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MEMORANDUM FOR: Deputy Director for Science and Technology

SUBJECT : Comments on D/NRO Issue Paper for 23 April 1971 ExCom

REFERENCE : BYE-12754-71, dtd 20 April 1971

1. This memorandum attempts to identify and comment on the most critical errors in the reference document.

2. The D/NRO reduces the Interim System issue to the question of whether or not [redacted] or FROG should be developed to provide an interim capability. The other options which have been proposed are set aside for a range of reasons all the way from performance to cost and schedule. Both [redacted] and FROG, however, do represent very expensive programs with relatively long schedules and relatively high development risks. The D/NRO seems to have identified these as the desirable options based largely on their expected coverage and quality performance.

3. [redacted]

[redacted]

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we know nothing SAFSP has done, speaks intelligently to these trades. Therefore, no firm decision to proceed with should be made until a careful consideration of design requirements has been made.

4. FROG

Both the summary and subsequent more detailed sections on FROG are characterized by some serious misconceptions of both the FROG capability and the engineering realities. The paper states that the FROG option as an interim system has an additional appeal of also meeting the more general near real time readout requirements. The direct statement is made that two FROGS at a 170 n. mi. orbit are, from a performance standpoint, equivalent to the EOI system. In fact, two FROGS in this orbit not only have half the total target capacity of the EOI system, but also are characterized by an image quality distribution poorer than the EOI system. The best FROG image quality would be 22" GRD while the best EOI image quality would be The worst FROG quality for daily access is 5 ft.; the worst EOI quality for daily access is 26". Therefore, almost all of the EOI imagery on all targets will be better than the best FROG imagery achievable only for a few targets. The maximum FROG capacity is 400 images per day. The maximum EOI system capacity is 800 images per day. In addition, of course, there are basic image quality advantages of the solid state array type of transducer as opposed to silver halide film processed on orbit and read out with a scanner.

Another major misconception is the statement that the FROG option has the additional desirable attribute of providing growth to a VHR capability. This, of course, is ridiculous. Any VHR system providing anything better than the GAMBIT-3 quality is clearly a new development which bears no relation whatsoever to the FROG program.

A third area of concern is the apparent assumption that FROG is a simple modification to the GAMBIT-3 system. In fact,

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a careful review shows that all electronic subsystems are changed or modified in a major way without exception. The optics and the stereo mirror are the only common features between FROG and GAMBIT-3. This includes all of the film handling equipment in that the FROG film path consists of two separate 3" widths of film as opposed to one single 9" width of film. Under any circumstances, the problems of taking a system qualified for 27 days like GAMBIT-3 now is and extending it to one year cannot be categorized as simple changes to an existing system.

It is apparent that the coverage performance capability of FROG is at best a confused picture. The specific tasks that FROG might be called on to perform are always discussed separately, and the interaction with this capability with other tasks is not treated. For example, area coverage capability is quoted as being high without measuring the impact on film expenditure or on readout time. Pitch vagility is important to some missions described although FROG is limited to 40 pitch maneuvers per satellite. The impact of this limitation on performance is not discussed. FROG's ability to drop to low altitudes for higher resolution coverage is advertised without a careful consideration of the penalty on total mission duration of dropping to lower altitudes and then using propellant to maintain that lower altitude for unspecified periods of time. Changing the orbit to lower altitudes and to one day synchronous over specified targets, however, impacts both on ability for pitch maneuvers and on mission duration. The lower perigee altitude coupled with one day repeat orbits can lead to substantial reductions in readout time. All the factors need to be carefully weighed and their interaction established.

SAFSP has also suggested that with three FROG launches per year, two GAMBIT-3 launches would be sufficient to meet the total requirement. This can be done by flying FROG at 85 n.mi. altitude for some period of time after each launch, thereby collecting some high resolution material. It should be noted that the image quality of FROG at 85 miles with film processing on orbit and readout is not as good as GAMBIT-3 operating at 70 miles and recovering the film. In addition, the 3 x 3" frame size characteristic of FROG at a higher

altitude is proportionately reduced at the lower altitude to a 1 1/2 n.mi. x 1 1/2 n.mi. frame on the ground. This would certainly be an unacceptable frame size considering ephemerous errors and point errors. Therefore, both 3" webs would have to be driven simultaneously and the frame length doubled to 6". This leads to four times the film area to scan out per target which sequentially raises the question of constipation ala the [redacted] difficulty. Even with a 6" x 6" effective frame size per target, FROG at the lower altitude is not equivalent to GAMBIT with its 9" frame width and nominal 12" to 18" frame length.

The referenced paper alludes to potential cost savings per GAMBIT-3 and FROG vehicle. Because they are identical systems; and when more systems are procured, the cost per system goes down; a cost advantage is projected. This simple arithmetic is not sufficient to come to the stated conclusion. FROG and GAMBIT-3 are in fact very different and, except for the optical subsystem, bear little resemblance at the subsystem level. On the other hand, since both Eastman Kodak and Lockheed would be working FROG as well as GAMBIT-3, it is possible that a combination of those two programs might reduce the engineering overhead per vehicle.

The costs presented for FROG are not comparable to the costs presented later in the paper for EOI. Specifically, the FROG costs are not escalated at the 4% per year rate as are the EOI costs. Nor is money added to the total FROG program against potential engineering changes.

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