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20 Aug 1959

[redacted]

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MEMORANDUM FOR THE RECORD

ATTENTION : [redacted]

SUBJECT : PIC Evaluation of Project ARGON

1. I feel that it is necessary to qualify the PIC evaluation by including a preamble to the effect that PIC's acquaintance with project ARGON dates only from 7 August 1959. Though we realize that the scope of the project is very similar to that of the defunct VEDAS project with which we were associated several months ago, there have been many documents prepared, many verbal agreements noted, and various technical specifications agreed upon during the intervening period. On the 7th of August we were invited by [redacted] to provide technical representation and advice at a meeting with ARPA and [redacted] personnel, substituting for [redacted] Apparently [redacted] had been in touch with the project during the several months prior to this date. Because of this short acquaintance with the project and the many technical details involved, coupled with the urgency to provide objective technical advice to Mr. Bissell on the 21st of August, it is felt necessary to state these facts so that PIC's evaluation of the project can be viewed with these restrictions.

2. The first task seemed to be the separation of the project into logical parts for study. Subsequent information has indicated that the primary portion needing detailed evaluation was the [redacted] participation, and fortunately this was the part which falls mainly within the scope of PIC responsibility and technical capability. However, the early meetings were heavily involved with detailed specifications concerning the camera product. It is emphasized, at this point, that the specifics concurred in by PIC representatives were considered only in the light of film product specifications at the direct request of [redacted] and [redacted] so that they would not be limiting in definition with respect to a specific camera system. It was very plainly stated that the decision for a specific camera had not yet been made and that no camera design was to be excluded because of the product specifications. It was very obvious from the beginning that the specifications drawn up for film product to be sent to Mr. Plummer had been aimed at the 3-inch focal length camera utilizing a recent Baker-developed lens. There was some amount of discussion concerning the possible use of a 6-inch camera and the main rebuttal presented by ARPA and ANS representatives seemed to me to hinge upon the necessity to meet a particular firing schedule as apparently agreed upon

SECRET

for the 1960 season. It was felt, however, that the 6-inch package did not provide any particular advantage over the 3-inch package, and considerable re-work of associated components would have been necessary had this been accepted or agreed upon. The specifications for the film product as finally drawn and concurred in by CIA participants have been relayed to Mr. Plummer. An evaluation of these specifications indicates that none is impossible at the state of present day technology and if all are met by any reliable precision camera manufacturer, they will provide the basic input of sufficient quality to ultimately produce the desired end product from the project.

3. It must be assumed that several broader considerations have been accepted before it can be deemed possible to evaluate the [redacted] participation. The first assumption, of course, is that the program is needed. The second assumption must be that the program is needed within the time scale as set forth previously. The third assumption must be that the project is being designed to accomplishe primarily a single purpose, that being the establishment of a new world reference geoid and that it is not being confused with intelligence collection.

4. Proceeding on the basis of these assumptions, it follows that a critical evaluation, within the limited time available, of the [redacted] portion of the project is necessary. The evaluation that follows is general in nature but is substantiated by a detailed analysis, and was made without the benefit until this date of an opportunity to see the technical proposal by the [redacted] in which are stated some of the details of their program. Several aspects of the [redacted] are being pursued by them in parallel. They are not being worked, obsiously at this point, under ARGON sponsorship, but in pursuit of the satisfaction of an Air Force contract "Quick Check" which I believe is otherwise known as Monticello II. Several of the techniques and procedures and part of the equipment being developed under the "Quick Check" program are applicable, with not too significant modification, to the ARGON program. It should be stated here that those items of equipment and procedures to which I have been exposed at the [redacted] facilities during the past few days were the "Quick Check" items. Apparently, the only direct effort specifically directed toward the ARGON program has consisted of proposal preparation and a rather extensive photogrammetric analysis and equation derivation associated with photographic as well as orbital calculations.

a. An explanation and review of the analytical photogrammetry procedures and techniques to be used to satisfy the computer requirements of the ARGON program was made. It is, of course, a rather cursory evaluation but none of the critical analyses demonstrated were very far from orthodox

photogrammetric procedures. There are, of course, rather rigorous explicit solutions involved with orbit time, camera attitude, and calibration. The performance of these calculations upon receipt of the film product would naturally be preliminary to the statistical reduction.

b. The heart of the [redacted] approach to reducing the photo data is based upon a complicated statistical analysis by analog computation, based upon input from the photogrammetric analysis and other known data concerning specific world datums. The entire statistical reduction is of necessity based upon the assumption that all deviations from true data will be random in nature, and such fortunately seems to be the case with inputs from a satellite program. The digital inputs to the analog computer which will perform the statistical reductions will be provided from programs prepared for and executed by IBM 704 or 709 computers, based on the results of the photogrammetric and other numerical analysis. It should be stated at this point that the [redacted] proposes to construct for this sole purpose a unique analog computer of its own design to perform the iterations necessary for the statistical closure and adjustment of random distributions of data.

c. Several other operations must be in the process of work in parallel or prior to the numerical reductions. These are enumerated, not necessarily in proper sequence, with brief notes of explanation.

(1) Film Processing and Reproduction - It was stated by [redacted] personnel that they anticipated that they would, in their own facility, process and reproduce the live film negative. This seems somewhat contrary to the generally accepted notion held by many ARPA and CIA people. [redacted] However, [redacted] has reason for presenting a strong case in view of the fact that the parent organization, [redacted] processes many millions of feet of film per year. It is noted at this point that very rigid control must be exercised to preserve the inherent geometry as recorded by the stellar and terrain cameras if the result is to be as useful as desired. It is anticipated by [redacted] that the original negative film will be used only once after development to reproduce a master copy from which subsequent reproductions will be made.

(2) An analysis and measurement of the stellar pattern image exposed simultaneously with the terrain exposures must be made to determine camera orientation and to provide an assumed ground position of the camera at the time of exposure (this is the first assumption which will be introduced into the analog computer in conjunction with orbital data for comparison and successive iterations.)

(3) In order to provide the coordinate measurements from the photographic star pattern, [redacted] proposes to have developed by a sub-contractor an electronically guided star trace coordinate measuring machine [redacted]. The possible inclusion of such a measuring machine in the [redacted] data reduction system is a very encouraging note. Franck has a well-established reputation in this field, and I personally have spent many hours in his laboratory discussing with him precision measuring equipment similar to this particular item.)

(4) From the data produced by the reduction of the stellar images camera attitude is determined. The next step in the sequence would be to apply the camera orientation information thus determined into a photographic rectifier. Such a rectifier would necessarily be a high precision instrument designed especially for the product of the terrain camera of the Argon system. It should be noted here that [redacted] proposes to design and construct or have constructed such a rectifier as a part of their package. It is believed within the state of the art to manufacture such a machine. At this point in the process of reducing or correlating the photographic image data, two additional highly specialized and complex items of equipment are required. However, prototypes of each of these items have been fabricated by [redacted] within their facility under the sponsorship of the Quick Check program. Undoubtedly some modification to these items will be required to bring them to the required precision to reduce continuous tone photography as opposed to radar scope photography, for which they were designed. Both items were demonstrated during the visit to the [redacted] plant. The No. 1 item is an electronically guided fiducial registration device. The use of this machine permits rapid and quite accurate alignment of

conjugate photographic images for correlation in the second device. This item is the key to the [redacted] proposal in that it will correlate many thousands of photographic images on an overlapping pair of photos to achieve a single measurement which will be introduced for subsequent iteration, with previously noted data, in the analog computer. The [redacted] correlation device orients conjugate images on three axes, X, Y and Φ simultaneously and produces a digital count of the desired distance. Present accuracy of the image is in the range of several microns and it is expected by [redacted] people to be able to reduce this error in repeatability to even less, perhaps in the range of a single micron. This would be a desirable improvement since it would then provide more accurate data for the iteration procedure.

(5) The End Products. The ultimate product of the entire collection and reduction system is a new world reference geoid. The uses of such a datum are manifold and would represent a considerable step forward in the fields of geodesy, cartography, targeting, and intelligence. Another product of the system would be a library of photography collected by the system, available for rapid recall to all users. The suggested approach by [redacted] is that of reducing the photographic records for insertion into IBM aperture cards on which would be coded the pertinent scale, geographic coordinates, and azimuth pertaining to the particular photograph. Reasons for selection of the IBM aperture card method were given as being not conclusive but based upon the fact that [redacted] did not intend as a part of their package to construct a new data storage and retrieval system, but rather would use an existing method. Obviously, Minicard or RW Center Format could be used equally well. However, in order for [redacted] to utilize the IBM system of storage and recall it would be necessary for them to design and construct, or have constructed, a precision reduction printer, which would be a part of their proposed package.

(6) Summarizing the hardware portions of the [redacted] proposal, the following items of equipment are intended to be either constructed, purchased or supplied to [redacted]

Precision rectifier
Fiducial registration device
Stellar film coordinate reader
Analog computer
Terrain camera image automatic correlator
Precision reduction printer.

Possibly, depending upon the selection of the film processing facility, a film processor would be necessary (they mention a possible application to this task of the Houston-Fearless EH-6A processor. PIC evaluations of this processor to date have indicated that it is entirely unsuitable for use with thin base films.)

It is felt that a qualified opinion as to the validity of the [redacted] handling and data reduction can be made based on the rather rapid evaluation of the details mentioned before. There seems to be little doubt that a camera can be constructed to provide a film record which will meet the tolerance limits as previously specified. A single qualifier must be hung on this as regards the stellar portion of the camera. Never to date in my experience have I seen an exposure of star images made in the daytime. This is not to be construed as a statement that it isn't feasible. The statement is made primarily because of the fact that repeated questions about such images have been countered with statements that there is no doubt that this can be accomplished from at least a theoretical basis. I agree, but must repeat that to date from examination of amy rocket pictures I have yet to see a star image. Recognizing that these pictures were not made for this purpose, and assuming the theoretical statements to be valid, the identification, measurement, and reduction procedures to be applied to star images are sufficiently strong to provide the required data.

The [redacted] system for analysis and reduction of all photographic data is now considered. It is extremely difficult to evaluate a system of which some critical and major components are still in development. One can only extrapolate from that which is already proven and weigh this with expeie nce. However, a considered opinion at this date would indicate a good chance of success by the use of the system proposed. Geometrically and statistically at least, the techniques certainly appear feasible. On the basis of these statements I would say that the employment of such a system, though unconventional in some respe c ts, would have the capability to produce the desired end results.

It is understood that there has been considerable controversy by many knowledgeable people as to the use of the [redacted] system instead of something more "conventional." Our experience to date has been that there is in reality no conventional system for the accomplishment of this end and attempts at using so-called conventional techniques with existing photographic coverage have really, except in very limited examples, not yet proven themselves. This again must be qualified by the statement that so-called conventional systems of control extension through bridging and cantilever techniques are certainly feasible. At this point a considerable look must be taken at the indicated desired time schedules set for accomplishment. In any event the establishment of a new world reference datum will be very closely allied with the collection of a larger store of photographic coverage than presently exists. Obviously, the application of present holdings of photography to a new reference datum will be made regardless of the means by which it is accomplished and subsequent preparation of target sheets, maps, charts, etc., will follow.

[redacted]

Distribution:

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