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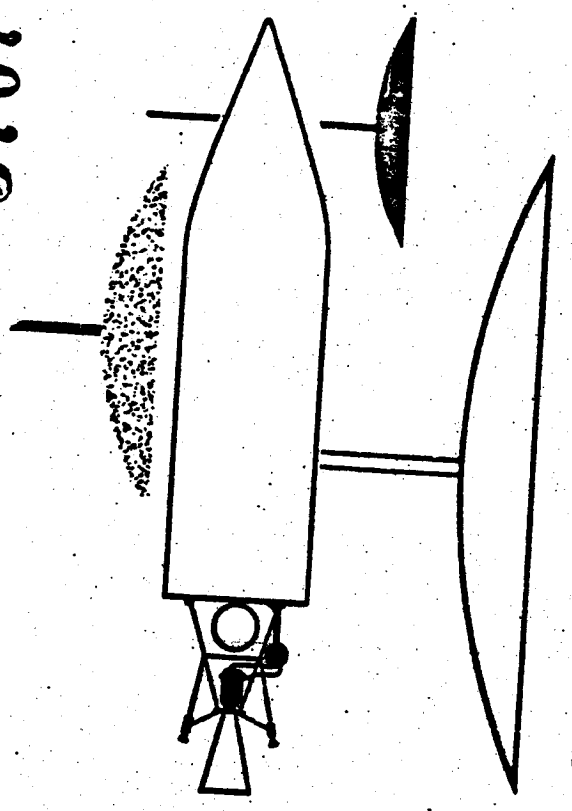

Pied Piper DEVELOPMENT PLAN

VOL. II SUB-SYSTEM PLAN

I. Airborne Test Systems

LOCKHEED AIRCRAFT CORPORATION
MISSILE SYSTEMS DIVISION
VAN NUYS, CALIFORNIA

CONFIDENTIAL

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1 MARCH 1956

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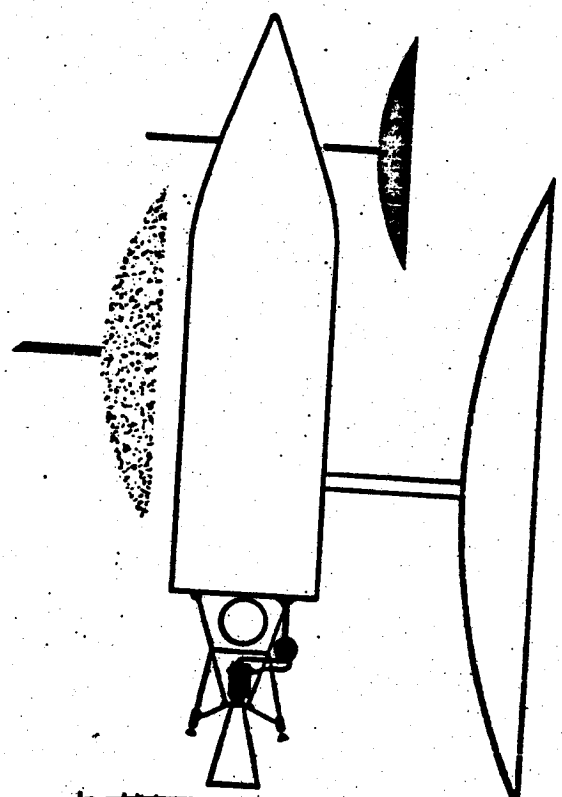

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~~SECRET~~
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FOREWORD

The Advanced Reconnaissance System (ARS) consists of a satellite vehicle containing equipment to perform visual, ferret, and infrared reconnaissance, together with the necessary system of ground stations and data processing centers.

This Development Plan for the accomplishment of the ARS was prepared by the Missile Systems Division, Lockheed Aircraft Corporation and its subcontractors, CBS Laboratories and Eastman Kodak Company. The specifications for the system were determined in the course of a one-year study now being conducted for the United States Air Force under contract AF 33(616)-3105. The plan is presented in two parts; Volume I, System Plan, and Volume II, Subsystem Plan. The subsystems are described in separate books, Volume II-A through II-L.

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 I Airborne Test Systems

SECRET
SECURITY CLASSIFICATION

MSD 1536

RDB PROJECT CARD

TYPE OF REPORT: New Subsystem Development Plan

REPORTS CONTROL SYMBOL DD-RDB(A)48

1. PROJECT TITLE: AIRBORNE TEST SUBSYSTEM FOR ADVANCED RECONNAISSANCE SYSTEM (Unclassified)

(Pied Piper)

2. SECURITY: Secret

3. PROJECT NUMBER: 1115

4. INDEX NUMBER:

5. REPORT DATE: 1 March 1956

6. BASIC FIELD OR SUBJECT:

7. SUBFIELD OR SUBJECT SUBGROUP:

7A. TECH. OBJ.:

8. COGNIZANT AGENCY:

9. DIRECTING AGENCY:

OFFICE SYMBOL:

TELEPHONE NO.:

10. REQUESTING AGENCY:

11. PARTICIPATION, COORDINATION, INTEREST:

12. CONTRACTOR AND/OR LABORATORY: Lockheed Aircraft Corp. Missile Systems Division

CONTRACT/W.O. NO.: AF 33(616)-3105

13. RELATED PROJECTS:

14. DATE APPROVED:

15. PRIORITY: Maximum

16.

17. EST. COMPL. DATES

RES.

DEV.

TEST

OP. EVAL.

18. FY | FISCAL ESTS. (M $)

19.

20. REQUIREMENT AND/OR JUSTIFICATION

a. This subsystem provides vehicles and airborne equipment and instrumentation for development flight testing of the Advanced Reconnaissance System.

b. Performance characteristics of reconnaissance and geophysical measurement devices will be evaluated under orbital conditions in free space.

c. Operational techniques associated with the preparation, launching, tracking, and data transmission of a satellite will be evaluated.

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

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MISSILE SYSTEMS DIVISION

SECRET
SECURITY CLASSIFICATION

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LOCKHEED AIRCRAFT CORPORATION

R&D PROJECT CARD
CONTINUATION SHEET

SECURITY CLASSIFICATION ~~SECRET~~

1. PROJECT TITLE	2. SECURITY OF PROJECT	3. PROJECT NUMBER
AIRBORNE TEST SUBSYSTEM FOR ADVANCED RECONNAISSANCE SYSTEM (Unclassified) (Pied Piper)	Secret	1115
	4.	5. REPORT DATE: 1 March 1956

21 a. Brief and Operational Characteristics

The subsystem consists of airborne test instrumentation and four types of vehicles which are to be used in development flight testing of airframes, payload (reconnaissance) equipment, and information sensing and transmission equipment. Environmental data and operational characteristics of range of elements from isolated items through complete subsystems will be provided. Ballistic and orbiting flight tests are scheduled. Instrumentation and test vehicles have been selected to utilize state-of-art components in the initial phases. Their flight test performance is to be adequate for the required data, and they have been scheduled to provide design and development information when required in the over-all system development plan.

21 b. Approach

Information concerning vehicle environment and dynamics and component operation is required. This subsystem is designed to supply a major part of this information through flight testing. Four basic vehicle types will be used, each of which has as its purpose the provision of an airborne vehicle for the evaluation of specific problem areas:

(1) Vehicle components and functions are tested in the System Test Vehicle (STV), a non-orbiting vehicle of limited range and flight duration;

(2) Full-scale airframe systems are functionally tested in captive firings of the orbit stage test vehicles (OSTV);

(3) Satellite systems are evaluated in long-range ballistic flight tests in the non-orbiting test vehicle (NOTV);

(4) Operational techniques and problems of satellite flight are evaluated with Orbiting Test Vehicles (OTV).

Major problem areas are expected to be principally those associated with the unknown environmental factors, namely the unattended operation of equipment for sustained periods of flight and the acquisition and transmission of test information in orbit at 300 n. miles. Targets in the development plan are successful staging from the booster, air-starting and cutoff of the propulsion units, and the placing of a test vehicle in orbit in CY 1958.

21 c. Subsystem Tasks

1.a Test Instrumentation (Airborne)

b Contractors: Lockheed Aircraft Corporation - Missile Systems

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21 c Division; CBS Laboratories; Eastman Kodak Company.

c A PWM/FM telemeter of approximately 15 channels will be used for transmission of flight test data. On early flights, measurements will consist of system performance parameters, environmental data for design information, and geophysical data affecting flights and equipment. Later flights will require instrumentation of payload systems to evaluate this operation in the satellite environment. Geophysical data such as meteor impact, radiation and atmospheric characteristics will be obtained in the orbiting vehicles.

2.a Systems Test Vehicle

b Contractor: Lockheed Aircraft Corporation - Missile Systems Div.

c The Systems Test Vehicle (STV) consists of a one-half scale airframe which weighs up to 1600 pounds gross weight and is boosted by a T-34 (Sergeant) rocket. This booster is essentially that used for the X-17 Re-entry Test Vehicle, with minor modifications to the fins and stage interconnect structure. Forty-three vehicles will be used for the evaluation of flight environment and for testing telemeter and vehicle electronics equipment, orbit stage propulsion system, battery and chemical auxiliary power units, guidance and control components and system, and components of the reconnaissance payloads. These vehicles are non-orbiting, but they permit approximately eight minutes of flight above 300 n. miles altitude when orbit stage propulsion is operative.

3.a Orbit Stage Test Vehicle

b Contractor: Lockheed Aircraft Corporation - Missile Systems Div.

c Two captive firings of the Orbit Stage Test Vehicle (OSTV) will be conducted. These are functional tests of the major vehicle subsystems. They will demonstrate proper operation of the propulsion units and their fuel supply and control systems. Environmental effects of operating engines on other equipment will also be evaluated.

4.a Non-Orbiting Test Vehicles

b Contractor: Lockheed Aircraft Corporation - Missile Systems Division

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AIRBORNE TEST SUBSYSTEM FOR ADVANCED RECONNAISSANCE SYSTEM (Unclassified) (Pied Piper)	Secret	1115
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21 c

c Full-scale non-orbiting flight tests (NOTV) will be conducted with the combined systems that have been proved satisfactory in the STV series of tests. Three NOTV tests are scheduled and will provide performance characteristics of essentially complete satellite vehicle systems. These vehicles will be boosted by Atlas "C" boosters, and they will demonstrate guidance and control characteristics of the booster-vehicle combination, separation, air starting of satellite stage propulsion and APU units, and vehicle transition trajectory data.

5.a Orbiting Test Vehicles

b Contractor: Lockheed Aircraft Corporation - Missile Systems Div.

c Six orbiting tests are planned as final demonstration of the system capability and will investigate the problems associated with the placing of a payload in orbit. Primary emphasis in these flights will be placed in providing as much instrumentation as is required to evaluate proper operation and accuracy, as well as the useful life of attitude controls, the programmer, sensing and telemetry equipment, and reconnaissance components. Data on orbital environment, such as meteorites, drag and cosmic radiation, will also be obtained. An additional series of 15 orbiting vehicles, designated Payload Test Vehicles (PTV), are also planned. Although used primarily for the testing of complete reconnaissance, ferret, and nuclear APU systems, they are identical in configuration to the operational satellite.

21 d Other Information

1. General. The purpose of this subsystem is to provide flight test data required for reconnaissance system development. A description of the configuration and performance is contained in the General Design Specification.

2. Survey of Similar Existing Standardized Equipment. All known available items have been used wherever their performance characteristics are compatible with the subsystem requirements and over-all system development plan. X-17 booster motor and airframe are employed for one-half scale tests; Vanguard second-stage propulsion units are also used. Early instrumentation systems are similar to that used in the X-17 project. Standardized hardware and accessories are used wherever appropriate.

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21 d

3. Similar Equipment in Process of R & D. This subsystem consists of flight test items for the Advanced Reconnaissance System, and does not duplicate any equipment in the process of R & D.

4. Replacement Recommendations. This subsystem is for test purposes only and will not replace any known existing equipment.

5. Statement of Effects. This subsystem will be maintained and operated by contractor personnel. Facilities for flight test operation and range instrumentation will be required at AFMTC.

21 e Background History

This subsystem is a result of work conducted under contract AF 33(616)-3105. The requirement for this subsystem is described in Pied Piper Progress Reports (see references).

21 f Future Plans

Development of this subsystem is contingent upon provisions of boosters for STV, NOTV, and OTV series. Flight test schedules may be revised to satisfy data requirements by re-assigning objectives and instrumentation.

f References

Lockheed Missile Systems Division Report MSD 1363, Pied Piper - First Quarterly Progress Report, Vol. IV, 1 November 1955 (S)

Lockheed Missile Systems Division Report MSD 1481, Pied Piper - Second Quarterly Progress Report, 15 January 1956 (S)

SECRET

Pied Piper

MSD 1536

LOCKHEED AIRCRAFT CORPORATION
MISSILE SYSTEMS DIVISION

TABS

SECRET

Subsystem I - AIRBORNE TEST SUBSYSTEM

Tab 1 - General Design Specifications

I. GENERAL

A. Statement of the Problem

It is required that information be obtained to evaluate the environment in which the satellite vehicle will be operating. The flight dynamics of the system and the general performance characteristics of the equipment and payload subsystems to obtain this information will require that a flight test program be conducted concurrent with the research and engineering analyses, so that the operational equipment can be placed in an environment as similar as possible to that which will exist in orbit.

B. Approach

A flight test program has been devised to provide answers to the problems described above. These problem areas define the performance characteristics which will be required of the vehicles. Flight loads, such as accelerations and vibrations will be attained which will correspond more closely to the operational environment than laboratory testing permits. Aerodynamic heating and structural problems will be evaluated. Environmental effects such as drag, cosmic radiations, meteors, and temperature control will be investigated in the orbiting test vehicles. To accomplish these objectives sustained flight at high altitude is an ultimate requirement. A preliminary evaluation of these effects can be obtained, however, by vehicles which obtain a high apogee ballistic trajectory even with limited range. Such a partial solution imposes less strenuous requirements on test range launching facilities and instrumentation. In the latter phases of the program, orbiting vehicles are planned which will result in a vehicle configuration thoroughly demonstrating the operational characteristics required.

C. Solution

To implement the flight test program as rapidly as possible, existing components have been surveyed to determine their possible utility in early flight tests. An available solid propellant rocket booster, the T-34 (Sergeant) will be used for ballistic testing at approximately 1/2 scale. This vehicle will accommodate full scale components of the

ultimate payload. Airborne test instrumentation will be used which is currently available; it will be similar to the instrumentation of the X-17 Re-entry Test Vehicle. Components of reconnaissance payload, optical equipment and electronic data link equipment, may be tested early in the flight program to determine the performance characteristics of these isolated units.

Flight testing will continue to provide the earliest feasible sources of information, and the objectives of each test are established to provide information inputs in the overall system development program, as they are most urgently needed. In this manner, the earliest possible freezing of the design and characteristics of operational equipment can be obtained. Further, through orbiting test vehicles, information of general interest, such as geophysical measurements, will be forthcoming, and the performance and reliability of more or less complete payload subsystems may be evaluated.

II. DESCRIPTION

The following test vehicles have been selected to satisfy the requirements outlined in the preceeding paragraphs. The flight test program will proceed from 1/2 scale ballistic vehicles, through test orbiting airframes which are fired on ballistic trajectories, to the final airframe which is almost identical to that of the first operational vehicles. A full range of payload equipment can be flight tested, and the number of tests of each vehicle type has been established to provide all flight operational data which will be required.

Task 1 - Airborne Test Instrumentation

For the gathering of information during flight test, equipment will be provided to measure accelerations, vibrations, pressures, and temperatures. Strain gages will be applied for structural measurements. Tell-tales will monitor operations such as stage unlatching and separation. Payload equipment will be instrumented to obtain data on component functioning and failure analysis, should malfunction occur.

In addition, orbiting vehicles will be instrumented to obtain indications of meteor impact (by microphones and pressure gages), drag, cosmic radiation and geophysical information as described in the appendix to this volume.

Task 2 - Systems Test Vehicle

The Systems Test Vehicle (STV) will consist of an airframe of 31-in. diameter and approximately 45 feet long including its booster and is very nearly one half the size of the operational vehicle. It will be as similar in configuration (nose shape and equipment location) as is permitted by the testing of full scale components in a reduced scale vehicle and will weigh up to 1600 lbs. with its full payload capacity. It will be boosted by a T-34 rocket. The booster airframe is essentially that which is used for the X-17 Re-entry Test Vehicle, except that minor modification may be required to the fins for aerodynamic stability, and to the stage interconnect structure to accommodate a nose which is of the same diameter as the rocket. A typical configuration of the STV is shown in the appendix. This vehicle will carry, in later flights, a full scale vehicle sustainer engine with a limited quantity of fuel and two control engines as used in the full scale vehicle for attitude and transition trajectory control. Forty-one of these vehicles will be flight tested.

The typical performance of the STV without sustainer engine operation results in apogee and range of 150 and 800 miles respectively, for a flight duration of 6 minutes above 100,000 feet, and for a total flight duration

of 8 minutes. With sustainer engine operating, trajectories wi l . . -. tained which result in flight above 300 miles for 8 minutes. It . . lent that flights of considerable duration at extremely high altitude (. 300 miles) will provide much data on the operational characteristi s in vacuo of the equipment being tested.

Task 3 - Orbital Stage Test Vehicle

The Orbital Stage Test Vehicle (OSTV) is a full scale vehicle airframe which will be used for captive flight test. Such firings will be performed to provide a functional test of several major test vehicle subsystems. Principally, they will demonstrate the proper operation of the propulsion subsystem units, the fuel supply and control equipment, and engine starting and cut off techniques. In addition, they will allow an evaluation of the operational characteristics of payload and vehicle electronic components in the environment attendant on engine operation, such as vibration, acceleration, and local temperatures during engine burning.

Task 4 - Non Orbital Test Vehicles

Full scale non-orbital test vehicles (NOTV) flight tests will be conducted of combined subsystems that have been proven out in the STV series. Three of these tests are scheduled. They will be boosted by the XSM-65C.

The configuration of the NOTV, shown in the appendix, will contain items of payload equipment which have been advanced in their development to a quasi-operational level. This vehicle is 61 in. in diameter and 216 in. long and will weigh 3500 pounds. A typical flight of the NOTV will be a ballistic trajectory with apogee of over 600 miles and 1,000 miles total range. Significantly more information will be obtained from these flight tests concerning general system parameters and equipment performance and reliability, since the effective flight duration is about 15 minutes.

Task 5 - Orbital Test Vehicle

The Orbital Test Vehicle(OTV) is essentially an operational satellite vehicle, except that it will not contain complete subsystems for obtaining reconnaissance information. It may be flight tested either at AFMTC or the proposed ultimate launching site. These vehicles will be placed originally on east-west orbits which will not provide information of strategic reconnaissance interest, but which can be better implemented with ground control facilities. A typical OTV configuration is shown in the appendix to subsystem A. These vehicles will be boosted by the XSM-65C

and will be able to carry up to 1600 lbs. of payload equipment depending on booster performance. The OTV flight test will have orbiting durations ranging from 5 days to 10 days, depending upon the type of auxiliary power subsystem supplied. A total of 6 flight tests is planned.

An additional series of fifteen orbiting vehicles, designated Payload Test Vehicle (PTV), are also planned. They are configurationally identical to the operational satellite (see appendix) though used primarily for the testing of complete reconnaissance, ferret and nuclear APU subsystems. These vehicles will utilize the advanced propulsion subsystem. They may be launched either from AFMTC or the ultimate site.

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Subsystem I - AIRBORNE TEST

Tab 2 Summary - Subsystem Milestones

FY 56 | FY 57 | FY 58 | FY 59

CY 56 | CY 57 | CY 58 | CY 59

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
1 Complete Design for First STV
1
1 Delivery of First STV to AFMTC
1
1 Delivery of First STV with Second
1 Stage Propulsion to AFMTC
1
1 Delivery of First OSTV for Captive
1 Test LAC STF
1
1 Delivery of First NOTV to AFMTC
1
1 Delivery of First OTV Instrumentation
1 Package
1
1 Delivery of First OTV to AFMTC
1
1 Delivery of First PTV with Ferret
1 Payload to AFMTC
1
1 Delivery of First PTV with Visual
1 Recon. Payload to AFMTC
1

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Subsystem I - AIRBORNE TEST

Tab 2 Summary - Subsystem Milestones (Continued)

	FY	FY	FY
	CY 60	CY 61	CY 62	CY 63
	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 Delivery of First PTV with Large
3 Scale Visual Recon. to AFMTC
4
5
6 Delivery of First PTV with Advanced
7 Ferret Payload to AFMTC
8
9
10 Delivery of First PTV with Visual
11 Surveillance Payload to AFMTC
12
13
14 Delivery of First PTV with I.R.
15 Payload to AFMTC
16
17
18 Delivery of First PTV with Electro-
19 magnetic Monitoring Payload to AFMTC
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Subsystem I - ~~AIRBORNE~~ TEST

Tab 2 Summary - Hardware Delivery

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