BYE-7285-69
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MEMORANDUM FOR : Director, National Reconnaissance Office

SUBJECT : HEXAGON Targeting Function

REFERENCE : (1) SAFSP HEXAGON Software Development Plan, BYE-16593-68, 3 January 1968

(2) HEXAGON Targeting Software Development Plan, BYE-7285-69, April 1969

1. In line with our various conversations on the HEXAGON targeting function, this memorandum summarizes what I see as the key issues. In addition, Attachments two through five deal with four questions that arose during the course of our conversation with General Martin on 8 April.

2. Reference II is a summary version of the HEXAGON Software Development Plan prepared by the Design and Analysis Division of the Office of Special Projects. The plan calls for the development of the HEXAGON Targeting Program and associated mission planning software by D&AD, in direct support of the Satellite Operations Center (SOC). The HEXAGON Targeting Program will be operated in the Agency Computer Center and will be accorded the same operational priority as now is the case with CORONA Software support activity. In addition to undertaking the tasks of defining and developing the HEXAGON Targeting Program, D&AD provides continuous analytical and operational support to the SOC at a level of effort of between 10 and 15 people. (These people are in addition to those Agency personnel detailed to the SOC).

3. The D&AD plan is based on the central theme that the SOC should function as a true operations center for the HEXAGON program. The key to implementing this goal in the case of the HEXAGON is to vest in the SOC line operational authority over the

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targeting of the system. This means in the context of the D&AD Plan that first, the SOC will have complete control over the targeting software and second, will make the final determination of what areas and targets are to be photographed at what times during the course of a mission. This objective requires that the SOC have under its control a complete coverage data file and the capability to use this file. An important additional consideration of the D&AD approach to the HEXAGON Targeting Function is that the SOC, drawing on its own resources as well as the dedicated D&AD resources, will be in a good position to do meaningful mission planning and requirements analysis in the context of its interactions with the intelligence community.

4. The SAFSP Plan (Reference I) on the other hand, emphasizes total operational control by the HEXAGON System Program Director (See Attachment I). All HEXAGON related software, in particular the HEXAGON Targeting Software, will be operated by the SPD in the STC. The role of the SOC will be to provide to the SPD the basic HEXAGON collection requirements and the pertinent additional mission guidance. Also any analysis or computer support required by the SOC will in general be provided by the SPD.

5. The important point made in support of this approach to the HEXAGON Targeting Function appears to be that the SPD needs full authority over HEXAGON operations in order to discharge the basic SPD assignment in a responsible manner. An additional point which has been stressed by the SPD in various conversations, is that with this approach the SPD is in a position to react in a timely manner to various operational contingencies which may develop during the course of a mission. In this arrangement the SOC performs more nearly as a staff organization responsible primarily for liaison with the intelligence community.

6. It is clear that either of these proposed arrangements is feasible from a technical point of view. The CORONA on the one hand demonstrates that D&AD has the assets to develop and operate targeting software of the sort that would be required for the HEXAGON Program. On the other hand the GAMBIT Program demonstrates that it is possible to mechanize the targeting function in the context of the STC. Therefore, the basic issue is not one of feasibility

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but rather how best to relate the needs of the intelligence community to the capabilities and constraints of the HEXAGON system.

7. The SAFSP Plan emphasizes the need for complete operational authority of the SPD and the importance of maximizing operational efficiency in a technical sense. The D&AD Plan emphasizes the need for a strong SOC with real operational targeting authority working in close conjunction with the intelligence community. While the goal of achieving a high level of operational efficiency in a strict sense of the term is certainly important, it is my view that this consideration by itself should not be allowed to dominate considerations of how best to configure the HEXAGON Targeting Function. Particularly, in the case of the HEXAGON system, it is clear to me that efficiency in the larger sense measured in terms of meeting the needs of the community is best served with the targeting function performed in Washington along the lines of the D&AD proposal. In order to realize the full expectations of the intelligence community the collection requirements for the HEXAGON system will be both dynamic and diverse. The system must be responsive to a broad range of needs including general search, target surveillance, specific mission target and area objectives, as well as mapping and charting needs. The problem of responding to the needs and at the same time using the HEXAGON system efficiently is not a small task and success will depend upon a clear understanding of these intelligence requirements and close working relationships in the Washington area.

8. There is another set of considerations which in my view lobby in favor of the D&AD approach. First, the team of people responsible for providing HEXAGON support to the SOC includes people who have been involved with the HEXAGON Program from its inception. These people performed the analysis supporting the definition of the HEXAGON configuration and are therefore in an excellent position to continue developing methodology for employing the system. Second, D&AD is in a good position to implement a smooth transistion from the CORONA system to the HEXAGON system. In particular, the central coverage data file now being used for CORONA and much of its associated software can be carried directly into the HEXAGON Program.

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9. If you feel any further discussion of this issue would be useful to you, I would be glad to meet with you personally or make any other arrangements you would judge helpful.

CARL E. DUCKETT
Director
CIA Reconnaissance Programs

Attachments:

1. SOC HEXAGON Targeting Responsibilities in Accordance with the SAFSP Plan.
2. Tasking and Operation of the GAMBIT System.
3. Data Required From STC to Support HEXAGON Targeting.
4. Targeting of the 12 Inch Framing Camera With the HEXAGON System.
5. Mission Accomplishments File Data.

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Attachment 1 to:
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SOC HEXAGON TARGETING RESPONSIBILITIES IN ACCORDANCE WITH THE SAFSP PLAN

Reference: SAFSP, HEXAGON Software Development Plan, BYE-16593-68, dated 3 January 1968

1. During the past year there has been considerable discussion of what the SOC role would be under the SAFSP Plan for operating the HEXAGON system. In general it is clear that the SAFSP Plan calls for running the total HEXAGON operation in the STC. This includes developing those software programs associated with mission planning and on orbit targeting, and writing them as part of the overall software system in the STC. The basic role of the SOC will be to perform liaison with the Intelligence Community and to provide to the HEXAGON SPD general HEXAGON collection requirements, along with any specific mission guidance needed prior to a launch or during the course of a mission.

2. In accordance with these arrangements, the SPD is fully responsible for all aspects of HEXAGON operations, including the specific targeting of the system (deciding what geographical areas and targets will be photographed at what times during the course of the mission). During the course of a HEXAGON mission the SAFSP Plan calls for transmitting to the SOC data describing the progress of the mission. It is not clear whether or not the SOC will be in a position to act on the information and impact on future operational decisions. In principle, at least, the SOC could note progress and adjust

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priorities in the basic intelligence guidance. There has been discussion from time to time which would indicate that the targeting software could be designed so that the SOC could manipulate various logical criteria in the software so as to adjust the way in which targeting decisions are made.

3. Specific targeting decisions for HEXAGON must of necessity take into account many factors which can only be manipulated by a complex software package. There will undoubtedly be various threshold and weighing parameters which will need to be varied during the course of a mission depending upon mission accomplishments, intelligence requirements and system status; however, how these parameters actually impact targeting will be determined by the logical structure of the targeting software.

4. The nature of this entire process requires that specific targeting decisions must be reviewed, along with supporting data, by a senior operations officer. It is important that this operations officer have a basic intelligence background along with a clear appreciation for the specific intelligence problems behind collection guidance to the HEXAGON system. This role, historically, for the CORONA system has been filled by the SOC Operations Officer. This review and approving function will be particularly important for HEXAGON given the multi-faceted collection requirement, the system is intended to satisfy.

5. If the SOC is to have full targeting authority, it must have complete control over the logical content of the targeting software and a detailed understanding of how the software is structured. It is the structure of this software that will determine not only what types of requirements can be dealt with, but also will have a dominant influence on the specific targeting generated. In the case of the CORONA Targeting Program, the SOC has had full specification approval authority and complete control over any modifications made to the Targeting Program. In the case of the GAMBIT targeting software, this has not in general been the case. The SAFSP Plan for the HEXAGON software calls for SOC participation in the definition and development process; however, the final authority is not the SOC but rather the SPD.

6. If the targeting software is to be developed and operated by the SPD but the SOC has some authority to manipulate target parameters during the course of a mission, there is a serious risk of diffusing the responsibility for targeting decisions in that neither the SPD nor the SOC has complete control on the process. Furthermore, the SOC is in a weak position in that it is manipulating parameters which are difficult to relate a priori to future targeting selections. This is particularly the case if the SOC has only limited visibility into mission status. It appears that SAFSP has recognized this problem and intends in practice to assume full responsibility for meeting the intelligence collection objectives. This procedure, of course, requires that intelligence collection requirements for HEXAGON be precisely defined in quantitative terms and remain relatively static.

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TASKING AND OPERATION OF THE GAMBIT SYSTEM

1. From the beginning of the original GAMBIT Program, the interfaces between operations and the intelligence community has been fraught with serious difficulties. The initial targeting software from the GAMBIT system was not developed in coordination with the intelligence community. As a result, the software was not well understood by those responsible for developing the tasking for the system, and in the final analysis, probably not at all appropriate in basic methodology in view of the real intelligence needs.

2. Subsequent generations of targeting software have achieved significant improvements measured in terms of technical and operational criteria and also probably resulted in some improvements in intelligence yield, although it is very difficult to sort out improvements attributable to hardware changes as opposed to operational changes. However, the community of people concerned with developing and operating targeting software and those in the intelligence community concerned with developing requirements and tasking continue to have very little constructive interaction. Requirements documents generated by the intelligence community are, in general, not well understood by those directly responsible for GAMBIT targeting software and operations. Specifically, intelligence guidance for planning purposes as opposed to specific mission requirements are frequently confused in their application.

3. As a result of the overall arrangements and responsibilities for the tasking and operation of the GAMBIT system, the intelligence community on the one hand is not in a position to do a good job of requirements definition and the targeting software on the other hand is probably not configured in the best manner. It is difficult for the intelligence community to know how best to

formulate their guidance for the system. The community is not clear on the implications of targeting prioritization, categorization, and coverage frequency statements. The whole question of image quality and its interrelationship with numbers of targets covered has never been seriously addressed. Specifically, the development of the Bloc-II GAMBIT configuration with two reentry vehicles was not carefully considered in terms of real intelligence community needs.

4. Despite all of the above, the current GAMBIT-III system does achieve large quantities of excellent quality photography. As of this time, there are probably no critical intelligence problems which are being adversely impacted in a serious way as a consequence of the current GAMBIT arrangements. In fact, the substantial performance improvements (over the past several years) both in terms of image quality and in terms of number of targets covered by the GAMBIT-III system has tended to diffuse the importance of tasking and operational questions. Nonetheless, there are undoubtedly serious deficiencies in these arrangements.

5. The core of the problem lies in the fact that the responsibilities for tasking and operating the GAMBIT-III system are spread, in a way which is not clearly defined, between three organization entities: the intelligence community represented by the COMIREX, the Satellite Operations Center, and the System Program Director. What is lacking is a clear formal definition of the interfaces between these elements and effective, energetic working-level arrangements. There has been much discussion of this issue over the years and even some paper generated. On occasion individuals have emerged (particularly in the SOC) who have worked hard to improve the situation. However, an effective arrangement with a realistic balancing of authority, responsibility, and capability does not yet exist.

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DATA REQUIRED FROM STC TO SUPPORT HEXAGON TARGETING

1. Certain data are required from the STC for input to the targeting process on a once or twice daily basis. They consist of two different types of data, namely those needed for the prediction computations and those used for updating computations.

- Pre-mission nominal orbit for planning purposes.

- Commanding Schedule - a list of available command loading station contacts indicating the primary and back-up station (if available), schedule of times for targeting data inputs from GWC, CIA, SOC and STC relative to actual command time. This also includes a definition of portions of the mission profile for which camera operations are denied by system constraints.

- Orbital Ephemeris - predicted orbital elements sufficient to allow prediction capability through the end of the active mission life.

- Camera Operations Executed - scan sector, center and system time of beginning and end of stereo coverage for each camera operation executed, and refined orbital elements for previous days' revs.

- Consumption Data - actual film expended on each camera operation as determined from T/M analysis.

- System Status - status of the various vehicle items pertaining to the targeting process, such as film remaining, active life remaining, power constraints; and malfunctions constraining camera operations, such as one camera failure, mode selection restrictions, and changes in camera stop/start performance.

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2. These transmission are expected to require about 30 to 60 minutes of total transmission time per day, utilizing the existing 150 lines per minute (80 characters per line) capability.

3. After each film recovery, a frame ephemeris is required for input to the coverage assessment program.

~~TOP SECRET~~ Unclassified

~~CORONA GAMBIT HEXAGON~~

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TARGETING OF THE 12 INCH FRAMING CAMERA WITH THE HEXAGON SYSTEM

1. Starting with HEXAGON flight number 7 or thereabouts, a 12 inch framing camera will be carried on the HEXAGON space vehicle. This camera is designed to satisfy the mapping requirements for photographic material to support the production of 1:50,000 scale maps. There is also a requirement for HEXAGON panoramic camera coverage in support of the mapping community. About 20% of the HEXAGON panoramic film has been budgeted for this purpose.

2. The HEXAGON Targeting Program as it is now planned will perform the targeting function for this 12 inch camera, as well as the panoramic cameras. The targeting will be based upon the mapping community requirements for coverage and will be handled with the same Coverage Data file as the targeting of the panoramic camera.

3. The three inch framing camera now carried with the CORONA system for mapping community support has a mode of operation independent of the CORONA panoramic camera. The pre-mission targeting program for this three inch framing camera is now prepared by the SOC using the CALICO software and on-orbit selections are made manually by the SOC. Work is currently under way to incorporate the CORONA framing camera targeting in the CORONA Targeting Program (CTP).

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MISSION ACCOMPLISHMENTS FILE DATA

1. A mission accomplishments file that contains all data pertinent to the targeting of each element of area contained in the world land mass must be maintained during an active mission. This data consists of all items required to ascertain the last successful photography date, the probability that this area element has been successfully photographed to date this mission, and the probability that it will be successfully photographed in meeting the stated requirements.

2. This file consists of 140 million bits (or about 3.3 million 32 bit words), and is based on extensive use of optimized data packing techniques.

3. Data contained in this file consists of the following for the 320,000 area elements (WAC Mosaic Charts) containing land:

- Area element pseudo number
- Latitude and longitude of the area element centroid
- Correlation index for obtaining climatology data
- Intelligence coverage requirement index code indicating the types of requirements established
- Identification number for current mission high priority area objective
- Obliquity constraints
- Illumination or sun angle constraints
- Date of last successful photography as established from film read-out

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. Cumulative probability of accomplishment this mission

. Probability of future successful accomplishment exclusive of current mission

. Number of photographic attempts during this mission by bucket

. Verified cloud-free probability for each photographic attempt this mission

4. There will be additional area element data required as input to the targeting algorithm, and will be established in the course of design studies to define this algorithm.