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ITEK CORPORATION, 10 MAGUIRE ROAD

LEXINGTON, MASSACHUSETTS

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Dear [redacted]

We would like to review with you some thinking we have done and some activity now in progress, in connection with the M search system.

It seems likely that the next generation satellite search system will be of such complexity and sophistication that it will not be operationally reliable and ready to replace the M system until the end of this decade. Meanwhile the M system, though performing with great reliability and substantially better ground resolution than it was designed for, has not been modified in any significant way since it was designed in 1960. We believe serious consideration should be given to an improvement program which will exploit more fully the performance potential of the M system without reducing its high reliability; and we believe such a program can be accomplished at relatively modest cost and on a schedule which is quite short compared to the development schedule of a wholly new search system.

We are fortunate in having available a team of highly competent engineers, many of whom have had firsthand experience with the M system, and all of whom have worked together on a similar task involving intensive analysis of the kind which bears directly on the problem of improving the M system. This team is currently actively engaged in a detailed analysis of the M camera and vehicle, with particular emphasis on the establishment of an error budget and the development of a prediction of performance capability. The goal of this study, which is presently supported by Company R & D funds, is to uncover sources of performance degradation; rank these error-generators in order of importance; and develop a spectrum of proposed system improvements to neutralize them. To attempt to list all possible error sources here in quantitative ranking would be to pre-empt the results of the study; but it is nevertheless possible to indicate in general terms some of the more obvious approaches that may be taken to improve the flight performance of the system.

A modification which has been under consideration for some time involves the elimination of the oscillatory scan arm and drum in favor of a continuously rotating drum. This change would require expansion of the present flight vehicle diameter to 60 inches. This would only

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involve moving the camera section in the Agena from its present position in the forward tapered section to a central section where the vehicle diameter is 60". Thus no major vehicle change is involved. (This has already been engineered and flown for the L camera.)

This change would eliminate the lens-drum interlock mechanism which is a potential source of camera vibration. The two heavy momentum balance wheels could be eliminated, and the two cameras synchronized in opposing directions. The net dynamic reaction on the vehicle would be very significantly reduced, and as a result the vehicle roll rate should drop.

Furthermore, the elimination of the oscillating members would allow faster camera cycling, permitting photographic operation at altitudes of 70 or 80 miles.

If at the same time a mechanism were incorporated for compensating the cross-track image motion, we believe the two largest camera-centered sources of performance degradation will have been removed.

We would further reduce image blur by introducing a device for varying exposure, so that the camera could at all sun angles operate with the shortest possible exposure time. This exposure control could be responsive to a simple on-board exposure meter, or it could be driven by the existing vehicle programmer.

If the vehicle stabilization system, relieved of the interdynamic disturbances it presently receives from the camera, were adjusted to exploit the improved capability of the camera (and we understand that the present Agena stabilization system already has this potential), we estimate that the present performance, assumed here to be 10' ground resolution from 115 n. miles, might be improved to be 6 or 7 feet. This would be an improvement of 30 to 40 percent in linear resolution over present performance, regardless of how it is computed.

The modification package described above could be accomplished for approximately [redacted], and could put an improved system in operation in 18 months or less. The costs of the equipment would also go up from the present [redacted] per unit by about [redacted]

With a somewhat longer time scale (but still considerably less than for a second-generation system) we can consider optical modifications. A relatively simple improvement involves the addition of one element and some redesign of the other elements to enable the lens to cover 5-inch film. This would cut the cycling speed of the camera in half and produce a more desirable format for intelligence users.

A more major optical improvement would be to increase the relative aperture from its present 3.5 to say 2.8. The advantages of making this change are two fold and fairly dramatic: the potential lens-film resolution increased by a further 20%; and the exposure time (and thus image blur) for a given sun angle is halved. The further overall camera improvement resulting from this last modification would be in the order of an additional 33%. (The 7' resolution projected above could thus be further improved to about 5'.) We are not yet prepared to estimate the time required to effect this change, nor the impact on system weight.

At the present time our capabilities are test-equipment limited and we will need additional test facilities costing in the order of [redacted]

As our study progresses and our quantitative grasp on these problems improves, we would appreciate the opportunity to review the results with you.

Sincerely,

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