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1 October 1965

MEMORANDUM FOR: Mr. William A. Tidwell

SUBJECT : Use of KH-4 to Photograph Orbiting Satellites

1. There are two problems to be solved in investigating the use of the KH-4 to photograph orbiting satellites -- the first, how to get the target object into the field of view of the KH-4 camera and, second, an estimation of the likely product which might be obtained.

2. The field of view, at the ground 100 NM below, of the KH-4 24 in. focal main camera is about 10 miles along track and 140 miles across track. Two possible situations will be looked at -- the case where the KH-4 orbit and the target orbit are nearly coplanar, and the second where the tracks cross at near right angles. For simplicity, circular orbits are assumed for both vehicles, even though this probably is more optimum than for eccentric orbits. The KH-4 orbit will be assumed to be higher than the target by 10, 20 and 40 NM. For the near coplanar case, the following table applies:

Δ A (NM)	10	20	40
Along Track Field (NM)	1	2	4
Cross Track Field of View (NM)	14	28	56
Time in Along Track Field of View (sec)	6	6	6
NM Gain of Target/Rev	40	80	160
IMC Uncorrected (ft/sec)	1500	3000	6000
Expected Resolution (ft)	2	3.5	7

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For the case where the orbit planes are 90° apart, the following table applies:

Δ A (NM)	10	20	40
Along Track Field (NM)	14	28	56
Cross Track Field of View (NM)	1	2	4
Time in Along Track Field of View (sec)	3.5	7	14
IMC Uncorrected (ft/sec)	25000	25000	25000
Expected Resolution (ft)	25	25	25

3. The launch requirements can be summarized as follows:

Angle Between Orbit Planes	# of Consecutive Revs in Field of View	Launch Window Length (sec) (for at least 1 look)		
		Δ A = 10	Δ A = 20	Δ A = 30
0	All			
5	7	40	42	45
10	4	20	21	23
15	2	13	16	18
20	1	10	12	16
90	1	3.5	7	14

4. Experience has shown that there is no problem in achieving an orbital plane within a degree or two of desired and that specified orbit altitudes can be achieved within 1-5 NM. This then would imply a launch window duration something like a minute up to five minutes if coplanar orbits are attempted. Both 65° or 51° angle of inclination are obtainable with U. S. satellites although with some payload penalty for PMR launches. Penalties in subsequent ground area coverage are related to the geography of the U.S.S.R., the loss of potential coverage being the areas north of the latitude corresponding to the particular angle of inclination. For occasional missions, this penalty might be acceptable. Since most Soviet

satellites are over the northern middle latitudes during good illumination periods, and that is also the case for U. S. satellites, the illumination problem should not have unacceptable solutions.

5. In summary, it might be estimated that if a launch window of about five minutes could be obtained, pictures of a Soviet on-orbit satellite could be obtained from a KH-4 to a resolution of a few feet. It should be added that every time the KH-4 camera is turned on, an appreciable fraction of its film is expended. An orbiting satellite might be photographed when ground intelligence was collectable also. Finally, the limited on-orbit camera control flexibility of KH-4 might result in several, if not many, attempts being necessary before success. Ultimately the purpose and value of the photograph should be considered. As a trick it may be great; the substantive intelligence value may be considerably less. It must be obvious that this cursory examination is insufficient. A detailed plan would be needed, both refining these rough calculations and including eccentricity, before the feasibility, chance of success, etc. can be firmly established.

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Chief, Systems Analysis Staff

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