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WASHINGTON, D.C.

FRO A-6-b

THE NRO STAFF

19 August 1968

MEMORANDUM FOR COLONEL ALLEN

SUBJECT: Trip Report 5-7 August 1968

Personnel Contacted

Colonel F. S. Buzard - SP
Capt. David Berganini - SP
[redacted] - NPIC
Mr. Roy Burks - CIA
[redacted]

PURPOSE OF TRIP

The purpose of the trip was to attend the meeting Chaired by Colonel Buzard under instructions from Dr. Flax to determine NPIC mensuration requirements which must be fulfilled by the HEXAGON system.

DISCUSSION

Colonel Buzard opened the meeting by explaining that the purpose of the conference was to arrive at the NPIC requirements for mensuration which affect the HEXAGON system design. [redacted], of NPIC, presented data which showed that the most critical requirements that affect the need for accurate camera attitude data is Target Positioning. He stated that in the past NPIC has been called on to furnish target coordinates in connection with the GAMBIT system to 960 ft. accuracy. This work had been done by using data from several missions and then averaging the result. If NPIC were to furnish this

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type of data from the HEXAGON system, they would need camera attitude data to an absolute accuracy of 3 arc minutes. This is necessary, he explained, in order that the Target Positioning can be done during first phase readout and using monoscopic techniques only. [redacted] also stated that NPIC is not currently manned or equipped to do all mensuration by stereoscopic techniques and that they therefore felt they would have to continue to work in the monoscopic mode. People from NPIC, especially [redacted] stated they did not know what their requirements would be with the HEXAGON system, but could only assume they would be similar to those currently being addressed with material from the CORONA and GAMBIT systems; therefore, they could not state firm requirements or justify their request for camera attitude to 3 arc minutes absolute accuracy.

[redacted] and Mr. Burks of CIA, repeatedly tried to present the NPIC request as a hard requirement which had to be met with the prime sensor because the SI would not be in all systems, and since NPIC had been asked to do some Target Positioning verification, this requirement would continue and has no relationship to geodetic requirements.

All agreed from the data presented that dimensional determinations accurate to 1% which is the current NPIC requirement, could be met by the automatic attitude determinations system currently proposed for the HEXAGON system which has an absolute accuracy of 24 minutes, and could be improved to about 9 minutes without the inclusion of stellar trackers. The 3 minute system would require stellar trackers if one was to avoid using data from the SI camera.

At Attachment A is the mensuration and positioning requirements paper which the SPO had hoped to reach agreement on. In view of [redacted]'s reluctance to state a firm requirement, especially for positioning, the necessary blanks in this paper were not filled in, and a more generalized paper was written. However, [redacted] reserved the right to re-work this paper in Washington.

CONCLUSIONS

It is apparent from the reticence of [redacted] to state requirements, that, at best, a very general paper may be agreed to. Much of this whole problem has come about by people in the HEXAGON SSPO trying to establish a requirement for NPIC which would allow them to incorporate stellar trackers in the main sensor subsystem.

RECOMMENDATION

In view of the lack of a firmly established requirement for NPIC to do Target Positioning (which in the past has been done almost entirely by the MC&G community) it is recommended that the proposal to include stellar trackers as a portion of the main sensor be disapproved, and that the SI system be used to provide data required for updating Target Positions or establishing positions to new targets.

William E. Williamson

WILLIAM E. WILLIAMSON
LtColonel, U.S.A.

MENSURATION AND POINTING REQUIREMENTS FOR THE HEXAGON SYSTEM

I Current NPIC Tasks

As of August 1968, NPIC is required to perform certain mensuration and position determination tasks. It is postulated that, in the operational time span for the Hexagon System, Hexagon materials will be used to support similar or expanded tasks to a similar or more stringent accuracy. The current NPIC tasks and associated requirements are as follows:

a. Determination of horizontal dimensional measurements for objects of various lengths. Of these lengths 95% are 1000 ft or less; however, some high priority length determinations are required in the 1000 to 2000 foot range.

b. Determination of vertical dimensional measurements for objects of various lengths. Of these 95% are ____ ft or less.

c. Short term readout (2-3 days after NPIC receipt of the photography) is required for dimensional and often for positioning data.

d. NPIC currently has the task of positioning targets to an accuracy of 960 feet 2 sigma.

e. A large percentage of both dimensional and position measurements are currently accomplished by NPIC in the monoscopic mode of analysis.

II Mensuration and Pointing Goals

To support future requirements and to optimize the total intelligence

process, the following goals become desirable:

a. As a goal (with respect to conservation of cost, manpower availability, and time) measurements and position determinations should be accomplished only once and to the highest degree of accuracy possible. Changes in object dimensions, due to later more complete exploration using improved data and procedures, can result in much rework of technical intelligence reports.

b. Since satellite attitude data is required by a variety of technical intelligence interpretive agencies in their mensuration and positioning activities and since provision of attitude from other than a single source results in different solutions, it should be a goal to supply attitude in an automatic manner. Also, this goal is justified by the cost and manpower utilization of the multiplicity of users (approximately 20 in addition to NPIC).

III Future Requirements

In the preparation of the Mission Correlation Data (MCD) package, the ability to provide the target location on the respective frames to the NPIC x-y coordinate references is limited by attitude and ephemeris data accuracies. Refined correlation is expected to be required for the following reasons:

a. As pointing systems are refined and larger focal length systems are developed more accurate, positioning will be required for pre-launch or on orbit programming.

b. Accurate correlation is required prior to examination of the material if the film target chip concept proposed for the processing site is to prove successful.

c. Knowledge of target location within a given frame of photography prior to examination of the material is an essential part of NPIC'S proposed automatic target cloud coverage determination system.

IV NPIC Point Positioning Requirements

The present capability for the determination of target location with respect to an established datum is about 960 feet (2 sigma). This accuracy includes all error sources. With the present ephemeris and attitude errors, this accuracy is achievable only by averaging the results of at least four photographic missions. Time does not permit application of this technique in satisfying first phase positioning requirements. If this requirement is to be equaled or exceeded by the Hexagon System, then the following attitude and ephemeris accuracies are required:

a. Ephemeris accuracy at the 2 σ level is required to be:

In track	500 feet
Cross track	175 feet
Radialy	225 feet

b. If monoscopic readout is assumed, then attitude with respect to an absolute reference is required at the 2 σ level accurate to within the following:

pitch	$\overset{\frown}{\text{min}}$
roll	$\overset{\frown}{\text{min}}$
yaw	$\overset{\frown}{\text{min}}$

c. If stereoscopic readout is assumed, then the relative attitude between the two halfs of a stereo pair is required at the two sigma

level accurate to within the following:

pitch	$\widehat{\text{min}}$
roll	$\widehat{\text{min}}$
yaw	$\widehat{\text{min}}$

In addition, the absolute attitude error is required to be less than the following:

pitch	$\widehat{\text{min}}$
roll	$\widehat{\text{min}}$
yaw	$\widehat{\text{min}}$

V NPIC Mensuration Requirements

To insure that no one error source dominates for 95% of dimensional measurements which NPIC provides, it is required that attitude errors be maintained to such a level that they contribute no more than the basic resolution of the system for horizontal lengths up to 1000 feet and vertical lengths up to _____ feet.

For the Hexagon Sensor Subsystem (SS) with 2.7 feet (2σ) resolution on the ground this means that the following attitude accuracies are required:

a. If monoscopic readout is assumed, then attitude with respect to an absolute reference frame is required accurate at the two sigma level to within the following:

pitch	$\widehat{\text{min}}$
roll	$\widehat{\text{min}}$
yaw	$\widehat{\text{min}}$

b. If stereoscopic readout is assumed, then the relative attitude between the two halfs of a stereo pair is required at the two sigma

level accurate to within the following:

pitch	3 min
roll	min
yaw	3 min

In addition, the absolute attitude error is required to be less than the following:

pitch	min
roll	min
yaw	min