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U.S. AIR FORCE
Project RAND

RECOMMENDATION

TO THE AIR STAFF

AN EARLIER RECONNAISSANCE SATELLITE SYSTEM (S)

12 NOVEMBER 1957

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Deputy Chief of Staff, Development
Headquarters, United States Air Force
Washington 25, D. C.

SUBJECT: AN EARLIER RECONNAISSANCE SATELLITE SYSTEM

In the light of recent events, RAND has reviewed national and military intelligence problems, existing and proposed reconnaissance systems, and in particular, the current USAF satellite reconnaissance program (WS 117L). As a result of certain technical and conceptual breakthroughs, it is concluded that efficient satellite reconnaissance systems of considerable military worth can be obtained earlier and more easily than those envisioned in the current 117L program.

The systems proposed in this recommendation differ substantially from the current 117L system concept.

- The proposed systems use a spin-stabilized payload stage.
- They use a transverse panoramic camera of essentially conventional design, fixed to spin with the final stage, which scans across the line of flight.
- Either the entire payload or the film is recovered.

The first of the proposed systems uses a 12-inch camera, carrying 500 feet of 5-inch wide film. The extremely short exposure time--1/4000 sec--eliminates the need of attaining a precise altitude, exact image speed synchronization, difficult performance characteristics, and related problems. It will provide sharp photographs of about 60-ft ground resolution. Each exposure, covering some 300 miles across the line of flight, will photograph some 18,000 sq mi. The 500-ft roll will cover some 4,000,000 sq mi (almost half the S.U.) and show major targets, airfields, lines of communication, and urban and industrial areas. This satellite could weigh about 300 lb and be placed in a polar orbit at 180 ± 35 miles altitude by a combination of rockets such as Thor plus second stage Vanguard plus a third stage small solid rocket similar to the Vanguard's third stage. A one-day operation is envisaged, with recovery by command firing of a braking rocket on the 16th pass, so as to impact in a predictable ocean area.

The next, more sophisticated, system would use a 36-inch camera, carry much more film, do more detailed reconnaissance--with a ground resolution of about 20 feet. This system can possibly be Thor boosted.

A third system--undoubtedly requiring Atlas-type boosting--would use a 120-inch camera and would have very large film capacity. This system will be able to accomplish very high quality photo reconnaissance and, most important, will do it better than any Air Force system now in development or in prospect will be able to do in the 1960's.

The earliest and simplest of the several systems will collect at least as much information in its one-day operation as the "early" 117L vehicle will in its useful life.

Because of our belief that the first system could be available about a year from start of work, the second in less than two years, and the third in about three years, we recommend that the U. S. Air Force begin work immediately to accomplish this program.

Success of this type of system should result in refocus of the present components of the 117L program to those tasks requiring the communication link and cyclic talk-back facility of 117L--warning, and daily surveillance of selected targets, being the principal high priority tasks requiring such an operation. Thus this new family of satellites and the type of satellite at present scheduled under 117L program would be mutually complementary and not competitive.

Descriptive diagrams and more detailed discussion of the proposed system are contained in the attached appendix. A RAND Research Memorandum, RM-2012, is also available.

RAND is actively engaged in further and more detailed studies supporting these proposals and will help in every way possible with the fulfillment of these objectives.

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AN EARLY RECONNAISSANCE SATELLITE SYSTEM

This appendix describes a reconnaissance satellite system that would be relatively simple in operation, would be available quickly as compared with the current 117L program, and would serve an extremely useful military purpose. The system would use a camera of essentially conventional design in a relatively unsophisticated orbiting vehicle. A launching date about one year from the date of contract is contemplated. The system will produce pictures of a scale and resolution that will yield valuable intelligence information about large areas of the Soviet Union.

1. RECONNAISSANCE: NEEDS AND MEANS

The need for better military intelligence on the USSR is acknowledged and aerial photographic reconnaissance is certainly a preferred means. For one thing, the area occupied by the Soviet Union and its political satellites is very large and, for the most part, inaccessible except by overflight. Secondly, in the immediate future it will be vital for us to know a great deal about the patterns of use, installation, and concealment of Soviet ICBM's. Finally, it is essential that we have detailed information from time to time on aircraft-missile phasing in the Soviet Union. We must know the character and composition of these major threats to our lives and security.

In describing airborne photographic reconnaissance systems, it is convenient, by way of developing an operational concept, to think in terms of four levels of reconnaissance: A, B, C, and D.

Level A provides large-area search, measured in millions of square miles. Level B is limited-area search, measured in hundreds of thousands of square miles. Level C, specific-point-objective photography, is measured in hundreds of square miles. And Level D, technical-intelligence-objective photography, provides coverage in blocks tens of square miles or less in size.

The reconnaissance satellite system proposed permits us to progress systematically from Level A toward Level D in a series of system improvements. It will first enable us to cover millions of square miles of the Soviet Union giving us photographs of such a scale and resolution that significant intelligence information can be obtained. Such missions can be repeated from time to time to reveal new developments in the Soviet posture. Reconnaissance at Level A will also be valuable in providing information on where to conduct more detailed reconnaissance. While the system will not provide us with warning intelligence, it will help us estimate Soviet capabilities and identify certain kinds of major targets.

2. THE CAMERA

The camera proposed for this system is a transverse panoramic camera containing a 12 in. focal length, highly corrected f/3.5 lens which covers a fairly narrow angle of approximately 20 degrees. Wide-angle scanning is accomplished by the expedient of moving the lens across the field during the exposure time.

For transverse scanning of the ground from a satellite, the camera must rotate around the longitudinal axis of the vehicle. For this application it is proposed to rotate the entire payload stage with the camera firmly attached, thus generating a sweep across the line of flight.