AF-WP-L-29 MAY 53 SM

~~CONFIDENTIAL~~ [redacted]
SECURITY CLASSIFICATION

Part of Weapons System Midas G

RDB PROJECT CARD	TYPE OF REPORT: New Project		REPORTS CONTROL SYMBOL DD-RDB(A)82
1. PROJECT TITLE: (SECRET TITLE) INFRARED RECONNAISSANCE SUB-SYSTEM FOR ARS, WS-117L (UNCLASSIFIED TITLE) SUBSYSTEM G, WS-117L	2. SECURITY: ~~SECRET~~	3. PROJECT NUMBER: 1761	
	4. INDEX NUMBER: 2-117L	5. REPORT DATE: 2 April 1957	
6. BASIC FIELD OR SUBJECT: Strategic Air Warfare System 117L	7. SUBFIELD OR SUBJECT SUBGROUP: 37-Recon-Electronic Equipment	7A. TECH. OBJ.: SA-9A,9B 10,10-9	
8. COGNIZANT AGENCY: ARDC	12. CONTRACTOR AND/OR LABORATORY: Lockheed Aircraft Corp.	CONTRACT/W.O. NO.: AF 04(647)-97	
9. DIRECTING AGENCY: HQ ARDC, WDD	Sec 21 C		
OFFICE SYMBOL: WDTR	TELEPHONE NO.: Ext. 1343		
10. REQUESTING AGENCY: HQ USAF	13. RELATED PROJECTS: WS-117L	17. EST. COMPL. DATES: RES. 1959; DEV. 1961; INST. 1965; OP. EVAL.	
11. PARTICIPATION, COORDINATION, INTEREST: USAF/AMC-P, SAC-I, APGC-I, ATIC-I, ADC-I, ATC-I, USN/CNO-I, USA/C/S-I, OTHER/CIA-I	14. DATE APPROVED	18. FY / FISCAL ESTS. (M $): Prev. OM; 57 191M; 58 1000M; 59 3000M; 60 3000M; 61-65 10000M; TOTAL 17191M	
	15. PRIORITY: 1A; 16. A (Missiles)		

INFORMATION COPY

19.

This is the initial report on this project.

20. REQUIREMENT AND/OR JUSTIFICATION

The Infrared Reconnaissance Subsystem is designed to fulfill, in part, the intelligence objectives outlined in System Requirement No. 5, dated 17 October 1955. Development of an infrared sensing capability provides unique intelligence data for strategic warning purposes. Ultimately, with a system of satellites simultaneously on orbit, unfriendly territory will be placed under continuous and complete surveillance. The subsystem will automatically screen out unintelligible signals and respond only to highly emitting targets which rise out of the lower atmosphere. This fixes its response to large jet or rocket types of airborne vehicles and permits rapid interpretation of signals received.

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

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DOWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY DECLASSIFIED. DOD DIR 5200.10

[redacted]
SECURITY CLASSIFICATION

WD-57-01332

INFRARED RECONNAISSANCE SUBSYSTEM FOR ARS, WS-117L Project: # 1761 2 April 1957

21 a. Brief and Military Characteristics: As visualized, the Infrared Subsystem in a satellite vehicle at 1000 miles altitude will detect and locate ICBM launchings to a range of approximately 2600 miles. The information is relayed directly to a ground receiving station within 2400 miles range. With one such station located at high latitude, and fifteen satellites in operation simultaneously, the entire region above latitude 55° North can be kept under continuous surveillance. When a data link is developed which will permit information to be relayed between satellites for transmission to the ground, greater coverage with half as many vehicles can be achieved. From a 300 mile orbit, the Infrared Subsystem will locate large jet aircraft and missiles to slant ranges of approximately 420 miles. Since immediate transmission is not essential when air breathing vehicles are detected, the data may be stored and read out later during the 90 minute orbital cycle.

21 b. Approach:

Target detection ranges and background effects will be studied to establish the performance to be expected of an infrared system. An optimized subsystem will be evolved, progressing from component and system breadboard studies to experimental and prototype models, with orbital flight tests of the prototype system. Suitable detector elements and scanning and cooling methods are critical features of the design. When the utility of infrared reconnaissance by a single satellite has been successfully demonstrated, multiple satellites and higher orbital altitudes will be attempted. Concurrently, development of an intersatellite data link and accurate tracking angle reference systems will be pursued at an appropriate pace.

21 c. Subsystem Tasks

(1) Task 39832: Background Effects

(a) Contractors:

Prime Contractor: Lockheed Aircraft Corporation, AF 04(647)-97

Subcontractors: Baird Associates
General Mills, Inc.

Technical Advisor: Mr. L. H. Meuser
WCLR, WADC

(b) Objective: Determine the extent to which background radiation imposes limitations on the infrared detection system and determine the choice of system parameters which will minimize it. This will contribute to early evaluation of the target detection capabilities of a satellite-borne infrared-sensing system.

(c) Approach: Balloon flight tests will be conducted using elements of the system as initially conceived, with suitable spectral sensitivity, filtering, field of view, scan speed, chopping rate, etc., and provisions for variations thereto. A limited number of day and night balloon flights will be conducted at maximum attainable altitude, in the vicinity of 100,000 feet, under representative and extreme terrain and cloud conditions. Measurements of background radiation will be correlated with significant features of observed areas.

(2) Task 39833: Target Characteristics Viewed from High Altitude

(a) Contractors:

Prime Contractor: Lockheed Aircraft Corporation, AF 04(647)-97

Subcontractors: Eastman Kodak Company (Proposed)

Technical Advisor: Mr. L. H. Meuser
WCLR, WADC

(b) Objective: Measure infrared radiation intensity emanating from appropriate types of missiles and aircraft as a function of their altitude. Make these measurements from as high an altitude as possible to minimize the very great effect of the lower atmosphere. Together with background effects investigated under Task 39832, these measurements are essential to evaluating operational performance expectations.

(c) Approach: An instrumented aircraft will be flown at 45,000 feet or higher. Equipment will have in-flight calibration features to measure intensity in important spectral regions, placing particular emphasis on the 2-3 and 4-5 micron regions. Measurements will be performed on two-target types as follows:

1. Air-breathing turbo-jet or turbo-prop aircraft with high horsepower engines, such as the B-47, B-52, C-130, F-102 and F-104. The target aircraft altitude will be varied from sea level to 45,000 feet with particular emphasis on altitudes above 20,000 feet. The target aspect will be varied sufficiently to allow construction of approximate polar intensity plots.

2. Burning rocket engines of the ICBM type. Radiation intensity will be measured during ascent from sea level to burnout, and beyond if possible.

Pursuit of this task is contingent upon obtaining a suitable USAF aircraft with crew and such operational support as is necessary. A request for test aircraft and support from AFFTC, Edwards Air Force Base, has been initiated and resources annexes are in preparation.

(3) Task 39834: Prototype Infrared Subsystem

(a) Contractors:

Prime Contractor: Lockheed Aircraft Corporation AF 04(647)-97

Subcontractors: Aerojet-General Corporation
Eastman Kodak Company

Technical Advisor: Mr. L. H. Meuser
WCLR, WADC

(b) Objective: Develop a prototype Infrared Subsystem with detection capabilities as outlined in the General Design Specification.

The prototype will have no tracking capability nor will it be equipped for intersatellite communication.

(c) Approach: The feasibility of various technical approaches will be studied. Scanning methods for locating small targets in a large field of view will be investigated. These include techniques such as rotating a fan of pencil beams in conjunction with an electronically scanned linear array of detecting elements, utilizing a solid angle of pencil beams emanating from an electronically scanned stationary mosaic of detectors, or utilizing a single element with an optical scanning device. Promising detector elements such as lead sulphide, lead telluride, lead sellenide, indium antimonide, gold doped germanium, etc. will be evaluated. Relative suitability of such detectors will be determined in terms of spectral response, sensitivity, time constant, cooling requirements, physical properties, nuclear radiation damage, and environmental compatibility. Airborne data processing equipment similar to that under development for the Electronic Reconnaissance Subsystem will be utilized, with and without, data storage features.

Breadboard component studies will be conducted and an experimental model built. The experimental model will be tested exhaustively on the ground and in aircraft. Test results will lead to prototype design specifications. Power requirements, heat generation, weight, and size of the prototype will be reduced to an absolute minimum by miniaturization and transisturization wherever possible. A very substantial effort will be exerted to achieve an extreme degree of reliability for the entire system. Redundant as well as improved components will be considered. After extensive ground and aircraft tests, the prototype will be given orbital flight tests.

(4) Task 39835: Feasibility of Advanced Applications

(a) Contractors:

Prime Contractor: Lockheed Aircraft Corporation, AF 04(647)-97

Subcontractor: Undetermined

(b) Objective: Study the feasibility of more difficult and advanced applications of satellite-borne infrared-sensing equipment.

(c) Approach: Practicable operational concepts and equipments will be studied to extend the performance of the Infrared Subsystem beyond that of the prototype system. Coverage of enemy territory as a function of orbital plane, orbital altitude, number of vehicles on orbit, and data transmission methods will be investigated. The operational utility of a satellite system in an AICBM role will be considered, including the feasibility of tracking the ICBM over its burning path for trajectory prediction. Characteristics and requirements of a reliable intersatellite communication link to enlarge the area under prompt surveillance will be established. Methods for obtaining an accurate angle reference system will be studied, including line-of-sight between satellites and celestial references.

21 d. Other Information:

The satellite platform furnishes a unique vantage point for viewing infrared targets in that it provides a very large horizon distance and minimum intervening atmosphere. Technical problems involved in the subsystem development are also unique, considering the environment and the long duration of unattended operation. Duplication of other efforts is therefore not believed to exist. Equipment and techniques are under development which have similar operational applications, but which have more limited coverage. In particular, development work undertaken by AFOIN-4 is closely related to this effort and coordination between the two programs will be effected.

21 e. Background History

During early design study of the WS-117L, the Missile Systems Division, Lockheed Aircraft Corporation, recognized the possibility of accomplishing useful reconnaissance with satellite-borne infrared-sensing equipment. A proposal to this effect was included in MSD-1726, 30 June 1956, "Pied Piper First Annual Report" on Contract AF 33(616)-3105. Feasibility was further pursued by Lockheed, results being given in periodic reports and being summarized in MSD 1929, 6 September 1956, "Preliminary Study of WS-117L Warning System Against ICBM Attack." Lockheed was also engaged in a separate AICBM study on Contract AF 33(616)-3284, reporting potential AICBM applications of a satellite infrared system in MSD 1844, 31 August 1956, "Third Quarterly Report - AICBM Study Program." A related program initiated by AFOIN-4 contributed to the feasibility and desirability of this approach.

21 f. Future Plans:

During the next reporting period feasibility studies will be extended. Measurements of background effects on an elementary system and of target characteristics as viewed from high altitude will establish range and performance capabilities. Preliminary design of the subsystem will be conducted leading to specifications for an experimental model.

21 g. References

(1) General Operational Requirements (80) SA-2C, 11 March 1955

(2) System Requirement 5, 17 October 1955

(3) MSD 1726, 30 June 1956, "Pied Piper First Annual Report"

(4) MSD 1844, 31 August 1956, "Third Quarterly Report-AICBM Study Program"

(5) MSD 1929, 6 September 1956, "Preliminary Study of WS-117L Warning System Against ICBM Attack"

(6) Contract AF 33(616)-3105

(7) Contract AF 33(616)-3284

INFRARED RECONNAISSANCE SUBSYSTEM FOR ARS, WS-117L Project: # 1761 2 April 1957

(8) Contract AF 04(647)-97

21 h. Coordination and Signature Block

George E. Austin

GEORGE E. AUSTIN
Major, USAF
Project Engineer

FREDERIC C. E. ODER
Colonel, USAF
Assistant for WS-117L

GENERAL DESIGN SPECIFICATION

I. General

a. Statement of the Problem: The Infrared Subsystem will partially fulfill the objectives outlined in System Requirement No. 5, 17 October 1955, by providing the following capabilities for the WS 117L:

(1) Detection of ICBM launchings whenever and wherever they occur, giving immediate and unambiguous warning of ICBM attack.

(2) Detection of large jet aircraft and missiles for early warning of attack by such vehicles, and for surveillance of air traffic patterns as an indicator of the imminence of hostilities.

(3) Tracking of ballistic missiles during their burning stages with sufficient accuracy for trajectory and impact prediction in AICBM applications. This represents a very advanced capability.

b. Approach: The Infrared Subsystem will passively receive infrared signals in selected portions of the 1-12 micron region, process these signals, and feed them to the Ground Space Communication Subsystem for transmission to the ground in suitable form for immediately locating the emitting sources. Hopefully, these sources will be limited to large rocket or jet engines at altitude, with ground targets blanked out by the lower atmosphere.

Since warning of ICBM attack requires instantaneous reporting of targets detected by the Infrared Subsystem, data storage and subsequent readout during passage over a ground receiving station cannot be considered for this capability. Using multiple satellites simultaneously on orbit, but with no intersatellite data link, direct transmission from each satellite to ground must be utilized. The geographical area under surveillance at any time is then limited by the readout range as well as by the detection range. Each of these ranges is expected to be approximately 2500 miles for an orbital altitude of 1000 miles.

Preliminary analysis indicates that with one high latitude ground receiving station and fifteen satellites equally spaced on an 83 degree, 1000 mile orbit, all launching sites within the USSR for missiles with a 5500 nautical mile range can be kept under constant surveillance. The coverage of total Soviet territory will be no less than 50% at any time and will average approximately 80%. With intersatellite communication, greater coverage can be obtained with half as many satellites.

For operation against manned aircraft and other airbreathing vehicles, storage and later transmission of detection data is feasible. Whereas, the ICBM detection range is line-of-sight limited and can be increased by increasing orbital altitude, the less intense emissions from airbreathing targets are not likely to be detected from a 1000 mile orbit. A 300 mile orbital altitude must therefore be utilized for this application. A single satellite will provide useful surveillance of USSR aircraft patterns and activity. Cutting approximately a 600 mile swath with each passage, the

the satellite brings a very large percentage of Soviet territory under observation at some time during each day. The type of intelligence data so obtained is an activity indicator, providing an alert whenever significant deviations from normal patterns occur.

c. Solution:

The infrared Subsystem must detect and locate emitters of minute size in a large field of view. A conceptual but non-optimized design to accomplish this employs a line array of approximately 150 cooled lead telluride detecting elements. These are placed in the focal plane of a 56 inch diameter corrected reflector system, creating a fan-shaped field of view comprised of 150 digitalized, 0.25 degree pencil beams. As the fan beam is rotated around a vertical axis, 150 concentric annular rings are swept out. Simultaneously with the mechanical rotation, each of the detecting elements in the line array is scanned electronically. Target location is determined from the azimuthal orientation of the optical system together with the identity of the detecting element in the line array.

Target radiation falling upon a detecting element changes its conductivity and produces a voltage signal which is amplified by an individual pre-amplifier mounted on the rotating scanner. A commutator system receives the signal from the preamplifier and passes it to another amplifier. An azimuthal potentiometer produces a voltage indicative of the scanner's position. The electronic scanning voltage, which is used to scan the elements, is fed to an electronic scan coder circuit which associates and correlates all target signals out of the target amplifier with the appropriate scan voltage. These target position data, together with a timing code signal are passed through a data processing circuit to put the signals into appropriate form to be relayed to ground by the satellite-to-ground transmitter.

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1.

R & D SCHEDULE

☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER

2. REPORTS CONTROL SYMBOL

3. DATE 2 April 1957

4. TITLE
(SECRET TITLE) INFRA-RED RECONNAISSANCE SUBSYSTEM FOR ARS, WS 117L
(UNCLASSIFIED TITLE) SUBSYSTEM G, WS 117L

5. INITIAL ☒ CHANGE

6. NUMBER 1761

SCHEDULE

CALENDAR YEARS

TITLE	PROJECT OR TASK NR	1957 J A S O N D	1958 J F M A M J J A S O N D	1959 J F M A M J J A S O N D	1960 1 2 3 4	1961 1 2 3 4	1962 1 2 3 4	TO COMPL 1 2 3 4
Subsystem G	1761							63 [illegible]465
Background Effects	39832		R	B	C D	P		E J K
Target Characteristics	39833		R					
IR Equipment Components	39834			B	C D	P		E J K
Feasibility of Adv. App.	39835		R					

Key - A - Contract Awarded (October 1956)
B - Fabrication of Development Model Started (Prototype Flight Article)
C - Development Model Fabrication Completed (Prototype Flight Article)
D - End of Contactor Compliance Testing of Development Model (Acceptance Test)
E - Completion of Functional Testing of Development Model to Demonstrate Capability
J - Preparation of Procurement Data (End)
K - Production - Engineering (End)
Q - Ground Test Starts
P - Integration with First Flight (Completion of Ground Test)
R - Completion of Study

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1.

R & D TEST ANNEX

☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER

2. REPORTS CONTROL SYMBOL

PAGE OF PAGES

3. DATE: 2 April 1957

4. TITLE: (SECRET TITLE) INFRA-RED RECONNAISSANCE SUBSYSTEM FOR ARS, WS 117L
(UNCLASSIFIED TITLE) SUBSYSTEM G, WS 117L

5. INITIAL ☒ CHANGE

6. NUMBER: 1761

7. RESP CENTER	8. PROJECT OFFICER	9. SUPPORTS (Sys or Proj)	10. CONTRACTOR	11. CONTR NR	12. PRIORITY AND PREC	13. SECURITY
WDD (WDTR)	Major G. E. Austin	WS 117L	Lockheed Acft.Corp	AF 04 (647)-97	1A, 1-6	SECRET

14. ITEM NUMBER	15. TEST ITEM	16. TEST DESCRIPTION	17. TEST AGENCY AND SITE	18. TEST ITEM AVAILABLE	19. RQD TEST COMPL DATE
1.	Infrared radiation characteristics from appropriate targets as seen from high altitude.	One A/C with IR sensing equipment will measure the radiation intensity in selected spectral regions from burning ICBM rockets and jet aircraft with high horsepower engines. High altitude capability in excess of 40,000 feet is necessary for the instrumented A/C in order to subordinate effects of the lower atmosphere. Variations in target radiation with altitude and aspect will be determined. Data obtained will be used to evaluate performance of an IR detection system mounted on a very high altitude platform.	(1) Agency to be determined. AFFTC or AFAC under consideration. (2) Site - Some flights necessary in vicinity of Patrick AFB. Site of other flights optional.	(1) IR instrumentation avail 30 Aug 57 (2) A/C to be instrumented desired 30 Aug 57 (3) ICBM targets available as scheduled in WS 107A and WS 315A test Programs. (4) A/C targets for fly-by to be arranged.	31 Mar 58

TEST CENTER APPROVAL

20. NAME	ORGANIZATION	DATE
21. NAME	ORGANIZATION	DATE

RESPONSIBLE CENTER APPROVAL

22. NAME	ORGANIZATION	DATE

ARDC FORM 1 JUL 55 105 PREVIOUS EDITIONS OF THIS FORM ARE OBS[illegible]

CONFIDENTIAL [redacted]

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1.

R & D TEST AND TEST SUPPORT AIRCRAFT ANNEX

☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER

2. REPORTS CONTROL SYMBOL

PAGE OF PAGES

3. DATE: 2 April 1957

4. TITLE: (SECRET TITLE) INFRARED RECONNAISSANCE SUBSYSTEM FOR ARS, WS 117L
(UNCLASSIFIED TITLE) SUBSYSTEM G. WS 117L

5. INITIAL ☒ CHANGE ☐

6. NUMBER: 1761

7. ITEM NUMBER	8. AIRCRAFT REQUIRED QTY	TYPE, MODEL AND SERIES	SERIAL NUMBER	9. ASG CODE	10. MODE CODE	11. DATE REQD AND LOCATION	12. ESTIMATED RELEASE DATE	13. RECOMMENDED DISPOSITION	14. HRS EST	15. EST COST
1.	1	B-47 (or equivalent)			L	30 Aug 57	31 Mar 58		**	**
2.	1	B-47 (or equivalent)			A	*	*		110	110M
3.	1	F-100 (or equivalent)			A	*	*		12	12M
4.	1	C-130 (or equivalent)			A	*	*		4	3M
5.	1	B-52 (or equivalent)			A	*	*		15	12M
								TOTAL	12	24M
										161M

* Location and Dates to be determined by Center. Center is expected to be either AFAC or AFFTC. 60 flight hours involving Item 1 must be conducted within 200 miles of Patrick AFB at times determined by Missile Launchings. The additional 50 hours and all hours indicated for Items 2 through 5 are to be flown at times and places of convenience during the period 30 Aug 57 to 31 March 58. Estimated hours are considered minimal.

** Hours and costs are totalled for period 30 Aug 57 through 31 Mar 58.

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WD-57-01352

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1.

R & D MANPOWER ANNEX

☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER

2. REPORTS CONTROL SYMBOL

PAGE OF PAGES

3. DATE: 2 April 1957

4. UNCLASSIFIED TITLE: Subsystem G, WS-117L

5. INITIAL ☒ CHANGE ☐

6. NUMBER: 1761

7. ORG COMP CODE	8. ORGANIZATION TITLE	9. TYPE ORG	10. ACTUAL MAN-QTRS LAST QTR	11. PROJECTED DIRECT MAN-YEARS						
				FY 19 57		FY 19 58		FY 19 59	FY 19 60	TO COMPL
				AVAL	RQRD	AVAL	RQRD	RQRD	RQRD	RQRD
..JTR	WS-117L Project Office, WDD	R	1.0	0.5	1.0	0.5	1.0	2.0	2.0	*
WCLR	Aerial Reconnaissance Lab., WADC	R	0.5	0.5	0.5	0.5	0.5	0.5	0.5	*
	TOTALS:		1.5	1.0	1.5	1.0	1.5	2.5	2.5	*
	TOTAL MANPOWER DOLLARS:		2,730	7,280	10,920	7,280	10,920	18,200	18,200	91,000

* Continuing Requirements

ARDC FORM 1 JUL 56 109 PREVIOUS EDITIONS OF THIS FORM ARE OBSOLETE

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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) INFRARED RECONNAISSANCE FOR ARS, WS-117L
(UNCLASSIFIED TITLE) SUBSYSTEM G, WS-117L

5. INITIAL ☒ CHANGE ☐

6. NUMBER 1761

7. ITEM	8. PROJ OR TASK NR	9. END ITEM CAT	10. CONTRACT NUMBER	11. BPSN	12. PREV YRS 000	12. PREV YRS OTHER	13. FY 57 000	13. FY 57 OTHER	14. FY 58 000	14. FY 58 OTHER	15. FY 59 000	15. FY 59 OTHER	16. FY 60 000	16. FY 60 OTHER	17. TO COMP 65 000	17. TO COMP 65 OTHER
SUBSYSTEM G, WS-117L	1761	E	04(647)-97	2-117			191M		1000M		3000M		3000M		10000M	
			P-100 Funds:													
			P-200 Funds:					150M		500M		550M		500M		2000M 2000M
		Sub Totals:														
			P-600				191M		1000M		3000M		3000M		10000M	
			P-100					150M		500M		550M		500M		2000M
			P-200													2000M
TOTAL							191M	150M	1000M	500M	3000M	550M	3000M	500M	10000M	4000M

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R & D COST ESTIMATE RECAPITULATION

☐ SYSTEM ☒ PROJECT ☐ TASK ☐ OTHER

2. REPORTS CONTROL SYMBOL

PAGE OF PAGES

3. DATE: 2 April 1957

4. UNCLASSIFIED TITLE: SUBSYSTEM G, WS 117L

5. INITIAL ☐ CHANGE ☒

6. NUMBER: 1761

ITEM		A. PREVIOUS YEARS		B. FISCAL YEAR 57		C. FISCAL YEAR 58		D. FISCAL YEAR 59		E. TO COMPLETE	
		000	OTHER	000	OTHER	000	OTHER	000	OTHER	000	OTHER
7. CONTRACT	A. TOTAL			191M	150M	1000M	500M	3000M	550M	13000M	4000M
	B. AVAILABLE			191M							
	C. NEW REQ				150M	1000M	500M	3000M	550M	13000M	4000M
8. MATERIEL	A. TOTAL										
	B. AVAILABLE										
	C. NEW REQ										
9. FACILITIES											
10. MANPOWER		2.7M		10.9M		10.9M		18.2M		109.2M	
11. TRAINING											
12. TEST ITEMS											
13. TEST SUPPORT AIRCRAFT						161M					
14. SUBTOTAL				191M	150M	1000M	500M	3000M	550M	13000M	4000M
15. TOTAL		2.7M		351.9M		1671.9M		3568.2M		17109.2M	

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RDB PROJECT CARD	TYPE OF REPORT: New Project		REPORTS CONTROL SYMBOL DD-RDB(A)48
1. PROJECT TITLE: (UNCLASSIFIED TITLE) Ground-Space Communications Subsystem for ARS, WS 117L	2. SECURITY: SECRET		3. PROJECT NUMBER: 1762
	4. INDEX NUMBER:		5. REPORT DATE: 2 April 1957
6. BASIC FIELD OR SUBJECT: Strategic Air Warfare System 117L	7. SUBFIELD OR SUBJECT SUBGROUP: 46-Communications		7A. TECH. OBJ.: SA-9A, 9B 10, IO-9
8. COGNIZANT AGENCY: Air Research and Development Command	12. CONTRACTOR AND/OR LABORATORY: Lockheed Aircraft Corporation		CONTRACT/W.O. NO.: AF 04(647)-97
9. DIRECTING AGENCY: HQ, ARDC, WDD			
OFFICE SYMBOL: WDTR	TELEPHONE NO.: X-1343		
10. REQUESTING AGENCY: HQ USAF	13. RELATED PROJECTS: WS 117L		17. EST. COMPL. DATE: RES. 1959; DEV. 1962; TEST 1965; OP. EVAL.
11. PARTICIPATION, COORDINATION, INTEREST: USAF/AMC-P, USN/CND/I, SAC-I, USA/C/S-I, ADC-I, Other/CIA-I, ATC-I, APGC-I	14. DATE APPROVED:		18. FY / FISCAL ESTS. (M $): Prev. 535M; 57 1472M; 58 5000M; 59 5000M; 60 6000M; 61-65 20000M; Total 37472M
	15. PRIORITY: 1A	16. A (Missiles)	
19. This is the initial report on this project			

INFORMATION COPY

20. REQUIREMENT AND/OR JUSTIFICATION

The objectives of this project are to assure the satisfactory development of equipment to perform all of the functions concerned with air to ground data transmission and receipt, establishment and maintenance of contact with the vehicle (including acquisition tracking, and ground control), orbital computations, and command communications.

Reference ARDC System Requirement No. 5 dated 17 October 1955.

21a Brief and Military Characteristics:

The "Ground-Space Communications" ground equipment will provide for acquisition and tracking, reception of data, and transmission of specific commands to a satellite vehicle moving on an orbit at approximately 300 miles altitude. This capability will be provided for a maximum radio range from the ground stations. In addition, the ground equipment will provide for inter-station ground communications, including transmission of reconnaissance data; computation necessary for acquisition, programming and for geographic

22. RDB	SN	CN		X.	I.	C.
RD-613						

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SECURITY CLASSIFICATION

DOWNGRADED AT 12 YEAR INTERVALS; NOT AUTOMATICALLY DECLASSIFIED. DOD DIR 5200.10

WP-57-01143

registration of the vehicle position, telemetry reception and recording, and a synchronized timing system.

The electronics to be contained in the vehicle and which are to be developed under this project will provide the means for transmission of the reconnaissance data to the ground receivers, control and programming of the vehicle payload functions, telemeter encoding and transmitting, vehicle timing and, as an important function of the command facility, a destruct command channel.

b. Approach

A system of ground stations will be strategically located to provide efficient tracking, command control, and intercept of the vehicle. When the vehicle is within radio range of a station, an acquisition and tracking system will determine the position of the vehicle and transmit the position data to the orbit computer. Discrete program commands will be based upon a determination of the position of the vehicle in its orbit. The high-gain telemetry and reconnaissance data receiving antennas will be slaved to the tracking system. The video output from the data link receivers will be available for monitoring and will be conveyed to the Intelligence Center for decoding and data storage. The directional data link antenna on the vehicle will be scanned so that the ground receiver can detect errors in its direction. Antenna orientation in the vehicle will be corrected over the command link.

The station locations are to be determined to provide maximum coverage while still preserving security. Inter-station communication systems are to be used; these will rely on wire and radio nets.

The major problems to be overcome are (1) high reliability of vehicle electronic equipment due to long unattended operation in a foreign environment, (2) development of a steerable airbrone data link tracking scheme, and (3) availability of a suitable data transmitting tube.

"See Tasks"

c. Subsystem Tasks

The Ground-Space Communication Subsystem is divided into the following tasks:

1a. Task No. 39840 (Uncl Title) Acquisition and Tracking Equipment

b. Contractor: Lockheed Aircraft Corporation
Missile Systems Division
P. O. Box 504
Sunnyvale, California

Contract No. AF 04(647)-97

(UNCLASSIFIED TITLE) Ground-Space Communications Subsystem for ARS, WS 117L
Project 1762 -2 April 1957

Task Advisor: Mr. J. Fallik, RADC - RCEMBL - X71217
Mr. G. H. Parker, RADC

c. Objective: The objective of this task is to design, develop, fabricate and test acquisition and tracking equipment for the WS 117L Flight Test and Operational Phases.

Acquisition equipment will insure the acquisition of a vehicle at a maximum line-of-sight range for a 5° elevation angle from the ground station, under all situations following periods in which the vehicle has not been under ground surveillance. One such equipment will be provided at each Vehicle Tracking and Intercept Station.

Each Intercept Station will contain ground tracking equipment whose primary purposes will be to obtain vehicle position and velocity data for orbit computations, and to dynamically orient ground data receiving antennas at the vehicle in order to receive reconnaissance data.

d. Early test flights will utilize modified pulse radar equipments for tracking. During later flights, nulling interferometers or radars will perform the tracking function. Independent acquisition equipment will be provided at all times.

The approach will be to utilize existing techniques and equipments insofar as possible.

2a. Task No. 39841 (Uncl Title) Vehicle Transponder Beacon Equipment

b. Contractor: Lockheed Aircraft Corporation
Missile Systems Division
P. O. Box 504
Sunnyvale, California

Contract No. AF 04(647)-97

Task Advisor: Mr. A. J. Falkowski - WADC - WCLNO-2 - X21239

c. Objective: The objective of this task is to design, develop, fabricate and test the vehicle beacon equipment utilized to supply a tracking signal for the ground acquisition and tracking equipments. During a good portion of the flight test program, a pulse beacon transponder compatible with the ground pulse radar will be provided. In the later test phases the tracking signal furnished to the ground nulling interferometers, if used, will be supplied by either the vehicle telemeter or data transmitter.

d. A beacon having all the required features is not available in inventory or in the process of R&D. However, related items are being developed by Evans Signal Laboratory of the Army, NRL, and the Air Force Missile Test Center.

e. A program is necessary to develop beacon equipment compatible with the vehicle and associated ground equipments.

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Project 1762 - 2 April 1957

3a. Task No. 39842 (Uncl Title) Orbit Computing and Ground Programming Equipment

b. Contractor: Lockheed Aircraft Corporation
Missile Systems Division
P. O. Box 504
Sunnyvale, California

Contract No. AF 04(647)-97

Task Advisor:

c. Objective: The objective of this task is to design, develop, fabricate and test the ground orbit computing and programming equipment. A computer will be provided at each Vehicle Intercept and Control Station to compute the vehicle's orbit for indexing reconnaissance data, reacquisition, and vehicle programming. A master computer at the Master Intercept Station, will have an additional capability relative to determining the operating mode of each Intercept Station.

d. The orbit computer will be selected and requisitioned from several which are now under development and which meet requirements. Required input-output devices will be developed.

4a. Task No. 39843 (Uncl Title) Ground Timing and Synchronization Equipment

b. Contractor: Lockheed Aircraft Corporation
Missile Systems Division
P. O. Box 504
Sunnyvale, California

Contract No. AF 04(647)-97

Task Advisor: Mr. G. H. Parker, RADC, RCEMBL
Mr. J. Fallik - RADC - RCEMBL - X71217

c. Objective: The objective of this task is to design, develop, fabricate and test the ground timing equipment required to provide a time base for the weapon system. Timing equipment will be provided at each Intercept Station suitably synchronized with the over-all timing system and possessing sufficient accuracy to permit geodetic indexing of vehicle position.

d. The approach will be to select and procure the necessary equipment such as crystal oscillator secondary standards, and standard radio receiver and time delay equipments. Auxiliary equipment will be designed and developed as required.

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5a. Task No. 39844 (Uncl Title) Vehicle Programming and Timing Equipment

b. Contractor: Lockheed Aircraft Corporation
Missile Systems Division
P. O. Box 504
Sunnyvale, California

Contract No. AF 04(647)-97

Task Advisor: Mr. A. J. Falkowski - WADC - WCLNO-2 - X21239

c. Objective: The objective of this task is to design, develop, fabricate and test of vehicle programming and timing equipment. The vehicle programmer will accept and store commands received over the command link and release them for execution at the correct time. Vehicle timing equipment will be provided since the sequence of programmed actions is dependent upon time. Timing is also necessary in the vehicle to provide a means for geodetically indexing the reconnaissance data.

d. Although the items of hardware to accomplish these task functions are within the state-of-the-art, specific items are not available in the inventory. A development program is therefore necessary.

6a. Task No. 39845 Ground Command Control Equipment (Uncl Title)

b. Contractor: Lockheed Aircraft Corporation
Missile Systems Division
P. O. Box 504
Sunnyvale, California

Contract No. AF 04(647)-97

Task Advisor: Sidney Rosenberg, RADC, RCVO - X-3117

c. Objective: The object of this task is to design, develop, fabricate and test the Ground Command Control Equipment for the WS 117L System.

(1) The purpose of the ground command control equipment is to transmit operational program commands and time signals to the vehicle in proper form, sequence and quantity for both real time and programmed vehicular, time-sequenced execution. It will also be capable of initiating "lost bird" operation. The equipment will be capable of transmitting reliable commands (via a high gain directional antenna) to the vehicle at radio range up to 2000 n. miles for elevation angles greater than 5°.

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(2) An encoder will be employed to transform commands to a suitable form for modulation of the transmitter carrier. Command coding will be capable of being changed periodically for security purposes. Means will be provided to automatically indicate correct reception and decoding of the commands at the vehicle.

d. Proposed Approach

(1) When a pulsed radar-transponder combination is used for primary tracking, consideration will be given to the possible use of a common transmitter and/or antenna for primary tracking and command control purposes.

(2) For the early Pioneer Test Program, the following engineering approach will be taken:

(a) Procure and modify, if necessary, a suitable high power FM command transmitter. The choice of frequency will be determined by the results of interference and jamming studies.

(b) Procure and modify a suitable standard parabolic antenna and pedestal for item (a) above.

(c) Develop and fabricate an antenna feed system for a circular polarized antenna.

(d) Assemble, and conduct compliance and field tests on above equipment.

(3) For the Advanced Ground Command Control Equipment, the following engineering approach will be undertaken:

(a) Investigate methods of improving transmission reliability and decreasing sensitivity to interference and jamming.

(b) Design, develop, fabricate and test an Advanced Command Control Transmitter and Modulator.

7a. Task No. 39846 (Uncl Title) Vehicle Command Receiving Equipment

b. Contractor: Lockheed Aircraft Corporation
Missile Systems Division
P. O. Box 504
Sunnyvale, California

Contract No. AF 04(647)-97

Task Advisor: Mr. A. J. Falkowski - WADC - WCLNO-2 -X21239