

Declass Review by
NIMA/DOD

PROJECT ASSIGNMENT RECORD

TO: O/ISB

DATE: 11 Dec 67

FROM: DC/DB

TIME: 1500

SUBJECT: GEMS PROGRAM; disposition of

STATINTL

1. Request you prepare a memo recommending disposition of subject program.
2. Suggest you utilize report updating received info and conclusions, as an attachment, of 19 Dec 67
3. Suggest remarks concerning "knowledge gap re means of defining "image interpretability/perceptibility."

IP FORM 241A (8/65)

ASSIGNED TO	SUBJECT	NUMBER	DUE DATE	DATE COMPLETI
ISB	GEMS PROGRAM			

20 DEC

TDS/DS TYPING SLIP

SUBJECT: CONTRACT PERFORMANCE EVALUATION - GRADED ESTIMATED MEASURING SAMPLES (GEMS)

ORIGINATOR: DATE: 10/18/67

CLASSIFICATION: SECRET PROJECT NO. 04066

	DRAFT:	INITIALS:	FILE COPY:
<u>X</u>	TYPE ROUGH	<u>CS</u>	D/CH, DS _____
<u>3</u>	BRANCH CHIEF	<u>RJS</u>	ORIGINATOR _____
<u>2</u>	ORIGINATOR	<u>ME</u>	SEC. FOR FILING _____
	TYPE SMOOTH	_____	
	ORIGINATOR	_____	
	CHIEF, DS	_____	
<u>9</u>	D/CHIEF, DS	_____	
	ASST. FOR TD	_____	

DATE OF FINAL DISPOSITION: _____

COMMENTS:

Frank, As I told you before I believe this is an excellent job of gleaming and compiling a historical analysis of the GEMS program.

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D R A F T
NPIC/TDS/D-_____-67
19 October 1967

MEMORANDUM FOR:

SUBJECT : Contract Performance Evaluation - Graded Estimated
Measuring Samples (GEMS)

1. OBJECT: To evaluate the performance achieved under the current contract covering "GEMS Development" in order to determine the advisability of pursuing the project further.

2. SCOPE: This memorandum covers the correlation of the "Scope of Work" set forth in the contract with the performance realized and, the dependent extrapolation of anticipated contractor performance under any subsequent pursuit of the project.

3. SUMMARY: Based on (1) a detailed study of the contract and concomitant documents and correspondence, (2) an interview with the presently assigned NPIC Technical Development Staff Contract Monitor, and (3) an interview with personnel in the NPIC, Technical Intelligence Division involved in the "Psychophysical GEMS Test", it is concluded that:

a. With the imminent receipt of certain reports, the present contract will have been satisfied.

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b. The sought after simulation of photography at spatial frequencies up to 200 cycles per millimeter was not realized.

c. Performance of the contractor was characterized by delays and a certain lack of aggression.

Execution of the present contract by the contractor indicates that he will be able to develop a useable set of GEMS (simulated photography at spatial frequencies approaching 200 cycles per millimeter) within about one year.

It is recommended that the GEMS project be continued for the express purpose of producing a useable set of GEMS ^{of} Pseudo - GEMS which include simulated photography at spatial frequencies up to at least 180 cycles per millimeter.

4. HISTORY: In early 1964, the [redacted] began active pursuit of the initial "GEMS Development" [redacted] This resulted in some simulations of aerial photography, wherein the photographic parameters of exposure, haze, granularity, and modulation transfer function were varied experimentally.

Work under the above mentioned contract, which terminated in mid 1965, was directly related to a previous effort known variously as the "Photographic Image Simulation Program". A commentary on the work performed under this previous effort and the initial "GEMS Development" contract was given in a "Report on the Image Quality Evaluation Program, July 1965", prepared by our

[redacted] Included in this commentary

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were certain recommendations relative to continuation of "GEMS Development".

Expanding on the recommendations contained in the "Report on the Image Quality Evaluation Program, July 1965", [redacted] 25X1A
submitted a proposal for further work on "GEMS Development". This proposal

[redacted] 25X1A

On 9 February 1966, a contract was offered to the [redacted] 25X1A
under which they would provide all of the manpower, facilities, services,
and materials required to accomplish the GEMS Development Program described

[redacted] 25X1A

acknowledged and accepted by the contractor on 21 February 1966. The
estimated cost of performance (exclusive of the fixed fee) was [redacted] 25X1A

The fixed fee for performance was [redacted] 25X1A
The period of performance
expiration date was stipulated as 30 June 1967. Verbal authorization to
proceed with this contract was apparently given on or about 10 January 1966.

Basically, the proposed program consisted of four tasks:

- a. GEMS Specification Study
- b. Alternate GEMS Fabrication Technique
- c. GEMS Viewer Study
- d. GEMS Matrix Fabrication

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A fifth task was delineated, which involved preparing specifications, estimated fabrication costs, and a fabrication cycle for the GEMS Viewer. Included in the GEMS Specification Study was a provision for a psychophysical testing program to be conducted by a subcontractor, [redacted] 25X1A
[redacted] 25X1A utilizing NPIC personnel.

Conclusions reached early in the "GEMS Development" program indicated that a GEMS matrix should consist of about 1000 to 1500 distinct GEMS. Continuing study by the contractor resulted in the development of a theoretical technique which would eliminate the need for such a large GEMS matrix, reducing the required number to about 10. This technique, although appearing to be technically sound, had not been investigated experimentally

[redacted]

On 8 November 1966, an amendment to the master contract was offered to the [redacted] 25X1A under which they would perform all work necessary to set up a "Psuedo-GEMS Breadboard" and undertake experiments therewith in accordance with their proposal MW-M-1536, dated 1 September 1966. This offer, designated Amendment No. 1, Task Order No. 8, Contract 25X1A [redacted] was acknowledged and accepted by the contractor on 17 November 1966. The estimated cost of performance (exclusive of the fixed fee) was 25X1A increased to [redacted] The fixed fee for performance was increased to 25X1A [redacted] All other term^s, conditions, and requirements of Task Order No. 8 25X1A remained unchanged. *ABE*

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Promising results from the Pseudo-GEMS investigation plus certain technical problems encountered in the ^{previous} work prompted the contractor to submit a "Proposal ^{ed} Change-in-Scope for the GEMS Study Effort" dated 6 January 1967.

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Accordingly, on 16 March 1967, an amendment to the master contract was offered to the [redacted] under which they would re-direct their efforts in the performance of the Task Order in accordance with their proposal dated 6 January 1967, entitled "Proposal ^{ed} Change-in-Scope for GEMS Study Effort". This offer, designated Amendment No. 2,

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Task Order No. 8, [redacted] was acknowledged and accepted by the contractor on 28 March 1967. The period of performance expiration dated was extended from 30 June 1967 to 30 September 1967. All other terms, conditions, and requirements of Task Order No. 8, as amended, remained unchanged.

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5. CONTRACT SCOPE OF WORK: Under Task Order No. 8, Contract No.

[redacted] accepted by the contractor on 21 February 1966, [redacted]

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[redacted] agreed to provide all of the manpower, facilities, services and materials required to accomplish the program described in Section 3.0 of their proposal with the following exception:

"Such psychophysical experiments and tests as are required shall be performed at the customer's facility with the assistance of the customer's personnel. [redacted]

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[redacted] shall provide for the supervision of these experiments and tests by means of a subcontract with [redacted]

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[redacted]

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The specific objectives and deliverable material included in the program, described in Section 3.0 of the contractor's proposal were:

- Item #1. Preparation of a two dimensional GEMS matrix wherein modulation transfer function is varied against exposure. ^a 110E
- Item #2. Performance of a psychological test with the objective of ~~scaling~~ the matrix elements in psychologically equal intervals among modulation transfer function and exposure. ^b 110E
- Item #2a Application of the ~~scaled~~ matrix to the assessment of mission photography to determine the extent to which the assessments of one individual are consistent and the extent to which individuals agree with one another. ^c 110E
- Item #2b Repeat application of the ~~scaled~~ matrix as described under item #~~2~~^{2a}, utilizing additional GEMS in place of mission photography, the objective being to establish accuracy of assessment. ^d 110E
- Item #2c Prepare a final report on results of psychological tests (scheduled for delivery in October 1966). ^e 110E
- Item #3. Conduct a study toward refining existing simulation techniques, by determining the precision with which ~~each~~^{each} of the image quality parameters ~~can~~^{can} be controlled, and prepare a final report on results (scheduled for delivery in October 1966). ^f 110E
- Item #4. Prepare specifications for one or more GEMS sets appropriate to such applications as the customer wishes to make (scheduled for delivery in November 1966). ^g 110E

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- Item #5. Investigate an alternate method of controlling the modulation transfer function of a photographic image. The alternate method will be breadboarded and simulated photographs will be produced and evaluated. *h*
- Item #5a Prepare a final report on the alternate GEMS technique (scheduled for delivery in December 1966). *i*
- Item #6. Prepare a design layout of a GEMS viewing equipment and conduct a study thereof. Submit specifications for the instrument together with an accurate cost estimate applicable to the detailed design and fabrication of the device (scheduled for delivery in August 1966). *g*
- Item #7. Upon completion of items #1 through #4 above, prepare 1000 to 1500 GEMS. Deliver all GEMS prepared to the customer with appropriate documentation (scheduled for delivery in June 1967). *k*
- Item #8. At the completion of the program, prepare a comprehensive summary report (report due 30 June 1967). *l*
- Item #9. Submit monthly letter type status reports. *m*

Under Amendment No. 1, Task Order No. 8, accepted 25X1A
by the contractor on 17 November 1966, agreed 25X1A
to furnish the personnel, materials, and facilities to accomplish the following items:

- Item #10 Construct a simple "Pseudo-GEMS" breadboard and conduct an experiment to determine if a high-quality GEMS may be degraded in a known, controllable manner to simulate GEMS of lower quality. Check correspondence of different

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subjects and repeatability of individuals. Investigate each of the degrading factors with respect to limits and interrelationships. ^m

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Item #10a Submit a letter report on the results of item #14 with recommendations for future work (scheduled for delivery in February 1967). ^v

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Under Amendment No. 2, Task Order No. 8, [redacted] accepted 25X1A
by the contractor on 28 March 1967, the [redacted] agreed 25X1A
to provide all the manpower, facilities, services, and materials required to accomplish the following items:

Item #11 Preparation of a two dimensional GEMS matrix wherein modulation transfer function ^m is varied against exposure. An alternate GEMS procedure to be used in preparing this matrix. ^p

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Item #12 Conduct a study toward the development of a GEMS technique which will provide a means of generating equal magnification GEMS to be used in the evaluation of mission material. This study to encompass the exploration of conventional and unconventional silver and non-silver photographic systems. ^v

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Item #13 Objectively measure and define the operational system parameters of modulation transfer function, contrast, exposure, granularity and sensitometry. ^v

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Item #14 Anticipating that the Equal Magnification GEMS study or the Pseudo-GEMS Viewer study may necessitate the acquisition of new original negative material, specify the appropriate processing of such film and establish a detailed flight plan in coordination with the customer. ^s *ME*

Item #15 Anticipating that a Pseudo-GEMS Viewer can be fabricated from a modified GEMS Viewer design, specify the viewer modifications essential to the control of the image parameters and specify the nature of the material to be employed in such a device. ^t *ME*

Item #15a Submit specifications and a cost estimate applicable to the detailed design and fabrication of a Pseudo-GEMS Viewer. ^t *ME*

6. CONTRACTOR PERFORMANCE: In order to provide an indication of contractor performance, the progress made toward accomplishing each of the items listed in paragraph 5 is summarized. For convenience, this is done on an item by item basis.

Item #1. "Preparation of a two dimensional GEMS matrix-----etc." *ME*

This matrix was to be ^{prepared} ~~proposed~~ as a working tool for use in the psychological tests. It was originally planned to produce this matrix utilizing personnel and photographic facilities that had been engaged in the previous GEMS program. However, due to the delay in formalizing the contract under discussion, the contractor found it necessary to undertake other GEMS contracts to insure availability of the personnel and photographic facilities. This resulted in a continuing overl^oad which the contractor

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attempted to resolve by preparing additional photographic facilities and acquiring new personnel. Difficulty in procuring certain darkroom equipment delayed completion of the photographic facilities until May 1966. Since the psychological tests for which the matrix was to be prepared were to be accomplished by a subcontractor [redacted]

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[redacted] utilizing NPIC personnel, it was logical that the subcontractor be consulted relative to the matrix specifications. Contractor negotiations with the subcontractor and conferences between the contractor, the subcontractor and NPIC resulted in a delay until 8 August 1966, at which time

the prerequisite imagery for the matrix was delivered to the contractor by NPIC. In early September 1966, production of the psychophysical GEMS was initiated by the contractor and shipment of the completed GEMS set was made to [redacted] on 17 October 1966. Upon visual

examination of the matrix array, it was determined that the increment spacing of the modulation transfer function was not as desired. The problem was traced to the use of poor resolution masters, and the manufacture of a new psychophysical GEMS matrix was deferred pending solution

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of this problem. A sensitometric study of the problems indicated that the simulated photographs would be markedly improved by employing original negative material possessing a processing gamma of unity, but not if this material was obtained under previous flight conditions. On 6 January 1967, the contractor noted that his earlier course of action would not permit accomplishing the desired program goals, and proposed a redirection of effort which was concurred in by NPIC. This redirection of effort included

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preparation of a two dimensional GEMS matrix by an alternate GEMS procedure. For purposes of this report, this new specification for the matrix has been listed as item #11, which is merely a redirection of item #1.

Item #2. "Performance of a psychological test with the objective
2a of scaling the matrix elements in psychologically equal
2b and 2c intervals-----etc."

The psychological (later called psychophysical) test, being dependent upon the manufacture of a test matrix, was necessarily delayed until completion of item #1 (redirected to item #11). The subcontractor [redacted] 25X1A [redacted] 25X1A who was responsible for conducting the psychophysical test, acted in a consulting capacity during the compilation of the test matrix GEMS. A delay in the planning of the psychophysical test was attributed to clearance difficulties early in the program. An additional delay in preparing the test matrix was attributed to late receipt of suitable source material from NPIC. On 17 October 1966, the production of the 25X1A psychophysical GEMS set was completed and shipped to [redacted] 25X1A [redacted] 25X1A for the purpose of designing the psychophysical experiments. With the completion of this work, representatives of the contractor and subcontractor visited NPIC on 7 November 1966 for the purpose of conducting the psychophysical GEMS Test. During this test, it was determined that the increment spacing of modulation transfer function was hardly evident, and further testing was postponed. The problem was attributed mainly to the use of poor resolution masters and, on 21 November 1966, the contractor agreed to investigate the feasibility of predicting and controlling

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modulation transfer function simulation for a nonlinear photographic system. A new psychophysical GEMS matrix was to be generated after the resolution problem was ^sresolved. Under Amendment No. 2 to the Contract, (in January 1967) an alternate method for preparing the Psychophysical GEMS matrix was approved and work began in this direction. Problems in finding a suitable film type were experienced and apparently overcome in time to effect production of the matrix in June 1967. On 17 July 1967, the psychophysical GEMS test was initiated by the contractor and subcontractor at NPIC. ^{This} These tests took three weeks longer than planned, partially due to a manpower availability at NPIC. Delay in compiling the data caused a slippage past the amended contract termination date of 30 September 1967. Delivery of the final report was promised in October 1967.

Item #3. "Conduct a study toward refining existing simulation techniques by-----etc."

Under this portion of the contract, each of the image quality parameters were to be studied separately, i.e., modulation transfer function, granularity, haze~~x~~ and exposure, etc. Since a limited capability for producing simulated photography existed from previous endeavors, initiation of this study was executed almost immediately with signing of the contract. One of the first steps was the analytical evaluation of the diffraction effects of the transparency which, due to its numerical complexity, was conducted utilizing a computer. Preliminary results indicated that near field effects, in some cases, played a significant role in the formation of the image in the GEMS making process. By March 1966, the spatial frequency

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at which near field effects limited the usefulness of the then used GEMS making technique was being fairly well defined. An experimental investigation was then contemplated wherein the modulation transfer functions of various GEMS photographic images were to be determined by edge ^{gradient} ~~gradicut~~ techniques. However, it was determined that a prerequisite evaluation of the edge ^{gradient} ~~gradicut~~ technique had to be made. This evaluation was successfully completed and reported in June 1966. An analysis was then performed on the factors influencing the control and predictability of the modulation transfer function and contrast (haze) simulation techniques. During this analysis, it was determined that an original negative must be photographically processed to a gamma of unity in order to properly simulate the parameters of the mission material by the GEMS technique. Also, the major problem associated with predicting the pre-exposure and image exposure times for the atmospheric haze simulation technique, Reciprocity ^{Law} ~~Failure~~, was overcome. With the redirection of effort authorized under Amendment No. 2 to the contract in early 1967, this task was enlarged to include the Equal Magnification GEMS Study, the System Parameters Study, and the Flight Program Specification activity (Items #12, #13, and #14). In the contractor's Progress Report No.11, covering the period 29 November 1966 to 24 January 1967, paragraph b), it was stated that a report covering the previous work performed under this task was being prepared.

Item #4. "Prepare specifications for one or more GEMS sets appropriate to-----etc."

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This portion of the contract was directly dependent upon the completion of items #1 (redirected to item #11), 2 and 3. However, under the redirection of effort authorized by Amendment No. 2 to the contract, this item was dropped and the following substituted,----"At the conclusion of this proposed program, the customer would be given a final report that relates the findings of the Psychophysical GEMS Study, a description of the developed technical approaches to accomplish simulated photography by both GEMS techniques, and a recommendation as to what GEMS efforts should be continued in order to obtain a finalized evaluation technique."

Item #5. " Investigate an alternate method of controlling the modulation
and 5a. transfer function of-----etc. "

During April 1966, the theoretical analysis of the alternate methods of preparing GEMS was initiated and it was determined that a modified copy system employing a rotating area mask was most suitable. By July 1966, the breadboard model of the Alternate GEMS Making Equipment was completely fabricated and a computer program was written to allow the computer to specify the mask shape required for the desired modulation transfer function results. Some trouble was experienced with the lens system being used on the breadboard model in that it did not yield the resolution performance anticipated. However, it was decided to proceed with this lens system, even though it fell short of the goal of 200 cycles per millimeter. The experimental work of this item was completed during the latter part of 1966 and the final report was delivered in February 1967.

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Item #6. " Prepare a design layout of a GEMS viewing equipment and conduct-----etc. "

On or about 1 March 1966, the contractor released a request for quotation describing a split field microscope comparator to be used in the design study of an automated GEMS Viewer. Answers to this request resulted in placement of an order for an American Optical Split Field Microscope Comparator with delivery scheduled on 15 June 1966. The design study on the requirements of a GEMS Viewer was to be built around this device. By June 1966, the straight forward aspects of the Viewer had been committed to a design layout and the design study was completed in August 1966. A final report on this item was delivered in September 1966.

Item #7. " Upon completion of items #1 through #4 above, prepare 1000 to 1500 GEMS.-----etc. "

This item was primarily dependent on the results achieved during the basic GEMS Study. With the knowledge gained during the early stages of this study, the need for a large number of GEMS was considered as being no longer necessary and this item was deleted from the contract by Amendment No. 2.

Item #8. " At the completion of the program, prepare a comprehensive summary report. "

Delays in accomplishing various of the items has resulted in a slippage past the contract termination date of 30 September 1967. Delivery of required reports have⁴ been promised in October 1967.

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Item #9. "Submit monthly letter type status reports."

With the exception of one report during December 1966, monthly reports were submitted.

Item #10 "Construct a simple "Pseudo-GEMS" breadboard and conduct
10a an experiment to determine-----etc."

This item was authorized by Amendment No. 1 to the contract in November 1966 and planning to satisfy this additional work was started immediately by the contractor. By the end of December 1966, the breadboard had been fabricated and experiments utilizing this equipment were performed during early January 1967. A final report on this item was delivered during February 1967.

Item #11 "Preparation of a two dimensional GEMS matrix wherein modulation transfer function is varied----etc."

With Amendment No. 2 to the contract, item #1 was redefined and; for purposes of this report, redesignated as item #11. The contractor was to conduct a parallel effort in producing the matrix by both simulated photographic GEMS and Pseudo-GEMS. This program to analytically and experimentally prove the feasibility of an alternate procedure for making GEMS was initiated in February 1967. Investigation relative to the appropriate film for use in generating the GEMS caused a delay until June 1967 when the GEMS matrix was completed. A psychophysical GEMS Matrix Data Report, dated 30 June 1967, was received with the contractor's Progress Report No. 16 (covering the month of June 1967).

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Item #12 " Conduct a study toward the development of a GEMS technique which will provide a means of generating equal magnification GEMS-----etc. "

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This study was initiated by the contractor during April 1967. By 30 June 1967, most of the concept phases of the Equal Magnification GEMS approach had been completed. However, the choice of reversal film to be used in this approach still had not been determined. In the contractor's Progress Report No. 18 (covering the month of August 1967), it was noted that the writings of the final task reports existed at various stages of completion. The final report on this item was delivered in early October 1967.

Item #13 " Objectively measure and define the operational system parameters-----etc. "

This sub-study was added as an extension of item #1 under Amendment No. 2 to the contract. In the contractor's Progress Report No. 15 (covering the month of May 1967), it was stated that some difficulties were being experienced. However, the final report for this item was promised to be forthcoming in June. With the full time involvement of the report engineer on the Psychophysical GEMS Matrix Study during June, the report on this item was delayed. The report was received during the latter part of September 1967.

Item #14 " Anticipating that the Equal Magnification GEMS Study or the Pseudo-GEMS Viewer study may necessitate the acquisition of new original negative material, specify----etc. "

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Since there was no mention of this item in the contractor's monthly Progress Reports, it is assumed that the need to acquire new original negative material through special flights was not required.

Item #15 " Anticipating that a Pseudo GEMS Viewer can be fabricated
and
15a from a modified GEMS Viewer design, specify the viewer
modifications-----etc. "

During March 1967, the Pseudo GEMS Viewer Study was initiated. With verification of certain desirable features by the customer, the Pseudo GEMS Viewer Study was completed in May. A final report on this item was received in June 1967.

7. PERFORMANCE EVALUATION: The contractor's performance delineated in section 6 of this report is here ^o compared with the contract scope of work outlined in section 5 above and an evaluation made relative to completion of each item. For convenience, this is done on an item by item basis.

Items #1 The preparation of a usable two dimensional GEMS matrix
and
#11 was completed in June 1967, exactly one year later than the target date specified in the original contract. Some justifiable delays in constructing new facilities, hiring additional personnel, obtaining usable material, and in producing a matrix having the proper increment spacing, contributed to the overall delays in manufacture of this test set. However, it was completed in ample time to conduct the psychophysical test prior to the revised contract completion date of 30 September 1967, authorized under Amendment No. 2. It should be noted that a GEMS test set was completed and

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delivered to on 17 October 1966 for evaluation. This set was rejected, after visual inspection, due to the undesirable increment spacing of the modulation transfer function. This, of course, required additional study which was accomplished under the authorized redirection of effort. These items are considered satisfied within the terms of the amended contract.

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Items #2 The final performance of a psychophysical test, being

- 2a directly dependent upon the manufacture of a usable GEMS
- 2b test set, was necessarily delayed until 17 July 1967. With
- 2c a customer delay in furnishing personnel to perform the test and a contractor delay in compiling the data obtained during the test, a slippage past the amended contract termination date of 30 September 1967, occurred. As of 12 October 1967, the final report had still not been received by NPIC. Should this report be received in October 1967, it will be exactly one year later than the date specified in the original contract. Receipt of this final report will constitute satisfaction of this item.

Item #3. Due to availability of simulated photography from previous endeavors, the study toward refining existing simulation techniques proceeded rather rapidly. However, apparently unpredictable factors precluded completion of this study by October 1966, as specified in the original contract.

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It was noted, the the contractor's proposal leading to Amendment No. 2 to the contract, that "several items in this task have been completed". Further, in the contractor's Progress Report No. 11, covering the period 29 November 1966 to 24 January 1967, ^{it was stated} that "a report covering the previous work performed ^{is} ~~was~~ being prepared." A final report on this item has not been received nor is there any reference to this item in the contractor's Progress Reports after Report No. 11. Completion of this item would be effected by receipt of a final report which includes the material specified in the original contract.

Item #4. With the redirection of effort authorized by Amendment No. 2 to the contract, this item was deleted.

Item #5. These items (alternate production method and report) were and 5a. scheduled for completion in November 1966 in the original contract. Actual delivery of the required report was made in February 1967, which was well within the original contract termination date of 30 June 1967. This item is considered to be satisfied within the terms of the contract.

Item #6. The design layout and study of the GEMS Viewer was completed and a final report delivered in September 1966. This was one month after the scheduled delivery date but well within the original contract termination date of 30 June 1967. However, the submission of specifications for the instrument

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together with an accurate cost estimate applicable to the detailed design and fabrication of the device, as stipulated in the original contract, was never made by the contractor. Subsequent developments which led to Amendment No. 2 to the contract precluded submission of these items. Therefore, this item is considered to be satisfied for practical purposes, but not within the terms of the contract.

Item #7. This item ^{was} deleted by Amendment ¹ No. 2 to the contract. ME

Item #8. With the slippage past the amended contract termination date of 30 September 1967, delivery of the summary report has been delayed. The contractor has promised delivery of reports in October 1967. Receipt of a summary report will constitute satisfaction of this item.

Item #9. Monthly letter type status reports, with the exception of one missing report, were delivered. This item is considered to be satisfied within the terms of the contract.

Item #10 and 10a. The Pseudo-GEMS experiment was conducted and a final report delivered in February 1967, satisfying the terms set forth in Amendment No. 1 to the contract.

Item #11 (See comments under items #1 and #11 above).

Item #12 An Equal Magnification GEMS Study was started by the contractor in April 1967 and a report delivered to NPIC in early October 1967, slightly past the revised contract termination date of 30 September 1967. Completion of this study satisfies the terms set forth in Amendment No. 2 to the contract.

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- Item #13 The System Parameters Study was completed and a report delivered to NPIC in September 1967. Completion of this study satisfies the terms set forth in Amendment No. 2 to the contract.
- Item #14 Although neither the Equal Magnification Study nor the System Parameters Study apparently required acquisition of new material through special flights, mention is made in the report on the former study to a "Flight Program Considerations Report." This report may or may not be delivered under the present amended contract. In either case, due to loose ~~of~~ wording of the specifications, completion of this item may be argued, by the contractor, as not being mandatory.
- Item #15 and 15a A study to determine if the previously designed GEMS Viewer could be altered to produce a Pseudo-GEMS Viewer was successful and resulted in delivery of a report in June 1967. This report, in combination with the report on the GEMS Viewer, contain simple specifications but do not include "a cost estimate ~~to~~ applicable to the detailed design and fabrication of a Pseudo-GEMS Viewer". Therefore, until receipt of this cost estimate, the terms of the amended contract have not been met.

8. UNSATISFIED CONTRACT SPECIFICATIONS: As of 12 October 1967, the following items specified in the contract and its amendments had not been ~~met~~ satisfied.

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- a. Final report - "Psychological Test".
- b. Final report - "Refinement of Existing Simulation Techniques".
- c. Summary report - "GEMS Study".
- d. Cost estimate - "Detailed Design and Fabrication of a Pseudo-GEMS Viewer".

9. CONTRACT MONITOR INTERVIEW: On 16 October 1967, the NPIC, Technical Development Staff, Contract Monitor [redacted] was interviewed in order to determine if any late date reports or communications had been received. During this interview, it was learned that all correspondence received was available in the TDS contract file. In addition, it was learned that contractor personnel planned a briefing at NPIC, sometime during October 1967, during which the final reports would be presented and discussed.

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10. PSYCHOPHYSICAL TEST PARTICIPANT INTERVIEW: Interrogations of some of the NPIC personnel who participated in the psychophysical test conducted by the contractor revealed that what appeared to be a control test was first conducted using GEMS material only. The participants indicated that they had very little trouble in matching an unknown GEMS with its counterpart in the test matrix as long as the ^{scene} ~~same~~ content was the same. However, when the ^{scene} ~~same~~ content was varied, their ability to pick the matching GEMS deteriorated. This break down in accuracy was further evidenced when they tried to match actual mission material with the appropriate GEMS.

The description of the test indicated that it was designed and conducted essentially as written in the contract.

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11. DISCUSSION: During previous studies by the contractor, techniques were developed that permitted production of simulated photographs which gave a realistic impression of photographic image quality. As a logical follow-on to this achievement, psychophysical tests to determine practical increment variation between simulated reference photographs was indicated. The contract^c being evaluated in this report had the overall objectives of performing these psychophysical tests and continuing refinement of the simulation techniques. The aim of these objectives was the production of a set of GEMS which could be used to designate photographic image quality in terms meaningful to a varied audience. Specification of necessary hardware to permit efficient use of the GEMS was a correlative aim.

As with many studies, the paths pursued toward accomplishing these objectives met with varying degrees of success. Although the achievement of the sought after degree of quality is open to question, substantial progress was made and techniques perfected which show apparent promise.

12. CONCLUSIONS: With delivery of the reports and cost estimate listed in paragraph 8 above, the performance of the contract appears to have been substantially satisfied.

The questionable achievement of the sought after degree of quality (spatial frequencies up to 200 cycles per millimeter) should not be considered as being a reflection on the contractor's ability. Rather, it should be considered as being the result of cost producing delays due to inherent ^{devious} ~~devices~~ and unproductive explorations.

There are indications that certain delays in performance of the contract could have been obviated by the contractor. However, this should not

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be considered as derogatory since, in some instances, NPIC contributed to the delays.

Overall contractor performance in executing the contract indicates a certain lack of aggression.

13. CONTRACTOR FUTURE PERFORMANCE: Based on the proceeding review of the contractor's performance in executing the present contract, it is anticipated that he will be able to develop a useable set of GEMS within approximately one year. This is not to say that the originally sought after simulation of photography at spatial frequencies up to 200 cycles per millimeter will be realized. Rather, a limit approaching 200 cycles per millimeter (say 180 lines) appears to be a more practical achievable goal. It should be noted that this limit is in excess of the 120 cycle per millimeter performance level of our present camera system.

14. RECOMMENDATION: Based only on the evaluation of contractor performance, it is recommended that the GEMS project be continued for the express purpose of producing a useable set of GEMS or Pseudo-GEMS; this set to include simulated photography at spatial frequencies up to at least 180 cycles per millimeter.

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Approved For Release 2002/06/17 : CIA-RDP78B04747A000700010007-7