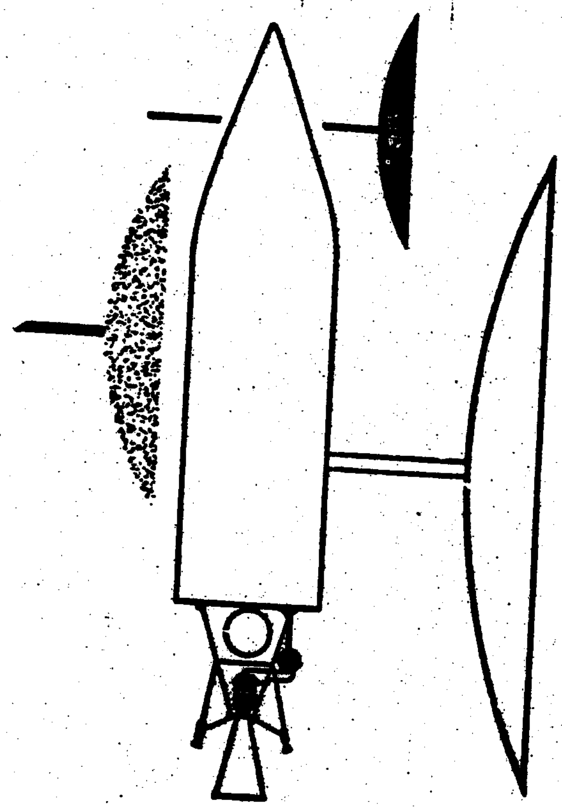
CONFIDENTIAL

MSD 1536



Pied Piper DEVELOPMENT PLAN

VOL. II SUB-SYSTEM PLAN

K. Ground Data Processing

LOCKHEED AIRCRAFT CORPORATION
MISSILE SYSTEMS DIVISION
VAN NUYS, CALIFORNIA

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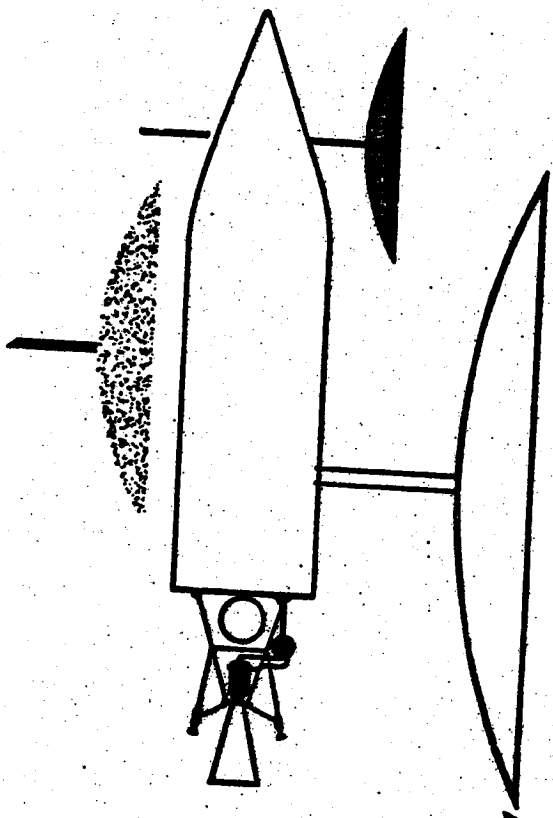
MSD 1536
1 MARCH 1956
COPY NO. E-64
32 SHEETS



Pied Piper DEVELOPMENT PLAN

VOL. II SUB-SYSTEM PLAN

K. Ground Data Processing

In addition to security requirements which must be met, this document is subject to special export controls; [illegible] transmittal to foreign governments or foreign nationals may be made only with prior approval of [illegible]

LOCKHEED AIRCRAFT CORPORATION
MISSILE SYSTEMS DIVISION
VAN NUYS, CALIFORNIA

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PIED PIPER DEVELOPMENT PLAN

VOLUME I. SYSTEM PLAN

VOLUME II. SUBSYSTEM PLAN

A. Airframe

B. Propulsion

C. Auxiliary Power

D. Guidance and Control

E. Visual Reconnaissance

F. Electronic Reconnaissance

G. Infrared Reconnaissance

H. Vehicle Electronics

I. Airborne Test Systems

J. Vehicle Intercept and Control Ground Station

K. Ground Data Processing

L. Vehicle Ground Support

CONTENTS

Subsystem K Ground Data Processing

1. PROJECT TITLE	2. SECURITY OF PROJECT	3. PROJECT NUMBER
GROUND DATA PROCESSING SUBSYSTEM FOR ADVANCED RECONNAISSANCE SYSTEM (UNCLASSIFIED) (PIED PIPER)	Secret	1115
	4.	5. REPORT DATE: 1 March 1956

21 c. Continued

the data, as acquired from the satellite, is received by radio-photo, wirephoto or physical delivery by air shipment from the intercept station.

Data processing begins by preparation of the data for delivery to interpretation groups through the combined use of mechanical, photographic, optical, electronic and audio-visual aids as well as a sophisticated storage and recall system.

Limits of performance capabilities can be described only in terms of meeting the demands in rapid delivery of photos, charts, tabulations, or whatever forms in which data becomes useful.

2. a. Visual Reconnaissance Processing

b. Contractors: Lockheed Aircraft Corp., Missile Systems Division
Eastman Kodak Company

c. Early data processing in this area is primarily an extension of the present concept of photo interpretation. The many aids to human interpretation of variform data will include coder-decoders, special purpose computers, sorters, tabulators, and audio-visual aids.

Range and limits of performance capabilities will be measured only in terms of manpower initially, and eventually in the achievement of an optimum ratio of automation to manpower.

3. a. Electronic Reconnaissance Processing

b. Contractor: Lockheed Aircraft Corp., Missile Systems Division

c. Data processing in the area of electronic reconnaissance, which primarily concerns ferret data, offers the inherent advantage of lending itself more directly to automation than photo data. By way of example, "logical" computers are conceived as a means for eliminating the greater part of the redundant information expected.

Training and operational aids will be provided in a pattern parallel to that in the visual program above.

Performance limits will be those which are characteristic of computers and electronic display systems.

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Pied Piper

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LOCKHEED AIRCRAFT CORPORATION
MISSILE SYSTEMS DIVISION

TABS

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Subsystem K - GROUND DATA PROCESSING

Tab 1 - General Design Specifications

I. GENERAL

A. Statement of the Problem

The basic objective may be stated as a solution to the problem of data handling on such a large scale that machine and manpower demands may rapidly exceed realistic values. It is essential that means be found for minimizing redundancy, for speeding up interpretation of reconnaissance information, and for acquisition of trained intelligence personnel.

B. Approach

The subsystem objective will be approached by providing for three primary functions within the structure of the ARS Intelligence Center (ARSIC). These will be the operation of a Visual Reconnaissance Processing Center, an Electronic Reconnaissance Processing Center, and an Infrared Reconnaissance Center. While these need not have maximum effort capabilities in the early programs, they must arrive at a reasonable degree of sophistication by the time a useful satellite is operational.

The Intelligence Center will be augmented by data pre-screening and relay to the center from Vehicle Intercept Stations and manned from intelligence operations training program. A preliminary concept of units of the ARSIC, and the manning organization, is shown in Figures 1 through 10.

Fig. 1 Photo Interpretation Slow-Scan Pickup Center.

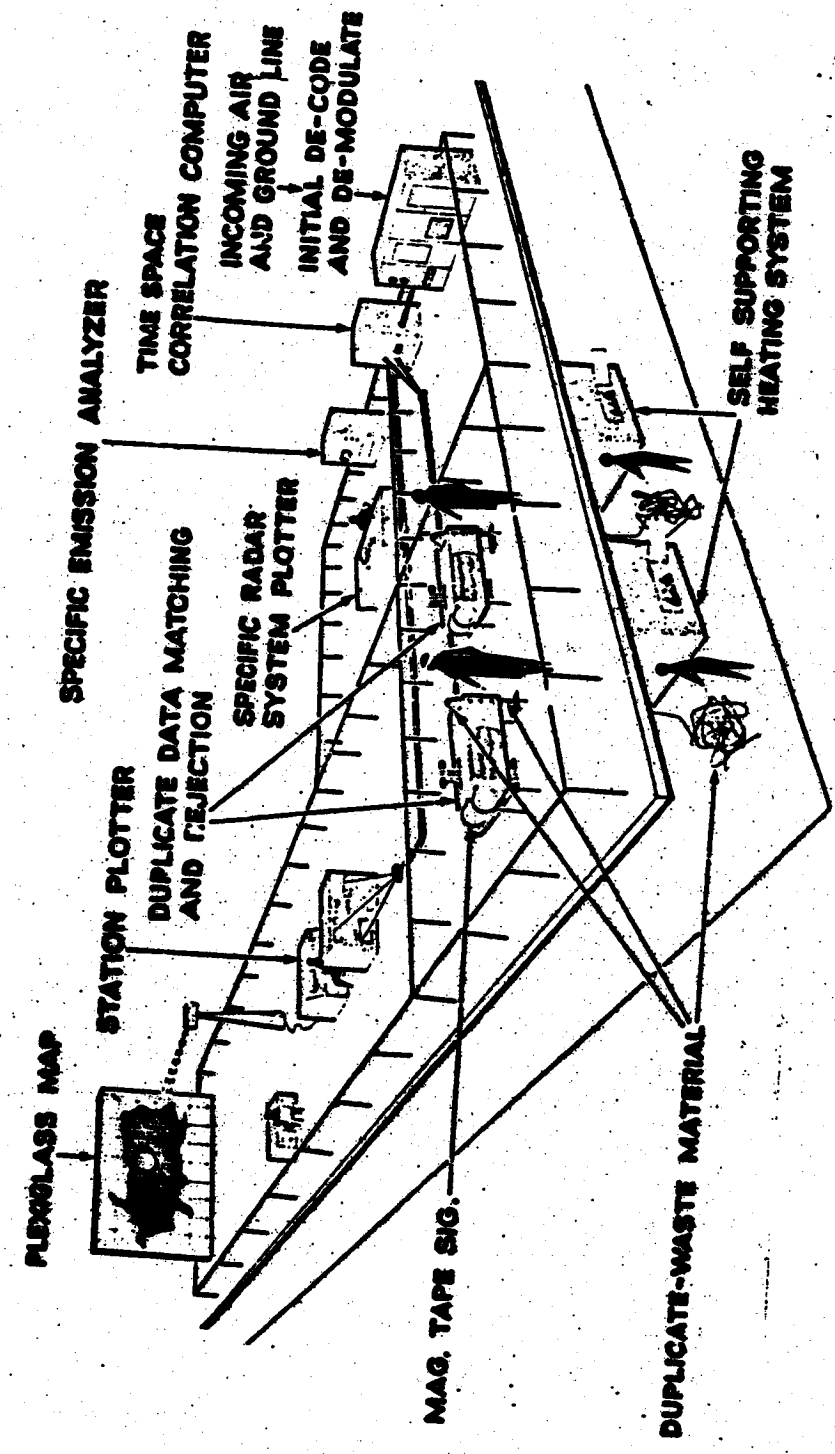

Fig. 3 Electronic Reconnaissance Process Unit

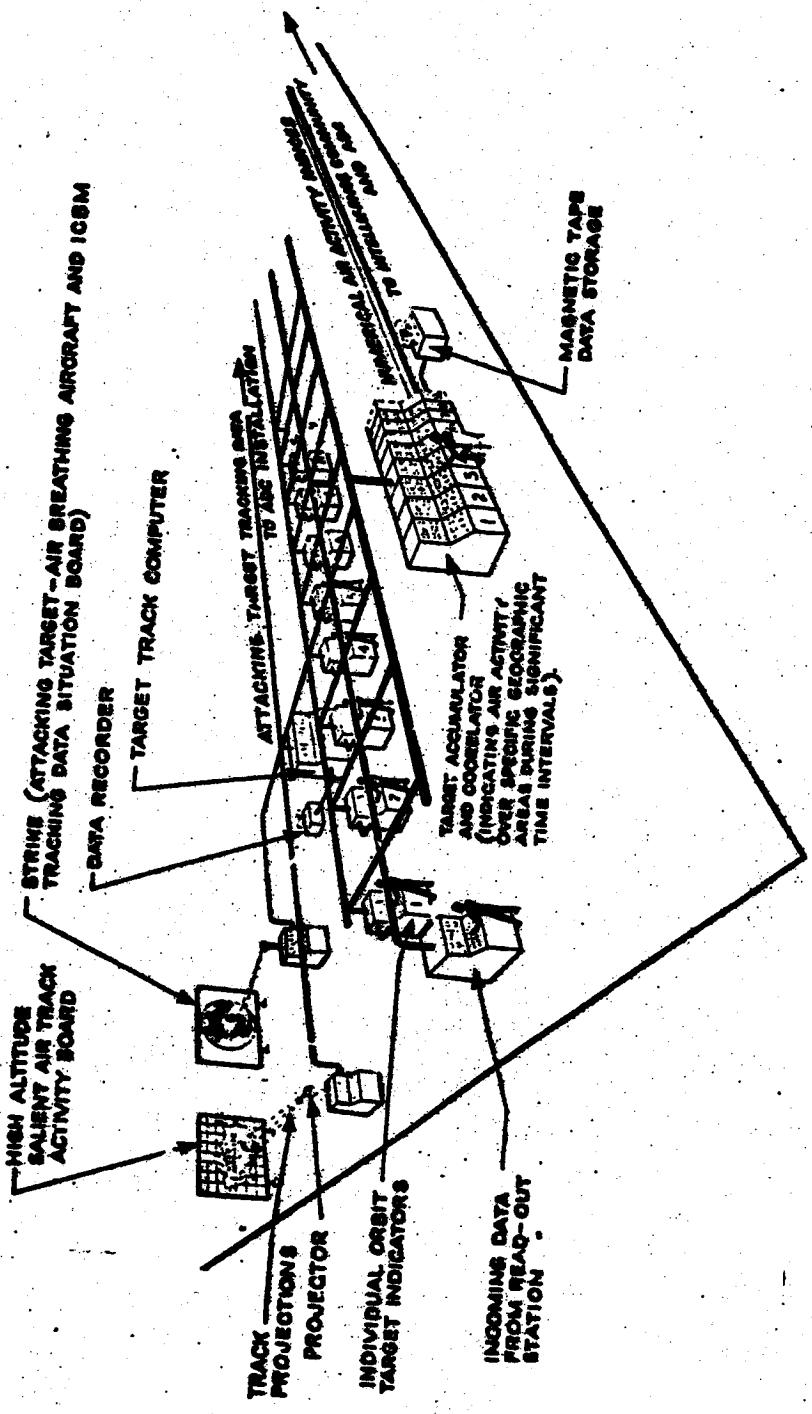

Fig. 4 Infrared Analysis Unit

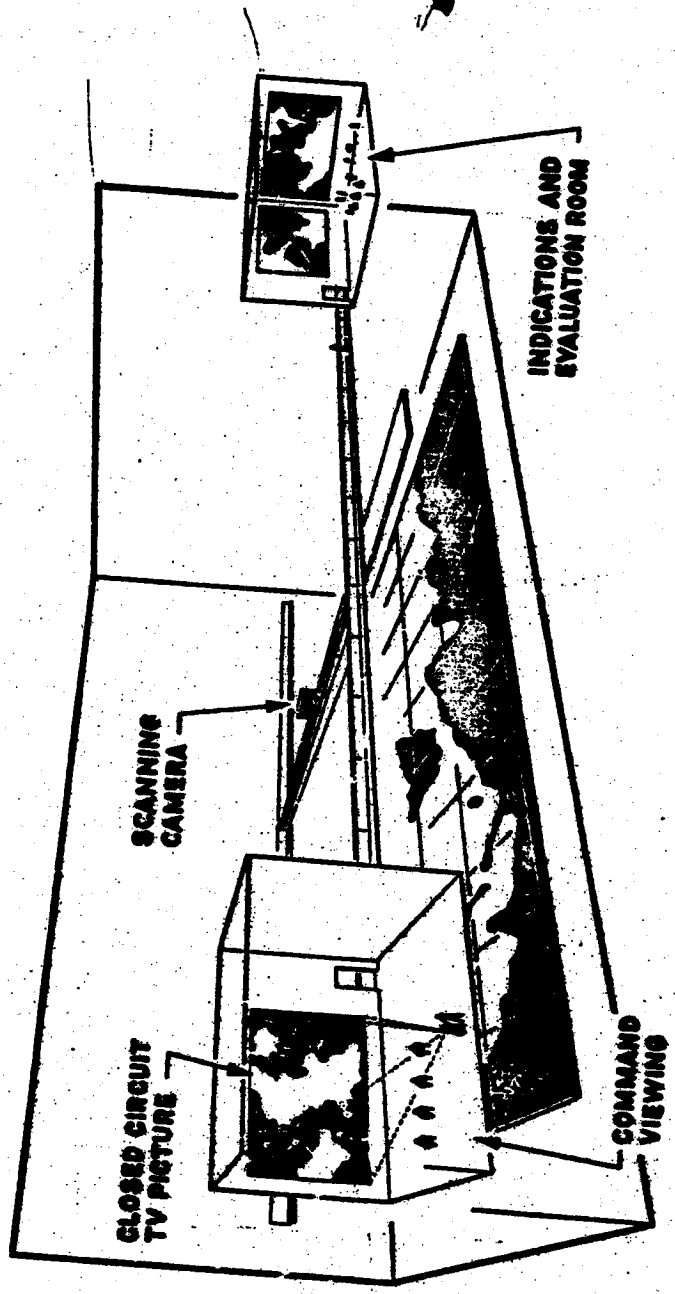

Fig. 5 Master Mosaic Map Builder

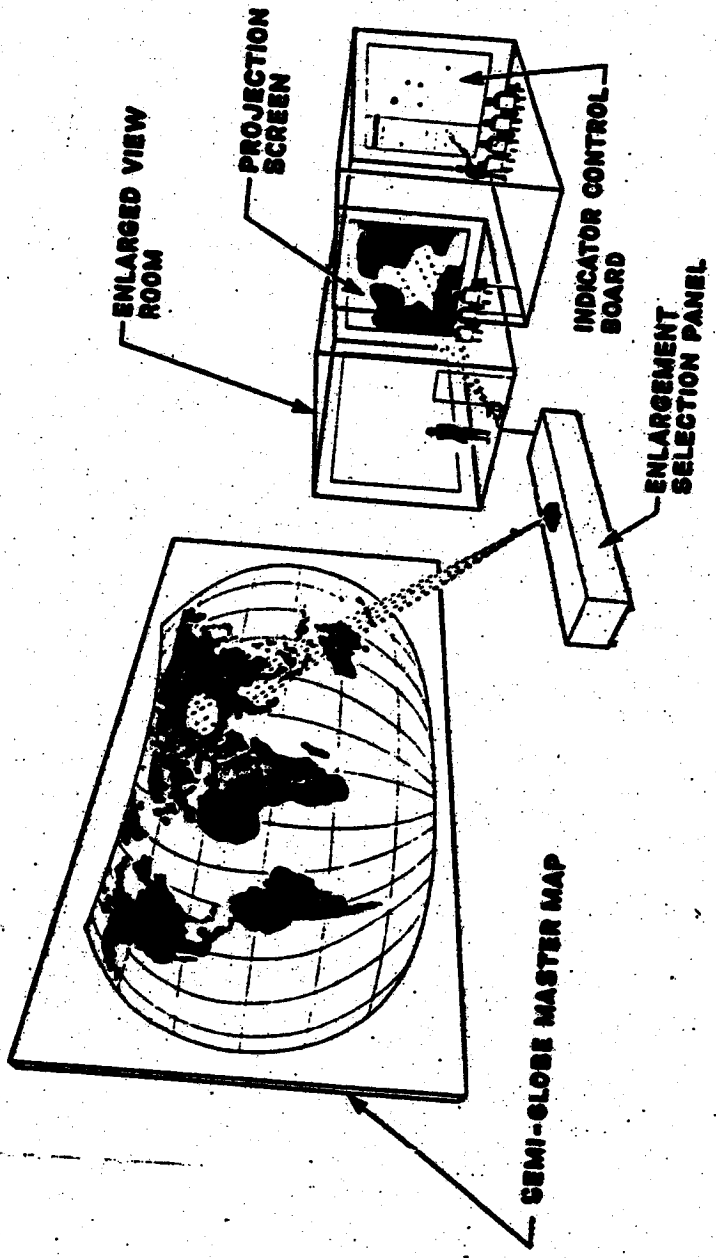

Fig. 6 Command Control and Indication Center

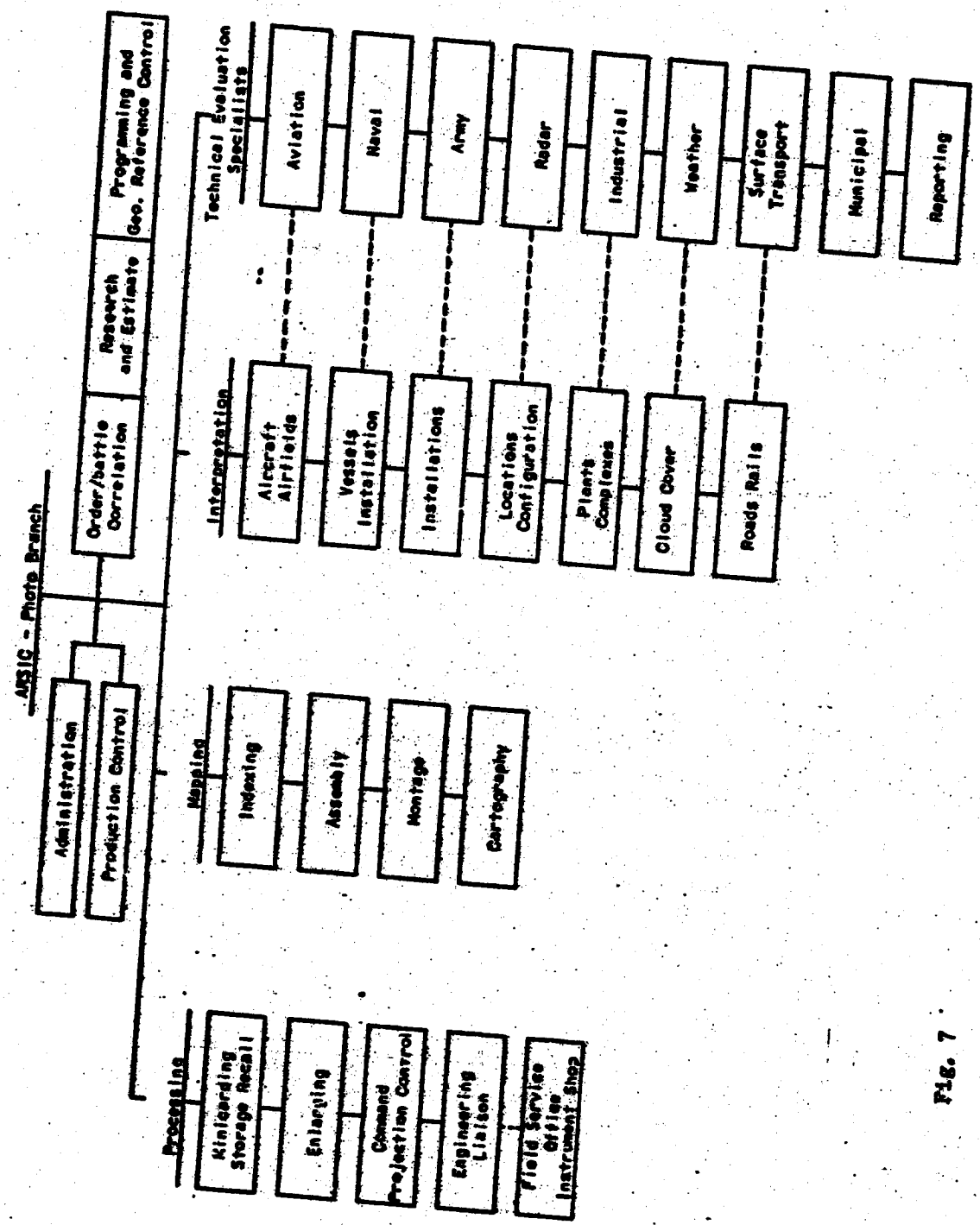
ARSIC - Photo Branch
Programming and Geo. Reference Control
Research and Estimate
Order/battle Correlation
Administration
Production Control
Technical Evaluation Specialists
Aviation
Naval
Army
Radar
Industrial
Weather
Surface Transport
Municipal
Reporting
Interpretation
Aircraft Airfields
Vessels Installation
Installations
Locations Configuration
Plants Complexes
Cloud Cover
Roads Rails
Mapping
Indexing
Assembly
Montage
Cartography
Processing
Klnlgarding Storage Recall
Enlarging
Command Projection Control
Engineering Liaison
Field Service Office Instrument Shop

Fig. 7

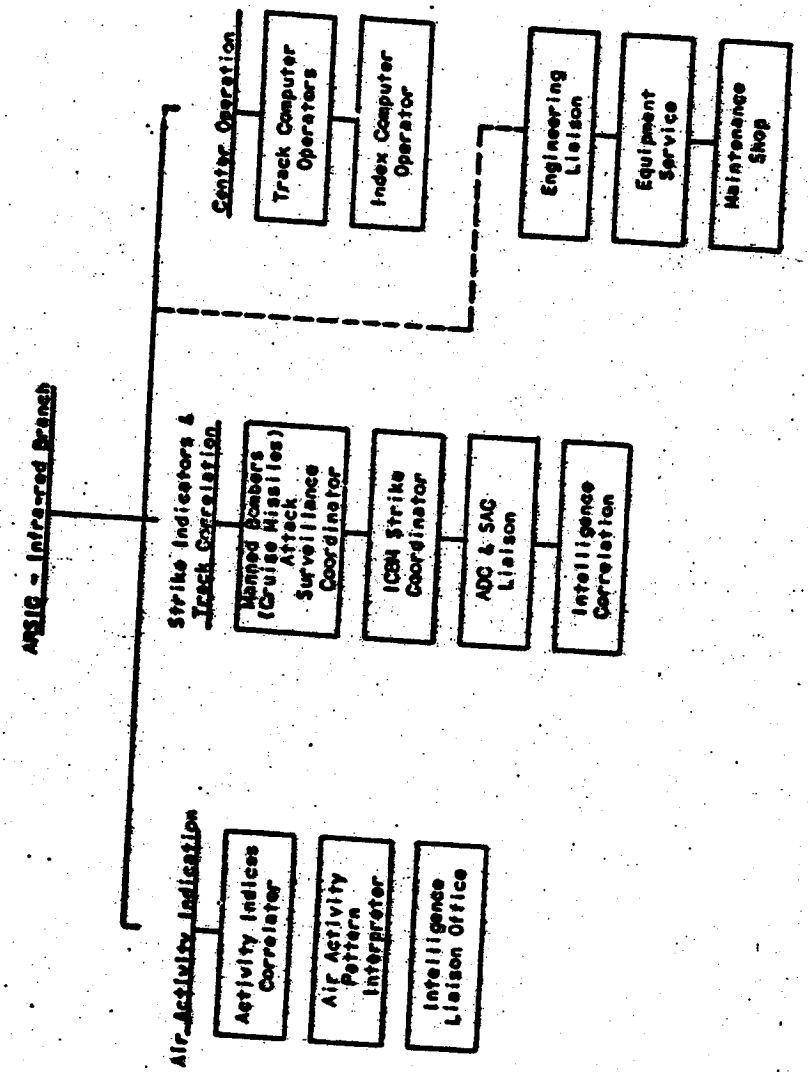
AMSIR - Infrared Branch
Center Operation
Track Computer Operators
Index Computer Operator
Engineering Liaison
Equipment Service
Maintenance Shop
Strike Indicators & Track Correlation
Manned Bombers (Cruise Missiles) Attack Surveillance Coordinator
ICBM Strike Coordinator
ADC & SAC Liaison
Intelligence Correlation
Air Activity Indication
Activity Indices Correlator
Air Activity Pattern Interpreter
Intelligence Liaison Office

Fig. 9

A.R.S. Intelligence Center (ARSIC)
Tech. Liaison USAF Staff, MSD CBS, BMC
Dissemination USAF Command Liaison
Administration
Accounting
Personnel
Offices
Security
I.R. Branch
See chart
Maintenance
Plant Engineering
Elektr. Branch
See chart
Installations
Material
Purchasing
Photo Branch
See chart

Fig. 10

C. Solution or Recommendation

1. Equipment Requirements

While the coordinated effort of the various tasks in this subsystem represent an extension of the principle applied at interpretation centers, much of the equipment must materialize through development programs.

a. In the Data Prescreening and Relay task of this subsystem the ground vehicle-intercept will perform its main function of duplicating and relaying the data acquired from the satellite. Injected into this operation will be the secondary action of index printing under the command of a Geo-Reference Index Computer to facilitate establishing identity of a given photo with its geographical coordinates. It thus becomes feasible to fill requests for monitoring particular areas and commanding immediate viewing of them at the center via the Slow Scan Transmission Channel discussed in the Appendix. This facility will not be called upon to make decisions beyond those required to recognize proper functioning and correct fulfillment of requests.

b. Visual Reconnaissance Processing will employ equipment such as Video Signal Receivers, Kine-recorders, Geo-Reference Index Computers, Slow Scan viewers, photo duplicators, command projection equipment, as well as a Minicard storage and recall system. The operational function will be the conversion of incoming data into variform presentations for assimilation by the interpretation groups.

Early Training Schedules may employ breadboard types of newly developed equipment and easily simulated raw data acquisition.

c. Electronic Reconnaissance Processing will employ more of the computer type of equipment to accomplish sorting out, redundancy rejection and other functions on a semi-automatic basis at least until development work brings it to higher degrees of sophistication.

Data processing by such means will result in displays of the radar-plot type, tabulations and other aids to correlative interpretation.

The extent of electronic components employed will result in greater needs for trouble-shooting technicians than for operating trainees in these areas.

d. Infrared Reconnaissance Processing will be a more complete example of applied automation. Its general character will be somewhat similar to that of Electronic Reconnaissance Processing with an even higher ratio of electronic trouble shooters to operating personnel. Interpretation of infrared data is basically much simpler than handling data derived from other media.

Training programs in this area should be correspondingly less difficult and will be On-Job-Trained and include OJT personnel.

2. State of the Art

Nearly all aspects of this subsystem may be considered within the state of the art, in spite of the development programs required to produce the specialized types of computers envisioned. Much of the equipment employed both as interpretation aids and training aids will be acquired as modifications of generally available items.

The unusual aspects of the subsystem hinge entirely on the number of people involved and the magnitude of the training problem.

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Subsystem K - GROUND DATA PROCESSING

Tab 2 Summary - Subsystem Milestones

MISSILE SYSTEMS DIVISION

SECRET

K - Tab 2, p 1

LOCKHEED AIRCRAFT CORPORATION

Revised Form 103

MSD 1536

Subsystem K - GROUND DATA PROCESSING

Tab 2 Summary - Subsystem Milestones (Continued)

CY 60 | FY | CY | FY | CY | FY | CY

J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42

Automatic Rejection (Redundant Data)

Electronic

Photo

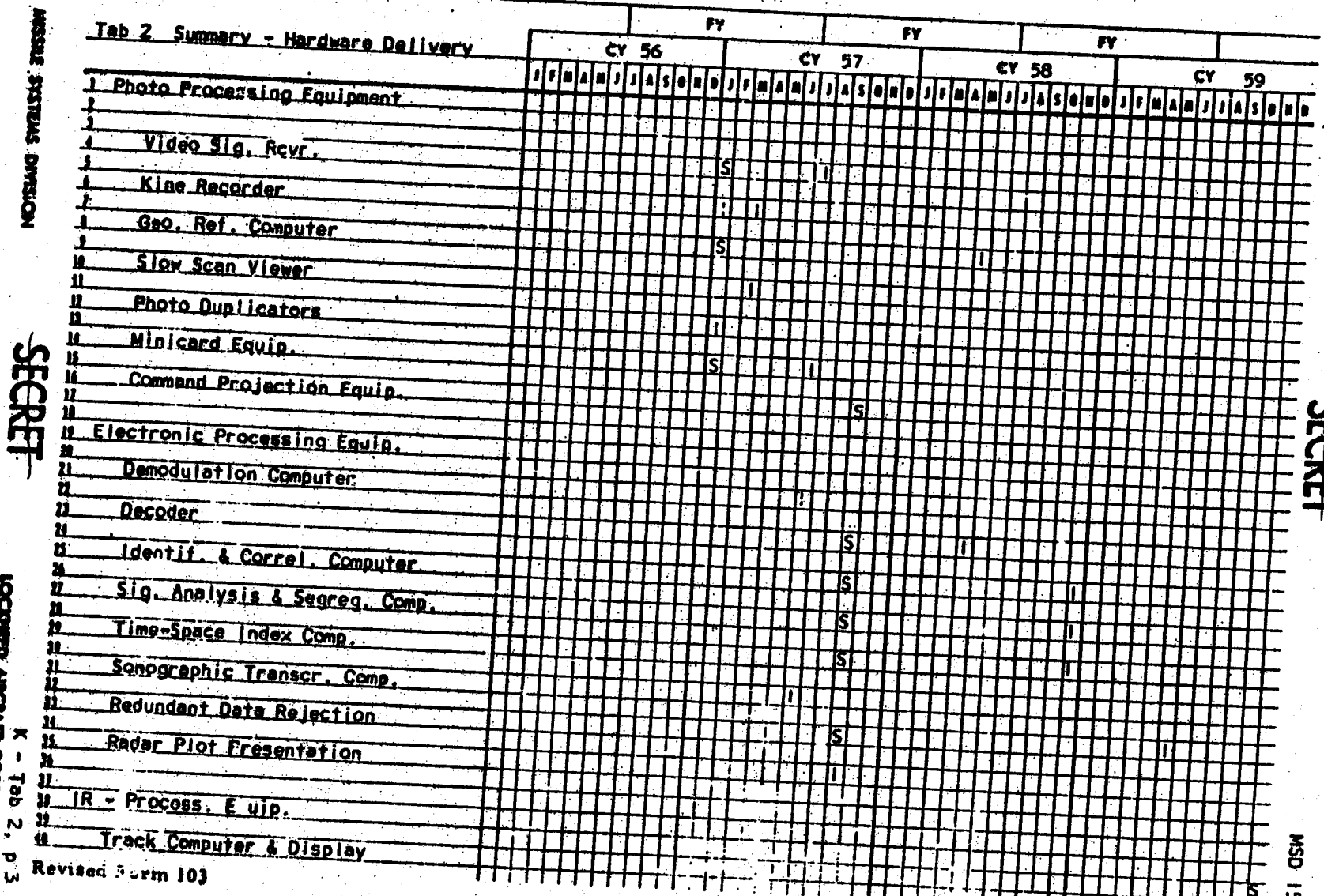
MISSILE SYSTEMS DIVISION

LOCKHEED AIRCRAFT CORPORATION

Revised Form 103

Subsystem K - GROUND DATA PROCESSING

Tab 2 Summary - Hardware Delivery



S = Simulators, developed and del'd as training aids.

ARSIC Operational

MSD 1536

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MSD 1536

Subsystem K - GROUND DATA PROCESSING

Tab 2 Summary - Subsystem Test Schedule

MISSILE SYSTEMS DIVISION

LOCKHEED AIRCRAFT CORPORATION

Revised Form 103

MSD 1536

Subsystem K - GROUND DATA PROCESSING

Tab 2 Summary - Subsystem Test Schedule
(Continued)

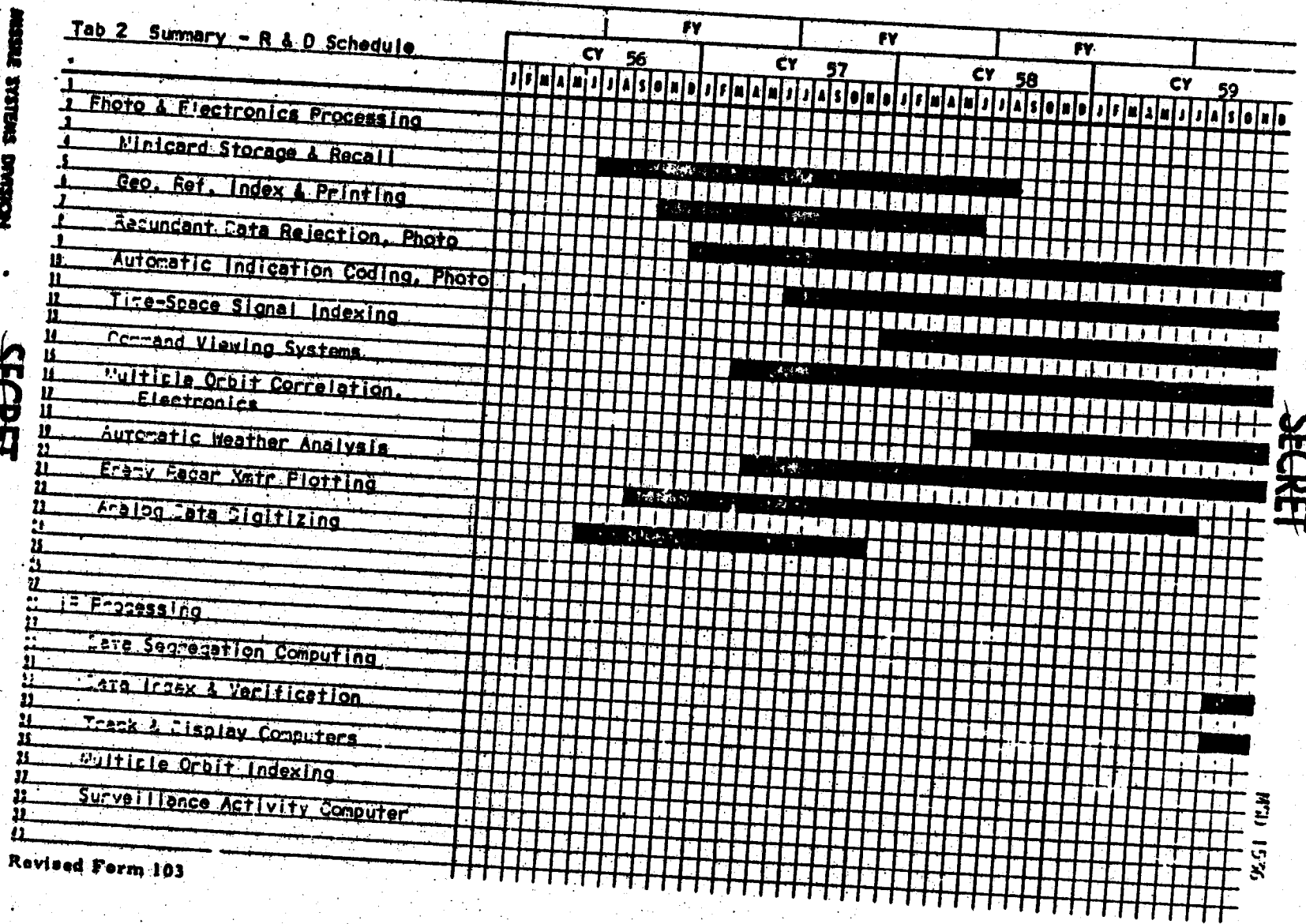
CY 62 | CY 63 | CY | FY | FY | CY

J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

1 Operational Checkout of Integrated
1 ASSI Center Processing (Cont'd)
1 Equipment
2 Photo
11 Electronic
12 Infrared
11

Subsystem K - GROUND DATA PROCESSING

Tab 2 Summary - R & D Schedule



Revised Form 103

MSD 1536

Subsystem K - GROUND DATA PROCESSING

Tab 2 Summary - R & D Schedule
(Continued)

Revised Form 103

MISSILE SYSTEMS DIVISION

LOCKHEED AIRCRAFT CORPORATION

MSD 1536

1. R & D TEST AND TEST SUPPORT AIRCRAFT ANNEX
☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER

2. REPORTS CONTROL SYMBOL

PAGE 1 OF 1 PAGES

3. DATE: 1 March 1956

4. TITLE: Subsystem K - GROUND DATA HANDLE

5. INITIAL ☐ CHANGE

6. NUMBER

7. ITEM NUMBER	8. AIRCRAFT REQUIRED: QTY	TYPE, MODEL AND SERIES	SERIAL NUMBER	9. AIG CODE	10. MOS CODE	11. DATE REQD AND LOCATION	12. ESTIMATED RELEASE DATE	13. RECOMMENDED DISPOSITION	14. MFG COST P.A.	15. EST COST

NO SPECIAL AIRCRAFT ASSIGNMENT REQUIRED FOR SUBSYSTEM K.

ARDC FORM 1 JUL 55 186 PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE.

MISSILE SYSTEMS DIVISION

SECRET

R & D MATERIEL ANNEX

☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER

2. REPORTS CONTROL SYMBOL

PAGE 1 OF 1 PAGES

3. DATE 1 March 1956

4. NUMBER

4. TITLE

Subsystem K - GROUND DATA PROCESSING

5. INITIAL ☐ CHANGE

7. MATERIEL REQUIREMENTS (Indicate Items in Columnar Form using Columns as cited in Examples)

No current G.F.E. applicable.

Visual & Electronic Processing Equipment will be specified at a later date.

No specialized test equipment is required.

SECRET

MSD 1536

ARDC 1 FORM JUL 55 107 PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE.

K - Tab 5, p 1

BOEING AIRCRAFT CORPORATION

SECRET

MSD 1536

SUBSYSTEM K - GROUND DATA PROCESSING

DATE 1 March 1956

ITEM: ARS INTELLIGENCE CENTER *

LOCATION:

USING AGENCY: LOCKHEED M.D., CBS LABORATORIES, EASTMAN KODAK CO.

BUDGET CONTROL ESTIMATE:

NEED DATE:

SCHEDULE:

1956												1957												1958												1959			
J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D

DESCRIPTION AND UTILIZATION:

* Complete description for this facility is given in Tab 6, - Subsystem L - Vehicle Ground Support.

REMARKS:

MISSILE SYSTEMS DIVISION

SECRET

LOCKHEED AIRCRAFT CORPORATION

Revised Form 108

Tab 7

R & D Contract Funds

Subsystem K - Ground Data Processing

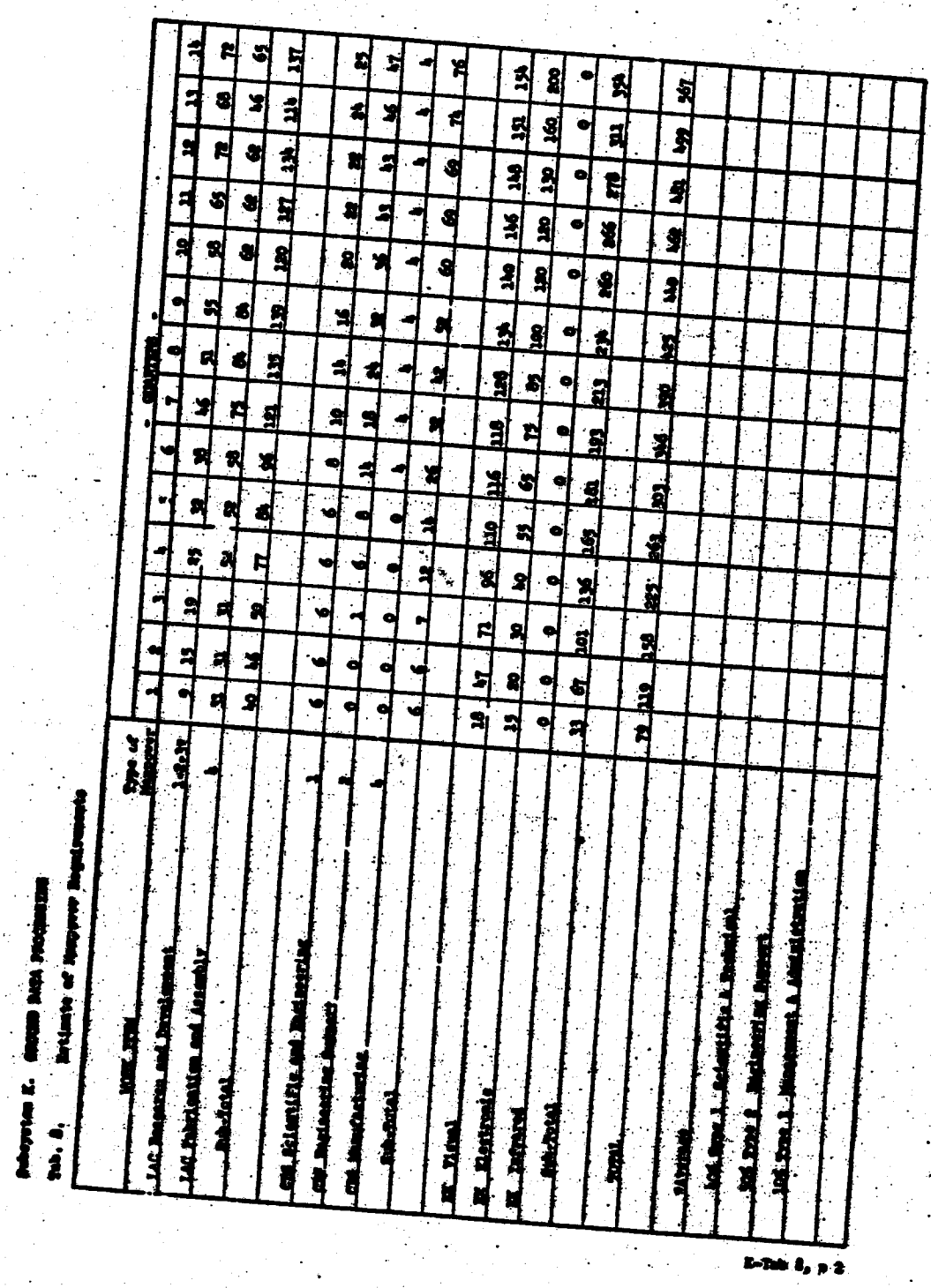
Subsystem K, GROUND DATA PROCESSING

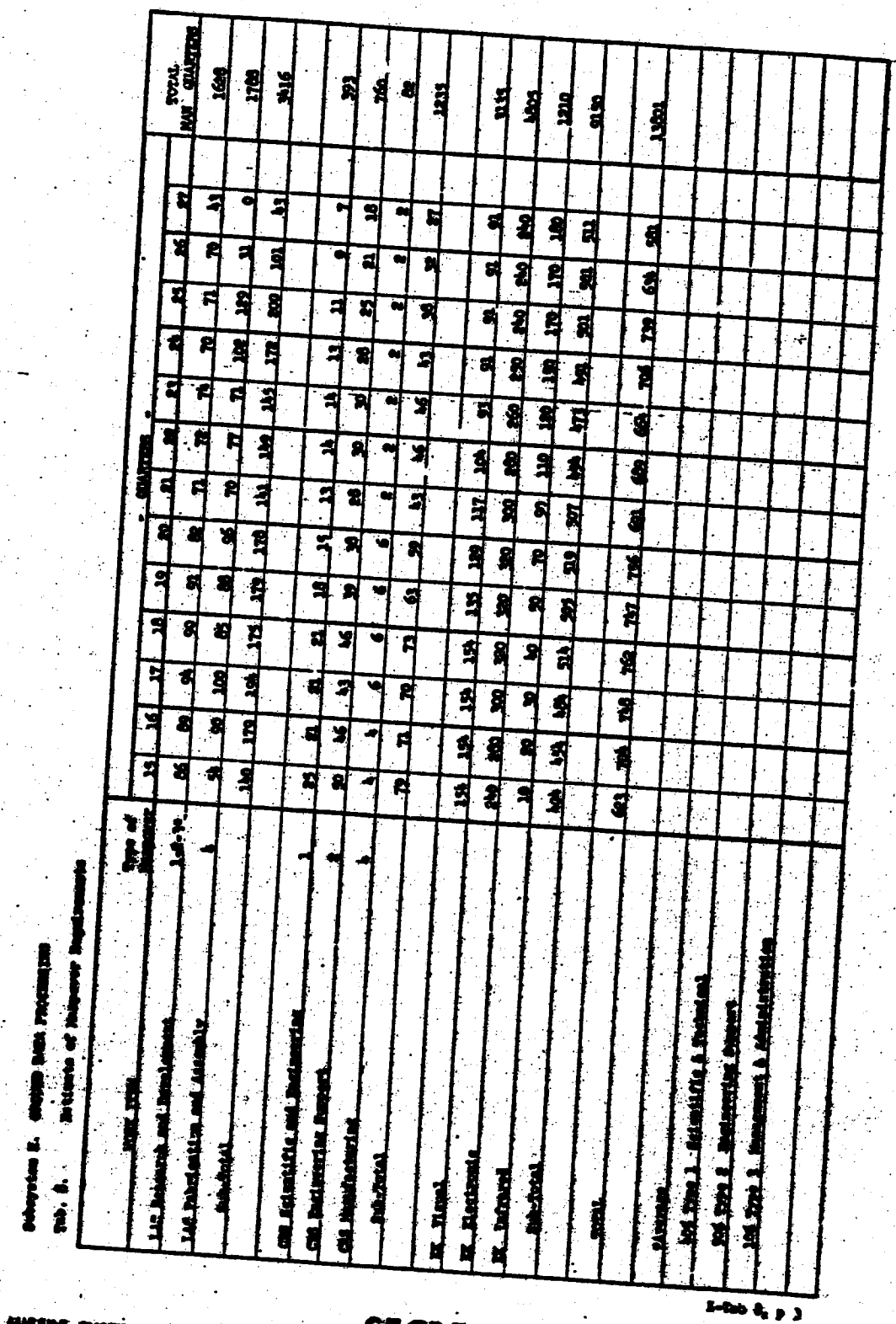
Tab 7. R & D Contract Funds (in thousands of dollars) (Cont'd)

	FY 60		FY 61				FY 62				FY 63			TOTALS
	15	16	17	18	19	20	21	22	23	24	25	26	27	
LAG														
(1) Research and Engineering	430	443	470	450	454	409	355	359	372	352	357	352	218	8,200
(2) Fabrication	187	312	347	295	305	333	242	267	248	356	450	108	-0-	6,272
Sub Total	617	757	817	745	739	742	597	626	620	708	807	460	218	14,472
EASTMAN														
(a) Visual														
(b) Electronic	765	765	738	738	848	619	493	438	392	383	383	383	383	14,856
(c) Infrared	1124	1311	1311	1420	1420	1420	1154	1077	1000	951	915	915	715	20,793
Sub Total, Eastman	142	150	226	316	407	498	457	584	662	662	701	701	701	6,404
	2032	2267	2396	2475	2476	2538	2114	2099	2054	2007	2000	2000	2000	42,054
CBS														
	437	407	408	417	359	332	247	264	264	247	217	182	152	7,111
Sub Total														
	3407	3432	3515	3637	3595	3612	2959	2991	2939	2963	3025	2643	2371	63,637
Fee														
	310	343	351	363	359	362	295	299	293	296	302	264	237	6,353
TOTAL*	3813	3775	3907	4002	3955	3974	3256	3291	3211	3259	3328	2908	2609	70,000
Total Fiscal Year		13322			15798				13039			8845		70,000

*Difference in totals due to rounding

X-C-0 ... p 3





SECRET

Pied Piper

MSD 1536

LOCKHEED AIRCRAFT CORPORATION
MISSILE SYSTEMS DIVISION

APPENDIX

SECRET

Subsystem K - GROUND DATA PROCESSING

APPENDIX

SLOW SCAN TRANSMISSION LINK

Introduction

If the satellite visual reconnaissance system is to have tactical value, there must be a faster means of getting vital information to the central intelligence agency than air transport of the transparencies. Since each ground vehicle intercept center will have a limited staff of photo interpreters, some of the more important bits of information could be verbally transmitted over radio or telephone facilities; in addition, standard facsimile equipment could be used to transmit a limited amount of visual information. However, the necessity for using different scale magnifications to make best use of the incoming information, coupled with the facsimile machine' requirement of a standard transparency size would make this method too slow for practical use.

Slow Scan

In order to overcome the disadvantages of standard facsimile equipment, a special Slow Scan TV system will be used. This system will operate over 15-kilocycle link and is capable of transmitting 10,000 picture elements in 33 seconds with an equal horizontal and vertical resolution of 1000 TV lines. The pickup device will be a

special 2-inch vidicon tube which is capable of over 1000 line resolution when used with appropriate horizontal and vertical aperture compensation circuits. One vidicon camera with several lenses of varying focal length will be used at each photo interpretation viewing table. Whenever the photointerpreter sees something of interest, he switches in the appropriate lens and starts the camera scanning. The camera output is directly connected to the outgoing phone or radio circuit, or if the circuit is already busy, the video signal is temporarily stored on an Ampex Model 500 recorder operating at 60 inches per second, and later transmitted when the circuit is available. The tape recorders will be played backwards on reproduction to save rewinding time. See Fig. 1.

Intelligence Center Reproduction

At the intelligence center the incoming signal will be displayed on a projection monitor using a storage type projection tube having an extremely long effective persistence. This monitor will allow immediate viewing of the incoming pictures; in addition, a high quality 12-inch kinescope having a short persistence ultra violet phosphor will display the signal for photographic purposes. A camera-rapid processor combination similar in principle to that manufactured by "Kenyra" under the trade name "Repromatic" will view the kinescope and deliver developed transparencies within 5 seconds after a picture is received. Thus, only 40 seconds need elapse between the time the interpreter finds a picture of interest and its reproduction at the intelligence center. See Fig. 2

Information Capacity

The total amount of incoming information from the satellite is contained on a 2-inch by 30-inch piece of film capable of resolving approximately 100 optical lines per millimeter. Each optical line is equal to 2 TV lines and hence there are 15×10^8 TV picture elements received at the ground station per 90 minute orbital pass. The slow scan system if it is to cause no degradation of the information can only use approximately 1/3 of its theoretical 10^6 picture elements per 33 seconds. Out of 90 minutes, perhaps 20 minutes would be lost due to operator inefficiency and synchronization signal time; thus $.42 \times 10^8$ TV elements can be transmitted in the 90 minutes available. This is 2.8% of the possible information and since it is doubtful that more than 1% of the incoming information will be of importance it should be sufficient. If however, more information is required parallel transmission circuits could be used at the exchange rate of 2.8% information per 15-kc channel available.

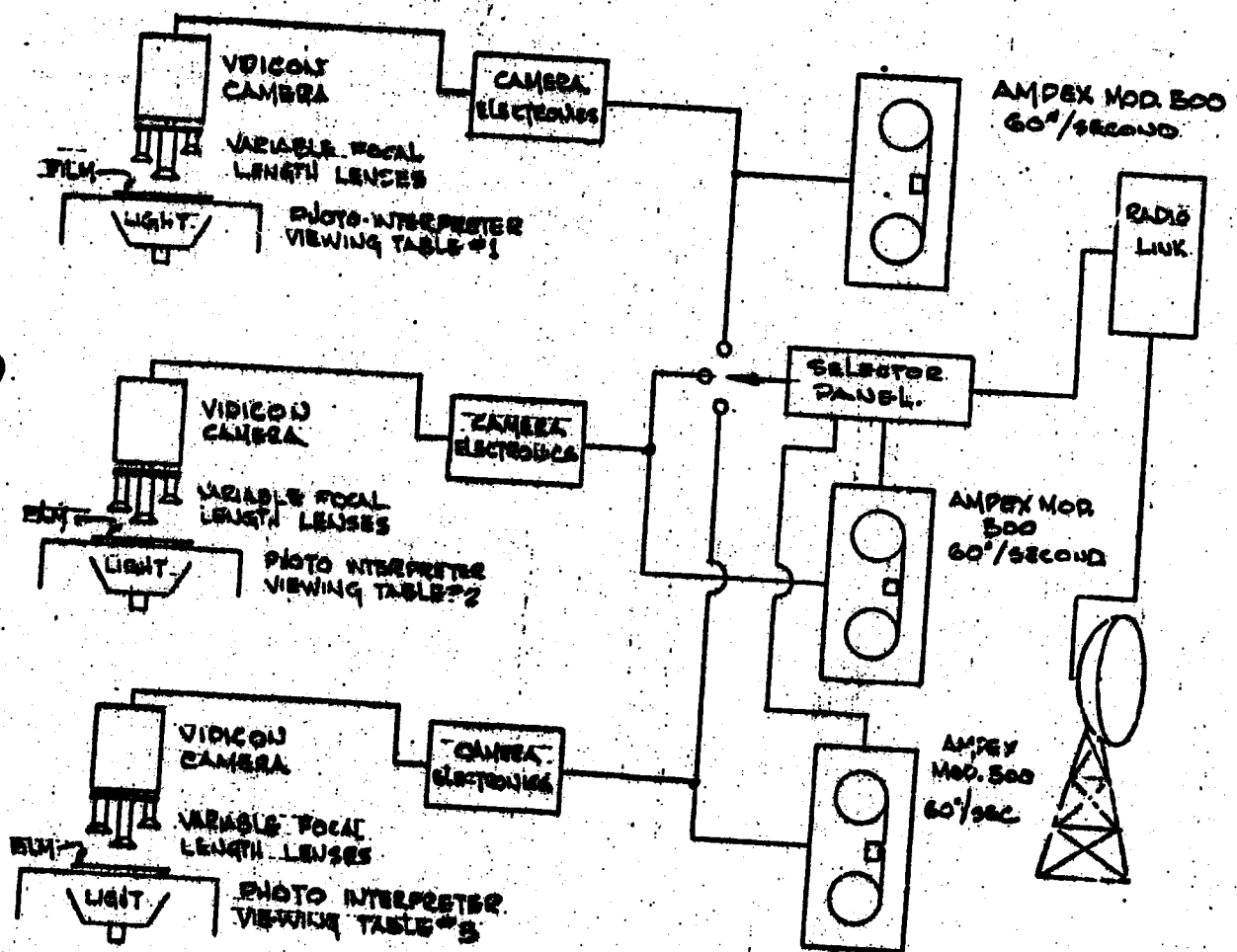


Fig. 1 Photo Interpretation - Slow Scan Pickup Center

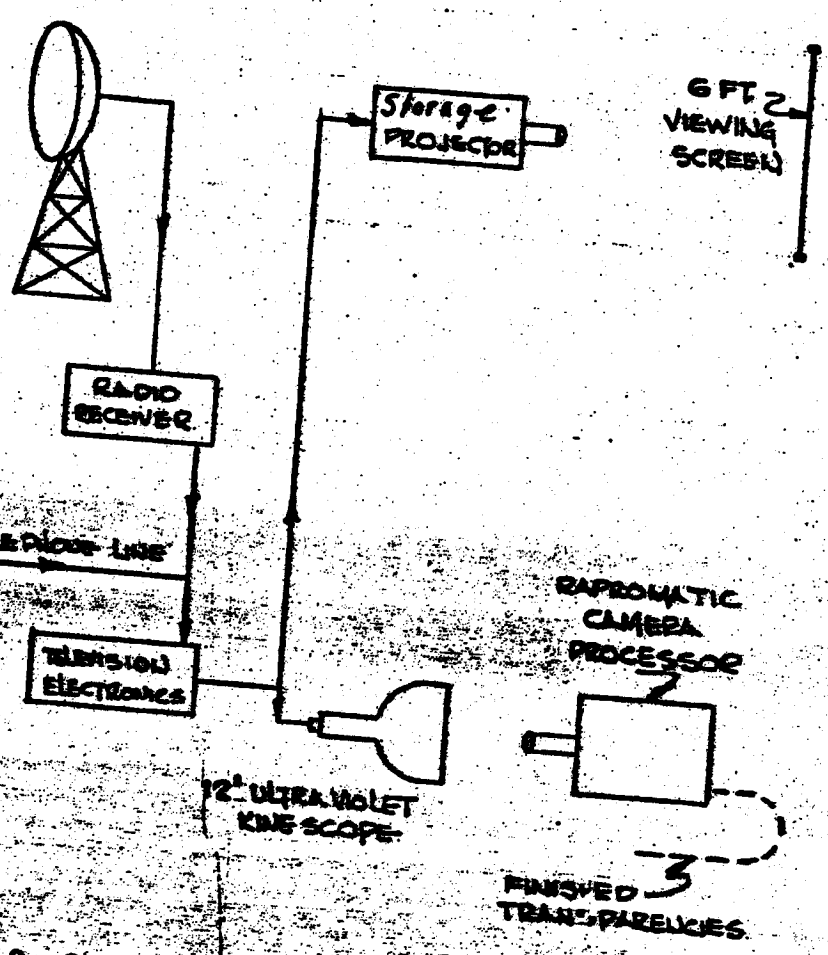


Fig 2 Central Intelligence Slow Scan Receiving Center