1 as in the E-2 system. The qualitative aspects in terms of degradation due to transmission, reproduction, and system complexity (reliability) are the same as for the E-2.

4. There is an R&D advantage or carry-over value from E-1 onto E-2 in that the image formation, in-flight processing, scanning, transmission, etc., are the same. The degree of success of the E-1 program will define better than any other system study the final destiny of readout programs.

5. The questionable resolution of the end results obtained from this system and the great need for reconnaissance-intelligence information from satellite vehicles for evaluation purposes and future R&D guidance are considered to be the major problem areas.