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MEMORANDUM FOR DISTRIBUTION

SUBJECT: Revision to Section II, 30 April 1959 DISCOVERER Development Plan

1. Attached are correction pages to Section II (Funding Program), Pages II-1 through II-5, of the 30 April 1959 DISCOVERER Development Plan.

2. Please insert these pages in subject plan and destroy the replaced pages in accordance with the procedures outlined in Air Force Regulation 205-1.

1 Incl
Sect II, Funding Program
Pages II-1 thru II-5

C. E. HUGHES
Colonel, USAF
Assistant for Programming

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30 OCT 1989

HEADQUARTERS
AIR RESEARCH AND DEVELOPMENT COMMAND

(UNCLASSIFIED TITLE)
DISCOVERER
SPACE SYSTEM DEVELOPMENT PLAN

REVIEW ON 31 Dec 1989

30 April 1959

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AIR FORCE BALLISTIC MISSILE DIVISION

HEADQUARTERS

AIR RESEARCH AND DEVELOPMENT COMMAND

30 April 1959

FOREWORD

This volume presents the planning for the accomplishment of the Advanced Research Projects Agency (ARPA) Program Discoverer. This plan has been prepared in compliance with ARPA Order No. 48-59, dated 16 December 1958, which calls for the separation of the Thor-boosted Discoverer Program from the overall WS 117L Program structure and Headquarters, USAF message AFDAT 59353 dated 27 April 1959.

This plan summarizes the technical approach and research objectives of the Discoverer Program and describes the physical characteristics of and operating techniques for the Discoverer-Thor combination. It also provides an explanation of the various subsystems that comprise the whole, the testing program being used in developing the system, and other significant areas that bear directly on the task of meeting the designated requirements. In addition, this volume covers the facility program requirements, including: (1) test facilities at ARDC centers, and (2) the military construction required in support of the development system. Lastly, a summary of the funding requirements is included to reflect the revised FY 1959 financial plan. The plan also includes the FY 60 Financial Plan and the FY 61 Budget Estimate.

R. Curtin for

O. J. RITLAND
Brigadier General, USAF
Commander

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AIR FORCE BALLISTIC MISSILE DIVISION (AFBDC)

DISCOVERER DEVELOPMENT PLAN

TABLE OF CONTENTS

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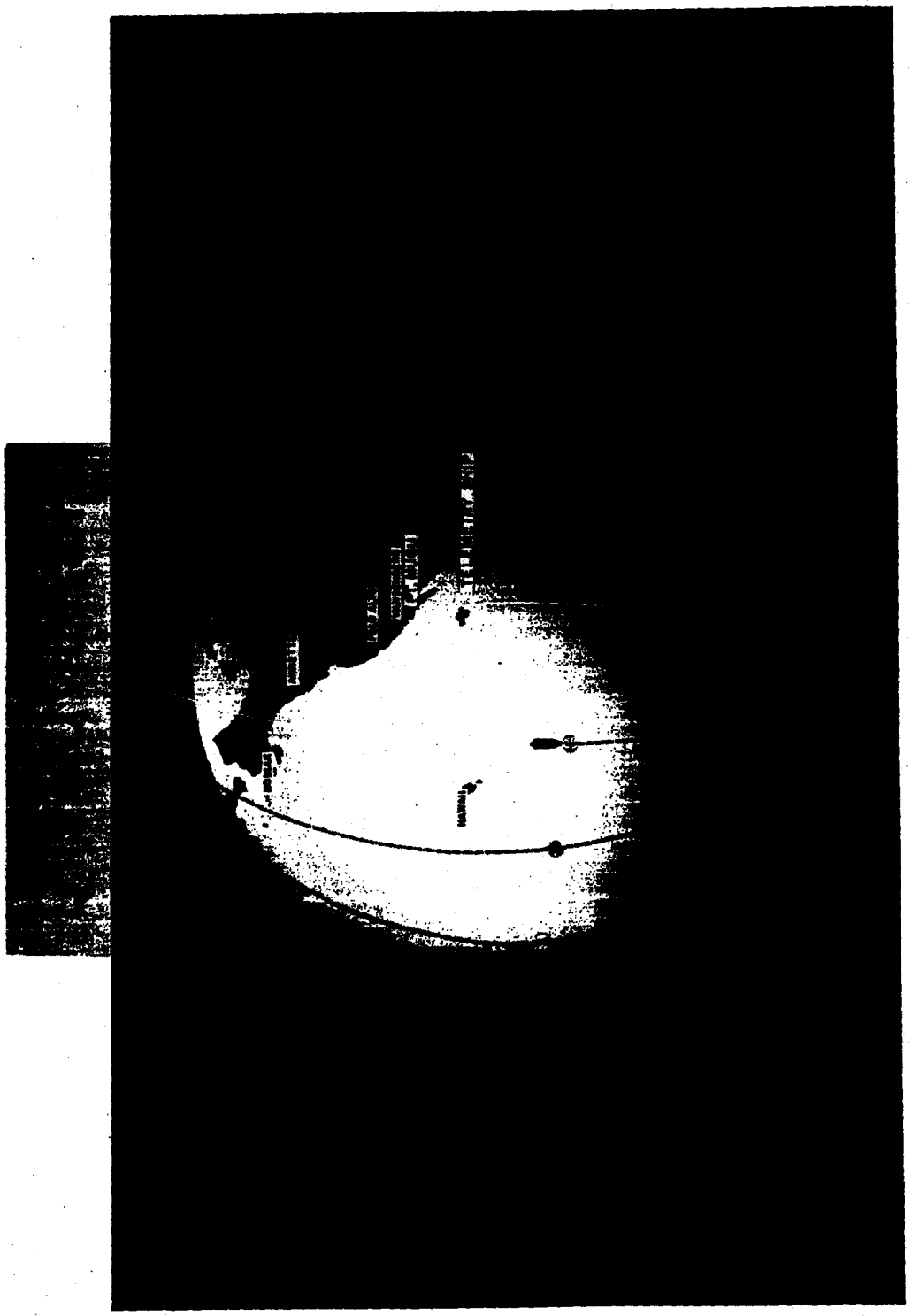

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DISCOVERER

BACKGROUND

The concept for using an Earth satellite as a platform for detecting, measuring, and transmitting significant scientific data to ground-based stations was a natural outgrowth of progress here and abroad with research rockets. The need for timely and continuous scientific research utilizing instrumented rockets and Earth satellites after the close of the International Geophysical Year was also emphasized by the first conference on the International Geophysical Year held in the United States. The impetus which motivated the United States Government to support new methods for collecting otherwise unattainable scientific information was man's rapidly increasing ability to view the world as a whole. From these observations will come a vast body of geophysical data which will permit American scientists to observe all the large scale aspects of the Earth: its exterior, the lower and upper atmosphere, gravity and magnetism, and extraterrestial features.

The results of numerous studies conducted since 1946 by American scientists established that a satellite used as a scientific data gathering medium was feasible and would satisfy to a great extent the requirements of the scientist for information.

The concept of the satellite research system is a result of studies conducted at the Rand Corporation. A study completed in 1947 together with similar investigations by other contractors concluded that such a satellite system was feasible. In subsequent years, further studies were conducted by the Government leading to the award in October 1956 of a contract to Lockheed Aircraft Corporation for the development and test of a satellite research system. The following month, Massachusetts Institute of Technology was awarded a contract for the research and development of the guidance and orbital altitude control equipment for the system.

As the result of the Advanced Research Projects Agency (ARPA) Order No. 17-59, dated 4 September 1958 with subsequent amendments, the program was established to provide for 25 Discoverer flights.

ARPA Order No. 48-59, dated 16 December 1958 confirmed previous instructions to identify this program as DISCOVERER; thus, separating this development from the overall WS 117L program structure.

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DESIGN CHARACTERISTICS

INTRODUCTION

Discoverer is a program which uses a large satellite vehicle as a scientific data gathering medium. This program is one of progressive improvement whose goal is to continually increase the capabilities and useful life span of the satellite so that increasingly advanced scientific experiments may be conducted. The immediate objectives of the Discoverer program shall be:

a. The achievement of orbital capability of the basic satellite vehicle.

b. The development of operational system techniques and procedures.

c. The recovery of biomedical and other data through the utilization of a suitable re-entry capsule.

d. The execution of nonrecoverable advanced engineering tests.

OVERALL OPERATIONAL CHARACTERISTICS

Discoverer is composed of the satellite vehicle, the Thor booster, launch facilities, tracking facilities, and a complex communication and data processing network with related facilities. The Thor booster provides the primary propulsive power as the first stage for the satellite vehicle.

Separation occurs on attaining the proper altitude and attitude. As the booster falls away, the satellite vehicle continues in a self-stabilized predetermined coast. At the termination of the coast phase, the internal satellite power plant activates, supplying the orbital velocity increment required to establish a substantially circular orbit. The internal controls will then erect the vehicle to the proper attitude. The most common orbits will pass within a few degrees of the poles.

The vehicle will continue around the earth, and when within range of a ground receiving station, upon command, will begin to transmit the recorded data. The data will be received, processed, and transmitted to the using agencies.

The vehicle will then begin its next cycle. These revolutions will be repeated at approximately 90-minute intervals. Because the orbit is essentially fixed in space, while the earth rotates inside it, successive passes over the earth's surface will be displaced approximately 22-1/2 degrees at the equator. Useful operation will be terminated either when air drag slows the vehicle to where it plunges into dense atmosphere, when the electrical power supply is exhausted, or when a failure of equipment takes place.

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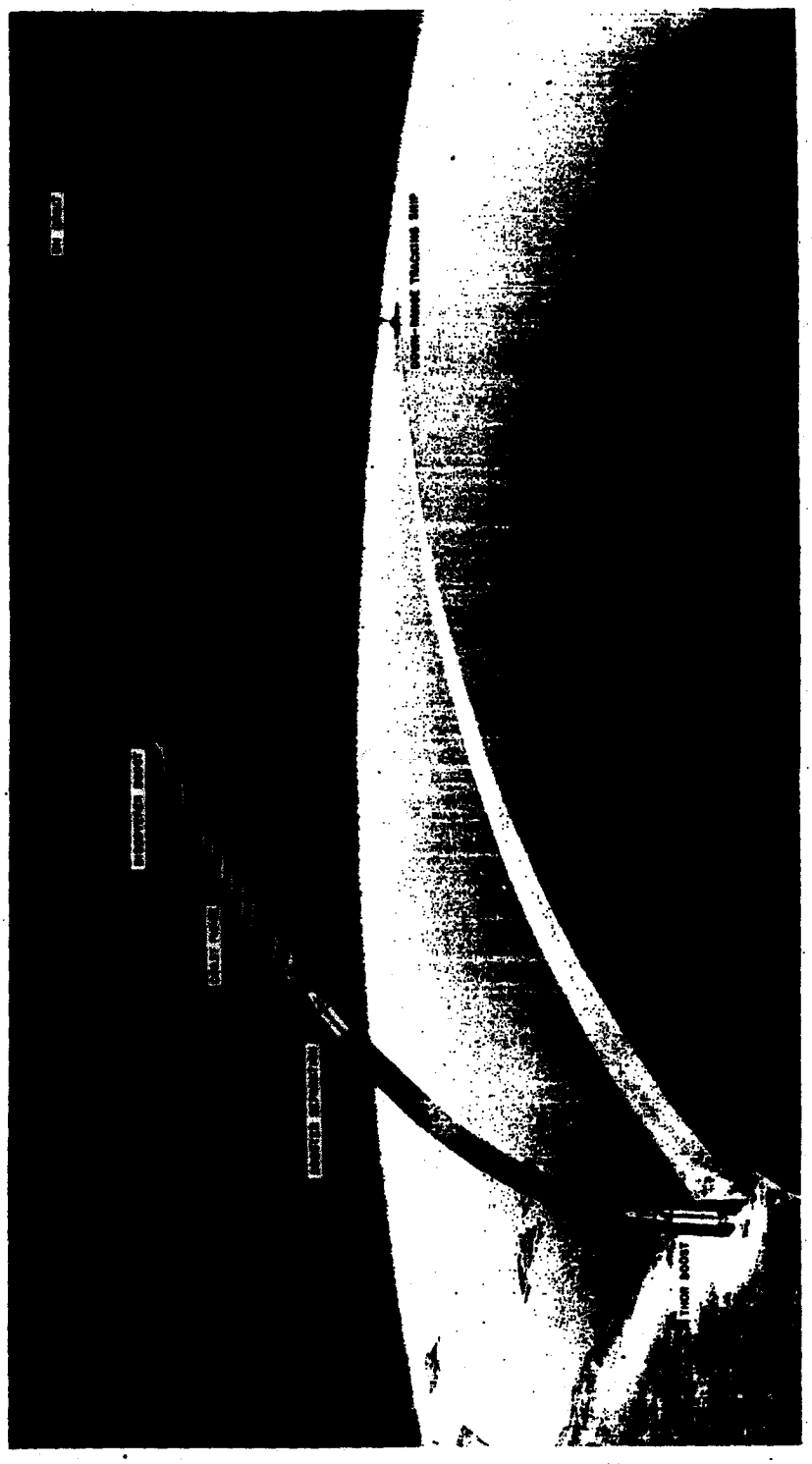

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DESIGN OBJECTIVES AND GENERAL OPERATING DATA

A. SATELLITE VEHICLE

The DISCOVERER satellite vehicle is being developed over a period of years and will include a variety of configurations, capabilities, and useful satellite life spans. Development of the system will proceed from a simple design of limited capability to a more refined version capable of greater scientific investigation.

The DISCOVERER Program utilizes seven different vehicle configurations as follows:

1. Flight Configuration I - Flights 1 and 2

The vehicle airframe will consist of the following sections and equipments: The nose cone assembly; the forward midbody assembly including the forward equipment rack; the aft midbody assembly; the aft equipment rack; the adapter, including provisions for the retro-rockets; the propellant tanks, but not the propellant liquids; the pressure spheres, but not pressure gases; the fairings; and the flight termination system. Functionally, the airframe will be the carrier for the equipment it houses, supports, and/or jettisons, as applicable, during its ascent to orbit and during its orbital life. During the coast phase, the vehicle airframe will separate from its adapter which will have been permanently attached to the Thor booster during preparation for launch.

2. Flight Configuration II - Flights 3 and 4

Same as Flight Configuration I except that it includes a Mark I Capsule. During the orbit phase, the capsule, forming the nose cap, will be ejected for recovery.

3. Flight Configuration III - Flights 5 through 9

Same as Flight Configuration II except for Advanced Engineering Test Payload.

4. Flight Configuration IV - Flights 10, 11 and 12

Same as Flight Configuration III except for additional propellants, additional batteries, increased total impulse of pneumatic control system and interchangeability of payloads.

5. Flight Configuration V - Flights 13, 14 and 15

Same as Flight Configuration IV except that the payload is the heavier Mark II type capsule.

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6. Flight Configuration VI - Flights 16, 17, 18 and 19

Same as Flight Configuration V except that improved recovery system and tracking techniques are used.

7. Flight Configuration VII - Flights 20, 21, 22, 23, 24 and 25

Same as Flight Configuration VI except that more sophisticated payloads will be carried.

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B. SUBSYSTEMS

1. The overall system development has been divided into seven subsystems which are identified as follows:

Subsystem A - Airframe
Subsystem B - Propulsion
Subsystem C - Auxiliary Power
Subsystem D - Guidance and Control
Subsystem H - Ground-Space Communications
Subsystem J - Geophysical Environment
Subsystem K - Personnel
Subsystem L - Recovery System

a. Subsystem A - Airframe. The Airframe Subsystem will consist of the propellant and pressurization tankage, structures, aerodynamic fairings for the satellite, a destruct system, and all mechanical and electrical installations in the satellite not specifically included in the definition of other subsystems.

The Airframe will include a 60-inch diameter cylinder adapter (which will be attached to the booster and remain with it after separation), and the orbiting vehicle. The vehicle will be a 60-inch diameter, load-carrying cylinder about 14 feet long, containing or supporting all other subsystems. This cylinder will be inclosed for about half its length in the adapter. The payload and structure on the front of the vehicle will be protected from aerodynamic effects by a conical nose section. The engine and pressurized gas storage will be carried at the rear of the vehicle making an overall length of about 18 feet. Maximum utilization of structural material will assure the highest possible ratio of payload weight to gross weight.

b. Subsystem B - Propulsion. The Propulsion Subsystem will consist of the rocket engine; pressurization; feeding and loading systems (other than propellant and gas tanks); the engine gimbals (but not gimbal actuators); and the equipment required to start, stop, and control thrust magnitude in response to an electrical signal from the ground or from the guidance subsystem; and the equipment required to control the propellant flow mixture ratio. It will also include any auxiliary devices required to establish proper ullage orientation in the fluid system prior to and during start of the main rocket engine, including the equipment required to operate these devices.

The Project Hustler XLR-81, 15, 150-pound-thrust, pump-fed engine will be used for the main satellite rocket power plant. The XLR-81-BA-3, using IRFNA (inhibited red fuming nitric acid) and JP-4 propellants, having a 263-pound-second/pound vacuum specific impulse, will be used in the first two Thor-boosted flights. The XLR-81-BA-5 modified to use IRFNA and UDMH (unsymmetrical Dimethylhydrazine) as propellants, has a 277-pound-second/pound vacuum specific impulse and will be used on subsequent flights. Forces required to provide proper

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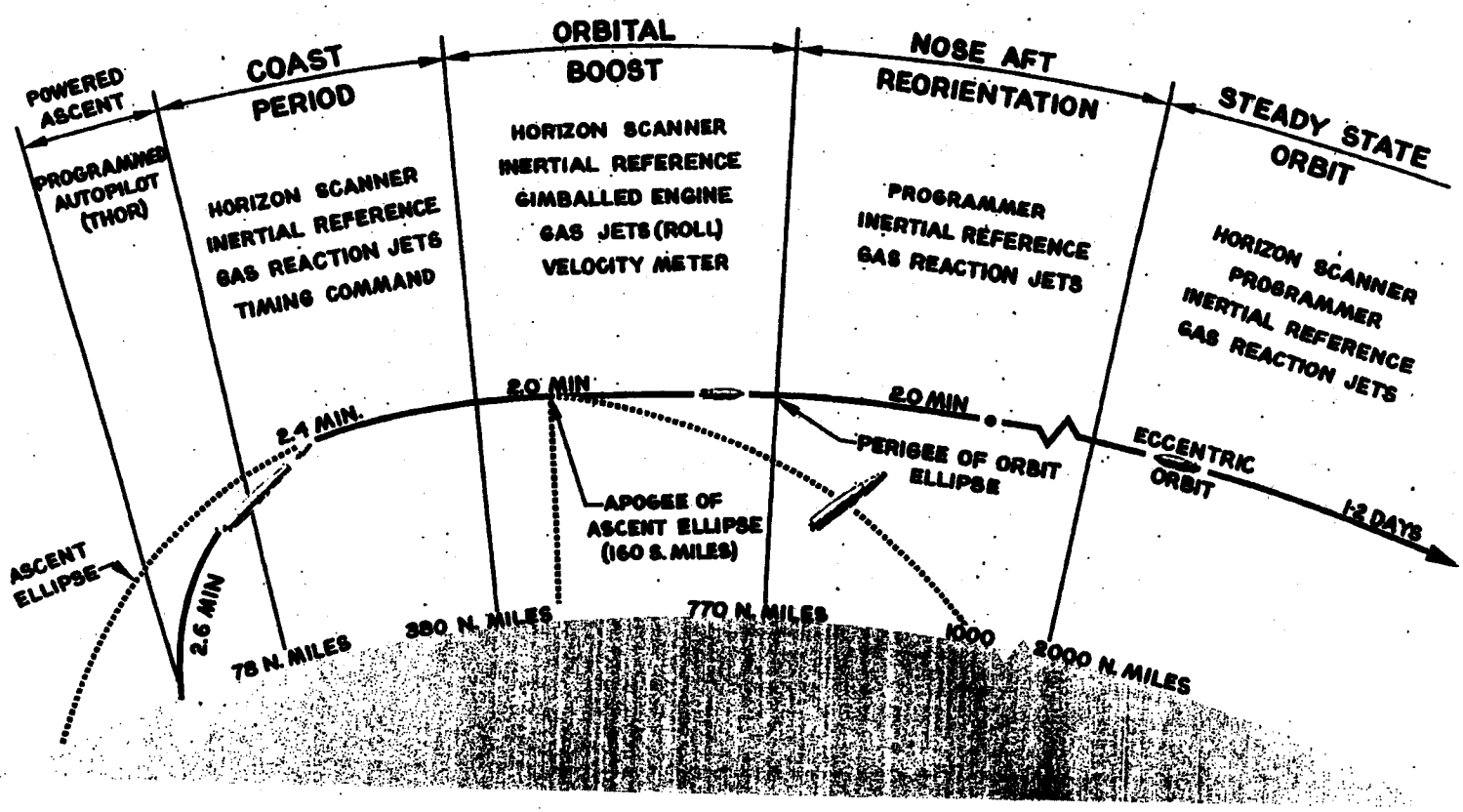
GUIDANCE & CONTROL SYSTEM

TYPICAL DISCOVERER ASCENT



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fuel orientation prior to firing the main rocket engine at the completion of the coast phase will be provided by small 20-second duration, 120 pound thrust, solid-propellant rockets (ullage rockets).

c. Subsystem C - Auxiliary Power. The Auxiliary Power Subsystem consists of equipment required to supply electrical power to all subsystems within the satellite vehicle from a time just prior to launch until the end of the vehicle's lifetime.

The Discoverer Auxiliary Power System will be based on the use of a nominal 28-volt battery power source, a 2-KC, 115-volt, single-phase, general power ac distribution system, a 400-cycle, 3-phase, precision ac power system and a -28 volt supply. The 2000-cycle ac inverter furnishes power for the -28 volt supply as well as power for a ± 28-volt series booster regulator, operating from the prime energy source. The auxiliary power system will incorporate silver peroxide-zinc batteries of refined design, yielding 72 watt-hours per pound. Power conversion equipment will utilize power transistor inverters and static transformer rectifier components; due to the limitation of available electrical energy power, conversion equipment of exceptionally high efficiency is a requirement. Early power inverters have an efficiency of 65 percent and are adequate for initial test flights. An improvement program will be initiated for the development of controlled diode inverters that show promise of considerably higher efficiency for later flights. The initial utilization of a photovoltaic power supply will be made on at least one flight to furnish 14-volt dc power to the acquisition beacon.

d. Subsystem D - Guidance and Control. The Guidance and Control Subsystem will be comprised of those items of equipment required to sense and direct vehicle attitude and velocity so as to establish a satisfactory orbit. In addition it will:

(1) Provide self-contained means for the initial alignment and maintenance of the desired vehicle attitude during orbital operation.

(2) Provide an indication of attitude, and rate of change attitude, to other subsystems in the vehicle as necessary.

e. Subsystem H - Ground-Space Communication. The Ground-Space Communication Subsystem consists of those items of equipment required to perform the following functions:

(1) Determine the position of a satellite vehicle relative to the earth, as a function of time, by a process of observation and computation

(2) Command and program the functioning of the vehicle payload and auxiliary devices on a time-sequence basis or in real time

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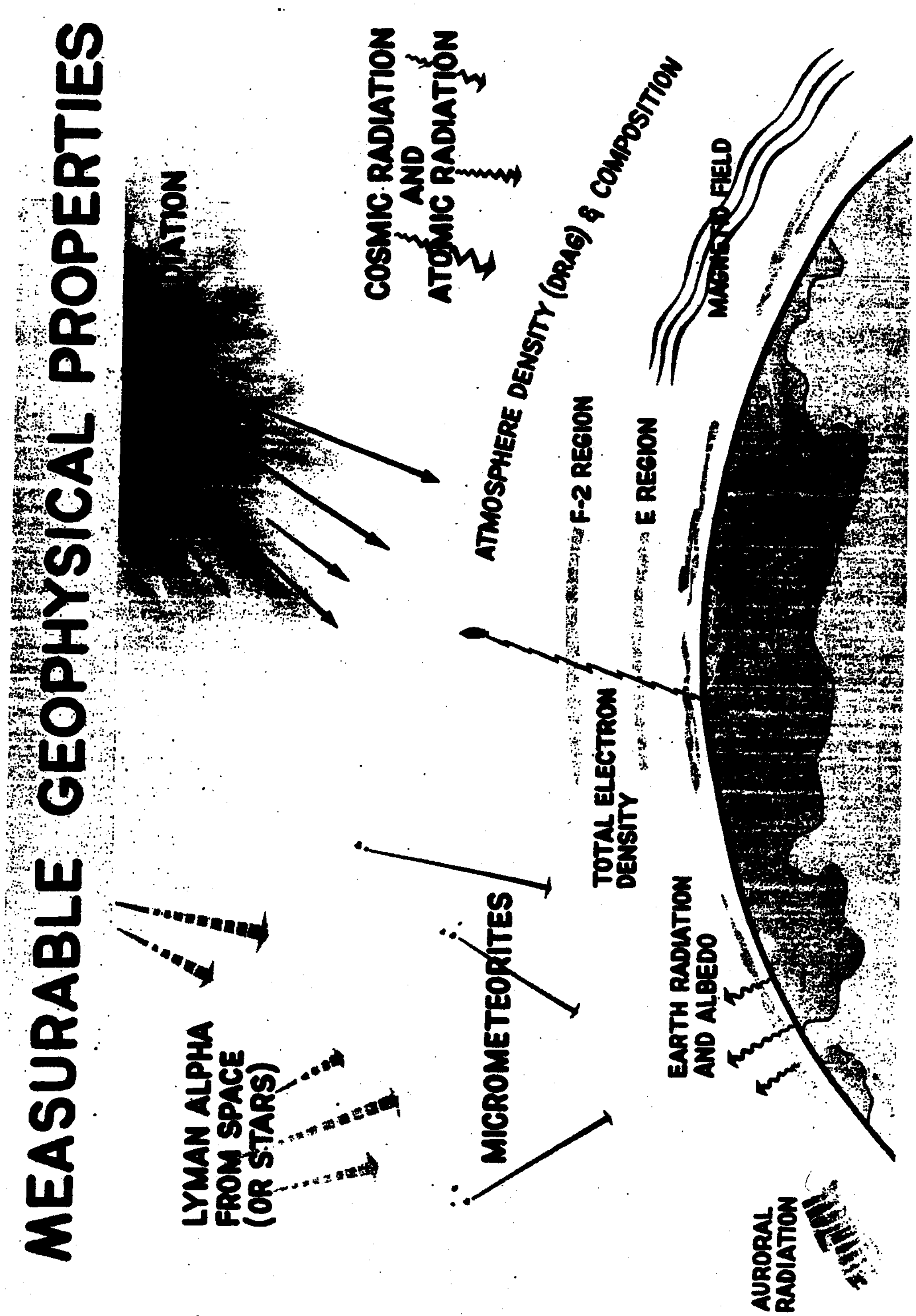

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(3) Provide a means for communicating with the vehicle from ground stations and for receiving and encoding environmental, vehicle functional and telemetry data from other vehicle subsystems

(4) Provide communication facilities and terminal magnetic tape recording equipment ground installations for efficient and reliable recording and transmission of received information

(5) Provide a common time reference for the vehicle and ground complex and a reference date-time index for the orbital passes.

Subsystem ground equipment at tracking and acquisition sites includes all non-airborne specialized equipment required to transmit, receive, checkout and test, record, process, store, and decode indexed information and to safeguard or otherwise perform functions at the tracking and acquisition sites immediately subsequent to launch and throughout the Discoverer's orbiting life.

The Discoverer ground-space communications program will be based on a VHF/S-band system.

f. Subsystem "J" Geophysical Environment

(1) This subsystem consists of the studies, equipments, both rocket-borne and satellite borne, required to provide environmental data considered essential to insure and simplify the design of a successful Advanced Reconnaissance System. This subsystem also includes the ground equipment required to maintain, service, calibrate and checkout prior to flight, those equipments described above.

(2) Insufficient data exists on geophysical environment to insure successful design and test of the satellite vehicles in the following areas:

a. Atmospheric density
b. Cosmic radiation
c. Thermal environment
d. Meteor physics
e. Solar ultraviolet radiation
f. Atmospheric composition

g. Subsystem K - Personnel. A personnel subsystem exists whenever any other subsystems, or the booster subsystem, requires the interaction of personnel. A properly designed personnel subsystem consists of the following components:

(1) Human engineering to insure optimum man-machine compatibility

(2) Determination of the kinds and numbers of personnel required to operate and maintain the associated hardware subsystem

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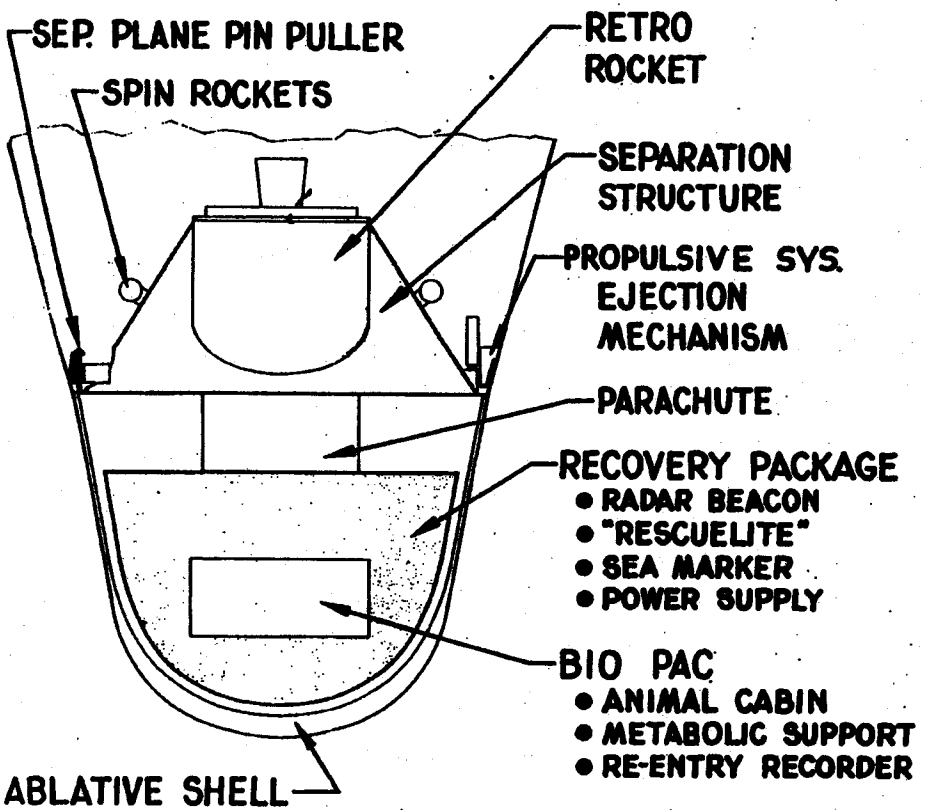
BIO MED RECOVERY SYSTEM



	MK-I	MK-II
RECOVERY SHELL	77 LBS.	88 LBS.
PROPULSION EJECTION	58	75
RECOVERY SYSTEM	45	65
BIO PAC	15	57
TOTAL	195 LBS	279 LBS.

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(3) Training and training equipment required to obtain suitably trained personnel

(4) Appropriate personnel support in the form of technical manuals and other job aids.

h. Subsystem L - Recovery Subsystem. The Recovery Subsystem consists of a satellite-borne capsule, suitable payloads, and equipment that will collect and transmit data by telemetering and that will insure successful re-entry and recovery from orbit.

Design modifications shall be accomplished as required to maintain the Recovery Program current.

C. GROUND SUPPORT EQUIPMENT

1. The term "Ground Support Equipment" refers to any or all non-airborne implements or devices which are required at the launch complex to inspect, test, adjust, calibrate, appraise, gage, measure, repair, overhaul, assemble, disassemble, service, transport, safeguard, record, store, actuate, or otherwise perform a function in support of the airborne vehicle prior to launch.

2. The test ground support equipment shall be prototype ground support equipment. That equipment required for the Discoverer program is essentially the equipment already built and on hand. Continuous redesign, fabrication and test effort is necessary to:

a. Modify, as required, existing equipment to correct deficiencies arising during the test program.

b. Support new payloads and any other changes to the vehicle and its subsystems which require GSE support.

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SUMMARY DESCRIPTION OF CONTRACTS

A. AF 04(647)-97 and AF 04(647)-181 Lockheed Aircraft Corporation

1. Management

LMSD: The central direction and control of concepts, studies, analyses, expenditures, programming, scheduling and reporting; the administrative support required to provide manning, funding and coordination of all activities of the program; the source of evaluation and progress information to the customer.

2. Systems

LMSD: Perform analyses, design studies and flight tests (and basic development tests not applicable to a particular subsystem) in determining compatibility of systems, establishing system concepts, design criteria and contraints to ensure: compliance of space bound system components with the concept for each successive system and complete systems integration. This includes design, development and/or provision and operation of ground equipment systems, ground-space tracking, communications, command systems and related test, servicing, calibration and logistical support equipment (both contractor and/or government furnished) embracing human engineering and Q.P.R.I. studies as well as engineering research and required manufacturing.

Subcontract: Conduct a program of analytical study and system simulation and conduct A&E studies.

3. Airframe Subsystem

LMSD: Develop and produce satellite airframe. Provide: propellant and pressurization tankage; aerodynamic fairings; structural supports, brackets and fittings; mechanical and electrical fittings not included in other systems; environmental controls; and ground equipment required for transporting, servicing, erecting and launching.

4. Propulsion Subsystem

LMSD: Obtain and integrate the orbital thrust rocket engine. Develop and provide propulsion subsystem including: feed and loading systems, engine gimbals, and equipment required to start and stop rocket engine in response to command (or program) ullage orientation requirements, and ground based items for testing, calibrating and servicing.

Subcontract: Bell Aircraft Corporation: Modification and development of XLR-81 rocket to YLR 81-Be-3 (IRFNA and JP-4 propellants)

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engine; performance of PFRT and delivery of ground and flight engines, including spares, engine rework, engine repair and handbooks. Modification and development of YLR 81-Be-3 to IRFNA and UDMH propellant configuration, perform PFRT and delivery of ground and flight engines including spares, engine rework, engine repair and handbooks.

Aerojet-General: Design, develop and manufacture of solid propellant ullage orientation rockets.

5. Auxiliary Power Subsystem

LMSD: Develop and/or provide and integrate: energy source and power conversion equipment required to furnish electrical power for all subsystems within satellite from time just prior to launch to mission's ending and equipment required for testing and servicing.

Subcontract: Design, development and production of prime energy sources and power conversion equipment, including power inverters, voltage regulators, photovoltaic collectors, control relays and design, development and production of primary and secondary batteries.

6. Guidance and Control Subsystem

LMSD: Develop and/or provide and integrate: ground based and on board guidance and control (command) equipment required to stabilize, direct, separate and boost orbiting vehicle and equipment required for servicing, testing and calibration:

Subcontract: Design, development and production of horizon scanners, inertial reference package, control valves and nozzles, and MIT inertial guidance system.

7. Ground-Space Communications Subsystem

LMSD: Develop and/or provide and integrate and operate space-ground and ground communication and tracking equipment required by contractor to coordinate and monitor all flights and assist the government in determining, equipping and manning facilities required for service controlled activities. This includes all ground support equipment required for servicing, testing and calibrating.

Subcontract: Philco Corporation: Conduct a program for research, design, development and fabrication effort for the ground space communication subsystem and early operation of subsystem; manning and planning of ground stations; and installation of Subsystem H ground equipment.

8. Biomedical Subsystem

LMSD: Develop a recoverable capsule to accommodate an aeromedical package for use with the Thor-boosted vehicles.

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B. AF 04(647)-165 - Space Technology Laboratories, Ramo-Wooldridge Corp.

1. Since Lockheed Aircraft Corporation has the prime contract under the direction of AFBMD, contribution of the Space Technology Laboratories lies primarily in the area of consulting services and technical studies. These services are performed for, and at the specific request of AFBMD.

2. The STL studies are general in nature and indicate trends rather than highly detailed final results. STL is not responsible for technical direction, quality of design, contractor performance, or contractor evaluation.

C. Letter Contract Designated as Supplemental Agreement #15, Contract AF 04(645)-65, Douglas Aircraft Company

Responsible for providing such services as are required to adapt the SM 75 booster, its facilities, ground support equipment, etc., to the Discoverer and launch the combined SM 75 - Discoverer vehicle into orbit.

D. OA 58 - 10, Air Force Cambridge Research Center

Responsible for conduct of a program of research and development on equipments, techniques and methods for the collection of geophysical environmental data. AFCRC has been delegated the responsibility for the conduct of the program for the Geophysical Environment Subsystem.

E. MIPR 58 - 54, Naval Air Station, Moffett Field, California Helium for Lockheed.

F. CSO 58 - 33, Ballistic Research Laboratory, Aberdeen, Indiana Wind Tunnel Tests.

G. MIPR 59 - 73, Navy, For Restoration and Modification of USNS Pvt. Joe E. Mann

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PROGRAM SCHEDULE

DISCOVERER

	FY 59												FY 60												FY 61											
	CY 58												CY 59												CY 60											
	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
LAUNCH SCHEDULE (VAFB)													1	1		1	1	2	2	2	2	2	2	1					2	2	2	2					
LAUNCH FACILITIES (VAFB)																																				
• Thor Pad #4											A																									
• Thor Pad #5												B					X																			
• Rim Bldg Addition																B	X																			
GROUND STATIONS																																				
* VAFB (I)											A																									
Pt. Mugu (I)												A																								
Chiniak (I)											A																									
Annette (I)											A																									
* Hawaii (I)											A																									
* Development Control Center (I)											A																									
Recovery Control Center														A																						
Telemetry Ships											A																									
LEGEND																																				
• Available From 315 Program																																				
* Available From SENTRY Program																																				
I Interim Capability																																				
B BOD																																				
X Need Date																																				
A Available																																				

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SECTION I - TEST ANNEX

DESCRIPTION OF TEST PROGRAM

A. GENERAL

1. Test Description

The basic test philosophy is that in all tests the progression will be from the simple to the complex. This approach will be followed in the verification of components, equipments, subsystems, and the complete vehicle system and ground facilities.

Another aspect to the Discoverer test program is that all vehicle equipments will undergo complete environmental, proof, and qualification tests prior to installation in the vehicle. Further, the vehicle itself will undergo static test firing prior to delivery to the flight test base.

Certain flight tests will be concerned with the collection of geophysical and environmental data for the design of future vehicle configurations. These will include requirement for optical tracking to provide precise orbital characteristics. Other tests will be concerned with verification of components, equipments and systems for future configurations.

The Discoverer Flight Test Program involves flights using the Thor booster for launching from Vandenberg AFB on a polar orbit. The objectives for Discoverer Program are divided into four broad categories, namely Discoverer vehicle and system operation testing, Discoverer/Thor compatibility, and recovery capsule operation and testing.

The first flights are primarily engineering tests to establish orbital capability and to determine Discoverer/Thor compatibility, as well as the first tests of the complete system, including the tracking stations.

The following flights will provide a gradual increase in the test complexity by the addition of experimental capsules carrying a variety of payloads and by more advanced engineering tests. The test objectives will be governed in large part by the results of previous experience and flight results, primarily refinement of recovery of unique payloads from orbit.

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2. System Testing Responsibilities

a. Support Testing. In support of the development design of payloads and consequent vehicle design, the following design support testing will be accomplished as required:

(1) Wind tunnel tests

(2) Environmental tests

(3) Recovery system tests

(4) Propellant tank tests

(5) Telemetry system tests

(6) Ground support equipment tests

(7) Roll control tests (Simulation)

(8) Propulsion system altitude start tests

(9) Aircraft/ship data package snatch test

b. Captive Testing. Douglas Aircraft Company will have the responsibility for any component and captive testing on the Thor booster. LMSD will provide captive testing for the Discoverer satellite vehicle in the form of an inplant systems run and a captive firing of each satellite vehicle, less its recoverable payload, at the Santa Cruz Test Base. From Santa Cruz, each vehicle will be delivered to the flight test launch area at Vandenberg AFB.

c. Flight Testing. The responsibility for overall technical flight test direction and planning falls on LMSD. Preflight checkout responsibility will be shared, however, by LMSD and Douglas Aircraft for their respective vehicles and equipment. Douglas Aircraft Company will have primary responsibility for design and construction of the launch pad as the booster contractor. Discoverer system control will be vested in the Development Control Center, Palo Alto, under direct government cognizance, from which control will be subrogated to other LMSD stations as the need arises during an operation.

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B. FLIGHT TEST OBJECTIVES

1. Overall Program Objectives

The primary objectives of the Discoverer Program will be to demonstrate orbital capability and to obtain biomedical and advanced Engineering Test data from the recoverable payload capsules.

2. Detailed Test Objectives

Detailed test objectives will be prepared for each flight.

C. FLIGHT TEST PLAN

1. Vehicle

The Discoverer Program utulizes seven different vehicle configurations as described in Tab 2, "Design Characteristics".

2. Facilities

a. Overall control of the Discoverer flight operations will be exercised by the Palo Alto Development Control Center. Two UNIVAC Scientific 1103 large-scale digital computers in Palo Alto will support the Palo Alto Development Control Center, converting binary tracking data to an ephemeris, issuing acquisition data to tracking stations for subsequent passes, and predicting the recovery area. Stations reporting directly or indirectly to the Palo Alto Development Control Center will be:

(1) The Vandenberg Control Center located at Vandenberg AFB, which controls blockhouse launch operations and stations 2, 3 and 8 below.

(2) The Vandenberg Tracking Station

(3) The Vandenberg Auxiliary Tracking Station located at Pt. Mugu (Pt Mugu Tracking Station).

(4) Annette Tracking Station, Annette Island, Alaska

(5) Chiniak Tracking Station, Kodiak Island, Alaska

(6) Hawaii Tracking Station, Oahu Island, T. H.

(7) Hawaiian Control Center, Oahu Island, T. H.

(8) Telemetry Ships

(9) Space Track, Radar and Optical Tracking

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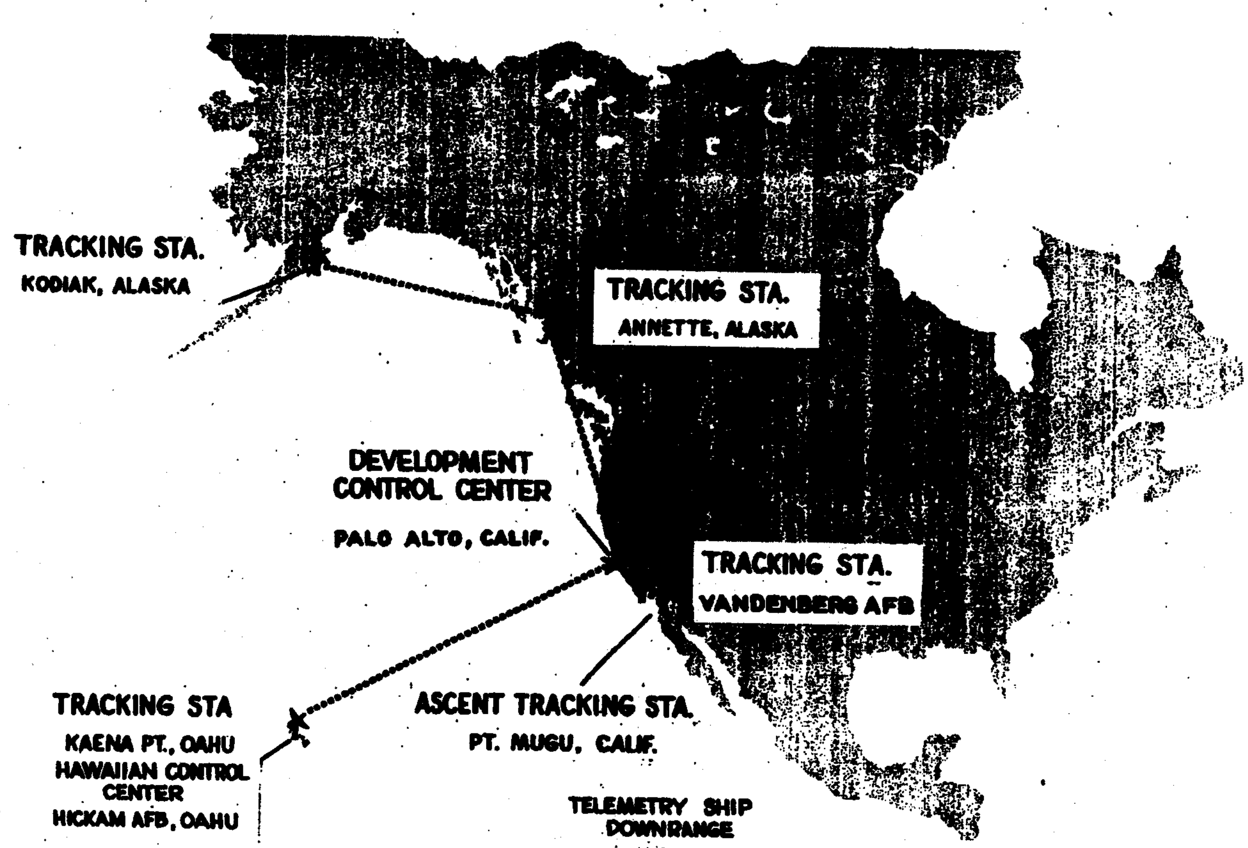
DISCOVERER STATION LOCATIONS



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b. The Vandenberg and Hawaii Tracking Stations will use the following equipment:

(1) VERIORT (Modified Mod II) radar

(2) TLM-18 self-tracking telemetering antenna

(3) Tri-helix antenna

(4) Doppler range detection equipment

(5) Telemetry tape recording equipment

(6) Telemetry decommutators for real time data presentation

(7) Plot boards for radar and TLM-18 tracking data

(8) Conversion equipment for teletype transmission of radar, TLM-18, and doppler tracking data in binary format

(9) Acquisition programmer for pre-acquisition direction of antennas

(10) Equipment for transmission of satellite commands

c. The Annette and Chiniak Tracking Stations will use the equipment listed in 2 above, except that the TLM-18 antenna and associated equipment are not provided. The radio signal reception functions of the TLM-18 antenna will be shifted to the tri-helix antenna already installed.

d. The Pt Mugu Tracking Station will have the same configuration as Annette and Chiniak above, and in addition will be equipped with a guidance computer which determines and issues the necessary commands to initiate and terminate second-stage burning at optimum times.

e. A Recovery Force presently consisting of nine C-119J aircraft equipped with search gear is stationed and is being maintained at Hickam AFB, Hawaii. Three destroyers equipped with radio search gear are also stationed in Hawaii. As needed, the Air Force will assign four RC-121 radar picket aircraft to assist in the recovery operation.

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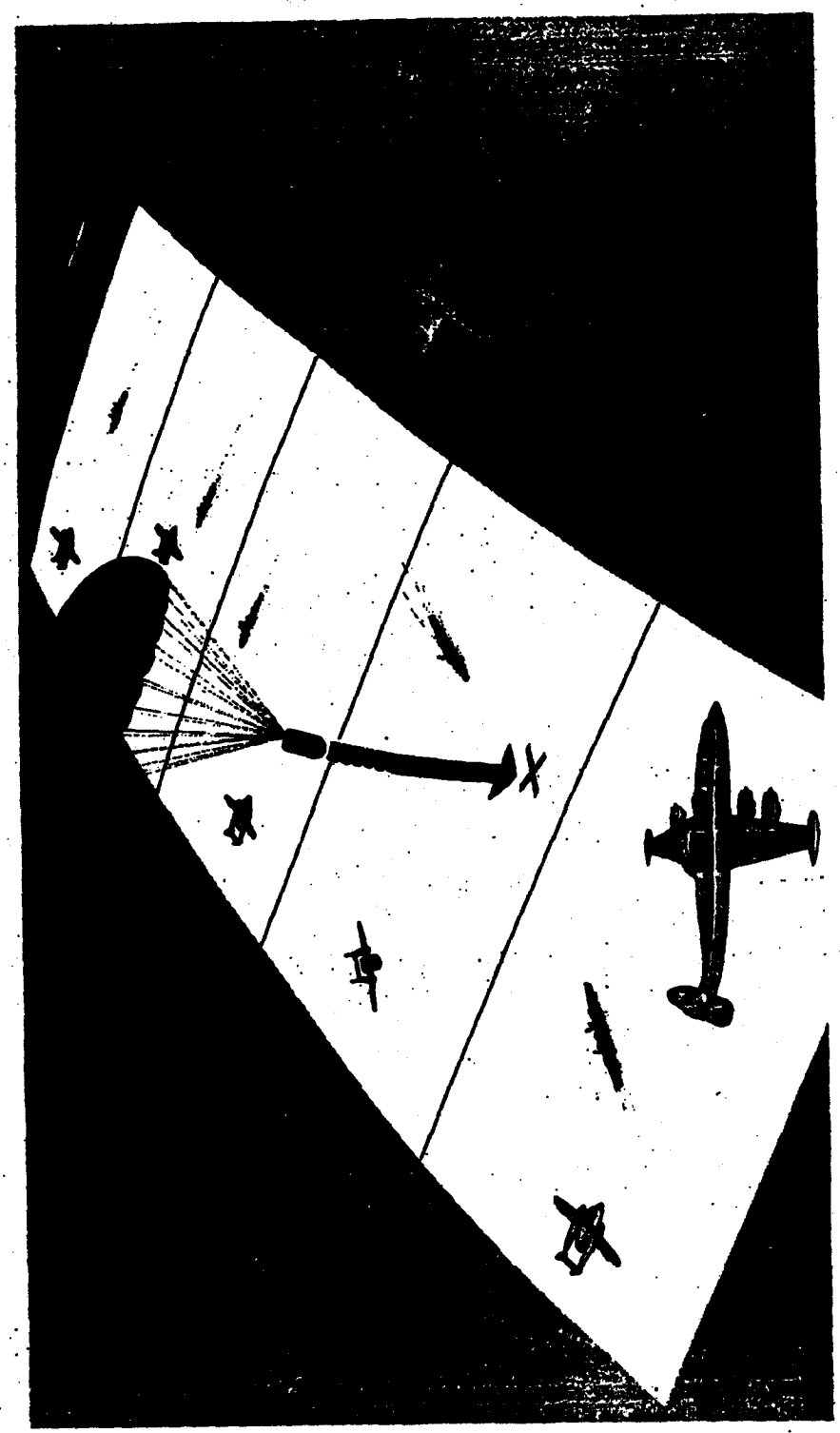
DISCOVERER RECOVERY



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D. TEST ORGANIZATION

1. GENERAL

Subject to the overall management by the Air Force Ballistic Missile Division, the Lockheed Missile System Division (LMSD) has been assigned responsible technical direction of the Discoverer Development Program. In accordance with ARDC Regulations, the AFBMD Weapons System Project Office (WSPO) exercises technical test control of Discoverer Systems tests. The Chief, Palo Alto Field Office, is the Systems Test Controller who is assigned responsibility for exercising control of the technical tests of the Discoverer during the test planning phase and flight test operations. Within the broad direction established by AFBMD for Discoverer development, system requirements are generated and integrated by LMSD, and appear as general and detailed test plans and support requirements. Following project approval at AFBMD, the documents become official test plans with which all participants in the program comply. The test operations are executed by LMSD and Douglas Aircraft Company (DAC), the booster contractor, under the control of the Systems Test Controller. In general, systems test direction and execution is accomplished by LMSD personnel. In the case of the SM-75 booster, DAC personnel have been assigned responsibility for direction and execution of booster activities. Test control and direction has been established at each Discoverer field site, with the center of operations located at the Palo Alto Development Control Center (PADCC). Major decisions concerned with such items as launch under marginal conditions will be made at PADCC based on recommendations made by various field stations. In all cases, final authority in the areas of test control and direction is at the PADCC.

E. PROGRAM SYSTEM OPERATION

1. GENERAL

The system consisting of orbiting vehicle, launch and checkout facilities, tracking stations, control centers, and computing facilities, is considered as an operating entity and the functioning of each element of the system is discussed as that element becomes active in the test.

2. PRELAUNCH PLANNING

The basic planning, initiated several months prior to the scheduled launch date, includes an adequate description of the test configuration and test objectives. In addition, the specific plans for attaining the objectives are explained. These plans thus represent a summary discussion of the vehicle booster combination and the ground station configuration as they are planned for any given flight.

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F. SYSTEM TEST AND CHECKOUT

1. Vehicle

a. The complex nature of the satellite requires a constant checkout of components, subsystems, and systems to ascertain flight readiness to attain the flight objectives. Equipment has been developed for this checkout. From manufacturing, the vehicle goes through a checkout period at Palo Alto during which components, subsystems, and the system are checked to determine that they are operating properly and that the vehicle is flight ready.

b. At Santa Cruz Test Base the vehicle is installed in a test stand and the engine operated. In the contracted facility at Vandenberg AFB, the vehicle is again checked out, using equipment similar to that at Palo Alto to determine flight readiness. The Vandenberg AFB facility is also equipped to do major disassembly of the vehicle should the need arise. On the launch pad, the blockhouse consoles maintain parameter checks of the vehicle operating systems until the vehicle is launched.

c. The checkout equipment will be modified to suit changing flight objectives and will be improved as test results permit operation evaluation.

2. Tracking Stations

The tracking stations undergo a continuous program of checkout to maintain operational readiness. Local checks consist of internal checks and aircraft "flyby" to assist in calibration. Prior to a flight, or an anticipated orbit pass, the tracking station is checked out in conjunction with the Palo Alto Development Control Center. As the Discoverer Program progresses, the tracking station equipment will be optimized, based on test results, to increase reliability for tracking and data acquisition.

3. Palo Alto Development Control Center

The Palo Alto Development Control Center maintains a constant program of checkout with Vandenberg AFB launch base facilities and the tracking stations. In addition, Palo Alto Development Control Center utilizes as part of the testing, the Palo Alto Computer Center to generate an orbit ephemeris which is transmitted to the tracking stations for equipment checkout.

4. Recovery Force

The air recovery of the capsules ejected from orbit requires a separate test program to develop the direction finding and air snatch equipment and procedures. An additional program of checkout and continued training of this recovery force has been initiated. The recovery equipment and direction finder must undergo testing and checkout prior to each flight to maximize the probability of recovery. In addition, aircraft crews will participate in a continuous training program.

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5. Recovery Capsule

The recovery capsule is to be supplied by General Electric to suit the Discoverer configuration. The test and checkout of the capsule is a coordinated effort by G.E. and LMSD.

G. COMMUNICATION SYSTEM COUNTDOWN

Communication system countdown is initiated five hours before launch, with a communication check to each station which also provides a station readiness report and a time synchronization. Throughout the countdown the Palo Alto Development Control Center directs major activities of individual tracking stations, the recovery force, and the launch base activities system condition from individual status reports, and integrates separate efforts into a coordinated, unified operation. The time relationship of individual station operations are planned for a simultaneous readiness condition of launch and tracking support equipment.

H. LAUNCH, EXIT AND ORBIT INJECTION PHASES

1. The operation of the complete system from the instant of launch to the end of attitude stabilization on orbit is beyond the scope of this Plan; only a representative description is given here.

2. At the instant of lift-off, all booster/vehicle systems will be operating.

3. Commencing with lift-off, the booster will be programmed to roll until it attains its nominal flight path azimuth. During this period, the booster/vehicle will be in vertical flight.

4. After the roll programming is completed, the booster will be programmed in pitch to hold a zero-lift trajectory until the separation attitude is reached. From then until separation a constant-attitude trajectory will be programmed into the Discoverer control system.

5. Separation occurs on attaining the proper altitude and attitude. As the booster falls away, the satellite vehicle continues in a self-stabilized, pre-determined coast. At the termination of the coast phase, the internal satellite power plant activates, supplying the required orbital velocity increment to establish a substantially circular orbit. The internal controls will then erect the vehicle to the proper attitude.

I. ORBITAL PHASE

1. The operation of the entire system during the period after the vehicle is on orbit and stabilized in attitude, and before the time when the capsule is ejected, is described as the orbital phase.

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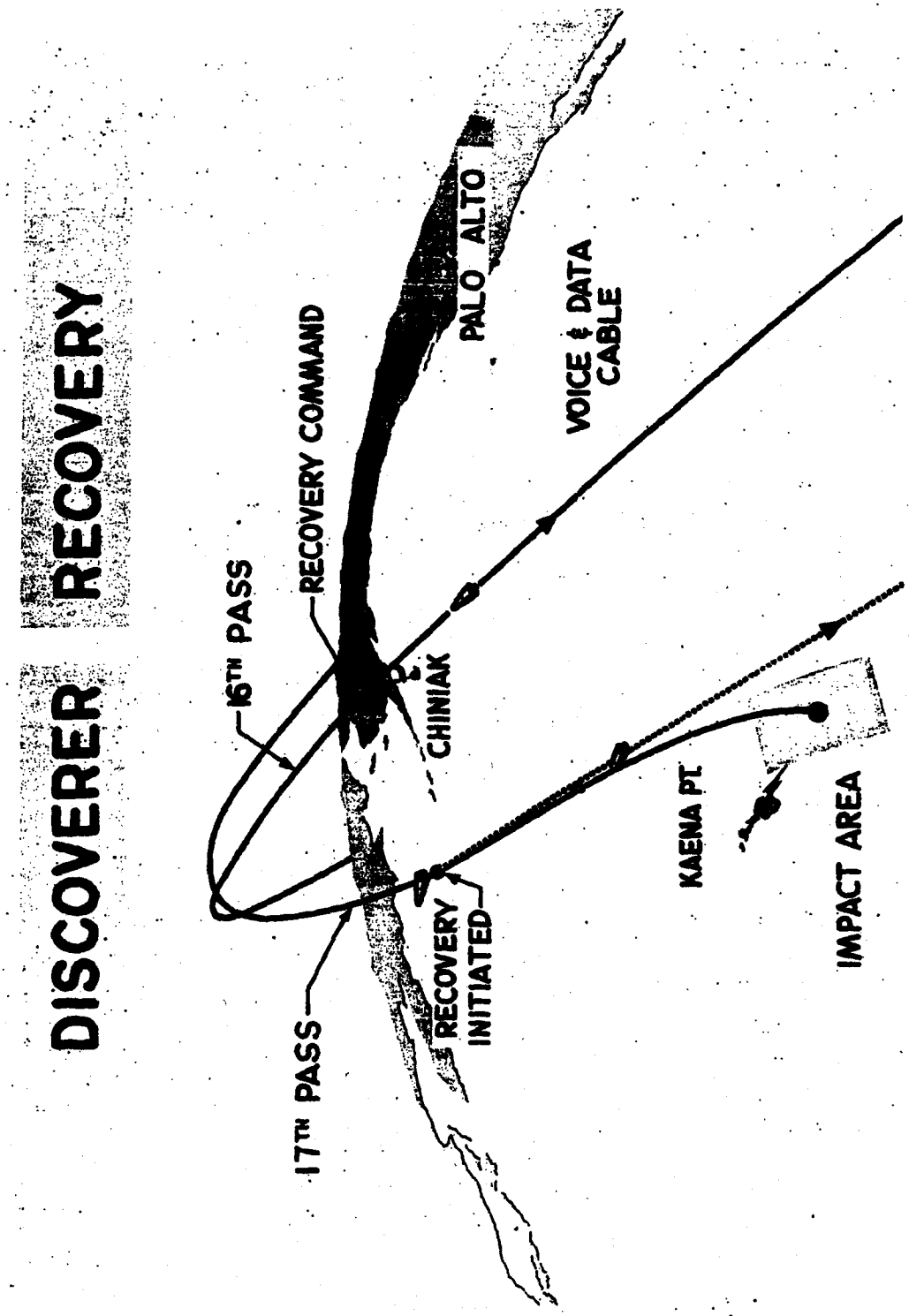

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2. All tracking stations of the Discoverer system conduct a systematic equipment check prior to each vehicle contact. This exercise serves to indicate the readiness of the station and verifies the operability of its equipment.

J. RECOVERY OPERATION

Present planning provides that the recovery capsule will be ejected from orbit to be air-recovered by C-119J aircraft, in the ocean area southwest of Hawaii.

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SECTION II - TEST ANNEX

COMMAND AND CONTROL RESPONSIBILITIES AND PROCEDURES

A. GENERAL

1. System command and control is a world-wide problem requiring an extensive communication network. The actual functions of command and control are not complex in themselves. The problem is made complex because of the geographic separation of the various ground stations and the need for reliable transmission of tracking and system status data on a 24-hour basis.

2. The tasks to be accomplished in the command and control of the Discoverer test configurations include:

a. The collection and presentation of various types of data that can serve as the basis for command generation.

b. The refinement and analysis of selected data to permit its employment in the decision or command determination process.

c. The definition and selection of emergency operational modes in the event of system component failure.

d. The transmission of system commands.

e. The evaluation of system response to the commands and the determination of required modifications to scheduled command flow.

3. Central control authority will be vested in the Palo Alto Development Control Center. A portion of this authority will be delegated to the Vandenberg Control Center and to the Hawaiian Control Center for the control of operations in their local areas.

4. The degree to which control can be exercised over the system is limited by the capability of the ground-to-vehicle command link and by the high degree of system automaticity.

B. PRELAUNCH

1. The Palo Alto Development Control Center monitors the system checkout and the countdown during the prelaunch phases. Specifically, during the system dry-run at X-2 days and again during the system countdown at T-5 hours, the Palo Alto Development Control Center initiates the following activities:

a. Communication system checkout

b. Simulation transmissions from tracking stations to the computer center

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c. Dry-run orbit calculation

d. System component repair and test rerun.

2. During the system countdown, the launch facilities aspects of the countdown are under the direct control of the Vandenberg Control Center. The Palo Alto Development Control Center in its direction of the overall countdown, is continually receiving and retransmitting system status information and other pertinent data such as weather and recovery force status. Vandenberg Control Center plots the important data received from Palo Alto Development Control Center. In turn, Vandenberg Control Center continuously advises Palo Alto Development Control Center of the status of the launch countdown.

3. The Hawaiian Control Center is also in constant contact with Palo Alto Development Control Center during the countdown. Of particular concern to Hawaiian Control Center is the estimated time of launch and the weather condition in the planned impact area. The mission of all control centers during this phase clearly is to establish the readiness of the system for the planned flight. The decision to initiate or delay a launch is made at the Palo Alto Development Control Center. This decision can be made only after all the major system components have been verified as operative.

C. LAUNCH AND ASCENT

1. The Palo Alto Development Control Center functions during this phase are concerned primarily with system coordination as follows:

a. The tracking stations are alerted and notified of initial orbit parameters.

b. The Computer Center receives the times of vehicle engine start and termination of orbital boost

c. The recovery force is informed of orbit achievement and redirected if required.

2. The Vandenberg Control Center functions are the direct control of the launch facilities and vehicle command during this phase of the test operation.

D. ORBIT

1. The exercise of control over the vehicle in orbit is limited to the following commands:

a. Reset of the orbit timer

b. Adjustment of the orbit timer

c. Control of orbit altitude and period

d. Initiation of the recovery sequence

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2. The intervals at which these commands are given are controlled by the vehicle position in orbit relative to the tracking stations. Therefore the Palo Alto Development Control Center has very little freedom in command choice or determination insofar as the vehicle, itself, is concerned. However, it must continuously monitor the Discoverer system during the orbital phase. Unexpected component failure in the vehicle or on the ground will dictate a redetermination of the normal operational sequence.

E. RECOVERY

1. The decision to initiate recovery is made by the Palo Alto Development Control Center and the command issued to the vehicle on orbit by one of the Discoverer tracking stations. The ships of the recovery force will previously have been deployed to the predicted impact area prior to launch. The aircraft will have departed shortly before the dump command is sent. From this point on, Hawaiian Control Center becomes the focal point for the exercise of system control as delegated by Palo Alto Development Control Center.

2. Progress of the search and recovery operation is plotted against a predetermined time schedule. Appropriate periods, which have been established following rigid safety standards, are allowed for air and sea search. Changes in weather conditions are carefully evaluated in terms of these predetermined standards. The Palo Alto Development Control Center is continuously informed of the progress of the recovery operation. Any decision to postpone or halt the recovery attempt or the capsule search will be made at Palo Alto Development Control Center on the basis of the information received from Hawaiian Control Center.

F. SYSTEM TEST EVALUATION

A comprehensive evaluation of test results will be accomplished at all appropriate levels

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G. DATA FLOW

1. System test data generated will be initially observed and recorded at seven geographical locations as follows:

a. Vandenberg Air Force Base, California
b. Point Mugu, Naval Air Missile Test Center, California
c. Telemetry Ship, 950 nautical miles downrange
d. Kaena Point Tracking Station, Hawaii
e. Chiniak Tracking Station, Alaska
f. Annettee Tracking Station, Alaska
g. Recovery Force, East of Hawaii

2. The types of data involved are:

a. Telemetry data
b. Radar tracking and control data
c. Launch (umbilical) data
d. Optical data
e. Weather data
f. Prelaunch servicing notes
g. Recovery data
h. Operations data (range interference, communications).

3. Data will be recorded and transmitted as follows:

a. Radar, TIM-18 tracker (where provided) and Doppler range-tracking precise digital data will be punched on teletype tape in binary format and transmitted to the Palo Alto Development Control Center for computer analysis and computations.

b. Radar and TIM-18 tracker (where provided) data will be presented at the tracking stations as analog plots for station on-the-spot evaluation of operations.

c. Telemetry data will be recorded on magnetic tape which will be transmitted to Sunnyvale for analysis by the fastest available means.

d. Critical telemetered data will be decommutated if necessary and presented in real time at the tracking stations. Reports of significant events will be made to the Palo Alto Development Control Center immediately.

e. Space track data - radar data will be transmitted directly to the Palo Alto Control Center in real time; optical data will be appropriately reduced by Space Track and then transmitted to Palo Alto Control Center.

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4. To insure the rapid incorporation of test results in the planning and conduct of subsequent operations, it is imperative that a complete evaluation of each test be accomplished within the time span occurring between flights. Because of the scope of Discoverer test operations, this places a most stringent time factor on the tasks associated with post-test data handling and evaluation. Every effort will be made, therefore, to streamline the data flow process so that lag times may be minimized.

H. DATA HANDLING PROCEDURES

1. General

Each item of the above types of data will be correlated with system timing and will be clearly identified as to source, content, and test number. Other items not listed, but which are pertinent to test results, will be included in written reports. Because of the many individual pieces of information which must be assembled within a short period of time, every attempt will be made to deliver each item of data within a specified time. Deviations dictated by conditions peculiar to an individual flight will be covered in the detailed test objectives. Other necessary deviations resulting from conditions arising during or subsequent to a test will be coordinated through the Palo Alto Development Control Center. Designated representatives from Douglas Aircraft and LMSD will be present at Vandenberg AFB for each flight to collect and handcarry the required launch data to Santa Monica and Palo Alto.

2. Thor Launch Data

Douglas (Vandenberg AFB) will be responsible for supplying booster data which included launch data, telemetry data, prelaunch servicing notes and operation data.

3. Discoverer Data

Lockheed (Vandenberg AFB) will be responsible for supplying Discoverer Data items as listed above. Delivery of radar and telemetry tapes generated during orbit flight will be the responsibility of the tracking station managers utilizing the communication network to Palo Alto Development Control Center.

I. DATA REDUCTION

1. Discoverer Data Reduction

a. With the exception of data derived from metric optics, all raw Discoverer test data requiring reduction to usable terms will be processed by LMSD. Since nearly all quantitative information derived from a flight will be of this category, rapid processing of such data is essential to the timely flow of information. Also, because of the large volume and the random order of arrival of many separate items of data, the processing scheme must be both expedient and highly flexible. To permit an early evaluation of results, the data reduction process will be accomplished in two parts in the manner described below.

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(1) "Quick Look" Data. Data reduction required to support "Quick Look" evaluation activity will be accomplished on a first priority basis within 24 to 36 hours after receipt of pertinent radar and telemetry tapes. Nominal "Quick Look" data requirements will be specified in detail 60 days prior to each flight. Additional data requirements which may be necessary because of flight events will be specified after a preliminary review of real time records within eight hours following the test.

(2) Final Data. A final, comprehensive compilation of data as required for detailed subsystem analysis will be completed within a period of three to five days after launch.

2. Thor Data Reduction

The reduction of booster data will be accomplished by Douglas Aircraft Company at Santa Monica. These data will be transmitted to cognizant organizations.

J. SYSTEM EVALUATION

1. A complete operational evaluation of test results will be made. This evaluation will encompass all weapon system test activities as they affect the achievement of ultimate program goals and objectives. Major emphasis, however, will be devoted to the timely evaluation of system flight tests as required to properly redirect the program. The areas to be covered will include:

a. Overall system performance in terms of predicted versus actual results.

b. Validity of test plans and conduct in terms of the timely achievement of test objectives.

c. Techniques and procedures employed in the conduct of system test operations.

d. Adequacy and suitability of systems communications, ground support equipment, facilities and logistics.

2. Detailed follow through action will be taken on investigation of problem areas revealed by preliminary evaluation and detailed analysis. A completely integrated evaluation of overall system operation will be performed. Necessary remedial actions affecting the planning and conduct of the next test will be coordinated with all organizations concerned and fully implemented at the earliest possible date.

3. Accurate and complete records of program test activity and results will be maintained. A continuing evaluation of system operations on a flight-to-flight basis will be performed. Operations concepts, equipment, and procedures will be modified as necessary for proper program redirection.

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DEPARTMENT OF THE AIR FORCE
DISCOVERER PROGRAM
REVISED FY 1959 FINANCIAL PLAN AND FY 1960 FINANCIAL PLAN
AND FY 1961 BUDGET ESTIMATE

GENERAL STATEMENT

The Discoverer Program consists of 25 launches during Calendar 1959 and 1960. Discoverer is funded by ARPA Order 48-59. This fund section reflects fund requirements necessary to support the 25 flight schedule.

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DEPARTMENT OF THE AIR FORCE
DISCOVERER PROGRAM
REVISED FY 1959 FINANCIAL PLAN AND FY 1960 FINANCIAL PLAN
AND FY 1961 BUDGET ESTIMATE

SUMMARY OF REQUIREMENTS

	FY 1959	FY 1960	FY 1961
LMSD	112,900,000	18,500,000	1,500,000
MANAGEMENT AND SYSTEMS ENGINEERING	(30,600,000)	(5,000,000)	(1,500,000)
VEHICLE SUBSYSTEMS	(31,400,000)	(6,600,000)	-0-
COMMUNICATIONS SUBSYSTEM	(30,300,000)	(3,500,000)	-0-
PAYLOAD SUBSYSTEMS	(8,700,000)	(2,400,000)	-0-
GSE	(11,900,000)	(1,000,000)	-0-
THOR BOOSTER	17,500,000	15,300,000	2,000,000
AFCRC	1,200,000	-0-	-0-
MISCELLANEOUS	700,000	800,000	100,000
TOTAL	132,300,000	34,600,000	3,600,000

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DEPARTMENT OF THE AIR FORCE
DISCOVERER PROG[illegible]
REVISED 1959 FINANCIAL PLAN AND [illegible] 1960 FINANCIAL PLAN
FY 1961 BUDGET ESTIMATE

JUSTIFICATION OF REQUIREMENTS

	FY 1959	FY 1960	FY 1961
1. MANAGEMENT AND SYSTEMS ENGINEERING:	30,600,000	5,000,000	1,500,000

Funds requested in this category are for design studies, establishing criteria, manufacturing costs, and testing the vehicle. Included under manufacturing costs are those expenses resulting from tooling, planning, mockup, vehicle fabrication, manufacturing services, and quality assurance. Under testing are included the operation of tracking sites and the Development Control Center, along with implant, static test firings and flight testing.

The Lockheed Program Management Cost is also included in this estimate.

2. VEHICLE SUBSYSTEMS:	31,400,000	6,600,000	-0-

The basic vehicle subsystems including airframe, propulsion, auxiliary power, and guidance are included in this estimate. It covers the cost of Research and Development on these subsystems and the production of these subsystems for the 25 flight vehicles. One particularly costly item is the design, development, and change over from a JP-4 engine to a UDMH engine.

3. COMMUNICATIONS SUBSYSTEM:	30,300,000	3,500,000	-0-

Work to be accomplished in the Communications Subsystem consists of providing equipment for the 5 tracking sites, the Development Control Center, and the 25 flight vehicles. The work consists of research, development, and production work as follows:

a. To provide vehicle-borne CW acquisition beacon, S band transponder, telemetry transmitters, command decoder, programmer, antenna, multiplexers and antenna system.

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DEPARTMENT OF THE A FORCE
DISCOVERER PROGRAM
REVISED 1959 FINANCIAL PLAN AND FY 1960 FINANCIAL PLAN
AND FY 1961 BUDGET ESTIMATE

JUSTIFICATION OF REQUIREMENTS

	FY 1959	FY 1960	FY 1961
b. To provide inter- and intra-station communication equipment as required.			
c. To conduct subsystem analysis, checkout, and performance evaluation.			
4. PAYLOAD SUBSYSTEM:			
The payload subsystem in the Discoverer Program is a recoverable capsule. To accomplish this objective it is necessary to conduct high altitude separation tests of the re-entry capsule, develop the structure, and conduct aero and thermal analysis of the payload. Included are component design, development of the retro-system and recovery system.	8,700,000	2,400,000	-0-
5. GROUND SUPPORT EQUIPMENT:			
The GSE requirement is associated with the need of equipping a blockhouse, two pads and a missile assembly building at the launch site. In addition, one set of checkout equipment and a set of blockhouse and pad equipment is required-inplant. Also required and funded under this category are various handling dollies, slings, acid and fuel trailers, air conditioning units, and transporter erectors. Replacements of certain items will be necessary during FY 1960.	11,900,000	1,000,000	-0-
6. THOR BOOSTER:			
The estimate covers the basic missile, spare parts, GSE costs and flight test costs to support the 25 flight schedule. Standard pricing for the Thor Boosters has been employed.	17,500,000	15,300,000	2,000,000

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DEPARTMENT OF THE AIR FORCE
DISCOVERER PROGRAM
REVISED 1959 FINANCIAL PLAN AND FY 1960 FINANCIAL PLAN
AND FY 1961 BUDGET ESTIMATE

JUSTIFICATION OF REQUIREMENTS

	FY 1959	FY 1960	FY 1961
7. CAMBRIDGE RESEARCH CENTER:	1,200,000	-0-	-0-
The following tasks comprising the geophysical subsystem will be performed by Cambridge Research Center: Thermal radiation, meteor physics, atmospheric density, atmospheric composition, solar ultraviolet radiation, rocket instrumentation, electron charge and ion density, and cosmic radiation.			
8. MISCELLANEOUS:	700,000	800,000	100,000
Funds stated in this category are to satisfy unforeseen work accomplished by other DOD agencies.			

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SECTION III

MILITARY CONSTRUCTION PROGRAM

GENERAL STATEMENT

1. The Discoverer program requires facilities to support the following essential functions; test direction, booster and satellite assembly, and checkout maintenance and repair; launch and launch instrumentation; satellite tracking, control, and telemetry; capsule recovery; and data interpretation and dissemination.

2. All facilities required for the Discoverer program are existing. These facilities, with exception of the SM-75 Launch Complex at Vandenberg AFB, were programmed under the Sentry (WS 117L) Development Plan in the FY 1958 Military Construction Program.

3. The existing facilities required to support the Discoverer program and their functions are as follows:

LOCATION	FACILITY DESCRIPTION	FUNCTION
Vandenberg AFB Launch Base	Administration Building Bldg. T-11356 1,475 sq ft	Program Direction
	Admin. and Storage Bldg. Bldg. T-11363 1,350 sq ft	LMSD Base Services
	Engineering Building Bldg. T-11364 2,500 sq ft	LMSD Base Engineering
	Flight Test Opns. and Supply Bldg. T-11362 1,940 sq ft	Test Opns. and Supply
	G.H.E. Bldg. Bldg. T-11354 2,950 sq ft	Maintenance and Storage G.H.E.
	Sub-system "L" Bldg. Bldg. T-11345 2,400 sq ft	Biomedical and Recovery Package Maintenance and checkout
	G/M Assembly Bldg (Addn Bldg Nr 9227) 9,600 SF	Missile Checkout
	Shop and Administration Bldg 3200 SF	GSE Maintenance

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LOCATION	FACILITY DESCRIPTION	FUNCTION
Vandenberg AFB Launch Base	Receiving and Storage Bldg. Bldg. T-11344 2,100 sq ft	LMSD Base Services
	Interim MAB Bldg. T-11352 15,200 sq ft	Missile Check-out
	SM-75 Launch Complex Thor Launch Pads 4 and 5 Associated Blockhouses and Service Structures	Launch Thor-boosted Discoverer vehicles at maximum rate of two per month
Vandenberg AFB Tracking Station	VHF Telemetry Receiver Bldg 2,300 sq ft	Launch and Orbital Tracking and Telemetry Data Reception, trajectory measurements and calculations to determine time to initiate boost.
	60-foot Dish Antenna Tri-Helix Antenna	
	VERLORT Radar Van Installation	
	Mark II Optical Tracker	
Kaena Point Tracking Station Oahu, T.H.	Administration 6400 sq ft and VHF Telemetry Receiver Bldg. with 60-foot Dish Antenna and Tri-Helix Antenna	Orbital Tracking and Telemetry Data Reception
	VERLORT Radar Van Installation	
Point Mugu Tracking Station N.A.M.T.C. Pt. Mugu, Calif.	VHF Telemetry Van Installation with Tri-Helix Antenna	Launch Ascent Tracking and Telemetry Data Reception
	VERLORT Radar Van Installation	
Pvt. Joe E. Mann (Ship)	VHF Telemetry Van Installation with Tri-Helix Antenna	Final Stage Launch Tracking and Telemetry Data Reception
Annette Tracking Station Annette Is. Alaska	VHF Telemetry Van Installation with Tri-Helix Antenna	Orbital Tracking and telemetry Data Reception Including First Pass Acquisition and Recovery Package Tracking and Impact Prediction
	VERLORT Radar Van Installation	

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LOCATION	FACILITY DESCRIPTION	FUNCTION
Annette Tracking Station Annette Is. Alaska	Pan-Am Leased Personnel Housing	
Chiniak Tracking Station Cape Chiniak, Alaska	VHF Telemetry Van Installation with Tri-Helix Antenna	Same as Annette Tracking Station
	Existing AC & W Composite Bldg.	
Hawaiian Control Center Hickham, AFB	Wing E of Hale 6,000 sq ft Makai Bldg.	Center for Direction of Capsule Recovery Operations.

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