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DEPARTMENT OF THE ARMY

THE ENGINEER GEODESY, INTELLIGENCE AND MAPPING
RESEARCH AND DEVELOPMENT AGENCY
FORT BELVOIR, VIRGINIA 22060

IN REPLY REFER TO:
ENGGM-

8 April 1966

SUBJECT: Transmittal of Trip Report

TO: Chief of Engineers
ATTN: ENGTE-L [redacted]
Department of the Army
Washington 25, D. C.

Inclosed is a copy of a trip report prepared by [redacted] of Technical Plans and Systems Analysis Division covering the meetings held on the west coast on 16 and 17 March 1966. Because of the scope of the topics discussed, it was felt that the report would be of interest to OCE. [redacted] can be made available to discuss or elaborate on any of the topics on which you may desire further information.

FOR THE COMMANDING OFFICER:

[redacted]

1 Incl
as

Acting Director, Dev[redacted]ment Laboratories
Mapping and Geodetic Systems, GIMRADA

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U. S. ARMY ENGINEER
GEODESY, INTELLIGENCE AND MAPPING RESEARCH AND DEVELOPMENT AGENCY
FORT BELVOIR, VIRGINIA

TRIP AND CONFERENCE REPORT

PROJECT NO: [redacted] 7 April 1966

SUBJECT: PG Working Group Meeting

DATE & PLACE OF VISIT: 16-17 March 1966
[redacted]
Palo Alto, California

SUBMITTED BY: [redacted]
Special Projects Branch
TP&SA Division

OTHER REPRESENTATIVES PRESENT:

Name	Organization
[redacted]	NPIC
	"
	ACIC
	AMS
	[redacted]
	DIA
	Itek
	"
	"
	"
	Fairchild
	"
	"
	"

[redacted]

PAGE 1 OF 6 PAGES
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SUMMARY: The meeting was opened by [redacted] who is the program manager at [redacted]. After a few welcoming remarks the meeting was turned over to [redacted] who essentially chaired the remainder of the sessions. The discussions were concerned primarily with the status of PG-1 (the first KH-4 package modified to include a reseau, IMC trace and improved timing hacks). The PG-1 had been fabricated by Itek Corporation, calibrated, and subjected to the usual environmental tests required of the camera manufacturer, and shipped to [redacted] for further testing and systems integration by [redacted] and the systems Contractor (Lockheed). At the time of the meeting PG-1 was undergoing tests at [redacted] Exhaustive operational tests are applied; 20,000 cycles by Itek and another 20,000 cycles at [redacted] during checkout prior to launch. In addition the environmental testing is quite severe. The equipment is required to successfully undergo environmental tests much more severe than that actually encountered during launch. It was learned that the environmental test standards had just been substantially increased and that PG-1 must meet these new standards. It was considered likely that problems not encountered before would arise that could possibly result in lengthy delays.

[redacted] Itek Corporation, gave a report on the status of PG-1. He stated that the tests conducted by Itek had indicated that, in general, the design goals were met. However, there were problems in getting a complete registration of the three IMC scan traces under operational conditions. Samples were demonstrated over a light table. At the beginning of each scan, the traces were not continuous but were interrupted. About 2 inches out of a total of 30 inches were affected. It was claimed that the cause was known but that very little could be done to correct the situation on PG-1. Since only a relatively small portion of the format was adversely affected, and that being the seldom used end portion of each frame, it was decided that this condition alone should not delay launch. In addition to the interrupted scan trace problem the line widths (50 microns) exceeded the 20 to 40 micron range allowed in the specifications. However, experience has shown that under the rarefied air conditions encountered operationally, the projected line widths will be significantly smaller; supposedly well within the 40 micron limit.

The cause of the interrupted scan trace problem was traced to a design deficiency which is to be expected only on PG-1. With PG-2 assurance was given that the problem would not occur. PG-1 has an "unbalanced lens" design and a 2 degree field collimator which projects three IMC traces, only 1 cm apart, down the middle of the format.

[redacted]

[redacted]

PG-2 will have a "balanced lens" design which will supposedly eliminate the interrupted scan trace problem and will provide a 4 degree collimator projecting three scan trace lines; one down the center and one near each edge. Completion of [redacted] testing of PG-1 is scheduled for June 1966 with launch probably in July or August. PG-2 is expected to be delivered to [redacted] in August-September with launch possible in late CY66 or early CY67. PG-3, which substitutes the "nodding" system for the present IMC achieved through lens motion is tentatively scheduled for completion in August 1967.

Experiences with PG-1 by [redacted] were presented as being essentially the same as those cited by Itek with several minor exceptions.

[redacted] brought up the seemingly age old topic of in-flight calibration by photographing stars with the terrain panoramic cameras. This scheme was again determined to be impractical for the usual reasons. It was agreed that no in-flight calibration would be attempted other than a photogrammetric calibration utilizing ground control.

[redacted] then opened a discussion of the possibility of monitoring the gas jets as they are fired for attitude control purposes. According to [redacted] time data on the gas jet firings would identify the points of discontinuity on the roll rate curves and be of considerable benefit in establishing where to begin and end meaningful curve smoothing operations. It was decided that [redacted] would look further into the possibility of obtaining this data on PG-3 flights.

[redacted] Itek Corporation, then presented the status of the PG calibration. He questioned the contract requirement that he prepare the camera calibration programs in FORTRAN IV for a 7090-94 type computer. His claim was that for the programs to be written for computers having a 32K memory would be inefficient and represent considerable extra effort on his part. Also, he claimed, needless costs would be incurred unless the Government intended to utilize these programs by performing such calibrations on their own in the future. After considerable discussion it was decided that the programs would be prepared for 32K memory computers, in FORTRAN IV, as presently required by the contract. The question then arose as to the specific formats and types of data the using Agencies wanted the calibration data supplied in. A discussion followed which resulted in [redacted] DIA, scheduling a working level meeting at Itek Alexandria on 29 March to resolve this problem. [redacted] requested of DIA that the agreed upon formats be forwarded to him.

[redacted]

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Representatives from Itek then presented some of the problems involved in developing the PG-3 system. This system which is presently scheduled for completion in late CY67 utilizes the "nodding" technique of IMC rather than the present lens translation method. This will obviate the necessity for slave collimators and IMC scan traces. PG-3 also incorporates a "balanced" constant rotational lens system. Calibration procedures utilizing nodding and scanning shaft encoders, and double exposures both with and without nodding was discussed. The PG-3 system shows considerable promise over PG-1 and 2 systems since it will be internally much more stable. However, many mechanical-optical design, fabrication, calibration and testing problems are yet to be overcome.

[redacted] Fairchild Camera and Instrument Corporation, then presented a proposal for a new and unique attitude determination system. The proposed system was labeled "Solid-State Stellar Recording Subsystem." It was claimed that a proposed "near term" system would give attitudes to 30-60 seconds of arc, and a proposed "long term" system would yield attitudes to 5 seconds of arc. The proposed system would utilize a 6" f.1. stellar lens and mirror arrangement that would scan a 19° by 60° star field and record stellar positions using a 2-inch solid state linear array developed by the Fairchild Semi-Conductor Division. Shaft encoders would record scan angles. Essentially a digital star map would be recorded for entry into a computer to determine attitudes. The proposed system would weigh 42.5 lbs. and occupy 1174 cubic inches.

During the absence of Contractor personnel, [redacted] presented details of an attitude determination system which shows considerably more promise than does the Fairchild proposal. The system, labeled "Automatic Payload Attitude Determination (APAD)" is described in detail in copies of briefing materials which [redacted] agreed to mail to the undersigned; consequently, details will not be presented here. However, the APAD is proposed by [redacted] utilizes an electrostatic gyroscope, weighs 35 lbs., is an "off-shoot" from the Polaris guidance system, good to something like 3 seconds of arc with a precision of 3/10 of an arc second, records attitudes direct in binary data block form and is highly classified plus "Company Confidential." The R&D costs to further develop and adapt the system to our use is [redacted] with 20 operational systems supplied for [redacted] firm fixed price. Per unit cost after the

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first 20 is quoted at [redacted] Delivery would begin 18 months after the date of award of the contract. Everyone agreed that this was "THE" system but no indication was given as to who would fund it or when.

It was learned that on 15 March (one day prior to the meeting reported on herein) a group had convened, again chaired by [redacted] to discuss satellite experiments using color film with KH-4 packages. Tentative plans were established calling for a color KH-4 test mission in either August or September, CY66.

[redacted] and [redacted] Fairchild Program Manager, described the status of the Stellar Index (SI) portion of the new system. The improved 3-inch f.l. terrain camera and improved 3-inch double stellar cameras are now commonly referred to as the DISIC system. Apparently the first DISIC system meets the requirements of the contract with the exception of the distortion requirements. The radial distortion on systems checked so far has considerably exceeded the 30 micron limitation. The emphasis has been placed on achieving the highest resolution possible even at the expense of not meeting the distortion requirements. This is as it should be. The [redacted] will not be adversely affected by this distortion provided the cameras are adequately calibrated. However, the materials may not be suitable for maximum exploitation in the M-4 type plotters at AMS. The resolution requirements of 60 lines/mm, AWAR, at 2:1 contrast on 4400 film, has been met. It is to be expected, however, that the distortion and resolution values will vary considerably on each individual lens since aspheric elements are involved and each lens is "hand tailored" for maximum resolution. It was reported that the first DISIC system would be "together and running" and acceptance tests completed by 10 May, systems qualification would be completed by 1 July, and available for flight by 1 August 1966. The warning was given though, that the more severe systems qualification requirements recently imposed could easily necessitate a slippage in this schedule of up to 3 months.

Discussions then ensued, primarily involving [redacted] ACIC, and [redacted] DIA, concerning the responsibility for calibration of the knee angle and distortion of the DISIC packages. [redacted] made a strong pitch for this work, citing his experience and capabilities in this area. He stated that he had been doing this type of work in the past; but not for DIA. He stated emphatically that he did this type of work directly for NRO and that DIA should not be concerned.

[redacted]

5 [redacted]

[redacted] did not agree and rather heated exchanges followed. [redacted] reminded the group that AMS had calibrated the first two packages. This was done at the request of [redacted] shop [redacted] NRO, said nothing.

Fairchild made a proposal, in the form of a briefing, to calibrate the knee angles and do all of the required data reduction at the rate of one per month for approximately [redacted] for six units. It was decided, after considerable discussion among the Government representatives present, that this was not at all desirable since both the Army and AF already had this capability and could perform the data reduction portions of the calibration at a cost of from [redacted] to [redacted] per unit. It was agreed that the Contractor would continue to calibrate the individual cameras and put them in a bracket. The Government would then re-check the distortions and determine the knee angles.

The matter of flight readiness criteria for the PG-1 system was discussed. No firm decisions were made on this subject. It was decided that the topic would be re-opened at a subsequent meeting.

A report citing the history and status of PG-1 up to the date of this meeting was requested and assurances were given that it will be forwarded to the undersigned. For security reasons the report could not be handcarried back to the east coast. The report includes (1) Itek's acceptance test results, (2) [redacted] experience with PG-1, (3) Itek PG calibration data, and (4) flight readiness criteria. Also, as stated previously, [redacted] agreed to forward copies of his briefing materials on APAD since no report is available on the subject. These promised materials have not been received as of this writing.

CONCLUSIONS: Apparently the PG-1 program is proceeding satisfactorily. Certain deficiencies and relatively minor problems were cited during the two-day discussions but none of the deficiencies are considered serious nor were the problems considered unsolveable. Indications are that the PG-1 will fly possibly in August but most likely in the early fall. Whether or not the DISIC will fly with the first missions is uncertain. We should continue to expedite our efforts to develop the data reduction techniques, procedures and software required to test and to exploit these materials.

[redacted]
7 April 66
(DATE)

[redacted]