THE SECRETARY OF DEFENSE
WASHINGTON

July 28, 1959

Dear Mr. President:

I am forwarding herewith the Military Space Projects Report for the quarter ended June 30, 1959.

The DISCOVERER II satellite was successfully launched into a polar orbit on April 13, 1959, from the Pacific Missile Range. The timer command reset failed to adjust to the actual orbit period, which was less than planned; consequently, the biomedical capsule was not ejected in the planned recovery area. Search operations failed to locate the capsule, after it was reported seen in the Spitzbergen, Norway, area. DISCOVERER III, launched on June 3, 1959, and DISCOVERER IV, launched on June 25, 1959, experienced successful ascent, separation and orbit boost; however, both vehicles failed to achieve orbit. DISCOVERER V, originally scheduled for July 1, 1959, has been postponed until July 28, 1959.

Due to launch pad availability problems and difficulty with the ATLAS-D missile, the first MIDAS (very early warning satellite) launch has been delayed two months to January 1960.

Firm objectives have been established for the SAMOS (reconnaissance satellite) project with polar orbiting satellites capable of performing visual and ferret reconnaissance functions. The first flight is scheduled for April 1960.

The first two of the eight engines for the SATURN (clustered booster) project have been successfully tested at the Army Ballistic Missile Agency. Development of the navigation and communication satellites is in the hardware stage and continues on schedule.

As indicated in my letter transmitting the previous quarterly report, project TIROS (meteorological satellite) was transferred to the National Aeronautics and Space Administration effective April 13, 1959. In addition, project CENTAUR, the high energy upper stage, was transferred to the National Aeronautics and Space Administration at the close of this quarter.

With great respect, I am

Faithfully yours,

/s/ Thomas S. Gates
Deputy

1 Incl.:
Report
cc: Members of the National Aeronautics and Space Council

The President
The White House

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PROGRESS HIGHLIGHTS

During the Quarter Ended June 30, 1959

(Project code names were assigned to all major ARPA projects during the quarter and are evident throughout this document.)

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The first flyable infra-red scanner for Phase I of the MIDAS infra-red reconnaissance satellite program was delivered in June, and the first satellite launch is scheduled for January 1960. Delay of approximately two months is due to conflict in pad schedules and to difficulty in the ATLAS-D program.

Transfer to NASA of the meteorological satellite project (TIROS) was made in April 1959.

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The combined MINITRACK-DOPLOC fence, a portion of Project SHEPHERD, continues to successfully track satellites in space.

Under TRIBE, the project for development of a continuing family of military space vehicles, the first two engines of the 1.5 million pound thrust cluster engine SATURN were successfully fired at ABMA.

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SAMOS PROJECT

(FORMERLY SENTRY)

INTRODUCTION

Project Renamed

This project was formerly known as the WS-117L or SENTRY Program prior to the establishment of DISCOVERER and MIDAS as separate projects. It was recently named SAMOS to remove the earlier all-inclusive connotation associated with the SENTRY title.

SAMOS to provide both Visual (Photographic) and Ferret (Electronic) data.

The objective of the SAMOS project is the development of a reconnaissance system utilizing polar orbiting satellites to collect and process visual or photographic data and ferret or electromagnetic data. Specifically, the SAMOS system is expected to acquire a great amount of technical intelligence, resulting in a more precise knowledge and evaluation of enemy military and industrial strength and their deployment. The data obtained should enable the United States to do a better target analysis job and to detect and identify unknown targets. Information obtained will provide evidence of build-up and consequently relatively long-lead warning of attack.

Ground acquisition of data by capsule recovery and by readout.

Two approaches are being developed for acquisition of intelligence data: (1) the recovery system in which a data capsule is ejected from the satellite upon command and physically recovered, and (2) the electronic data readout system in which all data is transmitted upon command to ground stations. The recovery system is used for photography and the data readout system for both photography and ferret. The recovery system will be used when rapid time response is not necessary, thus permitting collection of data over a large geographic area at a rate which would exceed the limits of a readout link capability. The

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photographic readout system will be used for surveillance of specific targets when time response is an important factor.

Flight Program

The program initially included 22 launchings. Current program reviews of payloads planned may reduce this to 18 launchings. The first launching is scheduled for April, 1960.

SAMOS PAYLOADS

GENERAL

Initial flights to have both visual and ferret capabilities.

A dual payload, consisting of components of both visual and ferret systems, will be used on the initial development flights to test equipment. When in orbit, both the visual and ferret equipment will be checked out for satisfactory operation, prior to jettisoning of the ferret payload. The visual payload will then be permitted to operate without interference and will have a useful life of 10 to 15 days, depending upon the power supply used. Later satellites will carry only the visual or the ferret payload.

Visual payload to utilize wideband data link.

A wideband data link will be used for the visual payload ground-space communications. This link includes a payload camera, using strip film which is automatically developed while in orbit. On ground station command, readout of the developed negative is accomplished by electronic scanning (in the satellite) and conversion of the image to a video signal for transmission to a ground station over the wide-band link. The video signal is then converted into modulated lines and displayed on a kinescope. The kinescope lines are photographed by a 35 mm continuous-strip camera which records the images as a series of positive frames.

Recovery Payload

Bids for development of recovery payloads have been received and are being evaluated. The design objective for the recovery camera is to obtain resolution sufficient to identify objects on the ground as small as five feet on a side.

VISUAL

Flights of first visual payloads (E-1) to be used for component testing.

Photo payloads, employing the readout technique, to be used in the initial vehicles, have been designated "E-1" and include some components of a more advanced design payload, designated "E-2." The E-1 payload will test in orbit the film storage transport unit, experiemental control devices, command control system and the E-2 payload processor and readout system.

E-1 dummy payload complete; ground equipment progress is substantial.

The E-1 dummy payload is available and will be used to provide mechanical fit and electrical harness compatibility with the satellite vehicle. Fabrication and assembly of the E-1 ground handling equipment is complete.

Assembly of E-1 package is underway.

The first flyable visual reconnaissance (E-1) package, now being assembled, contains component refinements, particularly in readout, instrumentation and control.

E-2 payload goal is to achieve 20-foot ground resolution.

The design objective of the E-2 version is to achieve ground resolution of 20 feet. This payload will be controllable to permit photographing of ground objects 150 miles on either side of the flight path and 17 degrees fore or aft along the flight path. Control for a given mission will be entered into a vehicle programmer by ground station command.

E-2 payload in advanced design stage; some fabrication started.

All detail and assembly drawings for the E-2 payload camera are finished. Hardware packaging of the optical system for the 36-inch focal-length lens was accomplished and collimator testing indicates performance exceeds design specifications. (See Figure 3)

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FERRET

Ferret payload provides for three progressively more sophisticated versions.

The reoriented ferret reconnaissance program provides for the development of three payloads attaining progressively advanced design consistent with maintenance of program scheduling. These payloads are designated F-1, F-2, and F-3 and will be used to intercept electronic emissions, measure and store the signal parameters, and transmit the data to ground receiving stations on command.

Ferret payload work proceeding on schedule.

All ferret payload work is proceeding on schedule. The second article of the F-1 prototype vehicle equipment was checked out completely. Qualification testing of the F-1 payload will be conducted in July. Two antenna assemblies have been completed for the F-2 payload. Assembly drawings for the F-2 payload data handling unit and ground data handling equipment have been released for fabrication.

FACILITIES AND SITES

TRACKING

Program requires extensive ground data handling network.

The SAMOS Program requires an extensive ground data handling network, including several tracking and acquisition stations and a central data processing and control facility to be located at Sunnyvale, California. Tracking stations are planned for the eastern, western, and central regions of the United States. In addition, use will be made of DISCOVERER facilities as applicable.

Control equipment being developed for tracking stations.

A study of the requirements for data obtained and required by tracking stations has resulted in the start of development of the Programmable Integrated Control Equipment (PICE) system. This equipment, installed at tracking stations, will accept and store all incoming data and make portions of the data available instantaneously. Specifications for this equipment are complete.

Construction of control center nearing completion.

Construction of the first increment of the Develppment Control Center at LMSD, Sunnyvale, California, will be completed in December 1959. Design of the second increment is scheduled for completion in July. Construction of the Data Acquisition Building is on schedule at Vandenberg Air Force Base with completion of various facilities scheduled on an incremental basis from October to December, 1959. This facility will be used to provide the readout function until the three operational stations are complete.

LAUNCH

Launch pad to be completed in September.

Construction of the SAMOS launch pad at Point Arguello, California, will be completed in September 1959.

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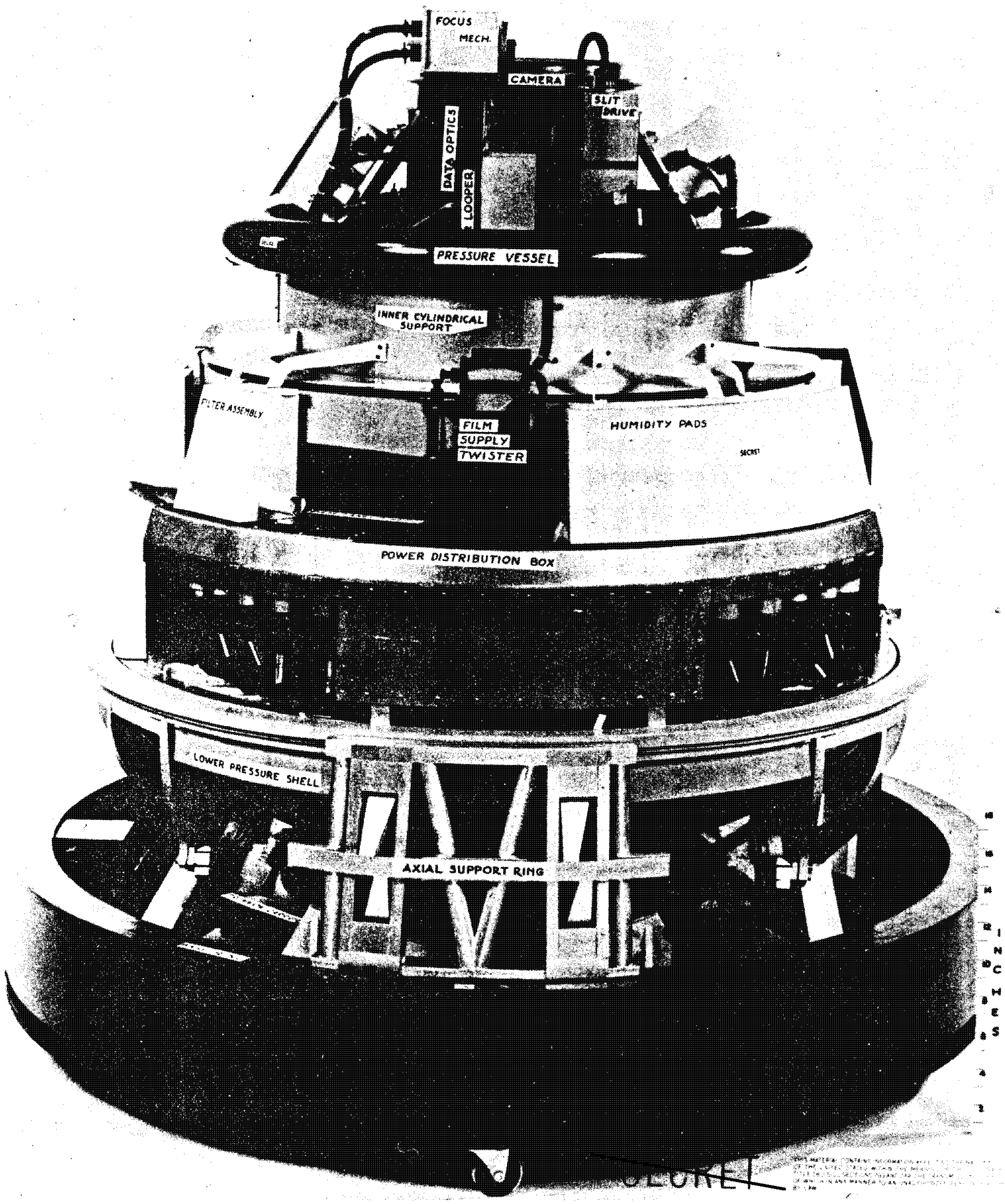
Figure 3 - Mockup of SAMOS (E-2) Visual Reconnaissance Package.



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MIDAS PROJECT

(VERY EARLY WARNING SATELLITE)

INTRODUCTION

MIDAS will provide early warning of Ballistic Missile attack.

Phase I, and a more advanced Phase II series of flights expected to follow it, are aimed toward establishing a reliable operational satellite-borne missile-alarm capability in the 1962 time period. The MIDAS (Missile Defense Alarm Satellite) Project, when operational, will place a series of satellites around the earth in polar orbits. These will carry payloads consisting of infra-red detection scanners capable of keeping watch over large areas of the upper atmosphere. Infra-red emanations from ballistic missiles being launched will be detected as the missiles rise above the atmosphere, and the alarm so given will be transmitted instantaneously to far north readout stations on the ground. Warning will then be relayed directly to the Zone of Interior intelligence and operations centers, providing maximum alert time for retaliatory forces.

FLIGHT SCHEDULE

First flight scheduled for January 1960.

The MIDAS Phase I program involves four ATLAS boosted, low-latitude, low-altitude (300 to 700 mile) flights from the Atlantic Missile Range (AMR). Hardware will be available in time to meet the originally scheduled November 1959 flight date. However, limited launching facilities to accommodate both MERCURY and MIDAS at AMR, together with delays encountered in the ATLAS D program, indicate that January 1960 is the earliest date for the first MIDAS launch.

MIDAS COMPONENT STATUS

GENERAL

First MIDAS satellite shipped to Modification Center.

All aspects of the MIDAS satellite vehicle remain on schedule. The first MIDAS satellite was shipped from Sunnyvale to the Modification and Checkout Center at Palo Alto on June 25.

PROPULSION

Development of restart engine initiated.

A simulated altitude testing program with a modified Bell XLR81-Ba-5 rocket engine was successfully completed in April 1959. (See AGENA modification, under Project TRIBE.) Authorization was then given to proceed with the design and development of a restart engine. This capability must be provided to meet the high altitude orbital requirement of the MIDAS system.

INFRA-RED SCANNERS

The first flyable infra-red undergoing test.

The first flyable infra-red scanner for use in the first Phase I flight, shown in Figure 4, was delivered early in June. The unit is undergoing tests at Lockheed prior to being installed in the satellite. A test to check for possible pick-up of S-band beacon signal by the scanner unit was successfully completed.

TRACKING AND READOUT FACILITIES

PHASE I FLIGHT

Facilities for Phase I include AMR, Palo Alto, PMR and Hawaii.

Initial Phase I flights will use the following facilities:

1. Atlantic Missile Range - Launch and readout of data from satellite in orbit.

2. AMR Down-Range Stations - Tracking during ascent and through orbit injection; readout of exit telemetry data.

3. Development Control Center (Palo Alto/Sunnyvale) - Operations control; ground presentation in real time and analysis of infra-red data.

4. Vandenberg Air Force Base - Tracking; ground presentation of infra-red data in real time, satellite interim timer command, infrared scanner command.

5. Kaena Point, Hawaii - Tracking; infra-red data readout, satellite interim timer command, infra-red scanner command.

Targets, launched from AMR, White Sands Proving Ground, Point Mugu and Vandenberg Air Force Base, will be observed by the orbiting satellites.

ADDITIONAL READOUT SITES

Churchill and Frobisher, Canada, being considered for Northeast Atlantic readout sites.

Churchill and Frobisher, Canada, are being studied as possible sites for a readout station between those in the North Pacific and the United Kingdom.

Donnelly Flats, Alaska, selected as North Pacific readout site.

Donnelly Flats, Alaska, was selected as the site of the North Pacific readout station. Design of this facility has been completed and construction will be started during July with an expected occupancy date of June 1960.

United Kingdom site selection initiated.

Site selection for the East Atlantic station has been initiated, and it is anticipated that siting teams will visit potential areas in the United Kingdom during July.

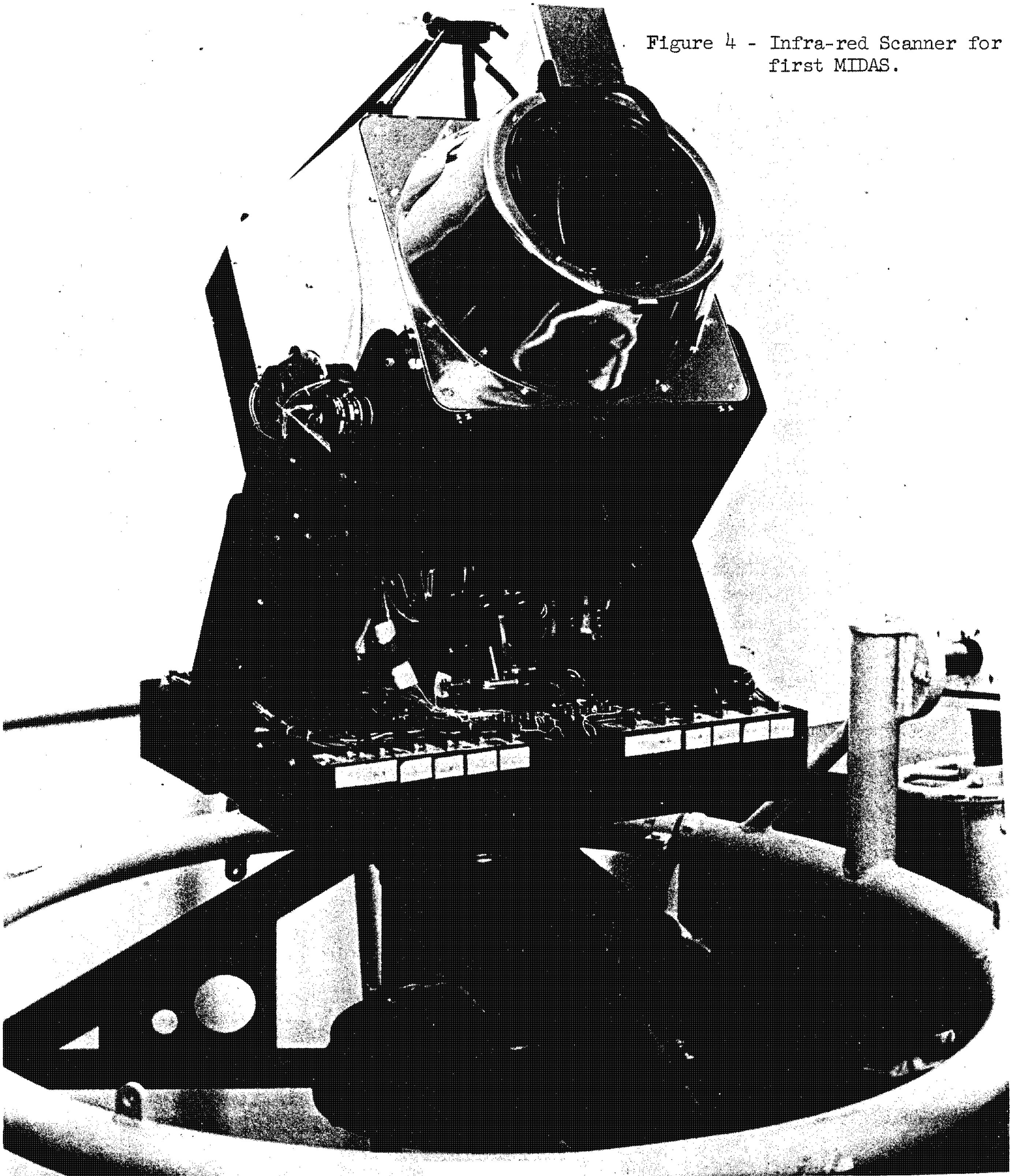

Figure 4 - Infra-red Scanner for first MIDAS.

STATUS OF FUNDS

(In Millions)

Project	Programmed FY 1959 & Prior Years Projects	FY 1959 Commitments (ARPA Orders Issued) June 30, 1959	FY 1959 Obligations As Of May 31, 1959	FY 1959 Expenditur As Of May 31, 195
DISCOVERER	$ 136.5 1/	$ 136.5	$ 101.8	$ 61.0
SENTRY	105.6 1/	105.6	90.9	65.2
MIDAS	22.8 1/	22.8	13.6	8.2
Meteorological Satellite	12.8	12.8	7.4	5.0
Navigation Satellite	10.7	10.7	3.0	.4
Communications Satellite	16.7	16.7	2.2	1.0
Tracking	31.9	27.6	22.0	7.6
Feasibility Studies	11.5	10.5	11.3	6.7
Vehicle Development and Modification				
Clustered Engine	34.0	34.0	19.8	6.5
CENTAUR	21.5	21.5	15.8	6.5
Upper Stage Modification	2.6	2.6	.5	.1
Large Thrust Test Stand	.7	.7	.2	—
TOTAL	$ 491.4 1/	$ 402.0	$ 288.5	$ 168.2

1/ $84.1 programmed during Fiscal Year 1958 and prior years for WS 117L Program. DISCOVERER, SENTRY and MIDAS projects are an outgrowth of WS 117L.

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DOD SATELLITE LAUNCH SCHEDULE

Program	Vehicle	Launch Site	FY 1960 1959 Quarters 1	2	3	4	FY 1961 1960 Quarters 1	2	3	4	FY 1962 1961 Quarters 1	2	3	4
1. DISCOVERER	Thor-Agena	PMR	2	3	4	5	4	5	4	2				
2. Reconnaissance (SAMOS)	Atlas-Agena	PMR						2	2	2	2	2	1	2
3. Communications (NOTUS)														
a. Delayed Repeater (COURIER)	Thor-Agena	AMR						1	1		1	1		
b. SAC Polar (STEER)	Atlas-Agena	PMR							1	1	2			
c. Adv. Polar (TACKLE)	Atlas-Agena	PMR											1	2
4. Navigation (TRANSIT)														
Transit I	Thor-Delta 1/	AMR			1		1							
Transit II	Thor-104	AMR						1	1					
Transit III	—	PMR											2/	
Transit IV	—	PMR											2/	
5. Early Warning (MIDAS)														
Phase I	Atlas-Agena	AMR					2		1	1				
Phase II	Atlas-Agena	PMR									1	1		
6. SATURN	SATURN	AMR				3/				1 4/			1 4/	

1/ Launch scheduled first quarter 1960 will use Thor-104.
2/ Payloads planned to be launched with some other programmed payload.
3/ Static test firing at ABMA.
4/ Launch of vehicle with dummy upper stage but without payload.

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Document No. 2

USAF - brackets [ ]
NSC - red underlining

MILITARY SPACE PROJECTS

REPORT OF PROGRESS
FOR
QUARTER ENDED 30 JUNE 1959

ARPA
ADVANCED RESEARCH PROJECTS AGENCY

Secret Cont. 5-1105

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COPY NO. 1

ARPA

MILITARY SPACE PROJECTS

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QUARTER ENDED 30 JUNE 1959

Department of Defense

Washington 25, D.C.

SECRET

ADVANCED RESEARCH PROJECTS AGENCY
WASHINGTON 25, D. C.

July 28, 1959

MEMORANDUM FOR THE SECRETARY OF DEFENSE

SUBJECT: Progress Report on Military Space Projects for Quarter Ended June 30, 1959

This transmits the Military Space Projects Report for the quarter ended June 30, 1959.

Project TIROS (meteorological satellite) and Project CENTAUR (high energy upper stage) were transferred to the National Aeronautics and Space Administration on April 13, 1959, and July 1, 1959, respectively. Therefore, this is the last time progress on these projects will be included in this report. However, because of their potential military application, the Advanced Research Projects Agency will maintain close liaison with the National Aeronautics and Space Administration in order to keep abreast of progress in these two important projects.

Highlights of major events to date are briefly covered in the accompanying draft of your letter of transmittal of the report to the President.

John E. Clark
Rear Adm., USN
Acting Director

1 Incl.:
Report, subject
as above

THE SECRETARY OF DEFENSE
WASHINGTON

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Under TRIBE, the project for development of a continuing family of military space vehicles, the first two engines of the 1.5 million pound thrust cluster engine SATURN were successfully fired at ABMA.

Fabrication of a full scale mockup of a SATURN booster tail section is complete and all major structural drawings for the SATURN test vehicle were released.

The Bell-Hustler upper stage vehicle (code name AGENA) is being modified to provide a greatly improved high altitude capability.

The CENTAUR project (high energy upper stage) will be transferred to NASA on July 1, 1959. Assembly of the engine is near completion and the first run date is scheduled for July 1959.

TOPICAL SUMMARY

DISCOVERER PROJECT

(COMPONENT TESTING SATELLITE)

INTRODUCTION

Project Objectives-Development and Testing of Components for Military Space Technology Program.

The objectives of the Discoverer Satellite Project are to conduct research and development on components, equipment, instrumentation, propulsion, data processing, communications and operating techniques. Development testing will be conducted in a secure military manner and at an early date relative to over-all system development schedules. Developments accomplished under this project are expected to make major contributions to many advanced military space systems. For example, MIDAS, SENTRY and the SAC Recall Communications Satellite will all use the basic satellite vehicle, and to varying degrees, components, communications, tracking equipment, and operating techniques developed and tested in this program.

The Discoverer project is characterized by an open-ended series of space flights which will be utilized for testing classified equipments within the space environment. The program permits varied test conditions which will duplicate the actual operating conditions of the space equipment being tested. All of the earlier flights planned for this project will utilize the THOR IRBM booster and the AGENA second stage.

Flight Schedule

The current schedule for the Discoverer project calls for a total of 29 firings through fiscal year 1961; the majority of which will be in fiscal year 1960.

DISCOVERER FLIGHTS

DISCOVERER II

DISCOVERER II successfully achieved polar orbit.

On April 13, 1959, DISCOVERER II was successfully injected into orbit approximately six minutes after being launched from Vandenberg Air Force Base. The 1,858 lb. DISCOVERER II vehicle, containing 6,352 lbs. of propellants, separated from the THOR booster and coasted to near-apogee altitude where rocket engine ignition occurred and required orbital velocity was attained. The satellite required 90.43 minutes to complete an almost circular orbit of the earth with an apogee of 215.7 and a perigee of 157.6 statute miles.

Orbit, ejection, and re-entry aspects successful.

During the seventeenth orbit the satellite nose was tilted 60 degrees downward to permit ejection to cause re-entry of the 197 lb. recoverable capsule payload. Telemetered data show that control and ejection equipment operated as planned.

Capsule did not impact in recovery area; search unsuccessful.

A reset error, introduced into the satellite timer by ground command on the second pass, however, made it impossible to adjust capsule ejection to permit impact within the planned recovery area; and the automatic ejection program took effect. Based on the known orbit characteristics and the predicted time of automatic ejection occurrence, it was calculated that the capsule would impact near the Arctic Circle. A "space watch" was alerted and, at the predicted time and in the predicted area, observers on the Norwegian islands of Spitzbergen saw a "starburst," probably foil chaff, and a descending parachute. Search activities conducted by the Norwegian government and the U. S. Air Force throughout the extremely rugged, snow-covered, Spitzbergen area were unsuccessful.

Radar and telemetry contact excellent.

Telemetry, radar beacon and continuous-wave beacon operation was excellent thoughout the lifetime of the batteries. Telemetry and radar beacon were operative until after the 25th pass (about one and one-half days), confirming predicted battery life. The continuous-wave beacon, which operates from its own battern, was heard for the last time on April 19, almost a week after launch. The satellite, visible only in the Antarctic region because of its orbital plane in relation to the sun, was sighted repeatedly in that area. It was last seen at the South Pole on April 25 and is believed to have re-entered the atmosphere the next day.

Changes made to prevent recurrence of error.

Steps have been taken to prevent recurrence of the error which caused loss of ejection timer control. The interim timer installed in the vehicle has been replaced by the more sophisticated Fairchild timer, previously planned for installation in DISCOVERER IV.

DISCOVERER III

DISCOVERER III failed to achieve orbit.

DISCOVERER III was launched from the Pacific Missile Range on June 3 after three unsuccessful attempts during the previous two weeks. Inclement weather and minor technical difficulties with the lift-off staging caused the postponements. Launch, ascent, separation, coast, and orbital boost were accomplished as planned. Premature satellite engine shut-down resulted in failure to achieve required orbital velocity, and impact occurred approximately 30 degress south of the equator. Indications are that fuel exhaustion was the cause of premature shut-down, since fuel for additional burning should have been present in the tanks at the time of shut-down.

DISCOVERER IV

DISCOVERER IV failed to achieve orbit.

DISCOVERER IV was launched on June 25 from Pacific Missile Range (See Figure 1). Launch, ascent, separation coast, and orbit bbost were successfully accomplished. However, the vehicle failed to achieve orbit. A detailed review of DISCOVERER III and IV flight records is being made since neither vehicle achieved orbit, in spite of successful systems and component operation. Several modifications are planned to increase the probability of achieving orbit, such as a change in fuel and a reduction of weight in orbit. Launch of DISCOVERER V on July 1 has been postponed until this review has been completed.

FUTURE FLIGHTS

Vehicles on hand at Vandenberg, Santa Cruz and Palo Alto.

DISCOVERER V is installed on a Vandenberg Air Force Base launch pad. Two additional satellites are at Vandenberg undergoing pre-mating checks. At Santa Cruz Test Base (SCTB), two vehicles are installed in test stands awaiting acceptance testing. A third vehicle is ready for installation when a stand becomes available. Four vehicles are at the Modification and Checkout Center at Palo Alto.

BIOMEDICAL RECOVERY PROGRAM

Successful data obtained from "Mechanical Mice" on DISCOVERER II flight.

Extensive testing of the Biomedical Recovery Capsules is being conducted. "Mechanical Mice" (multi-vibrators emitting a pulse similar to the heartbeat of live mice) were carried in the DISCOVERER II recovery capsule instead of a live payload. Telemetered data showed viability on all channels during the flight.

Live mice data successful on DISCOVERER III flight.

Live mice, contained in the life-cell of DISCOVERER III, were in a satisfactory condition throughout the period of telemetry reception and their behavior was as predicted. The animals sustained 11 G acceleration during THOR boost and about eight minutes of weightlessness between the start of coast and re-entry. Photographs of a biomedical package may be seen in Figure 2.

TELEMETRY AND TRACKING

Down-range radar station needed for additional DISCOVERER Flight Data.

Flights of the first three DISCOVERER vehicles revealed that additional radar data is required immediately after orbital injection to obtain precise calculation of orbital trajectory. During the critical two minutes after satellite engine burn-out, the vehicle passes beyond range of the existing radar. Surveys have indicated the desirability of locating an additional station on the southern tip of Baja, California. This possibility is being actively explored.

Modification of two tracking and recovery vessels essentially complete.

Modifications to two VC-2 vessels for use in tracking and recovery operations were completed during the latter part of June with the exception of installation and testing of certain direction finding equipment. Both ships departed for San Francisco on June 28, 1959, and were scheduled to arrive at Pearl Harbor on July 3, 1959. They will be under operational control of the Commander, Pacific Missile Range. While these ships are designated for tracking and recovery operations for several satellite projects, their initial use will be associated with the DISCOVERER Program.

CAPSULE RECOVERY TRAINING

Operationally-ready recovery forces continuing training programs.

The recovery forces, although operationally-ready, are being given full-scale training exercises involving location and recovery of capsules dropped by parachute from B-47 aircraft. Progressive improvement has been demonstrated in both air and sea recovery training missions. About 90 percent of air pickup attempts were successful this quarter, as compared with less than 50 percent during the first month of training.

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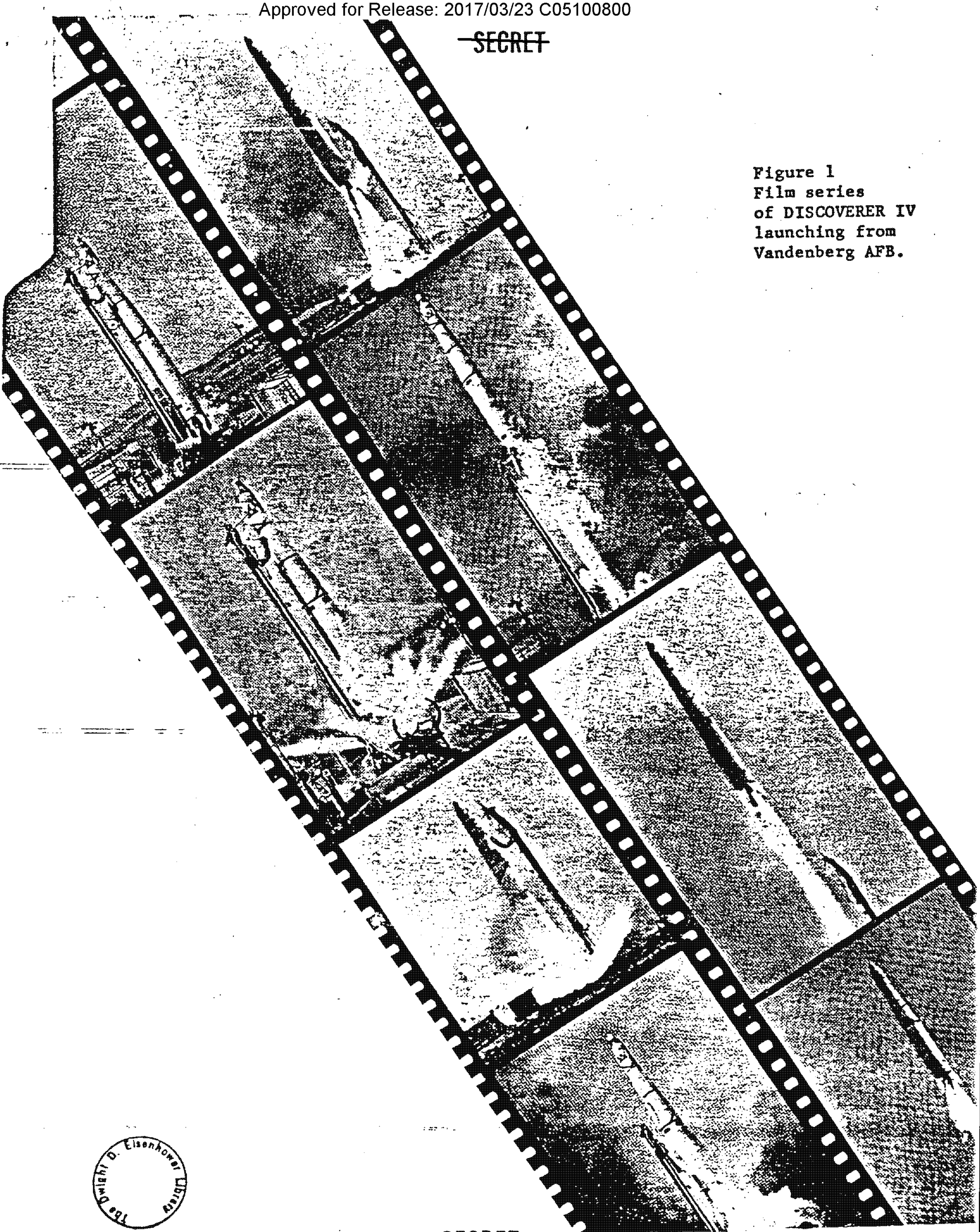
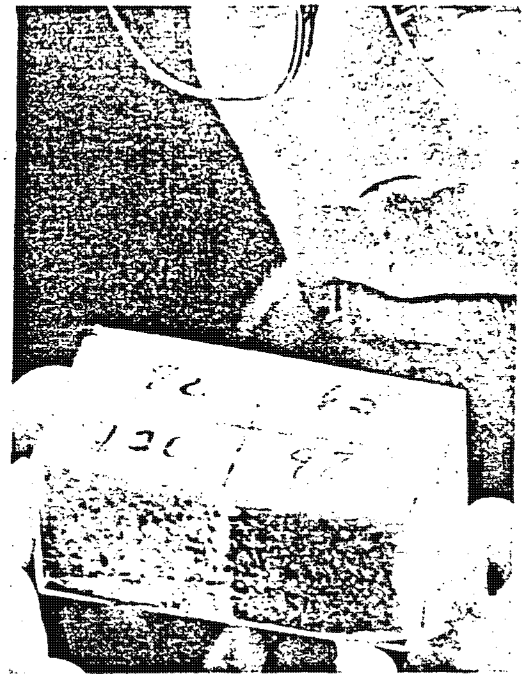


Figure 1
Film series
of DISCOVERER IV
launching from
Vandenberg AFB.

SECRET

BIOMEDICAL PACKAGE

Veterinary Surgeons implanting viability transmitter electrodes into subject.



Examination of food pack prior to installation in viability capsule. Numbers identify wave lengths assigned to different subjects.

Installation of electrical connections between life cell and chassis.

Life cell placed in altitude chamber prior to test.

FIGURE 2

entire section

SAMOS PROJECT

(FORMERLY SENTRY)

INTRODUCTION

Project Renamed

This project was formerly known as the WS-117L or SENTRY Program prior to the establishment of DISCOVERER and MIDAS as separate projects. It was recently named SAMOS to remove the earlier all-inclusive connotation associated with the SENTRY title.

SAMOS to provide both Visual (Photographic) and Ferret (Electronic) data.

The objective of the SAMOS project is the development of a reconnaissance system utilizing polar orbiting satellites to collect and process visual or photographic data and ferret or electromagnetic data. Specifically, the SAMOS system is expected to acquire a great amount of technical intelligence, resulting in a more precise knowledge and evaluation of enemy military and industrial strength and their deployment. The data obtained should enable the United States to do a better target analysis job and to detect and identify unknown targets. Information obtained will provide evidence of build-up and consequently relatively long-lead warning of attack.

Ground acquisition of data by capsule recovery and by readout.

Two approaches are being developed for acquisition of intelligence data: (1) the recovery system in which a data capsule is ejected from the satellite upon command and physically recovered, and (2) the electronic data readout system in which all data is transmitted upon command to ground stations. The recovery system is used for photography and the data readout system for both photography and ferret. The recovery system will be used when rapid time response is not necessary, thus permitting collection of data over a large geographic area at a rate which would exceed the limits of a readout link capability. The photographic readout system will be used for surveillance of specific targets when time response is an important factor.

Flight Program

The program initially included 22 launchings. Current program reviews of payloads planned may reduce this to 18 launchings. The first launching is scheduled for April, 1960.

SAMOS PAYLOADS

GENERAL

Initial flights to have both visual and ferret capabilities.

A dual payload, consisting of components of both visual and ferret systems, will be used on the initial development flights to test equipment. When in orbit, both the visual and ferret equipment will be checked out for satisfactory operation, prior to jettisoning of the ferret payload. The visual payload will then be permitted to operate without interference and will have a useful life of 10 to 15 days, depending upon the power supply used. Later satellites will carry only the visual or the ferret payload.

Visual payload to utilize wideband data link.

A wideband data link will be used for the visual payload ground-space communications. This link includes a payload camera, using strip film which is automatically developed while in orbit. On ground station command, readout of the developed negative is accomplished by electronic scanning (in the satellite) and conversion of the image to a video signal for transmission to a ground station over the wide-band link. The video signal is then converted into modulated lines and displayed on a kinescope. The kinescope lines are photographed by a 35 mm continuous-strip camera which records the images as a series of positive frames.

Recovery Payload

Bids for development of recovery payloads have been received and are being evaluated. The design objective for the recovery camera is to

SECRET

obtain resolution sufficient to identify objects on the ground as small as five feet on a side.

VISUAL

Flights of first visual payloads (E-1) to be used for component testing.

Photo payloads, employing the readout technique, to be used in the initial vehicles, have been designated "E-1" and include some components of a more advanced design payload, designated "E-2." The E-1 payload will test in orbit the film storage transport unit, experiemental control devices, command control system and the E-2 payload processor and readout system.

E-1 dummy payload complete; ground equipment progress is substantial.

The E-1 dummy payload is available and will be used to provide mechanical fit and electrical harness compatibility with the satellite vehicle. Fabrication and assembly of the E-1 ground handling equipment is complete.

Assembly of E-1 package is underway.

The first flyable visual reconnaissance (E-1) package, now being assembled, contains component refinements, particularly in readout, instrumentation and control.

E-2 payload goal is to achieve 20-foot ground resolution.

The design objective of the E-2 version is to achieve ground resolution of 20 feet. This payload will be controllable to permit photographing of ground objects 150 miles on either side of the flight path and 17 degrees fore or aft along the flight path. Control for a given mission will be entered into a vehicle programmer by ground station command.

E-2 payload in advanced design stage; some fabrication started.

All detail and assembly drawings for the E-2 payload camera are finished. Hardware packaging of the optical system for the 36-inch focal-length lens was accomplished and collimator testing indicates performance exceeds design specifications. (See Figure 3)

FERRET

Ferret payload provides for three progressively more sophisticated versions.

The reoriented ferret reconnaissance program provides for the development of three payloads attaining progressively advanced design consistent with maintenance of program scheduling. These payloads are designated F-1, F-2, and F-3 and will be used to intercept electronic emissions, measure and store the signal parameters, and transmit the data to ground receiving stations on command.

Ferret payload work proceeding on schedule.

All ferret payload work is proceeding on schedule. The second article of the F-1 prototype vehicle equipment was checked out completely. Qualification testing of the F-1 payload will be conducted in July. Two antenna assemblies have been completed for the F-2 payload. Assembly drawings for the F-2 payload data handling unit and ground data handling equipment have been released for fabrication.

FACILITIES AND SITES

TRACKING

Program requires extensive ground data handling network.

The SAMOS Program requires an extensive ground data handling network, including several tracking and acquisition stations and a central data processing and control facility to be located at Sunnyvale, California. Tracking stations are planned for the eastern, western, and central regions of the United States. In addition, use will be made of DISCOVERER facilities as applicable.

Control equipment being developed for tracking stations.

A study of the requirements for data obtained and required by tracking stations has resulted in the start of development of the Programmable Integrated Control Equipment (PICE) system. This equipment, installed at tracking stations, will accept and store all incoming data and make portions of the data available instantaneously. Specifications for this equipment are complete.

Construction of control center nearing completion.

Construction of the first increment of the Develppment Control Center at LMSD, Sunnyvale, California, will be completed in December 1959. Design of the second increment is scheduled for completion in July. Construction of the Data Acquisition Building is on schedule at Vandenberg Air Force Base with completion of various facilities scheduled on an incremental basis from October to December, 1959. This facility will be used to provide the readout function until the three operational stations are complete.

LAUNCH

Launch pad to be completed in September.

Construction of the SAMOS launch pad at Point Arguello, California, will be completed in September 1959.

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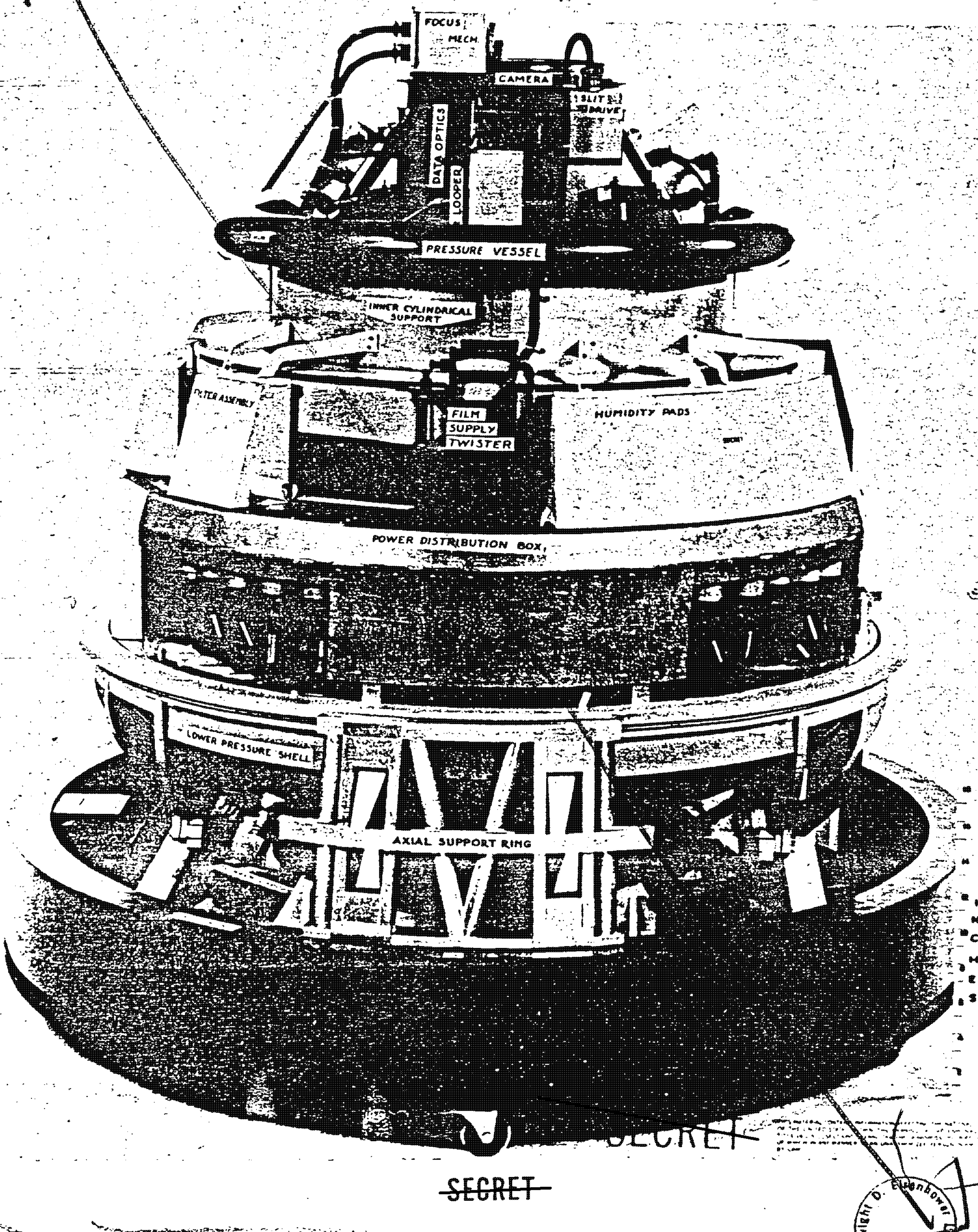
Figure 3 - Mockup of SAMOS (E-2) Visual Reconnaissance Package.



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MIDAS PROJECT

(VERY EARLY WARNING SATELLITE)

ENTIRE SECTION

INTRODUCTION

MIDAS will provide early warning of Ballistic Missile attack.

Phase I, and a more advanced Phase II series of flights expected to follow it, are aimed toward establishing a reliable operational satellite-borne missile-alarm capability in the 1962 time period. The MIDAS (Missile Defense Alarm Satellite) Project, when operational, will place a series of satellites around the earth in polar orbits. These will carry payloads consisting of infra-red detection scanners capable of keeping watch over large areas of the upper atmosphere. Infra-red emanations from ballistic missiles being launched will be detected as the missiles rise above the atmosphere, and the alarm so given will be transmitted instantaneously to far north readout stations on the ground. Warning will then be relayed directly to the Zone of Interior intelligence and operations centers, providing maximum alert time for retaliatory forces.

FLIGHT SCHEDULE

First flight scheduled for January 1960.

The MIDAS Phase I program involves four ATLAS boosted, low-latitude, low-altitude (300 to 700 mile) flights from the Atlantic Missile Range (AMR). Hardware will be available in time to meet the originally scheduled November 1959 flight date. However, limited launching facilities to accommodate both MERCURY and MIDAS at AMR, together with delays encountered in the ATLAS D program, indicate that January 1960 is the earliest date for the first MIDAS launch.

MIDAS COMPONENT STATUS

GENERAL

First MIDAS satellite shipped to Modification Center.

All aspects of the MIDAS satellite vehicle remain on schedule. The first MIDAS satellite was shipped from Sunnyvale to the Modification and Checkout Center at Palo Alto on June 25.

PROPULSION

Development of restart engine initiated.

A simulated altitude testing program with a modified Bell XLR81-Ba-5 rocket engine was successfully completed in April 1959. (See AGENA modification, under Project TRIBE.) Authorization was then given to proceed with the design and development of a restart engine. This capability must be provided to meet the high altitude orbital requirement of the MIDAS system.

INFRA-RED SCANNERS

The first flyable infra-red undergoing test.

The first flyable infra-red scanner for use in the first Phase I flight, shown in Figure 4, was delivered early in June. The unit is undergoing tests at Lockheed prior to being installed in the satellite. A test to check for possible pick-up of S-band beacon signal by the scanner unit was successfully completed.

TRACKING AND READOUT FACILITIES

PHASE I FLIGHT

Facilities for Phase I include AMR, Palo Alto, PMR and Hawaii.

Initial Phase I flights will use the following facilities:

1. Atlantic Missile Range - Launch and readout of data from satellite in orbit.

2. AMR Down-Range Stations - Tracking during ascent and through orbit injection; readout of exit telemetry data.

3. Development Control Center (Palo Alto/Sunnyvale) - Operations control; ground presentation in real time and analysis of infra-red data.

4. Vandenberg Air Force Base - Tracking; ground presentation of infra-red data in real time, satellite interim timer command, infra-red scanner command.

5. Kaena Point, Hawaii - Tracking; infra-red data readout, satellite interim timer command, infra-red scanner command.

Targets, launched from AMR, White Sands Proving Ground, Point Mugu and Vandenberg Air Force Base, will be observed by the orbiting satellites.

ADDITIONAL READOUT SITES

Churchill and Frobisher, Canada, being considered for Northeast Atlantic readout sites.

Churchill and Frobisher, Canada, are being studied as possible sites for a readout station between those in the North Pacific and the United Kingdom.

Donnelly Flats, Alaska, selected as North Pacific readout site.

Donnelly Flats, Alaska, was selected as the site of the North Pacific readout station. Design of this facility has been completed and construction will be started during July with an expected occupancy date of June 1960.

United Kingdom site selection initiated.

Site selection for the East Atlantic station has been initiated, and it is anticipated that siting teams will visit potential areas in the United Kingdom during July.

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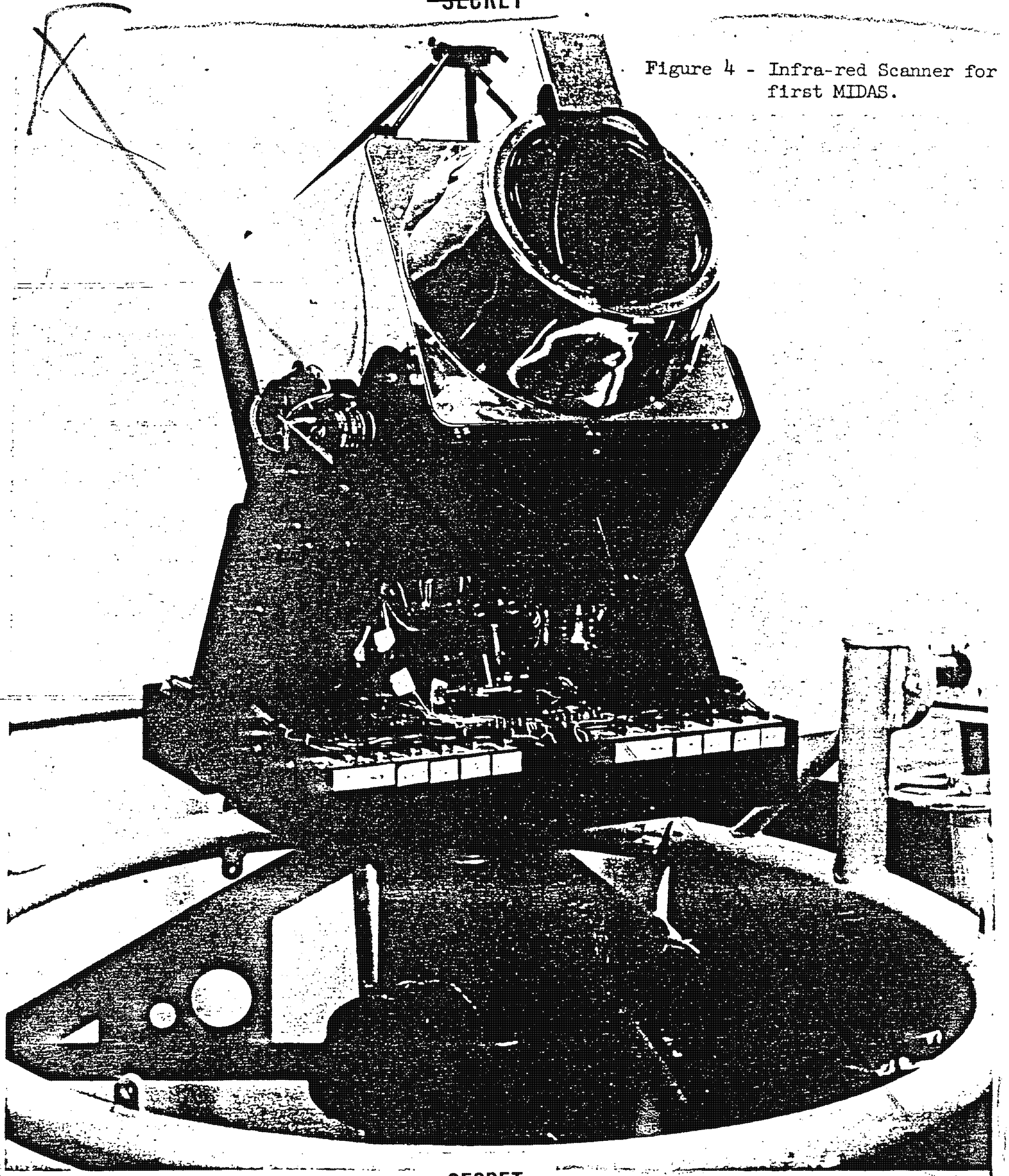
Figure 4 - Infra-red Scanner for first MIDAS.



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PROJECT TIROS

(METEOROLOGICAL SATELLITE)

TIROS Project transferred to NASA April 13, 1959.

Project TIROS, the meteorological satellite program, was transferred to NASA early in the report period; therefore, no specific progress can be included in this report.

Department of Defense participation will continue on a limited basis.

Because of the potential military application of information to be obtained from this program, however, Department of Defense participation will continue. This participation will be manifest in two different ways: (1) membership on a joint Department of Defense - NASA advisory group; and (2) continuation of work initiated in September 1959 regarding data reduction, processing and analysis. Techniques for full military utilization and dissemination of weather data received from satellites will be developed under this program.

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PROJECT TRANSIT

(NAVIGATION SATELLITE)

INTRODUCTION

Objectives

Objectives of the Navigation Satellite Project (TRANSIT) are: to provide a highly accurate global all weather means of fixing precisely (to .2 nautical mile) the position of surface craft, submarines and aircraft, and for providing mid-course and terminal guidance for long-range missiles, as well as providing a more accurate means of maritime and aerial navigation than is now available in polar areas. A schematic of the TRANSIT satellite system in operation is shown in Figure 5.

Assignment of responsibility: Bureau of Ordnance for satellite; USAF for launching.

Responsibility for the navigation satellite payload has been assigned to the Bureau of Ordnance, Department of the Navy. The responsibility for placing this satellite into orbit has been assigned to the Ballistic Missile Division, Air Force.

NAVIGATION SATELLITE FLIGHTS

First launch in September.

The first navigation satellite is now scheduled to be launched in mid-September at Cape Canaveral. Launching will be by a THOR-Delta vehicle. Additional launchings are planned in Fiscal Year 1960 and Fiscal Year 1961 to more fully develop and utilize the satellite navigation techniques.

Objectives of first navigation satellite.

Objectives of TRANSIT I are: to determine and to correct for refractive errors of signals passing through the ionsphere, to initiate geodetic measurements and analysis, to demonstrate navigation purposes, feasibility of Doppler techniques for precision, and to perform an infra-red scanner experiment in support of the MIDAS project.

SATELLITE DESIGN AND FABRICATION

Development and design work completed.

Development and design of the antenna, transmitters, telemetering, power supplies and structure has been completed during the report period. Construction of the payload for TRANSIT I is completed and final testing is under way. A cutaway of the TRANSIT I satellite may be seen in Figure 6.

TESTING

Launching vehicle enroute to Cape Canaveral.

The launching vehicle, the launch trajectory, the technical test objectives and the operation plan are enroute to the Test Director at Cape Canaveral. The test organization has completed their initial inspection for compatability at the Cape.

Vacuum chamber in service.

A test chamber capable of simulating the vacuum, solar radiation, and temperature extremes of outer space has been constructed and is being employed for vigorous testing of the complete satellite. A complete satellite has successfully met the launch acceleration requirements in the giant centrifuge of the Naval Weapons Plant.

Vibration testing in progress.

The electronics equipment and structures were tested under the conditions of vibration expected during launching. The satellite now meets all the environmental requirements which have been specified by the agencies concerned. Stabilization of the third stage of the launching vehicle is accomplished by spinning the rocket and satellite. This spinning, if not stopped after the satellite goes into orbit, would adversely affect interpretation of the satellite signals. A mechanism for "de-spin" of the satellite has been tested successfully.

MATHEMATICAL AND MACHINE COMPUTATIONS

New satellite computing process developed.

The analytical and machine computation effort has resulted in development of a satellite tracking computational process which is economical in machine computational requirements. A mathematical process has been developed for tracking refractive index of the ionosphere as it affects the signal. Computational procedures have been prepared for the navigation experiments and geodetic determinations to be performed on the signals from the satellite.

SECRET

FACILITIES AND SITES

Fixed ground stations established.

Fixed ground stations for precise tracking of the satellite have been established at the University of Texas, Austin, at the New Mexico State University, Los Cruces, and at the Applied Physics Laboratory, Howard County, Maryland.

Mobile stations nearing completion.

Two mobile stations are nearing completion. Arrangements are being made to operate one at the University of Washington in Seattle and the other at the U. S. Naval Station at Argentia, Newfoundland. Checkout of these stations and of the three fixed stations as a combined system should be accomplished by September 1, 1959. The Air Force Cambridge Research Center will furnish optical tracking information for purposes of comparison with the radio range techniques being developed.

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Project TRANSIT

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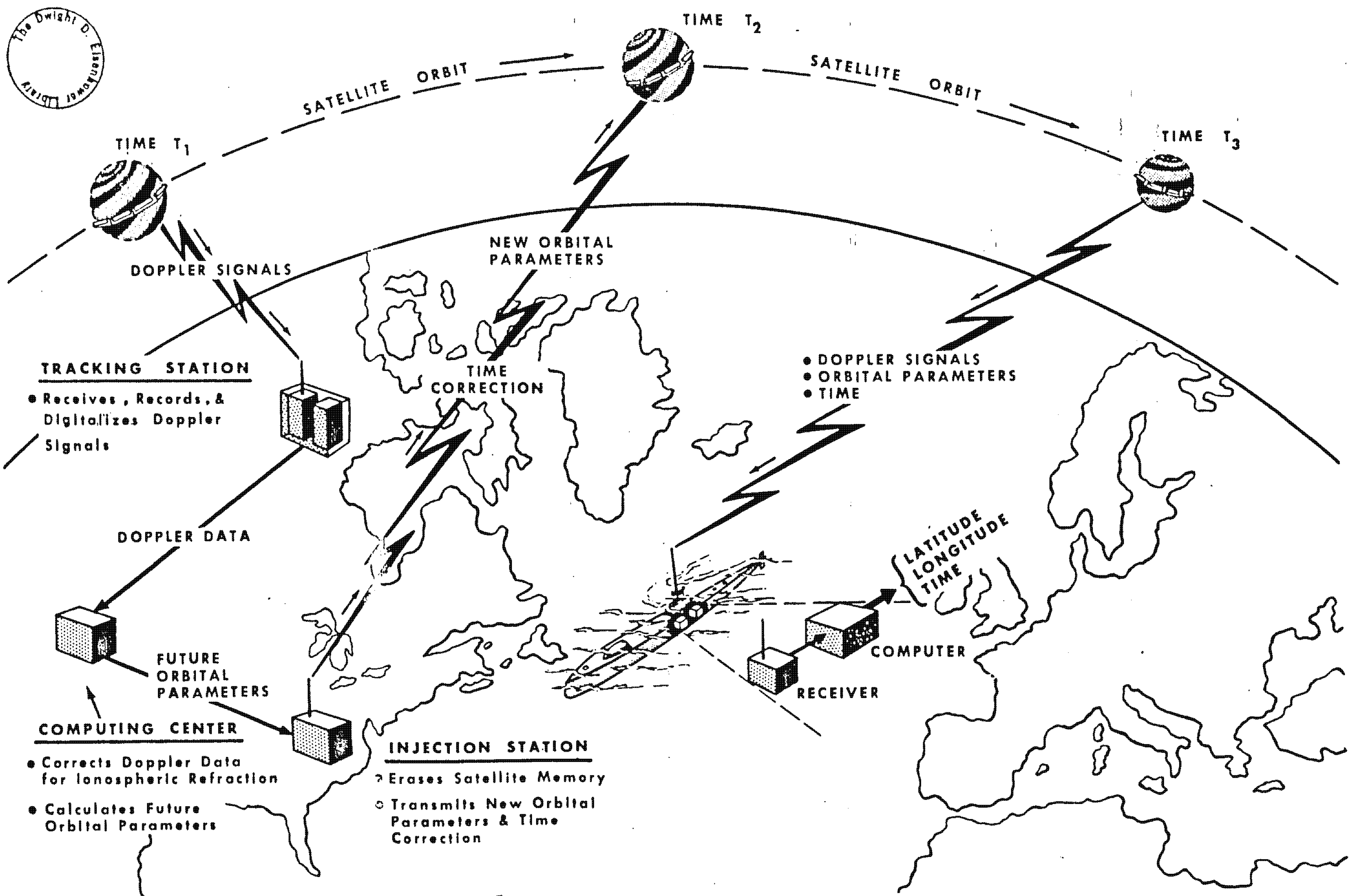

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FIGURE 5. **SCHEMATIC SYSTEM OPERATION**

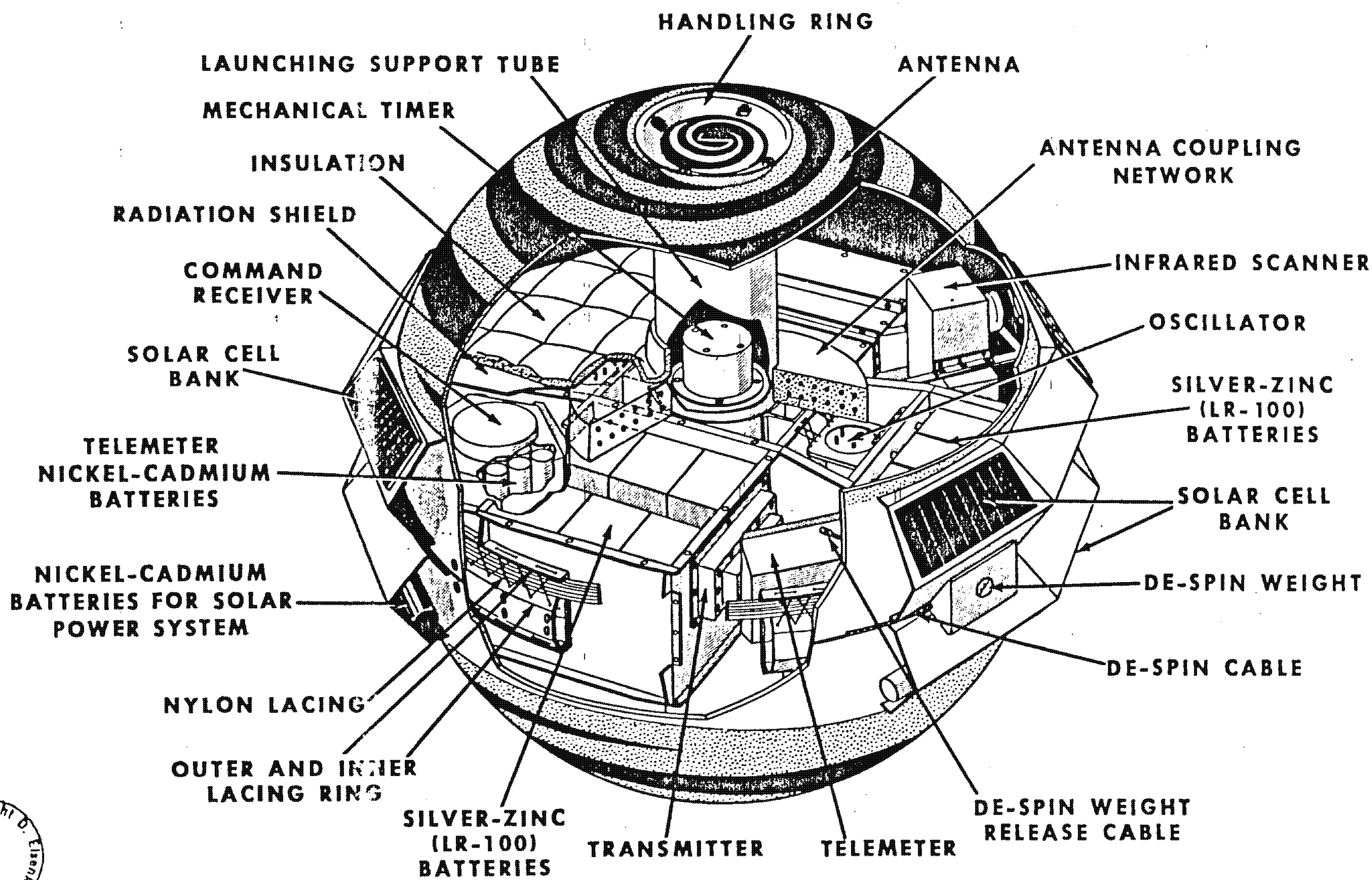
JUL 1959

Project TRANSIT

~~CONFIDENTIAL~~

Diameter—36 inches
Weight—270 pounds
Launching Vehicle—Thor-Able

Orbit—400 nautical miles (circular)
Inclination—50 degrees



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NAV I SATELLITE CUTAWAY VIEW

APL 1096
Rev Jul 1959

PROJECT NOTUS

(COMMUNICATION SATELLITES)

INTRODUCTION

Satellites to be used for receiving and retransmitting messages.

The objective of the Communication Satellite Project (NOTUS) is the development of a communication system utilizing satellites to provide long range radio communication links. The satellite communication system is expected to relieve the load on the presently overcrowded trunking facilities and to improve reliability of global communication. A series of communication satellites, properly spaced in orbit, could carry both the military logistics and the administrative communication traffic load.

DELAYED REPEATER

COURIER - Delayed Repeater Satellite.

The initial phase of the project is the development of a prototype of an operational delayed repeater satellite (designated COURIER) receiving messages over one point on the globe and retransmitting them over another. This concept was successfully tested under project SCORE in December 1958.

Initial flight schedule.

The initial launch of a COURIER dalayed repeater satellite is scheduled at the AMR in February 1960 using a THOR booster and an AJ 10-104 upper stage. Later firings will substitute ATLAS for THOR.

Assignment of responsibility.

The Army Signal Corps has been assigned responsibility for the development of the COURIER payload. Required booster development is under the cognizance of the Ballistic Missile Division, Air Force.

INSTANTANEOUS REPEATER

The second major division of the project, the instantaneous repeater satellite, is divided into three phases:

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STEER - Strategic Polar Communications Satellite.

(1) Initially, the design, development and fabrication of four (4) instantaneous communications satellites into polar orbit to obtain two-way communications, via the satellite, between ground stations in the United States and SAC aircraft flying in the polar regions is planned. These firings are scheduled for late 1960. This sub-project has been assigned the code name STEER.

TACKLE - Advanced Polar Communications Satellite.

(2) Secondly, the development and launching of four (4) advanced polar communications satellites to test satellite station-keeping capabilities, refined attitude control and microwave communication components as a preliminary to the global communications satellite program is proposed. These firings are scheduled for the last half of 1961 and early 1962. The code name TACKLE has been assigned this sub-project.

DECREE - Global Communications Satellite for Instantaneous Message Relay.

(3) Finally, the development and launching of seven (7) satellites into 24-hour equatorial orbit to obtain broad-band, point-to-point communication and, additionally, ground-to-aircraft communication is contemplated. These launches will commence in the early part of 1962 and continue for approximately one year. The code name of this sub-project is DECREE.

Assignment of responsibilities.

The Ballistic Missile Division, Air Force, has been assigned the over-all technical management responsibility for the project. General responsibility for the communications equipment has been assigned to the Army Signal Corps. However, Wright Air Development Center will develop the communications sub-system for STEER and the aircraft communications for TACKLE and DECREE. ARPA will provide policy and technical guidance and retain approval authority for certain scheduling decisions.

SATELLITE PACKAGE DEVELOPMENT

Contract awarded for the COURIER satellite package.

A contract was awarded on June 25, 1959 for four experimental, four preliminary development and four final development models of the COURIER communications satellite. Deliveries are scheduled to begin in December 1959 and continue to December 1961.

FACILITIES AND SITES

COURIER PROJECT

Contracts awarded for COURIER ground complex and for ground antennas.

A contract was awarded June 30, 1959 for development, fabrication and installation of three development model ground stations to be delivered in February 1960, one to each of the sites in Puerto Rico, Hawaii and Spain. One development model satellite checkout facility will be built and delivered to Cape Canaveral at the same time.

A contract was awarded on June 11, 1959 for development, fabrication and installation of the ground based tracking antenna system. Three development models will be delivered, one to each of the sites at Hawaii, Puerto Rico and Spain by February 1960.

PROJECT SHEPHERD

(TRACKING NETWORK)

INTRODUCTION

Objective

The objective of Project SHEPHERD is the establishment of an effective satellite detection fence to detect, identify and predict orbits of non-radiating objects in space. To accomplish this objective a fence has been constructed, consisting of integrated MINITRACK and DOPLOC satellite tracking systems. Additionally, Project SHEPHERD calls for the development of a world-wide tracking network in cooperation with NASA.

MINITRACK system modified and expanded.

In June 1958, ARPA directed the Naval Research Laboratory to modify and extend the original IGY MINITRACK system for its new role of tracking non-radiating satellites.

DOPLOC to complement MINITRACK Detection System.

To complement the MINITRACK System, as an interim measure, the Ballistic Research Laboratory was requested in June 1958 to proceed with the establishment of a doppler system complex, known as DOPLOC. The combined MINITRACK-DOPLOC fence consisting of an eastern, central and western complex became operational in February 1959. Each complex employs one transmitter and two receiver stations. A teletype network connecting the Naval Research Laboratory at Dahlgren, Virginia, with the MINITRACK stations has been established and is in operation.

Teletype communication to computing center.

Similarly, under the DOPLOC system, teletype communication and data transmission facilities will be used. Doppler frequency data is currently transmitted over a teletype circuit to the Ballistic Research Laboratories Computing Center at Aberdeen Proving Ground, Maryland. Data from the other three channels are stored in digital form on magnetic tape and are later transmitted to the computing center in sequence.

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Data integration.

The communication circuits will tie all stations together and to the MINITRACK communications network. Data transmission circuits will link the two receiving stations with the computing center at Ballistic Research Laboratories. Provisions will be made for transmitting computer orbital data to a National Space Surveillance Center when completed.

NSSCC to integrate data compilation from detection system.

In December 1958 the Air Research and Development Command was assigned the responsibility for the development of a permanent National Space Surveillance Control Center to receive, compile, and catalogue the orbital data gathered on these inter-related systems. The design parameters for this station are to be delivered by July 1, 1960.

World-wide tracking system to be cooperatively developed with NASA.

In cooperation with NASA initial steps have been taken toward the development of a world-wide tracking system involving the construction of two Department of Defense facilities, one in Spain and one in Japan or the Philippines. Responsibility for planning, constructing, and equipping these stations was assigned to the Army Signal Corps in January 1959.

CURRENT STATUS

Tracking of DISCOVERER II and VANGUARD I.

In April the first pass of DISCOVERER II coming within the antenna beam pattern, revolution 15, was successfully tracked by the DOPLOC system. MINITRACK detected DISCOVERER II each time it passed within the range of the stations during the period of its life. On May 15 the first observation of VANGUARD I was made at the Fort Stewart station at the predicted height of 450 statute miles. Completed installation of automatic lock-on equipment at the DOPLOC receiving stations in June permitted detection of signals from both satellite and meteors which were previously not detectable because they were below audible detection limits.

FACILITIES AND SITES

Space surveillance

The MINITRACK Space Surveillance Operations Center at Dahlgren, Virginia, began functioning on a 24-hour continuous operating basis on June 2, 1959. Structural steel is being erected for the Space Track Building at the Air Force Cambridge Research Center, which will provide the nucleus for the Interim National Space Surveillance Center. Effort has also been extended to assure operational installation of an IBM 709 computer for the Space Track Building by the beneficial occupancy date in September 1959.

Work initiated on world-wide tracking stations.

A letter contract to provide the necessary equipment for the two world-wide tracking stations has been signed and work has begun. However, no definitized contract has been successfully negotiated within funding limitations.

PROJECT LONGSIGHT

(FEASIBILITY STUDIES AND EXPLORATORY RESEARCH)

Objective -- The objective of the program is to find and remedy serious short and long-term gaps in study and research relating to foreseen military needs in space technology.

Areas of work include power supply, propulsion, materials and electronics. -- The scope of the current program is defined by the technical areas selected for attention and by the dollars committed to these. The five areas comprising the current program are as follows:

1. Space Power Supply Research.
2. Space Propulsion Research.
3. Research on Materials, Structures and Phenomena in and for Space Environment.
4. Space Electronics, Guidance and Control.
5. Space Systems Studies.

65 Contracts under way. -- The current program consists of a total of 65 individual research projects now assigned in a broad range of subjects, such as ion engines, plasma electronics, thermionic conversion, investigation of friction of moving parts in a space environment, super conductivity, and etc. Most of these are of one-year duration and, depending on results, may be continued for another year or more. Since projects in these areas have been under way only a relatively short time, specific results are not yet available.

PROJECT TRIBE

(VEHICLE DEVELOPMENT AND MODIFICATION)

PROJECT SATURN - CLUSTERED ENGINE

INTRODUCTION

SATURN to fill early need for orbiting large payloads.

The SATURN project evolved as the earliest possible solution to the urgent need for keeping pace with requirements to boost large payloads into orbit. On August 15, 1958, ARPA approved an Army Ordnance Missile Command proposal for providing a space vehicle booster capable of generating approximately one and one-half million pounds thrust.

Booster contains eight Rocketdyne H-1 Engines.

The SATURN booster consists of three main sections; the tail section, the container section, and the upper stage adaption section. The container section is made up of one JUPITER-type tank (105 inches diameter) for LOX and eight REDSTONE-type tanks (70 inches diameter), four for LOX and four for fuel, surrounding it. The tail section contains eight Rocketdyne H-1 engines (four mounted in an inner circle and four mounted in an outer circle).

TITAN approach, second stage, CENTAUR as third stage.

The SATURN second stage will be constructed from components of the TITAN first stage, modified as necessary for SATURN application. The CENTAUR was selected for adaptation as a SATURN third stage.

Project assignment for SATURN test and launch facilities.

On December 11, 1958, ARPA requested that AOMC: (a) accomplish the design, construction, and modification of the ABMA captive test tower and associated facilities required in SATURN booster development; and (b) determine design criteria for SATURN launch facilities to be located at the Atlantic Missile Range.

CURRENT STATUS

VEHICLE GUIDANCE AND CONTROL

JUPITER-type control system adopted.

The control system adopted for the initial SATURN vehicles is similar to the JUPITER system. This similarity includes use of a modified ST-90 stabilized platform converted digital computer output, a repackaged control computer and hydraulic control actuators.

First control computer available by mid-September.

Design of the SATURN control computer, which issues swivel actuator commands to all four control engines, is progressing satisfactorily. The first unit will be available for laboratory tests by September 15, 1959.

Effect of engine failure being studied.

The effect of failure of one of the eight engines of the SATURN booster on the required trim angles for the remaining control engines and on eventual requirements for alternate tilt programs and guidance programs is being studied.

STRUCTURES

Full scale mock-up of SATURN tail section completed.

Fabrication of a full scale mockup of a SATURN booster tail section has been completed. (See Figure 7) This mockup is used for accessibility investigation and determination of optimum layout for the power plant areas.

Major structural drawings for SATURN static test vehicle released.

All major structural drawings for the SATURN test vehicle were released during the report period. The second stage adapter design for mounting the TITAN-type second stage is being considered; however, no final decision can be made until the second-stage vehicle ignition time and characteristics have been determined.

PROPULSION

Two SATURN H-1 engines being hot fired at ABMA.

The first H-1 production engine was delivered to ABMA on schedule April 28, 1959. (See Figure 8) The second was delivered on June 8,

1959. These production engines are being hot fired at ABMA to calibrate the engine system in a flight configuration.

Optimum propellant loading for SATURN stages being studied.

A study was initiated to determine the optimum propellant loading for the different stages of SATURN based on the maximum payload capability for two basic missions, the 24-hour orbit and the 96-minute orbit.

TEST PROGRAM

Test schedule

The current SATURN test schedule provides for one dynamic captive test demonstration at ABMA in December 1959 and four flight test vehicles (SA-1, SA-2, SA-3 and SA-4).

First H-1 engine successfully static tested at ABMA.

The first 25-second firing on H-1 engine, H-1001, was successfully completed on May 26, 1959. All test objectives were accomplished. This engine was checked out, installed at ABMA Power Plant Test Stand, and instrumented within three weeks after receipt from Rocketdyne. Five tests have been successfully made on engine H-1001 for a total duration of 562 seconds, mainstage. All tests ran the intended duration without malfunction.

First tests on H-1002.

Two tests were successfully completed on the second H-1 engine for a total duration of 180 seconds of mainstage operation. Two additional engines were successfully tested at Rocketdyne during this period.

BOOSTER RECOVERY PROGRAM

Recovery scheme for flight test boosters being detailed.

Concurrently with SATURN booster design, the scheme for booster recovery is being detailed. Parachutes will be deployed after re-entry to retard the booster velocity. Retro rockets will decrease the final touchdown velocity to a minimum of near zero.

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FACILITIES AND SITES

CAPTIVE TEST FACILITIES

Captive test tower modifications on schedule.

Modification of the Captive Test Tower at ABMA for the SATURN program continued on schedule. (See Figure 9)

Fabrication and assembly of the SATURN master facility panel in the ABMA blockhouse is on schedule.

LAUNCH FACILITIES

Launch complex at AMR initiated.

Construction of the SATURN blockhouse at AMR was initiated on June 3, 1959.

CENTAUR - HIGH ENERGY UPPER STAGE

INTRODUCTION

Objectives

The CENTAUR is a liquid-hydrogen oxygen upper stage vehicle which will initially be used with the ATLAS booster to provide a vehicle with the capability of placing approximately 1,500 pounds in a 24-hour orbit. Specific objectives of this program, as initiated and developed by ARPA, are placing in orbit the 24-hour equatorial orbit communications satellites (Project DECREE) and for use as the third stage of the SATURN vehicle.

Assignment of responsibility.

Responsibility for the CENTAUR project was assigned to the Air Force in August 1958.

Delivery schedule.

The first two CENTAUR boosters are scheduled for delivery in May 1960. Additionally, fourteen engines are scheduled for delivery by October 1960.

CURRENT STATUS

FABRICATION AND ASSEMBLY

Flight weight thrust chambers fired.

All phases of the CENTAUR program are progressing satisfactorily. During the report period flight weight thrust chambers were fired to design chamber pressure. Ignition and combustion were smooth; however, subsequent inspections disclosed a number of ruptured tubes. Investigations are under way to determine the cause.

Assembly of first complete engine nearing completion.

Assembly of the first Pratt Whitney engine is nearing completion and the first-run date is scheduled for July 1959.

FACILITIES

Static test stand location undetermined.

A decision on location of a static test stand for CENTAUR Project is expected in July. NASA has officially requested permission to locate the stand at Sycamore Canyon, California.

PROJECT TRANSFER

Project to be transferred to NASA on July 1, 1959.

In accordance with arrangement made early this year, management of the CENTAUR Project will be transferred from the Department of Defense to the National Aeronautics and Space Administration effective July 1, 1959.

UPPER STAGE MODIFICATION

Development of AJ 10-104.

The AJ 10-104 is essentially a modification and simplification of the VANGUARD second stage with tank capacity for approximately twice as much propellant. Design has been completed and the vehicle partially fabricated. The AJ 10-104 stage is planned as the upper stage for use with a THOR booster to place in orbit the first early research and development versions of the communication relay satellite (COURIER) and the navigation satellite (TRANSIT).

Modification of the AGENA vehicle.

AGENA (the Lockheed second stage, powered with a Bell engine, formerly called the Hustler stage) is being modified to provide greatly improved high altitude capability for a number of military satellite missions. Design objectives include dual burn, airframe and guidance simplification, and increase of tankage. One of the early missions of the AGENA dual burn booster is to provide the upper stage for placing the navigation satellite payload in a polar orbit. It was recently agreed that the optimum tank size for use in the AGENA vehicles should be twice the development size.

LARGE THRUST TEST STAND

Preliminary plans essentially complete.

Work has been initiated on a large thrust test stand at Edwards Air Force Base and progress is on schedule. This stand is to be used in support of the NASA program for development of a single chamber 1.5 million pound thrust engine. At the close of the quarter preliminary plans are essentially complete. The contract for excavation work is scheduled to be let in July 1959.

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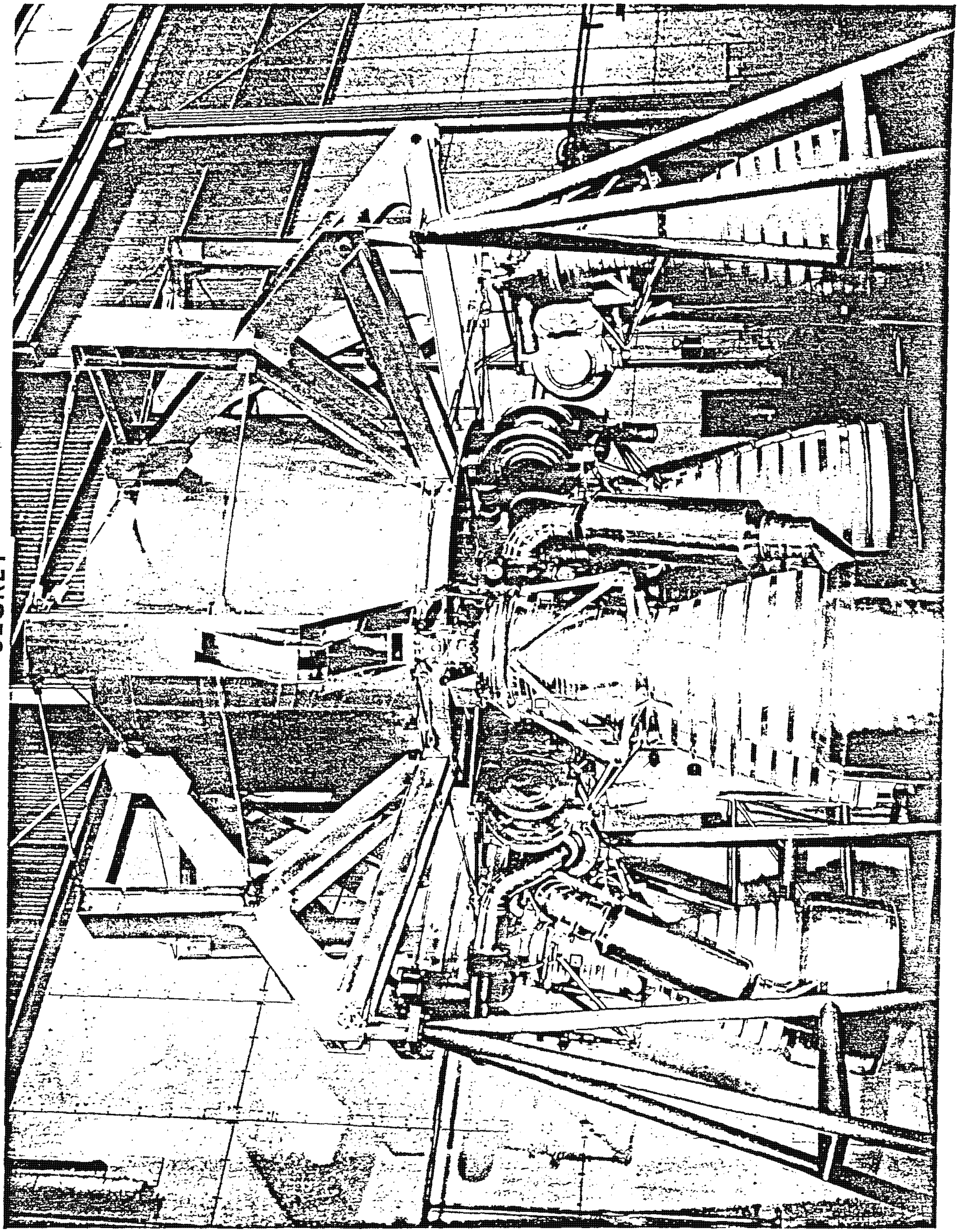

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FIG. 7 FULL-SCALE MOCKUP OF SATURN TAIL AREA

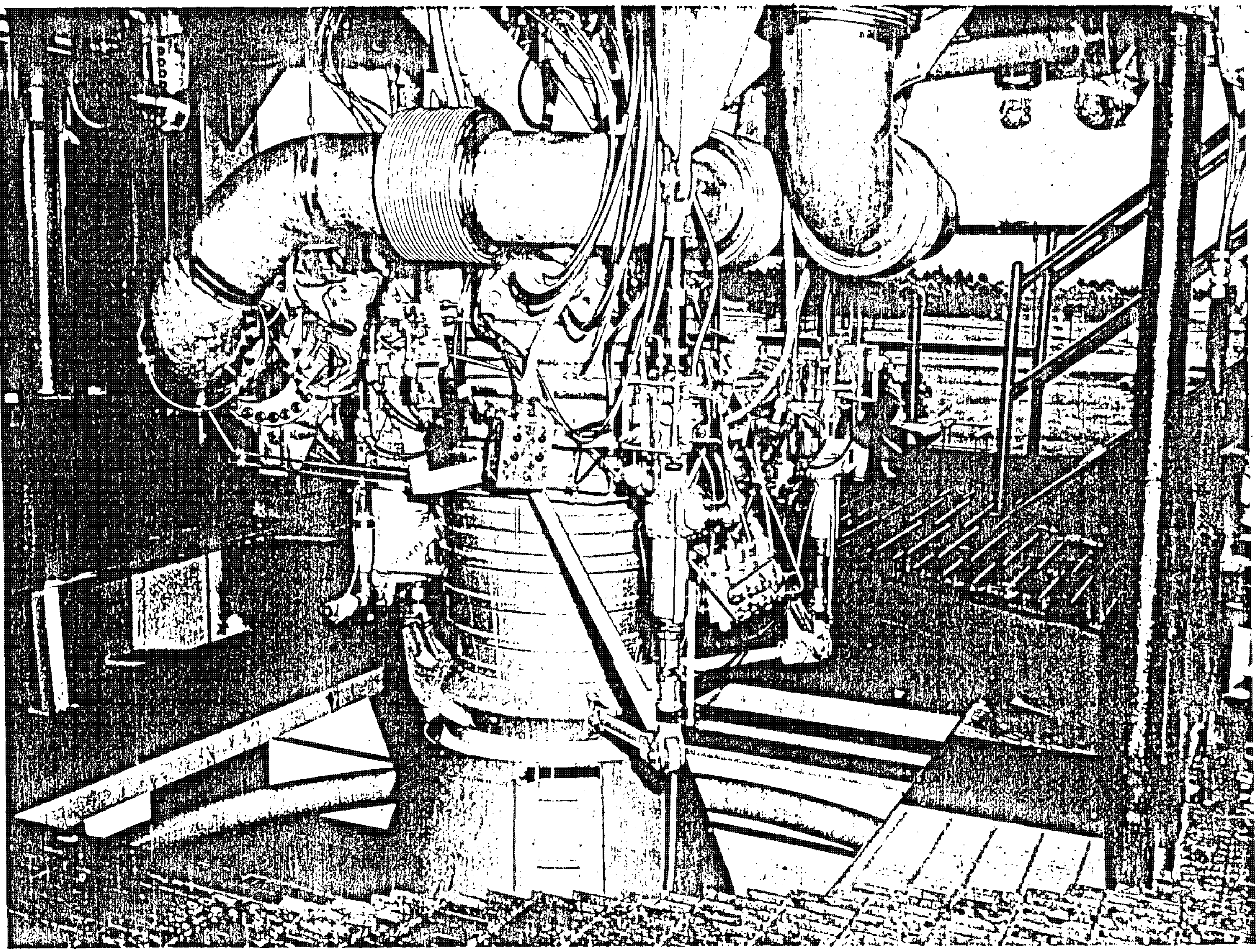

FIG. 8 SINGLE H-1 (H-1001) ENGINE ON ABMA POWER PLANT TEST STAND PRIOR TO ONE OF FIVE SUCCESSFUL STATIC FIRINGS.

Approved for Release: 2017/03/23 C05100800

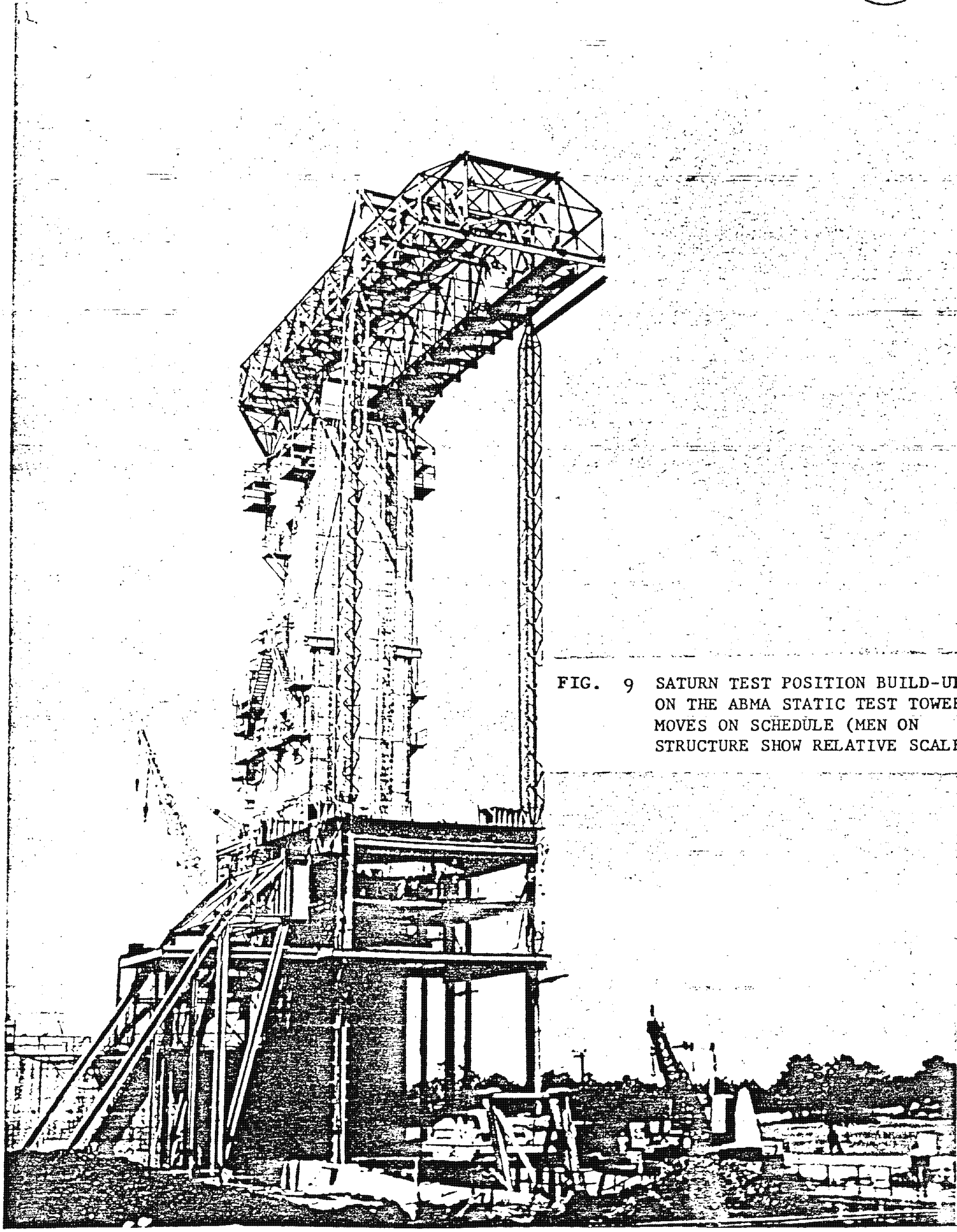

FIG. 9 SATURN TEST POSITION BUILD-UP ON THE ABMA STATIC TEST TOWER MOVES ON SCHEDULE (MEN ON STRUCTURE SHOW RELATIVE SCALE)

STATUS OF FUNDS

(In Millions)

Project	Programmed FY 1959 & Prior Years Projects	FY 1959 Commitments (ARPA Orders Issued) June 30, 1959	FY 1959 Obligations As Of May 31, 1959	FY 1959 Expenditure As Of May 31, 195
DISCOVERER	$ 136.5 1/	$ 136.5	$ 101.8	$ 61.0
SENTRY	105.6 1/	105.6	90.9	65.2
MIDAS	22.8 1/	22.8	13.6	8.2
Meteorological Satellite	12.8	12.8	7.4	5.0
Navigation Satellite	10.7	10.7	3.0	.4
Communications Satellite	16.7	16.7	2.2	1.0
Tracking	31.9	27.6	22.0	7.6
Feasibility Studies	11.5	10.5	11.3	6.7
Vehicle Development and Modification				
Clustered Engine	34.0	34.0	19.8	6.5
CENTAUR	21.5	21.5	15.8	6.5
Upper Stage Modification	2.6	2.6	.5	.1
Large Thrust Test Stand	.7	.7	.2	—
TOTAL	$ 491.4 1/	$ 402.0	$ 288.5	$ 168.2

1/ $84.1 programmed during Fiscal Year 1958 and prior years for WS 117L Program. DISCOVERER, SENTRY and MIDAS projects are an outgrowth of WS 117L.

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DOD SATELLITE LAUNCH SCHEDULE

FY 1960 FY 1961 FY 1962

Program	Vehicle	Launch Site	1959 Quarters				1960 Quarters				1961 Quarters			
			1	2	3	4	1	2	3	4	1	2	3	4
1. DISCOVERER	Thor-Agena	PMR	2	3	4	5	4	5	4	2				
2. Reconnaissance (SAMOS)	Atlas-Agena	PMR						2	2	2	2	2	1	2
3. Communications (NOTUS)														
a. Delayed Repeater (COURIER)	Thor-Agena	AMR						1	1		1	1		
b. SAC Polar (STEER)	Atlas-Agena	PMR							1	1	2			
c. Adv. Polar (TACKLE)	Atlas-Agena	PMR											1	2
4. Navigation (TRANSIT)														
Transit I	Thor-Delta 1/	AMR			1		1							
Transit II	Thor-104	AMR						1	1					
Transit III	—	PMR											2/	
Transit IV	—	PMR											2/	
5. Early Warning (MIDAS)														
Phase I	Atlas-Agena	AMR					2		1	1				
Phase II	Atlas-Agena	PMR									1	1		
6. SATURN	SATURN	AMR				3/				1 4/			1 4/	

1/ Launch scheduled first quarter 1960 will use Thor-104.
2/ Payloads planned to be launched with some other programmed payload.
3/ Static test firing at ABMA.
4/ Launch of vehicle with dummy upper stage but without payload.

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MILITARY SPACE PROJECTS

FLIGHT DATA

DISCOVERER FLIGHTS

DISCOVERER II (170-1018)

Date Launched: April 13, 1959
Booster: THOR #170, IRBM
Gross Weight: 114, 566 lbs.
Payload Weight: 145 lbs.
Mean Altitude: 313 Statute Miles
Payload: Mark I biomedical recovery capsule
Subsystems: Airframe, Propulsion, Auxiliary Power, Guidance and Biomedical.

Second Stage: DISCOVERER Vehicle
On-Orbit Weight: 1, 634 lbs.
Propulsion: XLR81-Be-5 Engine
Fuel: Unsymmetrical Di-Methyl Hydrazine/Inhibited Red Fuming Nitric Acid.
Flight Characteristics: Ballistic trajectory to orbit.

DISCOVERER III (174-1020)

Date Launched: June 3, 1959
Booster: THOR #174, IRBM
Gross Weight: 114, 388 lbs.
Payload Weight: 195 lbs.
Mean Altitude: 311 Statute Miles
Payload: Mark I biomedical recovery capsule.
Subsystems: Airframe, Propulsion, Auxiliary Power, Guidance and Biomedical.

Second Stage: DISCOVERER Vehicle
On-Orbit Weight: 1, 634 lbs.
Propulsion: XLR81-Be-5 Engine
Fuel: Unsymmetrical, Di-Methyl Hydrazine/Inhibited Red Fuming Nitric Acid.
Flight Characteristics: Ballistic trajectory to orbit.

DISCOVERER IV (179-1023)

Date Launched: June 25, 1959
Booster: THOR #179, IRBM
Gross Weight: 114, 292 lbs.
Payload Weight: 195 lbs.
Mean Altitude: 162 Statute Miles
Payload: Mark I biomedical recovery capsule.
Subsystems: Airframe, Propulsion, Auxiliary Power, Guidance and Biomedical.

Second Stage: DISCOVERER Vehicle
On-Orbit Weight: 1, 797 lbs.
Propulsion: XLR81-Be-5 Engine
Fuel: Unsymmetrical Di-Methyl Hydrazine/Inhibited Red Fuming Nitric Acid.
Flight Characteristics: Ballistic trajectory to orbit.