MILITARY SATELLITE PROGRAM

FOR QUARTER ENDING
31 MAY 1960

RCS DD-SD (Q) 397

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HEADQUARTERS
AIR FORCE BALLISTIC MISSILE DIVISION (ARDC)
UNITED STATES AIR FORCE
Air Force Unit Post Office, Los Angeles 45, California

WDLPM-4 211

10 June 1960

FOREWORD

During this reporting period, the successful flight of DISCOVERER XI marks an important step in the program. All test objectives, except capsule recovery, were completely achieved. Capsule recovery objectives were partially achieved. THOR performance, separation, AGENA ignition, and orbital injection were excellent.

A successful MIDAS launch was accomplished on 24 May. Performance with regard to attainment of planned orbital parameters was outstanding.

Each system covered in this report is preceded by a concise history of administration, concept and objectives, making the quarterly report more meaningful in terms of total program objectives.

Harry H. Evans

for O. J. RITLAND
Maj. Gen., USAF
Commander

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Discoverer

The DISCOVERER Program consists of the design, development and flight testing of 29 two-stage vehicles, using the THOR IRBM 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 Project's 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.

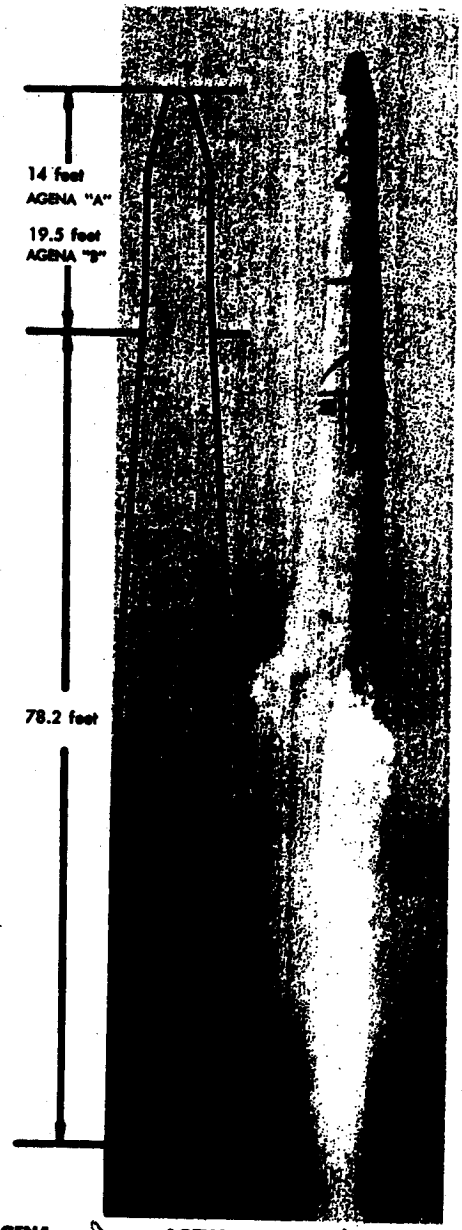
(e) Testing of ground support equipment and development of personnel proficiency.

(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 overall operational control exercised by the Satellite Test Center, Palo Alto, California.

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



SECOND STAGE	AGENA "A"	AGENA "B"	AGENA "B"
Weight—			
Inert	1,262	1,328	1,346
Payload equipment	497	887	915
Orbital	1,759	2,215	2,216
Impulse propellants	6,525	12,950	12,950
Other	378	511	511
TOTAL WEIGHT	8,662	15,676	15,722
Engine Model	YLR81-Ba-5	XLR81-Ba-7	XLR81-Ba-9
Thrust-lbs., vac.	15,600	15,600	16,000
Spec. Imp.-sec., vac.	277	277	290
Burn time-sec.	120	240	240
THOR BOOSTER		DM-18	DM-21
Weight—Dry		6,950	5,950
Fuel		33,750	33,750
Oxidizer (LOX)		68,300	68,300
GROSS WEIGHT (lbs.)		109,000	108,000
Engine		MB-3 Block 1	MB-3 Block 2
Thrust, lbs. (S.L.)		152,000	167,000
Spec. Imp., sec. (S.L.)		247.8	247.8
Burn Time, sec.		163	163

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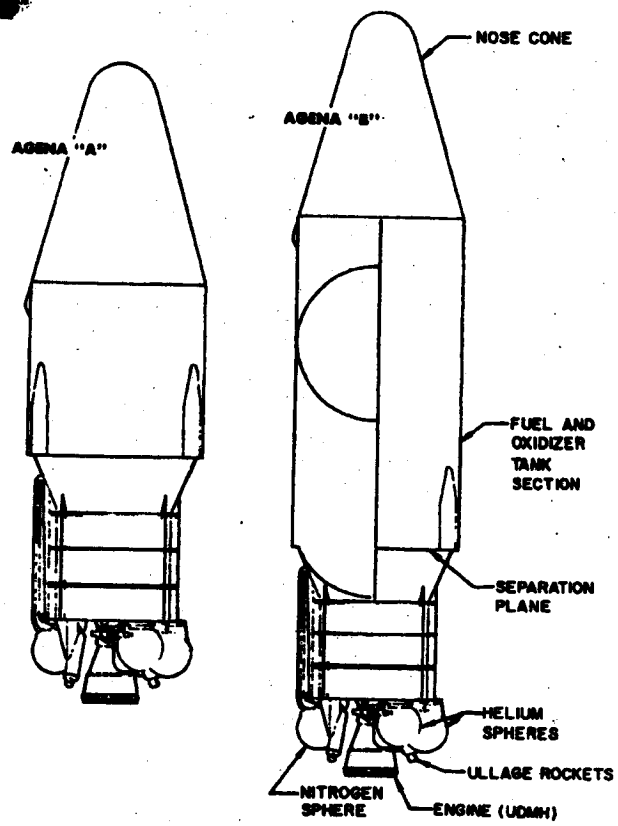
Telemetry ships are positioned as required by the specific mission of each flight. Figures 2 and 3 show a typical launch trajectory from Vandenberg Air Force Base, and figure 3 shows schematically a typical orbit. An additional objective of this program is the development of a controlled re-entry and recovery capability for the payload capsule (Figure 4). 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 aircraft and for sea recovery by Navy surface vessels. The recovery phase of the program has provided advances in re-entry vehicle technology. This information will be used in support of more advanced projects, including the return of a manned satellite from orbit.

FLIGHT VEHICLE

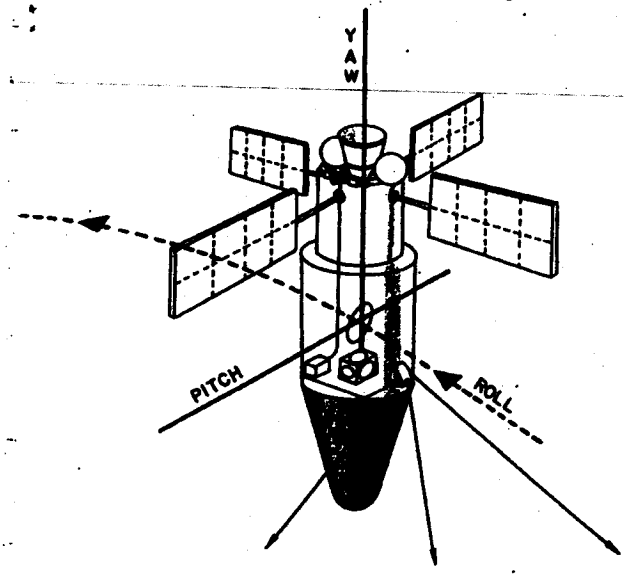
The three versions of flight test vehicles used in the DISCOVERER Program are defined in the launch schedule shown on page A-5. Specifications for the two THOR configurations and three AGENA configurations used are given on page A-1.

AGENA VEHICLE DEVELOPMENT

The AGENA vehicle was originally designed by the Air Force as the basic satellite vehicle for Advanced Military Reconnaissance Satellite Systems Programs. Basic design was based on use of the ATLAS ICBM as the first stage. ATLAS trajectory characteristics and the stringent eccentricity requirements of the advanced programs led to the selection of a guidance system suited to achieving orbital injection in a horizontal attitude. As a result, an optical inertial system was developed for vehicle guidance and a gas jet system for orbital attitude control. An urgent need for attaining higher altitude orbits resulted in development of the AGENA "B" versions which included doubling the propellant capacity and addition of engine restart and extended burn capabilities. The YLR81-Ba-5 version of the LR81-Ba-5 engine, developed by Bell Aircraft for B-58 aircraft, is used on AGENA "A" vehicles.



Early AGENA "B" vehicles will use a later version of this engine (YLR81-Ba-7), redesigned to use unsymmetrical dimethyl hydrazine fuel instead of JP-4. The majority of AGENA "B" vehicles will use the ~~XLR81-Ba-9 engine, incorporating a nozzle~~ expansion ration of 45:1, and providing a further increase in performance capability.

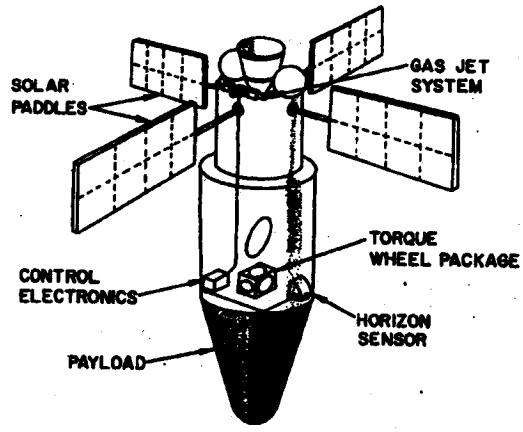


LINES OF SIGHT—HORIZON SENSING

PERFORMANCE CAPABILITIES

ALTITUDE
200–20,000 MILES

ATTITUDE
ROLL – 0.1 DEGREE
PITCH – 0.1 DEGREE
YAW – 1 DEGREE



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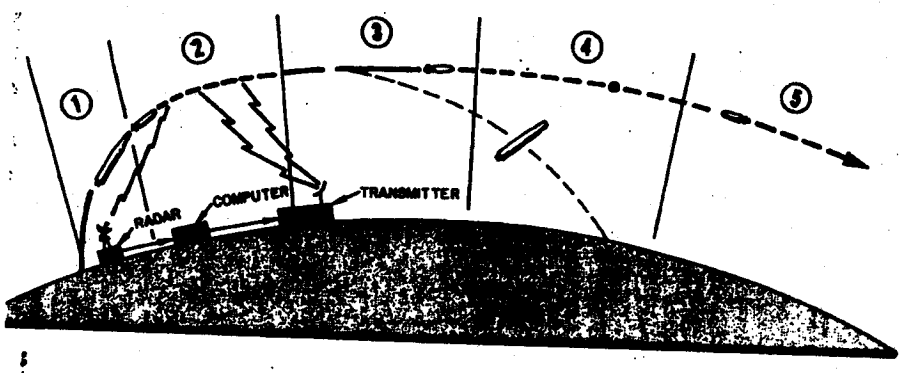
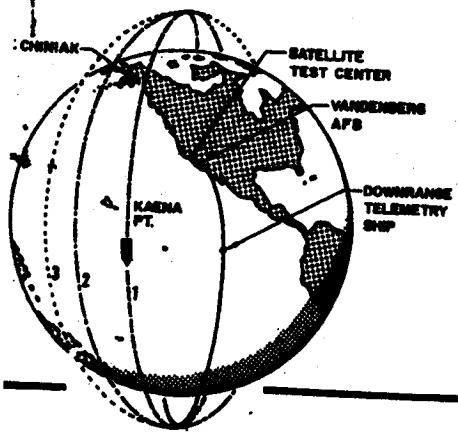
Powered Flight Trajectory



1. **First Stage Powered Flight**—2.5 minutes duration, 78 n.m. downrange, guided by programmed auto pilot.
2. **Coast Period**—2.4 minutes duration, to 380 n.m. downrange; guided and attitude controlled by inertial reference programmer, horizon scanner, gas reaction jets. Receives AGENA time to fire and velocity to be gained commands.
3. **Second Stage Powered Flight**—2 minutes duration, to 770 n.m. downrange. Guided and controlled by inertial reference programmer, horizon scanner, gas reaction jets (roll) gimballing engine, accelerometer.
4. **Vehicle Reorients to Nose Aft**—2 minutes duration, to 2,000 n.m. downrange. Guided and controlled by inertial reference programmer, horizon scanner and gas reaction jets.
5. **In-Orbit**—Guided and controlled (same as 4).

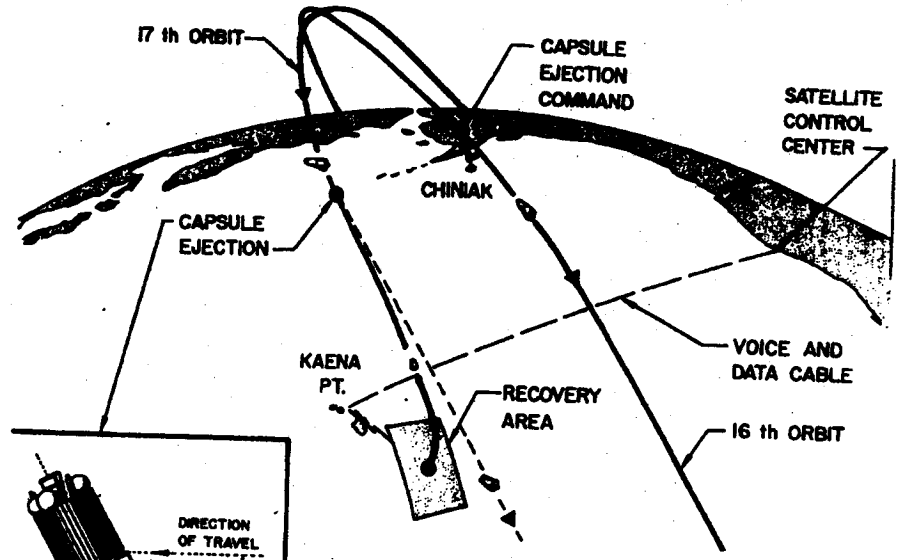


Orbital Trajectory

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 A-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 command on the 17th orbit, for capsule impact within the predetermined recovery area south of Hawaii. Aircraft and surface vessels are deployed within the area as a recovery force.



CAPSULE RECOVERY SEQUENCE

Capsule ejection command is sent to the satellite by the Chiniak, Alaska station on the 16th orbit. The vehicle reorients its position (see inset) to permit ejection to occur on a re-entry trajectory on the 17th orbit. The recovery capsule parachute is activated at about 50,000 feet, and the capsule beacon transmits a radio signal for tracking purposes. The recovery force is deployed in the recovery (impact) area.

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Facility	Equipment	Flight Function
Satellite Test Center	A	Over-all control, convert tracking stations data to obtain a predicted orbit and generate subsequent ephemerides issue acquisition data to tracking stations for subsequent passes, predict recovery area.
Vandenberg AFB	BCDEFGHIJK	Launch, ascent and orbital tracking, telemetry reception, trajectory measurements including time to ignite second stage.
Point Mugu	BCDEFGHIJKL	Ascent tracking and telemetry data reception, transmits command to ignite and shut down AGENA (via guidance computer).
Telemetry Ship (Pvt. Joe E. Mann)	DF	Final stage ascent tracking and telemetry data reception.
Annette Island, Alaska (tracking station)		Activity at this station terminated 1 December 1959 due to fund limitations.
Cape Chiniak, Alaska (tracking station)	BDEFGHIJK	Orbital tracking and telemetry data reception, including first pass acquisition, recovery capsule ejection and impact prediction.
Kaena Point, Oahu, Hawaii (tracking station)	BCDEFGHIJK	Orbital tracking and telemetry data reception.
Hickam AFB Oahu, Hawaii		Over-all direction of capsule recovery operations.

*Equipment

a. 2 UNIVAC 1103-A digital computers
b. VERLORT (Modified Mod II) radar
c. TLM-18 self-tracking telemetering antenna
d. Tri-helix antenna
e. Doppler range detection equipment
f. Telemetry tape recording equipment
g. Telemetry decommutators for real time data presentation
h. Plot boards for radar and TLM-18 tracking data
i. Conversion equipment for teletype transmission of radar, TLM-18 and doppler tracking data in binary format
j. Acquisition programmer for pre-acquisition direction of antennas
k. Ground command to satellite transmission equipment
l. Guidance computer

GROUND SUPPORT FACILITIES

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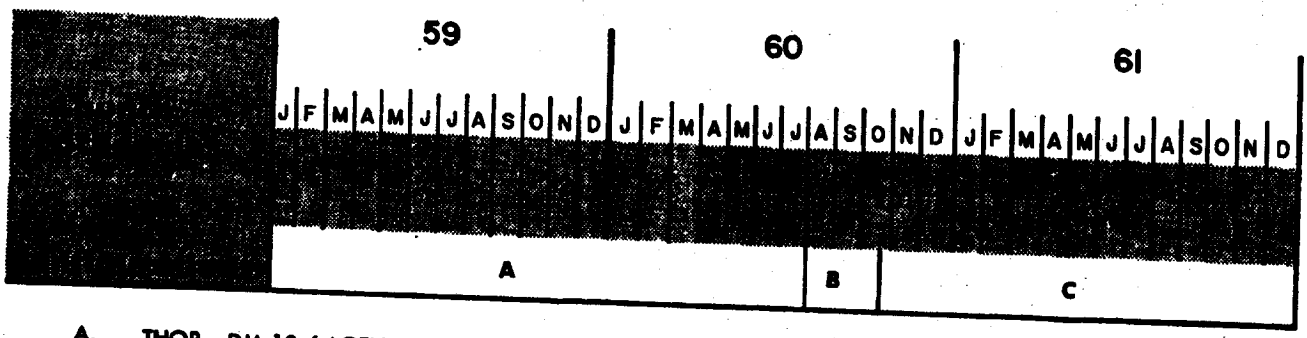

A. THOR—DM-18 / AGENA "A"

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

Flight History

DISCOVERER No.	AGENA No.	THOR No.	Flight Date	Remarks
0	1019	160	21 January	*AGENA destroyed by malfunction on pad. THOR refurbished for use on flight XII.*
I	1022	163	28 Feb 1959	*Attained orbit successfully. Telemetry received for 514 seconds after lift-off.*
II	1018	170	13 April	*Attained orbit successfully. Recovery capsule ejected on 17th orbit was not recovered. All objectives except recovery successfully achieved.*
III	1020	174	3 June	*Launch, ascent, separation, coast and orbital boost successful. Failed to achieve orbit because of low performance of satellite engine.*
IV	1023	179	25 June	*Same as DISCOVERER III.*
V	1029	192	13 August	*All objectives successfully achieved except capsule recovery after ejection on 17th orbit.*
VI	1028	200	19 August	*Same as DISCOVERER V.*
VII	1051	206	7 November	*Attained orbit successfully. Lack of 400-cycle power prevented stabilization on orbit and recovery.*
VIII	1050	212	20 November	*Attained orbit successfully. Malfunction prevented AGENA engine shutdown at desired orbital velocity. Recovery capsule ejected but not recovered.*
IX	1052	218	4 February	*THOR shut down prematurely. Umbilical cord mast did not retract. Quick disconnect failed, causing loss of helium pressure.*
X	1054	223	19 February	*THOR destroyed at T plus 56 sec. by Range Safety Officer.*
XI	1055	234	15 April	*Attained orbit successfully. Recovery capsule ejected on 17th orbit was not recovered. All objectives except recovery successfully achieved.*

TABLE 1.

[redacted]

A. BRIEF OF PROGRESS

DISCOVERER XI was launched from Vandenberg Air Force Base on 15 April. Launch, first stage THOR performance, separation, AGENA ignition, and orbital injection were excellent. All program objectives were attained with the exception of capsule recovery. Successful recovery was prevented by capsule ejection on a higher than nominal re-entry trajectory. Intensive testing of recovery system components has been initiated to provide maximum probability of successful recovery on future flights.

Launch date for DISCOVERER XII is dependent upon the installation of the diagnostic payload and the completion of the recovery system test program. Additional telemetry receiving stations are being provided for this DISCOVERER flight.

All AGENA "A" vehicles for the DISCOVERER Program were delivered to Vandenberg Air Force Base during March. The first AGENA "B" vehicle was delivered to Santa Cruz Test Base on 1 March. Testing of nozzle extensions for the XLR-81Ba-9 engine (AGENA "B") was continued at Bell Aircraft and Arnold Engineering Development Center during the quarter.

The manufacture of two transistorized S-band beacons was completed in March. Type testing of the first beacon was completed in April and the first flight beacon was delivered to LMSD for installation in the AGENA "B" vehicle.

The construction contract for the Vandenberg Air Force Base propellant storage and disposal facility was awarded in April with completion scheduled for September. The conversion of launch pad 5 at Vandenberg Air Force Base to AGENA "B" capability has been started. All ground handling and service equipment necessary to make the change has been shipped to the site. Changes also are being incorporated into the propellant loading system to permit two acid trucks to load propellant into the vehicle simultaneously.

[redacted]

B. TOPICAL SUMMARY

1. *Flights*

SUCCESSFUL DISCOVERER XI launch on 15 April.

a. DISCOVERER XI was launched from Pad 5, Vandenberg Air Force Base, at 1230 PST on 15 April. The countdown proceeded very smoothly despite high winds. Terminal countdown time was only 12 minutes, 45 seconds. Launch, first stage THOR performance, separation, AGENA ignition, and orbital injection were excellent. The resulting orbit has a perigee of 109.5 statute miles, an apogee of 380 statute miles, an eccentricity of 0.033 and an orbital period of 92.3 minutes.

Fifteen commands received and verified.

a. Acquisition was accomplished by every station on every pass. All fifteen commands were received and verified by the satellite. The horizon scanner, inertial reference package, and gas jet control system functioned extremely well, resulting in excellent satellite attitude stabilization. The satellite power supply, including the two advanced design static inverters, performed efficiently. The main batteries lasted through the 26th orbit.

Recovery capsule spin rockets may not have fired.

c. Telemetry data indicate that the recovery capsule was ejected on the 17th orbit as planned. The predicted re-entry trajectory did not occur. A good track of the capsule telemetry was obtained by the Kaena Point station. Capsule separation and retro-rocket firing were verified. However, spin rocket firing was not verified.

Intensive recovery system component test program is initiated.

d. The high re-entry trajectory of the recovery capsule has resulted in an intensive recovery system component test program. This program is designed to gather information from which corrections will be made to assure maximum probability of recovery on subsequent DISCOVERER flights.

Increased telemetry of payload recovery sequence.

e. As part of the diagnostic program a more complete "blossom" telemetry package is being installed to monitor the DISCOVERER XII capsule recovery sequence. This package will provide information on all phases of capsule ejection including retro, spin, and de-spin rocket operation and parachute deployment sequencing.

[redacted]

Holloman Air Force Base and Santa Cruz Test Base conduct recovery system test program.

f. Portions of the recovery system test program are being conducted at Santa Cruz Test Base and at Holloman Air Force Base. Spin rocket firings have been checked in a series of capsule drop tests at Santa Cruz. At Holloman, functional phases of the recovery system are being tested in a series of capsule drop tests from balloons.

DISCOVERER XI carries doppler beacon and optical tracking lights.

g. DISCOVERER XI was the first orbiting AGENA to carry the dual-frequency doppler beacon (Applied Physics Laboratory) and four optical tracking lights. Satisfactory tracking of both systems was achieved at stations in the United States and abroad. Sufficient data were received to indicate successful performance of the system. Although the APL beacon is being displaced by a portion of the diagnostic payload for the next DISCOVERER flight, the optical tracking lights will be operational. Subsequent AGENA "A" DISCOVERER vehicles will carry the complete system.

Increased telemetry receiving stations provided for DISCOVERER XII flight.

h. A flight readiness date for the launch of DISCOVERER XII depends upon the installation of the diagnostic payload and the completion of the recovery system test program. Deployment of the recovery force is being revised for this flight. Telemetry receiver equipment is being installed on Christmas Island in the South Pacific to provide telemetry reception if the re-entry trajectory carries the capsule beyond the planned recovery range. Ground tracking stations having telemetry receiving equipment are located at Kodiak, Alaska, Kaena Point, South Point and Barking Sands, Hawaii. Additional telemetry reception will be provided by five C-54 aircraft and three surface vessels, the Pvt Joe E. Mann, the Dalton Victory, and the Haiti Victory. All phases of the DISCOVERER XII payload recovery sequence from ejection through parachute deployment will be transmitted.

2. *Technical Status*

a. Second Stage Vehicles

All AGENA "A" vehicles delivered.

(1) The final AGENA "A" vehicle for the DISCOVERER Program was delivered to Vandenberg Air Force Base during March.

Three AGENA "B" vehicles complete hot firing tests.

(2) The first AGENA "B" vehicle (XLR-81Ba-7 engine) was delivered to Santa Cruz Test Base on 1 March. The vehicle was installed in test stand 2 and hot firing tests have been conducted. Both this vehicle and the third AGENA "B" delivered from manufacturing have completed their hot firing tests and have been returned to the Systems Test Area for rework and a second systems check prior to Air Force acceptance. The second AGENA "B" vehicle is in storage following Air Force acceptance on 3 May.

[redacted]

Nozzle extension tests continue at Bell Aircraft and Arnold Engineering Development Center.

(3) Testing of nozzle extensions for the XLR-81Ba-9 engine continued at Bell Aircraft and Arnold Engineering Development Center throughout the quarter. All tests of the 45:1 area ratio titanium nozzles have been successful. This nozzle has been released to production and will be used on flight vehicles. A test series was initiated on 6 May including starts and restarts at temperatures of plus 20 and minus 10 degrees Fahrenheit. Development of an uncooled nozzle which will provide a weight savings of five-to-ten pounds and simplify fabrication is being continued.

Thrust chamber erosion problem on XLR-81Ba-9 engines.

(4) Acceptance tests of the XLR-81Ba-9 engine at the contractor's facility revealed erosion of the thrust chamber throat. Corrective action to eliminate the erosion is underway and successful modifications are anticipated at an early date.

Transistorized S-band beacon installed in AGENA "B" vehicle.

b. Beacons

The manufacture of two transistorized S-band beacons was completed during March. One of the beacons will be used for type testing and the other will become the flight article for the first AGENA "B" flight. Type testing of the first beacon was completed during April and the first flight beacon was delivered to LMSD for installation in the AGENA "B" vehicle.

Delivery of test capsule (USE-77) is delayed until August.

c. Biomedical Capsules

Delivery of the test capsule (USE-77), to be used in the specialized biomedical environmental testing of Mark II flight components, has been delayed until August. Upon arrival a series of vibration, centrifuge, and impact tests will be conducted to assure reliable flight operation.

d. Ground Support Equipment

One hundred pin umbilical system will be installed in DISCOVERER XVII.

(1) Replacement of the present 200 pin umbilical system with a 100 pin system will begin with the launch of DISCOVERER XVII. The new system also will provide increased reliability by permitting simplification of checkout procedures, and will reduce over-all manhour requirements.

New ground handling equipment delivered in April.

(2) A ground handling dolly adaptable for either AGENA "A" or "B" configurations was introduced in April. The AGENA vehicle will be mounted in the dolly during assembly and checkout. A new vehicle transporter for transfer of AGENA "B" vehicles between LMSD, Santa Cruz Test Base and Vandenberg Air Force Base also was placed in service in April.

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AGENA "B" facilities checkout vehicle for use at Vandenberg Air Force Base completed.

(3) An AGENA "B" facilities checkout vehicle for use at Vandenberg Air Force Base was completed during April. This vehicle is capable of facilities checkout for the DISCOVERER, SAMOS, and MIDAS Programs.

3. *Facilities*

Modification of Hawaiian tracking station to support the TIROS project was completed on schedule.

a. Hawaiian Tracking Station—Modifications to the Hawaiian tracking station, in support of the NASA TIROS project were completed during March. Changeover time between programs was approximately 20 minutes.

Vandenberg Air Force Base propellant storage and disposal facility construction contract awarded. Conversion of Pad 5 at Vandenberg Air Force Base to provide AGENA "B" capability has started.

b. Vandenberg Air Force Base—The construction contract for the Vandenberg Air Force Base propellant storage and disposal facility was awarded in April with completion scheduled for September. The conversion of launch pad 5 at Vandenberg AFB to AGENA "B" capability has been started. All ground handling and service equipment necessary to make the change has been shipped to the site. Included is the new mast extension required to accommodate the greater length of the AGENA "B" vehicle. Changes also are being incorporated into the propellant loading system to permit two acid trucks to load propellant into the vehicle simultaneously.

[redacted]

SAMOS

BOOSTER—ATLAS ICBM	
Weight—Wet	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

SECOND STAGE	AGENA "A"	AGENA "B"
Weight—		
Inert	1,508	1,695
Payload equipment	2,605	3,058
Orbital	4,113	4,753
Impulse Propellants	6,492	12,950
Fuel (UDMH)		
Oxidizer (IRFNA)		
Other	606	718
GROSS WEIGHT (lbs.)	11,211	18,421
Engine	YLR81-Ba-5	XLR81-Ba-9
Thrust, lbs. (vac.)	15,600	16,000
Spec. Imp., sec. (vac.)	277	290
Burn Time, sec.	120	240

Figure 1.

Artists' concept of SAMOS satellite. Line drawing of complete flight vehicle (right) and detailed view of basic AGENA upper stage (left).

PROGRAM HISTORY

The SAMOS Program was included in Weapon System 117L when WS 117L was transferred to the Advanced Research Projects Agency early in 1958. ARPA separated WS 117L into the DISCOVERER, SAMOS and MIDAS programs with the SAMOS objectives based on a visual and ferret reconnaissance system. On 17 November 1959 responsibility for this program was transferred from ARPA to the Air Force by the Secretary of Defense.

PROGRAM MISSION

The primary mission of the SAMOS advanced reconnaissance system is to provide visual and electronic reconnaissance of the USSR and its allied nations. Efforts include development of hardware to permit:

a. Determination of characteristics of enemy electronic emissions.

b. Verification of known targets, detection of unknown targets.

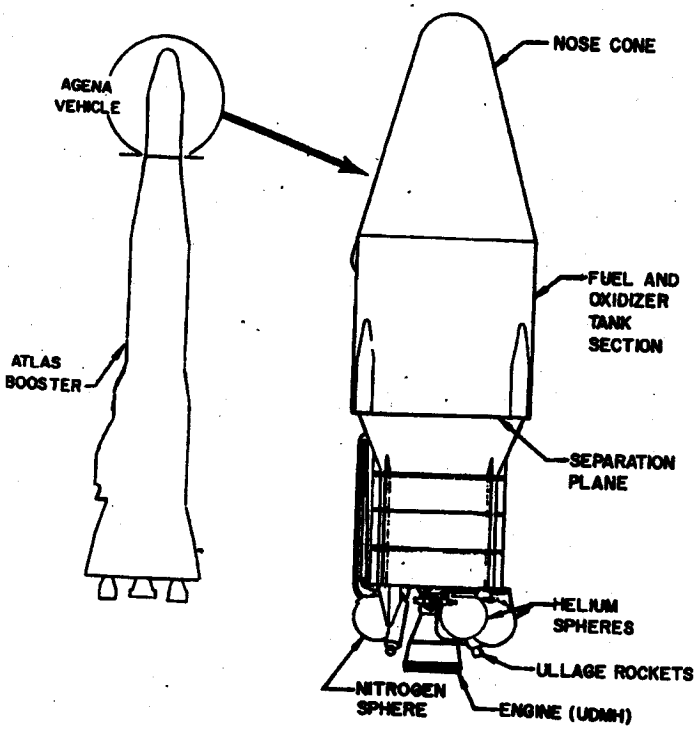
c. Location and evaluation of defenses.

d. Evaluation of military and industrial strength.

e. Assessment of high-yield weapons damage.

f. Reconnoitering of troop movements.

g. Location of naval forces throughout the world.



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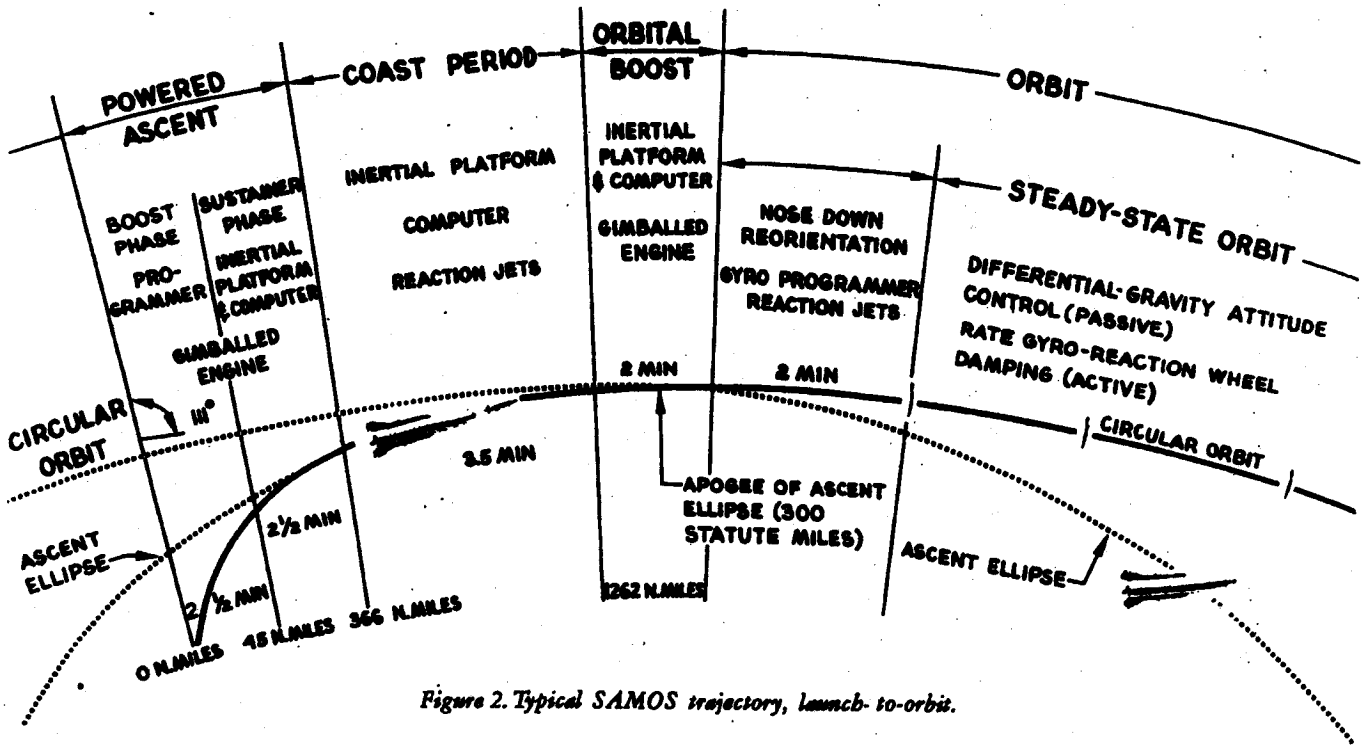

Figure 2. Typical SAMOS trajectory, launch- to-orbit.

- **Ferret Reconnaissance...**

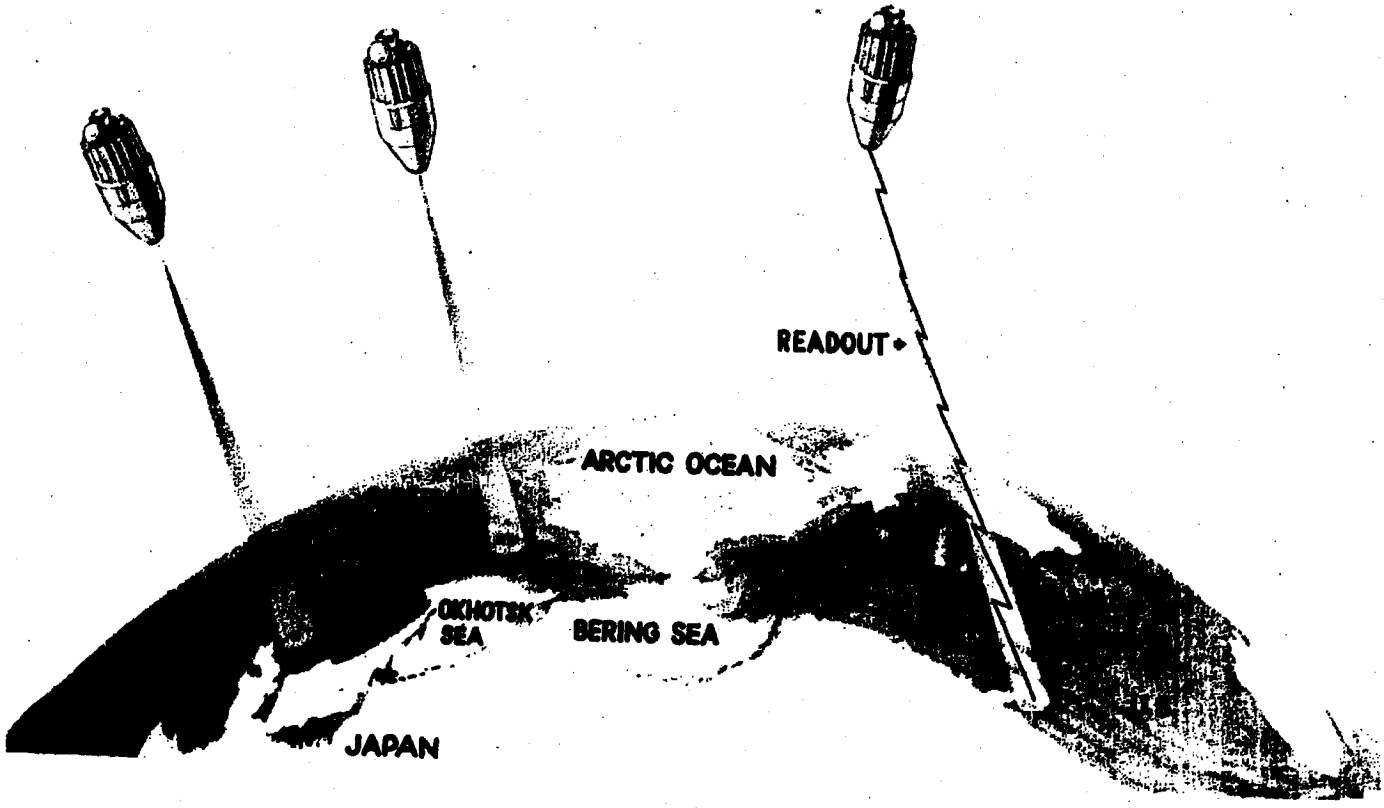

Figure 4. The Ferret reconnaissance system will gather data from electronic emissions over areas of interest.

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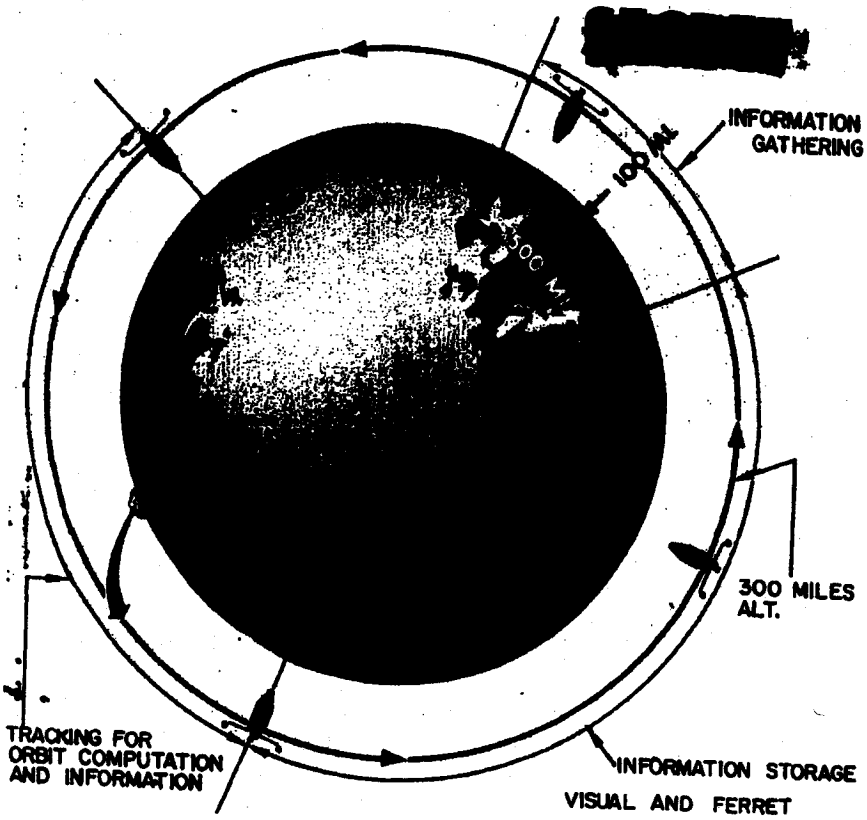

Figure 3.
Schematic of SAMOS system in operational orbit. When the satellite is over the area of interest the sensing equipment is turned on (Information gathering). When it leaves the area of interest the sensing equipment is turned off and the sensing data is processed (Information storage). When the vehicle comes within range of a ground receiving station, the data will be read-out upon command for processing and transmitted to using agencies. This process is continuously repeated during the useful lifetime of the vehicle.

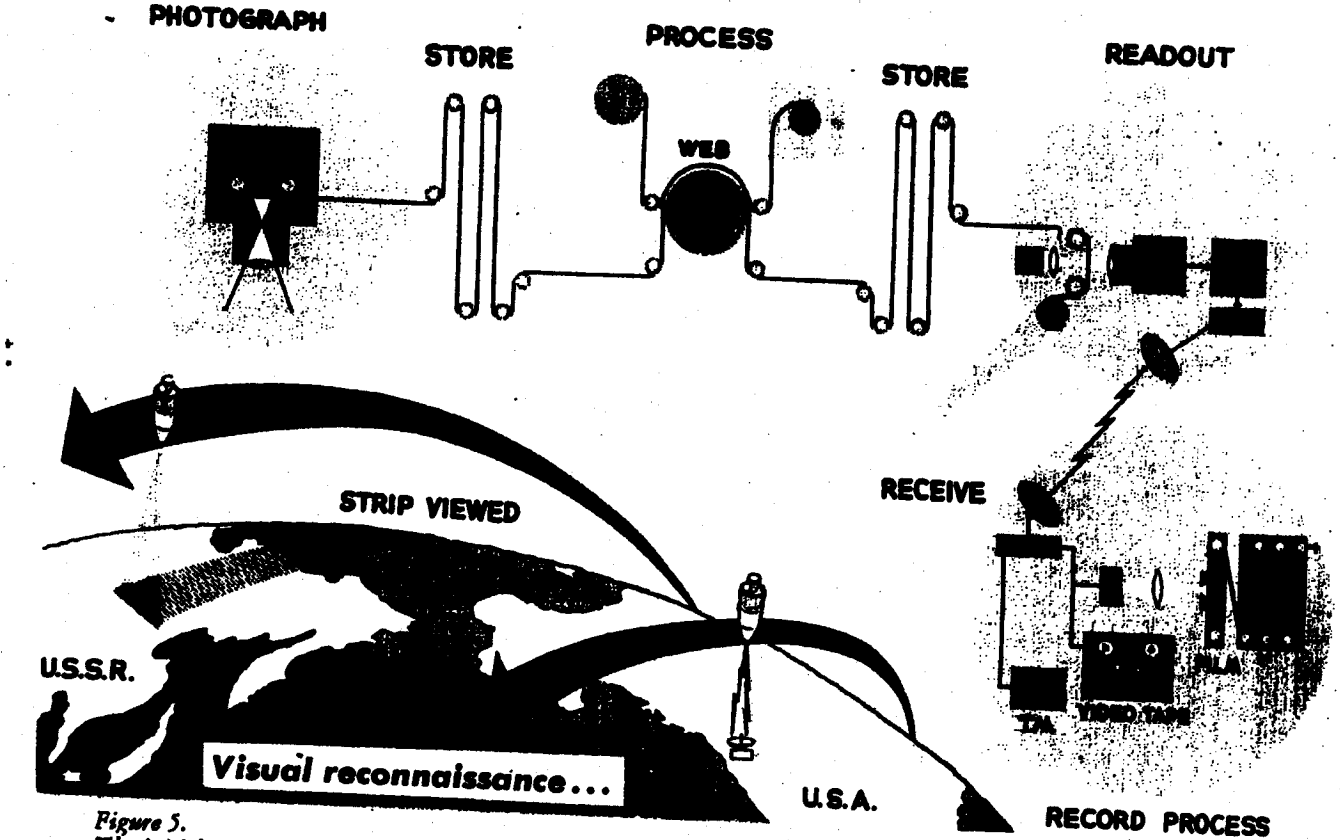

Figure 5.
The initial visual reconnaissance program will use conventional photo techniques with automatic film processing and TV-type electronic image readout to ground stations thru a data link. Ground electronics will reconvert the signal into photo image form, with a capability of resolving objects 20 feet in length.

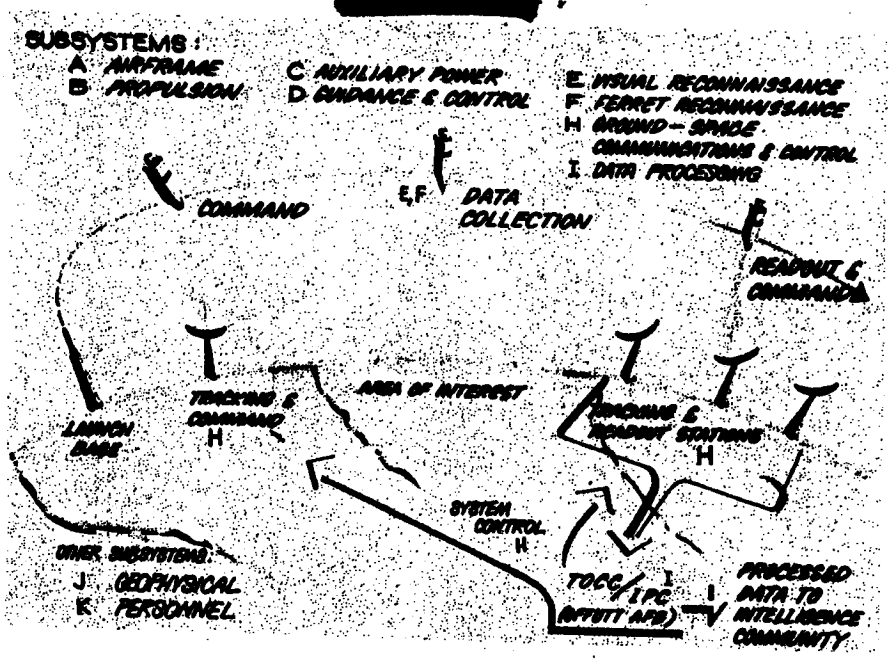

Figure 6. SAMOS concept, showing reception of commands and transmission of data between satellite and ground station; and subsystem functions (schematic).

For economical testing of components a dual-capability visual and ferret payload will be used during the early development phase. On later flights only a visual or ferret system payload will be carried. These payloads will be housed in the AGENA vehicle (Figure 1).

Data collected by the visual payloads will be electronically transmitted in the readout system and retrieved in the recovery system. Ferret data will be transmitted electronically. These systems are composed of the AGENA vehicle, ATLAS booster, launch facilities, tracking facilities, and a communications and data processing network. The recovery system will also include a re-entry capsule and a recovery force.

CONCEPT

ATLAS Series D missiles launched from VAFB will boost the AGENA vehicle into polar orbits. Injection into near-circular orbits (Figure 2) will be accomplished by the AGENA vehicle rocket engine. A self-contained guidance system using a horizon reference scanner will provide altitude stabilization. As the satellite travels in an orbit essentially fixed in space the earth rotates inside the orbit (Figure 3). Each successive orbit is djspiaced laterally approximately 23 ½ degrees at the equator, permitting one vehicle to observe the entire earth in a time period dependent upon the width of the area under surveillance. Early versions will have a useful life of approximately ten days. The readout systems will have a useful life of four months with a design objective in certain configurations of one year; recovery systems will have a useful life of fifteen to thirty days.

TECHNICAL DESCRIPTION

Visual Program—Payload camera, film processor and electronics readout equipment are being developed by Eastman Kodak Co. Cameras having a 36-inch focal length are being used. The payload equipment includes automatic film processing, film transport and take-up, electronic readout and temperature controls. The recoverable system will retain both the exposed film and the 66-inch local length camera.

Ferret Program—Ferret payloads are being developed on a progressively more advanced basis from R&D (F-1) to advanced systems (F-4). The F-2 all-digital, general coverage payload will use super-heterodyne scanning receivers in conjunction with directional antennas, an analog to digital converter and tape recorders (for storage). A programmer will be used to control read-in over areas of interest and readout over tracking stations. The F-3 payload will use similar receivers with stop-scan capability and controllable antennas added. Recording of the actual signal intercepted (rather than the digital representation) will be possible with a bandwidth up to 6mc. A complex programmer will permit satellite search of a given area or frequency range.

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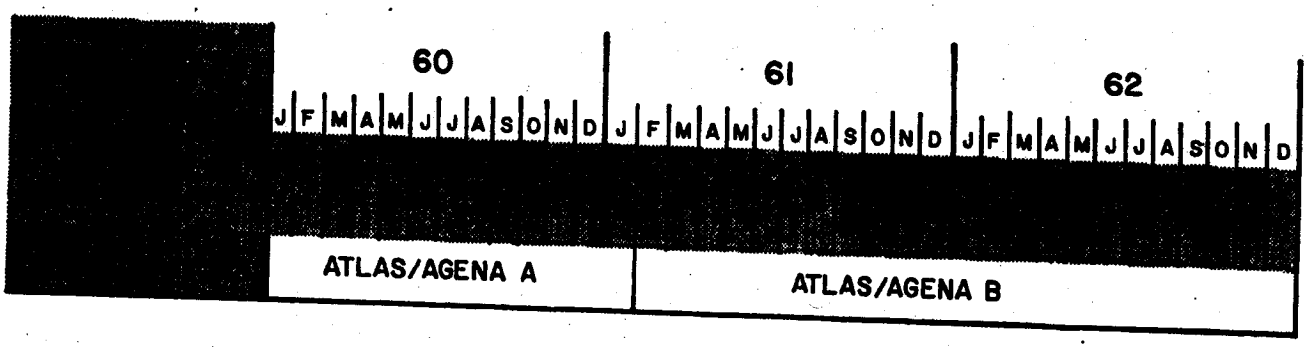

SAMOS LAUNCH SCHEDULE

[redacted]

A. BRIEF OF PROGRESS

Systems checks of the second stage AGENA vehicle for the first SAMOS flight are nearing completion with delivery to Santa Cruz Test Base scheduled for 2 June. The vehicle will be the first of three to carry a dual visual-ferret payload.

Subsystem testing of the first Visual payload has been completed successfully and payload AGENA capability established. The optical glass for two of the 66-inch, f/5 lenses for the visual recovery system (E-5) payload has been delivered from West Germany.

Subsystem tests of the first two ferret reconnaissance system (F-1) payloads were completed in March. The first F-1 payload was aligned with the E-1 payload and the dual package was installed in the AGENA vehicle. Systems testing of the complete installation was started in March.

The first of three AN/GPS-T1A calibration vans was received at LMSD on 8 April. These vans will be used to transmit calibrated signals to F-1 and initial F-2 payloads in orbit.

The missile assembly building at Vandenberg Air Force Base was completed during March 1960. Construction was started on the technical support and laboratory buildings.

Launch pad 1 at Point Arguello was completed in March and pad 2 was completed in May. The construction contract for the launch technical support buildings was awarded in April.

[redacted]

[redacted]

B. TOPICAL SUMMARY

1. *Technical Status*

a. Second Stage Vehicles

Second stage AGENA vehicles for dual payload flights proceeding on schedule.

System checks of the second stage AGENA vehicle for the first SAMOS flight are nearing completion with delivery to Santa Cruz Test Base scheduled for 2 June. This one month delay was caused by late delivery of airborne communications equipment and vehicle wiring changes. The vehicle will be the first of three to carry a dual visual (E-1) and ferret (F-1) payload. The third AGENA "A" vehicle was delivered to the system test area on schedule. Subassembly of the first AGENA "B" vehicle (flights 4 and subsequent) is proceeding on schedule. This is the first of the single-payload SAMOS vehicles which will carry either a photo readout (E-2) or a ferret reconnaissance (F-2) payload. Design of the AGENA "B" vehicles scheduled to carry the recoverable visual (E-5) payload is proceeding on schedule.

b. Payloads

(1) Visual Reconnaissance System

Visual Reconnaissance System payloads are being developed in a minimum number of configurations to attain readout and recovery mission objectives. The design and purpose of each configuration is as follows:

Readout:

E-1 Component Test Payloads

E-2 Steerable Reconnaissance Payloads (with 20-foot ground resolution)

Recovery:

E-5 High Resolution, Steerable, Recoverable Payload (with 5-foot ground resolution)

Payload compatibility with AGENA vehicle has been established.

(a) E-1 Payloads—Subsystem testing of the first E-1 payload has been completed successfully and payload compatibility with the AGENA vehicle has been established. Operational tests of the second E-1 payload have been completed and the payload is being prepared for subsystem testing and installation in the vehicle. The third E-1 payload was received from Eastman Kodak in mid-May.

[redacted]

Functional evaluation and environmental testing of E-2 payloads has started.

(b) E-2 Payloads—Testing and assembly of E-2 payload components is continuing at the contractor's facility. Functional evaluation and environmental testing of service test models has been started. Tests of the E-2 thermal model in the high altitude temperature simulator indicated that a change was required in the upper pressure shell conductance level. The lower pressure shell tests results were satisfactory.

Design and testing of E-5 system proceeds on schedule.

(c) E-5 Payloads—Design is continuing on the high acuity panoramic camera to combine all camera components as an integrated unit. The optical glass for two of the 66-inch, f/5 lenses has been delivered from West Germany. The release of engineering drawings for the payload thermal model and fabrication of the first recovery equipment test unit has been accomplished. Ballistic range tests of the recovery capsule configuration indicate satisfactory capsule stability. Wind tunnel tests of the recovery capsule configuration are being continued.

Ground reconstruction electronics equipment checkout nearing completion.

(d) Ground Support Equipment—During a subsystem test conducted in March with the E-1 payload mounted on the 40-inch collimator, all payload support equipment functioned successfully. Installation and alignment of the E-1 collimator and checkout of the E-1/E-2 ground reconstruction electronics equipment at the missile assembly building are nearing completion. Delivery of the E-1/E-2 ground reconstruction electronics equipment, primary record cameras, and operating consoles for the Vandenberg tracking and acquisition station has been delayed until June. Compatibility test and incorporation of design changes at Eastman Kodak caused this one month delivery slippage. Installation of the vacuum test chamber (for leak testing E-1 and E-2 payloads prior to launch) in the missile assembly building at Vandenberg Air Force Base is complete except for the electronics portion of the chamber. Delivery of the electronic portion is scheduled for June.

(2) Ferret Reconnaissance System

Ferret Reconnaissance System payloads are being developed in a minimum number of configurations. The designation and purpose of each configuration is as follows:

F-1 R&D Test Payloads

F-2 Digital General Coverage Payloads

F-3 Specific Mission Payloads—Analog Presentation

F-4 Technical Analysis (study stage only)

[redacted]

[redacted]

First two F-1 payloads complete subsystem tests.

(a) F-1 Payloads—Subsystem tests of the first two F-1 payloads were completed in March. The first F-1 payload was aligned with the E-1 payload and the dual package was installed in the AGENA vehicle. Systems testing of the complete installation was started late in March. Significant refinements were made in the F-1 payload during April. Circuitry improvements being tested indicate a potential increase of approximately 5 db pulse width measurement sensitivity. The third payload was received from Airborne Instruments Laboratory on 27 May.

Testing and assembly of F-2 payload components continues with delivery scheduled for October.

(b) F-2 and F-3 Payloads—Design and modification of the reoriented F-2 and F-3 systems was started in March. Testing and assembly of F-2 payload components is continuing at the contractor's facility with delivery of the first F-2 payload scheduled for October. Results of the F-2 thermal model environmental test conducted in April indicated satisfactory thermal control for all orbital conditions. Functional evaluation of service test models is in progress.

F-4 payload studies continue.

(c) F-4 Payloads—Studies of the F-4 System are being continued at Airborne Instruments Laboratory, based on 1965 intelligence requirements.

Installation and testing of F-1 data conversion equipment completed.

(d) Ground Support Equipment—Mechanical inspection by the Air Force of the F-1 data conversion equipment was completed on 22 March. This equipment converts the F-1 payload digital data for data processing. Installation and preliminary functional testing of the data conversion equipment in the interim area of the Satellite Test Center were completed during May. The checkout equipment for subsystem testing of F-1 payloads was shipped to LMSD on 25 March. This equipment will be installed in the missile assembly building at Vandenberg Air Force Base.

c. Communications and Control Equipment

UHF ground system dismantled and shipped to Vandenberg AFB.

(1) During March, the UHF ground system was dismantled by the contractor for shipment to Vandenberg AFB. Included in the system are the angle tracker, command transmitter, command tracker, and the tracking and acquisition system. Seventy per cent of the system was delivered to Vandenberg and installation was started in April.

Magnetron tube shortage results in substitution.

(2) The shortage of acceptable magnetron tubes for the narrow band transmitters may result in the substitution of a transmitter manufactured by General Electronics Laboratories on early SAMOS flights.

[redacted]

First AN/GPS/T1A calibration van delivered.

(3) The first of three AN/GPS-T1A calibration vans was received at LMSD on 8 April. These vans will be used to transmit calibrated signals to F-1 and initial F-2 payloads in orbit. These vans will be placed at 400-mile intervals along U.S. Highway 30.

Model 1604 computer accepted.

(4) Installation of the first Model 1604 computer and most of its support equipment in the Satellite Test Center was accomplished in April. Acceptance tests were completed late in April.

2. *Facilities*

Missile assembly building completed.

a. **Vandenberg Air Force Base**—The missile assembly building was completed during March 1960. Construction was started on the technical support and laboratory buildings. Completion of the laboratory building is scheduled for July and the technical support building is scheduled for October.

Point Arguello launch pads completed.

b. **Point Arguello**—Launch pad 1 was completed in March and pad 2 was completed in May. The construction contract for the launch technical support building was awarded in April with beneficial occupancy scheduled for August.

Construction of interim data processing facility deferred.

c. **Offutt Air Force Base**—A construction contract had been awarded for the interim data processing facility, but notice to proceed has been deferred by request of the Under Secretary of the Air Force. Requirements for data processing facilities are being reviewed at the present time.

Construction of technical facilities is complete.

d. **New Boston, New Hampshire, Tracking and Data Acquisition Station**—Construction of the technical facilities for this station is complete except for radomes required for winter operation. These are now being added to the contract. Design of support facilities for this station was completed during May and the project is being advertised for bid. Completion of these facilities is scheduled for December. Rehabilitation of support facilities at Grenier Field is under way with completion scheduled for October.

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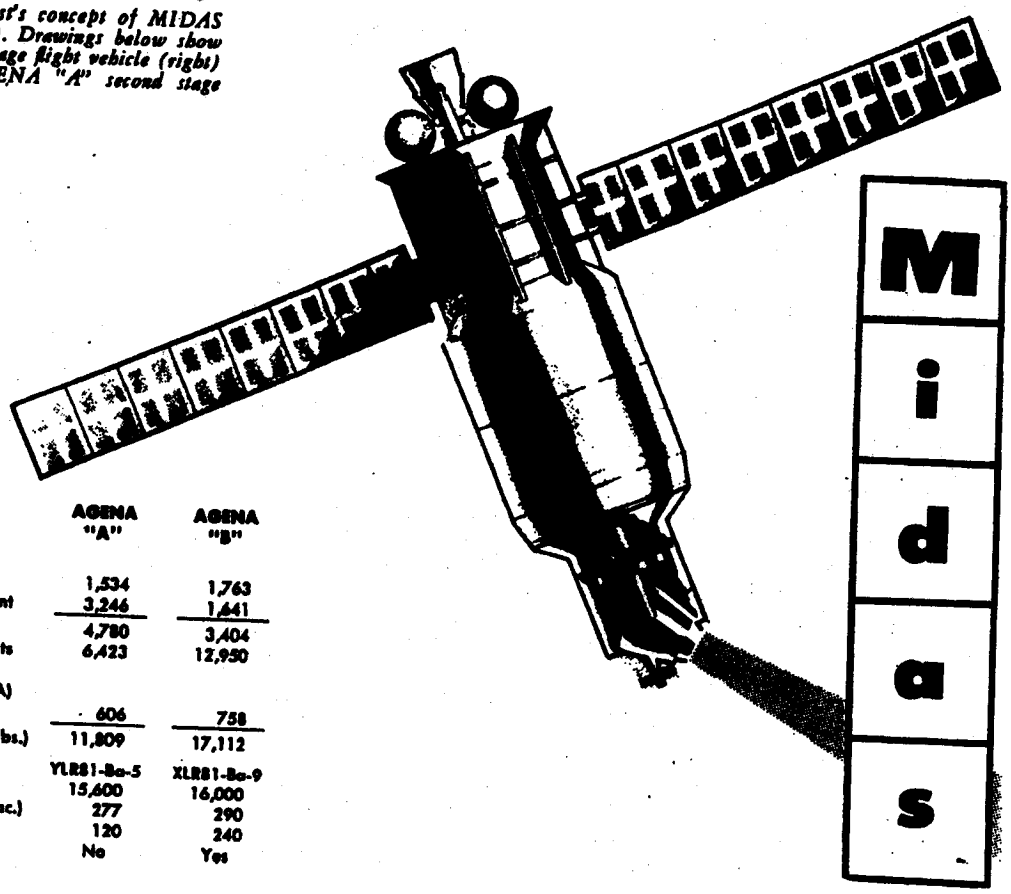
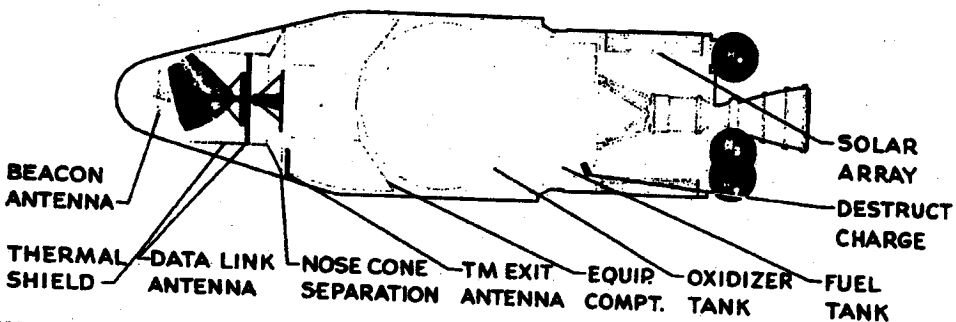
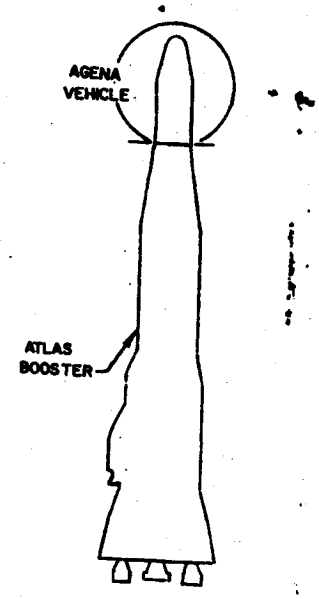
Figure 1. Artist's concept of MIDAS satellite (right). Drawings below show complete two-stage flight vehicle (right) and basic AGENA "A" second stage vehicle (left).



SECOND STAGE	AGENA "A"	AGENA "B"
Weight—		
Inert		
Payload equipment	1,534	1,763
	3,246	1,641
Orbital	4,780	3,404
Impulse Propellants		
Fuel (UDMH)	6,423	12,950
Oxidizer (IRFNA)		
Other	606	758
GROSS WEIGHT (lbs.)	11,809	17,112
Engine	YLR81-Be-5	XLR81-Be-9
Thrust, lbs. (vac.)	15,600	16,000
Spec. Imp., sec. (vac.)	277	290
Burn Time, sec.	120	240
Restart Provisions	No	Yes



NOTE: AGENA "A" configuration except for solar paddles (AGENA "B" only).



BOOSTER—ATLAS ICBM	
Weight—Wet	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	284

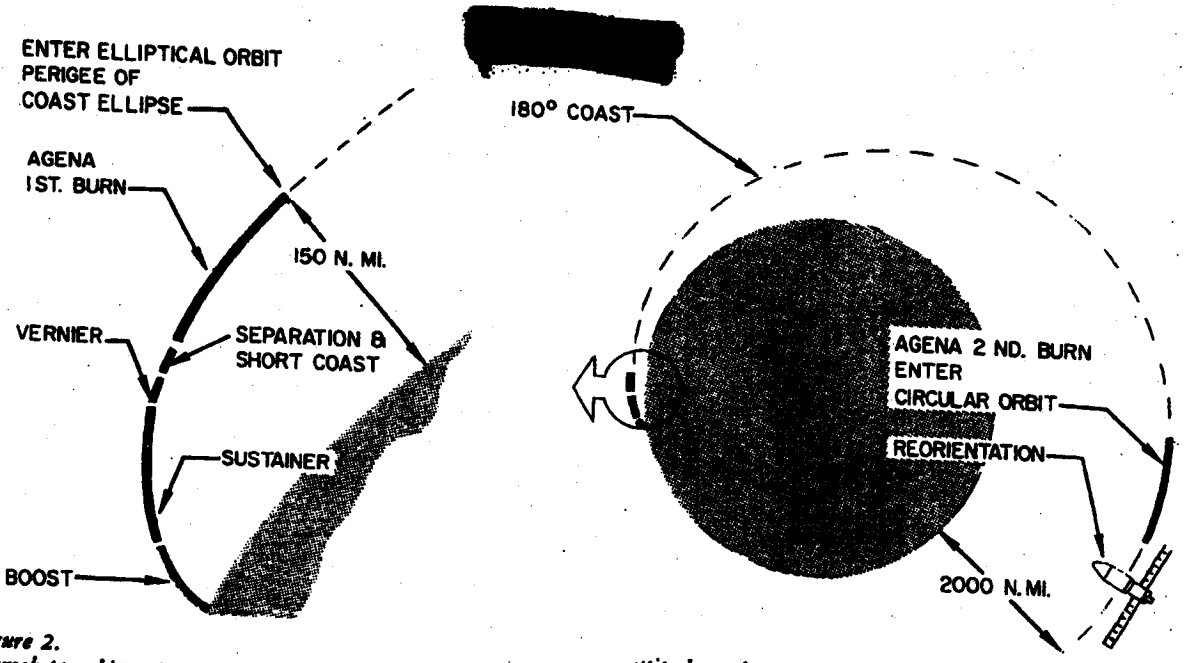


Figure 2.
Launch-to-orbit trajectory for flights 3 and subsequent. Optimum ATLAS boost, guided by radio-inertial system. AGENA ascent (coast, burn, coast, second burn) provides attitude reference. Also governs velocity magnitude and direction by inertial guidance system monitored by horizon scanner. Orbital attitude maintained by reaction wheel and gas jets.

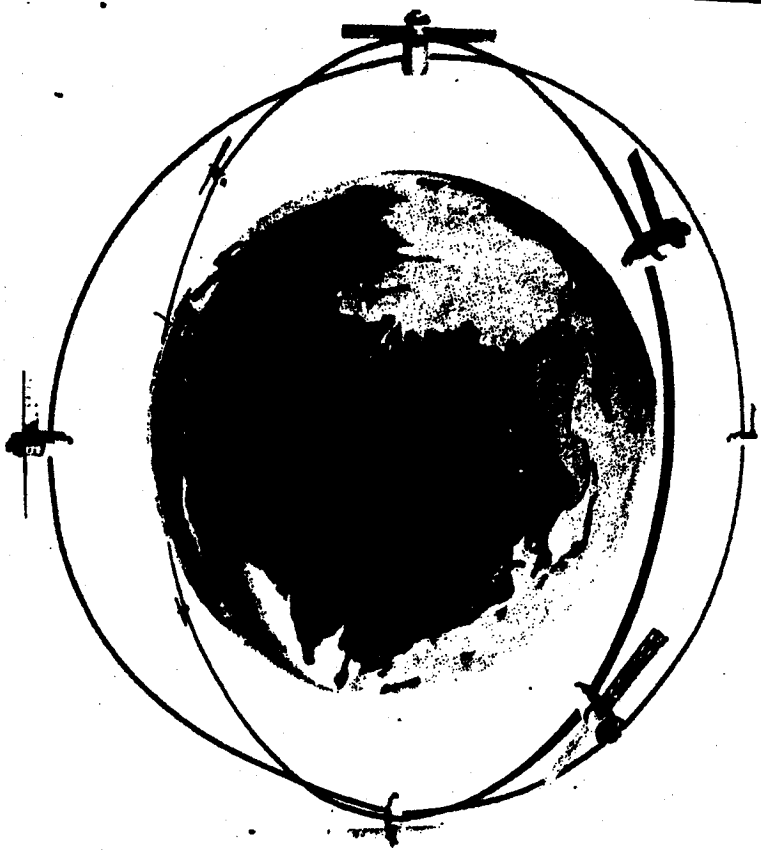


Figure 3.
Proposed MIDAS system. Four satellites spaced equidistant in each of two orthogonal planes at 2,000 n.m. altitude. Provides maximum coverage of USSR with minimum number of satellites.

PROGRAM HISTORY

The MIDAS Program was included in Weapon System 117L when WS 117L was transferred to the Advanced Research Projects Agency early in 1959. ARPA subsequently separated WS 117L into the DISCOVERER, SAMOS and MIDAS Programs, with the MIDAS objectives based on an infrared reconnaissance 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. An ARDC development plan for a ten flight R&D program has been approved. This R&D program will make possible the achievement of a reliable operational system by 1963.

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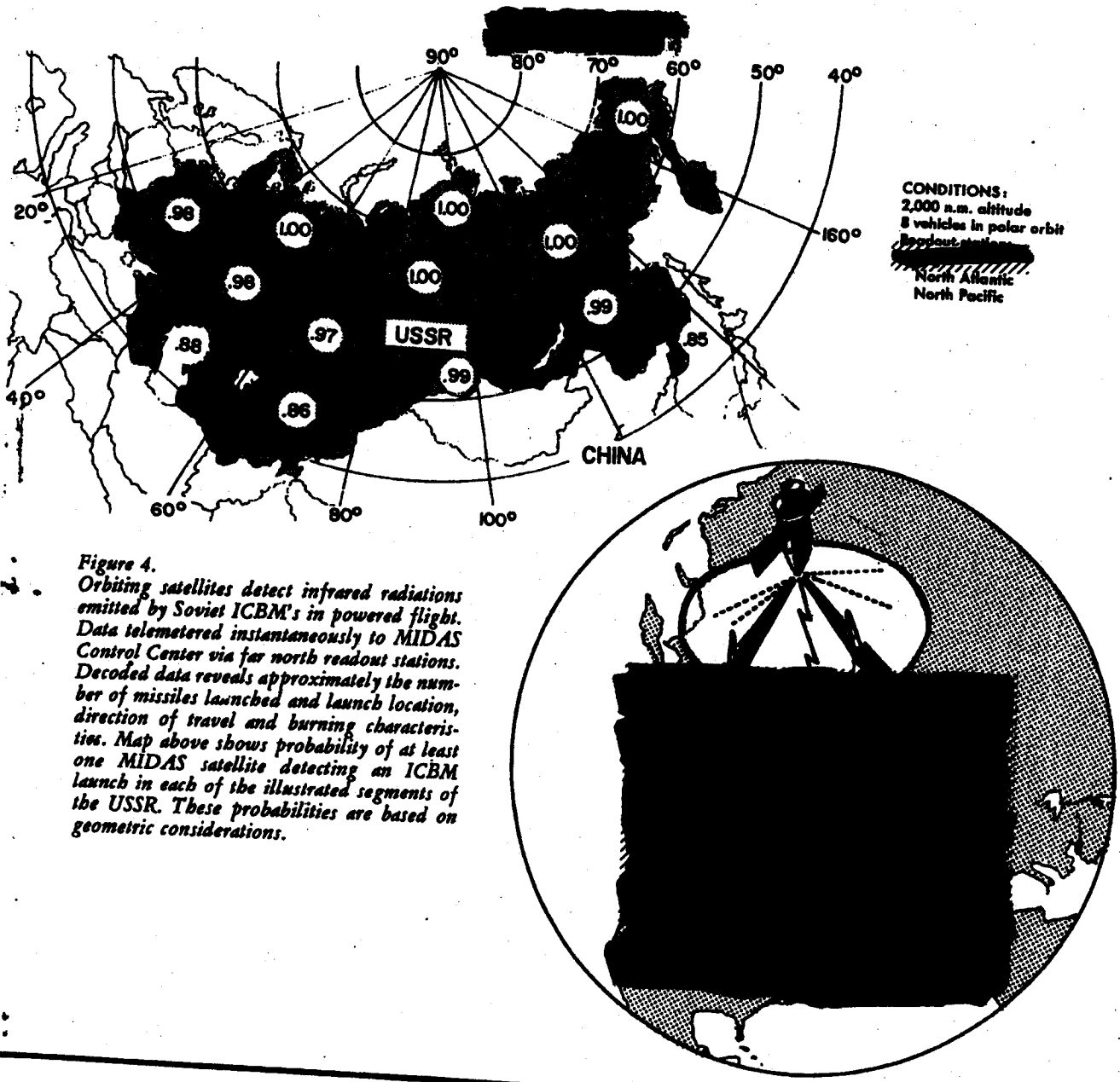

Figure 4.
Orbiting satellites detect infrared radiations emitted by Soviet ICBM's in powered flight. Data telemetered instantaneously to MIDAS Control Center via far north readout stations. Decoded data reveals approximately the number of missiles launched and launch location, direction of travel and burning characteristics. Map above shows probability of at least one MIDAS satellite detecting an ICBM launch in each of the illustrated segments of the USSR. These probabilities are based on geometric considerations.

TECHNICAL HISTORY

The MIDAS infrared reconnaissance payload is engineered to use a standard launch vehicle configuration. This consists of a "D" Series ATLAS missile as the first stage and the AGENA vehicle, powered by a Bell Aircraft rocket engine as the second, orbiting stage (Figure 1). The total payload weight is approximately 1,000 pounds.

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

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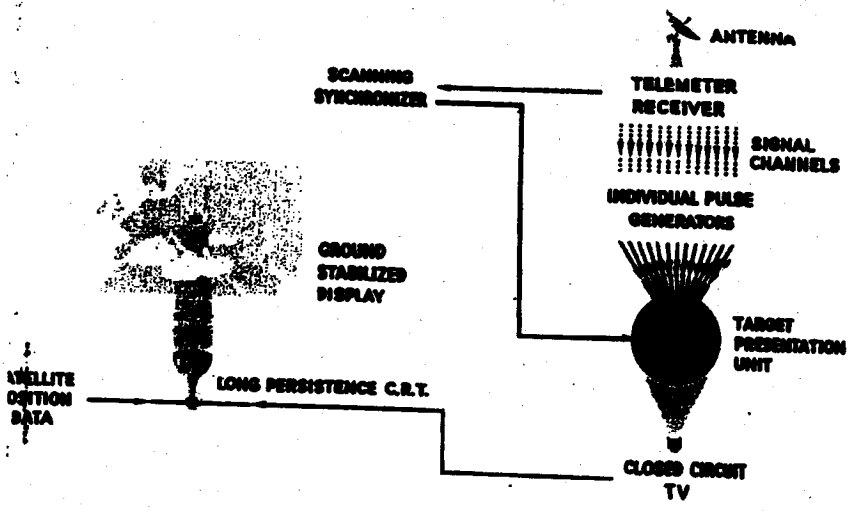
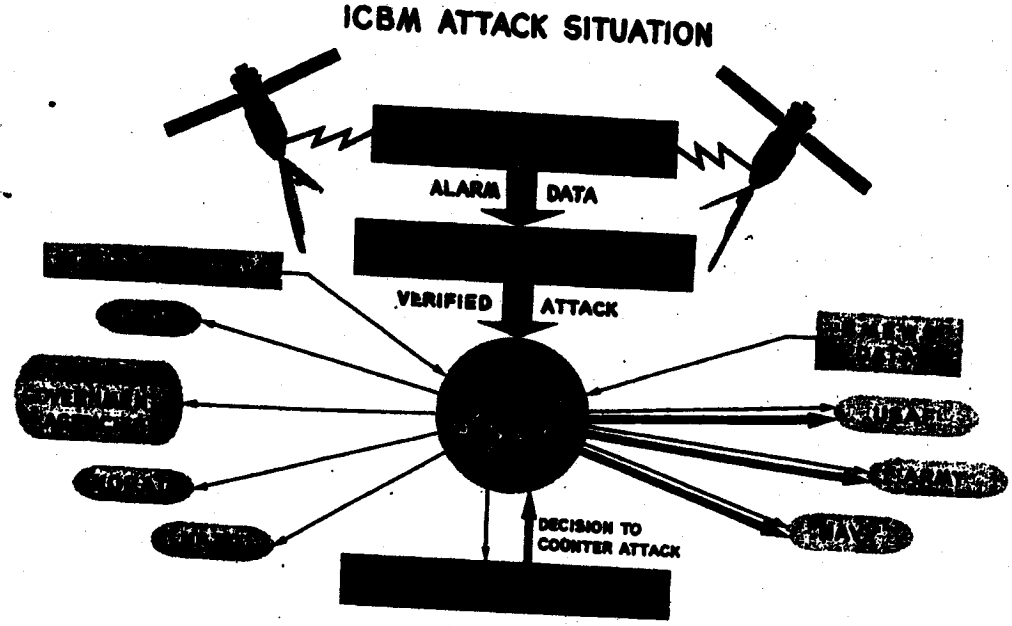


Figure 5.
Simplified version of ground presentation system (left) for display of infrared reconnaissance data. The data is displayed on a TV monitor with a map overlay. The chart below shows data flow from the readout stations to decision-making agencies. The MIDAS Control Center, or other using agencies having a correlated ground stabilized display, can determine when an actual attack has been launched. The decision to counterattack is made by the President, with all affected agencies reacting as preplanned.



CONCEPT

The MIDAS system is designed to provide continuous infrared reconnaissance of the Soviet Union. Surveillance will be conducted by eight satellite vehicles in accurately positioned orbits (Figure 3). The area under surveillance must be in line-of-sight view of the scanning satellite. Mission capabilities are shown in Figure 4. 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 Control Center where it is processed, displayed, and evaluated (Figure 5.) 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.

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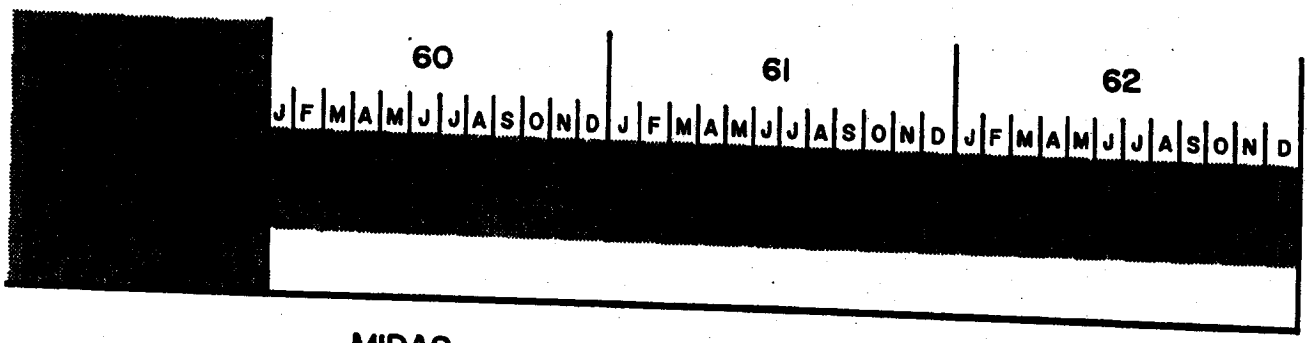

MIDAS LAUNCH SCHEDULE

[redacted]

A. BRIEF OF PROGRESS

The second MIDAS flight test vehicle was launched from the Atlantic Missile Range on 24 May. The countdown proceeded smoothly except for minor holds and liftoff was normal. Orbital performance was outstanding. A total of thirty minutes readout time was recorded during the first two passes.

AFBMD has authorized preliminary planning and design work in support of two additional MIDAS flights using THOR/AGENA vehicles obtained from the DISCOVERER Program.

A study is being made of the feasibility of extending MIDAS operational system capability to provide world-wide coverage.

A full scale mockup of the solar auxiliary power array was completed in March. Several functional tests of the mockup have been performed successfully.

Procurement has been authorized for a third Programmable Integrated Control Equipment (PICE) unit as part of the interim MIDAS equipment at the New Boston, New Hampshire tracking station. This unit will be identical to the PICE units at the Satellite Test Center and Vandenberg Air Force Base, except for a smaller memory unit and fewer access registers.

Construction of the Vandenberg Air Force Base data acquisition and processing building was essentially complete in May and ready for installation of technical equipment.

[redacted]

B. TOPICAL SUMMARY

1. *Flights*

Second MIDAS flight test vehicle launched on 24 May.

a. The second MIDAS flight test vehicle was launched from Pad 14, Atlantic Missile Range, at 1036 PST on 24 May. The countdown proceeded smoothly except for minor holds and liftoff was normal. Performance in regard to attainment of planned orbital parameters was outstanding. Acquisition was accomplished by every station.

Programmed and actual flight parameters indicate the success achieved in the launch phase of flight.

b. The high degree of success achieved in the launch phase is demonstrated by the comparison of programmed and actual ascent and orbital parameters given in Tables I and II.

PARAMETERS	PROGRAMMED	ACTUAL
Booster Cutoff	*148.8*	*146.8*
Sustainer Cutoff	*238.9*	*238.5*
Vernier Cutoff	*256.7*	*257.6*
AGENA Ignition	*551.6*	*551.1*
AGENA Cutoff	*661.1*	*660.0*

TABLE I. ASCENT PARAMETERS
(Times shown are in seconds)

PARAMETER	PROGRAMMED	ACTUAL
Apogee	*262 N. Mi.*	*280 N. Mi.*
Perigee	*262 N. Mi.*	*254 N. Mi.*
Period	*94.1 Min.*	*94.44 Min.*
Inclination Angle	*32.64°*	*33.04°*
Eccentricity	*0.0003*	*0.0025*
Injection Velocity	*25,023 fps*	*25,052 fps*
Satellite Life	*40 months*	
Active (battery) life	*28 days*	

TABLE II. ORBITAL PARAMETERS

Thirty minutes of readout time recorded on first two passes.

c. Real time display at Vandenberg Air Force Base during the first pass indicated satisfactory operation of the Aerojet-General payload. A total of thirty minutes readout time was recorded during the first two passes. This data indicate a considerable amount of infrared

[redacted]

[redacted]

background with "filter out." This data, unavailable until this flight, on the various levels of natural infrared radiation background will be most beneficial to later vehicles which must identify rocket exhaust temperatures. Payload data recordings have been received from subsequent vehicle passes, are being reduced, and will be analyzed.

Two additional MIDAS flights using THOR/AGENA vehicles obtained from the DISCOVERER Program.

d. In response to a March Headquarters USAF request, AFBMD has authorized preliminary planning and design work in support of two additional MIDAS flights using THOR/AGENA vehicles obtained from the DISCOVERER Program. The polar orbiting payloads launched from Vandenberg Air Force Base would have a useful life of four days. Each pass (eight passes per day) would provide an average readout time of four minutes. These interim flights would provide basic payload data for evaluation and analysis.

Study made to extend MIDAS operational system to provide world-wide coverage.

e. An investigation is being made of the feasibility of extending MIDAS operational system capability to provide world-wide coverage. The study, scheduled for completion in June, will consider the number of additional satellites and ground stations required to support this program.

2. *Technical Status*

a. Second Stage Vehicles

Full scale mockup of solar auxiliary power array tested.

A full scale mockup of the solar auxiliary power array was completed in March. Several functional tests of the mockup have been performed successfully. Solar cell manufacture is in progress.

b. Infrared Scanner Units—Infrared scanner units for flights 3, 4, and 5 are being manufactured by Baird-Atomic, Inc.

Bearing problem with Baird-Atomic scanner causes schedule slippage.

(1) The binding of the turret bearing during March low temperature tests of the Baird-Atomic scanner indicated that a modification of the bearing was required. A new bearing has been installed and acceptance tests were resumed in May. Delivery of this unit to LMSD is expected to be delayed until mid-July.

Development of Baird-Atomic display consoles continues.

(2) The development of the two Baird-Atomic ground presentation consoles continues with delivery expected to be compatible with payload unit delivery.

Initial design of infrared payload ground display consoles continued.

(3) Initial design of the advanced presentation unit for infrared payload ground display continued at General Electric. The first unit is scheduled for delivery in May 1961.

[redacted]

Qualification tests of the 256-channel PAM multiplexer begin.

c. Communications and Control

(1) Qualification testing of the engineering test model of the 256-channel (Model B) PAM multiplexer began in March. This unit will be used on the third MIDAS flight test. This multiplexer provides an increase in the amount of data transmitted and better quality than conventional telemetry commutation systems.

Procurement authorized for a third programmable Integrated Control Equipment (PICE) unit.

(2) Procurement has been authorized for a third Programmable Integrated Control Equipment (PICE) unit for installation in December as part of the interim MIDAS equipment at the New Boston, New Hampshire tracking station. This unit will be identical to the units at the Satellite Test Center (STC) and Vandenberg Air Force Base except for a smaller memory unit and fewer access registers. Commands from the STC to the satellite, orbital predictions and other data are transmitted through the STC PICE to the tracking station PICE for distribution in the station or transmission to the sattelite. Tracking, payload data and other data are returned through PICE to the STC for computation, display, or storage.

3. *Facilities*

Vandenberg data acquisition and processing building ready for installation of technical equipment.

a. Vandenberg Air Force Base—Construction of the data acquisition and processing building was essentially complete in May and ready for installation of technical equipment. A redesign of this building to accommodate a revised computer configuration was initiated in May. Construction has started and will be completed in July.

Construction resumed at Alaska stations.

b. North Pacific Station—Construction of the technical facilities at Donnelly Flats, Alaska, and the support facilities at Fort Greely, Alaska, were resumed on 1 April. Facilities are scheduled for completion on an incremental basis from July through October.

Site surveys continue.

c. North Atlantic Station—Surveys are being continued to find a suitable site for this station.

[redacted]

[redacted]

DISTRIBUTION

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