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9204-SHF64-69

Copy # 3

7 July 1964

Gentlemen:

Itek is pleased to submit this proposal covering a six month feasibility study and design effort for Phase I of the "F" System Development Program.

This proposal constitutes a bid for specific items of work, the details of which may be found in Section I, entitled "Work Statement," of the attached proposal.

Further, our prices for these items are in accordance with the schedule in Section V.

Our prices do not contain federal, state, or local taxes, as none are believed applicable. Furthermore, the above prices do not contain a price or charge for royalties in excess of $250.

The price and delivery quotations found in this proposal are predicated on the following terms, conditions, and contract considerations:

1. That your activities will issue a cost-plus-fixed fee contract substantially in accordance with standard ASPR and AFPI provisions applicable to cost reimbursement type contracts with commercial institutions.

2. That subject proposal is valid for a period of sixty (60) days after which time, Itek reserves the right to amend the terms and conditions thereof.

3. That the costing as presented does not include consideration of facility acquisitions, leasehold improvements and capital equipment.

4. That the F.O.B. point of all items delivered under this contract is Lexington, Massachusetts.

5. That ten (10) rolls of Type 4404 film be furnished GFE in order to perform the necessary testing required under this effort. Itek will provide the necessary spools to hold the above GFE film.

We are enclosing, for your planning purposes, a schedule and budgetary quotation for Phase II of the "F" Program under Appendices B & C of the attached proposal.

Attached herewith for your information and files are fully executed copies of the Contingent Fee Statement and Certificate of Current Pricing.

Very truly yours,

Walter J. Levison,
Vice President

This is to certify that, to the best of my knowledge and belief:

(i) complete pricing data current as of 7 July 1964 have been considered in preparing the Proposal 9204-SHF64-69 and submitted to the Contracting Officer or his representatives:

(ii) all significant changes in the above data which occurred since the aforementioned date through 7 July 1964 have been similarly submitted; and no more recent significant change in such data was known to the undersigned at the time of executing this certificate; and

(iii) all of the data submitted are accurate.

Name ____________________

Title ____________________

Firm ____________________

____

Date of Execution

CONTINGENT FEE REPRESENTATION

Bidder represents: (a) That he has not employed or retained any company or person (other than a full-time bona fide employee working solely for the bidder) to solicit or secure this contract, and (b) that he has not paid or agreed to pay to any company or person (other than a full-time bona fide employee working solely for the bidder) any fee, commission, percentage or brokerage fee, contingent upon or resulting from the award of this contract, and requested by the Contracting Officer.

______________________ ______________________

Date of Execution

9204-SHF64-69

Copy No._____

7 July 1964

PROPOSAL FOR

FULCRUM CAMERA SYSTEM

FEASIBILITY STUDY

CONTENTS

SECTION 1

WORK STATEMENT

TASK I - FILM HANDLING FEASIBILITY STUDY

Itek will analyze the inherent problem in producing a high speed film transport system which has the capability of maintaining film velocities to level of accuracy consistent with the requirements of a high resolution (minimum of 100 l/mm on film) panoramic camera system for use in photography from orbiting satellites which may operate in a V/H range from 0.06 rad/sec to 0.035 rad/sec.

At least two of the more feasible approaches will be designed and manufactured in the form of engineering (non-flight) models. These models will be of a sufficient degree of sophistication to allow complete evaluation of film drive problems and will permit a determination to be made of their feasibility when incorporated as part of the complete camera. Both models will incorporate the necessary film drum rotation and translation mechanizations for compensation of all image motion vectors along a line in the format and over a 120-degree scan angle.

Two basic methods of film transport will be investigated. The first will be a method which allows exposure of the film frame after frame but necessitates storage of film loops to account for the periods during which no exposure is being made. The second method will be that in which the film is moved passed the exposing slit continuously at a constant velocity with the slit capped when exposure is not desired. This method requires a means of coding or indexing the films such that an accurate accounting of the positions of the unexposed areas can be maintained in order that these areas can be exposed at a later time. A careful study will be made of the reliability and practicability of the film reversing operation. Careful attention will be given to minimizing film wastage and the trade-off between start-up power and minimum time for an on-off cycle.

In the case of the accelerated film approach, an evaluation of wasted film due to degraded imagery should be made. Also the feasibility of using an interrupted scan mode of operation should be studied. The problem of additional programmer complexity should also be examined in this context.

The models will be operated in a vacuum chamber to ascertain the dynamic effects of the absence of air. No further environmental testing will be undertaken in conjunction with this effort. Vacuum tests will be conducted using existing facilities which are currently being utilized on other Government contracts. This effort is predicated upon the use of these facilities on a non-interference basis.

All design, testing and evaluation shall conform to good commercial practice rather than to military specifications.

At the conclusion of the six month program, a detailed evaluation report on each of the two prototypes will be delivered. This report will include the following:

a. The results of experiments designed to measure the film velocity errors with description of measuring techniques.

b. A statistical estimate of image degradation due to film velocity error.

c. The results of environment chamber tests designed to examine high speed film handling problems (such as corona discharge) at operational gas pressures and film dynamics.

d. The results of experiments with Kodak Type 4404 7" film designed to test the two prototypes for film damage (scratching, etc.)

e. A summary comparison of the two prototypes including operational considerations and estimated reliability.

TASK II - CAMERA DYNAMICS STUDIES

Task II is comprised of the following individual sub-tasks:

a. Dynamic Analysis

b. Camera Bearing Development

c. Evaluation and Reports

A. Dynamics Analysis

Analytical studies shall be made of camera dynamics in order to provide a basis for camera and spacecraft design and integration; specific items requiring study include:

(1) Critical system bearing loads during in-flight operation and pre-launch testing.

(2) The effect of rolling element bearing noise (in both the main bearing and film transport) on camera system vibration.

(3) The effect of spacecraft torquing on camera rotational rate and bearing loads.

(4) The effect of camera component (i.e: film supply and take-up spools, intermittent film drive roller, etc.) acceleration on camera rotational rate and bearing loads.

(5) The effect of shifts in film center of gravity on camera bearing loads and spacecraft attitude control.

(6) The integrated effect on image quality resulting from camera dynamics which shall include spacecraft motions directly related

inertial effects of the motion of the camera system and its components, but shall not include the effects of film transport errors.

B. Camera Bearing Development

A detailed design study and test program shall be conducted to develop the camera's main optical bar bearing. Two alternative approaches shall be considered: one, a gas-lubricated bearing and two, a rolling-element bearing. The design of each of these alternatives shall be suitable for in-flight operation, pre-launch (vertical attitude) testing and in-plant (horizontal attitude) testing when utilized with a small diameter rolling element outboard bearing and slip rings for electrically coupling the optical bar to the spacecraft. A complete full-scale single camera mock-up of each alternative shall be designed and fabricated for evaluation testing under operational environmental conditions. In order to permit realistic evaluation of operational conditions (i.e: steady-state, start-up and stop, and caged modes of operation in a near-vacuum environment), the weight and center of gravity of each mock-up shall be as accurate as the effort under Task V permits.

The design of each main bearing alternative shall be in accordance with the loads established in section A of this task. Design of the gas bearing shall be based upon a survey of large air bearings designed for operation under near-vacuum environmental conditions; particular emphasis shall be directed toward the development of a highly reliable bearing requiring a minimum gas flow rate. Included in this effort shall be the investigation of the design of a bearing caging system and a suitable air supply and metering system.

In addition to the functional testing of the two alternative main bearing designs, each shall be instrumented and tested for vibrational effects which could cause image degradation.

C. Evaluation and Reports

Upon conclusion of the task defined above, the following reports shall be prepared.

(1) A report summarizing the results of dynamics analysis studies included in section A.

(2) Upon completion of the design study and test program for the two alternative main bearings, test results shall be evaluated and summarized in a report which shall include:

(a) Bearing design study summary

(b) Test program results and conclusions

(c) Application of test results to free fall conditions and launch load conditions

(d) Preliminary design specification for the immediate detail engineering design of the (preferred) main and outboard bearing system and slip ring assembly.

TASK III - OPTICAL DESIGN

A six-month effort is planned for completion of a final optical design for the proposed system. The optical system to be designed shall be a 60-inch focal length, f/3 system, 6-inch field, capable of providing the best possible image quality on SO-132 film with a minus blue filter. The type of lens considered shall be a meniscus corrected catadioptric, preferably with no aspheric surfaces. The overall length and other optical characteristics shall be suitable for the intended application.

An optical design will be carried out using our 924 computer. The length constraints of the system will require modification of existing programs. The mechanical and ~~thermal~~ tolerances will be programmed and analyzed and system analysis will be done to evaluate the effect of environment upon the optical system. probably by Vydia

As a backup factor, a lens design will be procured from an independent source which will be evaluated along with the Itek design. This will be carried only to a stage sufficient to determine feasibility and image quality.

A technical summary will be prepared at the end of each month. A preliminary lens design and tolerancing analysis will be presented at the end of the third month. A final report will be supplied at the end of the sixth month covering all design and analysis carried out. Continuous system analysis and consulting services will be supplied to the project and to the optical manufacturing department.

The preliminary design will be satisfactory for prototype fabrication of elements. The final design shall incorporate all features appropriate to production quantities.

CRITICAL COMPONENTS

The preliminary design layout does not present any significant optical fabrication problems which would be beyond our capability. Our experience in large optics has resulted in a test-during-fabrication capability which exceeds the requirements of this system. Nevertheless, there are three optical components of sufficiently critical nature that thoughtful design and extreme care in fabrication and mounting are required if a successful system is to result. These three items are the meniscus corrector window, the folding mirror and the primary mirror. A fourth critical item is the choice of proper mounts for the components so that no image degradation will occur as a result of misalignment or stressing of the optical components.

During the optical design study, investigations into materials and structures, as well as fabrication, assembly and test techniques will be conducted to assure optimum selection of components and manufacturing methods conducive to as efficient a production schedule as is feasible for systems of this type.

The three most critical components will be designed in detail and fabricated and tested to a degree which will assure optical, mechanical, thermal and operational integrity.

1. Corrector Lens

We have studied the effects of thermal gradients and their optical effects on flat windows and these investigations will be extended to cover the heat transfer to and through the faces and edge of the nearly concentric spherical shell of the corrector lens. Calculations will be made of the defocussing and aberration effects of uniform temperature excursions to determine the degree to which such effects can be tolerated in operation. The amount and configuration of edge insulation and other mounting details need to be determined. Our past success in using cast-in-place epoxy locating shoulders for mounting large lens elements indicates that we can extend this technique to foamed-in-place resins to provide the edge insulation we expect will be required.

240" analysis performed by Vydec

Vydec

2. Folding Mirror

It is expected that thermal considerations will predominate. Quantitative evaluation for the precise final optical configuration within the anticipated environment will undoubtedly indicate that a metal mirror will be required for the diagonal flat. Intensity reflected solar radiation (albedo) incident on components behind the meniscus window nearest to and furthest from the entrance aperture will result in a significant difference in heat flux across the components. The preliminary optical design indicates a rectangular hold in the folding mirror which will introduce problems in manufacture and it will be necessary to establish proper polishing techniques applicable to a production schedule. Ritchie tests using laser interferometric techniques will be utilized in the testing of the flat.

Vydec

We have had some success in elastometric mounting of comparable metal mirrors; the suitability of these methods, or variations thereon, will be considered in light of the expected operational environment.

Two-plate ribbed sandwich construction for the folding mirror will be investigated in view of weight restrictions, but certain hazards in increasing the possibility of surface figure irregularities must be considered in going to such light-weight structures.

3. Primary Mirror

This component does not present any unique difficulties in fabrication. Weight considerations will undoubtedly dictate the use of ribbed fused silica. Mounting the primary will be the most critical item and efforts will be mainly directed toward the design of a strain-free mount which will fix the mirror in the proper alignment without imposing undue constraint or introducing surface figure irregularities beyond tolerable limits.

STRUCTURE

The criterion for the support structure of the optical system is one which will maintain the precision alignment required to insure elimination of any degradation resulting from the environmental effects on the components and their mounts. The individual mounting arrangements for the various components will be provided ample freedom of adjustment during final tuning of the optical system. Use of proper types of materials will provide compensation for thermal variations which would otherwise contribute a reduction in system performance.

As mentioned under the three critical components, extreme care must be taken in the choice of various mounting methods depending on the geometrical shape and inherent rigidity of the individual components. Various techniques such as precision edging for smaller components are not necessarily successful in large diameter optics and it is expected that our past successes in potting techniques will be used in the more critical components to achieve close tolerance alignment and perpendicularity.

The result of the six month effort will be a technical plan for follow-on production based on a final optical design suitable for qualification units and prototype manufacturing. This will be followed by a full production schedule at the required rate.

TASK IV - FACILITIES STUDY

The purpose of this task will be to survey Phase II facility requirements for environmental test, project, optical fabrication, assembly, field service, and mission support. Particular attention will be paid to requirements for leasehold improvements and government furnished equipment. Long lead items which might delay scheduled delivery of operational equipment will be identified to the contracting agency as soon as they are evident.

Specifications for facilities and equipment will be prepared in detail. Schedules and costs of facility construction and furnishings, including all pertinent data, will be developed and presented in a summary document at the end of the five month period.

TASK V - DESIGN AND ENGINEERING

Task V is comprised of the following individual efforts:

A. Task I and II Mockup Support

B. Interface Definitization

C. Structural Design

D. Panoramic Geometry Method

E. Pressurization Design

F. Weight, Balance and Momentum Accounting

G. Camera System Mockup

A. <u>Task I and II Mockup Support</u>

Provide coordination such that the brassboard designs for the film transport and bearing system are compatible to the extent that no major redesign will be necessary when they are mated in the final configuration.

B. <u>Interface Definitization</u>

Study power requirements, vehicle loading, window sizes and placements, electrical cable requirements, and all other items necessary to the definition of vehicle requirements.

C. <u>Structural Design</u>

Analyze pertinent parameters such as interoptic tolerance, expected thermal variation, launch loads and ground test requirements. Design appropriate camera structure and camera-to-vehicle mount to the detail which allows definition of required materials and allowable dimensional tolerances. Also included will be a continuous accounting of the system weight and balance. The production of detailed drawings and component specifications will not be part of this effort.

D. Panoramic Geometry Method

Considerat on will be given to providing a fiducial system such that a definite relationship can be established between image points and the original object points.

E. Pressurization Design

Consider the parameters affecting the maintenance of a pressure at the film transport area such that corona discharge is obviated. The amount of spillage of air from the camera air bearing will be accounted for and calculations made for makeup air if needed.

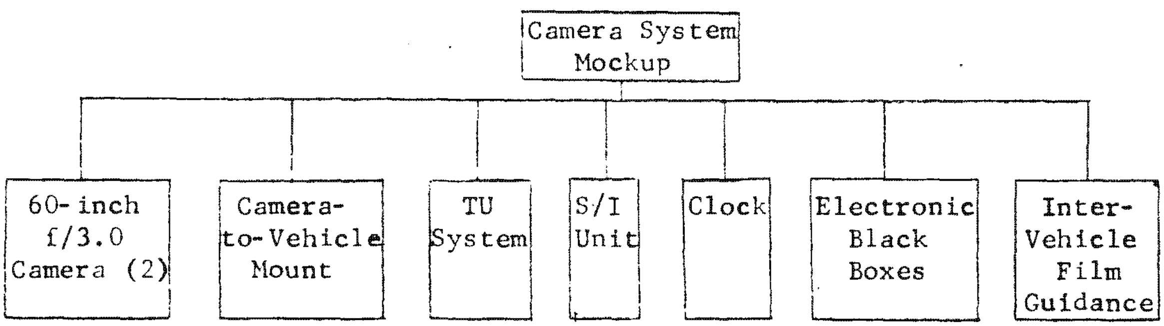
F. Weight, Balance and Momentum Accounting

Maintain a continual accounting in a detailed way of the noted items such that the contracting agency can maintain an accurate satellite reconnaisance system weight and balance budget.

G. Camera System Mockup

Construction of wood and metal mockups showing proper size and space relationships of all camera system components, their relationship to each other, and to the vehicle.

The following figure is a block diagram of the camera system mockup:



TASK VI - PROGRAM ANALYSIS

Continue analysis of the Phase II program with regard to schedules and lead times. This effort will result in a definitive schedule for Phase II at the completion of Phase I. During Phase I, long lead items affecting Phase II will be identified as they emerge.

SUMMARY OF DELIVERABLE ITEMS

Contractual requirements of the Phase I Program are as summarized below.

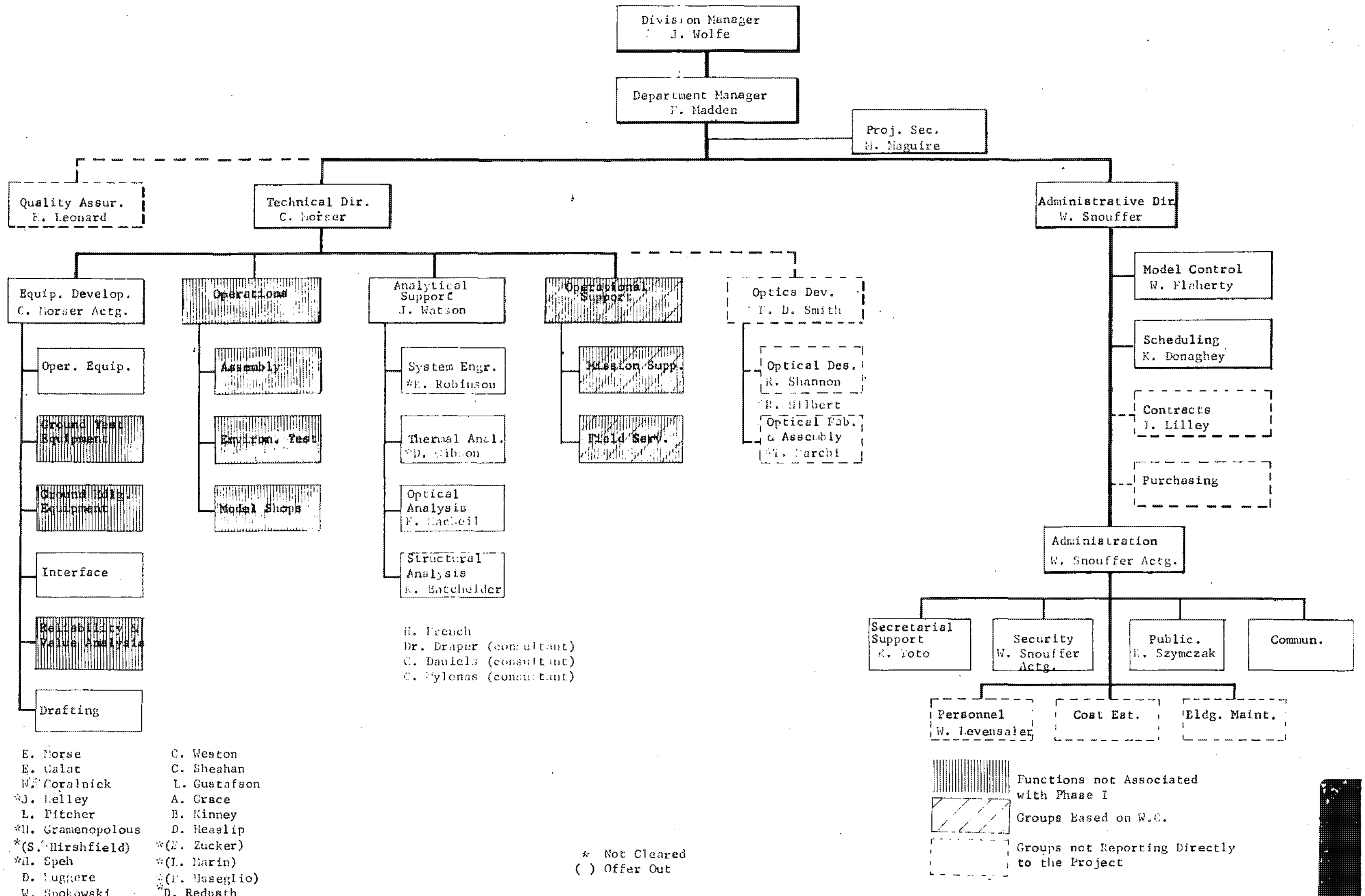
Item	Quantity	Description	Delivery Date
1	1	Engineering model of a constant velocity film transport system	12/31/64
2	1	Engineering model of an intermittent film transport system	12/31/64
3	1	Evaluation report of the performance of the two models (Items 1 and 2 above)	12/31/64
4	1	Full scale single camera dynamic mockup incorporating the main gas bearing	12/31/64
5	1	Full scale single camera dynamic mockup incorporating rolling element main bearings	12/31/64
6	1	Evaluation report of the performance of the bearings incorporated in the two models (Items 4 and 5 above)	12/31/64
7	1	Detailed report of the camera dynamics analytical studies	12/31/64
8	1	Engineering specifications for the fabrication of the optical system	9/30/64
9	1	Detailed report covering the design and expected performance of the optical system	9/30/64
10	1	Prototype elements of the optical system including one each of the corrector plate, primary mirror, folding mirror, associated cells and necessary holding fixtures	12/31/64
11	1	Summary report of facility requirements, costs, schedules and specifications for their construction	11/30/64
12	1	Interface document defining camera system envelope, weights, power requirements, and other camera-spacecraft interface factors	8/31/64
13	1	Full scale design mockup of the complete camera system	12/31/64

Item	Quantity	Description	Delivery Date
14	1	Detailed report summarizing the complete camera system design	12/31/64
15	1	Program plan for Phase II	12/31/64

SECTION 2

PROJECT ORGANIZATION CHART

SPECIAL HANDLING



SPECIAL HANDLING

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SECTION 3

PHASE I TASK ASSIGNMENTS

PHASE I
TASK ASSIGNMENTS

TASK I FILM HANDLING FEASIBILITY STUDY	TASK II CAMERA DYNAMICS STUDIES	TASK III OPTICAL DESIGN	TASK IV FACILITIES STUDY	TASK V DESIGN AND ENGINEERING	TASK VI PROGRAM ANALYSIS
E. Morse	C. Morser	R. Shannon	B. Kinney	D. Ruggere	K. Donaghey
E. Galat	*(E. Zucker)	*R. Hilbert	J. Kastler	C. Weston	
*H. Speh	W. Spokowski	F. MacNeil		*(L. Marin)	
N. Goralnick	C. Sheahan			A. Grace	
*J. Kelley	L. Gustafson			D. Heaslip	
L. Pitcher	*(F. Usseglio)			*D. Gibson	
*(S. Hirshfield)					
*N. Gramenopolous					
*D. Redpath					

GENERAL SUPPORT
J. Watson
*K. Robinson
R. Batchelder

* Not Cleared
( ) Offer Out

SECTION 4

PHASE I SCHEDULE

SPECIAL HANDLING

PHASE I SCHEDULE

	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER
TASK I	CONCEPT	DESIGN	FABRICATION	ASSEMBLY	TEST	TEST EVAL.
TASK II		SAME	AS TASK I			ANALYTICAL REPORT EXPERIMENTAL REPORT
TASK III Vydia Inc	MATERIAL PROCUREMENT		DESIGN COMPLETE	FABRICATION		TEST
TASK IV	FACILITIES REQ. STUDY		SPEC. WRITING	SUB CONTRACT COSTING	FACILITIES REPORT REPORT PREP.	
TASK V Vydia Inc.	CONCEPT	INTERFACE SPECIFICATION DETAILED DESIGN	CONTINUED WEIGHT, MOCKUP FABRICATION	BALANCE, AND POWER ACCOUNTING.	MOCKUP ASSEMBLY	REPORT PREP
TASK VI	CONTINUED SCRUTINY OF PHASE II REQUIREMENTS AND IDENTIFICATION OF LONG LEAD ITEMS.					

ALL FINAL RE[redacted]

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SECTION 5

PHASE I COSTS

SPECIAL HANDLING

"F" SYSTEM PROGRAM

PRICING SUMMARY - PHASE I

	Project Management		TASK I Film Handling Feasibility Study		TASK II Camera Dynamics Studies and Engineering Test Mock-Ups		TASK III* Optical Design	
	Hours	Dollars	Hours	Dollars	Hours	Dollars	Hours	Dollars
Senior Executive Engineer								
Executive Engineer	2,398	23,884	779	7,758			1,180	11,753
Staff Engineer	1,199	8,849	6,383	47,107	3,721	27,461	1,120	8,266
Senior Engineer	1,199	6,846	12,174	69,514	6,599	37,680	4,312	24,514
Engineer	3,598	15,759	3,891	17,043	2,623	11,489	2,304	10,092
Junior Engineer	2,763	9,505	2,202	7,575	1,513	5,205	1,580	5,435
Senior Technician	2,216	7,468	11,553	38,934			800	2,696
Technician					1,866	5,449		
Designer			10,166	40,257	2,377	9,412	240	950
Draftsman					4,388	10,049	60	137
Senior Draftsman			10,383	35,821			1,040	3,588
Optical Shop							2,540	8,484
Programmer							2,660	8,352
Technical Writer	2,216	10,349						
Technical Illustrator	1,017	3,743						
Senior Inspector			4,031	13,544	3,951	13,275	200	672
Experimental Machinist					6,090	16,626		
Senior Experimental Machinist			7,383	24,881	4,569	15,398	220	741
Senior Assembler					5,861	12,777	440	959
Project Secretary	10,886	23,949	2,141	4,710				
Computer Operator								
Total Direct Labor Hours	27,492		71,086		43,558		18,696	
Total Direct Labor Dollars		$110,352		$ 307,144		$164,821		$ 86,639
Overhead		169,942		473,002		253,824		132,888
Material & Sub-Contracts		22,800		85,000		50,000		81,150
Travel		24,690						2,764
Communications		13,000						120
Consulting				20,000		5,000		2,000
Special Tools & Equipment								18,050
Other Direct Labor		4,960						
Overtime Premium		4,255		5,802		3,272		
Other Direct Costs		6,000						
Sub-Total		$355,999		$ 890,948		$476,917		$323,611
G & A		51,620		129,187		69,153		46,758
Total Costs		$407,619		$1,020,135		$546,070		$370,369
Fee		36,686		91,812		49,146		33,333
Total Selling Price		$444,305		$1,111,947		$595,216		$403,702

* Includes Vidya, See Attached Schedule

SPECIAL HANDLING

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"F" SYSTEM PROGRAM

PRICING SUMMARY - PHASE I

	TASK IV Facilities Study		TASK V * Design and Engineering		TASK VI Program Analysis		TOTAL	
	Hours	Dollars	Hours	Dollars	Hours	Dollars	Hours	Dollars
Senior Executive Engineer			520	5,860			520	5,860
Executive Engineer			343	3,416			4,700	46,811
Staff Engineer	332	2,450	4,011	29,583			16,766	123,716
Senior Engineer	1,000	5,710	7,018	39,821			32,302	184,085
Engineer	1,000	4,380	8,275	36,245	1,000	4,380	22,691	99,388
Junior Engineer			934	3,213			8,992	30,933
Senior Technician			2,548	8,587			17,117	57,685
Technician			1,320	3,854			3,186	9,303
Designer			3,729	14,767			16,512	65,386
Draftsman	1,344	3,078	5,661	12,964			11,453	26,228
Senior Draftsman			328	1,132			11,751	40,541
Optical Shop							2,540	8,484
Programmer			1,040	4,659			3,700	13,011
Technical Writer							2,216	10,349
Technical Illustrator							1,017	3,743
Senior Inspector							8,182	27,491
Experimental Machinist			1,261	3,443			7,351	20,069
Senior Experimental Machinist							12,172	41,020
Senior Assembler							6,301	13,736
Project Secretary			160	470			13,187	29,129
Computer Operator			160	434			160	434
Total Direct Labor Hours	3,676		37,308		1,000		202,816	
Total Direct Labor Dollars		$15,618		$168,448		$ 4,380		$ 857,402
Overhead		24,052		255,764		6,745		1,316,217
Material & Sub-Contracts				50,964				289,914
Travel				3,078				30,532
Communications								13,120
Consulting								27,000
Special Tools & Equipment								18,050
Other Direct Labor								4,960
Overtime Premium				2,082				15,411
Other Direct Costs								6,000
Sub-Total		$39,670		$480,336		$11,125		$2,578,606
G & A		5,752		68,170		1,613		372,253
Total Costs		$45,422		$548,506		$12,738		$2,950,859
Fee		4,088		49,365		1,146		265,576
Total Selling Price		$49,510		$597,871		$13,884		$3,216,435

* Includes Vidya, See Attached Schedule

SPECIAL HANDLING

TASK III SUPPLEMENT

	GOVERNMENT SYSTEMS		VIDYA		TOTAL	
	HOURS	DOLLARS	HOURS	DOLLARS	HOURS	DOLLARS
Executive Engineer	1,180	11,753			1,180	11,753
Staff Engineer	1,120	8,266			1,120	8,266
Senior Engineer	3,800	21,698	512	2,816	4,312	24,514
Engineer	2,304	10,092			2,304	10,092
Junior Engineer	1,580	5,435			1,580	5,435
Senior Technician	800	2,696			800	2,696
Designer	240	950			240	950
Draftsman	60	137			60	137
Senior Draftsman	1,040	3,588			1,040	3,588
Optical Shop	2,540	8,484			2,540	8,484
Programmer	2,660	8,352			2,660	8,352
Senior Inspector	200	672			200	672
Senior Experimental Machinist	220	741			220	741
Senior Assembler	440	959			440	959
Total Direct Labor Hours	18,184		512		18,696	
Total Direct Labor Dollars		$ 83,823		$2,816		$ 86,639
Overhead		129,087		3,801		132,888
Material		81,150				81,150
Travel		2,764				2,764
Communications		120				120
Consulting		2,000				2,000
Special Tools & Equipment		18,050				18,050
Sub-Total		$316,994		$6,617		$323,611
G. & A.		45,964		794		46,758
Total Costs		$362,958		$7,411		$370,369
Fee		32,666		667		33,333
Total Selling Price		$395,624		$8,078		$403,702

Approved for Release: 2018/02/01 C05108510

SPECIAL HANDLING

TASK V SUPPLEMENT

	GOVERNMENT SYSTEMS		VIDYA		TOTAL	
	HOURS	DOLLARS	HOURS	DOLLARS	HOURS	DOLLARS
Senior Executive Engineer			520	5,860	520	5,860
Executive Engineer	343	3,416			343	3,416
Staff Engineer	3,851	28,420	160	1,163	4,011	29,583
Senior Engineer	5,818	33,221	1,200	6,600	7,018	39,821
Engineer	8,275	36,245			8,275	36,245
Junior Engineer	934	3,213			934	3,213
Senior Technician	2,548	8,587			2,548	8,587
Technician	1,320	3,854			1,320	3,854
Designer	3,729	14,767			3,729	14,767
Draftsman	5,661	12,964			5,661	12,964
Senior Draftsman	328	1,132			328	1,132
Programmer			1,040	4,659	1,040	4,659
Experimental Machinist	1,261	3,443			1,261	3,443
Project Secretary			160	470	160	470
Computer Operator		——	160	434	160	434
Total Direct Labor Hours	34,068		3,240		37,308	
Total Direct Labor Dollars		$149,262		$19,186		$168,448
Overhead		229,863		25,901		255,764
Material & Subcontract		40,000		10,964		50,964
Travel				3,078		3,078
Overtime Premium		2,082		———		2,082
Sub-Total		$421,207		$59,129		$480,336
G & A		61,075		7,095		68,170
Total Costs		$482,282		$66,224		$548,506
Fee @ 9%		43,405		5,960		49,365
Total Selling Price		$525,687		$72,184		$597,871

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LABOR RATES AND CLASSIFICATIONS

Executive Engineer	$9.96
Staff Engineer	7.38
Senior Engineer	5.71
Engineer	4.38
Junior Engineer	3.44
Senior Technician	3.37
Technician	2.92
Designer	3.96
Draftsman	2.29
Senior Draftsman	3.45
Optical Shop	3.34
Programmer	3.14
Technical Writer	4.67
Technical Illustrator	3.68
Inspector	2.57
Senior Inspector	3.36
Experimental Machinist	2.73
Senior Experimental Machinist	3.37
Senior Assembler	2.18
Project Secretary	2.20

Labor Overhead - Government Systems	154.0%
G & A	14.5%

VIDYA

LABOR RATES AND CLASSIFICATIONS

Senior Executive Engineer	$11.27
Staff Engineer	7.27
Senior Engineer	5.50
Senior Programmer	4.48
Computer Operator	2.71
Project Secretary	2.94

Labor Overhead - Vidya	135%
G & A	12%

SECTION 6

MANPOWER REQUIREMENTS

TECHNICAL MANPOWER REQUIREMENTS

	July	Aug	Sept	Oct	Nov	Dec
Principal Engineer						
Electrical	1	1/2	1/2	1/2	1/2	1/2
Optical	1	1	-	-	-	-
Analytical	1-1/2	1/2	1/2	1/2	1/2	1/2
Thermal	-	-	1	1	1	1
Staff Engineer						
Electrical	3	3	4	4	4	4
Mechanical	3	4	5	5	5	5
Optical	1	1	1	1	1/2	1/2
Analytical	1	1	1	1	1	1
Thermal	1	1	1	1	1	1
Senior Engineer						
Electrical	3	8	10	12	12	12
Mechanical	1	13	15	15	15	15
Thermal	1	1	1	1	1	1
Structural	2	2	2	2	2	2
Photo	1/2	1/2	1/2	1/2	1/2	1/2
Environmental	1	1	1	1	1	1

	July	Aug	Sept	Oct	Nov	Dec
Engineer						
Electrical	1	1	3	3	3	3
Mechanical	2	6	8	8	8	8
Optical	2	2	2	2	2	2
Structural	1	1	1	1	1	1
Facility	-	1	1	1	1	-
Junior Engineer						
Mechanical	1	2	4	4	4	4
Analytical	1	1	1	1	1	1
Designer						
Electrical	1	3	7	10	7	5
Mechanical	3	7	15	17	12	10
Draftsman	1	13	28	28	28	26

APPENDIX A

RESUMES

EDMUND J. GALAT
Staff electrical engineer, Optical Systems Division of Government Systems

Special Qualifications

Strong background in radar system design and supervision.

Experience

1963-Present: Itek Corporation. Signal processing of video and radar information.

1961-1963: RCA, Aerospace Communications and Control Division, Burlington, Massachusetts. Senior member of the technical staff and lead engineer on a program to develop a guidance coupler for a satellite program, a program to develop and electronic countermeasures analyzer, and a program to provide an integrated air traffic control tower for the AN/TSQ-47 System.

1960-1961: Sylvania Corporation, Waltham, Massachusetts. Directed project on the AN/MPQ-32 Radar System Track Signal Processor; designed the range servo-system and target detection circuitry.

1954-1960: RCA, Moorestown, New Jersey. Project engineer involved in the design of ranging systems for precision radar tracking systems. These included the AN/FPS-16, BMEWS, and Tradex systems. Areas of interest were range tracking, target detection and acquisition, and synchronization equipment design.

Education

B.S. in electrical engineering, University of Massachusetts, 1954.
Graduate study at the University of Pennsylvania and Northeastern University.

Associations

Institute of Electrical and Electronics Engineers

NORMAN S. GORALNICK
Electrical engineer, Advanced Programs Branch of Optical Systems Division

Special Qualifications

Design of control and pulse circuitry using transistor and semiconductor techniques.

Experience

1958-Present: Itek Corporation. Design of systems involving extensive use of semiconductor logic. Formerly, worked on control circuitry in the electrical design of viewers.

Education

B. S. in electrical engineering, Tufts University, 1958.

ROBERT S. HILBERT
Senior photo-optical engineer, Optical Design Department

Special Qualifications

Lens design, optical shop techniques.

Experience

1963-Present: Itek Corporation. Lens designer. Responsible for the optical design and analysis of a variety of lens systems. Specific types of lenses worked on include: catadioptric, wide angle, ultraviolet, wide spectrum, and copying lenses.

1962-1963: Institute of Optics, University of Rochester. Lens designer and graduate work towards Master's degree.

Summer 1962: University of Rochester. Lens designer.

Summer 1961: The Perkin-Elmer Co., Inc., Danbury, Connecticut. Optical engineer.

1959-1960: Itek Corporation. Precision optician.

Summer 1958: Frank Cooke, North Brookfield, Massachusetts. Optical technician.

Education

B.S. in optics, University of Rochester, 1962.
M.S. in optics, University of Rochester, 1964.

Associations

Optical Society of America.

Publications

Master's thesis, A Study of Catadioptric Systems; coauthor, R. E. Hopkins, University of Rochester volume on Optical Design of Mirror Systems, 1962.

Awards

American Optical Fellow, University of Rochester, 1962.
Future Scientist of America (for cycloramic camera design), 1957.

BERNARD W. KINNEY
Manager, Environmental Laboratory of Government Systems

Special Qualifications

Environmental testing of electromechanical-optical systems and components; organization and direction of environmental facilities.

Experience

1958-Present: Itek Corporation. Responsible for the scheduling, supervision, and conduct of all tests performed in the Environmental Laboratory, the design of handling equipment used in testing, and the preparation of all test procedures and reports.

1957-1958: Avco Manufacturing Corp., Wilmington, Massachusetts. Mechanical engineer. Conducted complex tests, prepared test reports, supervised technicians and engineers, and worked with personnel outside the company.

1955-1957: White Sands Proving Ground, New Mexico. Mechanical and Ordnance engineer. Designed and wrote specifications for instruments and shop fabrications required for ballistic measurements. Performed duties assigned in the fields of mechanical engineering testing. Developed test procedures, e.g., operational reliability and environmental tests. Arranged for data reduction. Analyzed and evaluated data to determine performance of equipment under test. Had project assignment to test missiles, missile components, and associated equipment for vibration, stress, strain, ruggedness and transportation. Prepared reports, scheduled work, and supervised engineers and technicians.

Education

B.S. in mechanical engineering, New Mexico State University, 1954.

Associations

Pi Tau Sigma, Sigma Tau.

FREDERICK C. MACNEIL
Optical engineer, Engineering Branch of Government Systems

Special Qualifications

Research and development of electro-optical systems.

Experience

1963-Present: Itek Corporation. Performing analytical research applicable to laser receiving systems.

1958-1963: Radio Corporation of America, Burlington, Massachusetts. Engineering scientist. Participated in the development of airborne infrared warning systems, trackers, radiometers, missile seekers, and reconnaissance systems as well as other visible and ultraviolet design programs.

1951-1958: Baird-Atomic, Inc., Cambridge, Massachusetts. Senior optical engineer. Participated in research and development of infrared trackers, analyzers, visible star trackers, and visible and infrared spectroscopic instrumentation.

Education

B.S. in physics, Boston College, 1951.

FRANCIS J. MADDEN
Staff engineer, Projects Department of Optical Systems Division of Government Systems

Special Qualifications

System R&D engineering on panoramic cameras and special photo-optical systems.

Experience

1958-Present: Itek Corporation. Responsible for the system design and engineering coordination of a photo-optical program.

1951-1958: Mechanical engineer, Boston University Physical Research Laboratories, Boston, Massachusetts. Designed pressurized containers to carry electronic instrumentation used in upper atmosphere research. Designed a synchronized, three-motion picture camera array which provided 100-percent film coverage of any event. Designed an armored, five-channel recording galvanometer and special parachute swivel bolt which, through a series of slip rings, carried information from strain gauges in the parachute webbing to the recording galvanometer. Designed two lens-polishing tables, and the mechanical components for a six-inch interferometer. Project engineer, development and testing of a twin metrogon lens camera. Designed a 240-inch, f/10 mirror camera and the same system scaled down to a 75-inch focal length. Project engineer, development of a system for obtaining accurate geodetic references. Project engineer, design of equipment necessary for the study of an airborne camera of high resolution with minimum mass. Project engineer, design and development of feasibility model of HYAC I. Designed a 100-inch, f/16 infrared camera. Former instructor in physics, Boston University College of Liberal Arts. Former lecturer in basic engineering thermodynamics, Boston University College of Industrial Technology.

Education

B.S. in mechanical engineering, Northeastern University, 1951.

Patents

One patent pending.

F. THOMAS MARCHI
Supervisor, Optical Products Section, Applied Optics Department
of Government Systems

Special Qualifications

Development of optical testing techniques as they apply to flat, spherical, and parabolic mirrors; development of design and fabrication techniques on lightweight metal mirrors; evaluation of optical systems by means of photo and optical tests.

Experience

1958-Present: Itek Corporation. Overall supervision of optical testing, assembly, fabrication, and experimental groups. Direct responsibility on contract AF33(616) 8426 (Environmental Effects on Large Optics) for procurement, fabrication, test, and acceptance of all optical components. Development work on metal mirrors for this and other programs. Performed quality degradation studies on aerial photographs to determine effect of film and scale factors. Designed prism for special camera installation. Performed quality performance tests on specialized photographic windows.

1953-1958: Pratt and Whitney, East Hartford, Connecticut. Test and photographic engineer. Tested materials and performed heat transfer work on nuclear propulsion systems. Applied photography and optics to engineering problems. Designed photography laboratory. Worked with high speed, multiple flash, time lapse, and motion picture photography.

1951-1953: Boston University Physical Research Laboratories, Boston, Massachusetts. Research assistant. Tested cameras, optical glass, and optical instruments photographically and optically.

Education

B. S. in engineering physics, University of Maine, 1951.

Associations

Sigma Pi Sigma; Optical Society of America.

Publications

Paper on lightweight metal mirrors (for internal use).

EDWARD P. MORSE
Manager, Engineering Branch of Operations of Government Systems

Special Qualifications

Design and development of electronic equipment (including servomechanisms) for reconnaissance systems, high speed photographic processing, telemetry tracking radiometric receivers, navigation systems, infrared tracking, and radar trainers.

Experience

1959-1961 and 1962-Present: Itek Corporation. Chief electrical engineer. Responsible for electrical and electronic system design of high acuity camera systems. Staff engineer, responsible for the electronic development of high speed photographic processors. Manager of in-house development on electrostatic vidicon cameras and signal processing techniques.

1961-1962: Ewen Knight Corp., Natick, Massachusetts. Manager of electrical research. Responsible for an engineering department involved in the development of microwave receiver and s-band telemetry tracking systems.

1954-1959: Nortronics (formerly Detroit Controls), Norwood, Massachusetts. Project manager on Polaris submarine radiometric sextant. Responsible for a project to develop a sun-moon tracking system using microwave radiometers. Formerly, chief electrical engineer. Responsible for electronic and servo design on type II periscope, MK104-6-axis coordinate converter, mark II Regulus plotting system, F102-F-106 rate-stabilization system, mark IV stable platform.

1952-1954: Photoswitch Inc., Cambridge, Massachusetts. Engineer. Responsible for circuit design for developmental model infrared tracking system.

1951-1952: American Machine and Foundry Co., Boston, Massachusetts. Engineer. Ultrasonic development for radar simulation used in radar trainers.

Education

B.S. in electrical engineering, Tufts University, 1951.
Near completion of M.S. in electrical engineering, Northeastern University.

Patents

Electromagnetic regulator, 1958.

CALVIN S. MORSER
Chief mechanical engineer, Engineering Branch of Government Systems

Special Qualifications

Engineering program management; design and development of navigation systems, tracking mounts and systems, hydrostatic bearings and fluid flow controls.

Experience

1963-Present: Itek Corporation. Chief mechanical engineer.

1955-1963: Marine Equipment Department, Nortronics Division, Northrop Corporation, Needham, Massachusetts. Program manager and chief engineer for the design, development, and production of a precision celestial tracking periscope drive system, and a submersible radiometric sextant, both for use in the Polaris submarine navigation system. Design of large precision tracking mounts, hydrostatic bearings, and control valves for nuclear reactors.

1954-1955: Schlage Lock Company, San Francisco, California. Design and development of small precision mechanisms and hydraulic components for high production manufacture.

1951-1953: California Research and Development Company, Livermore, California. Design and development of a 60-foot diameter high vacuum vessel and associated vacuum system for a linear particle accelerator.

1948-1951: Humble Oil and Refining Company, Houston, Texas. Design and development of the marine support equipment required for an offshore oil well drilling and production program.

1946-1948: General Electric Company, Lynn, Massachusetts. Development, testing, and evaluation of aircraft gas turbines.

1942-1946: US Navy. Lieutenant, USNR. Engineering duties involved the repair and maintenance of submarines in naval shipyards.

Education

B.A. in mechanical engineering, Stanford University, 1940.
B.S. in naval architecture and marine engineering, Massachusetts Institute of Technology, 1942.

Associations

Society of Naval Architects and Marine Engineers; American Society of Naval Engineers.

Patents

Three patents issued.

L. S. PITCHER
Staff senior component engineer, Optical Systems Division

Special Qualifications

Engineering consultation in the areas of component part application and reliability.

Experience

1962-Present: Itek Corporation. Aids circuit design engineers on component part application. Establishes operating procedures and ground rules to ensure compliance of parts with equipment requirements encompassing preferred parts list, derating philosophy, nonstandard parts waiver requirements, part reliability requirements, part testing.

1959-1962: Sylvania Electric Products, Waltham, Massachusetts. Senior component engineer, Component Engineering Section. Consultant in component part application in the areas of resistors, capacitors, connectors, wire, cable, motors, meters, servos and various mechanical components. Responsible for the initiation and preparation of purchase specifications. Coordinated component part usage with applicable Government agencies and prime contractors.

1957-1959: Raytheon Manufacturing Company, Wayland, Massachusetts. Component engineer, Component Engineering Section. Consultant on component part application. Prepared purchase specifications on various component parts. Performed liaison duties between Raytheon and various subcontractors, vendors, and Government agencies.

1956-1957: Raytheon Manufacturing Company, Wayland, Massachusetts. Engineering assistant, Sonar and Servo Departments. Design breadboarding and testing of various types of circuits for use in sonar and servo systems.

1954-1956: Raytheon Manufacturing Company, Waltham, Massachusetts. Power tube technician, Special Techniques Department. Devising and perfecting of special construction techniques to be used in the production of magnatrons.

1953-1954: CBS-Hytron, Salem, Massachusetts. Radio technician. Design and construction of test equipment for use in the production of receiving tubes.

1949-1953: U.S. Navy. Aerographer.

Education

Associate degree in electronic engineering, Lincoln Technical Institute, 1958.
B.B.A. in engineering management, Northeastern University, 1959.
M.B.A. in engineering management, Northeastern University, 1963.

Associations

Institute of Electrical and Electronic Engineers.

ROBERT R. SHANNON
Executive physicist, Optical System Research Department

Special Qualifications

Optical physics, lens design, image evaluation, computing methods.

Experience

1959-Present: Itek Corporation. Staff physicist and senior lens designer. Responsible for supervising and performing work in lens design and image analysis from both theoretical and engineering viewpoints; lens design for large reconnaissance systems; development of high speed computer programs for use in optical design, optical-photographic system analysis, and as an aid in fabrication of large systems. Performed and supervised theoretical and experimental studies of image formation and analysis. Responsible for development and construction of equipment for measurement of the spatial frequency response of optical and photographic systems. Conducted an investigation of signal and noise problems in high resolution aerial photographic and radar systems.

1954-1959: University of Rochester, Rochester, New York. Graduate student in physics and optics. As graduate assistant, performed research on microphotography and image evaluation.

1953-1955: Eastman Kodak Company, Rochester, New York. Optical engineer. Performed research on infrared tracking systems and on microphotography.

Education

B.S. in optics, University of Rochester, 1954.
M.A. in physics, University of Rochester, 1957.
Ph. D. (pending) in optics, University of Rochester; formal work complete.

Associations

Optical Society of America; Society of Photographic Scientists and Engineers; Sigma Xi.

Publications

Numerous papers on optics and transfer function equipment and tests.

DR. F. DOW SMITH
Manager, Optics Division

Special Qualifications

Direction of research programs; research in optics.

Experience

1958-Present: Itek Corporation. Planning and management of research programs in optics, photography, electronics, and documentary indexing as applied to graphic information systems.

1955-1958: Boston University Physical Research Laboratories. Director.

1951-1955: Boston University Physical Research Laboratories. Research associate.

1948-1951: University of Rochester, New York. Teaching assistant, optics.

1949-1950: Bausch & Lomb Optical Co., Rochester, New York. Research assistant.

1947-1948: National Research Council, Ontario, Canada. Research assistant.

Education

B. A. in physics, Queens University, Canada, 1947.
M. A. in physics, Queens University, Canada, 1948.
Ph. D. in optics, University of Rochester, 1951.

Associations

Sigma Xi; American Association of Physics Teachers; Optical Society of America; American Association for the Advancement of Science (AAAS); U. S. A. Committee of International Commission of Optics; Armed Forces NRC Vision Committee.

Publications

Author of several articles and papers dealing with various aspects of optics.

WILLIAM N. SNOUFFER
Assistant to vice president and general manager,
Government Systems

Special Qualifications

Administration and management of technical activities and personnel.

Experience

1959-Present: Itek Corporation. Administrative assistant to vice president of Government Systems. Served as project manager on three projects, 1961 to 1962.

1957-1958: Waltham Laboratories, Sylvania Electric Products, Inc., Waltham, Massachusetts. Assistant project manager (5 months) and project manager (10 months) for Plato Antimissile Missile System, responsible for all phases of a complex antimissile radar system project.

1937-1958: U.S. Air Force. Commissioned officer. Specialized in communications and electronics. Held command and staff positions in major Air Force Commands, prepared initial plans for the aircraft warning system for Alaska, supervised technical training for Army, Navy, and Air Force in atomic energy project at Sandia Base, New Mexico.

Education

Coe College, 2 years preengineering, 1931-1933.
B.S. in engineering, U.S. Military Academy, 1937.
M.S. in electrical engineering, University of Illinois, 1948.

Associations

Air Force Association.

RICHARD SZYMCZAK
Senior technical writer, Publications Department

Special Qualifications

Documentation cost estimating and contractual negotiations.

Experience

1961-Present: Itek Corporation. Project writer establishing project documentation requirements and preparing handbooks and reports.

1959-1961: Sylvania Electric Products, Inc., Needham, Massachusetts. Staff member of program office in charge of half-million dollar handbook program for Sylvania — BMEWS. Established, administered, and monitored BMEWS training program.

1957-1959: AC Spark Plug Division, General Motors, Milwaukee, Wisconsin. Project writer in research and development area for THOR guidance system.

Education

B.A. in English, Northeastern University, 1957.
Certificate in electronic engineering technology, Capitol Radio Engineering Institute, 1960.

Associations

Institute of Electrical and Electronics Engineers; Society of Technical Writers and Publishers.

JOHN T. WATSON
Executive engineer, development planning staff

Special Qualifications

Geometrical optics and high resolution photography; airborne and aerospace reconnaissance systems design.

Experience

1958-Present: Itek Corporation. Engaged in the design of systems for high acuity optics, photography, and reconnaissance.

1947-1958: Boston University Physical Research Laboratories. Research associate. Designed and developed the first differential surface refractometer for testing homogeneity of index in large glass blanks. Set up electronic equipment for the study of the photometrics and the refraction of the atmosphere for prediction of photographic range. Designed extreme-focal-length all-mirror unobstructed-aperture camera and carried out experiments from Pike's Peak to show haze penetration as a function of wavelength, film contrast, weather, and focal length. Performed experimental work in satellite photography. Carried out laboratory experiments to determine detection and recognition criteria for photographic details.

1946-1947: University of Maine, Orono, Maine. Instructor in physics.

1941-1946: Bausch and Lomb, Rochester, New York. Optical engineer. Carried out experimental work on range-finder design, and instrument and lens design for oblique-type photogrammetric projectors. Had responsibility for maintaining equipment and standards for optical control on production items. Performed lens and instrument design for a rectifying printer accepting 9- by 9-inch formats.

Education

A. B. in physics, University of Maine, 1942.

Associations

Optical Society of America; Sigma Xi.

JOHN A. WOLFE
Manager, Advanced Projects, Optical Systems Division of Government Systems

Special Qualifications

Organization and management of technical development and production programs.

Experience

1958-Present: Itek Corporation. Presently, responsible for all phases of execution on major contract involving the development and limited production of photo-optical and electromechanical systems. Formerly, project head and staff engineer on similar projects.

1948-1958: Boston University Physical Research Laboratories, Boston, Massachusetts. Project engineer and research associate. Designed methods and apparatus for testing the performance of gyroscopically stabilized aerial camera mounts. Designed and developed an airborne high-resolution television reconnaissance system, infrared scanning systems, electrical control systems, and an airborne azimuth stabilization system.

Education

B. S. in electrical engineering, Massachusetts Institute of Technology, 1948.
M. S. in electrical engineering, Northeastern University, 1956.

Associations

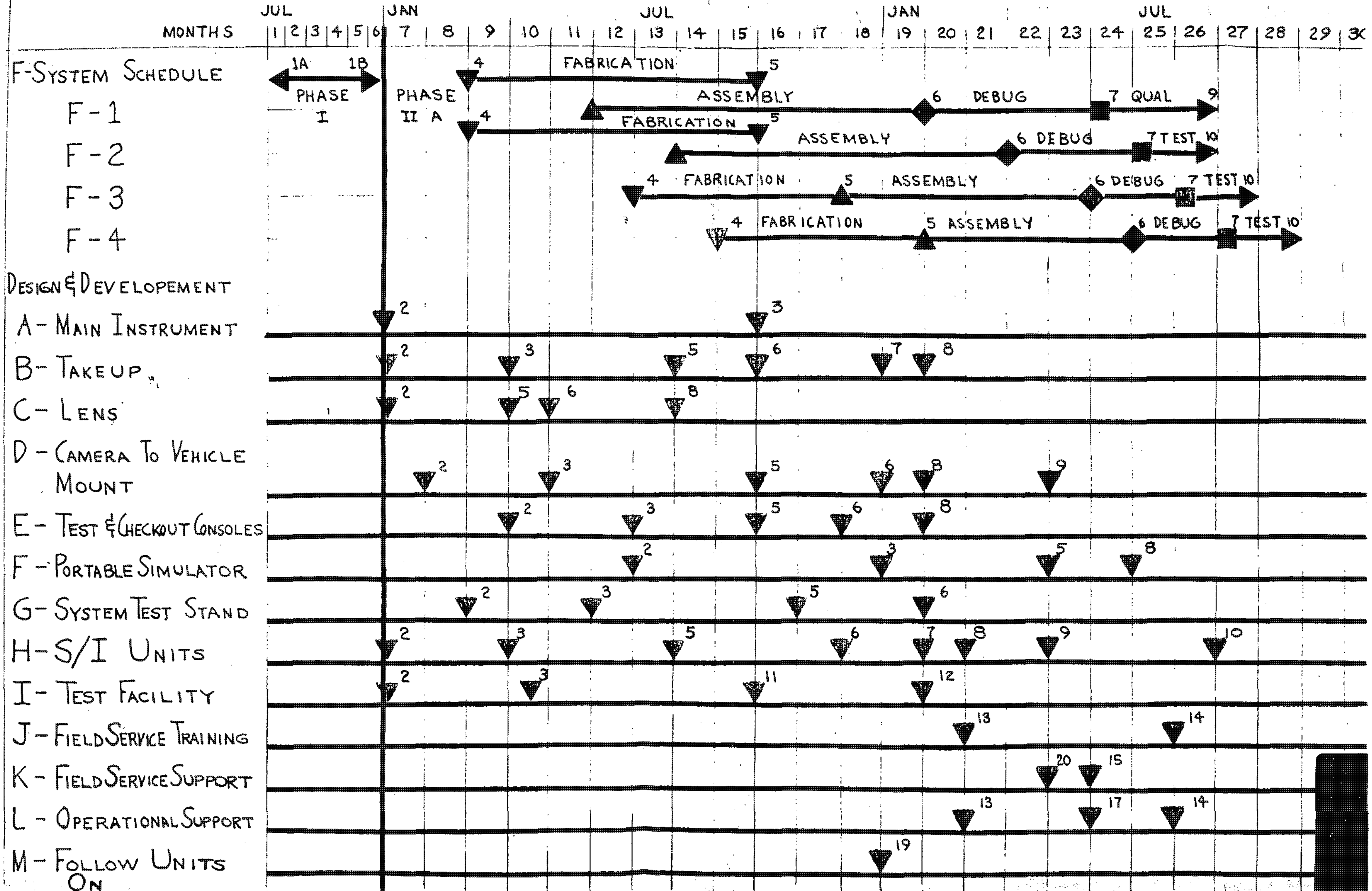
Institute of Electrical and Electronics Engineers; Sigma Xi; Coblentz Society.

APPENDIX B

PHASE II SCHEDULES

F-SYSTEM DELIVERY SCHEDULE

SPECIAL HANDLING



[redacted]

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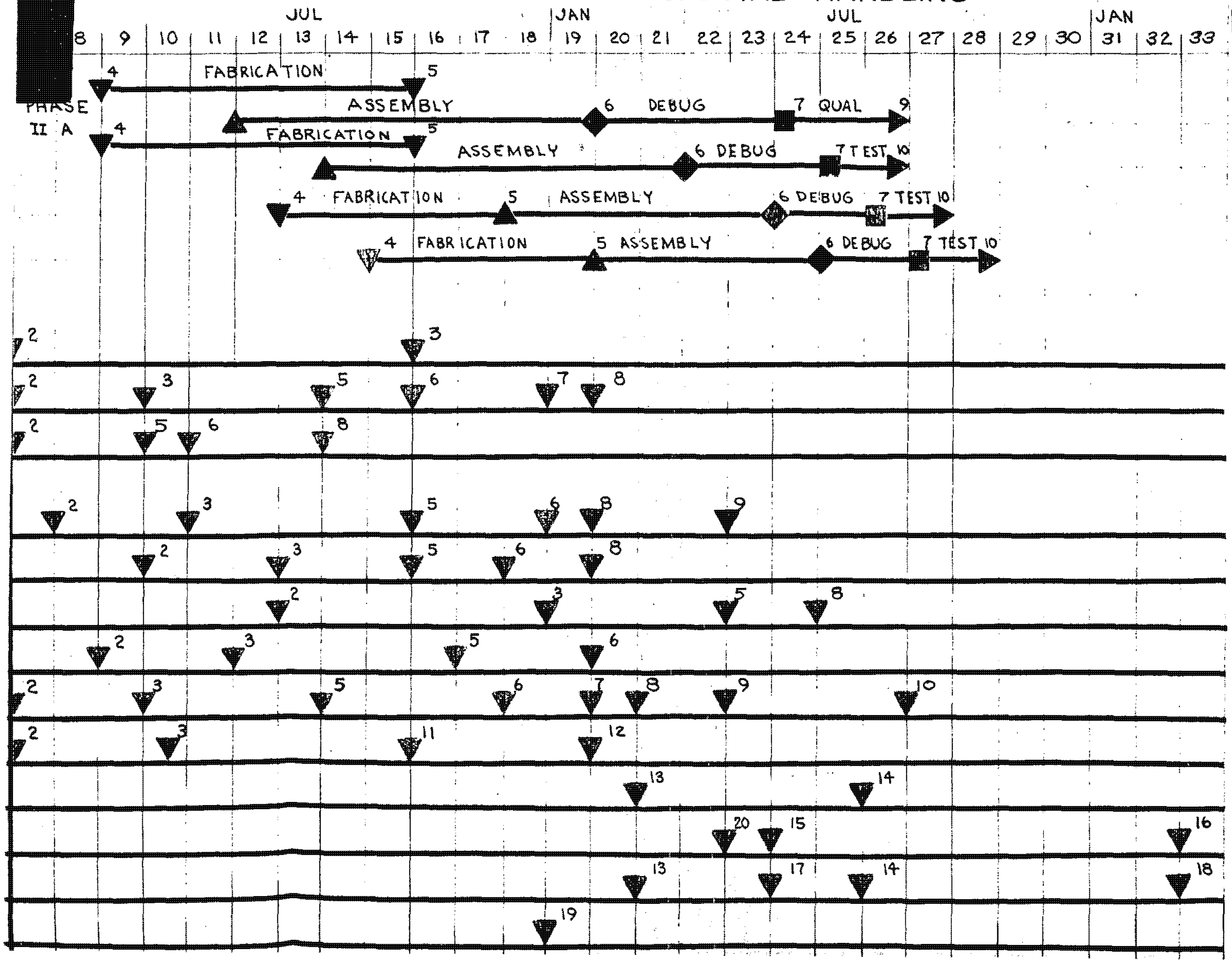
B-1

F-SYSTEM DELIVERY SCHEDULE

SPECIAL HANDLING



LEGEND

EVENT	DESCRIPTION
1A	STUDY GO AHEAD
1B	STUDY COMPLETE
2	DESIGN START
3	DESIGN COMPLETE
4	FABRICATION START
5	FABRICATION COMPLETI
6	ASSEMBLY COMPLETE
7	DEBUG COMPLETE
8	TEST COMPLETE
9	QUAL. COMPLETE
10	SHIP COMPLETE
11	BUILDING COMPLETE
12	INSTALL & CHECK EQUIP COMPLETE
13	FIELD SERVICE/O TRAINING START
14	FIELD SERVICE/ TRAINING COMPLETE
15	FIELD SERVICE OPERATION STA
16	FIELD SERVICE OPERATION COMPL
17	OPERATIONAL SUPPORT START
18	OPERATIONAL SUPPORT COMPLET
19	GO AHEAD DATE FOR FOLLOW ON UNITS
20	FIELD SERVICE FACILITY COMPLETE

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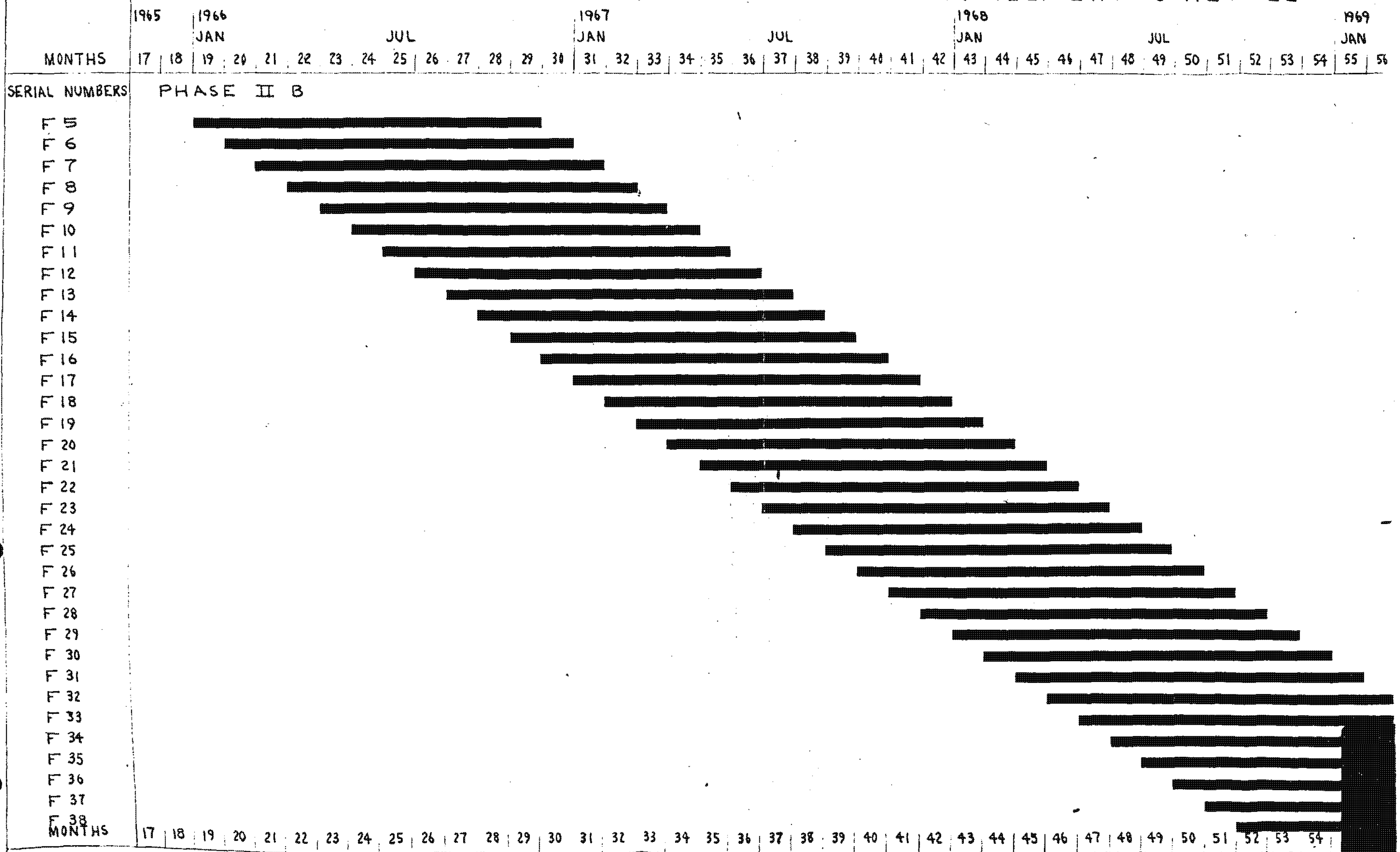
F-SYSTEM FOLLOW ON DELIVERY SCHEDULE



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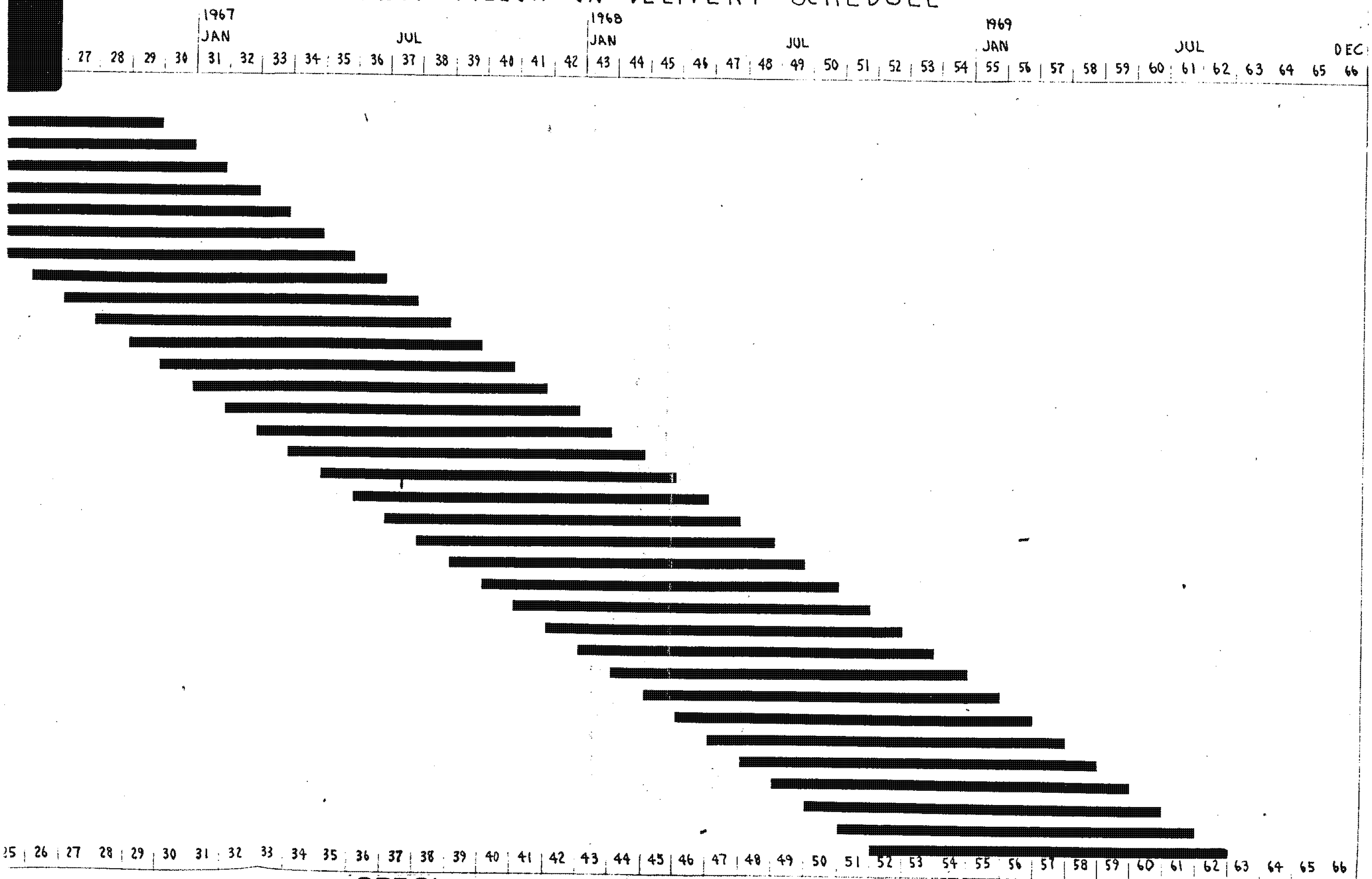
SPECIAL HANDLING

F-SYSTEM FOLLOW ON DELIVERY SCHEDULE

B-2



SPECIAL HANDLING

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APPENDIX C

ROM PHASE II COSTS

SPECIAL HANDLING

PHASE II

"F" SYSTEM PROGRAM
PRICING SUMMARY (BUDGETARY)

Description	(1) Engineering Qualification Model	(3) Engineering Flight Test Units	34 Operational Units	Total
A. Project Management	$ 1,740,000	$ 520,000	$ 2,800,000	$ 5,060,000
B. Operational Equipment				
Cameras	3,120,000	8,550,000	49,500,000	61,170,000
Lens	375,000	1,025,000	6,500,000	7,900,000
Take-Up Cassettes	300,000	500,000	2,500,000	3,300,000
Clocks	125,000	300,000	1,200,000	1,625,000
Cut & Splice Device	100,000	45,000	350,000	495,000
Double Frame Camera	500,000	225,000	1,900,000	2,625,000
Spools	100,000	150,000	500,000	750,000
Total Operational Equipment	$ 4,620,000	$10,795,000	$62,450,000	$77,865,000
C. Auxiliary Ground Equipment				
Shipping Containers				
Main Instrument	50,000	60,000	180,000	290,000
Take-Up Cassette	4,000	3,600	20,000	27,600
Clock	500	900	5,000	6,400
Cut & Splice	1,000	500	3,000	4,500
Double Frame Camera	2,000	1,500	8,500	12,000
Assembly Dollies	35,000	60,000	80,000	175,000
Portable Simulator	80,000	-	60,000	140,000
System Test Stand	65,000	36,000	20,000	121,000
Test Consoles	150,000	100,000	100,000	350,000
Total AGE	$ 387,500	$ 262,500	$ 476,500	$ 1,126,500
D. Back-Up Engineering & Analysis				
Systems Engineering	370,000	110,000	425,000	905,000
Interface Board	235,000	70,000	220,000	525,000
Thermal Design & Analysis	300,000	100,000	340,000	740,000
Total Back-Up Engineering & Analysis	$ 905,000	$ 280,000	$ 985,000	$ 2,170,000
E. Environmental Test	$ 600,000	$ 132,000	$ 2,240,000	$ 2,972,000
F. Operational Support				
Field Service	360,000	360,000	2,040,000	[redacted]
Operational Support	120,000	165,000	986,000	[redacted]
Total Operational Support	$ 480,000	$ 525,000	$ 3,026,000	$ [redacted]
G. Environmental Test Facility	2,950,000	-	-	[redacted]

[redacted]

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