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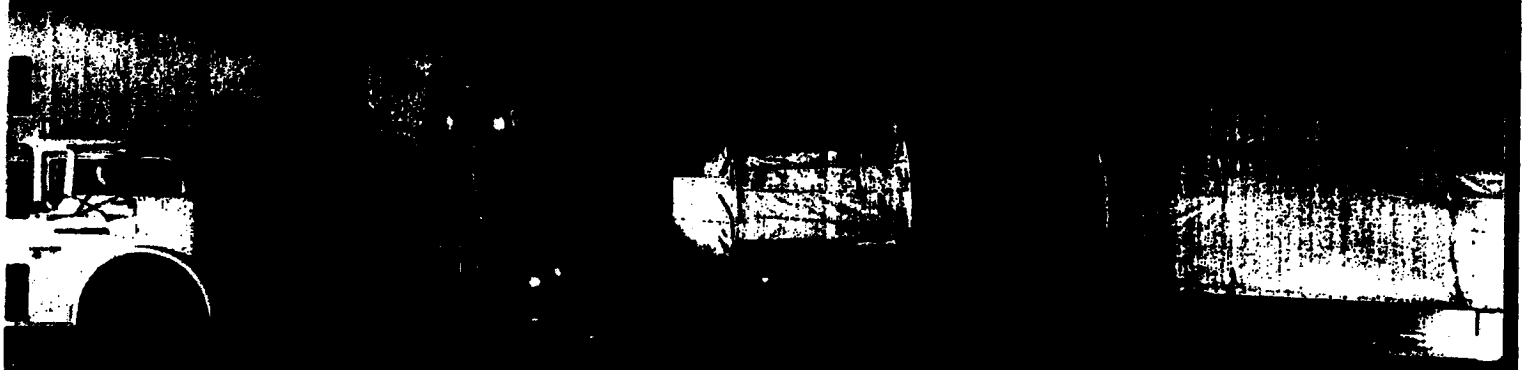
MILITARY SATELLITE PROGRAM PROGRESS REPORT

FOR QUARTER ENDING 31 MAY 1961
RCS DD-DR&E(Q) 397



Prepared By Headquarters, Space Systems Division
Air Force Systems Command
UNITED STATES AIR FORCE
Air Force Unit Post Office • Los Angeles 45, California

WDLPR-4-292

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HEADQUARTERS
SPACE SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
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WDLPR-4

12 JUNE 1961

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FOREWORD

During this quarter, two DISCOVERER satellites were launched. One of these attained orbit. Because of satellite stability problems and a vehicle command problem, the capsule was ejected upward rather than downward on a recovery trajectory. Eight DISCOVERER vehicles are scheduled for launch during the next quarter. Several of these vehicles will carry additional modules for further space exploration. During this quarter, the XLR-81Ba-9 engine reliability program was successfully completed. Also during this quarter, the launch equipment at two DISCOVERER launch pads was modernized and one pad was converted from a THOR/IRBM stand to a DM-21/AGENA "B" stand. A maximum effort in the MIDAS Program has readied the second stage vehicle, payload and ground tracking network for the scheduled 20 June launch.

The Military Satellite Program Progress Report has been determined to be a Group 3 document in accordance with paragraph 6, AFR 205-2. This categorization applies to all previous issues. Holders of these documents are responsible for acting promptly to place the correct notation on the document in accordance wih this regulation.

for Kenneth A. Berg Colonel, USAF

O. J. RITLAND
Major General, USAF
Commander

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Discoverer

The DISCOVERER Program consists of the design, development and flight testing of two-stage vehicles, using the Douglas DM-21 Space Booster as the first stage booster and the AGENA as the second stage, satellite vehicle. The program was established early in 1958 under direction of the Advanced Research Projects Agency, with technical management assigned to AFBMD. On 14 November 1959, program responsibility was transferred from ARPA to the Air Force by the Secretary of Defense. Prime contractor for the program is Lockheed Missile and Space Division. The DISCOVERER Program will perform space research in support of the advanced military reconnaissance satellite programs.

PROGRAM OBJECTIVES

(a) Flight test of the satellite vehicle airframe, propulsion, guidance and control systems, auxiliary power supply, and telemetry, tracking and command equipment.

(b) Attaining satellite stabilization in orbit.

(c) Obtaining satellite internal thermal environment data.

(d) Testing of techniques for recovery of a capsule ejected from the orbiting satellite.

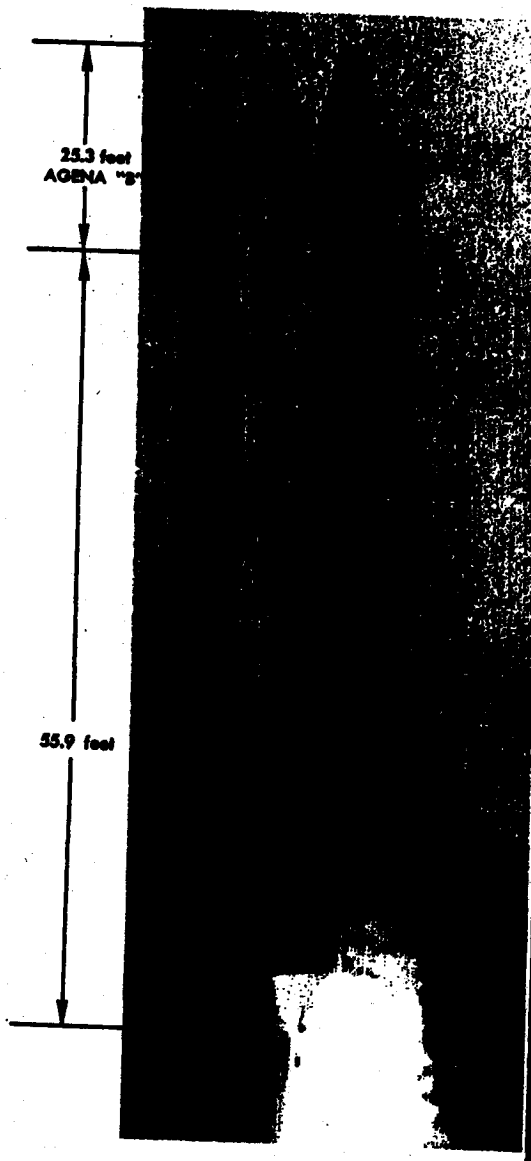
(e) Testing of ground support equipment and development of personnel proficiency.

(f) Conducting bio-medical experiments with mice and small primates, including injection into orbit, re-entry and recovery.

PROGRAM SUMMARY

Early launches confirmed vehicle flight and satellite orbit capabilities, developed system reliability, and established ground support, tracking and data acquisition requirements. Later in the program, biomedical and advanced engineering payloads will be flight tested to obtain support data for more advanced space systems programs. DISCOVERER vehicles are launched from Vandenberg Air Force Base, with orbital operational control exercised by the Satellite Test Center, Sunnyvale, California.

Tracking and command functions are performed by the stations listed in the Table on Page A-4. A history of DISCOVERER flights to date is given on pages A-5 and A-6.



SECOND STAGE	AGENA "B"
Weight—	
Inert	1,346
Payload equipment	915
Orbital	2,261
Impulse propellants	12,950
Other	511
TOTAL WEIGHT	15,722
Engine Model	XLR81-Ba-9
Thrust-lbs., vac.	16,000
Spec. Imp.-sec., vac.	290
Burn time-sec.	240
BOOSTER	DM-21
Weight—Dry	6,500
Fuel	33,700
Oxidizer (LOX)	68,200
GROSS WEIGHT (lbs.)	108,400
Engine	MB-3 Block 2
Thrust, lbs. (S.L.)	169,000
Spec. Imp., sec. (S.L.)	248.3
Burn Time, sec.	148

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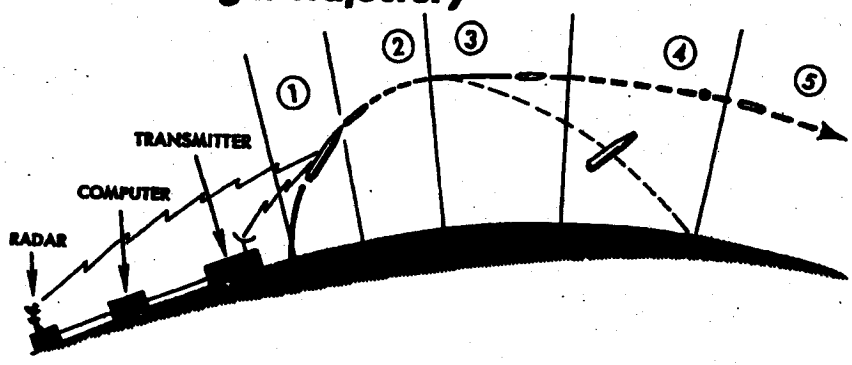
Powered Flight Trajectory



1. **First Stage Powered Flight** — 2.5 minutes duration, 78 n.m. downrange, guided by programmed autopilot.
2. **Coast Period** — 2.4 minutes duration, to 380 n.m. downrange, attitude controlled by inertial reference package, horizon scanner, gas reaction jets. Receives AGENA time to fire and velocity to be gained commands thru the STL system.
3. **Second Stage Powered Flight** — Approximately four minutes or until injection velocity is attained. Pitch and yaw stabilization achieved by gimballing the engine and roll by gas reaction jets. Engine shutdown achieved by integrator accelerometer cutoff command.
4. **Vehicle Reorients to Nose Aft** — 2 minutes duration. Guided and attitude controlled by inertial reference package, horizon scanner and gas reaction jets.
5. **In Orbit** — Controlled (same as 4).

Telemetry ships are positioned as required by the specific mission of each flight. Illustrations on the opposite page show a typical launch trajectory from Vandenberg Air Force Base and a typical orbit. An additional objective of this program is the development of a controlled re-entry and recovery capability for the payload capsule. The recovery operation is also shown on the opposite page. An impact area has been established near the Hawaiian Islands and a recovery force activated. Techniques have been developed for aerial recovery by C-119 and JC-130 aircraft and for sea recovery by Navy surface vessels. The recovery phase of the program has provided advances in re-entry technology. This information will be used in support of more advanced projects, including the return of a manned satellite from orbit.

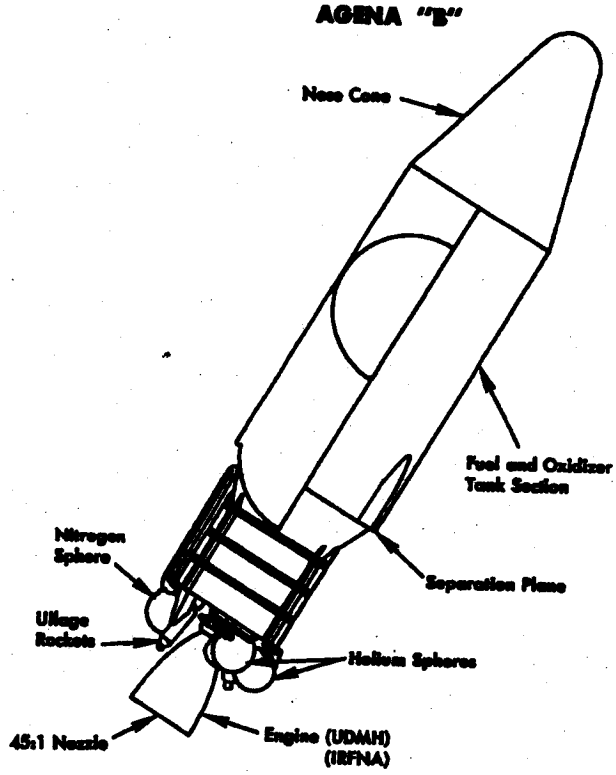
note

AGENA VEHICLE DEVELOPMENT

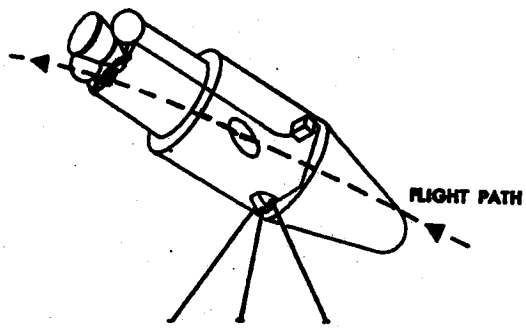
The AGENA vehicle was originally designed as a basic satellite vehicle for Military Space Programs.

The first AGENA "B" used the Bell XLR-81Ba-7 engine and was first flown on DISCOVERER XVI. The latest AGENA "B" vehicles use the 16,000 pound thrust XLR-81Ba-9 engine which has a restart capability. This larger vehicle permits achieving higher injection altitudes with equivalent weight payloads and the restart provision permits orbital adjustment.

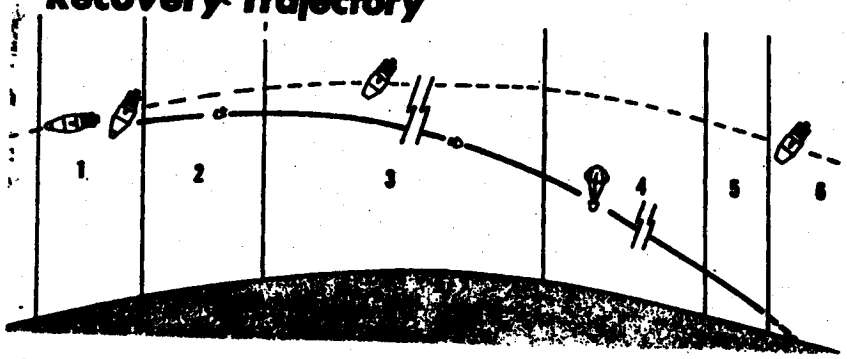
AGENA "B"



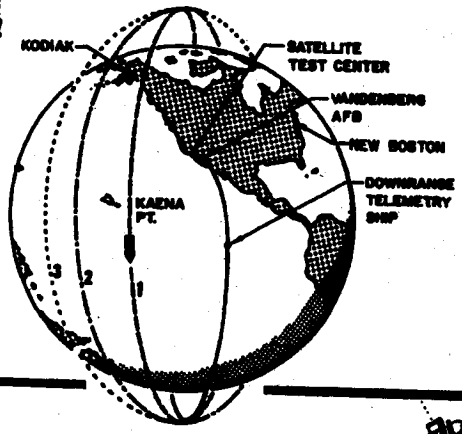
DISCOVERER/AGENA



Recovery Trajectory



1. **Vehicle Reorients to Separation Attitude**—83.5 seconds duration, 2,000 nautical miles north of impact point. Pitch reorientation starts and vehicle assumes separation attitude.
2. **Capsule Separation**—14 seconds duration, capsule separates, spin rockets fire, retro rocket fires and de-spin rockets fire. Retro rocket and thrust cone separate from re-entry capsule.
3. **Re-entry**—8 minutes duration, recovery capsule re-enters the earth's atmosphere. Parachute cover is ejected and ablation shell separated from capsule.
4. **Descent to Recovery Altitude**—18 minutes duration. Reefed parachute is deployed and chaff (to aid in radar tracking) is ejected. Capsule descends from 55,000 feet to 14,000 feet.
5. **Air Recovery**—6 minutes duration, capsule descends from 14,000 feet to 1,500 feet during which time air recovery is attempted.
6. **Sea Recovery**—Capsule impacts in the sea, surface forces attempt recovery.

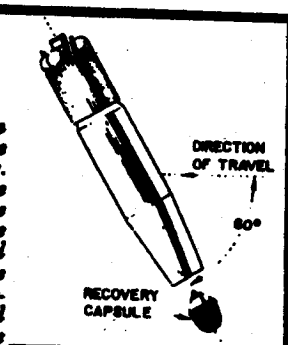


Orbital Trajectory

Schematic presentation of orbital trajectory following launch from Vandenberg Air Force Base. Functions performed by each station and a listing of equipment used by each station, is given on page 4.

RECOVERY CAPABILITY

This objective was added to the program after the first launch achieved vehicle flight and orbit objectives successfully. It includes the orientation of the satellite vehicle to permit a recoverable capsule to be ejected from the nose section of the AGENA vehicle. Ejection is programmed to occur on a selected orbit, for capsule impact within the predetermined recovery area near Hawaii. Aircraft and surface vessels are deployed within the area as a recovery force.



CAPSULE RECOVERY SEQUENCE

- *The desired orbit for capsule ejection is selected after the vehicle is on orbit based on satellite performance, longitudinal location of the orbits, recovery force status, and weather in the potential recovery area. A command is sent to the vehicle prior to the selected recovery pass which initiates the recovery sequence. This command may be sent from any of the primary tracking stations listed on page A-4.*

- *The ejection sequence includes a pitch down maneuver, capsule separation, spin-up, retro-rocket firing, de-spin and re-entry. Following parachute deployment the aerial recovery force converges on the descending capsule and snags the parachute. The capsule contains a radio beacon and reflective chaff which is dispersed to aid in tracking.*
- *The recovery force consists of C-119, RC-121, WVII and JC-54 aircraft supplemented by 2 or 3 surface vessels that receive and record telemetry data. If it is necessary to retrieve the capsule from the sea, these ships are available.*

[redacted]

Facility	Equipment*	Flight Function
Satellite Test Center	ABCD	Over-all control, orbit computations and predictions, acquisition data for tracking stations, prediction of recovery area.
†Vandenberg AFB Tracking Station	BDEFGHIJ	Ascent and orbital tracking, telemetry reception, trajectory measurements, command transmission.
Downrange Telemetry Ship	BGIJK	Telemetry reception and tracking during ascent and orbit injection.
†New Hampshire Tracking Station	BDFGHIJ	Orbit tracking, telemetry reception, commands to satellite.
†Kodiak Tracking Station	BDFGHIJ	Orbit tracking, telemetry reception, initial acquisition on pass 1, monitor events in recovery sequence.
†Hawaiian Tracking Station	BDFGHIJ	Orbit tracking, telemetry reception and transmission of commands to satellite.
Hickam AFB Oahu, Hawaii	D	Over-all direction of capsule recovery operations.
Tern Island	BGHJ	Recovery capsule tracking.

†Primary Tracking Stations (have command capability)

*Equipment

A. General Purpose Computer(s) and Support Equipment
B. Data Conversion Equipment
C. Master Timing Equipment
D. Control and Display Equipment
E. BTL Tracking Station (DISCOVERER ascent only)
F. VERLORT
G. VHF FM/FM Telemetry Station
H. VHF Direction Finding Equipment
I. Doppler Equipment
J. VHF Telemetry Antenna
K. APL Doppler Equipment

NOTE: In addition to equipment listed, all stations have inter- and intra-station communications equipment and checkout equipment.

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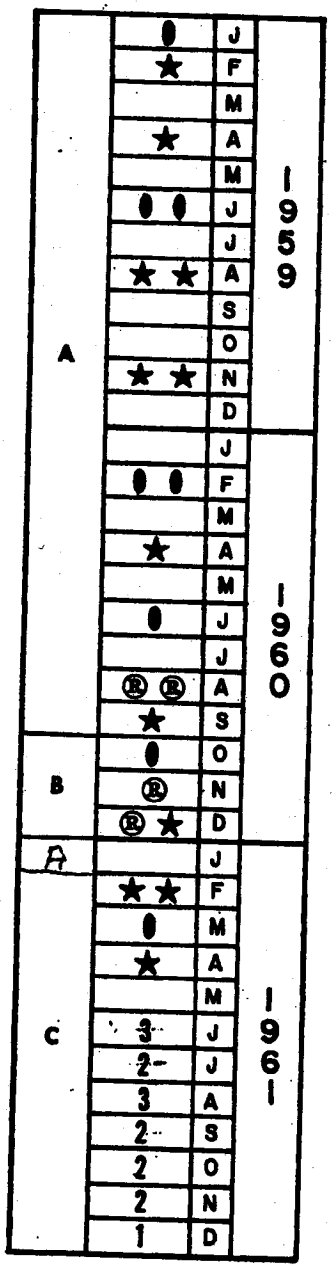
Launch Schedule



Flight History

DISCOVERER No.	DM-21 No.	AGENA No.	Flight Date	Remarks
				DISCOVERER FLIGHTS 0 THRU XX ARE ON PAGE A-6
XXI	261	1102	18 February	*Attained orbit successfully. Non-recoverable, radiometric data gathering MIDAS support flight.*
XXII	300	1105	30 March	*Launch, ascent, separation, coast and orbital stage ignition normal. Orbital velocity was not attained because of an AGENA hydraulic malfunction.*
XXIII	307	1106	8 April	*Attained orbit successfully. Loss of control gas prevented proper positioning of the satellite for capsule re-entry. Capsule was ejected into new orbit on re-entry pass.*

VEHICLE CONFIGURATIONS

A. THOR—DM-18/AGENA "A"

B. THOR—DM-21/AGENA "B"
MB-3 Block 1/XLR81-Ba-7

C. THOR—DM-21/AGENA "B"
MB-3 Block 2/XLR81-Ba-9

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Flight History (continued)

DISCOVERER No.	DM-21 No.	AGENA No.	Flight Date	Remarks
0	160	1019	21 January 1959	*AGENA destroyed by malfunction on pad. THOR refurbished for use on flight XII.*
I	163	1022	28 February	*Attained orbit successfully. Telemetry received for 514 seconds after lift-off.*
II	170	1018	13 April	*Attained orbit successfully. Recovery capsule ejected on 17th orbit was not recovered. All objectives except recovery successfully achieved.*
III	174	1020	3 June	*Launch, ascent, separation, coast and orbital boost successful. Failed to achieve orbit because of low performance of satellite engine.*
IV	179	1023	25 June	*Same as DISCOVERER III.*
V	192	1029	13 August	*All objectives successfully achieved except capsule recovery after ejection on 17th orbit.*
VI	200	1028	19 August	*Same as DISCOVERER V.*
VII	206	1051	7 November	*Attained orbit successfully. Lack of 400-cycle power prevented stabilization on orbit and recovery.*
VIII	212	1050	20 November	*Attained orbit successfully. Malfunction prevented AGENA engine shutdown at desired orbital velocity. Recovery capsule ejected but not recovered.*
IX	218	1052	4 February 1960	*THOR shut down prematurely. Umbilical cord mast did not retract. Quick disconnect failed, causing loss of helium pressure.*
X	223	1054	19 February	*THOR destroyed at T plus 56 sec. by Range Safety Officer. Severe pitch oscillations caused by booster autopilot malfunction.*
XI	234	1055	15 April	*Attained orbit successfully. Recovery capsule ejected on 17th orbit was not recovered. All objectives except recovery successfully achieved.*
XII	160	1053	29 June	*Launch, ascent, separation, coast and orbital stage ignition were successful. Failed to achieve orbit because of AGENA attitude during orbital stage boost.*
XIII	231	1057	10 August	*Attained orbit successfully. Recovery capsule ejected on 17th orbit. Capsule was recovered after a water impact with negligible damage. All objectives except the airborne recovery were successfully achieved.*
XIV	237	1056	18 August	*Attained orbit successfully. Recovery capsule ejected on 17th orbit and was successfully recovered by the airborne force. All objectives successfully achieved.*
XV	246	1058	13 September	*Attained orbit successfully. Ejection and recovery sequence completed. Capsule impact occurred south of the recovery forces; located but lost prior to being retrieved.*
XVI	253	1061	26 October	*Launch and ascent normal. AGENA failed to separate from booster and failed to attain orbit.*
XVII	297	1062	12 November	*Attained orbit successfully. Recovery capsule ejected on 31st orbit and aerial recovery was accomplished. All objectives were successfully achieved.*
XVIII	296	1103	7 December	*Attained orbit successfully. Recovery capsule ejected on 48th orbit and aerial recovery was accomplished. All objectives were successfully achieved.*
XIX	258	1101	20 December	*Attained orbit successfully. Non-recoverable, radiometric data gathering MIDAS support flight.*
XX	298	1104	17 February	*Attained orbit successfully. Capsule did not re-enter due to on-orbit malfunction.*

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A. BRIEF OF PROGRESS

DISCOVERER XXII was launched from Vandenberg Air Force Base on 30 March. The loss of engine control resulted in insufficient velocity to attain orbit. DISCOVERER XXIII launched on 8 April was injected into a near nominal orbit. Because of satellite stability problems and a vehicle command problem the capsule was ejected into a more elliptical orbit. Because of these malfunctions and in the continuing effort to increase reliability the horizon sensor has been modified, the command beacon circuitry has been changed, and electric blankets are being provided for the gas jet control valves. (S)

Eight DISCOVERER vehicles are scheduled for launch during the coming quarter. Additional equipment for measuring the space environment will be carried aboard several of these vehicles. DISCOVERER XXV will carry a Geophysical Research Directorate module in June. (C)

The XLR-81Ba-9 engine reliability test program which was conducted at Bell Aerosystems Company and the Arnold Engineering Development Center was successfully concluded during this quarter. (C)

[redacted]

B. TOPICAL SUMMARY

1. *Flights*

a. DISCOVERER XXII

DISCOVERER XXII launched on 30 March

(1) DISCOVERER XXII was launched from Vandenberg Air Force Base Pad 4, Complex 75-3, at 1234 PST on 30 March. Recovery of the vehicle's capsule was scheduled after four days on orbit. Booster operation was nominal. The 20 cycles per second longitudinal oscillation appeared as on previous flights but on a slightly lower level. AGENA ignition occurred as planned; however, approximately 20 seconds prior to engine shut down a rapid drop in hydraulic pressure caused a loss of engine control. This resulted in a total velocity less than that required to attain orbit. (S)

First use of BTL guidance system

(2) The Bell Telephone Laboratory (BTL) guidance system was used to guide the DM-21 booster for the first time. This system also commands AGENA ignition, vehicle correction and operation. Results indicate excellent BTL guidance performance. (C)

b. DISCOVERER XXIII

(1) DISCOVERER XXIII Flight

DISCOVERER XXIII launched on 8 April

(a) DISCOVERER XXIII was launched from Vandenberg Air Force Base Pad 5, Complex 75-3, at 1121 PST on 8 April. Recovery of the vehicle's capsule was scheduled after four days on orbit. All ascent operation: boost, separation, coast, and orbital boost were accomplished as planned and the DISCOVERER satellite was injected into a near nominal orbit. Table I shows the predicted and attained parameters. The AGENA operation proved the effectiveness of the hydraulic modification resulting from the DISCOVERER XXII malfunction. (S)

	Programmed	Actual
Apogee, statute miles	421.5	404
Perigee, statute miles	190	180
Eccentricity	0.0274	0.0257
Period, minutes	94.40	94.074

TABLE I. COMPARISON OF PROGRAMMED AND ACTUAL ORBITAL PARAMETERS FOR DISCOVERER XXIII

SATELLITE is unstable

(b) Tracking and telemetry data received on the first and second passes showed that the satellite had satisfactorily re-oriented to an engine first attitude and was stable. On the next contact with the vehicle (pass seven) abnormalities in horizon scanner operation were noted. Between pass nine and ten, all control gas was expanded and the satellite became unstable. Although ground stations were able to command the satellite and received usable telemetry data, this resulted in intermittent radar lock-on and cyclical fluctuations in signal strength from satellite RF transmissions. (S)

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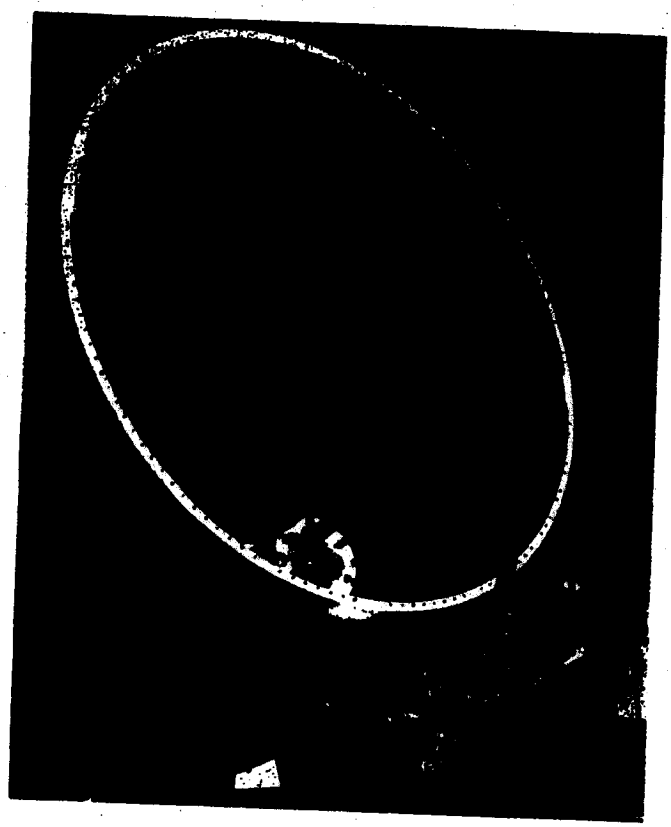

Figure 1. DISCOVERER XXIII (left) during final checkout at Complex 75-3, Pad 3, the morning of 8 April. The satellite's orbit was very close to that planned for the flight. Satellite instability caused the capsule to be ejected into a more elliptical orbit. Bell Telephone Laboratories guidance system components (above). This system is being used to guide the DM-21 booster. The upper container houses the flight controller and the large unit at one o'clock is the inertial reference package. The dark line following the skin contour is the waveguide which connects the flight controller with the antenna.

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Ejection attempted after two days on orbit

(c) The decision was made to attempt recovery of the capsule on pass 32 instead of the nominal pass 63. The New Hampshire Tracking station transmitted the ejection command but the satellite received a spurious command. As a result, the capsule was ejected on pass 31. The capsule retro-sequence operated satisfactorily, but since the satellite was not in the proper attitude at separation, the capsule was ejected into a new orbit. The capsule's orbit has an apogee of 850 nautical miles, a perigee of 120 nautical miles and a period of 101 minutes. (S)

Horizon scanner modified

(2) DISCOVERER XXIII Flight Analysis

(a) As a result of the continuing effort to improve reliability, a modified horizon scanner will be flown on future DISCOVERER satellites. One of the improved units completed 210 hours of bench tests and was then placed in a vacuum chamber to be operated until it fails. (C)

Command beacon circuitry modified

(b) The spurious command problem which resulted in the radar beacon receiving two commands when only one was sent is attributed to the difficulty of commanding an unstable satellite where radar lock cannot be held. The characteristics of the command signal tones and the rotation rate of the radar antenna operating on an unstable satellite can produce the results recorded on DISCOVERER XXIII. Although this explains the command problem, an intensive investigation has resulted in proposed changes to the command beacon circuitry and operating procedures which will minimize this kind of problem. (S)

Blankets provided for gas control valves

(c) Analysis of data indicates that sub-normal temperatures caused erratic operation of the gas jet control valves and resulted in the rapid expenditure of control gas. Temperature pickups located near some of the valves recorded temperatures considerably colder than those recorded on previous DISCOVERER flights. This probably resulted from the screening of the earth and solar radiation by the new flame shield. An analog simulation of the conditions demonstrated that the observed satellite behavior could have been caused by sluggish, sticky operation of the control valves. To prevent a recurrence of this difficulty on subsequent DISCOVERER satellites, control valves will be coated with a heat absorbent material and will be wrapped with thermostatically controlled electric blankets. (S)

c. Scheduled Flights

DISCOVERER XXIV

(1) DISCOVERER XXIV will be launched from Pad 4, Complex 75-3, Vandenberg Air Force Base, early in June. (S)

DISCOVERER XXV

(2) DISCOVERER XXV, which is scheduled for launch in mid-June, will be the first vehicle launched from the newly converted Pad 1, Complex 75-1, at Vandenberg Air Force Base. This pad has been converted from a THOR IRBM launch facility to a DISCOVERER facility. (S)

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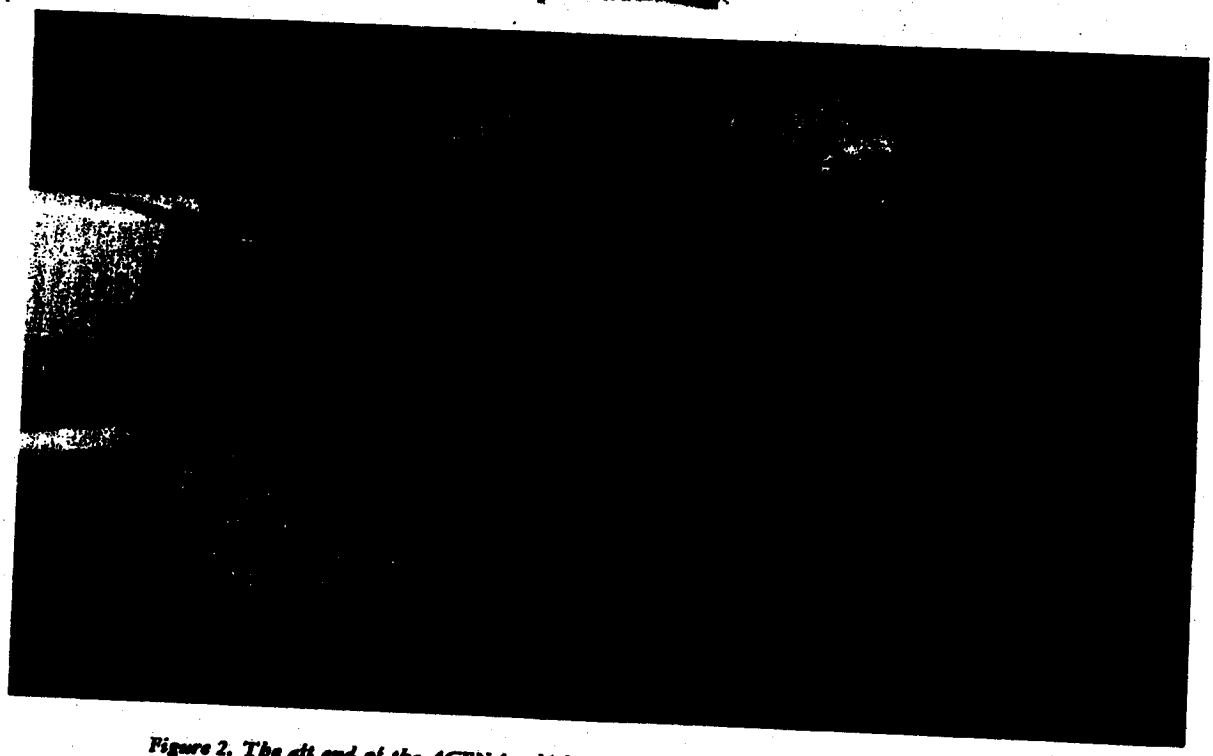

Figure 2. The aft end of the AGENA vehicle showing the heat shield (white cone around the engine nozzle). The pencil-like flame characteristics of a rocket engine in the atmosphere becomes a large ball which envelopes the engine in space.

20 cycle per second oscillation studied

(3) DISCOVERER XXIV and XXV will be instrumented to provide data on the 20 cycle per second longitudinal oscillation which has been apparent immediately prior to booster burnout on several recent DISCOVERER flights. Instrumentation added to these vehicles will provide data indicating the distribution of loads imposed by the oscillation. This data could serve as a basis for strengthening the spacecraft in areas where the loads approach the design limits. (S)

2. *Technical Status*

a. XLR-81Ba-9 Engine Development

Engine delivery stretchout

(1) Production of XLR-81Ba-9 engines at the Bell Aerosystems Company has practically been halted because of a substantial stretch-out in engine delivery requirements by Lockheed Missiles and Space Division. (S)

Engine reliability program completed

(2) All firings of the XLR-81Ba-9 engine reliability test program were completed in April. Forty tests were conducted at Bell Aerosystems Company, ten of which were restart and thirty were full-duration firings. Twenty-five restart firings were made in an Arnold Engineering Development Center altitude chamber. The tests were satisfactory and demonstrated a major component life far in excess of specification requirements. (C)

[redacted]

Space environment equipment to be carried

b. Geophysical Research Directorate (GRD) Experiments

(1) The Geophysical Research Directorate is furnishing equipment for a number of DISCOVERER flights aimed primarily at determining environment in space:

(a) Atmospheric Density: This will include measurements of atmospheric density and determination of the existence of atmospheric waves at altitudes of 100 to 400 miles as a function of latitude, time of day and season. Calculations based on these data will be valuable in determining vehicle drag and lifetime.

(b) Cosmic Radiation: These measurements will be made to assess the radiation hazard to components above 130 miles, in the Van Allen and Auroral regions.

(c) Thermal Radiation: Infrared radiation from the earth and atmosphere, scattered solar radiation will be measured to obtain data for calculating proper vehicle equilibrium temperatures.

(d) Micrometeorites: Rates of penetration of vehicle skin, mass, density and energy of micrometeorites, and skin erosion will be measured to obtain data on thermodynamic effects.

(e) Solar Ultra-Violet Radiation: Solar radiation in the ultra-violet and X-ray regions will be measured to determine aging effects on plastic and organic materials.

(f) Atmospheric Composition: Data on the kinds and states of atmospheric particles, since organic and plastic materials show aging, corroding or chemical effects when exposed to free radicals such as atomic oxygen. Data on ion concentrations are needed.

(g) Magnetic Field: Results from more complete studies of the earth's magnetic field are of interest for possible use in attitude stabilization systems. Magnitude and direction at various altitudes will be determined. Long term variations will also be determined.

DISCOVERER XXV to carry GRD module

(2) The first of the new modules to be used for carrying Geophysical Research Directorate instruments for measuring the space environment is at Vandenberg Air Force Base awaiting launch on DISCOVERER XXV. This module includes a cosmic ray monitor, micrometeorite detector, two atmospheric density gages and associated electronics. The equipment is powered by the satellite vehicle power supply and data is transmitted by the vehicle's telemetry system. (C)

Module to replace engine access door

(3) This is the first of several modules scheduled for flight on DISCOVERER satellites in a program designed to utilize the weight carrying capability available on some flights for space research purposes. The modules replace the engine access door and are designed with universal mounting rails upon which a variety of instruments can be mounted. Nearly all units and wiring are mounted on the modules so that installation and removal can be accomplished with minimum interference to prelaunch operation. (C)

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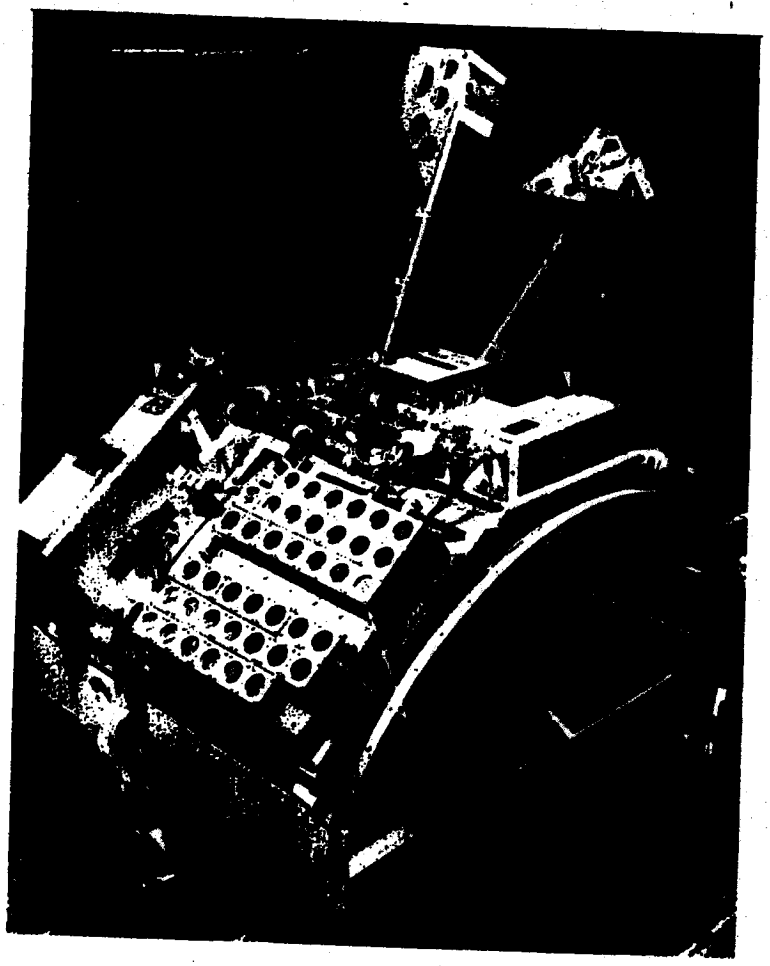
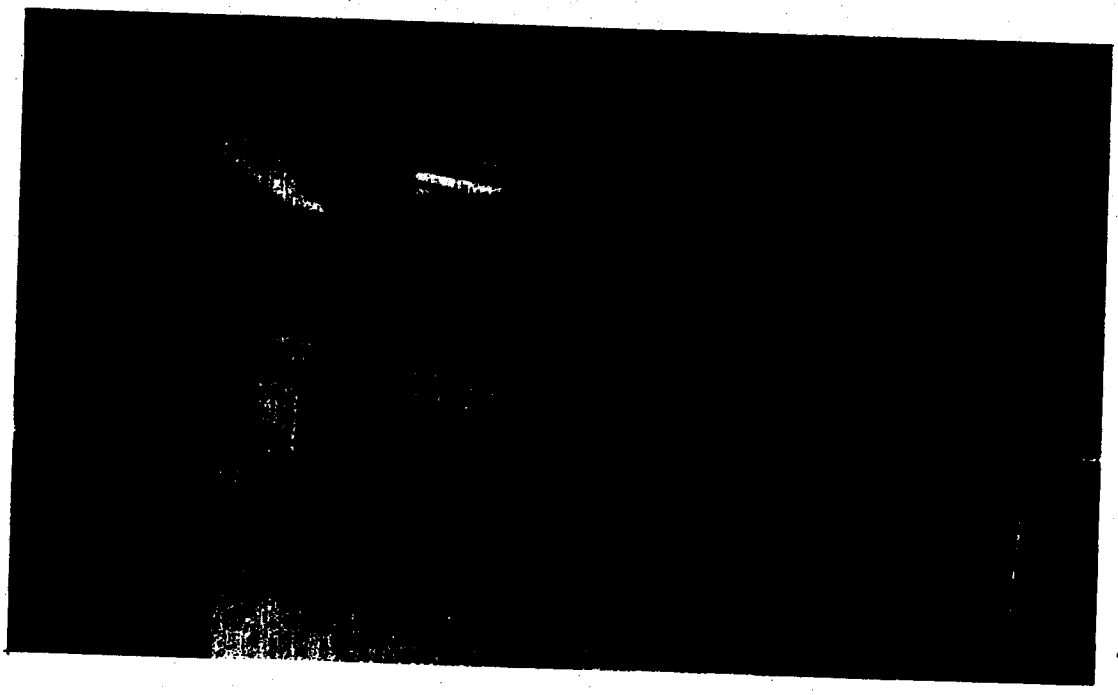


Figure 3. The first Geophysical Research Directorate module (left). This module and its instruments will replace an engine access door on DISCOVERER XXV. The atmospheric density gages, upper right, are held against the module during ascent and will pop-out to the position shown after orbit is attained. Installing the module on the AGENA vehicle (below). The units and wiring are mounted on the module so that installation and removal can be accomplished with minimum interference to prelaunch operations.



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3. *Facilities*

a. Complex 75-1

Pad 1 modified

Pad 1 of Complex 75-1 has been converted from a THOR IRBM to a DISCOVERER launch facility. Modifications completed include extending the missile shelter to accommodate the DM-21/AGENA vehicle, and adding the DISCOVERER fuel transfer, ground support and launch control systems. This new equipment will permit faster, more reliable launch operations. (C)

b. Complex 75-3

Propellant transfer system modernized

Modernization of DISCOVERER launch pads 4 and 5 at Complex 75-3, including installation of new propellant transfer sets and updated launch control system equipment, has been completed. Both pads are available for June launches. (C)

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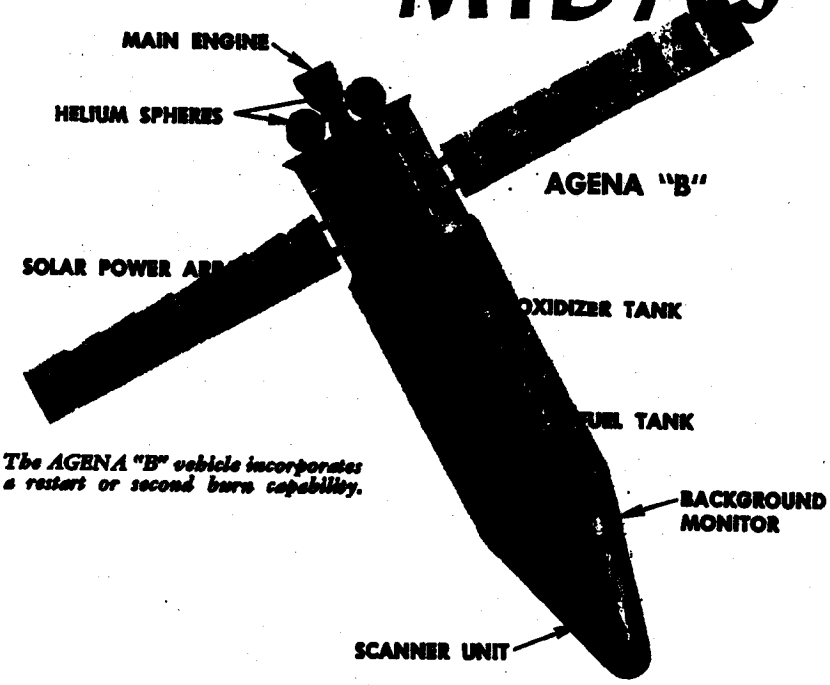
[redacted]

MIDAS

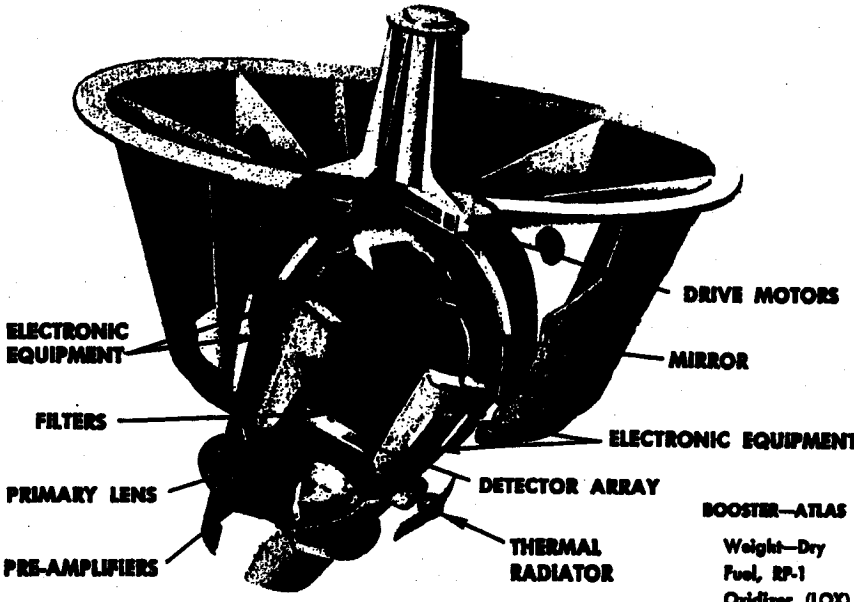
SECOND STAGE	AGENA "B"
Weight—	
Inert	1,763
Payload equipment	1,641
Orbital	3,404
Impulse Propellants	12,950
Fuel (UDMH)	
Oxidizer (IRFNA)	
Other	758
GROSS WEIGHT (lbs.)	17,112
Engine	XLR81-Ba-9
Thrust, lbs. (vac.)	16,000
Spec. Imp., sec. (vac.)	290
Burn Time, sec.	240
Restart Provisions	Yes

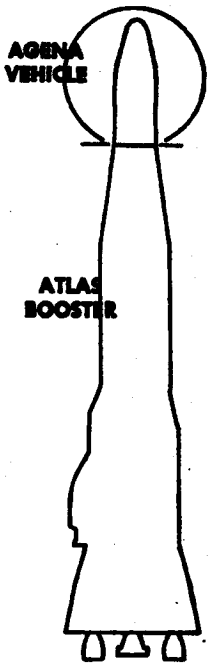


The AGENA "B" vehicle incorporates a restart or second burn capability.

MIDAS Infrared Detection Payload

Payload Operation: Incident radiation passes through the primary lens, then is reflected by the mirror which brings the energy into sharp focus on the detector array. The filter is located in front of the detector array to exclude unwanted radiation. Preamplifiers are mounted in back of the detectors.





BOOSTER—ATLAS ICBM		
Weight—Dry		15,100
Fuel, RP-1		74,900
Oxidizer (LOX)		172,300
GROSS WEIGHT (lbs.)		262,300
Engine—MA-2		
Thrust (lbs. vac.)	Boost	356,000
	Sustainer	82,100
Spec. Imp. (sec. vac.)	Boost	286
	Sustainer	310

[redacted]

PROGRAM HISTORY

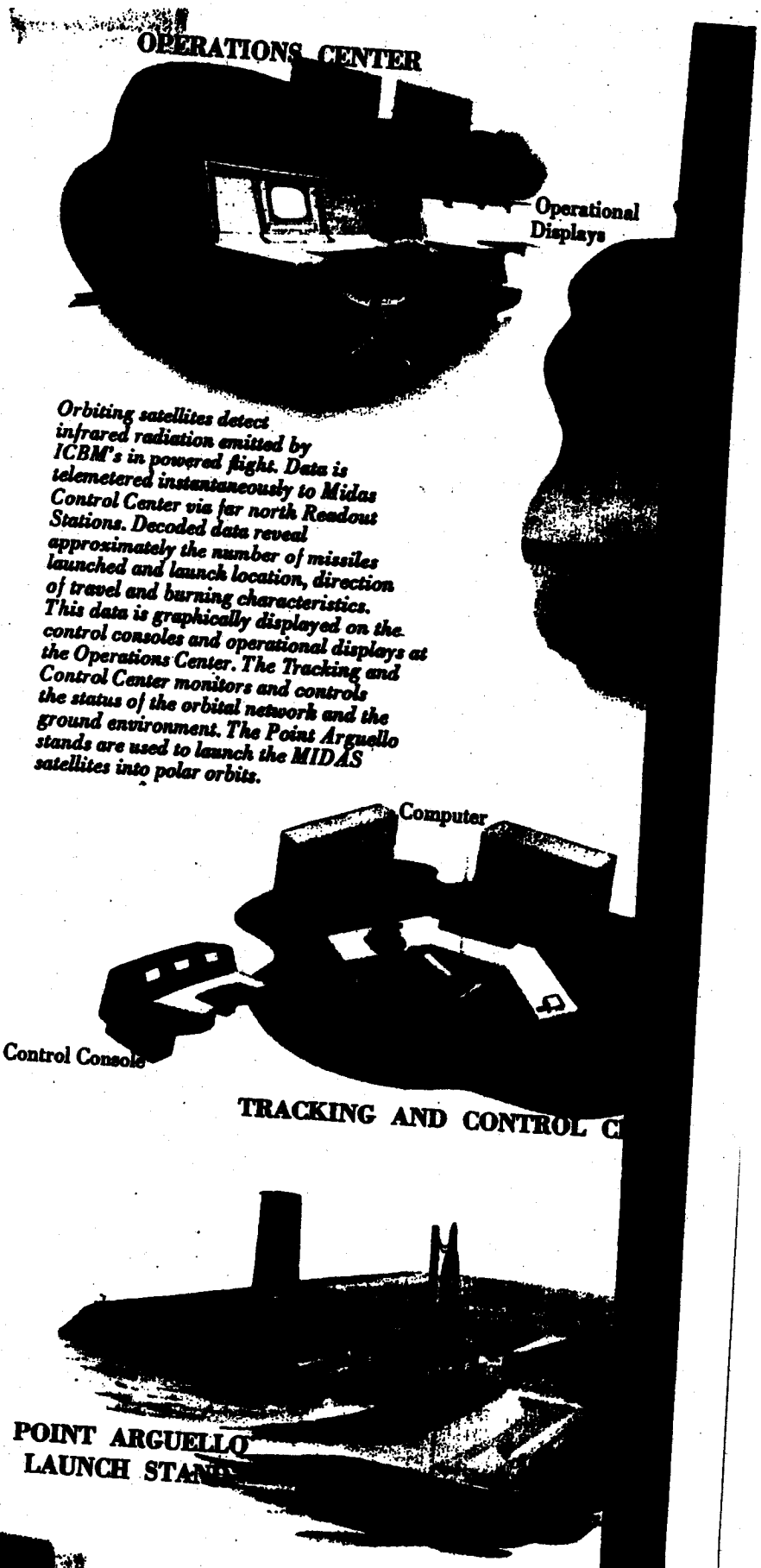
The MIDAS Program was included in Weapon System 117L when WS 117L was transferred to the Advanced Research Projects Agency. ARPA subsequently separated WS 117L into the DISCOVERER, SAMOS and MIDAS Programs, with the MIDAS objectives based on an infrared early warning system. The MIDAS (Missile Defense Alarm System) Program was directed by ARPA Order No. 38, dated 5 November 1958 until transferred to the Air Force on 17 November 1959. The Air Force directed that the program be continued under the technical guidance of the ARPA Order and approved the MIDAS R&D Development plan dated 15 January 1960. This plan was a "minimum essential" program directed toward the satellite vehicle and proof of the feasibility of infrared detection capabilities. It provided for ten test launches, two from the Atlantic Missile Range and eight from the Pacific Missile Range. Subsequent authorization was obtained to utilize two DISCOVERER flights (designated RM-1 and RM-2) to carry background radiometers in support of MIDAS.

A program of complete system development, including the ground environment of MIDAS, has been submitted to the Department of the Air Force and has been approved in principle and objective. The launch schedule of that program, 31 March 1961 MIDAS R&D Development Plan, is shown on page B-5. Authorization has been received to initiate action implementing the plan with reconsideration for approval to be accomplished subsequent to a successful test launch in 1961.

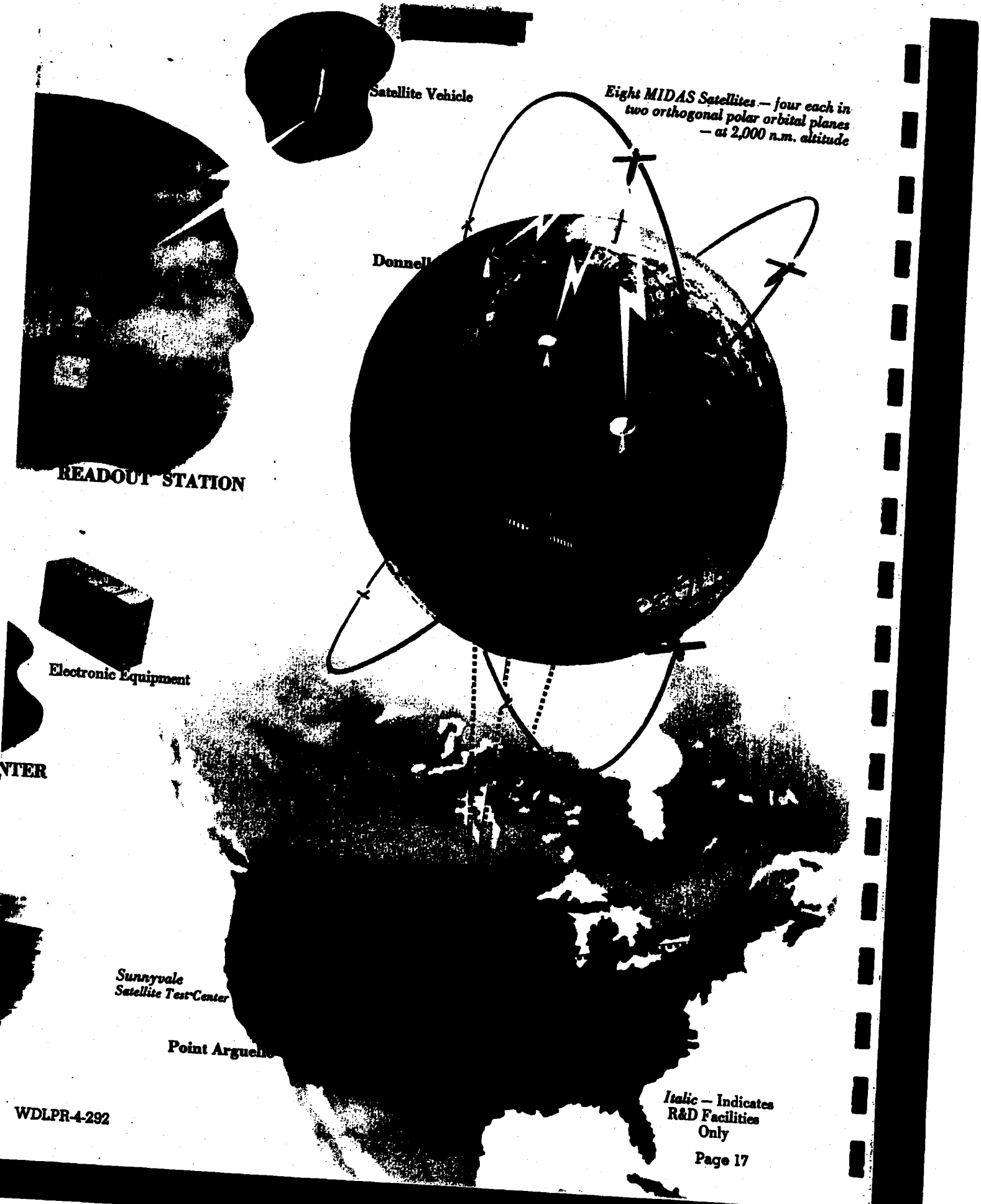
TECHNICAL HISTORY

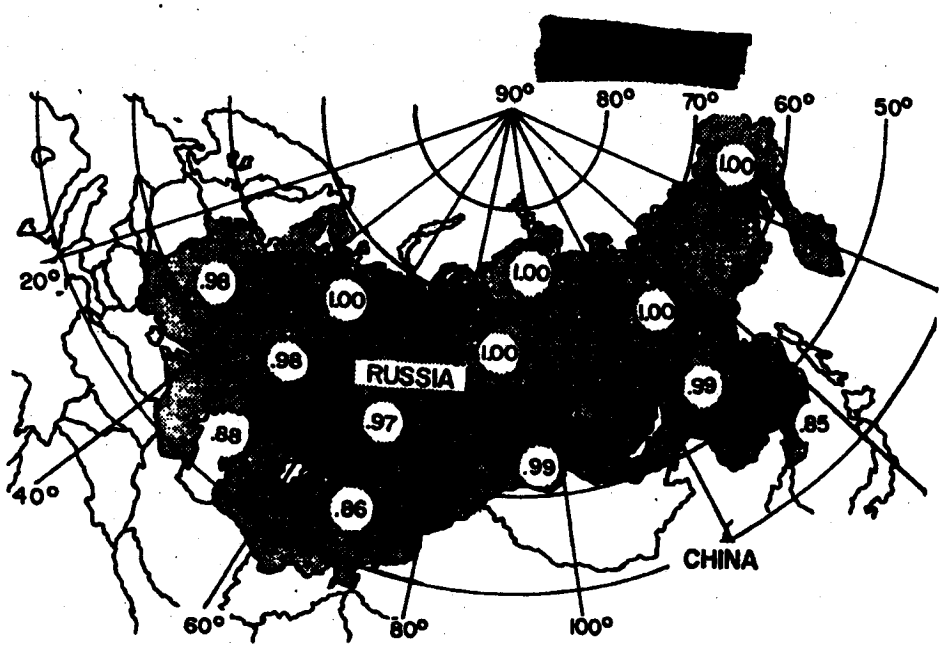
The MIDAS infrared early warning payload is engineered to use a standard launch vehicle configuration. This consists of an ATLAS missile as the first stage and the AGENA vehicle, powered by a Bell Aircraft rocket engine as the second, orbiting stage. The final configuration payload weight will be approximately 1,000 pounds.

The first two R&D flights used the AGENA "A" and ATLAS "D" vehicle programmed to place the payload in a circular 261 nautical mile orbit. Subsequent R&D flights will utilize the ATLAS "D"/AGENA "B" configuration which will be programmed to place the payload in a circular 2,000 nautical mile polar orbit.



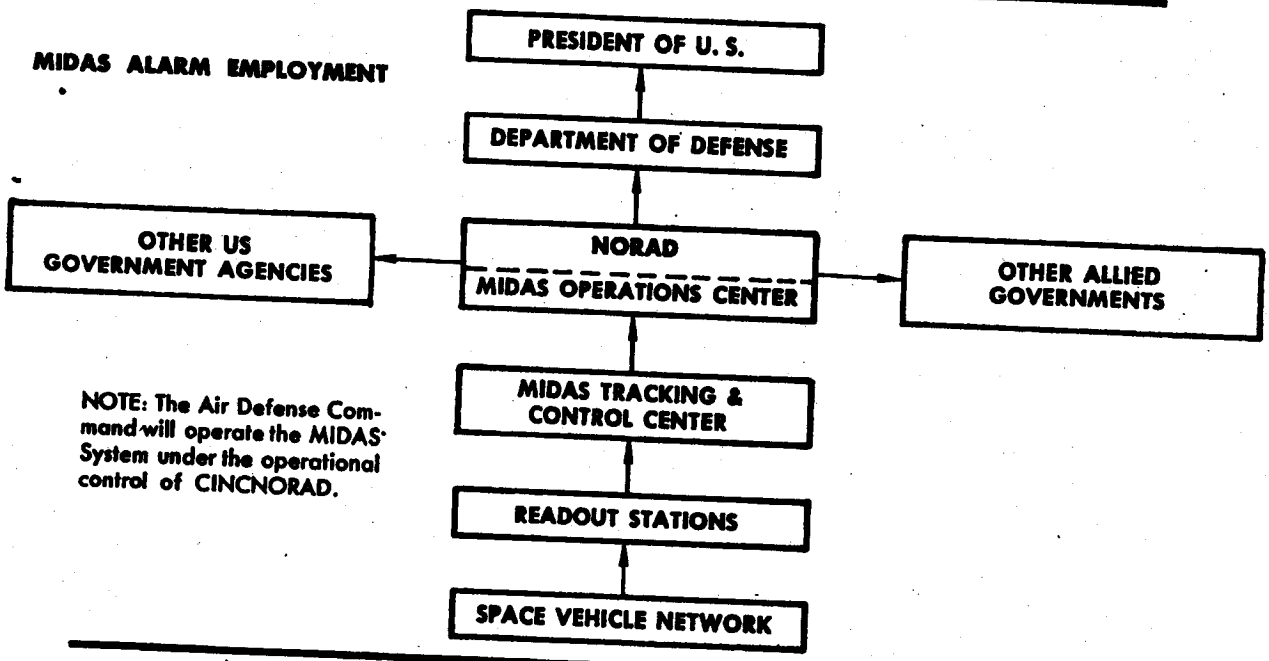
Orbiting satellites detect infrared radiation emitted by ICBM's in powered flight. Data is telemetered instantaneously to Midas Control Center via far north Readout Stations. Decoded data reveal approximately the number of missiles launched and launch location, direction of travel and burning characteristics. This data is graphically displayed on the control consoles and operational displays at the Operations Center. The Tracking and Control Center monitors and controls the status of the orbital network and the ground environment. The Point Arguello stands are used to launch the MIDAS satellites into polar orbits.


[redacted]
Satellite Vehicle
Eight MIDAS Satellites — four each in two orthogonal polar orbital planes — at 2,000 n.m. altitude
Donnell
READOUT STATION
Electronic Equipment
NTER
Sunnyvale
Satellite Test Center
Point Arguel
Italic — Indicates R&D Facilities Only



Probabilities of less than 1.00 on this map indicate the probability of at least one MIDAS satellite detecting an ICBM launch. Probabilities of 1.00 indicate that more than one MIDAS satellite will always be in position to detect an ICBM launch. These figures are based on geometric considerations of the family of satellites and ground readout station locations. Darker areas indicate most probable Russian ICBM launch site locations.

MIDAS ALARM EMPLOYMENT



NOTE: The Air Defense Command will operate the MIDAS System under the operational control of CINCNORAD.

CONCEPT

The MIDAS system is designed to provide continuous infrared coverage of the Soviet Union. Surveillance will be conducted by eight satellite vehicles in accurately positioned orbits. The area under surveillance must be in line-of-sight view of the scanning satellite. The system is designed to accomplish instantaneous readout of acquired data by at least one of three strategically located readout stations. The readout stations transmit the data directly to the MIDAS Tracking and Control Center where it is processed. It is then displayed and evaluated in the MIDAS Operations Center. If an attack is determined to be underway, the intelligence is communicated to a central Department of Defense Command Post for relay to the President and all national retaliatory and defense agencies.

[redacted]

[redacted]

Launch Schedule

Vehicle	Year	Month	Launches
ATLAS "D"/AGENA "A"	1960	J	
		F	⬮
		M	
		A	
		M	★
		J	
		J	
		A	
		S	
		O	
		N	
♦		D	★
♦	1961	J	
♦		F	★
ATLAS "D"/AGENA "B"		M	
		A	
		M	
		J	1
		J	1
		A	
		S	1
		O	
		N	
		D	
	1962	J	1
		F	
		M	1
		A	1
		M	1
		J	
		J	
		A	
		S	1
		O	1
		N	1
		D	1
	1963	J	1
		F	
		M	
		A	2
		M	2
		J	3
		J	
		A	
		S	
		O	1
		N	1
		D	1

Flight History

MIDAS No.	Launch Date	ATLAS No.	AGENA No.	Remarks
I	26 February	29D	1008	*Did not attain orbit because of a failure during ATLAS/AGENA separation.*
II	24 May	45D	1007	*Highly successful. Performance with respect to programmed orbital parameters was outstanding. Useful infrared data were observed and recorded.*
RM-1	20 December	DISCOVERER Vehicle		*Despite satellite oscillations, sufficient data were obtained for evaluation of payload operation. Information obtained in the 2.7- micron region agrees with data obtained from balloon-borne radiometric equipment. Data in the 4.3- micron region is somewhat higher than had been anticipated from theoretical studies.*
RM-2	18 February	DISCOVERER Vehicle		*All channels functioned properly and valid data were obtained on six stable orbits. Data confirmed previous radiometric measurements.*

♦ DISCOVERER vehicles carrying MIDAS radiometric payloads

★ Attained orbit successfully

⬮ Failed to attain orbit

[redacted]

MIDAS GROUND SUPPORT FACILITIES

Facility	*Equipment**	*Flight Function*
Satellite Test Center	ABCDEP	Operations control, orbit computations and predictions, initiation of commands to satellite (via tracking stations), process payload data.
Vandenberg AFB Tracking Station	ABCEFGHIJKLMP	Ascent and orbital tracking; telemetry reception; trajectory computations; command transmission; reception recording and processing of payload data.
Downrange Telemetry Ships	GHIJNO	Tracking and data reception during ascent. (Three ships are available for this function. Equipment is typical.)
Hawaiian Tracking Station	BEFGHJ	Orbital tracking, telemetry reception, payload data reception.
AMR	HJ	Orbital data reception.
New Hampshire Station	ABCEFGHIJKLM	Orbital tracking; telemetry reception; command transmission; reception, recording and transmission of payload data.
African Tracking Station	BEGJ	Telemetry reception and recording during second burn.
North Pacific Station	BCEHKMP	Satellite and payload data reception, command transmission.
Kodiak Tracking Station	FJ	Orbital tracking.
Mugu Tracking Station	BEFGJ	Tracking and telemetry reception.

NOTES: (1) In addition to equipment listed, all stations have inter- and intra-station communications equipment and checkout equipment.

(2) Equipment listed is either presently available or planned and approved for procurement.

**Equipment*

A. General Purpose Computer(s) and Support Equipment
B. Data Conversion Equipment
C. PICE
D. Master Timing Equipment
E. Control and Display Equipment
F. VERLORT
G. VHF FM/FM Telemetry Station
H. PAM FM Ground Station
I. Doppler Equipment
J. VHF Telemetry Antenna
K. UHF Tracking and Data Acquisition Equipment (60 foot F&D Antenna)
L. UHF Angle Tracker
M. UHF Command Transmitter
N. APL Doppler Equipment
O. SPQ-2 Radar
P. Midas Payload Evaluation and Command Equipment

[redacted]

[redacted]

A. BRIEF OF PROGRESS

A Development Plan was prepared and printed early in April. On 24 April, the Air Force Systems Command approved the plan. Final approval by the Air Force Ballistic Missiles and Space Committee is still pending. (U)

A proposal for simplifying the MIDAS operational prototype system has been submitted and is currently being evaluated by the Space Systems Division. Substantial increases in reliability and life expectancy are proposed benefits of this simplified system (U)

ATLAS 97D (MIDAS III booster) is being prepared for final validation for flight. The AGENA vehicle has been delivered to Point Arguello Pad 2 and is being readied for the 20 June launch. The payload is undergoing final testing prior to being mated with the AGENA satellite vehicle. ~~(S)~~

Considerable progress was made during the quarter on the design of facilities. The design of the technical support facilities at Vandenberg Air Force Base was completed. Final plans for the New Hampshire tracking station technical support were also completed. Preliminary design of the Ottumwa tracking and control center facilities was completed on 26 May. Authorization to proceed with the rehabilitation of base support facilities was given on 7 May. (U)

[redacted]

B. TOPICAL SUMMARY

1. Program Administration

Development Plan prepared

a. Program adjustments resultant to guidance received from the Air Force Ballistic Missiles and Space Committee (AFBMSC) were resolved with the major contractors and local governmental agencies during March. Coordination of the adjusted program plan was accomplished with the range facility, Pacific Missile Range. A Development Plan, dated 31 March, reflecting the increased scope and program acceleration approved by the AFBMSC and adjusted to the funding guidance received, was printed early in April. (U)

AFSC approves Development Plan

b. On 24 April, representatives from the Space Systems Division (SSD) briefed the Air Force System Command on the MIDAS R&D Development Plan. The plan received Command approval and the following day a briefing covering its background, content, and objectives was presented to members of the Department of Defense and to the Defense Panel of the Weapons Board, Headquarters USAF. Authority was given for SSD to proceed against the plan pending final detailed approval by the AFBMSC. (U)

"System Package Program" documentation prepared

c. A vigorous program to document a "system package program" in response to the 375 series of Air Force regulations was initiated in March. Initial documentation and formulation of management organization and concepts has been completed. Analysis of these efforts reveal that there remains a considerable amount of data to be generated and inter and intra-command coordination to be accomplished. The internal organization and management realignment resulting from the new structure of the Air Force Systems Command and the Air Force Logistics Command has had considerable impact on this effort. Results of this command structure and functional realignment are being incorporated into the documentation as they are identified and finalized. (U)

Operational system concept clarified

d. The MIDAS Operational System concept is being reviewed to define in greater detail, based on present knowledge, the operational philosophy and requirements for each system element. (U)

Operational prototype system simplification proposal analyzed

e. The Space Systems Division is presently analyzing and evaluating a Lockheed Missiles and Space Division proposal for simplification of the MIDAS Series IV prototype system. Primary emphasis is placed on vehicle simplification with ancillary reduction of complexity in the design and manufacture of support, checkout, and launch control equipment. Substantial increases in reliability and life expectancy are proposed benefits of this simplified system. Some of the concepts of the proposed simplified system are:

(1) Twelve satellites randomly spaced in orbit, four in each of three orbital planes. Two satellites in each plane would orbit in one direction and the other two would orbit in the opposite direction.

[redacted]

[redacted]

(2) All satellite equipment would operate on a continuous duty cycle.

(3) Provisions for orbital adjustment would not be required.

(4) The solar auxiliary power array would be static following its initial extension — no constant adjustment to provide maximum sun exposure.

(5) The attitude control requirements would be reduced.

(6) All data transmission would be accomplished on UHF.

(7) No command system would be required, eliminating the need for the orbital programmer and the power control unit.

(8) Reduced tracking accuracy requirement of 20 nautical miles would allow tracking to be accomplished with the 60-foot tracking and data acquisition antenna by angle tracking only.

While the proposal has many desirable and attractive possibilities, it must be carefully analyzed as to impact on mission capability, vulnerability, cost, schedules, productibility and logistic support, etc., to positively assure that this approach is optimum for this time period.

2. *Flights*

RM-2 flight transmits valuable data

a. Analysis of the data transmitted by the second radiometric flight (RM-2) conducted in February has provided valuable information despite vehicle tumbling. Telemetry, and reference channels performed satisfactorily. (C)

Final RM-1 and RM-2 reports to be published in mid-June

b. During the second pass the Kaena Point, Hawaii, station received particularly good data in the 4.3 micron range. This data was of better quality than that obtained on the RM-1 flight. At this time the vehicle was stable and pitched downward at approximately [redacted] 13th pass, despite the tumbling of the satellite, the New Hampshire station acquired some valuable data. A final report on the RM-1 and RM-2 data and an analysis of them is being published and will be available in mid-June. (C)

3. *Technical Status*

a. Boosters

ATLAS 97D ready for launch

On 9 March, ATLAS 97D (MIDAS III booster) successfully completed a flight readiness firing at the Point Arguello launch complex. The booster was then used to complete Stand and Automatic Programmed Checkout Equipment (APCHE) validation checks. The booster is also being prepared for final validation for flight which starts on the AGENA "on-stand" date. Booster progress is satisfactory to support the launch of MIDAS III. (C)

b. Second Stage Vehicles

MIDAS II SAPUT still operating

(1) MIDAS II, launched from the Atlantic Missile Range on 24 May 1960, was tracked by the Hawaiian tracking station on

[redacted]

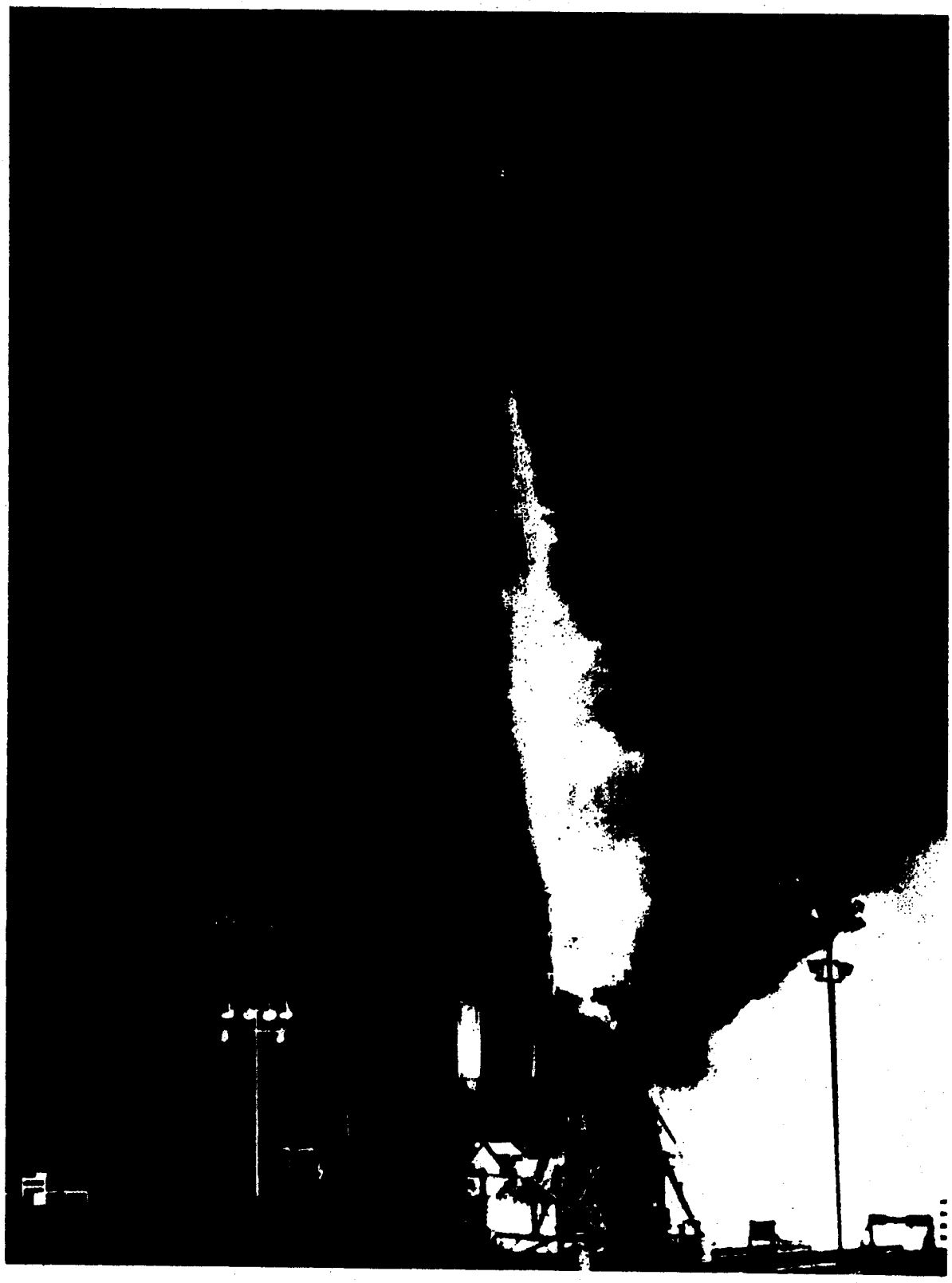


Figure 1. Successful flight readiness firing of ATLAS 97D at Point Arguello Pad No. 2. An AGENA checkout vehicle is installed on the ATLAS booster for these tests.