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15 November 1967

MEMORANDUM FOR: Assistant Deputy Director for Intelligence

THROUGH : Deputy Director for Science and Technology

SUBJECT : Comparison of the KH-4 and KH-4B Systems

1. This memorandum is for your information and is responsive to a request we received in your behalf from [redacted] We will attempt in the ensuing paragraphs to lay out the major advantages which the KH-4B system will realize over the present KH-4.

2. The major deficiency in the KH-4 panoramic camera system existed because of the oscillating members of the system, and the relationship of the transport system and focal plane. A failure mode known as rail pullout existed, particularly when the camera was cycled at high speed. (Two such failures have been experienced in flight in the past two years.) Because of this potential failure, a limiter is placed internal to the cameras which results in a mismatch of Image Motion Compensation (IMC) when the camera is flown on orbit below the altitude of 97 n. m.

3. One KH-4 mission (Mission 1006) was accidentally flown at a minimum altitude of 87 n. m. as a result of a perigee dispersion. Perigee on this mission was also dispersed northward to 60°N with the result that the scale of the Soviet photography was considerably greater than normal. Goddard's "First Law of Photo Reconnaissance" held true, and although IMC mismatches as great as 20 percent were experienced, and though the photographic resolution was appropriately degraded, the scale differential was so noticeable that Mission 1006 received the highest Mission Intelligence Potential (MIP) rating of any ever given by NPIC to a KH-4 system.

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4. The primary goal of the KH-4B camera redesign was to remove the rail pullout failure mode, thereby allowing for camera operation at lower altitudes, improving both the photographic scale and ground resolution as a result. An additional benefit of the improved KH-4B design achieved by removing the failure mode was a capability of handling Ultra Thin Base (UTB) film on the system. UTB provides a 50 percent increase in photographic coverage without an increase in film weight and without a requirement for redesign of the basic Space Recovery Vehicle (SRV). (Operating from present KH-4 altitude)

5. The KH-4B camera redesign did not involve a focal length change (24") and the Petzval high resolution lens has been retained. A modification to the lens central wavelength was instituted, however, on the forward cameras for the fourth and subsequent flight systems. A performance improvement is realized in this manner with the lens providing an increased resolution of approximately 20 percent. On Mission 1104 and subsequent missions, ground resolutions of approximately six feet at nadir can be expected as the norm when the system is flown at its design altitude of 80 n. m. (minimum altitude is 75 n. m.). The intelligence value of the projected improvement from ten feet to six feet in ground resolution between the KH-4 and KH-4B has not been assessed, however, it is clear that a number of military targets fall in this range. The improved scale of 20 percent should also add measurably to our intelligence information.

6. Two other serious limitations of the KH-4 system in terms of its flexibility as an intelligence system were the use of a single fixed exposure level (slit) and a single fixed filter. The single slit caused a compromise of exposure over the mission life, as well as over each individual revolution. The single slit also prevents optimization of photography for the intelligence desired on a particular high priority target.

7. Perhaps even more restrictive from the standpoint of the intelligence researcher was the limitation of a single filter. Certain elements of the intelligence community had expressed interest in multi-spectral photography with black and white films, color photography, infrared photography, night photography, et cetera. The single filter of

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the KH-4 dictated that only one film be used on each camera throughout the mission, and necessitated that photography be taken identically for all targets and that repeat coverages of a single target be the same photographically. Although it theoretically should have been feasible to vary the type of photography over a period of several years and thus increase the base of knowledge, the cost of each mission and the complexity of the requirements network dictated against it. Armed with the capability of multi-spectral photography the research analyst will have at his command the ability to vary and complement his data base now obtained only in black and white.

8. The KH-4B system provides the research analyst with a new capability in satellite photography. By having incorporated an inflight filter change capability, the KH-4B camera can handle both multiband black and white requirements and multiple film types. Since the KH-4B handles the special requirements on a selective basis without interfering with the remainder of the mission, the special requirements can now be processed expeditiously through the existing requirements channels.

9. The basic KH-4 system utilizes a stellar index camera for altitude reference and correlation in mensuration and photogrammetry. In the KH-4 a single stellar camera is used with a 1 - 1/2" focal length frame or index camera. The single stellar camera imposes a severe operational restriction on the system in that the launch window is defined by the period of good stellar coverage.

10. In the KH-4B a dual stellar index camera is used which removes the launch window restriction. Coverage of target areas can be planned to optimize weather or activity in the area. The new stellar index camera provides a three-inch focal length index lens which improves system capabilities for mapping. The SI camera also provides sufficient film for an independent mapping capability adding to the cost effectiveness of the flights.

11. A test program related to the KH-4B capabilities has been carried out by the DD/S&T/OSP and a series of reports have

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been produced at the [redacted] level and distributed throughout the community. Recently, OSP presented a summary briefing on the program to the requirements officers from DD/S&T and DDI, and OSP is working with these personnel to test the KH-4B capabilities against actual priority intelligence problems. We appreciate the support of the DDI in this ongoing analysis of the KH-4B capabilities.

/s/ John N. McMahon
JOHN N. McMAHON
Acting Director of Special Projects

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OSP [redacted] JNMcMahon [redacted] (15 Nov 67)

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