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AF-WP-L-29 MAY 53 5M

SECURITY CLASSIFICATION

RDB PROJECT CARD

TYPE OF REPORT	New Project
REPORTS CONTROL SYMBOL	DD-RDB(A)48
1. PROJECT TITLE	(SECRET TITLE) ELECTRONIC RECONNAISSANCE SUB-SYSTEM FOR ARS, WS117L. (UNCLASSIFIED TITLE) SUBSYSTEM F, WS117L
2. SECURITY	SECRET
3. PROJECT NUMBER	1760
4. INDEX NUMBER	2-117
5. REPORT DATE	2 April 1957
6. BASIC FIELD OR SUBJECT	Stategic Air Warfare System 117L
7. SUBFIELD OR SUBJECT SUBGROUP	48-Electronic Countermeasures
7A. TECH. OBJ.	SA-9A, 9B 10, IO-9
8. COGNIZANT AGENCY	Air Research & Development Command
9. DIRECTING AGENCY	HQ ARDC, WDD
OFFICE SYMBOL	WDTR
TELEPHONE NO.	Ext 1343
10. REQUESTING AGENCY	HQ USAF
11. PARTICIPATION, COORDINATION, INTEREST	USAF/AMC-P, SAC-I, ADC-I, ATC-I, ATIC-I, APGC-I, USN/CNO-I, USA/C/S-I, OTHER/CIA-I
12. CONTRACTOR AND/OR LABORATORY	Lockheed Aircraft Corp. See 21c.
CONTRACT/W.O. NO.	AF04(647)-97
13. RELATED PROJECTS	WS-117L
14. DATE APPROVED	
15. PRIORITY	1A
16.	A(Missiles)
17. EST. COMPL. DATES	RES. 1961; DEV. 1962; TEST 1965; OP. EVAL.
19.	This is the initial report on this project

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18. FY	FISCAL ESTS. (M $)
Prev.	374M
57	633M
58	1200M
59	4500M
60	4500M
61-65	13000M
TOTAL	24207M

20. REQUIREMENT AND/OR JUSTIFICATION

Electronic reconnaissance using ground, shipborne or conventional air-borne stations is seriously limited in penetration beyond the borders of the Soviet Bloc. The Advanced Reconnaissance System will provide a satellite vehicle from which electronic intelligence information may be obtained from signal sources located well within the borders of the Soviet Bloc. Although the peculiar environmental conditions and operational circumstances will affect the quantity and quality of the signal data obtained, it is expected that ample intelligence will be derived to justify the effort.

The development of an electronic reconnaissance subsystem is necessary because existing systems are not capable of operating unattended in the environ-mental conditions which will prevail in the satellite nor are they capable of performing the desired functions for the volume of traffic anticipated.

The intelligence provided by an electronic reconnaissance subsystem from a satellite vehicle is expected to augment the information available from existing sources. Data may also be obtained which will provide guidance in the direction of other intelligence gathering efforts. This subsystem will provide knowledge of Soviet military build-up, preparedness, capability, possible intent and approximate distribution of certain types of weapon and defense systems.

22. RDB	SN	CN	IC & P	X.	I.	C.

DD FORM 613 1 JAN 52 — DOWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY DECLASSIFIED. DOD DIR 5200.10

It will also provide indications of Soviet military and technological progress.

21.a. Brief and Military Characteristics

The Electronic Reconnaissance Subsystem will be capable of detecting, measuring and processing electromagnetic signals emanating from areas of interest.

The equipment will gather information describing the signal parameters and location of unknown emitters. Each flight will attempt to accomplish a predetermined intelligence mission. Information received by the ferret subsystem will be stored for subsequent re-transmission to the ground data link. Ground analysis and data reduction will be performed with the received data.

b. Approach

Ferret equipment will be designed to satisfy requirements based upon considerations of the electronic intelligence objectives of the United States that may be satisfied by a satellite reconnaissance system. Design and development of the pioneer equipment can be initiated immediately in order to obtain some intelligence data as soon as possible. Study must proceed simultaneously to establish the intelligence requirements for later missions and to develop the specialized equipment needed. In all cases, the equipment will be designed to satisfy certain specific intelligence-gathering missions.

Initial configurations of the equipment will gather data of primary intelligence importance available to a satellite reconnaissance system. The equipment will be capable of identifying the presence of known signals and unknown signals within each of several frequency bands. Accuracy of information concerning frequency and ground location may be sacrificed to optimize intercept probability.

Later configurations of the equipment will be tailor-made to perform specific intelligence missions. Improved accuracy will be provided for measurements such as ground location and signal parameters.

The physical environment will present several major problems to be overcome. These effects include shock, vibration, cosmic and nuclear radiation, meteorite collision, micrometeorite errosion, and low pressure. Other problems include: (1) obtaining a long-life power source, (2) providing equipment with high reliability in unattended operation, (3) designing antennas which have the desired beamwidth, gain and size characteristics, (4) determining the optimum settings for signal thresholds, bandwidths, etc., and (5) meeting payload restrictions.

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SECRET TITLE: ELECTRONIC RECONNAISSANCE SUBSYSTEM FOR ARS, WS117L — 2 April 1957
(UNCLASSIFIED TITLE) SUBSYSTEM F, WS117L — Proj 1760

c. Subsystem Tasks

(1) (a) Task 39822. Pioneer Ferret Reconnaissance Equipment.

(b) Contractor. Lockheed Aircraft Corporation
Sub-Contractor: Not Determined
Task Advisor: Lt W. Kram, WCLR, WADC

(c) Objective. The Pioneer configuration will gather basic intelligence data about two types of signals:

1. Known signals - Signals whose basic parameters match certain known patterns.

2. New signals - Signals whose basic parameters deviate significantly from known patterns.

(d) Approach. Knowledge of the characteristics of various Soviet signals will be used to design a portion of the equipment for maximum probability of intercepting known signals. Sufficient accuracy must be maintained in measuring the basic signal parameters to permit sorting of known signals from unknown signals. Equipment will meet the requirement of determining the approximate geographical locations of known signal types and determining the existence of new signals in certain bands where emitters are suspected.

Other portions of the equipment will use broadband antennas and receivers to permit the monitoring of selected bands where activity is presently unknown. Only the presence of signal activity within each of several broad bands, and perhaps a rough measure of certain parameters will be indicated. Accuracy of information concerning frequency and ground location will be sacrificed to optimize intercept probability.

(e) Characteristics. The ferret subsystem will be capable of receiving pulsed signals with the following priority:

Priority	Band	RF Precision	Spatial Accuracy
1	(S) 2.6-3.1 Kmc/S	± 9%	± 50 mi
2	(L) 0.65-1.3 Kmc/S	± 33	± 100
3	(X) 8.3-10.1 Kmc/S	± 10	± 50
4	(C) 3.9-6.2 Kmc/S	± 23	± 100
5	(K) 14.0-17.0 Kmc/S	± 10	± 100

The equipment having priorities 1 and 3 will intercept two large classes of known enemy radar. The other equipment will have high intercept probability in order to detect the existence of new signals.

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The preliminary analysis of the signal which is to be accomplished aboard the satellite will require circuitry which is well within the state-of-the-art. Each frequency band of interest will be allotted a recorder channel. Time also will be recorded in synchronism with the signal information. Recorded data will be such as to permit a 10 Kc bandwidth for each recorder channel. Measurements will be made of the following parameters:

1. Radio frequency
2. Ground location
3. Pulse repetition frequency: 50-5,000 pps ± 10%
4. Signal pulse widths in three categories: 0-0.5 micro-seconds, 0.5 micro-seconds - 5 micro-seconds, and above 5 micro-seconds. These categories will be indexed into three pulse widths for pulse width sorting.

Playback and transmission of the data to the ground will be accomplished by a telemeter link. The telemetry output on the ground will be stored on magnetic tape for subsequent analysis and reduction.

Ferret subsystem functional control will be provided by an interval-indicating programmer which will be re-set by command from the ground after each transmission period.

(f) Test and evaluation. Of prime importance to the success of the project is the specification and implementation of rigorous environmental and operational testing for all components and assemblies. All portions of the system will be evaluated both individually and as an integral part of the complete system.

(2) (a) Task 39823. Advanced Ferret Reconnaissance Equipment

(b) Contractor. Lockheed Aircraft Corporation
Sub-contractor: Not yet determined
Task Advisor: Lt. W. Kram, WCLR, WADC

(c) Objective. The Advanced configuration will be designed to overcome some of the limitations of the Pioneer equipment. The Advance Configuration will be capable of determining with greater accuracies such details as ground location and signal parameters.

(d) Approach. Parameters and accuracies will be established by correlating state-of-the-art techniques with the current intelligence knowledge and desires. Based on the results of the Pioneer evaluation, reconnaissance will be extended to additional portions of the frequency spectrum and to geographic areas of interest.

(e) Characteristics. The Advanced configuration will be composed of two types of receiving equipment. The first type will accomplish the purpose of obtaining more accurately the radio frequency and other electrical properties of the signal. It will consist of a frequency-scanning receiver capable of permitting PRF analysis to within a few per cent. The second type will accomplish improved locational accuracy. It will consist of fixed, tuned receivers of limited bandwidth capable of utilizing more sophisticated direction-finding techniques. Both types of receiver equipment will require research and development programs which should be started during 1957.

Data analysis for the Advanced equipment will be similar to the Pioneer except that more pulse width categories shall be considered. Amplitude quantizing will be required to permit scan patterns to be analyzed and to permit null detection direction-finding systems to be employed.

Telemetering, programming, and ground analysis shall be similar to that employed in the Pioneer configuration.

(3) (a) Task 39824. Surveillance Ferret Reconnaissance Equipment

(b) Contractor. Lockheed Aircraft Corporation
Sub-contractor: Not yet determined.
Task Advisor: Lt W. Kram, WCLR, WADC

(c) Objective. To provide answers to specific intelligence requirements in the radio frequencies of known or suspected enemy activity. by means of the satellite ferret reconnaissance vehicle. Surveillance equipment will be tailor-made to provide a capability of performing specific intelligence missions.

(d) Approach. On the basis of previous satellite reconnaissance data and national intelligence objectives, continuing refinement and sophistication of equipment and techniques will be performed. Frequency coverage and measurement accuracies will be extended as required.

(e) Characteristics. The Surveillance equipment will utilize previously developed ferret equipment and techniques where applicable to the mission to be performed. Equipment also will be made available with a capability for identifying VHF and UHF communications, such as may be used in long distance scatter propogation links. Parameters and accuracies of measurement will be determined by intelligence requirements and the current state-of-the-art in electronic techniques.

Telemetering, programming, and ground analysis should follow the lines of action of the previous ferret systems where applicable. Continuing analysis of the equipment capabilities and the intelligence objectives is essential to insure that specific missions can be attained, and that critical development areas are delineated.

d. Other Information

Work of a similar nature is currently being carried on for ground-based and airborne reconnaissance systems. However, the restrictions on size, weight, reliability, and operating environment are unique to this system and preclude usage of equipment not specifically designed for a ferret satellite. Because of specialized capability required it is planned that the majority of this subsystem will be developed by a suitable subcontractor to Lockheed Aircraft Corporation.

e. Background History

Studies have been made as long ago as 1947 by Project RAND of the Douglas Aircraft Co. to determine the problems and feasibility of launching an earth satellite and the tactical considerations relevant to an earth satellite. Recent studies of the feasibility of a satellite reconnaissance system were completed by Lockheed Aircraft Corp., G. L. Martin Co., and Radio Corporation of America.

f. Future Plans See Text

g. References

Quarterly and Final Reports on Contracts:

AF33(600)3104
AF33(616)3105
AF33(616)3106

Project RAND, Douglas Aircraft Co. reports RA-15021 through RA-15028 and RA-15032.

h. Signature and Coordination Block:

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1\.

R & D SCHEDULE

☐ SYSTEM [X] PROJECT ☐ TASK ☐ OTHER

2\. REPORTS CONTROL SYMBOL

3\. DATE 2 April 1957

4\. TITLE
(SECRET TITLE) ELECTRONIC RECONNAISSANCE SUBSYSTEM FOR ARS, WS 117L (UNCLASSIFIED TITLE) SUBSYSTEM F, WS 117L

5\. INITIAL [X]
CHANGE

6\. NUMBER 1760

SCHEDULE — CALENDAR YEARS

Title	Project or Task Nr	1956 J	1956 A	1956 S	1956 O	1956 N	1956 D	1957 J	1957 F	1957 M	1957 A	1957 M	1957 J	1957 J	1957 A	1957 S	1957 O	1957 N	1957 D
Subsystem F, WS117L	1760															R			
Pioneer Ferret Recon Equip	T 39822				A											R			
Advanced Ferret Recon Equip	T 39823				A											R			
Surveillance Ferret Recon Equip	T 39824				A											R			

Title	1958 J	1958 F	1958 M	1958 A	1958 M	1958 J	1958 3	1958 4	1959 1	1959 2	1959 3	1959 4	1960 1	1960 2	1960 3	1960 4	1961 1	1961 2	1961 3	1961 4	62 To Compl 1	62 To Compl 2	62 To Compl 3	62 To Compl 4
Subsystem F, WS117L																		Q	B		C	D	O	
Pioneer Ferret Recon Equip									Q	B		C	D	O			P					E		
Advanced Ferret Recon Equip															Q	B		C	DO			P		
Surveillance Ferret Recon Equip																		QB			C	D	O	

1. R & D SCHEDULE	2. REPORTS CONTROL SYMBOL
☐ SYSTEM [X] PROJECT ☐ TASK ☐ OTHER	3. DATE: 2 April 1957
4. TITLE: (SECRET TITLE) ELECTRONIC RECONNAISSANCE SUBSYSTEM FOR ARS, WS 117L (UNCLASSIFIED TITLE) SUBSYSTEM F, WS 117L — 5. INITIAL [X] CHANGE ☐	6. NUMBER: 1760

SCHEDULE / CALENDAR YEARS (19__: J A S O N D; 1963: J F M A M J J A S O N D; 1964: J F M A M J 3 4; 1965: 1 2 3 4; 19__: 1 2 3 4; 19__: 1 2 3 4; TO COMPL: 1 2 3 4)

TITLE	PROJECT OR TASK NR	1963 M	1965 2
Subsystem F	1760	P	E J K
Pioneer Ferret Recon Equip	T-39822		
Advanced Ferret Recon Equip	T-39823	E J K	
Surveillance Ferret Recon Equip	T-39824	p	E J K

KEY:
- A - Contract awarded
- B - Fabrication of development model started (Prototype flight article)
- C - Development model fabrication completed (Prototype flight article)
- D - End of contractor compliance te ing of development model (Acceptance test)
- O - Ground Test starts
- P - Integration with first flight (Completion of ground test)
- E - Completion of functional testing of development model to demonstrate capability (After flight test approval)
- J - Preparation of procurement data (End)
- K - Production Engineering (End)
- Q - Design studies completed.
- R - Engineering Analysis Report

R & D MANPOWER ANNEX

1. ☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER

2. REPORTS CONTROL SYMBOL

PAGE 1 OF 1 PAGES

3. DATE: 2 April 1957

4. UNCLASSIFIED TITLE: SUBSYSTEM F, WS 117L

5. INITIAL ☒ CHANGE

6. NUMBER: 1760

7. ORG COMP CODE	8. ORGANIZATION TITLE	9. TYPE ORG	10. ACTUAL MAN-QTRS LAST QTR	11. PROJECTED DIRECT MAN-YEARS FY 19 57 AVAL	FY 19 57 RQRD	FY 19 58 AVAL	FY 19 58 RQRD	FY 1959 RQRD	FY 19 60 RQRD	TO COMPL RQRD
WDTR	WS 117L Project Office, WDD	R	0.5	0.5	1.0	0.5	1.0	2.0	2.0	
WCLR	Aerial Reconnaissance Laboratory, WADC	R	0.5	0.5	1.0	0.5	1.0	1.0	1.0	*
	TOTAL:		1.0	1.0	2.0	1.0	2.0	3.0	3.0	*
	TOTAL MANPOWER DOLLARS:		1,820	7,280	14,560	7,280	14,560	24,840	24,840	124,200

*Indicates continuing requirement

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FORM 109 PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE

Approved for Release: 2017/08/17 C05099740

1\.

R & D CONTRACT FUNDS ANNEX

☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER

2\. REPORTS CONTROL SYMBOL

PAGE OF PAGES

3\. DATE: 2 April 1957

4\. TITLE
(SECRET TITLE) ELECTRONIC SUBSYSTEM FOR ARS, WS 117L
(UNCLASSIFIED TITLE) SUBSYSTEM F, WS 117L

5\. INITIAL ☒ CHANGE

6\. NUMBER: 1760

7. ITEM	8. PROJ OR TASK NR	9. END ITEM CAT	10. CONTRACT NUMBER	11. BPSN	12. PREV YRS		13. FY 57		14. FY 58		15. FY 59		16. FY 60		17. TO COMPL	
					600	OTHER	600	OTHER	600	OTHER	600	OTHER	600	OTHER	600	OTHER
Subsystem F, WS 117L	1760	E	AF04(647)-97	2-117	374M		633M		1200M		4500M		4500M		13000M	
			P-100	Funds:								350M		2300M		11500M
			P-200	Funds				30M		600M		600M		400M		1000M
		SUBTOTALS:														
			P-600		374M		633M		1200M		4500M		4500M		13000M	
			P-100									350M		2300M		11500M
			P-200					30M		600M		600M		400M		1000M
TOTAL					374		633 M	30 M	1200 M	600 M	4500 M	950 M	4500 M	2700 M	13000 M	22500 M

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R & D COST ESTIMATE RECAPITULATION

☐ SYSTEM [X] PROJECT ☐ TASK ☐ OTHER

2. *REPORTS CONTROL SYMBOL*

PAGE OF PAGES

3. DATE: 2 April 1957

4. UNCLASSIFIED TITLE: SUBSYSTEM F, WS 11/L

5. INITIAL [X] CHANGE

6. NUMBER: 1760

ITEM		A. PREVIOUS YEARS 600	A. PREVIOUS YEARS OTHER	B. FISCAL YEAR 57 600	B. FISCAL YEAR 57 OTHER	C. FISCAL YEAR 58 600	C. FISCAL YEAR 58 OTHER	D. FISCAL YEAR 59 600	D. FISCAL YEAR 59 OTHER	E. TO COMPLETE 65 600	E. TO COMPLETE 65 OTHER
7. CONTRACT	A. TOTAL	374M		633M	30M	1200M	600M	4500M	950M	17500M	15200M
	B. AVAILABLE	374M		633M							
	C. NEW REQ				30M		600M	4500M	950M	17500M	15200M
8. MATERIEL	A. TOTAL										
	B. AVAILABLE										
	C. NEW REQ										
9. FACILITIES											
10. MANPOWER		1.8M		14.6M		14.6M		24.8M		149.0M	
11. TRAINING		Not Applicable									
12. TEST ITEMS		Not Applicable									
13. TEST SUPPORT AIRCRAFT		Not Applicable									
14. *SUBTOTAL*		374M		633M	30M	1200M	600M	4500M	950M	17500M	15200M
15. TOTAL		375.8M		677.6M		1814.6M		5474.8M		32849.0M	

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Subsystem F - ELECTRONIC RECONNAISSANCE

Tab 1 - General Design Specification

I. General

A. Statement of the Problem

An earth satellite would provide a platform from which hitherto inaccessible portions of the Soviet Bloc nations could be subjected to surveillance of various types. The problem for the ferret subsystem is to design equipment which will overcome the severe environmental and payload restrictions and which will obtain such data concerning electromagnetic signals as will provide the maximum possible intelligence information.

B. Approach

The design of a system to obtain electronic reconnaissance information from a satellite vehicle requires the sub-division of the over-all effort into missions. These missions must then be ordered in priority such that, in general, the most useful information will be obtained first.

Equipment design may then be optimized for each mission and separate equipment may be designed for each if necessary. The ordering of missions should be such that information obtained from early missions will provide guidance in the design of equipment and establishment of objectives for later missions. In every case, the missions will be predicated upon intelligence needs and not necessarily upon equipment availability.

The general procedure must be as follows:

1. Define intelligence objective.

2. Determine which objectives can be best met by satellite reconnaissance.

3. Determine parameters and accuracies required to meet objectives.

4. Specify and develop equipment compatible with the physical environment that is within the state of the art to receive, detect, analyze and record the measured parameters within the desired accuracy, such as:

a. Antennas.

b. Receivers

c. Analysis and Recording Systems

d. Programmer requirements

C. Expected Results

1. Will provide an initial electronic reconnaissance system that is compatible with the physical environment, and that will yield useful intelligence data.

2. Will determine where the state of the art must be advanced (and physical limitations overcome) to satisfy all intelligence requirements placed on this sub-system.

II. Description

A. Intelligence Requirements

The reasons for preferring S-band are that, first, it is known that there are many signals in this part of the spectrum which can be used as calibrating or test signals and in effect give notice that the whole equipment is functioning. Second, there is every reason to believe that the national intelligence effort will benefit from knowing that there are signals in S-band from geographical areas that are now inaccessible to us. There is no point in using the satellite to record signals from satellite border areas, or along the China coast since adequate coverage is given by other collection methods.

In the S-band it will be possible to separate EW radars such as [redacted] by the difference in PRF. This ratio is about 300 to 1200. A further refinement would be the difference in scan rates if a long enough look-time were possible using the satellite. A higher PRF and a much different scan pattern could be expected for a height-finder as compared to an EW set in S-band. In other words, it is not possible to differentiate radars on S-band by frequency alone, but there should be enough other data available to make a gross identification possible. As an example, one Russian [redacted] system called the [redacted] believed to be in S-band, 50X1
has a PRF of 2000 and a 40 rpm scan. This information should allow the analyst to separate the [redacted] from other radars around [redacted] such as [redacted] GAGE, etc. Conversely, the GAGE, an EW set, is also in S-band with the [redacted] and has a PRF of the same order. The only way to identify the GAGE would be to have collateral information (e.g., that it was being used with a height-finder).

At present, very little activity is reported in L-band (around 1000 mc) in the Soviet Bloc. However, there is every reason to believe that the Soviets will follow the U. S. example and build very high-power EW radars using klystrons that operate at 1000 mc and below. The use of MTI (moving target indicator) is facilitated at these frequencies and it is apparent that with the new klystrons, very high powers can be reached. It is possible that the Soviets will construct radars to detect large missiles and it is in the S-band and L-band that successful designs seem possible.

A third band of interest is the X-band of frequencies. Here we expect to find airborne-intercept, fire-control, and missile-guidance radars. This band is also being used for airport traffic-control and acquisition radar for GCA. The first search should be made from 8300 to 10,100 mc.

The fourth band of interest is the C-band. The prime reason for selecting this band is that very few intercepts have been received by ELINT collectors on this band. This fact could mean that the Soviets have no equipment operating here, or it could mean that all their C-band equipment is used deep in the interior. This information from a satellite, even if completely negative, would be of great value to the intelligence community. This band should be searched in its entirety from 3900 to 6200 mc.

The fifth spectrum portion of interest should be the K-band. There have not been any signals reported as yet on this band but there are indications that some activity will shortly appear. The United States, for example, is building many high-resolution airborne navigators using 16 kmc for an operating frequency. The first search should be from 14,000 to 17,000 mc.

If it is physically possible to place large enough antennas on the satellite, the intelligence community would benefit from intercepting signals emanating from over-the-horizon scatter-propagation systems in use by the Soviet Bloc. One of the weak points in the Soviet Air Defense system has been their poor communication system. Their warning system has depended on rather low frequency radio links because their wire system is not adequate. It is possible that the Soviets will follow the U. S. lead in scatter techniques and promote systems such as "White-Alice" and the Limestone-Thule links. This means that the satellite will have to contain equipment to intercept signals in the range from 50 to 1000 mc.

The desired parameters and accuracies were specified tentatively to satisfy certain national intelligence objectives. They are detailed in paragraph 21.c.1e. of the DD Form 613.

B. Antennas

Physical limitations restrict the number of antennas on any one vehicle. Suggested antenna configurations to implement the above intelligence requirements are as follows:

1. S-band paraboloid having a bandwidth of approximately 300 mc and a beamwidth of 5° maximum. Use helical feed to receive most planes of polarization.

2. L-band helical antenna having approximately one octave bandwidth and 45° beamwidth. This will not provide a spatial resolution of 50 miles but will survey a wide territory for new signals.

3. X-band antenna having approximately 500 mc bandwidth and 3° beamwidth, probably a paraboloid with helical feed.

4. Antennas for other bands to obtain indications of activity; i.e., horn at K-band, large helix at VHF.

C. Power Supply

The only type of power supplies expected to be definitely available and proven by the time of the Pioneer system will be primary batteries. Weight of the best available will be in the order of 1800 pounds for a capability of 200 watts for 20 days continuous operation. Availability of the radio isotope power supply with batteries will enable the use of higher power for a longer operating time but will present problems concerned with radiation damage, induced circuit noise, and heat removal.

D. Receivers

Power consumption keeps receiver sophistication to a minimum. If certain frequency bands are chosen, TWT (traveling wave tubes) development to produce a suitable tube with permanent magnet focusing will be required. In other ranges, these tubes are on the market. At UHF frequencies, standard tube or transistor circuits may be suitable. Suggested receiver specifications are detailed in the task outlines under 21 c.

E. Data Analysis and Recording

Power consumption and weight considerations demand maximum simplification of analysis and storage processes to be performed in the satellite. Satellite analysis should be limited to essentially an encoding process with recorder or storage requirements being limited to multiple channel, narrow bandwidth, e.g., 10 kc/s. Requirements for the data analysis equipment are described briefly in the task outlines.

F. Telemetering Equipment

The telemetering system will make use of present standards and techniques. No major technical problems exist here and no minimum specifications are required at this stage of development.

G. Physical Environment

All estimates and calculations have been made on the basis of existing and predicted knowledge and are all subject to modification by projected experiments.

Tab 1 - General Design Specification (cont.)

1. Temperature - The use of suitable surface treatments will provide an average temperature environment compatible with existing off-the-shelf components that meet JAN specifications. This surface treatment, however, will have to be examined to insure the applicability to satellite vehicle components. Consideration shall be given to the internal heat dissapation of the equipment. Cooling might be accomplished by utilizing the vehicle as a heat sink. In addition, some means of protection must be provided to protect the equipment from the temperature variations encountered during ascent and passage from earth shadow to full sunlight during the orbit.

2. Radiation Damage - In the Pioneer system, operating for a limited period because of power supply limitations, damage produced by cosmic radiation will be negligible. Incorporation of radio-isotope or nuclear power supplies will require either adequate shielding for use of existing components or the development of special radiation-resistant components.

3. Meteor Damage - For even the short operating life of the Pioneer system, it is not practical to use a pressurized vehicle since an operating time of 100 hours is predicted with a 100 to 1 probability of puncture by meteors of magnitude 12 and larger. However, with the skin considered as a shield, equipment damage would be negligible for the Pioneer, the Advanced, and the Surveillance Systems. Micrometeorite erosion will be encountered during orbit. This will have the effect of abrading and wearing away of exposed surfaces and may have a deleterious effect on exposed equipment.

4. Reliability - Airborne equipments of this subsystem will be tested in simulated environments sufficiently to establish reliability of operation under expected launching and orbit conditions. In addition, the tests will be made whenever possible in a radiation field corresponding to that anticipated from the use of radio-isotope and nuclear auxiliary power sources. In order to achieve maximum reliability, any necessary increase in equipment complexity shall be accomplished, when practicable, at the ground station.