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MONTHLY SUMMARY OF

SPACE

Systems Division

ACTIVITIES

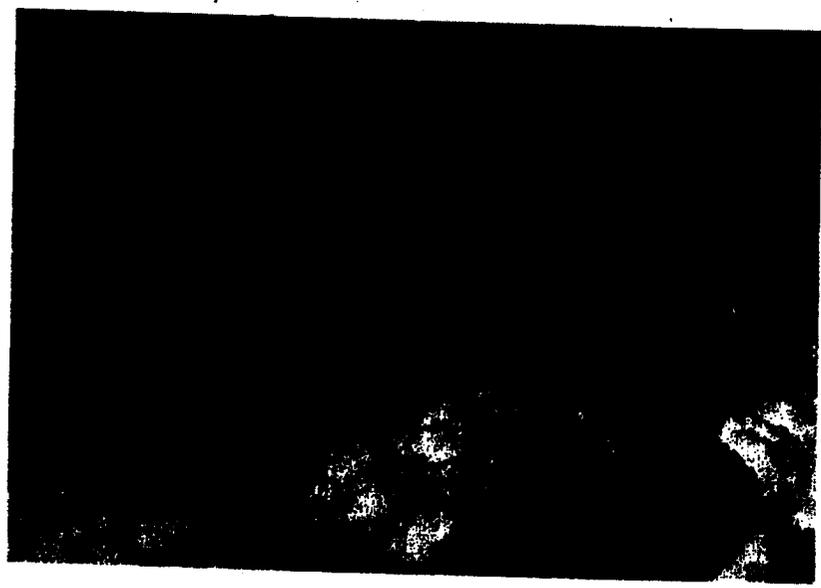
JULY 1961

**DOWNGRADE AND DECLASSIFICATION
NOT AUTOMATICALLY APPLIED**

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a foreword to...



SPACE

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HEADQUARTERS
BALLISTIC SYSTEMS DIVISION
AIR FORCE SYSTEMS COMMAND
UNITED STATES AIR FORCE
Air Force Unit Post Office, Los Angeles 45, California

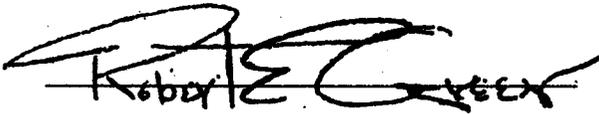
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24 August

Monthly Summary of
SPACE SYSTEMS DIVISION
ACTIVITIES
JULY 1961

FOREWORD

During July, two space vehicles were launched successfully, contributing significantly to the progress of satellite system programs. DISCOVERER XXVI was placed in orbit on 7 July. Two days later, on its 32nd orbit, the satellite capsule was returned to the atmosphere and aerielly recovered. On 12 July, the ATLAS-boosted MIDAS III was placed into a circular 1850 n.m. orbit. Payload data were received. Flight test records which have been reduced indicate that MIDAS III was successful. However, failure of one solar array to extend fully caused a partial power loss. Analysis is underway to determine the cause of this difficulty.



for
O. J. RITLAND
Major General, USAF
Commander

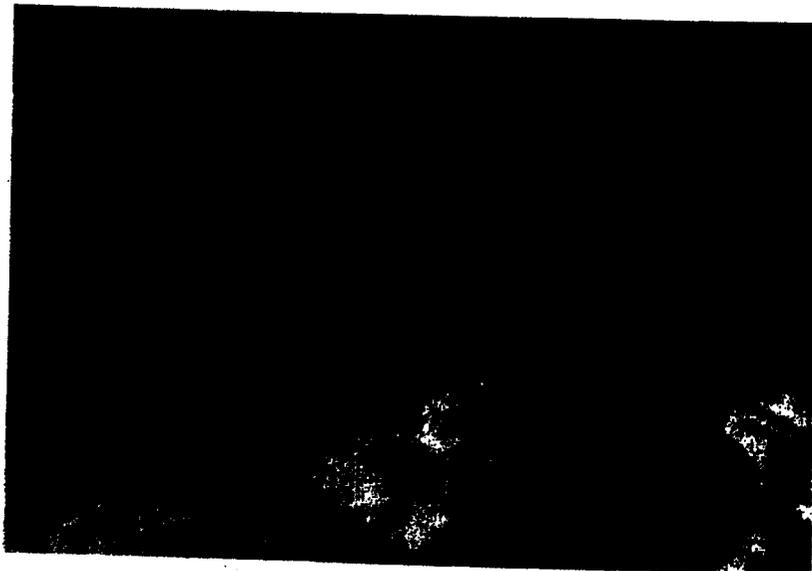
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SATELLITE

SYSTEMS



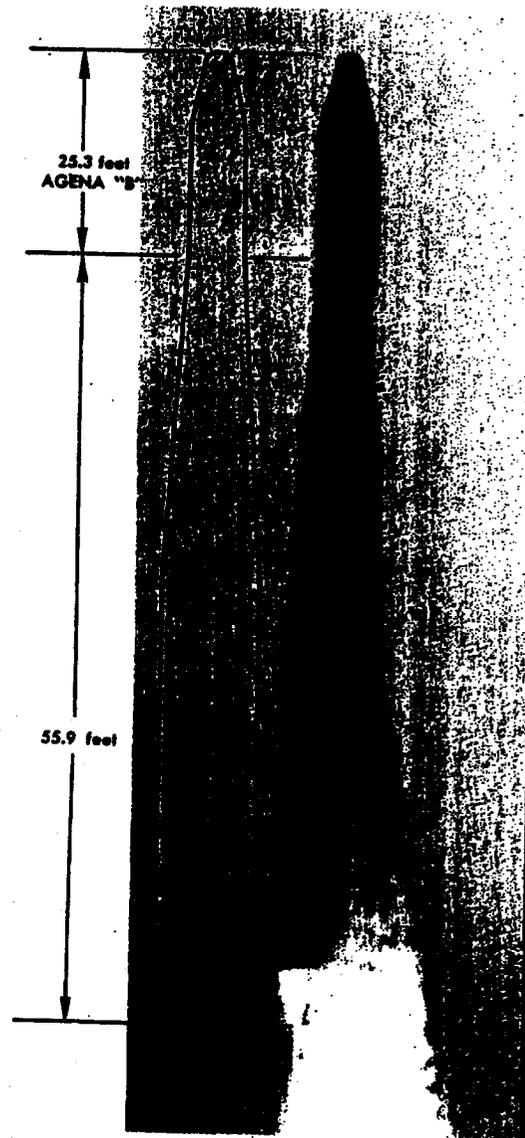
**DISCOVERER
MIDAS
BIOASTRONAUTICS
BLUE SCOUT
SAINT
VELA HOTEL**

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 advanced 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, including injection into orbit, re-entry and recovery.

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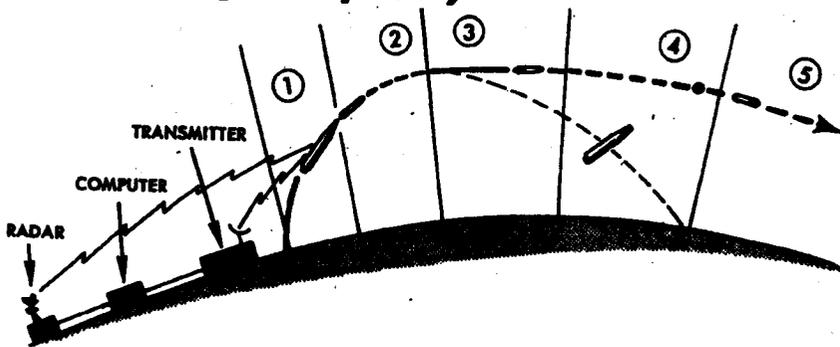
PROGRAM SUMMARY

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—	
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

Powered Flight Trajectory



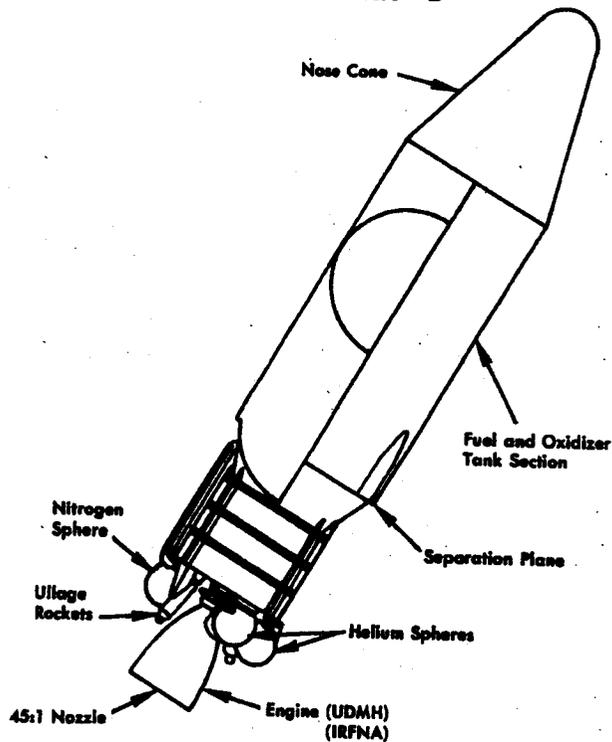
1. First Stage Powered Flight — 2.5 minutes duration, 78 n.m. downrange, guided by BTL guidance.
2. Coast Period — 2.4 minutes duration, to 380 n.m. downrange, attitude controlled by inertial reference package, horizon scanner, gas reaction jets. Receives AGENA time to fire and velocity to be gained commands thru the BTL system.
3. Second Stage Powered Flight — Approximately four minutes or until injection velocity is attained. Pitch and yaw stabilization achieved by gimbaling 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 Air Force pararescue men and 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.

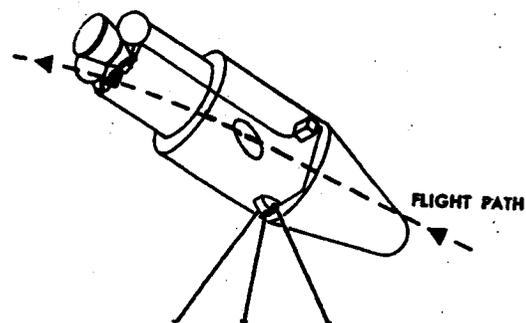
AGENA VEHICLE DEVELOPMENT

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.

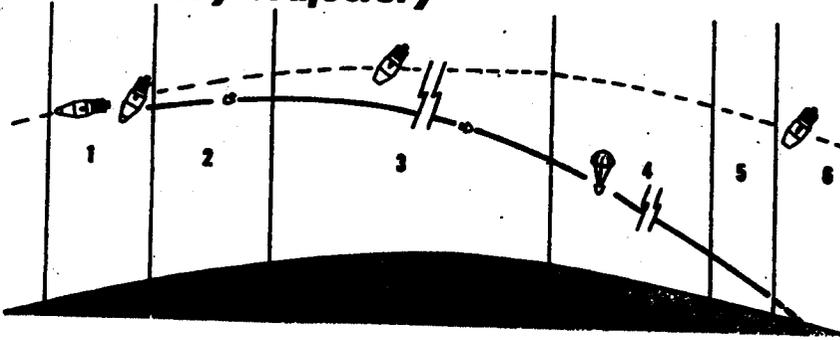
AGENA "B"



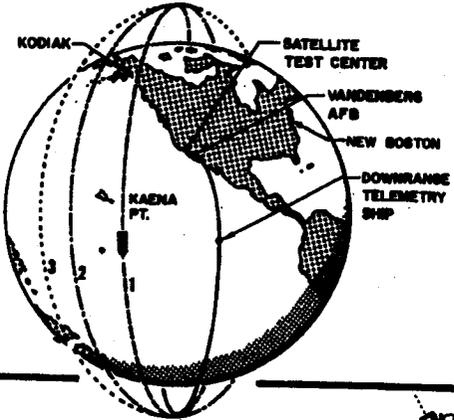
DISCOVERER/AGENA



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—18 seconds duration, capsule separates, spin gas jets fire, retro rocket fires and de-spin gas jets fire. Retro rocket and throat 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.

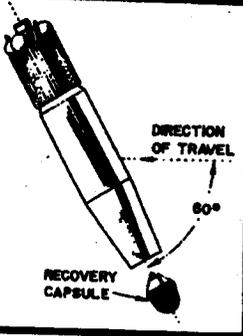


Orbital Trajectory

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 A-4.

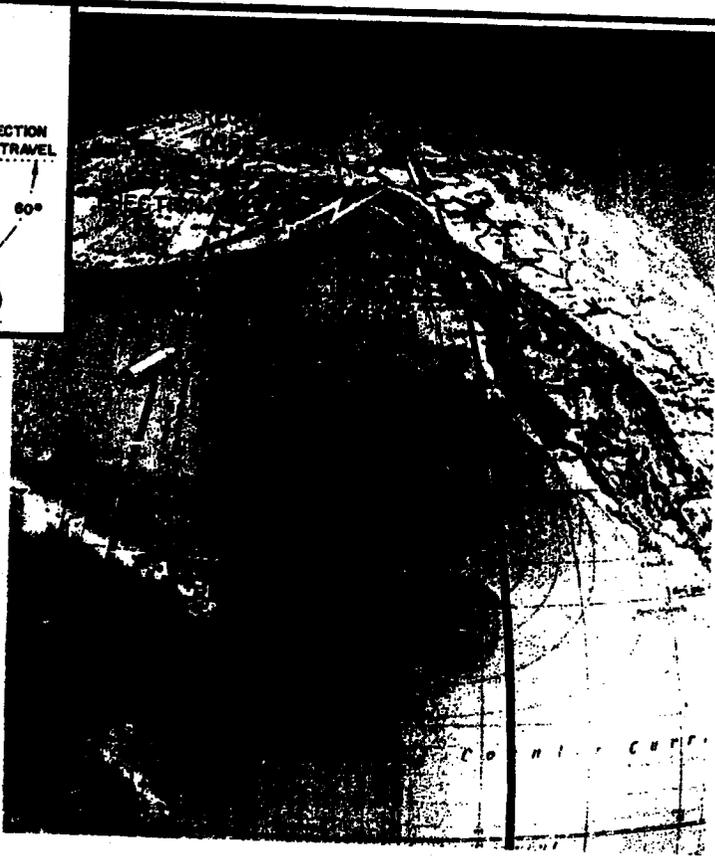
RECOVERY CAPABILITY

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 a selected orbit, for capsule impact within the predetermined recovery area near Hawaii. Aircraft and surface vessels are deployed within the area at 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 orbit, 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.



GROUND SUPPORT FACILITIES

Facility	Equipment*	Flight Function
Satellite Test Center	ABCD	Orbital control, orbit computations and predictions, acquisition data for tracking stations, prediction of recovery area.
†Vandenberg AFB Tracking Station	BDEFGHI	Ascent and orbital tracking, telemetry reception, trajectory measurements, command transmission.
Downrange Telemetry Ship	BFHI	Telemetry reception and tracking during ascent and orbit injection.
†New Hampshire Tracking Station	BDEFGHI	Orbit tracking, telemetry reception, commands to satellite.
†Kodiak Tracking Station	BDEFGHI	Orbit tracking, telemetry reception, initial acquisition on pass 1, monitor events in recovery sequence.
†Hawaiian Tracking Station	BDEFGHI	Orbit tracking, telemetry reception and transmission of commands to satellite.
Hickam AFB Oahu, Hawaii	D	Over-all direction of capsule recovery operations.
Tern Island	BFGI	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. VERLORT
- F. VHF FM/FM Telemetry Station
- G. VHF Direction Finding Equipment
- H. Doppler Equipment
- I. VHF Telemetry Antenna

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

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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	<i>Attained orbit successfully. Non-recoverable, radio-metric data gathering MIDAS support flight.</i>
XXII	300	1105	30 March	<i>Launch, ascent, separation, coast and orbital stage ignition normal. Orbital velocity was not attained because of an AGENA hydraulic malfunction.</i>
XXIII	307	1106	8 April	<i>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.</i>
XXIV	302	1108	8 June	<i>Failed to attain orbit because of a second stage malfunction.</i>
XXV	303	1107	16 June	<i>Attained orbit successfully. Capsule recovered from the ocean after two days on orbit. All objectives achieved.</i>
XXVI	308	1109	7 July	<i>Attained orbit successfully. Capsule was ejected on the 32nd orbit and aerial recovery was accomplished. All objectives achieved.</i>
XXVII	322	1110	21 July	<i>Failed to attain orbit because of severe booster pitch oscillation.</i>

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Flight History (continued)

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

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Monthly Progress - DISCOVERER

Flight Test Progress

DISCOVERER XXVI Flight

• DISCOVERER XXVI was launched from Vandenberg Air Force Base at 1629 PDT on 7 July and was injected into a near-nominal orbit. All events during launch, boost, separation, coast, AGENA burn and orbital injection occurred as planned except for a longer than normal AGENA burn time. This is attributed to an error in the accelerometer-integrator system. Table I shows the predicted and attained orbital parameters. (C)

Event	Programmed	Actual
Apogee, statute miles	293.6	505.5
Perigee, statute miles	147.4	142.8
Period, minutes	91.6	95.02
Eccentricity	0.0175	0.0421
Inclination Angle, degrees	81.5°	82.9°

Table I. Comparison of Programmed and Actual Orbital Parameters for DISCOVERER XXVI

• All subsystems operated satisfactorily throughout the orbital flight. The thermostatically controlled electric heaters installed on the control valves performed successfully. As planned, capsule recovery

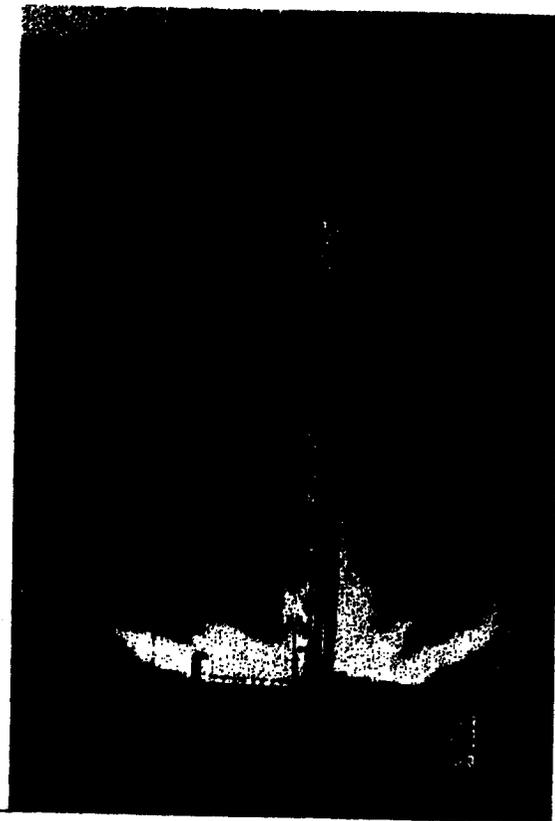


Figure 1. Launch of DISCOVERER XXVI on 7 July from Vandenberg Air Force Base.

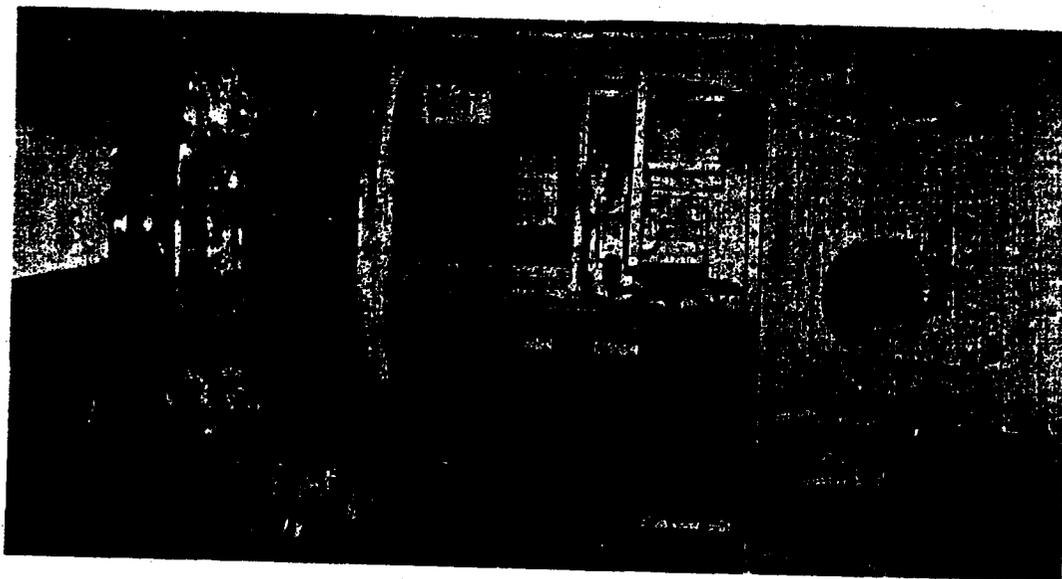


Figure 2. Discoverer XXVI AGENA B vehicle showing the space research instruments furnished by the Geophysical Research Directorate (center). The new "scuppers" are visible on the right of the experiment packages. They are part of a system for draining propellant slippage at liftoff. The rectangular box on the lower left is the attitude control valve heating element installation. These modifications corrected problems that had occurred on previous flights.

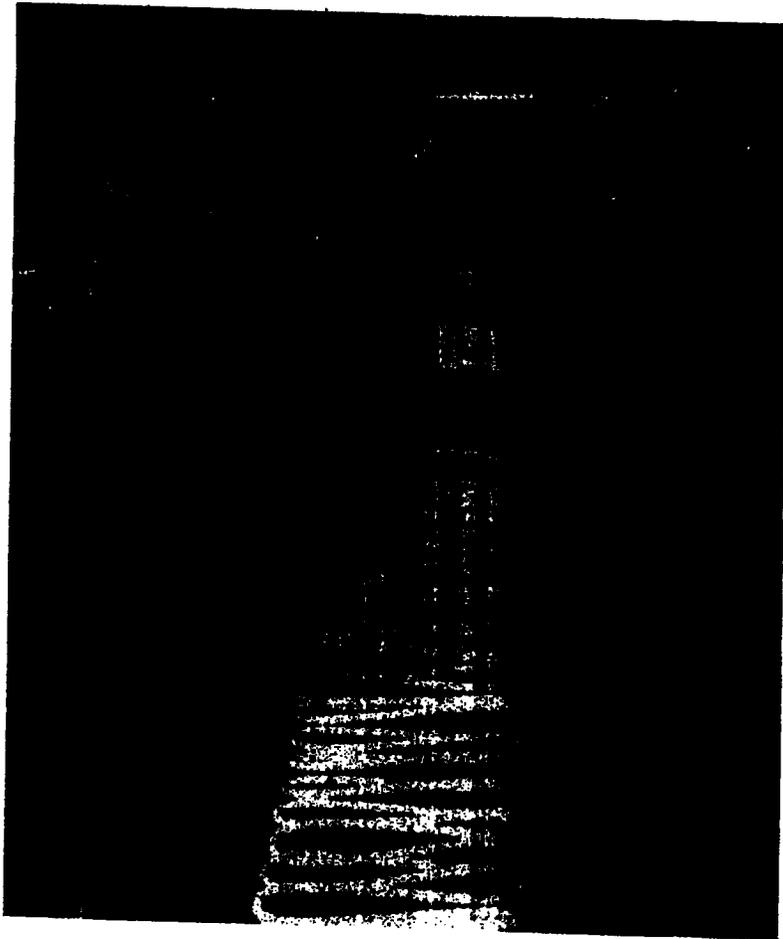


Figure 3. Recovery force airman (left) tying shock cord into the trough of the recovery aircraft. Cord from the winch reel is tied in zig-zag fashion to the trough. The insert (above) provides a close-up of the ties. When the parachute is caught, the string ties break and help cushion the shock. The hook which snags the parachute of the descending capsule is shown below.



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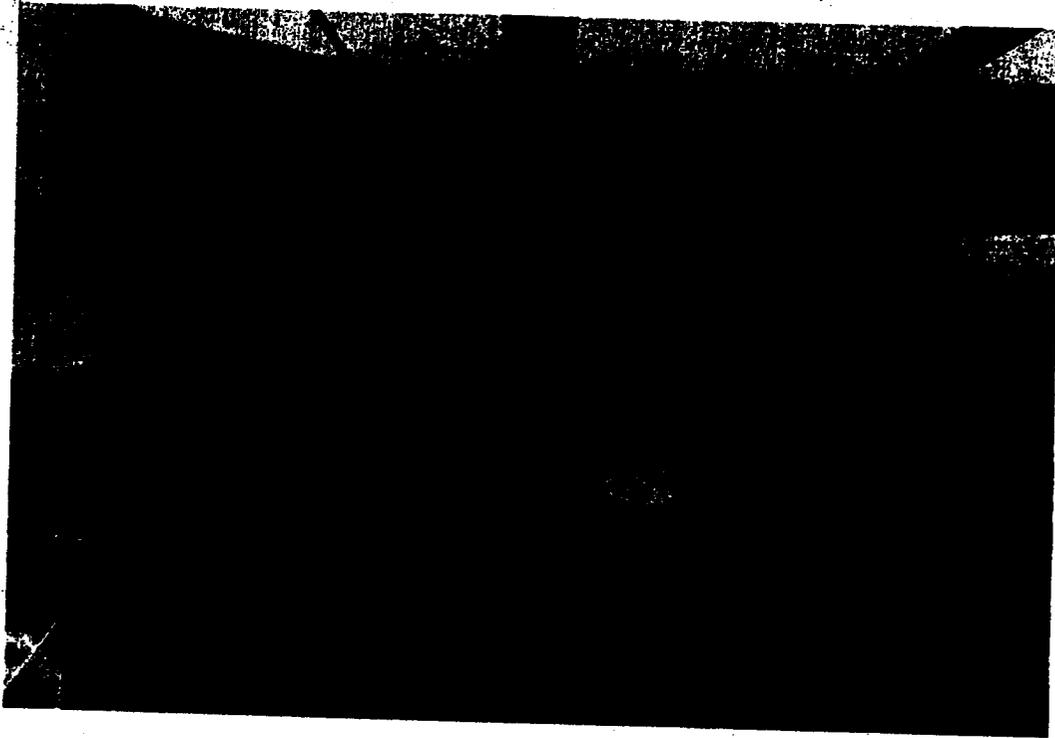
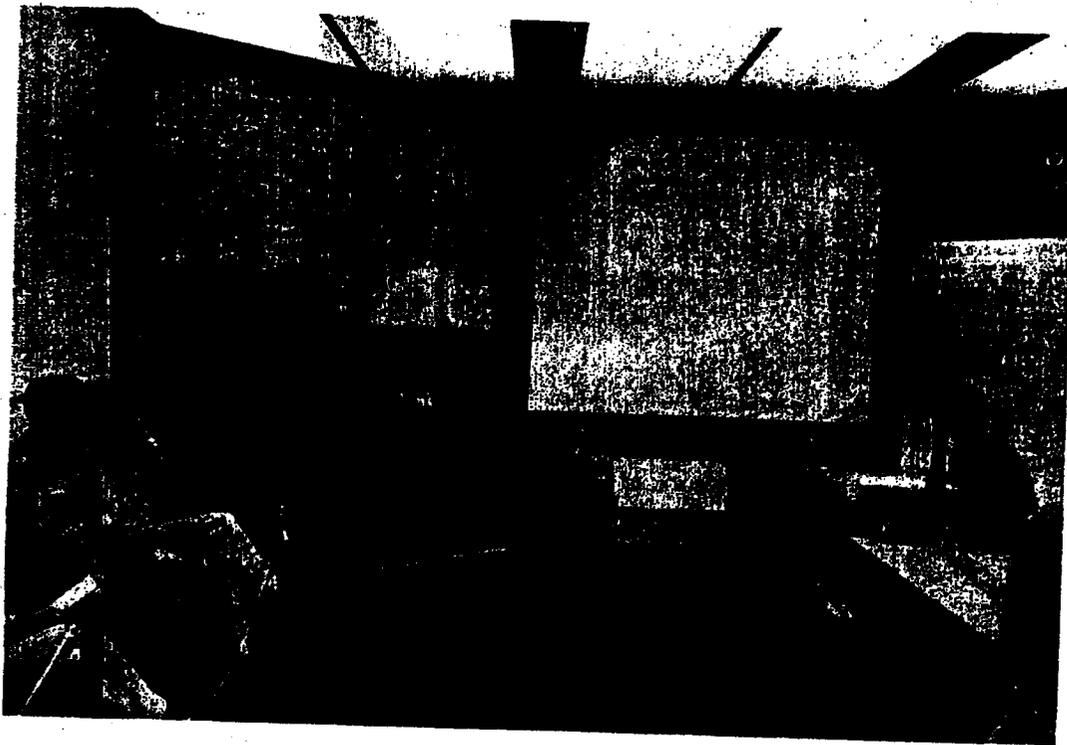


Figure 4. Views of the Hawaiian Control Center during recovery operations which resulted in the air-recovery of the DISCOVERER XXVI capsule. Prior to the start of the recovery operation, the predicted capsule impact point is determined. Then the aerial and sea forces are deployed and controlled from this center. All reports of contact are recorded on the glass charts, left. Reports of bearings taken on the descending capsule by the recovery craft, Tern Island and Kaena Point are projected on the screen, center.



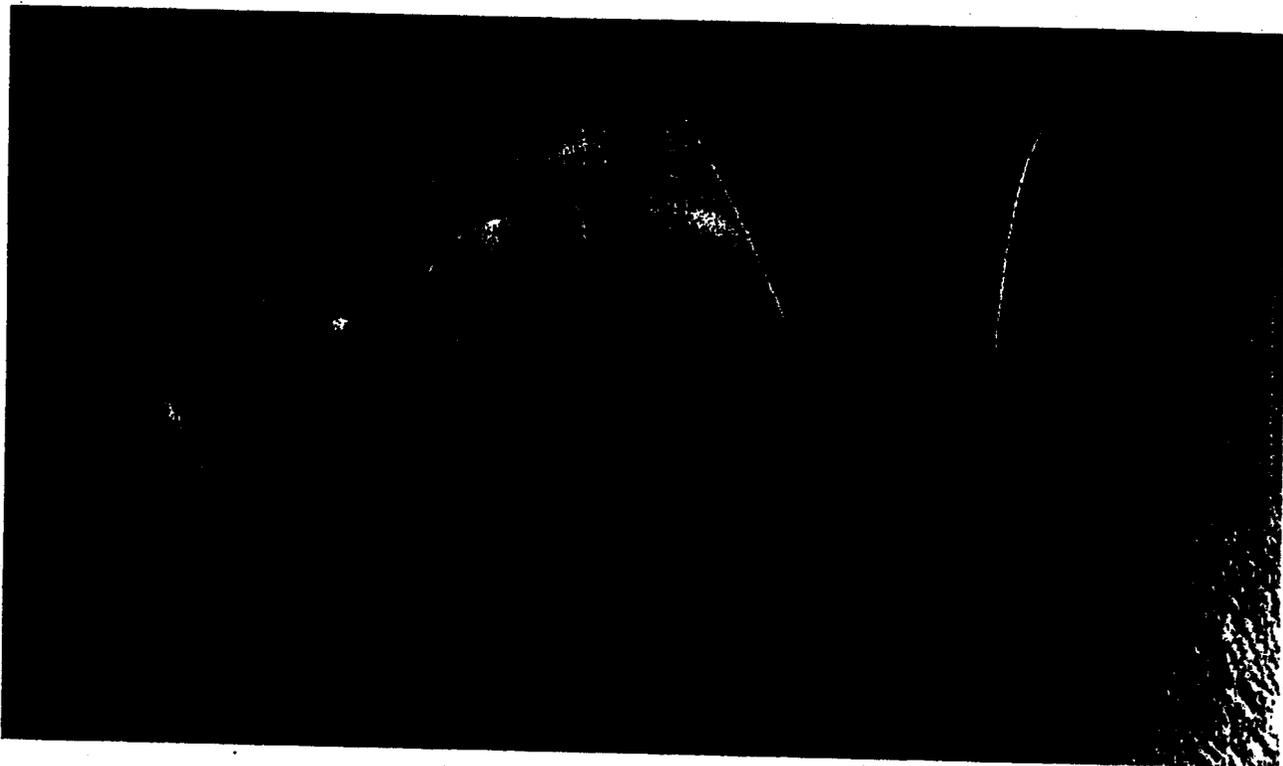
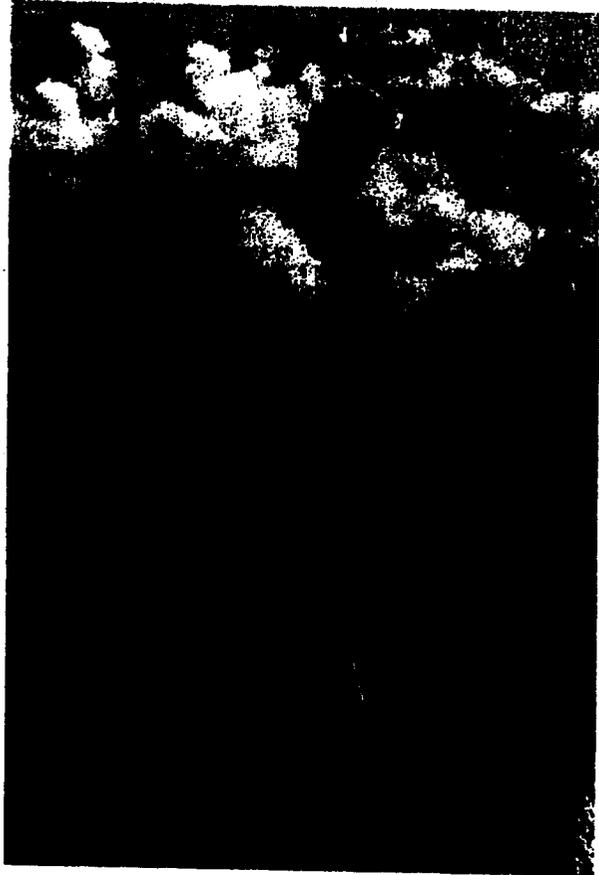
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DISCOVERER XXVI CAPSULE RECOVERY



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was initiated on the 32nd pass (two days on orbit) at 1905 PDT on 9 July. All events occurred as programmed and the capsule followed the predicted descent trajectory. The capsule was sighted northwest of Hawaii and aerial recovery was accomplished. This was the fourth DISCOVERER capsule recovered by the airborne forces, two other capsules have been recovered from the sea. Following capsule ejection, the AGENA satellite reoriented to its normal "on-orbit" attitude and operated satisfactorily for the remainder of its battery life. (C)

DISCOVERER XXVI Experiments

• As part of the continuing program designed to measure the space environment and determine radiation effects on various materials, nearly 45 pounds of instruments and specimens were carried on the DISCOVERER XXVI satellite vehicle and its capsule. The capsule carried "poker chip" samples of iron, nickel, ytterium, titanium, magnesium, lead and bismuth. Some of the samples were returned to the Air Force Geophysical Research Directorate for evaluation and the remainder are being analyzed by Lockheed scientists. Three canisters were also recovered with the DISCOVERER XXVI capsule. One contained various dosimeters and was returned to the Air Force Special Weapons Center. Another contained inert biological materials (cellulose products) and was transmitted to the Space Systems Division for analysis. Various metal and film samples were included in the third canister to provide information on the effects of space radiation on photographic materials. Analysis of the specimens is in process. (S)

• The non-recoverable Geophysical Research Directorate equipment, which was mounted on the module that replaces the engine access door, included two atmospheric density gages, two micro-meteorite detectors, a cosmic ray monitor and temperature probes. During the flight, data from these instruments were telemetered to tracking stations via the AGENA telemetry system. The information was sent to the Geophysical Research Directorate for reduction and analysis. Inspection of the raw data indicated that all instruments operated satisfactorily and the data obtained appeared to be valid. (U)

DISCOVERER XXVII Launch

• DISCOVERER XXVII was launched from Vandenberg Air Force Base at 1535 PDT on 21 July. A DM-21 booster pitch oscillation, evident immediately after launch, became severe after approximately one minute of flight. The vehicle apparently broke up at this time. A destruct command was sent at T + 95.1 seconds. Three minutes after launch the DISCOVERER satellite S-band beacon signal was lost and approximately two and one-quarter minutes later, booster telemetry was lost. The DISCOVERER satellite reached an altitude of only 35,000 feet and impacted twelve to fifteen miles down-range. Ships from the Pacific Missile Range located main parts of the DM-21 booster, but were unable to recover the parts connected with the failure. (C)

Future Flights

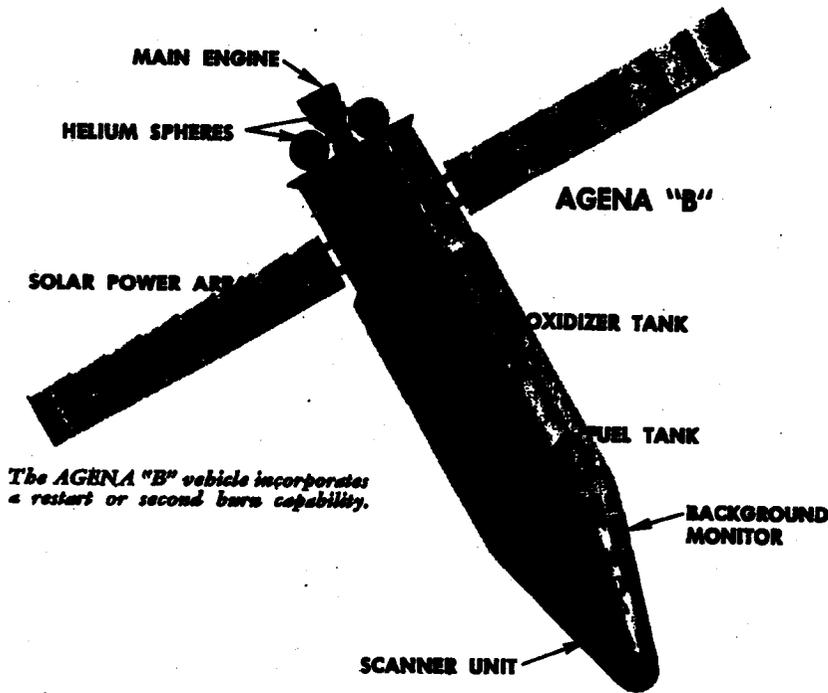
• The next three DISCOVERER satellites will carry recoverable capsules with recovery planned after between one to four days in orbit. (C)

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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	XLR81-8a-9	
Thrust, lbs. (vac.)		16,000
Spec. imp., sec. (vac.)		290
Burn Time, sec.		240
Restart Provisions		Yes

MIDAS



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



BOOSTER—ATLAS ICBM

Weight—Dry		16,100
Fuel, RP-1		74,900
Oxidizer (LOX)		172,300
GROSS WEIGHT (lbs.)		262,300
Engine—MA-2		
Thrust (lbs. vac.)	Booster	356,000
	Sustainer	82,100
Spec. imp. (sec. vac.)	Booster	286
	Sustainer	310

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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.

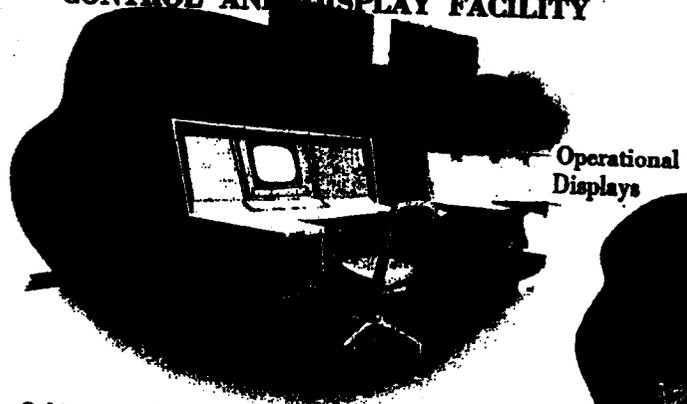
A program of complete system development, including the ground environment of MIDAS, has been submitted to the Department of the Air Force and has been approved in principle and objective. Authorization has been received to initiate action implementing the plan with reconsideration for approval to be 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 utilize the ATLAS "D"/AGENA "B" configuration programmed to place the payload in a circular 2,000 nautical mile polar orbit.

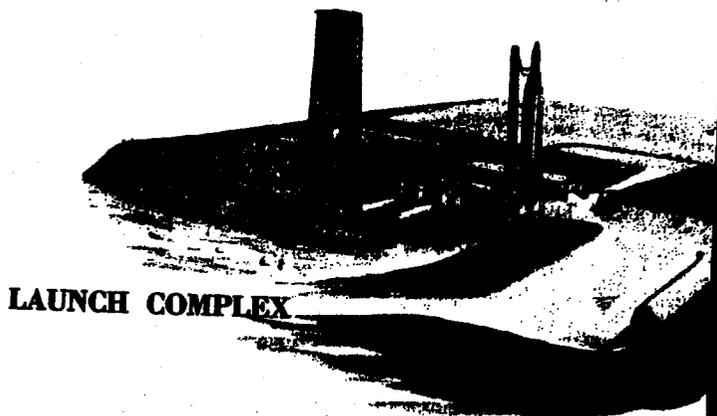
CONTROL AND DISPLAY FACILITY



Orbiting satellites detect infrared radiation emitted by ICBM's in powered flight. Data is telemetered instantaneously to Midas Tracking and 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 displayed in near real time on the control consoles and operational displays at the Control and Display Facility. 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 R&D satellites into polar orbits.



TRACKING AND CONTROL CENTER



LAUNCH COMPLEX

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Satellite Vehicle

*Eight MIDAS Satellites — four each in
two orthogonal polar orbital planes
— at 2,000 n.m. altitude*

Donnell

READOUT STATION

Electronic Equipment

ENTER

*Sunnyvale
Satellite Test Center*

Point Arguello Launch Complex

*and
Mission
Station*

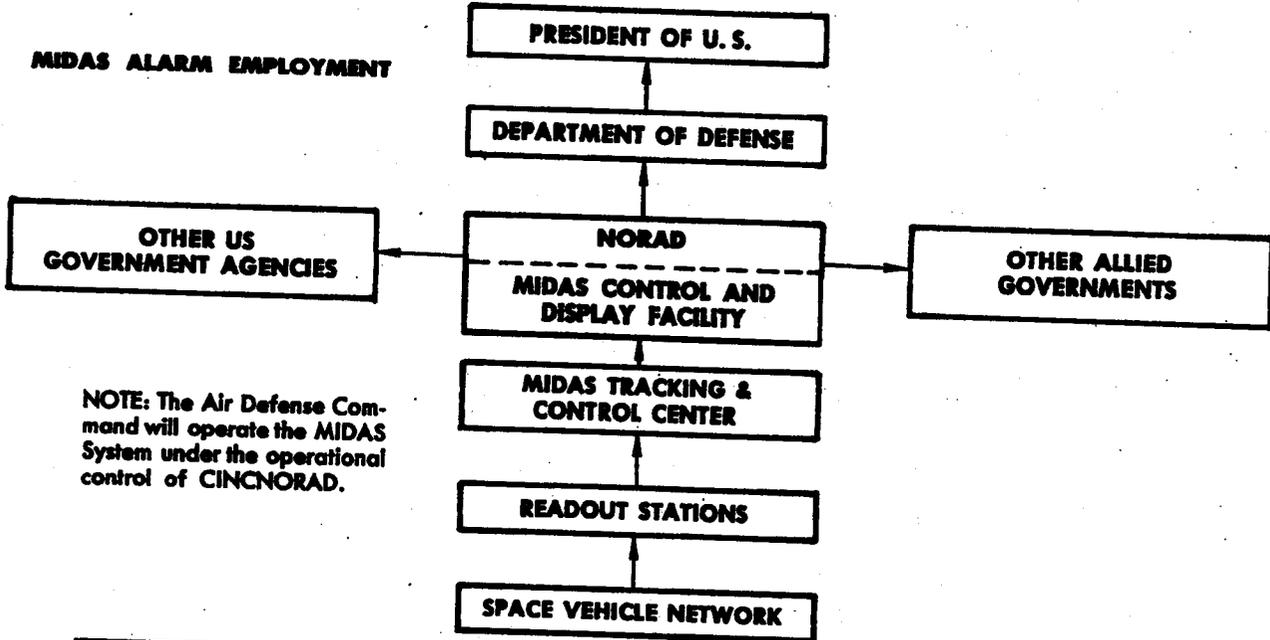
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MIDAS ALARM EMPLOYMENT



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 Control and Display Facility. 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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Flight History

MIDAS No.	Launch Date	ATLAS No.	AGENA No.	Remarks
I	26 February	29D	1008	<i>Did not attain orbit because of a failure during ATLAS/AGENA separation.</i>
II	24 May	45D	1007	<i>Highly successful. Performance with respect to programmed orbital parameters was outstanding. Useful infrared data were observed and recorded.</i>
RM-1	20 December	DISCOVERER Vehicle		<i>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.</i>
RM-2	18 February	DISCOVERER Vehicle		<i>All channels functioned properly and valid data were obtained on six stable orbits. Data confirmed previous radiometric measurements.</i>
III	12 July	97D	1201	<i>Extremely successful. Second firing of the second stage occurred as programmed. AGENA B vehicle was stabilized in an 1850 nautical mile circular orbit with an eccentricity of 0.0039. Operation of the payload and data link was excellent. Because of an electrical power loss, apparently caused by the failure of one solar array panel to extend, data acquired subsequent to pass fire was limited to Van Allen belt radiation information. Inability to properly control power consumption by appropriate and timely vehicle command programming resulted in nearly complete power deterioration within the succeeding several orbits. Van Allen radiation measurements will be obtained during the anticipated 60-90 day battery life of the High Energy Proton Damage Experiments (HEPDEX) package.</i>

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

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Monthly Progress -- MIDAS

Program Administration

• Lockheed Missiles and Space Company is continuing preliminary design of their proposal for a "simplified" MIDAS satellite configuration. Fundamental to the "simplified" MIDAS concept is the use of an orbital network of randomly distributed satellites as opposed to the controlled distribution previously proposed. System analyses are being conducted by LMSC, Aerospace Corporation, and Lincoln Labs to determine the coverage capability of the random network which will be evaluated in the light of operational requirements to be established by the Air Defense Command. (S)

• During July, Air Defense Command personnel were briefed on MIDAS coverage for various satellite network configurations. The purpose of these briefings was to acquaint ADC personnel with the fundamentals involved to facilitate their analysis which will result in determination of MIDAS operational requirements. (S)

Flight Test Progress

• On 2 July the countdown of MIDAS III went to T-6 seconds when an ATLAS booster malfunction caused the launch to be rescheduled to 10 July. The second countdown proceeded to T-0 when a malfunction of the ATLAS umbilical caused the booster engines to shut down immediately after ignition. The malfunctions were corrected and MIDAS III was successfully launched into orbit from Point Arguello Complex 1, Pad No. 2 at 0811 PDT on 12 July. Throughout ascent and orbit injection, booster and satellite engine performance were extremely close to the predicted values. Table I shows the predicted and attained orbital parameters. (C)

Event	Programmed	Actual
Apogee, nautical miles	1850	1891.2
Perigee, nautical miles	1850	1849.2
Period, minutes	161	161.5

TABLE I. COMPARISON OF PROGRAMMED AND ACTUAL ORBITAL PARAMETERS FOR MIDAS III.

• A number of significant firsts in space technology were achieved or proven during the MIDAS III flight.

1. The ability of the ATLAS/AGENA B (3672 pounds orbital weight) to successfully establish a

programmed, oriented, and stabilized 1850 n.m. circular orbit with 0.0039 eccentricity.

2. AGENA B dual burn performance.

3. ATLAS D/AGENA B compatibility.

4. Measurement of the high energy proton spectrum of the Van Allen belt from 90° to the equator. (S)

• Review of the flight data to date indicates that MIDAS III was highly successful. Failure of one solar array to extend fully caused a partial loss of power for transmittal of payload and vehicle telemetry data. The flight test data are being reduced and analyzed to determine the cause of this difficulty. (S)

• Considerable payload data, including vehicle systems information, were received through the fifth orbital pass. These, together with tracking data, indicated successful operation of second burn, re-orientation, initial attitude stabilization and satisfactory performance of the payload. (S)

• Vehicle "real time" command control was successfully accomplished on pass number one and pass number five activating payload operation and telemetry. However, deficiencies were revealed in the design of ground equipment and ground "command and control" operating procedures by the inability to resolve the emergency created by receiving only partial power from the solar array. The inability to formulate and load the required "stored program" commands into the vehicle contributed to the indicated early depletion of vehicle power and subsequent loss of payload data link and vehicle status telemetry. Vehicle status telemetry was received on pass one as programmed through stored commands loaded prior to launch. (S)

• The payload data received were still undergoing analysis at the close of the report period. Analysis thus far indicates no observed background, normal sensitivity, and verification of thermal and mechanical design. (S)

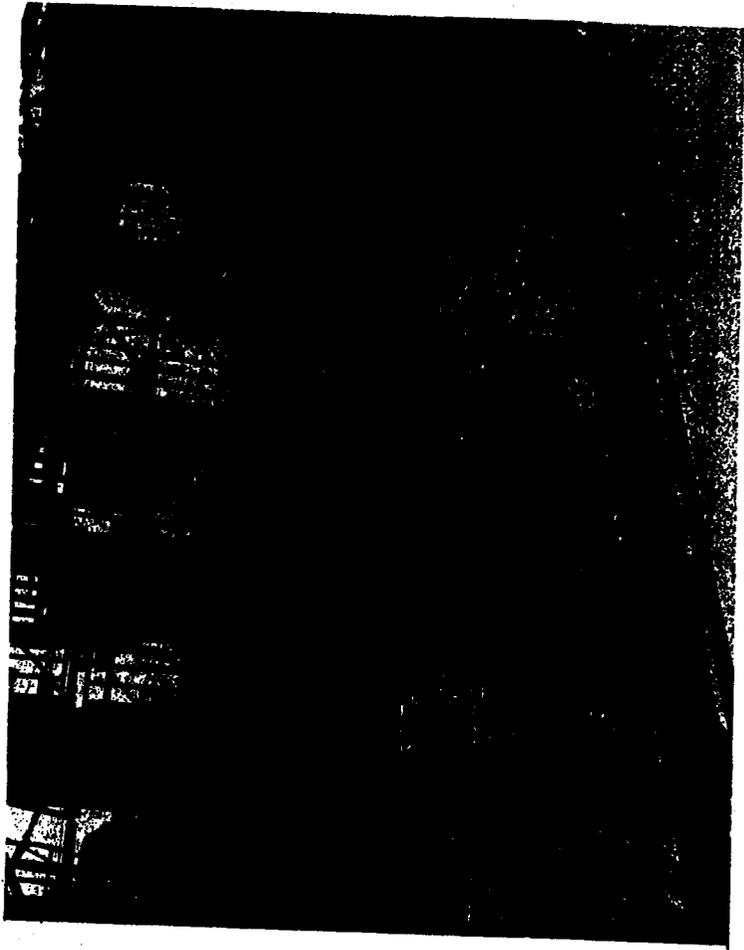
• Van Allen radiation measurement data required as a mission objective for MIDAS III were still being provided by the High Energy Proton Density Experiment (HEPDEX) at the close of the report period. The HEPDEX equipment power supply is independent of the solar array system and the data transmissions were still being received by all tracking stations on the satellite's 205th pass. (S)



Figure 1. Installation of the solar array (above) on MIDAS III. The new attitude control valve heating element installation is mounted at the 12 o'clock position behind the flame shield. This installation insured operation of the control valves in the extreme cold of space. Fastening a shield behind the ullage rocket (left). These solid propellant engines fire prior to main engine ignition and accelerate the vehicle to force the fuel and oxidizer toward the rear of the tank.

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Figure 2. Hoisting AGENA vehicle 1201 (right) above ATLAS 97D for mating as MIDAS III. Installing the Baird-Atomic payload (below) on the MIDAS III AGENA vehicle. This flight verified the thermal and mechanical design of the payload.

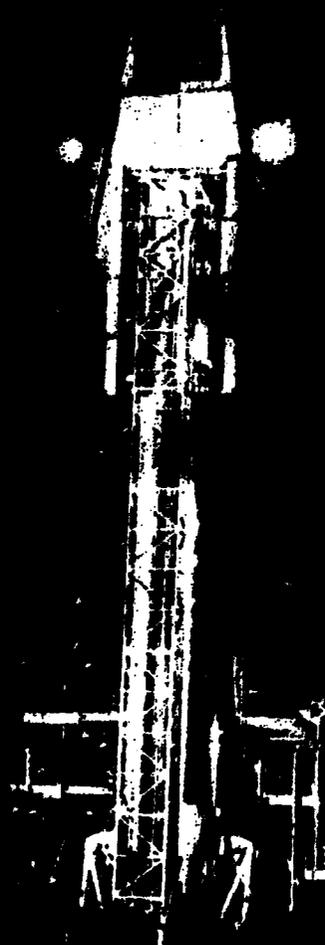


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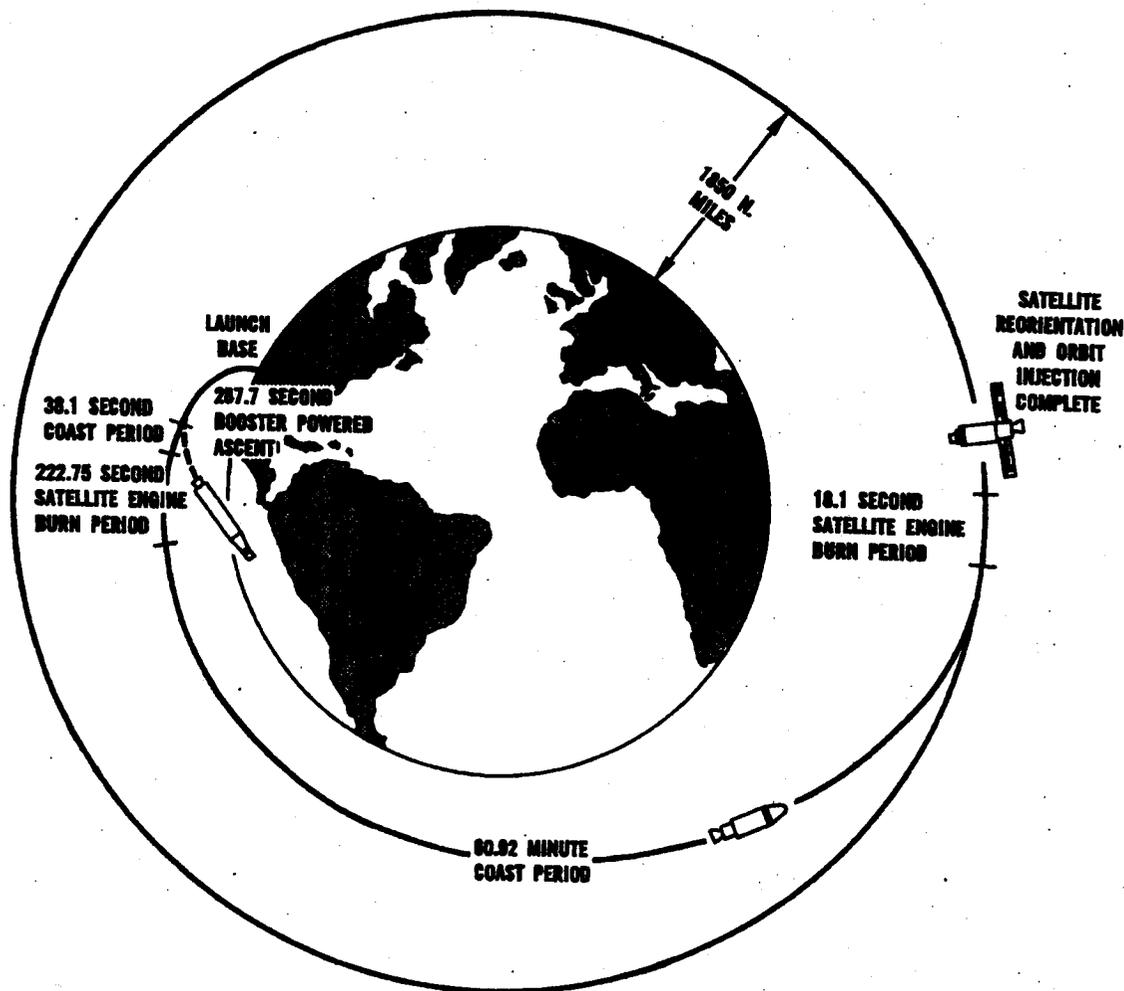


Figure 4. MIDAS III TRAJECTORY

Technical Progress

Boosters

- ATLAS 105D is presently "on stand" at Point Arguello and is being readied for MIDAS IV. (S)

Second Stage Vehicles

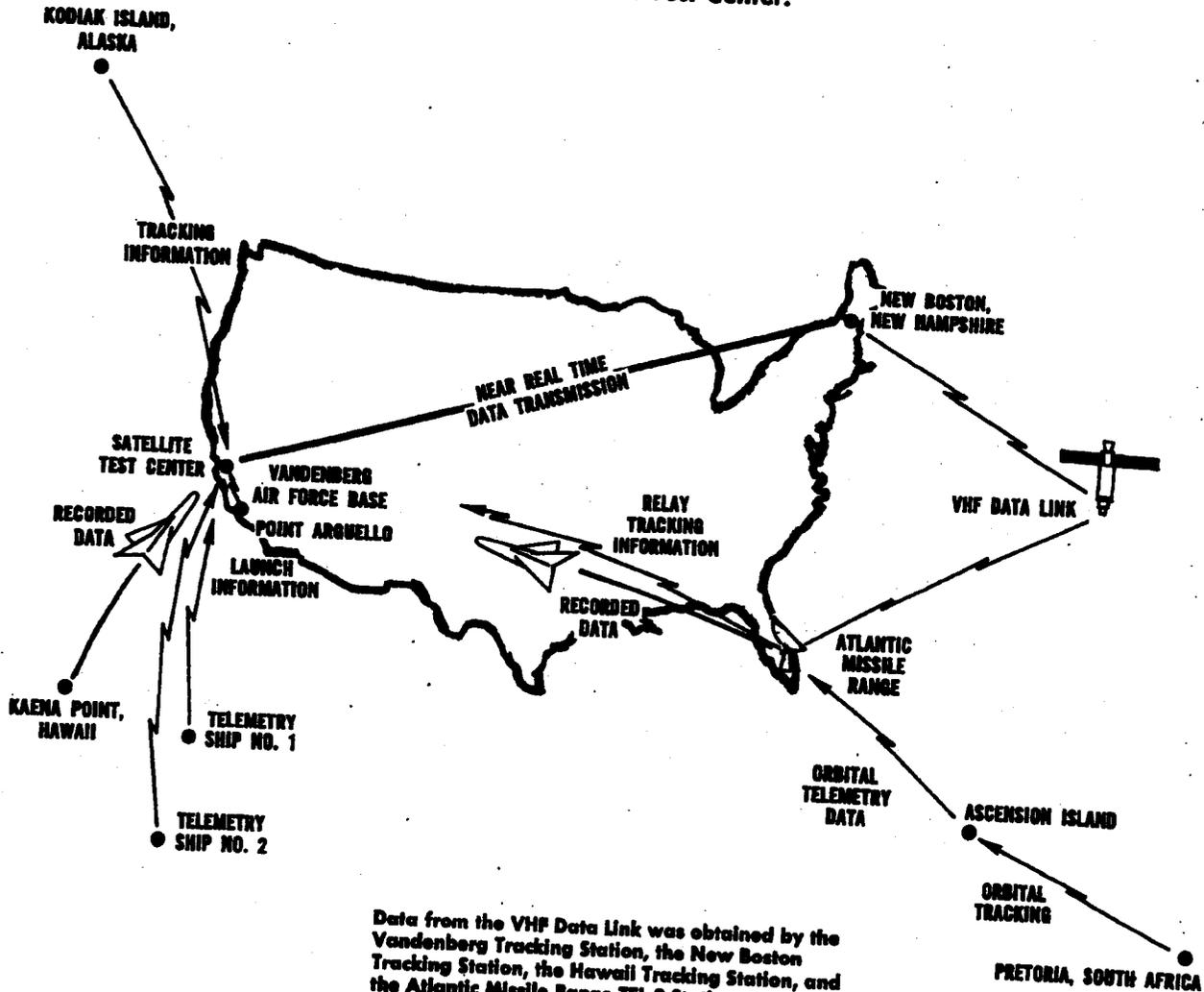
- The MIDAS IV vehicle (1202) completed operations at the Systems Test Complex, was shipped to Santa Cruz Test Base for flushing, and arrived at the Vandenberg Air Force Base Missile Assembly

Figure 3. Early morning photograph, opposite page, of MIDAS III at Point Arguello, Pad No. 2. This flight demonstrated the ability of the ATLAS D/AGENA B combination to establish a programmed, oriented, and stabilized 1850 nautical mile circular orbit with a 0.0039 eccentricity.

Building. During the inspection at the Missile Assembly Building, pin hole leaks were detected in an oxidizer fill line weld. The part was x-rayed and weld porosity was determined to be the cause. The defect was corrected. (S)

- During July the Air Force Space Systems Division initiated action to effect equipment changes to MIDAS IV, which will allow a higher orbital altitude (2050 n.m.) for participation in the Westford experiment. These changes include the deletion of the vacuum bearing tester, all Geophysical Research Directorate equipment, the APL doppler equipment and its power supply, the Speidel tape recorder and

Tracking Stations which received data from the VHF Data Link and the method of transmission to the Satellite Test Center.



Data from the VHF Data Link was obtained by the Vandenberg Tracking Station, the New Boston Tracking Station, the Hawaii Tracking Station, and the Atlantic Missile Range TEL 3 Station. Data obtained by Vandenberg was displayed in real time at Vandenberg. Data was transmitted in real time from the New Boston Station to the Satellite Test Center for display and analysis. Recorded data from Hawaii and AMR was flown to the Satellite Test Center for analysis and evaluation.

Ascent telemetry was obtained by the Vandenberg Tracking Station and the two telemetry ships. This information was transmitted in near real time to the STC by voice and teletype.

Orbital injection and tracking information was obtained by the South African Station and by the Kodiak Tracking Station and transmitted to the STC by voice and teletype.

Experimental telemetry data was received and recorded by the AMR station at Ascension Island.

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the R&D radiometer. Modifications are also being made to:

1. Increase the reliability of the solar array extension mechanism.
2. Provide "real time" commands for operation of the "S" band tracking beacon and vehicle status telemetry (FM/FM) readout.
3. Provide for transmission of selected, critical, vehicle status telemetry data over the SAPUT telemetry system.
4. Provide additional instrumentation of the solar array.

Vehicle changes are currently being implemented at the Vandenberg Air Force Base Missile Assembly Building. Satellite control procedures are being changed to provide more positive control and to improve backup procedures for operation if primary operational modes fail. MIDAS IV is scheduled for delivery to the launch pad on 3 September. (S)

After completing the flushing operation at the Santa Cruz Test Base, the MIDAS V vehicle was returned to the Lockheed Sunnyvale facilities and started integrated systems tests on 19 July. Systems tests will be conducted in a manner to comply with a pad ready concept that is expected to reduce the vehicle time in the Missile Assembly Building from 28 to 6 days. (S)

Infrared Scanners

- MIDAS Series III payload subassemblies completed acceptance tests at the Aerojet-General facility and data from these tests are being analyzed. The complete systems test of this payload is currently being accomplished. The first MIDAS Series III payload is scheduled for flight on MIDAS VI in early 1962. (S)

Facilities

- Construction on Point Arguello Launch Complex No. 2 was started on 1 July. All major items required during construction have been ordered by the contractor. Excavation for launch stand No. 3 is now under way and construction of the complex main access road and the access road to Stand No. 3 is progressing satisfactorily. Trailers to be used as "on site" offices by Navy, Air Force and contractor supervisory personnel have arrived. Initiation of a Critical Path Scheduling (CPS) program as a management tool for construction of this complex is believed to be the first use of this technique within the Air Force during facility construction. (U)
- Modification of the Vandenberg Air Force Base Technical Support facilities is in progress with beneficial occupancy scheduled for 30 August. The second increment of this package is now scheduled for contract award on 7 August, within limitations of FY 61 fund availability. The final increment of the modification effort will be awarded upon receipt of FY 62 Military Construction Program funds. (U)
- A shortage of funds has delayed award of the construction contract for modifications to the North Pacific, Donnelly Flats, readout station. Temporary deferral of a portion of the modifications will be required to allow award of contract for the most critical requirements. A joint USAF, Alaskan Air Command, and Space Systems Division effort is in progress to resolve this problem. (U)
- A government to government agreement providing for use of RAF Station Kirkbride as a MIDAS readout station, construction of technical facilities, and operation and maintenance of the station by the United Kingdom was consummated on 19 July. (S)
- Submission of final plans for the construction of the Ottumwa, Iowa, MIDAS Tracking and Control Center technical facilities is scheduled for 21 August. (U)

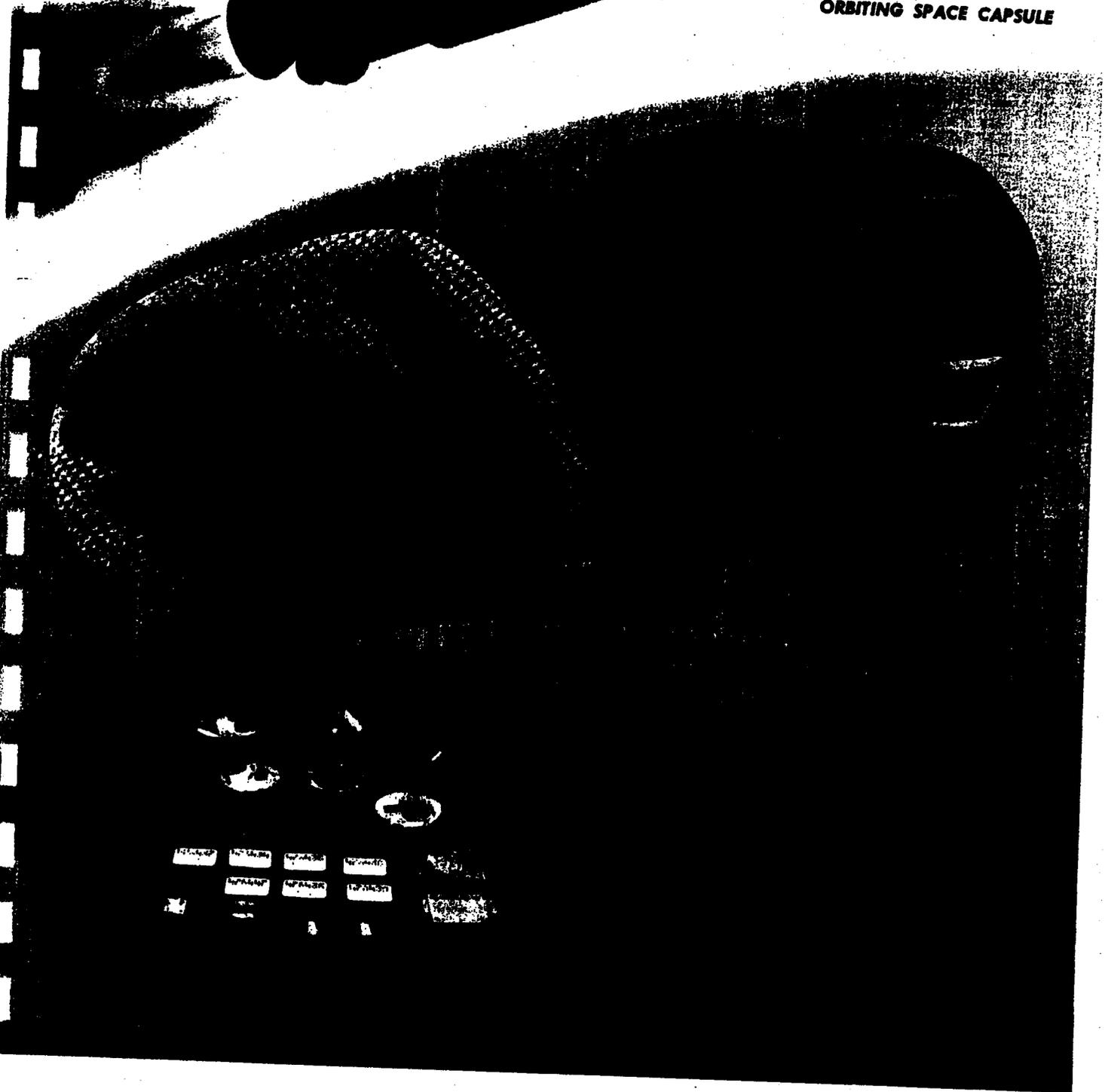
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BIOASTRONAUTICS



ORBITING SPACE CAPSULE



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Program History

The BIOASTRONAUTICS Office was established in May 1958 and charged with the biotechnical supervision of the early military "Man-in-Space" Program and the Bioastronautics aspects of the DISCOVERER Program. NASA was subsequently assigned the "Man-in-Space" responsibility in the fall of 1958. The development and fabrication of suitable Biomedical Recovery Capsules for the DISCOVERER Program has continued without interruption.

On 13 May 1959, a MARK I biomedical capsule was successfully flown without specimens. The flight telemetry demonstrated successful operation of the Bioastronautic subsystem as an engineering concept. Although re-entry was successful, recovery was not accomplished. A second MARK I capsule was launched on DISCOVERER IV on 25 June 1959 with four mice aboard. Although orbit and recovery were not achieved, 600 seconds to telemetry showed the animals to be in good condition throughout the flight.

Subsequent DISCOVERER efforts culminated in preparation of a MARK II capsule suitable for a small primate. Launch and recovery of a small primate from orbit awaits approval of an "Abbreviated Space Systems Development Plan, Biomedical Program" submitted to Hq AFSC in November 1960.

Applied Research contracts for the design and development of advanced biocapsule hardware include photosynthetic oxygen production, super-critical gas storage, radiation shielding and bio-instrumentation. All components are scheduled to be flown in subsequent advanced space biocapsule programs.

An Advanced Biomedical Capsule has successfully completed the mockup phase of development. The capsule is designed to carry a fifty pound chimpanzee to altitudes of about 25,000 n.m. to thoroughly explore and assess the radiation hazards of the inner and outer Van Allen Belts. In addition, long-

term weightlessness effects will be investigated. On 7 November 1960, Space Systems Division approved continued development of the advanced capsule in support of eventual manned military space systems.

Program Concept

The complete exploration of space, including limits to manned operational space systems, requires a determination of the biological effects of the space environment. The Space Systems Division is continuing its aggressive research and development program in this technical area to insure that sufficient bioastronautics knowledge will be available during the 1963-1965 time period. Present deficiencies in reaching these goals are: capsule development, life support system design, biological instrumentation and determination of space flight stresses (long term weightlessness, operational experience in the radiation belts, and isolation). Neither Project MERCURY with its short duration, low altitude orbit, nor DYNA SOAR with its low altitude suborbital flight will provide data concerning the key problems of long term weightlessness and Van Allen Belt radiation, Knowledge which is crucial to manned operational space systems.

The current BIOASTRONAUTICS Program is furnishing a limited amount of data from actual ballistic and orbital flights. Experiments include those made on a space-available basis aboard scheduled ICBM and DISCOVERER Program flights. The Bioastronautics Orbital Space System (BOSS), when approved as an Air Force system, will not be limited by piggy-back or space-available restrictions. Data obtained from these tests will be available for correlation with those obtained from laboratory experiments. The results will be of supplemental significance to the DYNA SOAR Program and Project MERCURY and will be necessary to the success of future manned military missions such as SMART.

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Monthly Progress — BIOASTRONAUTICS

Small Primate Unrestrained (Project SPURT)

- The second eighty-hour test of the capsular life support function was conducted at the General Electric Philadelphia facilities on 11 July. The ecological system functioned well. The monkey was in good physical condition at the end of the test. The elimination of paint from the capsule interior corrected the excessive carbon monoxide build-up observed during the first test. The quality of the film taken during the test was excellent. (C)
- The water feeder nipple was accidentally depressed during capsule assembly permitting water to flow freely from the feeder without requiring action on the part of the animal to initiate flow. The animal saw the water flow but made no attempt to drink. The feeder functioned for only thirty minutes. Modifications are being incorporated in the water feeder that will insure proper functioning of the feeder for twelve hours. The results of the two tests provide assurance that the hardware will function properly. No other eighty-hour tests are planned. (C)
- Because of the death of the animal in the previ-

ous test due to malnutrition and dehydration and the failure of the primate to respond to the water flow during this test, plans are being made to condition several animals to the capsule environment and the mission profile. (C)

BOSS Program

- A Development Plan for the Bioastronautics Orbital Space Satellite Program (BOSS) was prepared and forwarded to higher Headquarters for approval. This program calls for six orbital flights into the radiation belts to determine the effects of prolonged exposure to weightlessness and space radiation. Chimpanzees will be utilized as the test subjects. The initial phase of the program will be directed to the development of a suitable life support system and its mating to a suitable re-entry vehicle. Advantage will be taken of the developed capability inherent to the ATLAS D/AGENA B combination for orbital flights. (C)
- The Bioastronautics Orbital Space Satellite Program (BOSS) has been approved at Hq USAF with provisions for suitable funding during FY 62. Direction has been received from Hq AFSC to implement the program in accordance with the Development Plan. (C)

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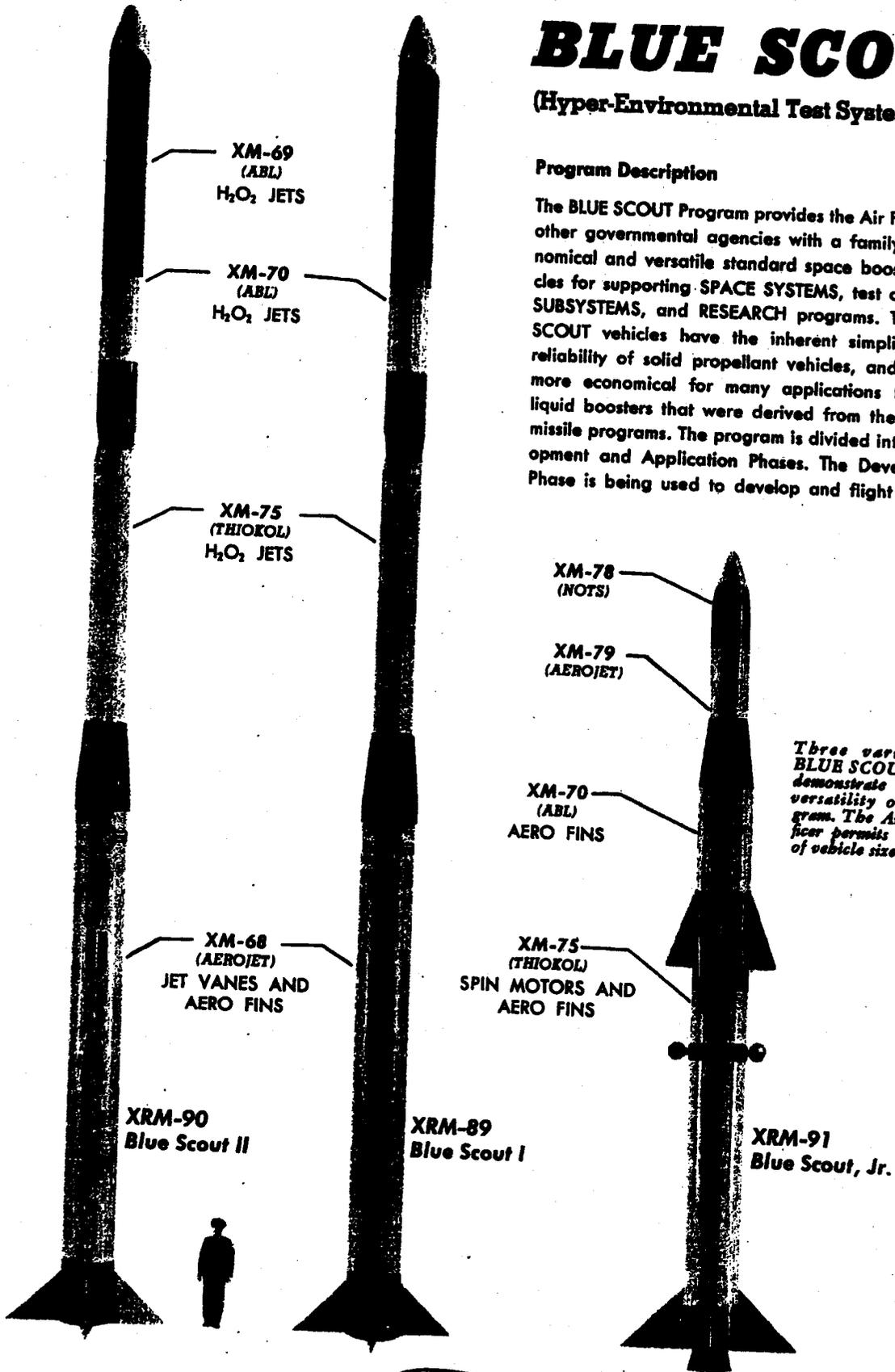
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BLUE SCOUT

(Hyper-Environmental Test System)

Program Description

The BLUE SCOUT Program provides the Air Force and other governmental agencies with a family of economical and versatile standard space booster vehicles for supporting SPACE SYSTEMS, test of SPACE SUBSYSTEMS, and RESEARCH programs. The BLUE SCOUT vehicles have the inherent simplicity and reliability of solid propellant vehicles, and are far more economical for many applications than the liquid boosters that were derived from the ballistic missile programs. The program is divided into Development and Application Phases. The Development Phase is being used to develop and flight test the



Three variations of BLUE SCOUT vehicles demonstrate the mission versatility of the program. The Air Force officer permits comparison of vehicle sizes.

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solid propellant vehicles, to train AIR FORCE PERSONNEL in processing launch of the vehicles, and to accomplish BLUE SCOUT Program objectives. The Application Phase will support programs such as SAMOS, SAINT, BAMBI, ASSET, TRANSIT, and PROBES. The vehicle receipt, assembly, payload mating, checkout and launch will be accomplished by Air Force military personnel during the Application Phase.

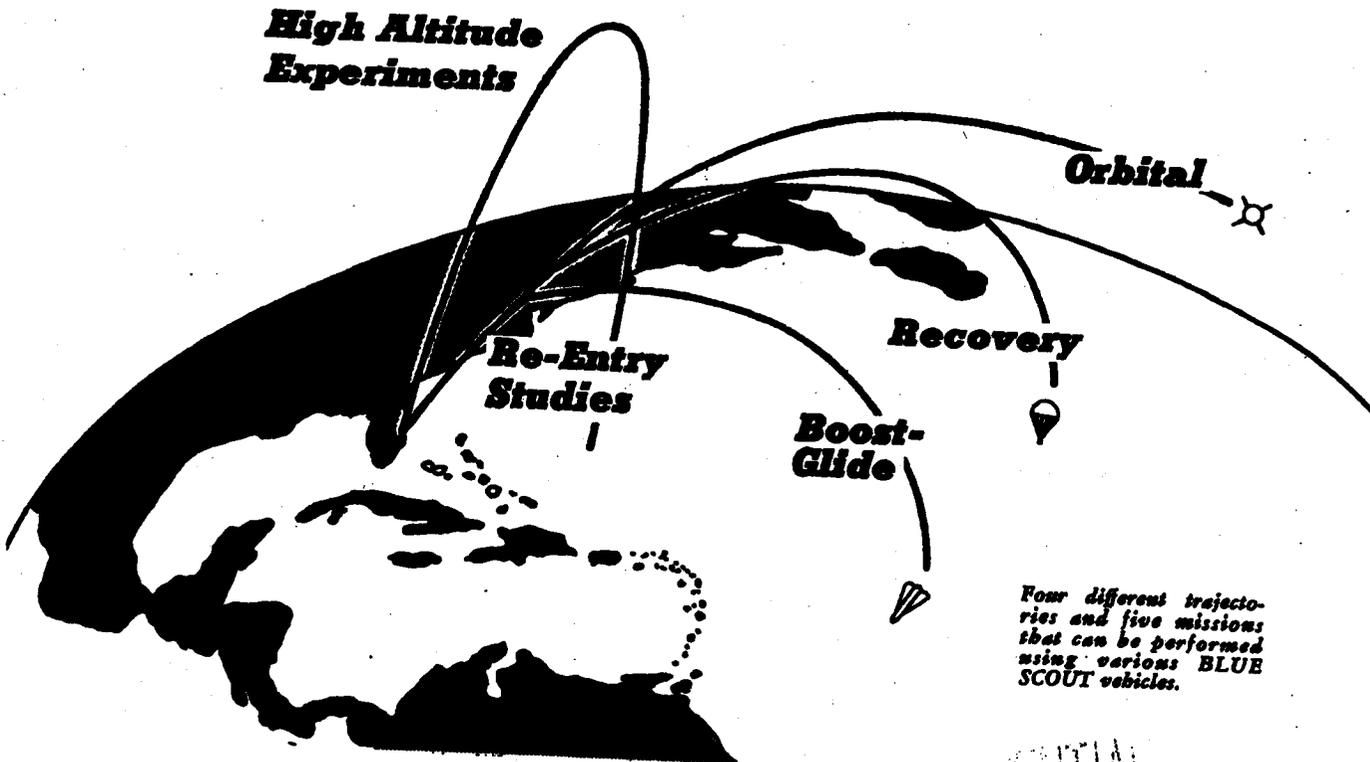
Performance

The BLUE SCOUT vehicles have a performance capability which permits them to: (1) place a 200-pound payload into a 400 nautical mile circular orbit, (2) boost a 200-pound payload to 4,000 nautical miles on a probe trajectory, (3) boost a 25-pound payload to 75,000 nautical miles on a probe trajectory, (4) place a 400-pound payload into a boost-glide trajectory at a velocity of 20,500 feet per second at 250,000 feet altitude. Besides ORBITAL FLIGHTS, PROBES, and BOOST-GLIDE trajectories, the vehicle can boost payloads into trajectories and downward booster HIGH-SPEED RE-ENTRY profiles, data RECOVERY capability and ATTITUDE STABILIZED final stage (and payload) are also provided.

Program Management

Development Phase: An abbreviated Development Plan, covering the Development Phase only, was approved on 9 January 1959. This plan gave Space Systems Division management responsibility. In June 1959, Aeronutronic Division of the Ford Motor Company was chosen through normal competitive bidding as the Payload, Test and Systems Integration Contractor. The procurement of vehicle components and associated support equipment, modified to meet BLUE SCOUT requirements, is being made through NASA, rather than direct procurement from the SCOUT contractors. Atlantic Missile Range launch complex 18 and an existing assembly building are being used for the Development Phase of the program. The 6555th Test Wing (Dev) manages the Development Test program at the Atlantic Missile Range and provides the Air Force personnel who are being trained to assume the vehicle processing, launch and evaluation tasks. An all-military operational capability will be developed from this group.

Application Phase: Space Systems Division will have the responsibility for providing BLUE SCOUT booster support to the Air Force and other government agencies for SPACE SYSTEMS, test of SPACE



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SUBSYSTEMS, and **SPACE RESEARCH** flight operations. This responsibility will include the coordination and establishment of agreements of responsibilities with payload agencies, both government and contractor, for the integration of the payloads and boosters; the monitoring of flight operation plans, objectives, schedules, accomplishment, and results; the funding action for the booster support; the planning for launch facilities and launch personnel; the procurement of booster vehicles and other equipment; and the over-all coordination required for execution of the **BLUE SCOUT** booster support program.

Missions

The Application Phase missions for the **BLUE SCOUT** Program, some of which are firm while others are in the planning stage, are as follows:

SAINT: Two **BLUE SCOUT** vehicles required, first launch from Atlantic Missile Range January, 1963.

ASSET: A requirement from Aeronautical Systems Division for seven **BLUE SCOUT** vehicles to be used in investigations of the aerodynamic and thermody-

amic properties of boost-guide vehicles. The first launch is scheduled from Atlantic Missile Range in mid-1962 with a three-month launch interval.

BAMBI: Four **BLUE SCOUT** vehicles required, first launch from Pacific Missile Range in mid-1962, interval between launches of three months.

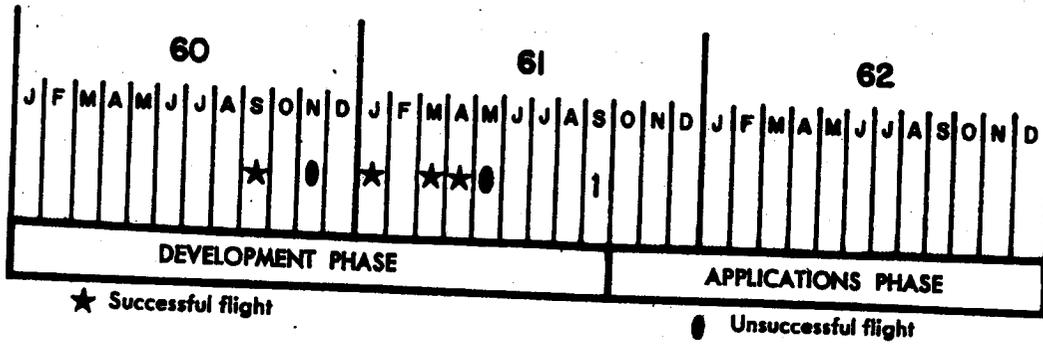
TRANSIT: Six **BLUE SCOUT** vehicles required, first launch from Pacific Missile Range in mid-1962, interval between launches of three months.

PROBES PROGRAM: A requirement from the Office of Aerospace Research for thirty **BLUE SCOUT** vehicles indicated FY62 funding will support approximately fifteen **BLUE SCOUT** vehicles. A requirement of approximately fifteen **BLUE SCOUT** vehicles per year for the period 1962-1970 is expected.

BEANSTALK: This program is under the management of Electronics Systems Division. Present information indicates that ten **BLUE SCOUT JUNIOR** vehicles will be required by Electronics Systems Division for launch operations from Pacific Missile Range during 1962.

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Launch Schedule



Flight History

Blue Scout	Launch Date	Type of Flight*	Type Designation	Remarks
D1	21 September	A	XRM-91	<i>Telemetry was lost prior to fourth stage burnout. All of the primary (vehicle) objectives were accomplished; none of the secondary (payload) objectives were achieved.</i>
D2	8 November	A	XRM-91	<i>A second stage motor failure occurred at T plus 60 seconds. The vehicle impacted approximately 240 n.m. downrange.</i>
D3	7 January	A&C	XRM-89	<i>The 392-pound payload was launched successfully. The recovery capsule survived re-entry but was not recovered. All other primary objectives were achieved as were the majority of secondary objectives.</i>
D4	3 March	A	XRM-90	<i>The 172-pound payload was launched successfully. The test was completely successful. All primary and secondary objectives were achieved. Valuable payload experiment data were obtained.</i>
D5	12 April	A&C	XRM-90	<i>The 365-pound payload was launched on a probe trajectory. Seven of the eleven primary test objectives were accomplished and one was partially achieved.</i>
D6	9 May	A&C	XRM-89	<i>Indications are that a control motor power lead became disconnected during second stage burning and caused the vehicle to veer left from the programmed trajectory. At T plus 81 seconds range safety action was taken.</i>

***Type of Flight**

- A — High Altitude Experiments
- B — Re-Entry Study
- C — Recovery
- D — Orbital
- E — Boost-Glide

Monthly Progress — BLUE SCOUT

Program Administration

- Preliminary Program Plans for Calendar Year 1962 were established. The planning included range support for the program, payloads that require space boosted support from the BLUE SCOUT Program, and submittal of cost estimates for the program. (U)

- A Complete Manpower Package has been prepared, justified, and submitted. Included in the package were the new jobs created and personnel required to support the new programs scheduled for inclusion in the Calendar Year 1962 launch program. (U)

Flight Test Progress

- The launch of the seventh BLUE SCOUT vehicle (D-8) is scheduled for early September. Recent payload equipment changes by NASA have caused the launch to be rescheduled from early August. This guided four-stage XRM-92 vehicle will be launched from the Atlantic Missile Range and will place a 150-pound payload into a 300-nautical mile circular orbit with a 32.5 degree inclination angle. The payload will check out airborne and ground-based units of the world-wide MERCURY tracking network. It will contain S-band and C-band radar beacons, a Mini-track system beacon, command equipment for controlling the payload equipment during flight, and telemetry equipment for obtaining data on payload operation and for assisting in the control and tracking of the satellite. In addition to the payload objectives, the vehicle objectives are as follows:

1. Evaluate the guidance and control system.

2. Investigate the temperature and vibration environment within the vehicle.

3. Verify motor performance.

4. Demonstrate stage separation of the Air Force Scout.

5. Verify the adequacy of Pad 18B for use in launching guided BLUE SCOUT vehicles.

6. Demonstrate the compatibility of the vehicle and the aerospace ground equipment.

7. Develop a military capability for assembly, checkout and launch of the Air Force Scout vehicle. (U)

- The BLUE SCOUT Junior vehicle (O-1) is being processed on a non-interference basis with vehicle D-8 at the Atlantic Missile Range. Launch preparation and documentation will be accomplished entirely by Air Force personnel of the 6555th Test Wing (DEV) and the Air Force Special Weapons Center, respectively. The launch of this vehicle with an AFSWC payload is scheduled for late in August. (U)

Facilities

- Approval for initiation of BLUE SCOUT facilities design at the Missile Test Annex at the Atlantic Missile Range has been requested from HQ USAF through HQ AFSC. Amended construction project justification data (Form 161) reflecting minimum facility requirements were forwarded to HQ USAF in April. Allocation of P-313 design funds has also been requested to permit immediate Architect-Engineer contract negotiations upon receipt of approval. (U)

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SAINT

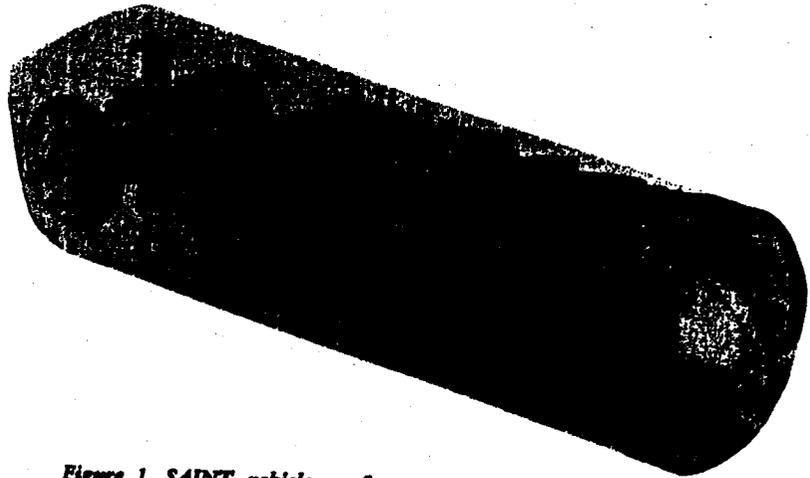
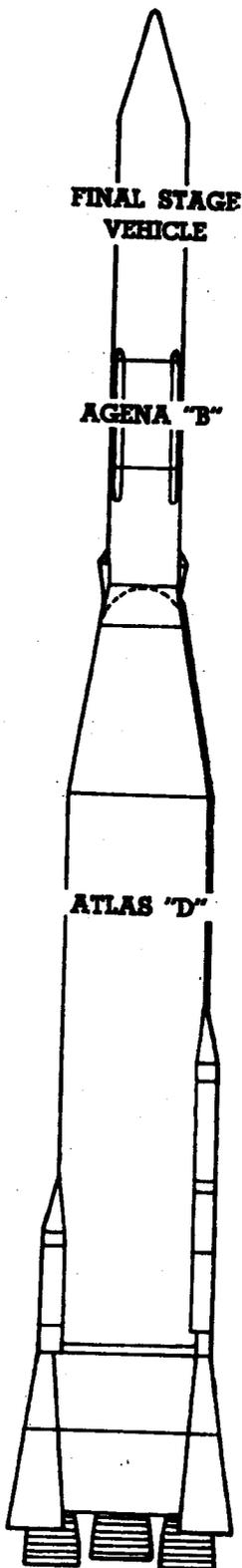


Figure 1. SAINT vehicle configuration (left). Proposed Final Stage Vehicle (above) showing search radar, velocity correction engine nozzle, control-gas storage spheres, and attitude control jets.

The SAINT (Satellite Inspector System for Space Defense) Program has been established to develop and demonstrate feasibility of a co-orbital satellite inspector system capable of rendezvousing with and inspecting suspected hostile satellites and assessing their mission.

Program Objectives

1. Design, fabricate, and demonstrate feasibility of a prototype vehicle capable of co-orbital rendezvous with another satellite at 400 nautical miles with a capability of inspecting and identifying the unknown satellite.
2. Study and define a SAINT vehicle which could be used as an ultimate defense vehicle having a capability of rendezvous up to 4,000 nautical miles with necessary orbit changes.
3. Develop and fabricate those long lead type items required for the ultimate defense system including a capability of negating hostile systems.

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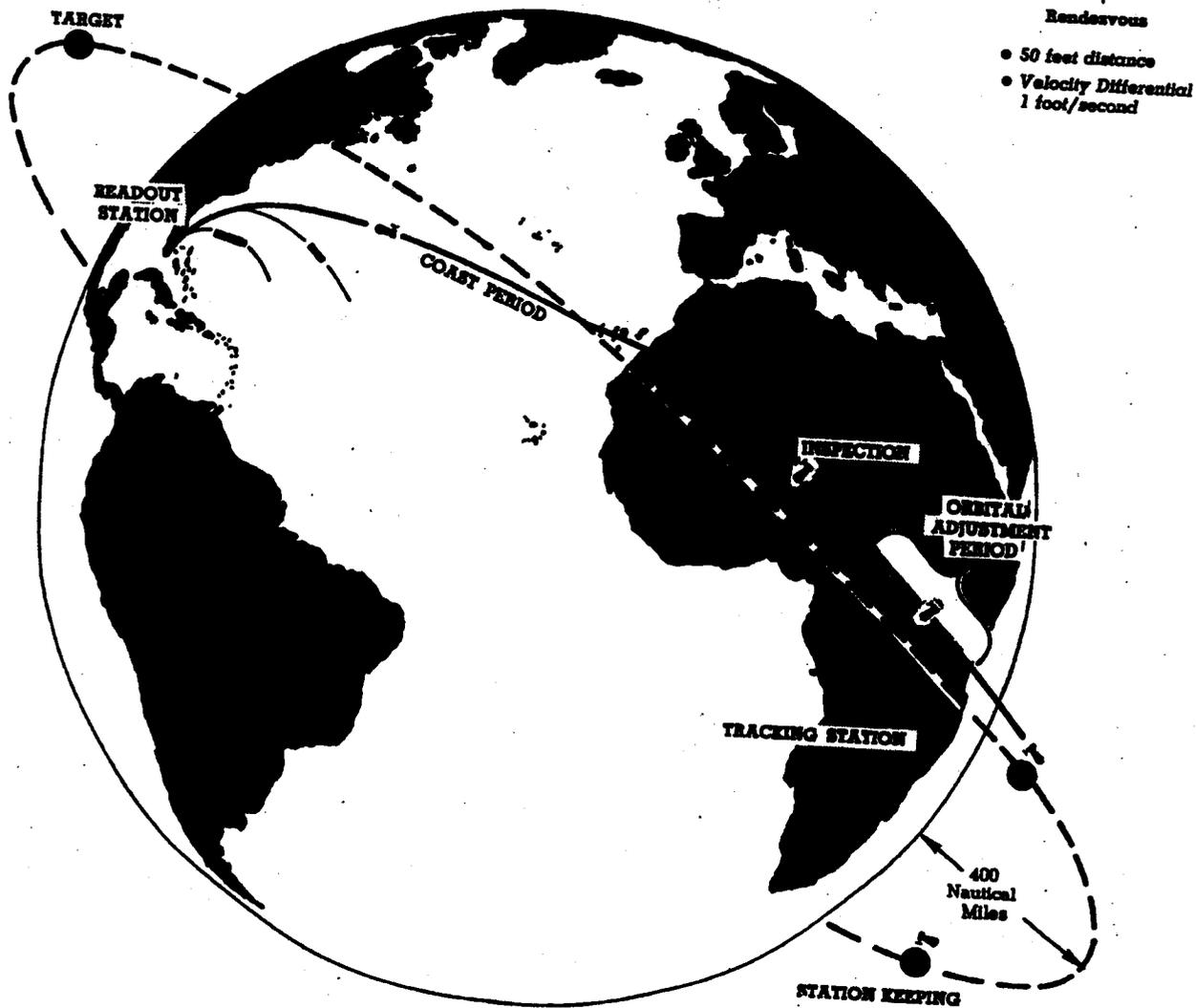
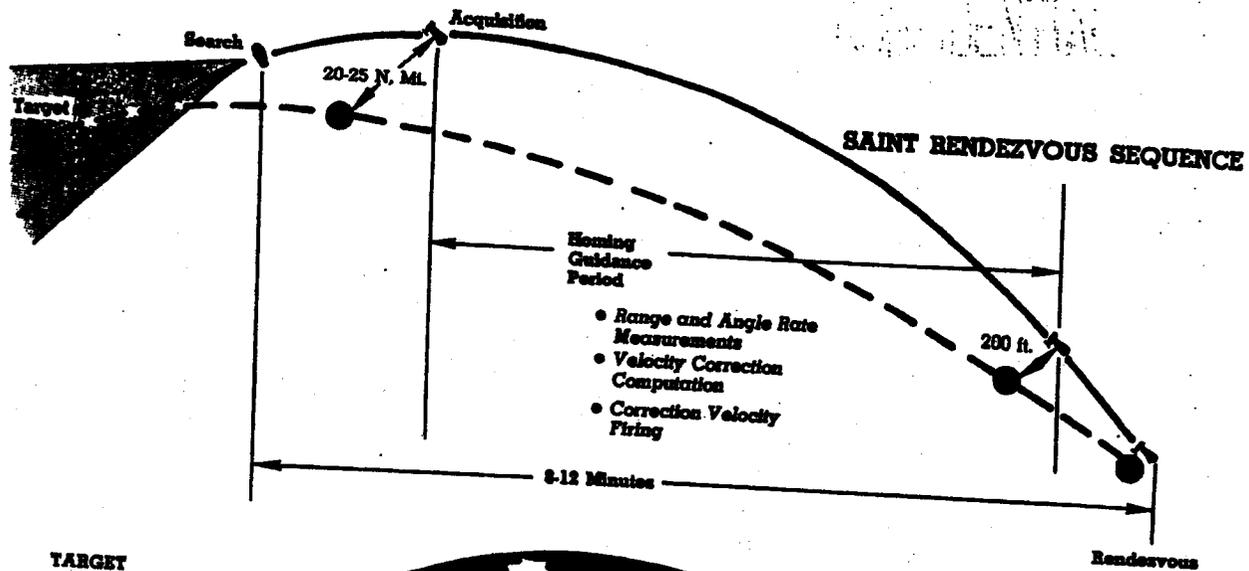


Figure 2. SAINT Program feasibility demonstration flight and rendezvous sequence.

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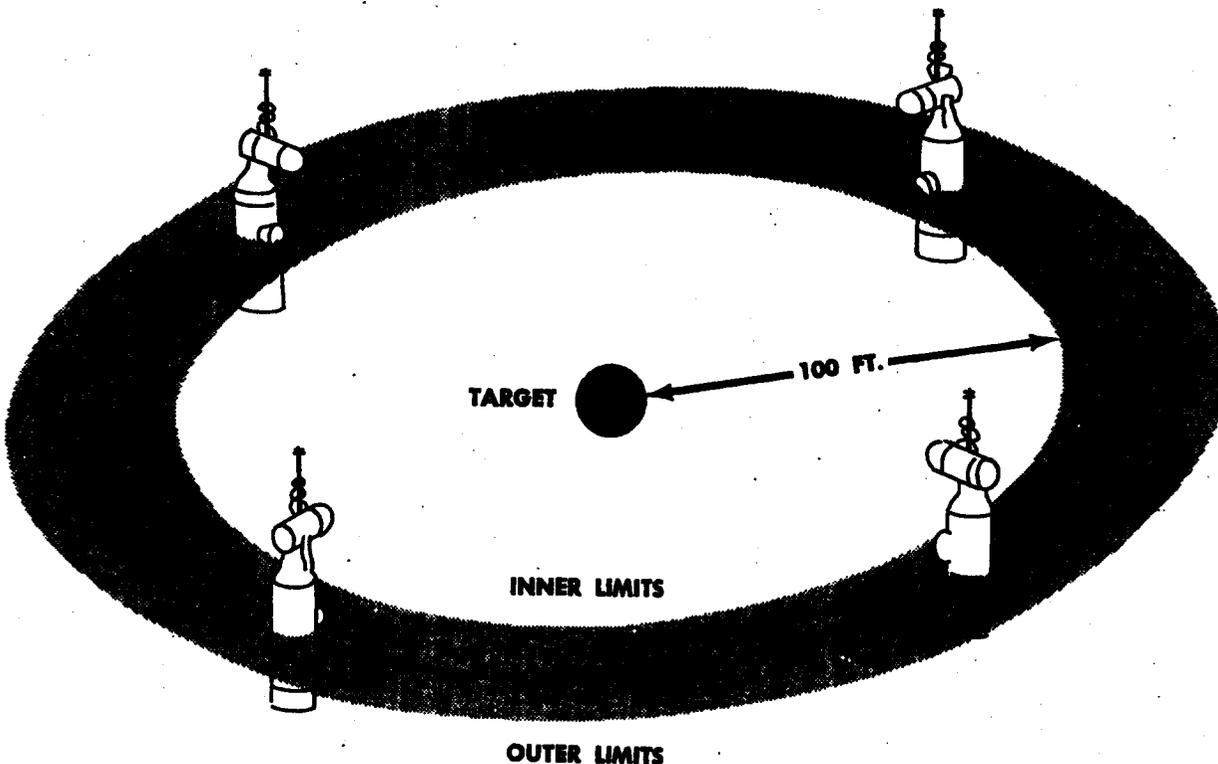


Figure 3. During station keeping, the Final Stage Vehicle will remain at a nominal distance of 125 feet from the target with the payload sensors pointed at the target. The Final Stage Vehicle will move around the target in a plane parallel to the surface of the earth at the rate of one revolution every sixteen minutes. This will permit inspection of the entire target during station keeping.

Program History

Initial studies were conducted by industry in 1958 under SR187. Studies were continued in 1959 by the Radio Corporation of America under ARPA contract and Space Technology Laboratories under Space Systems Division management. The STL study was completed 21 December 1959 and the RCA study 31 January 1960, both indicating SAINT would be a feasible system of practical value to the Department of Defense. Subsequently, the following actions have been taken:

1. AF System Development Requirement No. 18 published21 April 1960
2. AFBMC approval of SAINT Development Plan15 July 1960
3. Department of Defense approval of Development Plan25 August 1960
4. Air Force Development Directive No. 41217 October 1960
5. Assigned Systems No. 621A. .31 October 1960
6. RCA chosen as Final Stage Vehicle and payload contractor. . . .25 November 1960

7. Contract agreement with RCA 27 January 1961
8. Contract with RCA.17 March 1961

Concept

Philosophy — The philosophy for development of the prototype vehicle calls for a step-by-step development program with a conservative choice of subsystems and emphasis upon reliability. Ground tests will provide assurance of component capability and reliability before flight.

Over-all System — Unidentified orbiting objects will be acquired, catalogued, and the ephemeris accurately determined through the facilities of the Space Detection and Tracking System (SPADATS) utilizing available acquisition and tracking equipments. (It is anticipated that, for the ultimate operational system, the capabilities of SPADATS will be expanded to provide additional information such as target size, configuration and stability in orbit, possibly within 12 hours after detection.) This information will be relayed to a Defense Command Control Center which will determine if inspection

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is necessary. Should inspection be deemed necessary, the ephemeris information will be used to compute data which will be inserted into the guidance system of a SAINT vehicle. The vehicle will be launched into an appropriate position at a time which enables the final stage vehicle to go into orbit with the unknown satellite and inspect it at close range. This inspection data will be stored in the payload for transmission upon command to ground stations. After reception by the ground stations the data will be processed, displayed and evaluated, to determine the mission and intent of the unknown satellite.

Vehicle — The SAINT system as presently envisioned, consists of three stages including an active "Final Stage" or rendezvous vehicle. Early configurations of the SAINT vehicle will consist of a Series "D" ATLAS booster, AGENA "B" second stage, and a SAINT final stage vehicle. This configuration is shown in Figure 1. Later final stage vehicles having increased maneuvering capability and additional sensors would be boosted with the ATLAS/CENTAUR. The final stage vehicle (Figure 1) will include a radar seeker, launch and homing guidance system, attitude control, maneuvering propulsion and a payload. The payload will include television cameras and various other sensors to determine the nature of the target satellite and its functional purpose. In addition the payload will have a storage and communications capability.

Feasibility Demonstration — Four flights launched from the Atlantic Missile Range, are planned for the feasibility demonstration. The first flight is scheduled in March 1963 with the subsequent flights scheduled at three month intervals. The feasibility demonstration configuration of the SAINT vehicle will consist of a Series "D" ATLAS booster, AGENA "B" second stage and a SAINT final stage vehicle. The demonstration final stage vehicle weighs approximately 2,400 pounds. In this demonstration (Figure 2), the final stage vehicle will be programmed to rendezvous with an existing satellite if one is available in a three hundred to five hundred mile easterly orbit. If such a satellite is not available, a target satellite will be placed in a 400 nautical mile, 28.8 degree inclination circular orbit by a USAF SCOUT booster. Rendezvous will be accomplished while under surveillance of a

Southeast Africa station and a TV image of the target, in addition to the telemetered data of final stage vehicle performance, will be transmitted to the ground station. The image and data will also be stored and read out on command as the vehicle passes over the Air Force Missile Test Center. For the purpose of the feasibility demonstration rendezvous is defined as a closing of the final stage vehicle with the target satellite to within 50 feet and a relative velocity of less than one-foot per second. Station keeping will be maintained for one orbital period.

Future Development — Continued study toward definition of an ultimate operational system is being pursued simultaneously with the other phases of the program. This effort will distinguish certain long lead type items on which development action must be initiated and provide further refinements to the system. Included are extension of the maneuvering capability of the vehicle into 4,000 nautical mile orbits with the necessary station keeping and inspections of multiple targets as well as more exotic sensor capability. For example, a sensor capable of detecting a nuclear warhead is most desirable. Effort is currently underway to proceed with the development of such a sensor.

Program Management

Space Systems Division management of this program is based upon the associated contractor structure composed of a First Stage contractor, Second Stage contractor, Final Stage Vehicle contractor, and Systems Engineering and Technical Supervision contractor (Aerospace Corporation). Military support is provided by the Space Detection and Tracking System through the Air Force Command and Control Development Division, and by the 6594th and 6555th Missile Test Wings.

Facilities

The demonstration program will utilize existing launch, tracking and data reduction facilities insofar as possible. However, some additional ground support equipment will be required at the Air Force Missile Test Center and at the Southeast Africa tracking site.

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Monthly Progress — SAINT

Program Administration

- The fourth Management Meeting was held on 13 July. The current configuration and design status of the Final Stage Vehicle was reviewed. Tests will be conducted to determine the seriousness of propulsion heat and exhaust deposits on the Final Stage Vehicle optical sensors. The Radio Corporation of America will evaluate the impact of proposed design changes on the FSV system's functional capability and reliability. (S)
- Proposals for the SAINT target were received from prospective contractors on 14 July. The SAINT Target Evaluation Board convened on 17 July to choose the contractor who will design and fabricate the SAINT target. Selection of a contractor was postponed pending receipt of additional cost data requested from the participating contractors. (U)
- SAINT Program Office personnel attended a coordination meeting at the Arnold Engineering Development Center on 12 July. Discussions were

relative to the use of the AEDC altitude chamber for testing the main propulsion unit. Use of the facility has been requested and approval is pending. (U)

- The Final Stage Vehicle contractor (RCA) has established subcontracts with Emerson-Electric Company for the range and illumination radar. AVCO Corporation has been selected to design and fabricate the FSV structure. The Garrett Corporation was chosen to design and fabricate the temperature control unit. Douglas Aircraft Company will design and fabricate the Final Stage Vehicle ascent fairing. (C)
- Air Force Missile Test Center support requirements for the flight test phase are being finalized for inclusion in the SAINT Program Requirements Document due in September. Detailed launch complex facilities requirements for the Final Stage Vehicle and its ground environment were submitted to General Dynamics-Astronautics in July for inclusion in the integrated facility design criteria for modifications to Atlantic Missile Range Complex 13. (U)

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VELA HOTEL

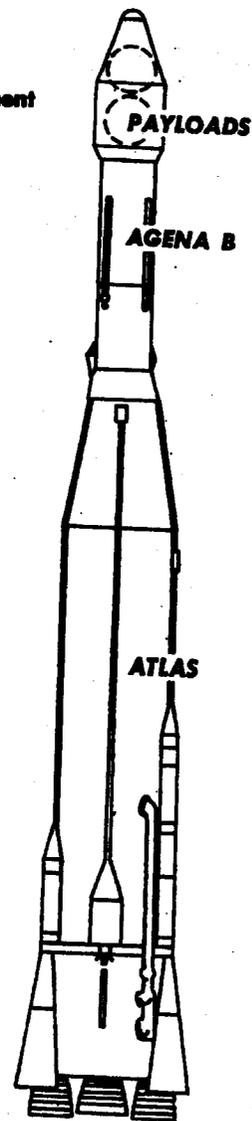
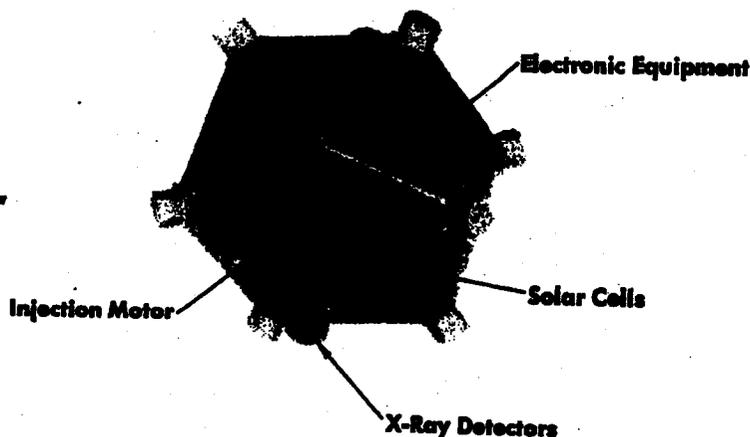


Figure 1. VELA HOTEL vehicle configuration (right). Artist's concept of payload showing solar cells, X-ray detectors and injection motor.

Program Objectives

The objective of the VELA HOTEL Project is to conduct a research and development program including experiments and prototype testing to gain information which will lead to the definition of an operational space-based system for high altitude nuclear detonation detection.

Program History

The Panefsky Panel on High Altitude Detection, reporting to the President's Scientific Advisory Committee, made several recommendations with respect to research and development work which should be accomplished in order to increase basic understanding of the physical mechanisms involved. The Department of Defense agreed to assume over-all responsibility with Atomic Energy Commission support in the high-altitude detection area. Further, it was agreed that the AEC would undertake laboratory development of the nuclear detection instrumentation and that the portion of the effort concerning measurements of natural radiations in space should be implemented jointly by the DOD and the NASA. Within the Department of Defense, the Advanced Research Projects Agency was assigned the management responsibility for Project VELA on 2 September 1959. On 18 September 1959, ARPA issued Order Number 102-60 to AFSC for a study and evaluation of the technical and operational factors associated with the detection of high-altitude nuclear detonations. The initial results were used in October 1959 to provide the State Department with supporting technical data for the United States delegation at the Geneva conference. Amendment No. 1 to the original ARPA Order directed AFSC to extend and refine the original study. It was subsequently requested that a joint working group including AFSC, AEC and NASA representatives, chaired by AFSC, be established. The mission of the Joint Working Group was to recommend a research and

development program which would investigate the concept of nuclear detonation detection from satellites. To facilitate conducting the work involved, the Joint Working Group formed subcommittees for payload, space boosters, and communications and control.

Program Concept

On 21 June 1961, the Secretary of Defense approved and funded the VELA HOTEL Program. The program will consist of five launches from the Atlantic Missile Range, beginning in April 1963 and extending through April 1964. The launch vehicle for the VELA HOTEL Program will be an ATLAS D/AGENA B. Each vehicle will place two spacecraft into a single highly elliptical orbit. The instrumentation aboard the spacecraft will be furnished by the AEC and will consist of X-ray,

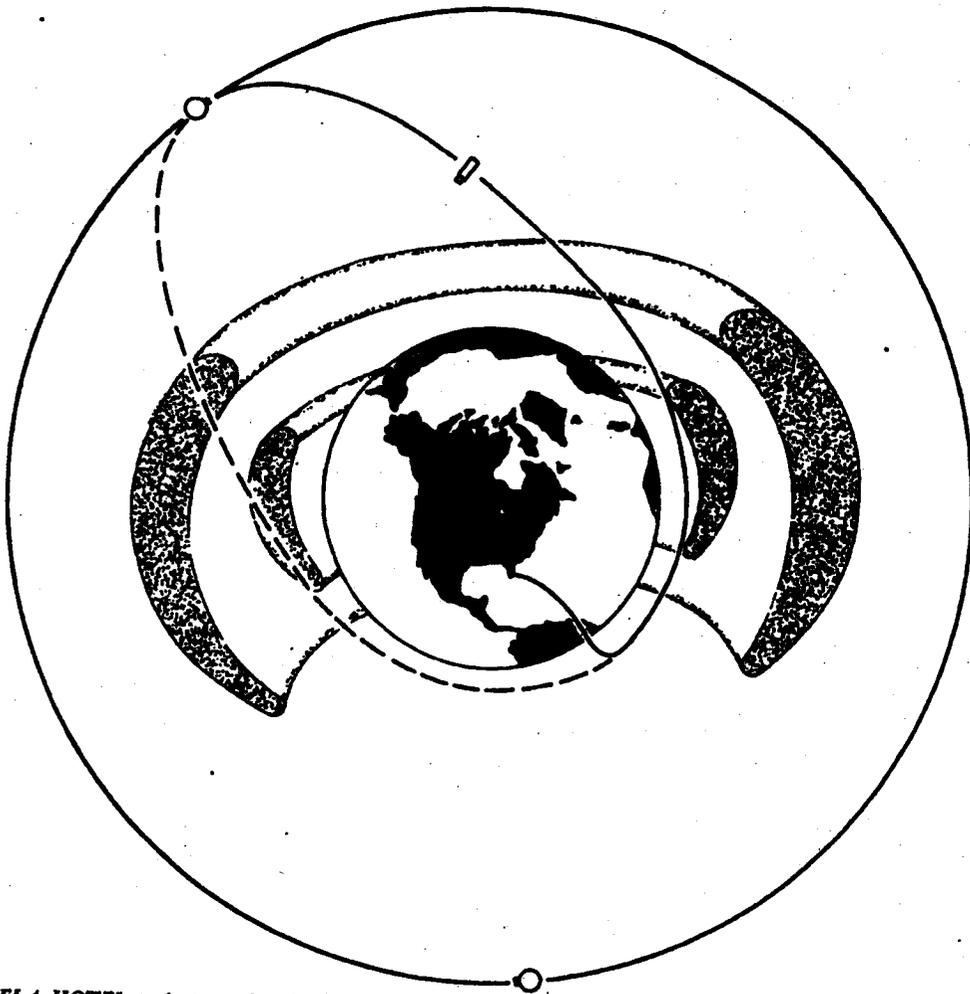


Figure 2. VELA HOTEL trajectory showing the elliptical transfer orbit which has a 200 n.m. perigee and a 50,000 n.m. apogee. On the first orbit one payload will be ejected, on the next orbit, the second payload will be fired and placed into orbit approximately 140 degrees behind the first payload.

gamma ray, and neutron detectors and Geiger-Mueller tubes. Each spacecraft will contain a propulsion unit capable of transferring the spacecraft into a minimum circular orbit of 50,000 nautical miles. The propulsion unit of one spacecraft will be fired at first apogee and the second spacecraft will be transferred at a later apogee such that the spacecraft will initially be 140° apart in orbit. The spacecraft will be designed to have an operating life of six months with redundant telemetry transmission capabilities in range of 75,000 nautical miles.

The vehicle will be launched from the Atlantic Missile Range at an azimuth of approximately 110°. After AGENA B separation from the ATLAS D, the AGENA B will program through two burns with final cutoff over Australia. A spin table on the AGENA B will then spin and separate the tandem payloads. The two spacecraft will then separate such that at apogee they will be several miles apart. The previously described transfer sequence will then be initiated.

Simultaneous tracking of the two spacecraft will be carried out by the SSD world wide tracking net. Data will be collected at Sunnyvale Satellite Test Center, punched on tape and shipped to the AEC at Albuquerque, New Mexico for reduction and analysis.

In addition to the major high-altitude portion of the VELA HOTEL Program, several Discoverer piggy-back low altitude polar orbit flights are being accomplished which will obtain background radiation data below the Van Allen belts. These flights as proposed will carry Lawrence Radiation Laboratory experiments consisting of X-ray, gamma ray and neutron detectors, PENG (proton-electron-neutron-gamma ray) detectors and solid state spectrometers.

The first of these launches will occur in August 1961. The AEC is also initiating, as a separate but related project, a piggy-back flight program aboard Rangers (Lunar probes), NASA Scouts and Mariners (Venus probes).

Monthly Progress – VELA HOTEL

Program Administration

• A pre-proposal briefing for the spacecraft was given to contractors on 20 July 1961. Proposals from contractors will be received on 18 August. Technical and management working groups are being selected to evaluate the proposals. (U)

Technical Progress

• A final systems test with the first of the VELA HOTEL "Piggyback" payloads was completed on 28 July and compatibility of the equipment and the DISCOVERER vehicles was demonstrated. A second systems test will be conducted early in August. (U)

LAUNCH

VEHICLES



**ADVENT
ANNA
DYNA SOAR
MERCURY
RANGER-NASA AGENA "B"
TRANSIT**

LAUNCH VEHICLES

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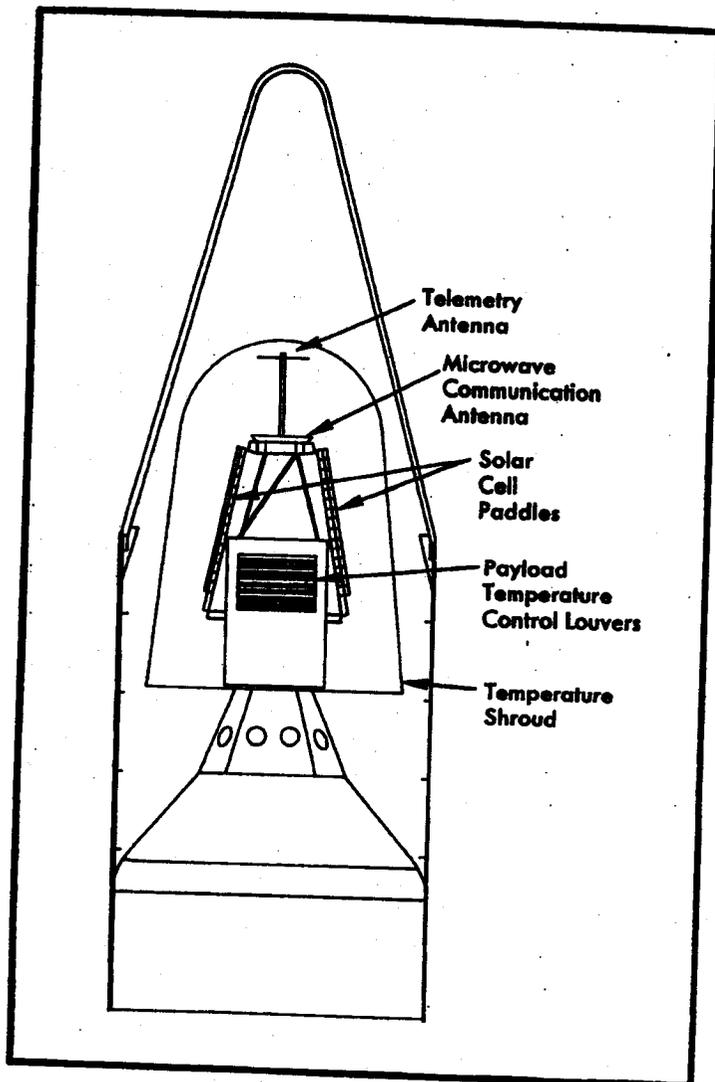
ADVENT

The ADVENT Program will investigate the feasibility of using satellites in synchronous orbit as instantaneous repeaters for microwave radio communications. A satellite vehicle station in synchronous equatorial orbit will remain in a fixed position relative to any point on the surface of the earth. Active communications equipment contained in this satellite will receive, amplify and instantaneously retransmit any message beamed in its direction.

PROGRAM HISTORY

The Research and Development program for active communication satellites was initiated by ARPA in January 1959. Following early research and development, a three-phased development program (STEER, TACKLE and DECREE) was initiated in May 1959 by Amendment No. 1 to ARPA Order No. 54. Phase I (STEER) was given priority in order to demonstrate the feasibility of providing an early UHF communications capability for positive control of the SAC strike forces. Space Systems Division (SSD) was given responsibility for the design, development, and flight testing of the complete system, including launch, satellite tracking and control, and necessary support facilities and ground equipment. Aeronautical Systems Division (ASD) and the U.S. Army Signal Research and Development Laboratory (USASRD) were delegated responsibility for the development of the communications subsystem for Phase I and Phases II and III, respectively.

Figure 1. Proposed satellite with jettisonable fairing mounted on CENTAUR second stage.



In April 1960, Amendment No. 5 to ARPA Order No. 54 reoriented the program. The research and development effort previously directed toward providing a ground-to-satellite-to-aircraft UHF communications capability for the SAC strike forces was cancelled. A single integrated ADVENT Program for the development of a 24-hour microwave communications satellite replaced the former STEER, TACKLE and DECREE Programs:

On 15 September 1960, the Secretary of Defense transferred over-all management responsibility for the ADVENT Program from ARPA to the Department of the Army. The development responsibilities of SSD and USASRD were retained essentially status quo. The Army was given responsibility for funding and for over-all systems engineering to provide guidance and a basis upon which detailed design data can be evolved by SSD and USASRD.

PROGRAM OBJECTIVES

The primary ADVENT objective is to demonstrate the feasibility of achieving a military system for microwave communications (surface-to-surface) employing satellite repeaters in 24-hour equatorial orbit. The feasibility of placing a satellite in predetermined

position in a 19,300 nautical mile equatorial orbit must be demonstrated. The feasibility of being able to stabilize the satellite, control its attitude and orbit, and keep it on station within the required tolerances must also be demonstrated. The satellite must be capable of providing broad band communications on a real time basis at microwave frequencies. The Program Plan is based upon the design of a single configuration of a final stage vehicle compatible with launching by either AGENA "B" or CENTAUR second stage boosters.

The ADVENT Program will consist of the following flight tests, launched from the Atlantic Missile Range:

Phase One. Three ATLAS/AGENA "B" flights, nominal 5,600 nautical mile orbits, beginning March 1962.

Phase Two. Two flight tests, using payload space on NASA ATLAS/CENTAUR research and development flights numbers 9 and 10, April and June 1963.

Phase Three. Five ATLAS/CENTAUR flights launched into 19,300 nautical mile equatorial orbits, beginning July 1963.

Launch Schedule

	62												63												64					
	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J
Funded By			1			1												1	1	1	1		1			1				
Vehicle Configuration	ARMY												NASA						ARMY											
	ATLAS/AGENA "B"												ATLAS/CENTAUR																	

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Monthly Progress — ADVENT

Technical Progress

Booster Vehicles

- General Dynamics-Astronautics started fabrication of the 1/14 scale models to be used in the NASA Ames Laboratory "ground" wind tunnel test program for ATLAS/AGENA and ATLAS/CENTAUR space vehicles. Work is proceeding on schedule with the tests programmed to begin on 15 September. (U)

- Wind tunnel model construction at Lockheed Missiles and Space Company is proceeding on schedule. Present planning calls for the LMSC supersonic tunnel portion of the test program to start on 4 September with the Langley transonic tunnel to be used starting on 11 September. The first phase of the Ames Research Center has been completed; this phase concerned pressure data on a 1/10 scale model. Initial evaluation of the static pressure data indicate no major problem areas. The fluctuating pressure data reduction will be completed during August. (C)

- A preliminary copy of a revised work statement for the ATLAS (Series I) booster has been completed and is currently being reviewed by the Space Systems Division and Aerospace Corporation. (U)

- LMSC is verifying the capability of the horizon sensor to see the sun at various launch dates and vehicle attitudes. The AGENA B horizon sensor has been a problem on other space programs. (C)

- Final assembly of the first ADVENT AGENA vehicle will be completed on 7 August. (C)

- A detailed work statement for the ADVENT/CENTAUR engines has been completed and is being reviewed and coordinated with other Air Force Systems Command agencies. (U)

- General Dynamics-Astronautics is revising the ADVENT/CENTAUR proposal to incorporate changes to the original proposal as requested by the Space Systems Division. Aerospace Corporation is providing technical assistance in this effort. It is anticipated that GD-A will submit the revised proposal no later than 15 August. (U)

Final Stage Vehicles

- A tentative agreement on the basic propellant handling and loading procedure for ADVENT Final Stage Vehicles has been reached by all agencies

concerned. The basic concept, as submitted by General Electric-Missile and Space Vehicle Department, is a remote loading procedure which involves mating the satellite to the second stage in an unloaded condition and filling the propellants from containers located at the base of the gantry. (U)

- Because of the ADVENT code generator "Secret-Crypto" classification there is an urgent need for clarification and an issuance of security guidelines for the handling of this material by the contractors. A visit by the Air Force Security Service to GE-MSVD has been set for 2 and 3 August. At this time AFSS will tour the General Electric plant and establish the proper security requirements for the ADVENT code generator. (C)

- An air and ground code generator resynchronization capability investigation has been conducted considering (1) no-resync, (2) resync without using telemetry, and (3) resync using telemetry. Upon reviewing the investigation it was recommended that the resync using telemetry be adopted. The National Security Agency was in agreement with this method. (C)

- As a result of the Orbit Test Vehicle schedule review, General Electric was directed to reschedule the structure completion date for two weeks earlier. This will permit subsystem installation to begin on 1 November. General Electric was requested to review their drawing release dates to avoid the inconsistency of having drawing completions occur in the middle of the fabrication period. (C)

Tracking, Telemetry and Command

- A study has been completed of the personnel manning requirements to support technical equipment maintenance and operation at Camp Roberts and Fort Dix. Recommendations were forwarded to the USAAMA with a request that a meeting be scheduled in the near future to establish the number of personnel, by job description that will be required. (U)

- Philco has officially subcontracted the Kaena Point antenna feed system modification. Down-time requirements at Kaena Point for the 60-foot antenna are being correlated with other program requirements for the same antenna. The investigation of interference from the Navy Communications Moon Relay Station is still proceeding, but the shadowing by land mass of direct-line-of-sight between the two installations will minimize this interference. (U)

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Systems Test

- Discussions were held with General Dynamics-Astronautics on the instrumentation for CENTAUR on the ADVENT Phase II launches. A detailed review of the telemetry measurements has been completed and is being correlated with the airborne instrumentation package requirements. A memo is being prepared summarizing the instrumentation requirements for Phase III ADVENT CENTAUR together with the associated instrumentation requirements. (U)

Facilities

- Detailed descriptions of the additional launch support facility requirements and facility modifications required for Pad 12 and Pad 36, are being compiled by Aerospace Corporation for release during the week of 31 July. Completion of this task has been delayed pending the definition and approval

of the procedure to be utilized for loading propellants on the Orbital Test Vehicle. (U)

- The contract for modifications to Atlantic Missile Range Hangar AA in support of ADVENT Program requirements was awarded on 29 June. A notice to proceed was issued on 13 July, with beneficial occupancy scheduled 110 days from that date. (U)

- Delays in receipt of final approved criteria and late release of construction funds by USAAMA for the Kaena Point tracking and telemetry station have resulted in the decision to allow the associate contractors (Lockheed Missiles and Space Company and Philco) to proceed immediately and provide the urgently required farfield boresight tower, and the transmitter support requirements. The remaining items required to support the ADVENT Program will be designed and constructed by the Corps of Engineers, Hawaii. (U)

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Project ANNA

Second Stage -- ABLESTAR (AJ-10-104)

Thrust (vacuum)	7900 pounds
Specific impulse (vacuum)	277 seconds
Burning time	296 seconds
Propellant	IRFNA UDMH

First Stage -- DM-21A

Thrust (sea level)	132,000 pounds
Specific impulse (sea level)	247 seconds
Burning time	163 seconds
Propellant	Liquid Oxygen RP-1

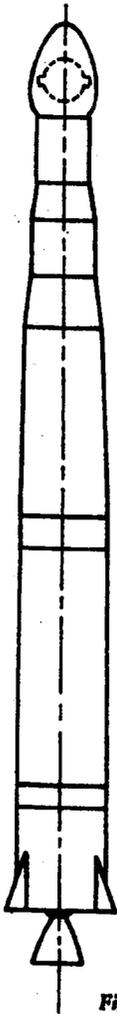


Figure 1. Two stage ANNA vehicle.

Program Description

Project ANNA is the tri-service geodetic satellite program. The program is designed to satisfy the primary military (Army, Navy, Air Force) and scientific (NASA) requirements in geodesy. The Navy has over-all program management responsibility and is also responsible for satellite system management. The Space Systems Division (SSD) was assigned the responsibility for booster system management, which includes providing the booster vehicles, integrating payloads to the vehicles, and being responsible for flight operations from launch through attainment of orbit. On 4 April 1961, the Navy officially directed the Space Systems Division to proceed with plans for launching the first ANNA satellite on 5 December using the THOR Ablestar (Figure 1) vehicle previously purchased for TRANSIT 5A.

Payload Description

The ANNA payload (Figure 2) is a 36-inch diameter sphere with a bank of solar cells encircling the package at the equator. The satellite contains an Air Force High-Intensity Pulsed Gas Discharge Lamp for optical measurements, a Navy (TRANSIT) doppler beacon for doppler measurements, and an Army SECOR Transponder for radio ranging data. The basic payload structure is the same as the TRANSIT Navigational Satellite. The payload weight is 325 pounds. The payload contains high magnetic permeability rods which will reduce the satellite spin to zero by hysteresis damping after a few days on orbit.

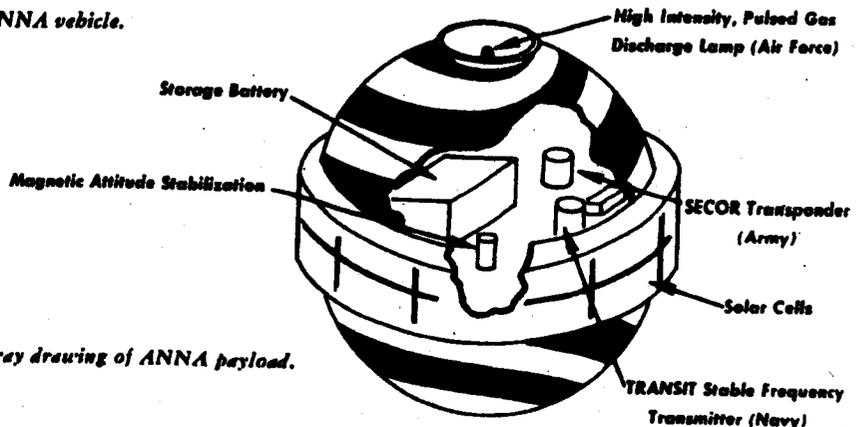


Figure 2. Cutaway drawing of ANNA payload.

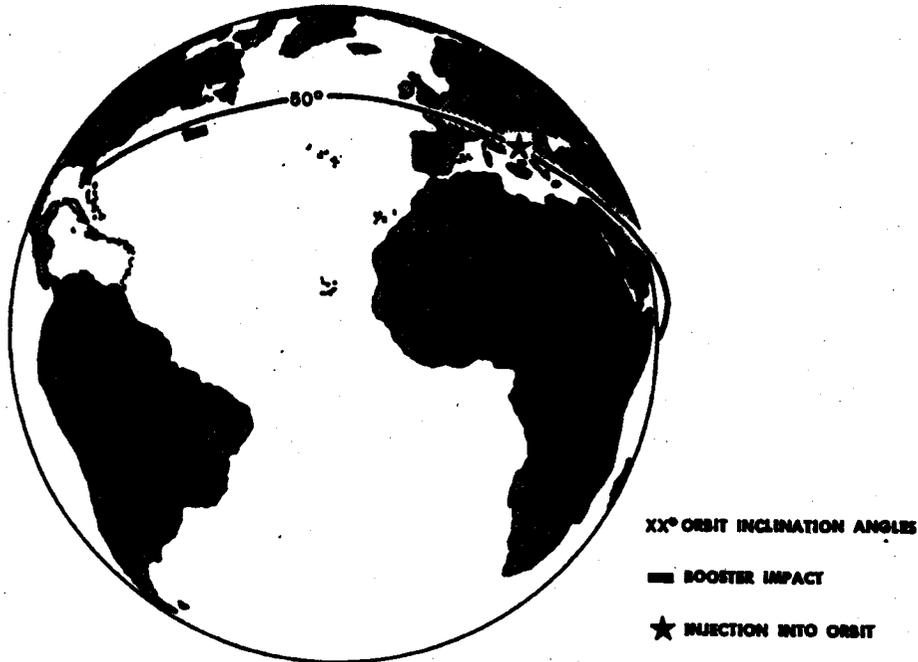


Figure 3. ANNA launch trajectory (50° orbit inclination angle) showing flight path, booster impact area, and orbital injection point.

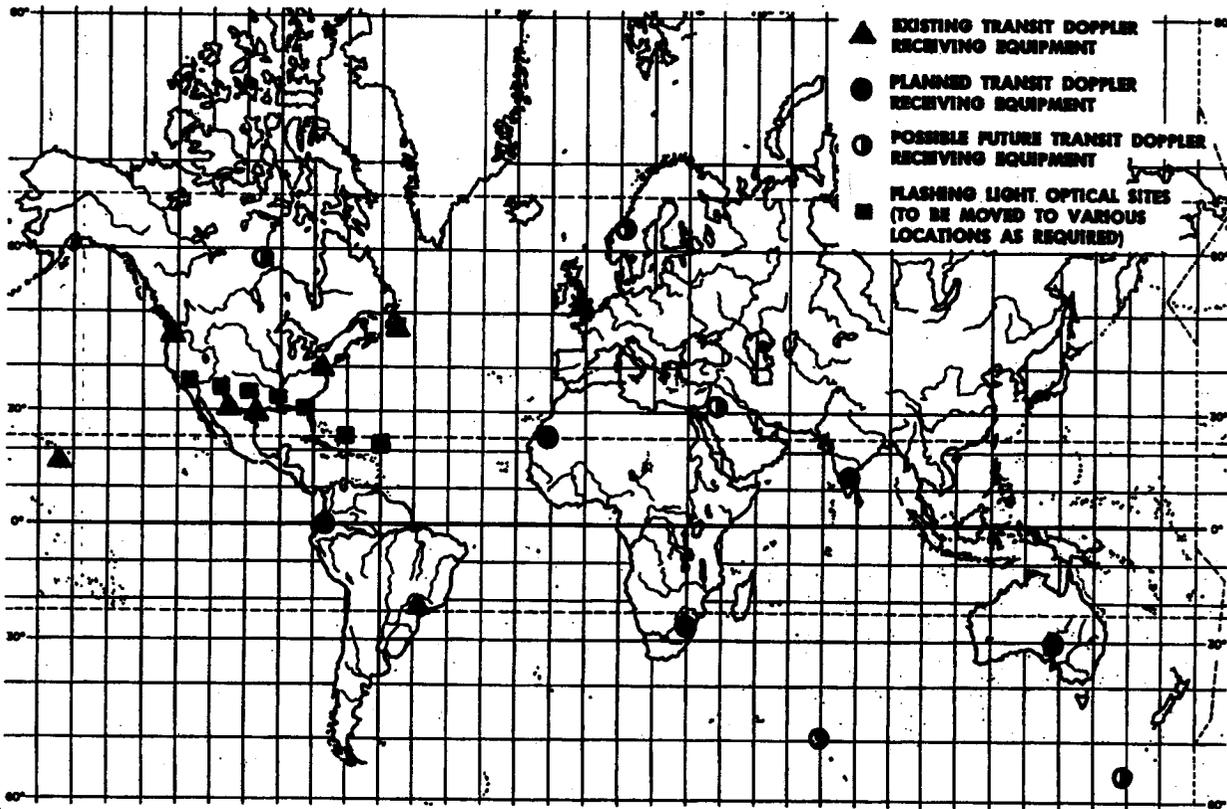
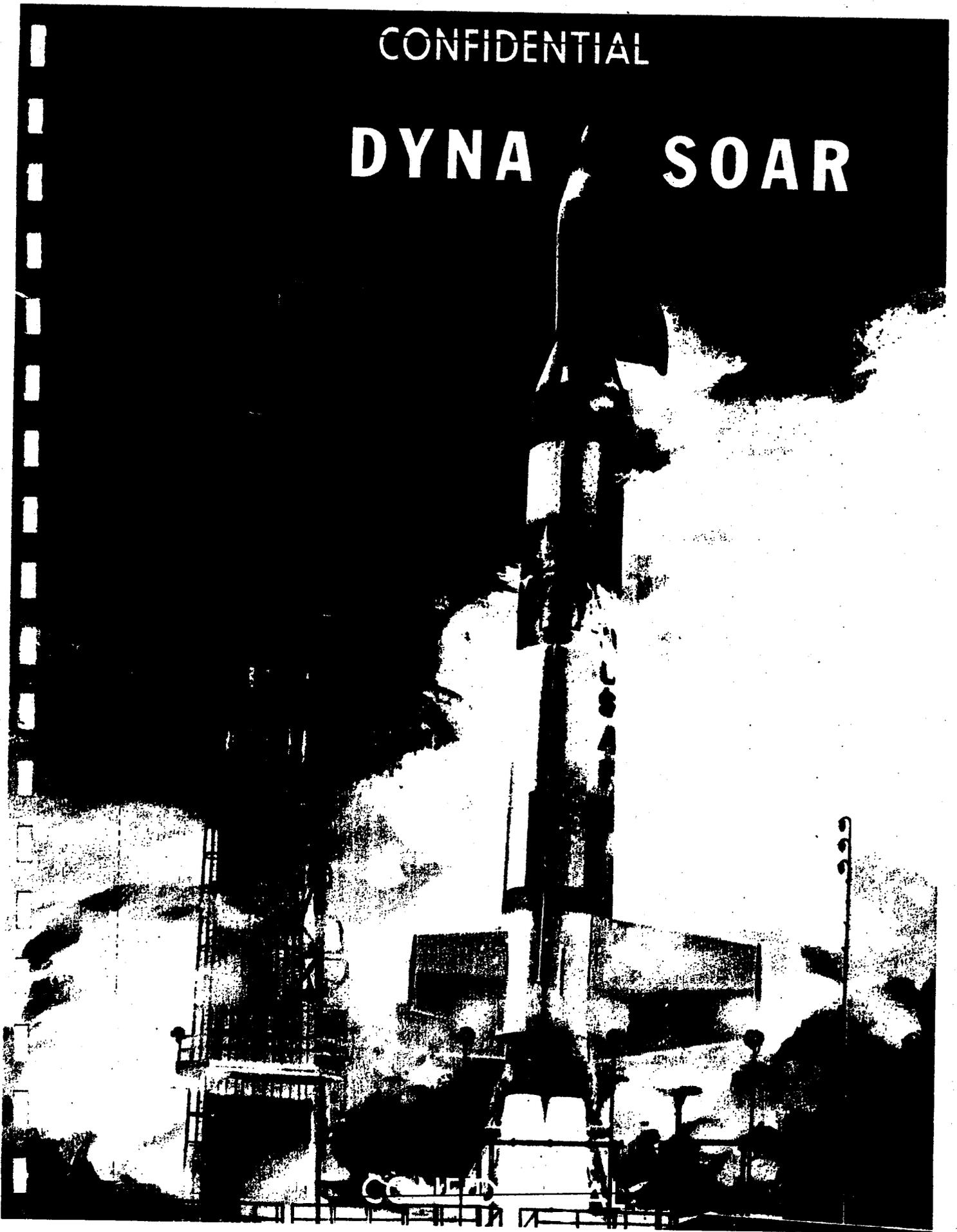


Figure 4. Location of ANNA tracking stations.

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DYNA SOAR



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Program History—Competition for the DYNA SOAR study contract was initiated in 1958 and resulted in the Boeing Airplane Company and the Martin Company being awarded the follow-on contract to more fully define their proposed approaches. In November 1959, following review and evaluation of the Boeing/Martin detailed studies by a Source Selection Board, it was announced that Boeing had been selected as the glider and system integration prime contractor, with Martin furnishing modified TITAN ICBM's for booster support. The conceptual phase of DYNA SOAR concluded with a study program requirement known as Phase Alpha. The objective of this study was to reaffirm proposed glider design. In April 1960, Phase Alpha was completed and results were presented to the Department of Defense. On 9 May, formal approval of the DYNA SOAR Step I Program was received by AFBMD/BMC from WADD/ASC.

During the period covering program go-ahead to the end of CY 1960, efforts on the program were concentrated on design refinements to TITAN I and possible increased booster performance to accomplish program objectives. Studies on booster capabilities revealed many favorable factors on cost, time and expanded objectives by use of the XSM-68B (TITAN II) as the booster. Results of these studies were presented to Headquarters USAF and the Department of Defense. Headquarters USAF directed

use of TITAN II as the SYSTEM 620 DYNA SOAR Step I Booster. Formal direction to use TITAN II was received by AFBMD/BMC from WADD/ASC on 13 January 1961. Effective April 1961, the symbols for AFBMD/BMC and WADD were redesignated SSD and ASD, respectively.

Program Objectives—The DYNA SOAR Program will explore the possibilities of manned flight in the hypersonic and orbital realms. The program will proceed in three major steps from a research and test phase to an operational military system. In Step I, a full scale, minimum sized manned glider will be developed. A modified version of the TITAN II ICBM will boost the glider into hypersonic flight at velocities up to 22,000 ft/sec and permit conventional landing at a predetermined site. In Step II the glider will be tested, using a more powerful booster to achieve orbital velocities. This phase may be expanded into an interim operational weapon system providing all-weather reconnaissance and satellite interceptor capabilities. The objectives of Step II are to test vehicle performance between 22,000 ft/sec and orbital velocities; and to gather re-entry data from various orbits; and to test military equipment and man-machine relationships. Step III will provide an operational weapon system with a vehicle that will operate primarily in a hypersonic glide, be able to maneuver within the atmosphere, and be able to make a conventional landing at a predetermined

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site. The capability of DYNA SOAR type systems to perform these programmed missions appears attractive as a result of studies made to date. The missions under study are: reconnaissance (manned and unmanned); air and space defense; strategic bombardment and logistics support. Manned and unmanned versions are being considered where applicable.

Flight Program — Step I includes twenty air-launched, manned flights with the glider being dropped from a B-52. Sixteen booster-launched flights will follow; flights 1 and 2 are designated as unmanned flights. If all significant flight objectives are achieved, the third flight will be manned. Flights 3 and 4 have been programmed as backup flights in the event that flights 1 and/or 2 do not achieve program objectives. The frequency is five launches at two-month intervals and eleven launches at six-week intervals. The range from Wendover AFB, Utah, to Edwards AFB is adequately instrumented for the tracking and telemetry required during the air-launched tests of the DYNA SOAR glider. Instrumentation sites for the AMR launches will be located at Cape Canaveral, San Salvador, Mayaguana, Antigua, Santa Lucia, and Fortaleza. Instrumentation, tracking, and recovery ships will be provided to supply additional support for the AMR launches. Landing facilities will be provided at Fortaleza, Brazil; Santa Lucia, Lesser Antilles; and Mayaguana, Bahama Islands.

Program Responsibilities — Steps I and II of the DYNA SOAR Program are to be conducted by the USAF with NASA participation. USAF will provide program management and technical direction, with ASD having responsibility for over-all system management.

SSD is responsible for the booster, and its Aerospace Ground Equipment (AGE), special airborne systems, and booster requirements of the launch complex. ASD will have responsibility for glider, glider AGE, and subsystem development. NASA will provide technical support in the design and operation of the glider in obtaining basic aeronautical and space design information.

Technical Approach — Space Systems Division technical approach to meet the objectives of the program are:

1. Modifying a TITAN II ICBM by adding stabilizing fins; strengthening the holddown and skirt area, intertank and interstage sections; redesigning the guidance bay; incorporating a malfunction detection system.
2. Modifying the XLR 87-AJ-5 and XLR 91-AJ-5 rocket engines to obtain structural compatibility with the modified booster; include malfunction detection system shutdown and fail safe systems.
3. Modification of an AMR launch pad.
4. Provide an integrated launch countdown.



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Monthly Progress — DYNA SOAR

Program Administration

- A decision by the System Program Office on the activation of DYNA SOAR test sites was announced on 13 July. The work in each test area will be integrated and supervised by a designated "area administrator." The area administrator for Atlantic Missile Range launch complex No. 20, as recommended by the Space Systems Division, is the Martin Company. (U)
- A DYNA SOAR Management Council Meeting was held at Wright-Patterson Air Force Base on 7 July. Subjects discussed included the full Step I contract negotiation schedule, the present design status and a possible program acceleration. (U)

- PERT networks were received from the booster associate contractors. After being reviewed, these will be integrated into a system network. (U)

- Statements of work for the entire DYNA SOAR Step I Program have been written for all associate contractors. These documents are now being reviewed by the System Project Office and the Space Systems Division. (U)

- Letter Contract AF 04(647)-894 between the Department of the Air Force and the General Electric Company Defense System Department for research and development on the DYNA SOAR Step I booster radio guidance, was fully consummated and distributed to the contractor on 19 July. (U)

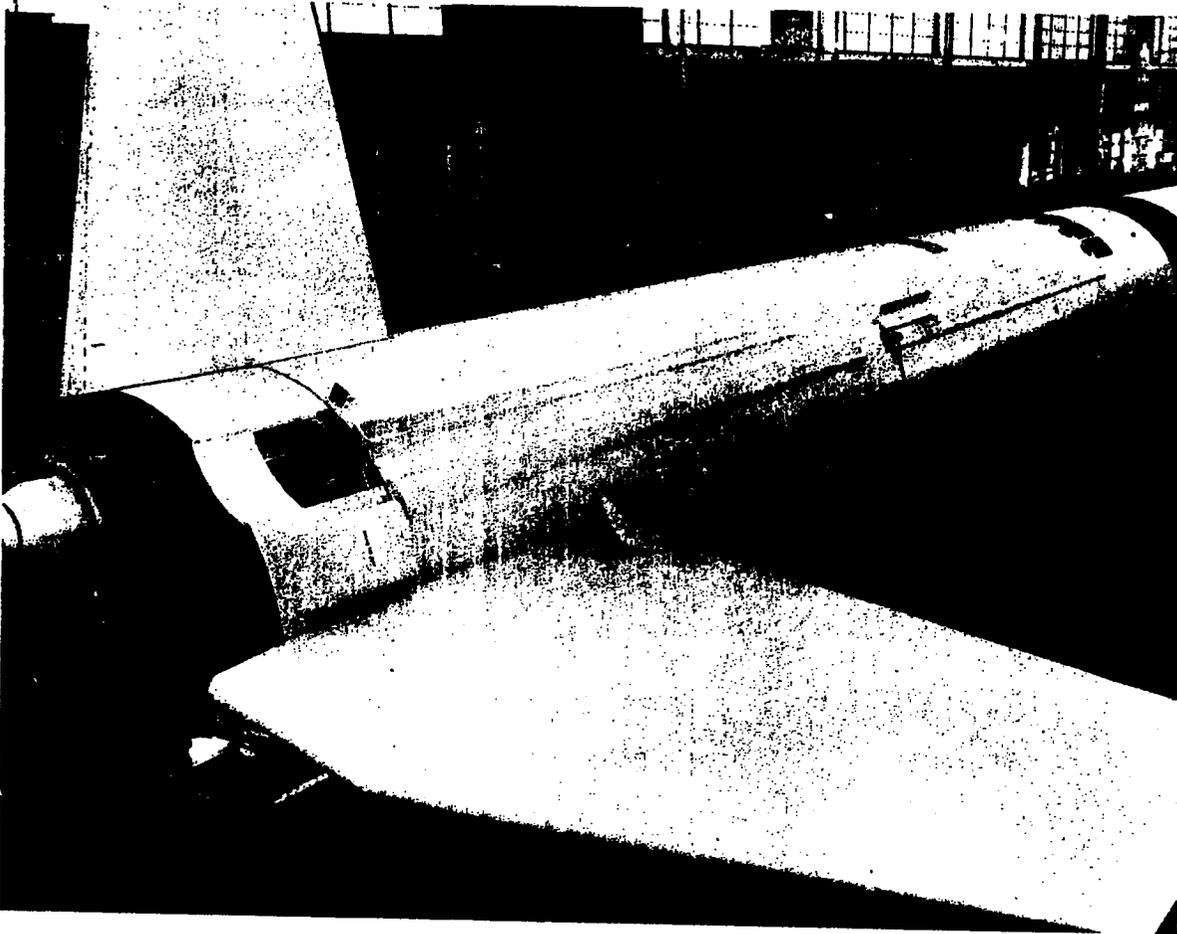


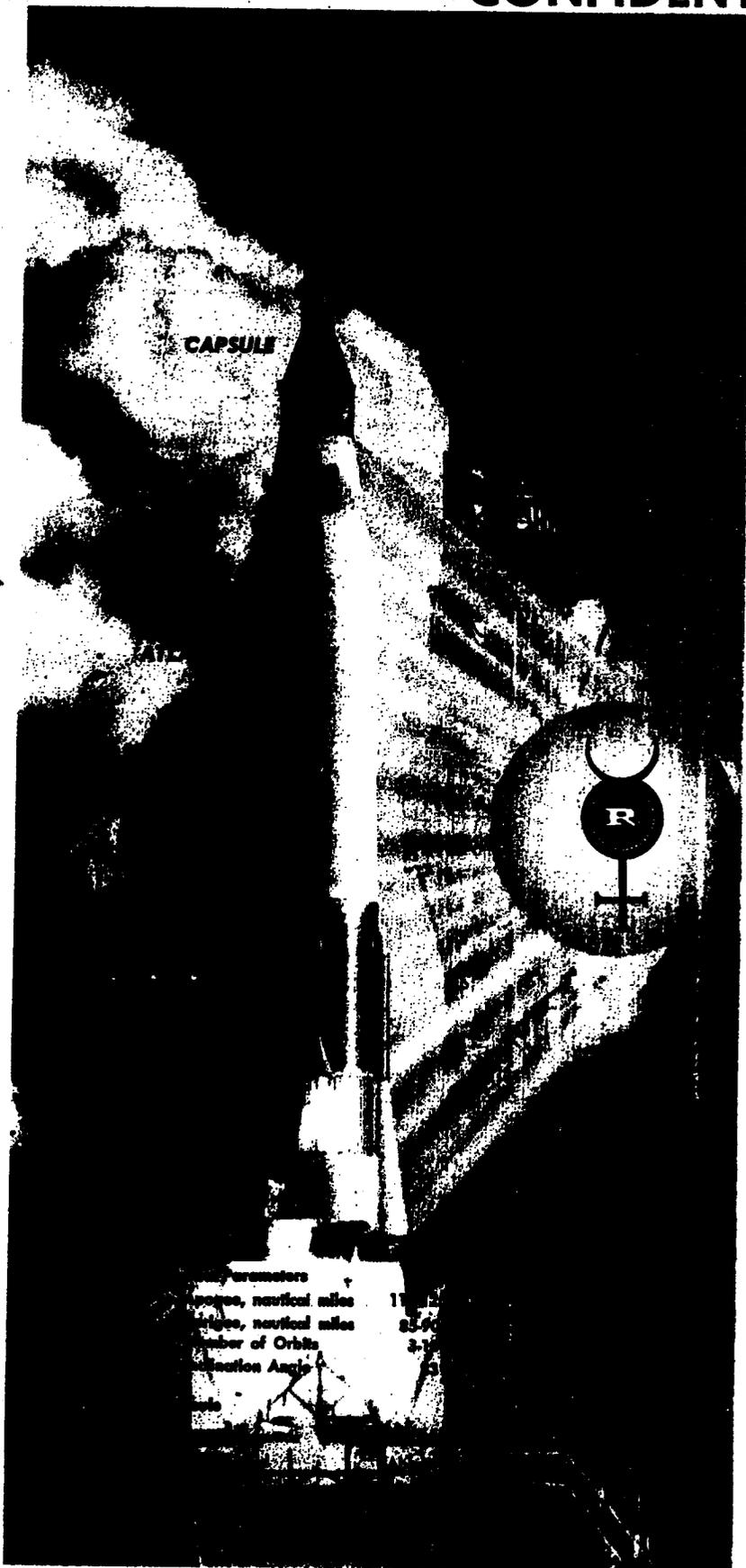


Figure 1. Mockup, opposite page, of the two-stage TITAN II booster which will be used to boost the DYNA SOAR glider. The pitch fin projects toward the right. The first stage motors are shown above and the second stage motor with its nozzle extension, dark area on the left of the combustion chamber, is shown below.



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MERCURY



Project MERCURY represents the transitional threshold between this nation's cumulative achievements in space research and the beginning of actual space travel by man. The primary program objective is to place a manned satellite into orbit about the earth, and to effect a controlled re-entry and successful recovery of the man and capsule. Unmanned ballistic trajectory and unmanned orbital flights will be used to verify the effectiveness and reliability of an extensive research program prior to manned orbital flights. The program will be conducted over a period of approximately four years. The initial R & D flight test was accomplished successfully in September 1959. The total program accomplishment is under the direction of NASA. The primary responsibility of Space Systems Division to date consists of: (a) providing 15 ATLAS boosters modified in accordance with program objectives and pilot safety factors, and (b) determination of trajectories and the launching and control of vehicles through injection into orbit.

Major contractors participating in the Space Systems Division portion of this program include: Aerospace Corporation, systems engineering and technical direction; Convair-Astronautics, modified ATLAS boosters; GE/Burroughs, ATLAS guidance equipment; and Rocketdyne, engines. All of these companies also participate in launch operations, special studies and engineering efforts peculiar to Project MERCURY requirements.

The MERCURY astronomical symbol (♿) with the "R" for Reliability will be attached to those components and missile end items which have been selected and accepted for use in boosters identified for Project MERCURY.

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General Sequence of Events for MA-4 Flight (Orbital)

Following the initial hold-down, the vehicle will lift-off Atlantic Missile Range Stand 14. Upon a General Electric ground guidance command the booster engine will shut down and staging will occur. Twenty seconds after booster staging, the pylon ring separation explosive bolts fire, the pylon clamp ring is separated, and the escape rocket is fired separating the pylon from the capsule. The sustainer engine accelerates the capsule to the predetermined velocity. The sustainer and vernier engines will shut down upon ground guidance command and the capsule separation explosive bolts will fire. The postgrade rockets will fire and separate capsule from the booster. After five seconds of damping the capsule initiates a 180° yaw maneuver and pitches to a 34° blunt-end-forward attitude. The capsule will maintain a 34° attitude throughout its orbit. At a specified time the Automatic Stabilization and Control System is commanded from the ground to start the orientation mode. If the capsule is in the proper attitude the retro-rockets fire. Sixty seconds after retro-fire the retro and post-grade package will be jettisoned and the capsule will assume a re-entry attitude. When the capsule has descended to 21,000 feet, the drogue parachute is deployed. At 10,000 feet, the drogue parachute and antenna fairing will be jettisoned and the main parachute deployed. At impact the parachute is jettisoned and the recovery aids are deployed.

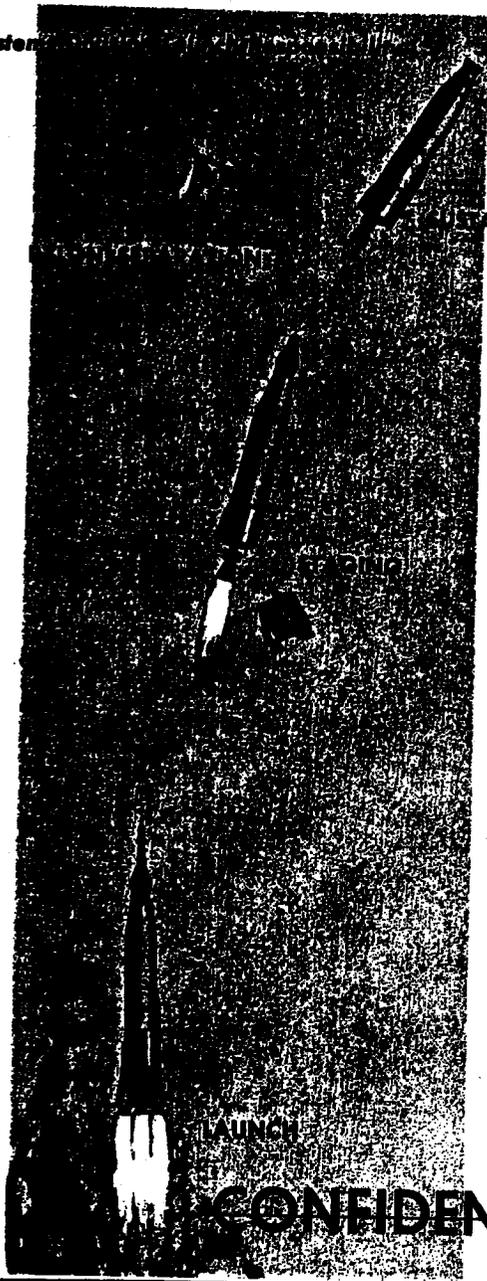
**Space Systems
MERCURY Support**

- Fifteen modified ATLAS
- Launch complex and support
- Systems development
- Studies and technical data
- Safety program

Trajectory Outline for

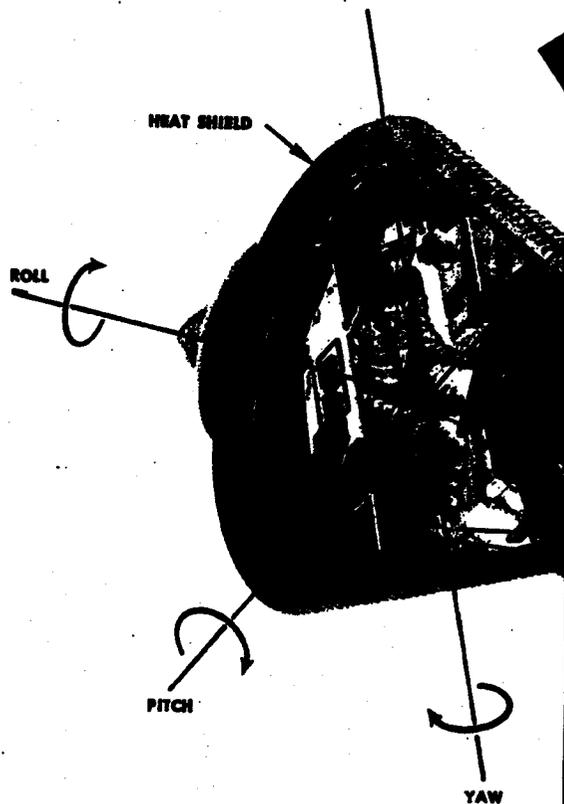
●
ROTATION
ORBIT
 Apogee
 Perigee

Space Systems



CAPSULE SEPARATION

SUSTAINER ENGINE CUTOFF



K-2

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Vision
Functions
"D" boosters
port thru orbital insertion
distance

MA-4 Flight

ATTITUDE

37 n.m.

87 n.m.

RETRO ROCKETS FIRE

RE-ENTRY

RETRO and POSIGRADE
ROCKETS JETTISONED

DROGUE PARACHUTE OPENS

MAIN PARACHUTE DEPLOYED

IMPACT

NORMAL ORBITAL FLIGHT

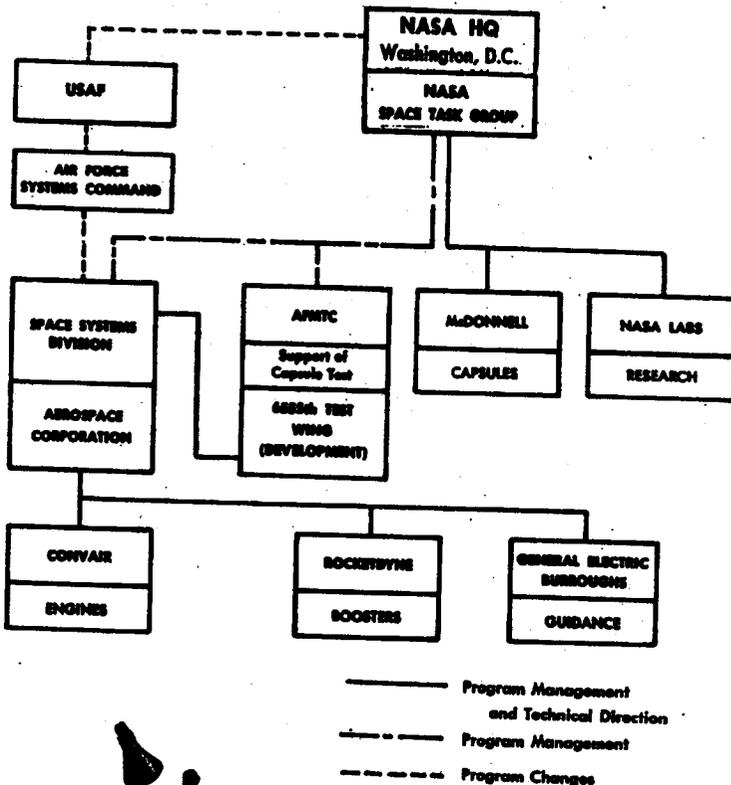
MAIN INSTRUMENT PANEL

MAIN PARACHUTE

DROGUE PARACHUTE

PERISCOPE

HORIZON SCANNER



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Launch Schedule

Flight History

	J	1959
	A	
★	S	
	O	
	N	1960
	D	
●	J	
	A	
	S	1961
	O	
	N	
	D	
★	J	
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	A	
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1	N	
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	J	1962
1	F	
1	M	
	A	
	M	
1	J	
	J	
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	S	1963
1	O	
	N	
	D	
	J	
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	J	
1	J	
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	S	
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	N	
	D	

MERCURY Flight	Launch Date	ATLAS No.	Remarks
Big Joe I	9 September	10D	<i>Flight test objectives were achieved to such a high degree that a second, similar flight was cancelled. The capsule was recovered intact.</i>
MA-1	29 July	50D	<i>After one minute of normal flight guidance, rate, track lock, and telemetry were lost and the vehicle was destroyed. The exact cause of the malfunction has not been determined.</i>
MA-2	21 February	67D	<i>Test analyses have been completed and all booster and capsule test objectives were achieved.</i>
MA-3	25 April	100D	<i>Vehicle destroyed after 43 seconds of flight by the Range Safety Officer. Programmed pitch and roll functions failed to occur and Range Safety criteria were violated. Investigations to determine the cause of programmer failure have resulted in changes to the autopilot system of the MA-4 and subsequent boosters.</i>

★ Successful flight
 ● Unsuccessful flight

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Monthly Progress — Project MERCURY

Flight Test Progress

- ATLAS 88D underwent a thorough review using procedures required by the ATLAS Booster Pilot Safety Program. Final factory acceptance was accomplished on 13 July using approved Factory Roll-out Inspection Procedures. This booster has been modified to include all engineering changes recommended by the MA-3 Investigation Board. (C)
- The launch of MA-4 is scheduled for the week of 21 August. ATLAS 88D was delivered to the Atlantic Missile Range on 15 July and was erected on Pad 14 on 18 July. MERCURY Capsule No. 8, which was recovered after a successful close in abort during the MA-3 launch, will be mated with the ATLAS booster on 7 August. (C)
- Analysis of the recovered ATLAS 100D autopilot

programmer is still in progress. Several engineering modifications were incorporated in the ATLAS 88D programmer and satisfactorily checked out during composite testing. (C)

- The decision to proceed with a test program for incorporation of baffled injectors on MERCURY launches is still awaiting a decision by the NASA Space Task Group. (C)

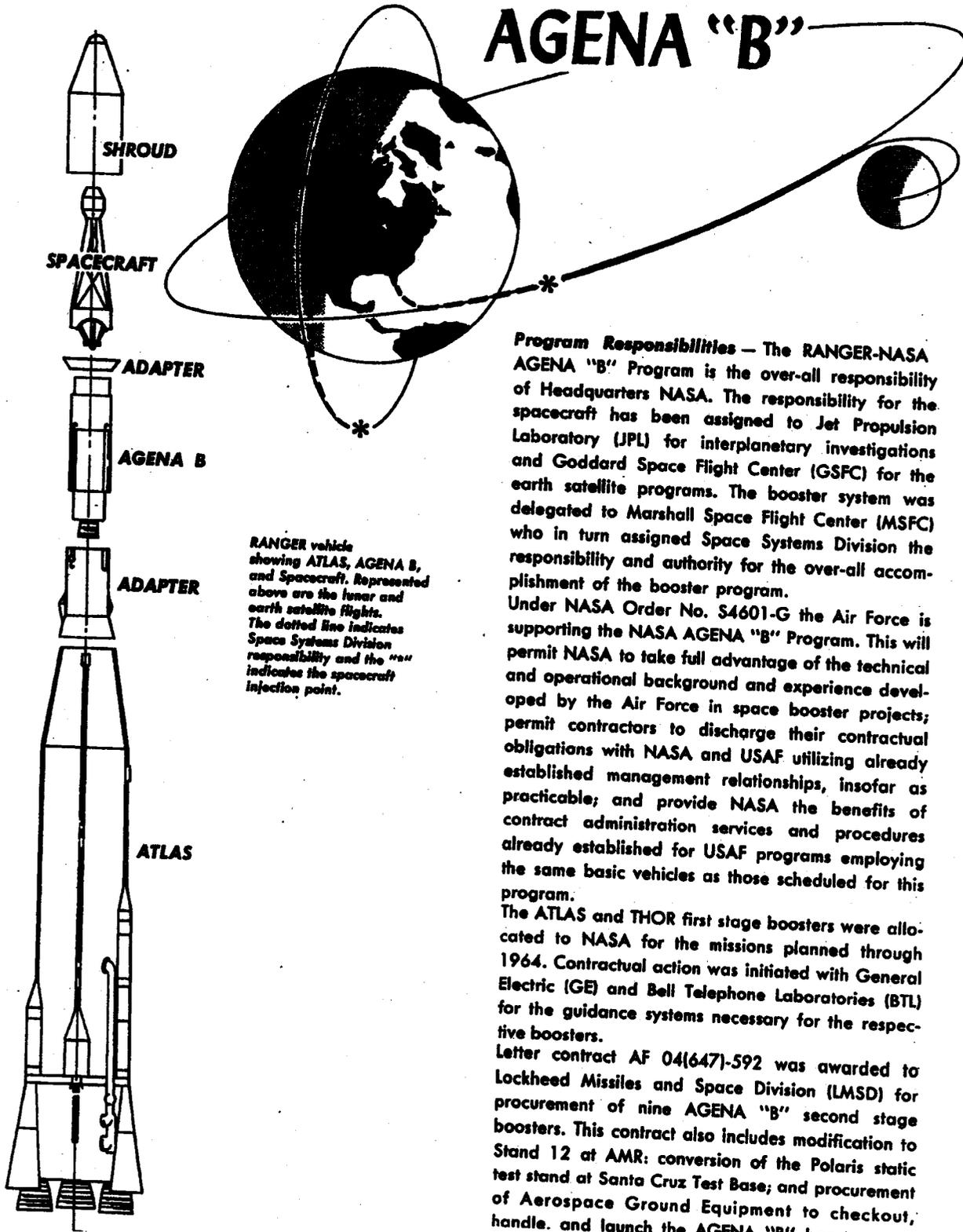
- During the week of 17 July General Electric Company demonstrated the operation of the recent modification to the Mod IIIA guidance system at the Atlantic Missile Range. These modifications will improve system performance by extending the theoretical tracking limit of the system to 92,000 miles, by providing rapid rate reacquisition to improve rate data early in flight, and by reducing the lateral rate noise resulting in smoother data and improved accuracy. (U)



Figure 1. Factory checkout of ATLAS 88D. This booster was installed on Atlantic Missile Range Stand 14 on 18 July.

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RANGER-NASA AGENA "B"



RANGER vehicle showing ATLAS, AGENA B, and Spacecraft. Represented above are the lunar and earth satellite flights. The dotted line indicates Space Systems Division responsibility and the "" indicates the spacecraft injection point.*

Program Responsibilities — The RANGER-NASA AGENA "B" Program is the over-all responsibility of Headquarters NASA. The responsibility for the spacecraft has been assigned to Jet Propulsion Laboratory (JPL) for interplanetary investigations and Goddard Space Flight Center (GSFC) for the earth satellite programs. The booster system was delegated to Marshall Space Flight Center (MSFC) who in turn assigned Space Systems Division the responsibility and authority for the over-all accomplishment of the booster program.

Under NASA Order No. S4601-G the Air Force is supporting the NASA AGENA "B" Program. This will permit NASA to take full advantage of the technical and operational background and experience developed by the Air Force in space booster projects; permit contractors to discharge their contractual obligations with NASA and USAF utilizing already established management relationships, insofar as practicable; and provide NASA the benefits of contract administration services and procedures already established for USAF programs employing the same basic vehicles as those scheduled for this program.

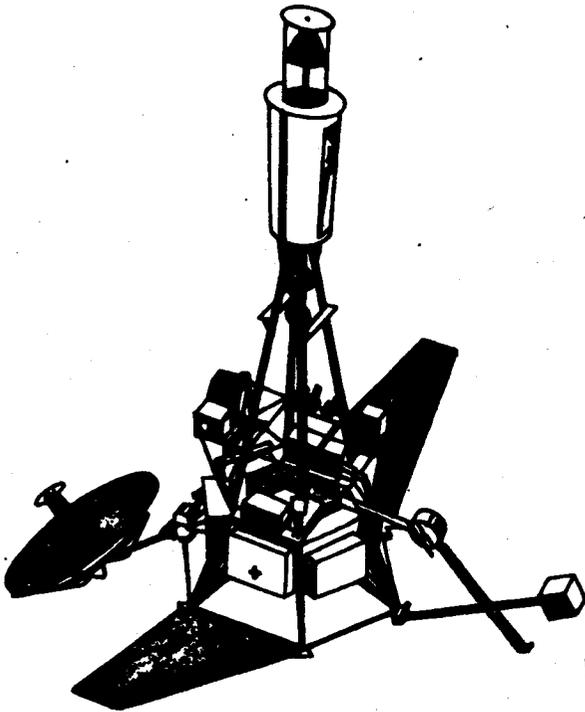
The ATLAS and THOR first stage boosters were allocated to NASA for the missions planned through 1964. Contractual action was initiated with General Electric (GE) and Bell Telephone Laboratories (BTL) for the guidance systems necessary for the respective boosters.

Letter contract AF 04(647)-592 was awarded to Lockheed Missiles and Space Division (LMSD) for procurement of nine AGENA "B" second stage boosters. This contract also includes modification to Stand 12 at AMR; conversion of the Polaris static test stand at Santa Cruz Test Base; and procurement of Aerospace Ground Equipment to checkout, handle, and launch the AGENA "B" booster.

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RANGER Program



The ATLAS/AGENA "B" booster system will include the standard ATLAS "D" first stage booster with GE Mod III G guidance system. The second stage will be a modified AGENA B second stage booster similar to those used in several Air Force space programs. The only major change to be incorporated for these missions is the capability to separate the RANGER spacecraft and fire a retro rocket to prevent the AGENA "B" from hitting the moon. Lunar impact of the AGENA "B" is not desired due to its unsterile condition.

The RANGER Program will be the initial launch by NASA of the Air Force developed AGENA "B" second stage. Maximum effort is being given toward using the same components that have been flown on Air Force missions.

Scientific Satellite Program

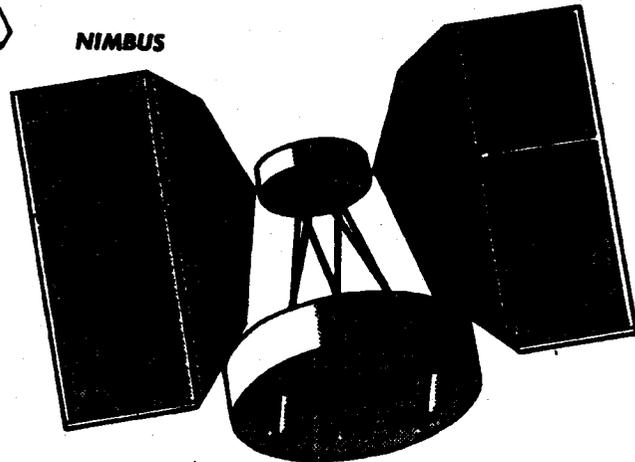
Lunar Test Missions

The RANGER Program is a series of five deep space probes to be launched from the Atlantic Missile Range (AMR) on the ATLAS/AGENA B booster system. Jet Propulsion Laboratory (JPL) under contract from the National Aeronautics and Space Administration (NASA) is responsible for the missions and providing the spacecraft hardware. The mission of the first two RANGER launches will be an interplanetary investigation in support of the follow-on lunar impact mission. The orbit will be highly elliptical (near escape velocity) and have an apogee of approximately 625,000 nautical miles. The spacecraft is planned for one orbit with approximately a 50 day period.

Lunar Impact Missions

The remaining three launches will impact the surface of the moon and transmit scientific information back to the earth. Experiments are designed to measure seismographic disturbances, temperature changes and impact acceleration. These Ranger spacecrafts will also have the capability of accomplishing a mid-course maneuver to correct for minor errors in the trajectory.

NIMBUS

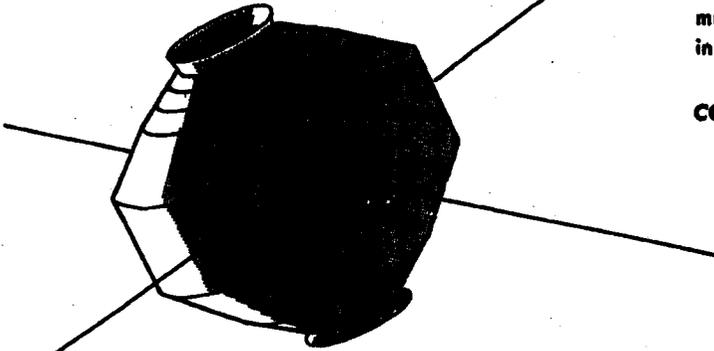


NIMBUS is a 650 pound earth oriented stabilized satellite to be placed in a "high noon" circular orbit at 600 miles altitude. This satellite is intended to serve as a platform for experiments designed to explore the meteorological process of the earth's atmosphere. Experiments include full picture coverage of the clouds over the entire earth, electromagnetic radiation maps of the earth, and the atmosphere around the earth and other experiments to determine the effect of the sun on the atmosphere.

A total of five NIMBUS satellites will be put into orbit by the THOR/AGENA B booster from Vandenberg Air Force Base. The first launch is scheduled for June 1962 with subsequent launches every six months. The booster system will be the same as used on Topside Sounder and the Communication Satellite with slight modification to accept the larger payload.

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TOPSIDE SOUNDER SATELLITE MISSION (S-27)



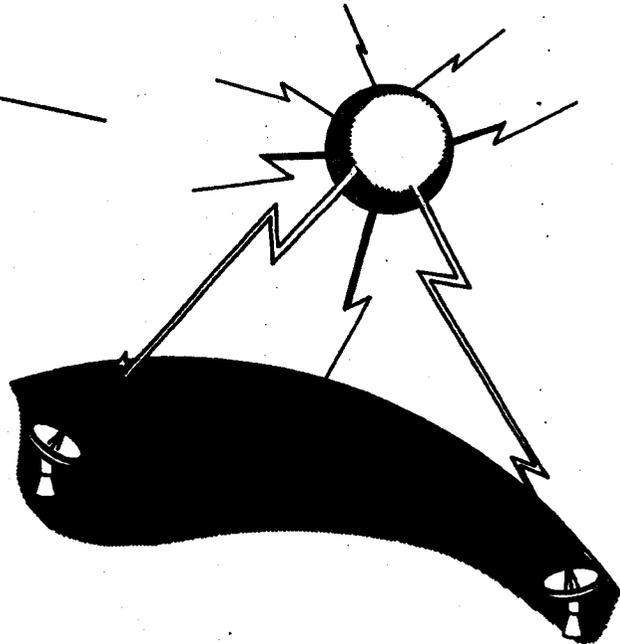
The primary objective of the S-27 Satellite is the examination of the structure of the ionosphere from above in a manner similar to that now being done by ground-based ionospheric sounders. In particular the objective is to obtain information about the ionosphere in the region above the F layer maximum. Other objectives are to measure the cosmic noise level and determine the plasma frequency at the altitude of the satellite.

The Topside Sounder (S-27) will be launched on board a THOR/AGENA "B" booster system from Vandenberg Air Force Base into a 540 n.m. circular orbit. This will be the first Pacific Missile Range launch in this program; however, it will be similar to previous Air Force THOR/AGENA B launches from Vandenberg Air Force Base.

The THOR/AGENA "B" booster system will be composed of the standard DM-21 THOR booster with Bell Telephone Laboratory guidance systems and AGENA "B" second stage similar to the one used

in the RANGER launches from Atlantic Missile Range. Minor modifications will be made to the AGENA to make it compatible to the mission; however, maximum use will be made of the experience developed in the RANGER Program.

COMMUNICATION SATELLITE MISSION (A-12)



The primary objective of Project Echo A-12 is the demonstration of a spacecraft deployment and rigidization technique applicable to passive communications satellites. Development of the spacecraft will be undertaken by the Langley Research Center. The Communication Satellite (A-12) will be launched into a 650 n.m. orbit aboard the THOR/AGENA "B" booster. The shroud which surrounds and protects the Communication Satellite will be the same general shape as the S-27 except the length is reduced to accommodate the shorter space craft.

61												62											
J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
							1	1				1		1	2		2			1			
							①	①				①	○	①	①	①*				*			
MISSION																							

LEGEND

- ① LUNAR TEST VEHICLE (ATLAS)
- ② LUNAR IMPACT (ATLAS)
- SCIENTIFIC SATELLITE (THOR)
- COMMUNICATION SATELLITE (THOR)
- * METEOROLOGICAL SATELLITE (THOR)
- * BACKUP VEHICLE (THOR)

Note: Lunar flights will be launched from the Atlantic Missile Range; all others will be made from Vandenberg Air Force Base.

Monthly Progress — RANGER

Lunar Test Missions

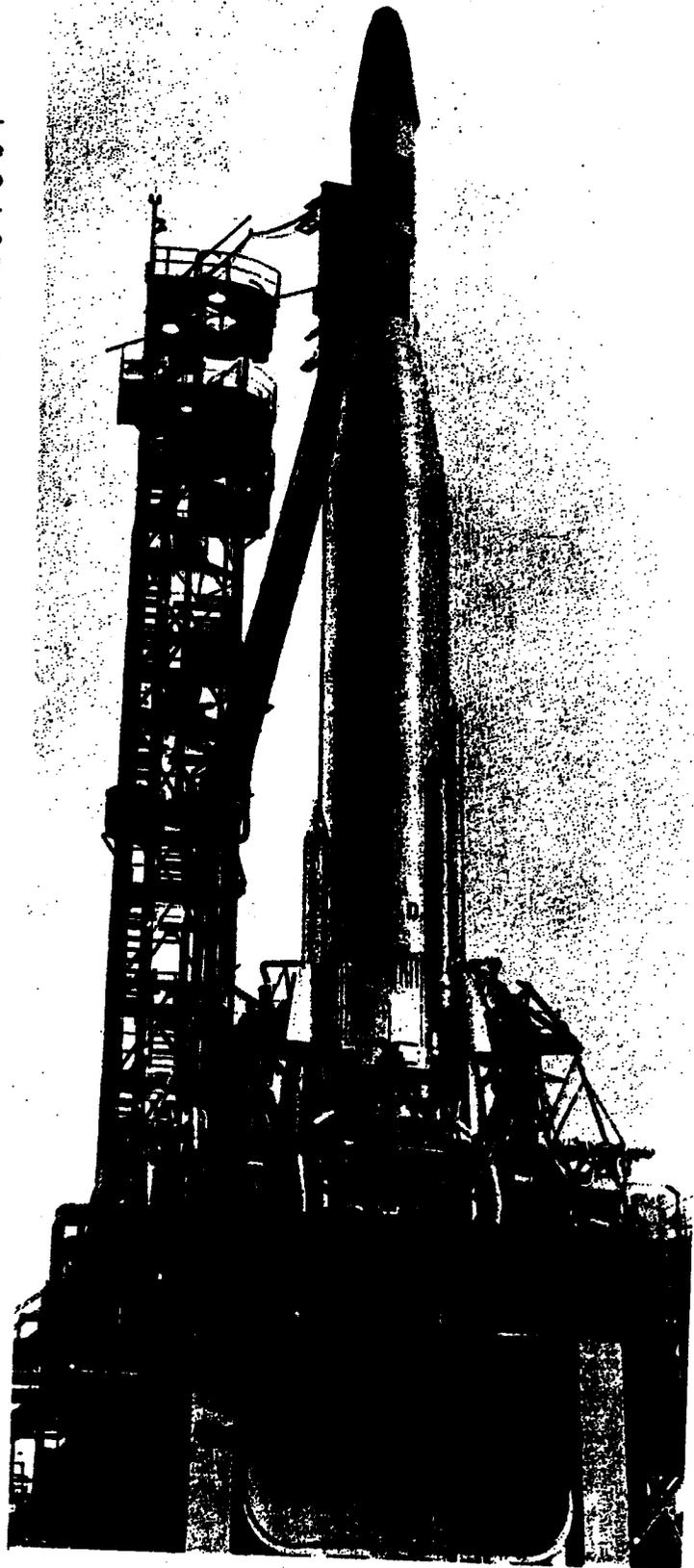
Flight Test Progress

• The first lunar test vehicle, RA-1, is now tentatively scheduled to be launched from Pad 12 at the Atlantic Missile Range on 24 August. Attempts to launch RA-1 during the July "window" were unsuccessful. On 29 July, the countdown progressed to T-27 minutes when a failure of base power caused the launch to be rescheduled. On 31 July, the countdown was started but was discontinued at T-232 minutes because of an inadequate supply of attitude control gas in the spacecraft. The countdown initiated on 1 August was discontinued at T-15 minutes when attempts to refill the ATLAS liquid oxygen tank failed. The tank had been emptied to allow Lockheed personnel to resolve a problem in the AGENA propellant pressurization ground system. More spacecraft problems developed during the 2 August countdown and caused the launch to be called off for this firing period. (C)

• Objectives for the first RANGER lunar test mission are:

1. Demonstrate the ability of the ATLAS to place the AGENA B vehicle at a predetermined position and velocity in space as defined by the guidance equation.
2. Inject the RANGER spacecraft into the prescribed orbit using the ATLAS/AGENA B vehicle.
3. Demonstrate the compatibility of the ATLAS/AGENA B/Spacecraft configuration.
4. Demonstrate the capability of the Atlantic Missile Range and DSIF (Deep Space Instrumentation Facility) tracking, telemetry, and communications to provide the required data and control of the RANGER system during all phases of the operation.
5. Demonstrate the ability of the launch control equipment, the AGE, and the launch procedures to launch the RANGER vehicle within severe time limitations. (The launch window for RA-1 has been limited to 34 minutes to avoid overloading the horizon sensor on the AGENA B vehicle.) (C)

Figure 1. RANGER I on Atlantic Missile Range Stand 12. The launch of this lunar test vehicle has been rescheduled for the next lunar firing period.



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Technical Progress

- The AGENA B vehicle scheduled to be flown on the second RANGER flight has been placed in storage at the Lockheed Sunnyvale facility awaiting shipment to the Atlantic Missile Range in August. (U)
- In early June the delivery date for ATLAS 117D was established for August. This booster will be used for the October Lunar Test Mission (RA-2). A review of the ATLAS Planned Systems Schedule, dated 20 June, revealed a one month delay in the delivery date. The Space Systems Division is making a concentrated effort to recover the schedule for this booster. (C)

Lunar Impact Missions

Technical Progress

- The first Lunar Impact AGENA B vehicle has entered final systems test. Following completion of these tests the vehicle will be shipped to Santa Cruz Test Base for static firing. (U)

Facilities

- Design of modifications to Complex 75-1 at Vandenberg Air Force Base in support of NASA polar launch requirements is progressing on schedule. Final plans were submitted on 31 July. (U)

A. THIRD STAGE—X-248 (Allegany Ballistic Lab.)

Thrust at altitude	3150 pounds
Specific impulse (vac)	250 seconds
Total impulse	116,400 lbs/sec
Burning Time	37.5 seconds
Propellant	Solid

B. SECOND STAGE—AJ10-42 (Aerojet-General)

Thrust at altitude	7700 pounds
Specific impulse (vac)	271 seconds
Total impulse (min)	870,000 lbs/sec
Burning time	115 seconds
Propellant	Liquid

C. FIRST STAGE—THOR IRBM

Thrust (s.l.)	151,500 pounds
Specific impulse (s.l.)	248 seconds
Specific impulse (vac)	287 seconds
Burning time	158 seconds
Propellant	Liquid

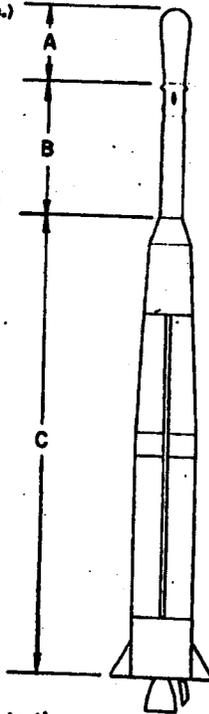
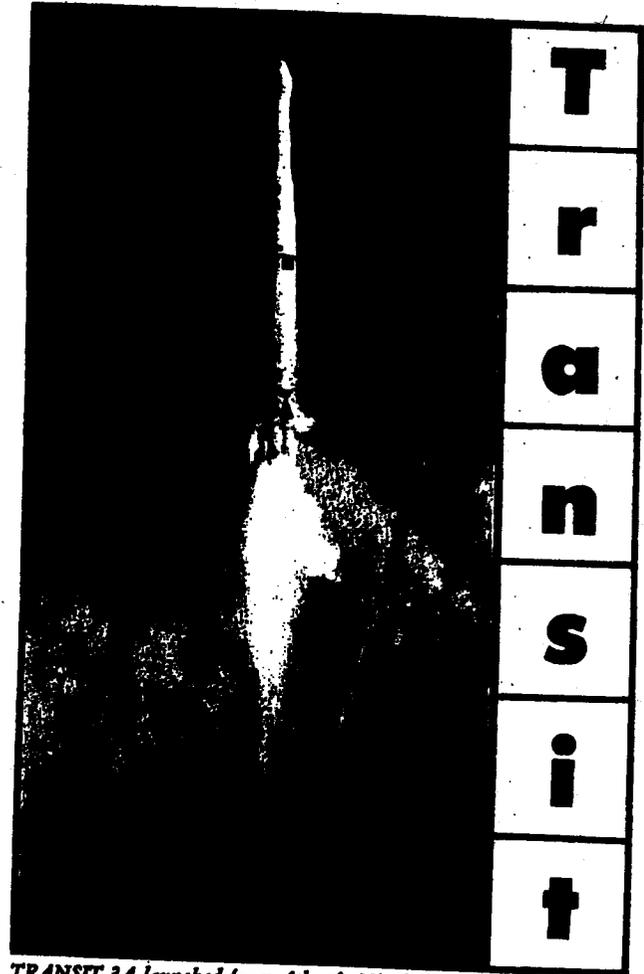


Figure 1. TRANSIT IA three stage flight vehicle.

The TRANSIT Program consists of the flight testing of eight vehicles to place 200-350-pound satellite payloads into circular orbits of 400 to 500 nautical miles. The program is designed to provide extremely accurate, world-wide, all-weather navigational information for use by aircraft, surface and subsurface vessels, particularly in relation to POLARIS missile firings. The ARPA Order for TRANSIT 1A was initiated in September 1958 and amended in April 1959 to



TRANSIT 3A launched from Atlantic Missile Range

add TRANSIT 1B, 2A and 2B flights. The TRANSIT 3A and 3B flights were initiated by a Navy MIPR, dated 18 May 1960. Because of the successful TRANSIT 2A launch and excellent payload performance the Navy elected to launch TRANSIT 3A rather than 2B. TRANSIT 2B was scheduled to carry the same type payload as was carried on the 2A flight. Subsequently, the Navy initiated requests for TRANSIT 4A, 4B, 5A and 5B.

The program was originally authorized by ARPA Order No. 97-60, which assigned AFBMD responsibility for providing the booster vehicles, integrating payloads to the vehicles, and flight operations from launch through attainment of orbit. The TRANSIT project was transferred to the Navy on 9 May 1960. The Navy has now assumed both the administrative and technical responsibility for the TRANSIT program. Payload tracking responsibility has been assigned to the USN Bureau of Weapons. Applied Physics Laboratory is the payload contractor.

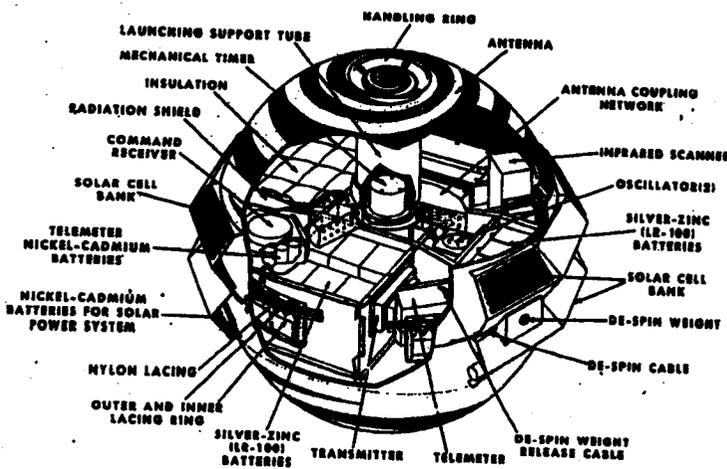
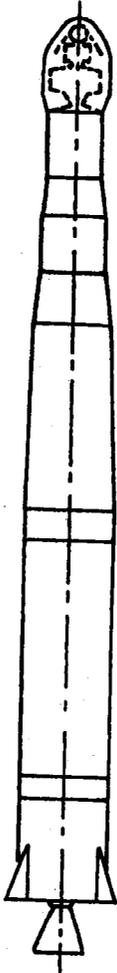


Figure 2. Cut-away drawing of TRANSIT IA payload (NAV 1).



SECOND STAGE — ABLESTAR (AJ10-104)

Thrust (vacuum)	7900 pounds
Specific impulse (vacuum)	277 seconds
Burning time	296 seconds
Propellant	IRFNA UDMH

FIRST STAGE — THOR IRBM

Thrust (sea level)	152,000 pounds
Specific impulse (sea level)	247 seconds
Burning time	163 seconds
Propellant	Liquid Oxygen RP-1

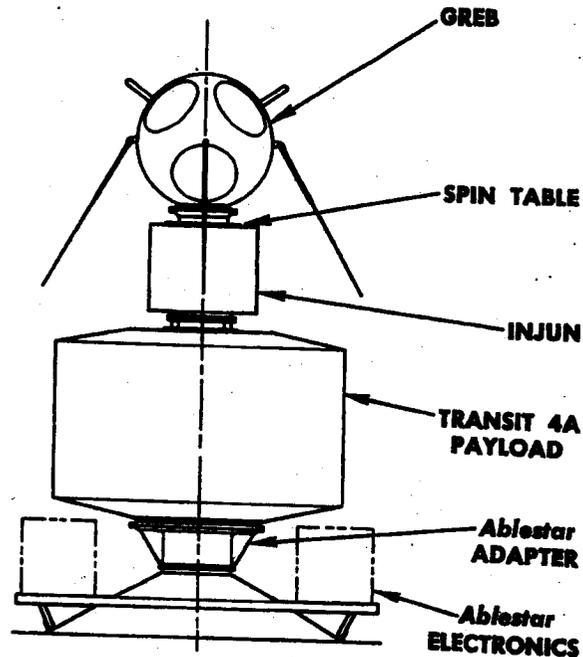


Figure 4. Payload arrangement for TRANSIT 4A flight.

Figure 3. Two stage vehicle used for TRANSIT 1B and subsequent flights.

Program Objectives

1. Provide accurate navigational reference information for POLARIS launches.
2. Precise determination of satellite position by measuring the doppler shift of satellite transmitted radio signals.
3. Investigate the refractive effect of the ionosphere on radio transmissions.
4. Acquire additional geodetic and geographical data by precision tracking of the orbiting satellite.

Flight Vehicles TRANSIT 1A was a three stage vehicle as shown in Figure 1. TRANSIT 1B and subsequent vehicles are two stage vehicles as shown in Figure 3.

Launch Plans All vehicles will be launched from Complex 17 at the Atlantic Missile Range. Launch azimuth will vary between 45.5° and 140° for each flight.

Payload Description The TRANSIT 4A payload is shown in Figure 4. The payload consists of three separate assemblies and has a total weight of 300 pounds. The TRANSIT payload (175 lbs) is the next step in the Navy Program to develop an operational navigation system. The payload is a short cylindrical shape as opposed to the spherical shape of all the previous payloads. The new shape is close to that which is proposed for the operational system payloads. The TRANSIT 4A payload is the first satellite to contain a Radioactive Isotope Power Supply (a SNAP Power Supply). This radioactive supply provides power for the operation of several satellite systems. The second satellite, the INJUN payload, (40 lbs) is under the cognizance of Dr. Van Allen of the State University of Iowa. It will perform radiation measurements. The third satellite (55 lbs) is a Naval Research Laboratory GREB with detectors to study solar emissions. There is also 30 pounds of interconnecting structure consisting of a spin table to spin the GREB, springs to separate the payloads, and supporting brackets for the launch phase.

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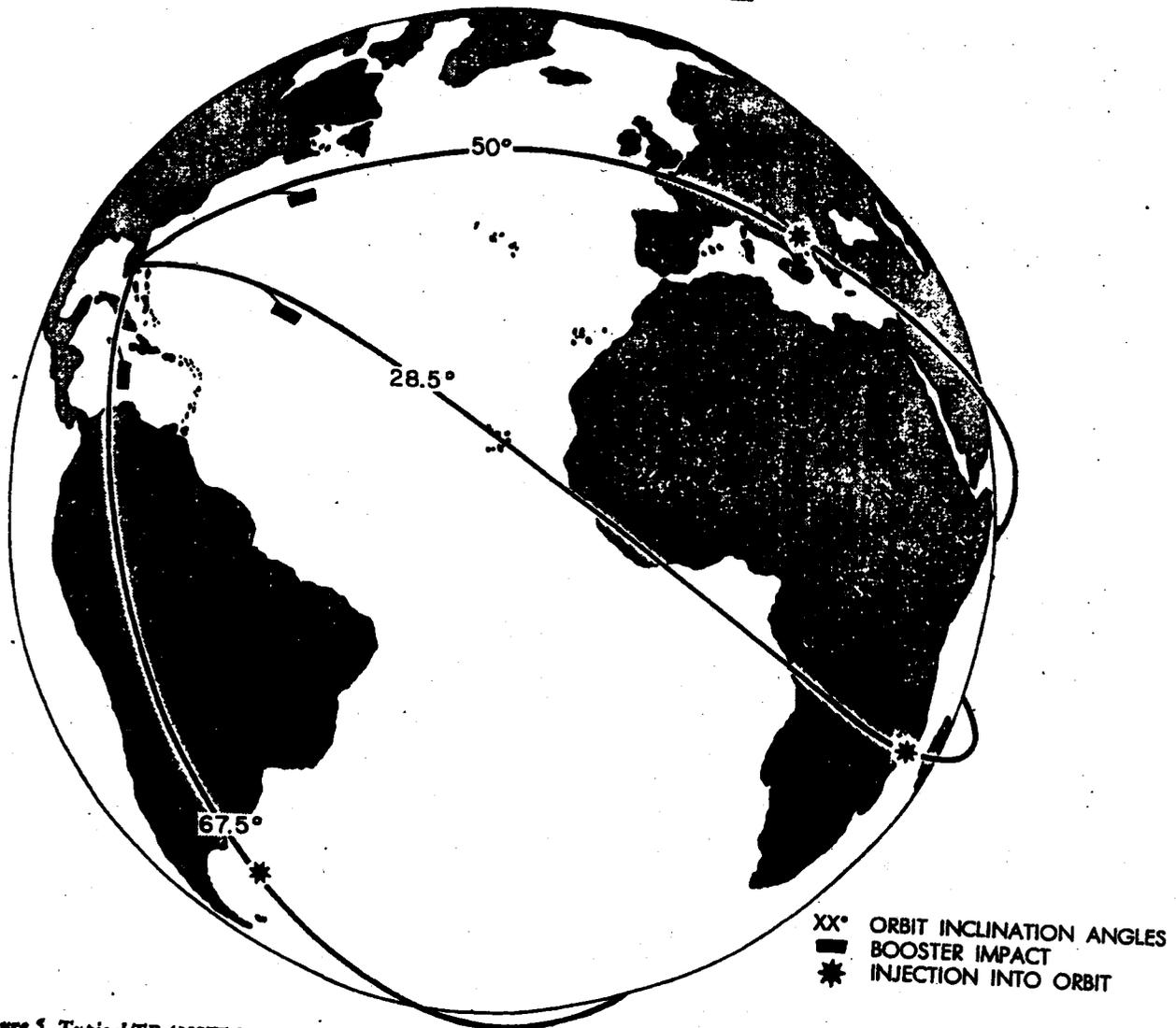


Figure 5. Typical TRANSIT launch trajectories showing flight path, booster impact areas, and orbital injection points.

Orbital Performance Achievement of program objectives is based primarily on measuring the doppler shift of satellite transmitted radio signals. During the first three months of flight, the four transmitters will be operated to obtain experimental confirmation of the theoretical mathematical relationship between the frequency and the refractive index of the ionosphere. Studies have shown that refraction effects on the doppler shift can be eliminated by using the transmission from two satellites. After four months of tracking the satellite by measuring the doppler shift of the satellite radio signal, the exact position of the satellite at any point in the orbit should be known. Using known orbital positions, ships and aircraft can then use satellite signals to make analogous computations to establish accurate position.

Ground Support and Tracking Stations The Navy Bureau of Weapons payload contractor provides a system of payload tracking stations which obtain information for precise orbit determination. These stations are located in Maryland, Texas, New Mexico, Newfoundland and Brazil. First and second stage tracking and telemetry, and second stage guidance will be provided by the facilities of the Atlantic Missile Range. A mobile downrange tracking station at Punta Arenas, Chile, will receive telemetry data and tracking information during the last portion of the second stage Ablestar coast, re-ignition and second burn, payload spin-up and payload injection periods. This station was located in Erding, Germany, for the TRANSIT 1B flight, Punta Arenas, Chile, for the TRANSIT 2A and 3A and Pretoria, Union of South Africa for TRANSIT 3B.

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M-3

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Monthly Progress – TRANSIT

Program Administration

- At the request of the Navy, the launch of TRANSIT 4B has been rescheduled from late August to mid-November. (C)
- The booster system recently scheduled for ANNA I will now be flown with a composite payload consisting of several secondary experiments in mid-December. (C)

Figure 6. Check out of the Ball Telephone Laboratories Ablator guidance equipment (below). Close up (right) of the equipment installed on the new mounting ring. The BTL equipment replaces the Space Technology Laboratories guidance equipment on TRANSIT 4B and subsequent TRANSIT flights.



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M-5

SPACE

BOOSTERS



**EXISTING OR PROGRAMMED
STAGES**

SPACE BOOSTERS

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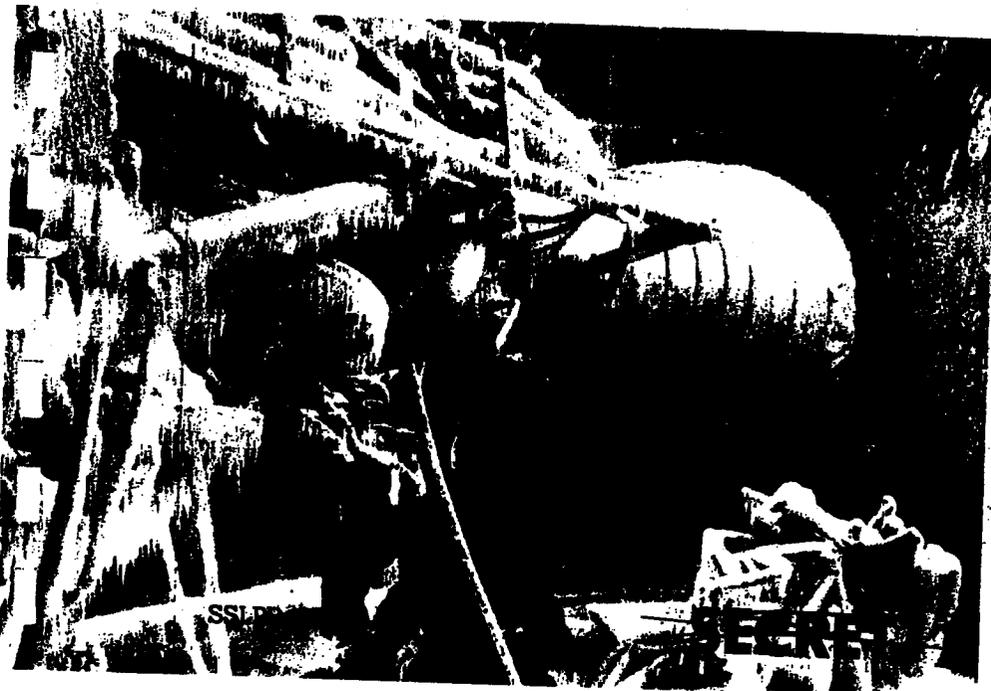
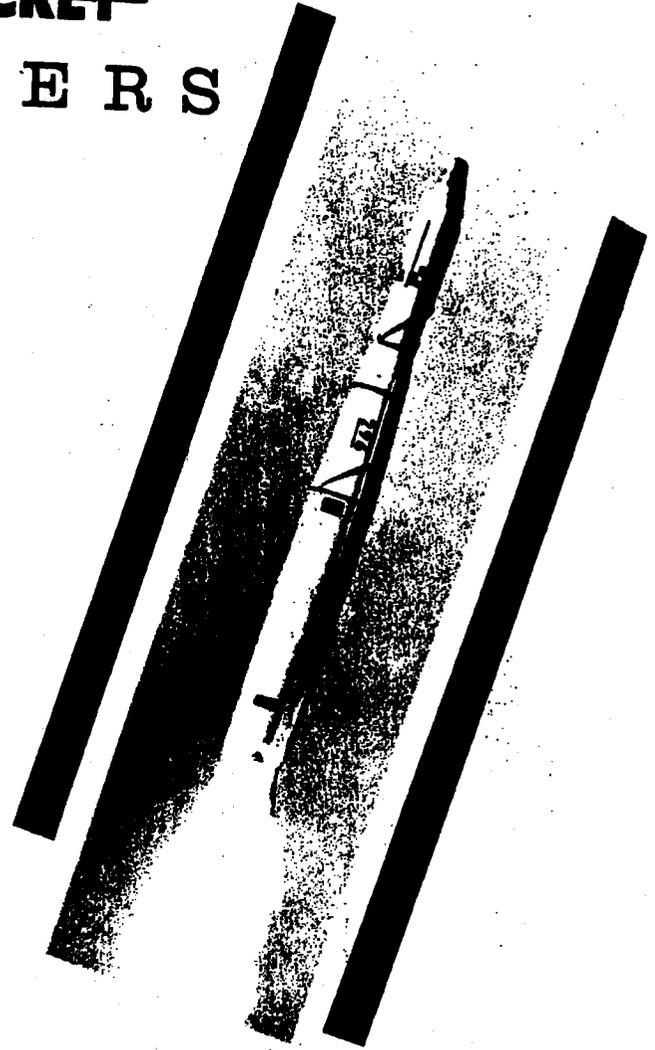
Space Program

BOOSTERS

● The primary pacing factor in the accomplishment of space missions has been, and for some time will continue to be, the availability of Air Force ballistic missiles and upper stages to boost the payload vehicle. Space flight planning requires close examination of all technological areas wherein advances provide increases in booster and mission capability. This, in turn, has required that space schedules be sufficiently flexible to incorporate rapidly those advances in the state-of-the-art which increase the potential for reliable and predictable space research.

● Because of the wide range of its activities, The Air Force Space Systems Division has accumulated a broad base of experience in booster selection for space missions. Experience in ballistic missile R&D programs and in development of upper stage vehicles have provided much information. Research programs in the propellant and materials areas also are providing new capability for space research. The number and variety of boosters available permit the selection of a combination of stages tailored to provide specific capabilities for specific missions.

● The following pages describe briefly the booster vehicles currently being used by The Air Force Space Systems Division to support military and civilian space programs. Nominal performance data is given to permit nominal comparisons of vehicle capabilities. Specific qualifications are made where necessary for clarity.





DM-19/AJ10-118/
ABL X248-A5



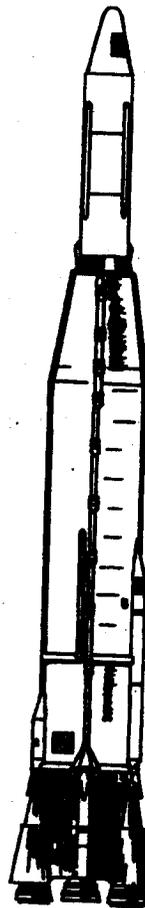
DM-21/Abtestor



DM-21/AGENA B



TITAN II



ATLAS D/AGENA B



ATLAS D/CENTAUR

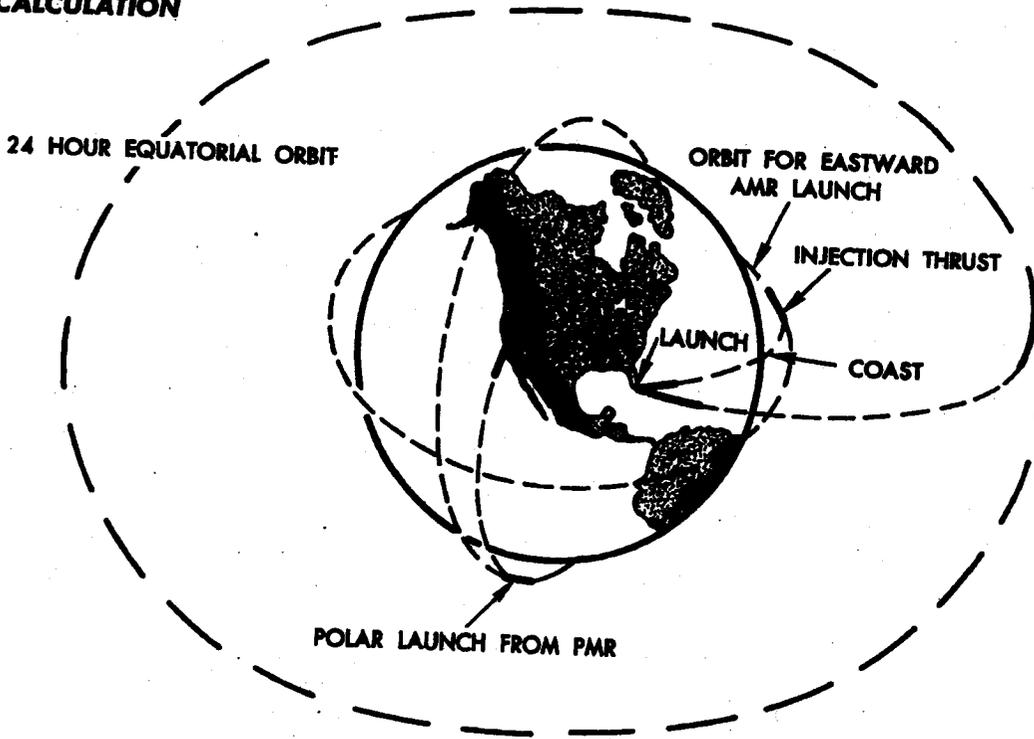
Program Vehicle Combinations

ABLE-1, -3 and -4.	A	M	R	DISCOVERER (1 thru 15)	A	H	NASA AGENA "g"...	E	K
ABLE-4 and -5.....	E	M	R	DISCOVERER (16 thru 19)	A	J		C	K
ADVENT (Phase One)			K	DISCOVERER (20 and subs)	C	K	NASA Delta	B	R
ADVENT (Phase Two)			P	DYNA SOAR	F	G	SAINT	E	K
ADVENT (Phase Three)			Q	MERCURY		E	TIROS	B	R
ANNA		D	N	MIDAS (I and II).....	E	H	TRANSIT 1A	A	L
BAMBI		E	P	MIDAS (III and subs)...	E	K	TRANSIT 1B thru 5B ..	D	N
COURIER		D	N				VELA HOTEL.....	E	K

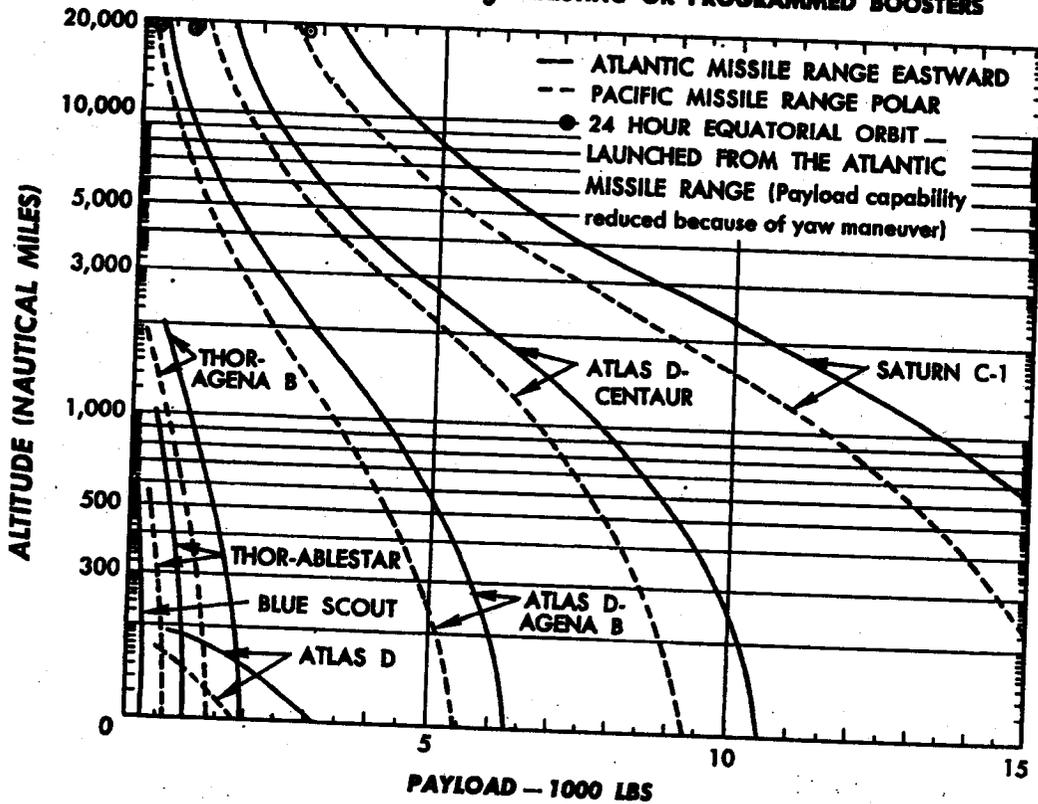
NOTE: Light type indicates completed programs Bold type indicates active programs

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**LAUNCH CAPABILITIES
CALCULATION**



Performance Summary — EXISTING OR PROGRAMMED BOOSTERS



SSLPR-20

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N-3

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BOOSTERS

THOR — Douglas Aircraft Company

Weight — dry	A DM-18	B DM-19	C DM-21	D DM-21A
Fuel — RP-1/RJ-1*	7,846	7,204	6,590	6,870
Oxidizer — Liquid Oxygen	31,500	31,500	33,500*	31,500
Total	68,000	68,000	68,000	68,000
Height — feet	107,346	106,704	108,090	106,370
Engine — Rocketdyne Division of North American Aviation	61.3	65.1	55.9	60.4
Thrust — lbs. (sea level)	MB-3 Block I	MB-3 Block I	MB-3 Block II	MB-3 Block I
Spec. Impulse — lb.-sec/lb. (sea level)	152,000	152,000	169,000	152,000
Burn Time — seconds	247.0	247	250	247
Guidance — Bell Telephone Laboratories series 400 or autopilot only.	160	160	149	160

(27) (31) (87) (5) (5) (100) (11) (12) (91.7) (5) (7) (72)

ATLAS — General Dynamics-Astronautics

Weight — dry	
Fuel — RP-1	
Oxidizer — Liquid Oxygen	
Total	
Height — feet	
Engine — Rocketdyne Division of North American Aviation	
Thrust — lbs. (sea level)	
Booster	
Sustainer	
Vernier	
Specific Impulse — lb.-sec/lb. (sea level)	
Booster	
Sustainer	

E Series D
15,100
74,900
172,300
262,300
69
MA-5
309,000
57,000
2,000

Guidance — Radio Mod II/III — General Electric (radar), Burroughs (computer)

251
214.7
(9) (12) (75)

TITAN II — The Martin Company

Weight — dry	F FIRST STAGE
Fuel — N ₂ H ₄ /UDMH	12,231
Oxidizer — N ₂ O ₄	83,713
Total	161,632
Height — feet (combined first and second stage)	257,576
Engine — Aerojet-General Corporation	
Thrust — lbs.	XLR87AJ-5
Specific Impulse — lb.-sec/lb.	430,000 (sea level)
Burn Time — seconds	258 (sea level)
Guidance — Radio Mod III — General Electric (radar), Burroughs (computer)	146.3

G SECOND STAGE
5,375
20,200
37,702
63,714
90
XLR91AJ-5
100,000 (vacuum)
314 (vacuum)
181.9

UPPER STAGES

R ABL X248-9 Allegany Ballistics Laboratory

Weight — wet	
Propellant — Solid	
Total	
Height — feet	
Engine	
Thrust — lbs. (vacuum)	
Specific Impulse — lb.-sec/lb. (vacuum)	
Burn Time — seconds	

60
459
519

2,750
254
42.1
(9) (11) (81.8)

Existing or Programmed Stages

SATELLITE VEHICLES

AGENA — Lockheed Missiles and Space Company

ENGINE MODEL — Bell Aerospace Systems	H YLR-81 Ba-5	J XLR-81 Ba-7	K XLR-81 Ba-9 ^③
① Weight — inert	1,262	1,328	1,346
Fuel — UDMH			
Oxidizer — IRFNA			
② Total	8,165	14,789	14,807
Height — feet	14	19.5	21
Engine	15,600	15,600	16,000
Thrust — lbs. (vacuum)	277	277	290
Specific Impulse — lb.-sec/lb. (vacuum)	120	240 ^④	240 ^④
Burn Time — seconds			
	(12) (17) (71) (3) (4) (75)		(4) (1) (5) (80)

ABLE Series — Aerojet-General Spacecraft Division

	L AJ10-42 (and -118)	M AJ10-101 (and -101A)	N AJ10-104 (Ablestar)
Weight — wet	1,247	848	1,297
Fuel — UDMH	875	869	2,247
Oxidizer — IRFNA	2,500	2,461	6,227
Total	4,622	4,178	9,771
Height — feet	18	16	15
Engine	7,670	7,720	7,900
Thrust — lbs. (vacuum)	267	268	277
Specific Impulse — lb.-sec/lb. (vacuum)		113	296
Burn Time — seconds			
	(10) (1) (14) (71.4)	(4) (2) (4) (100)	(4) (2) (5) (80)

CENTAUR — General Dynamics-Astronautics

	P	Q
Weight — dry	2,891 ^⑤	
Fuel — Hydrogen	—	
Oxidizer — Liquid Oxygen	—	
Total	32,000	
Height — feet	45.5	
Engines (Two) — Pratt & Whitney	RL10A-3	
Thrust — lbs. (vacuum) (15,000 each)	30,000	
Minimum Specific Impulse — lb.-sec/lb. (vacuum)	420	
Burn Time — seconds	370	

CENTAUR modifications necessary to meet ADVENT mission are being determined.

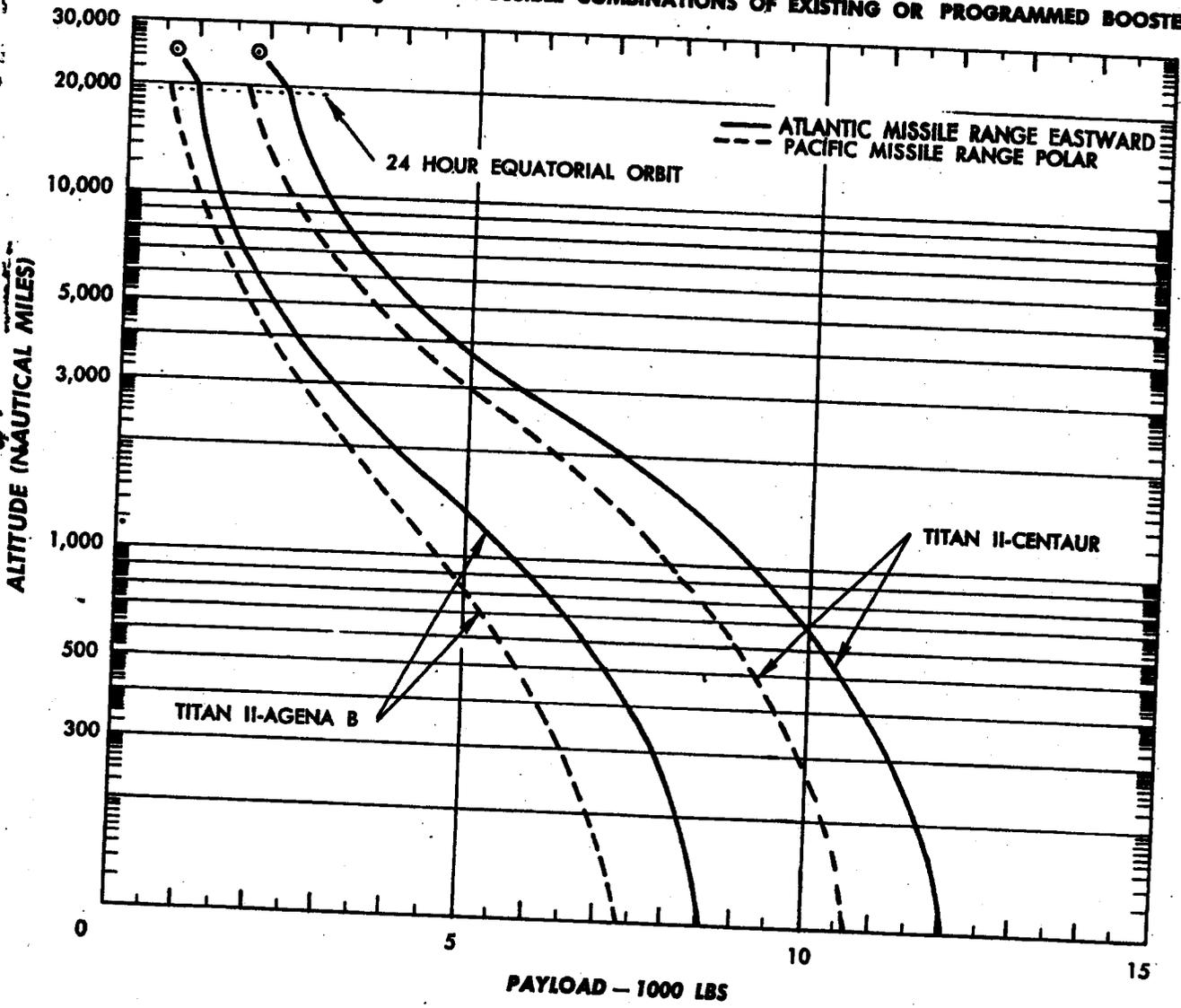
NOTES:

- ① Payload weight not included. Does include controls, guidance, APU and residual propellants.
- ② Does not include THOR adapter (225 lbs.) or ATLAS adapter (315 lbs.)
- ③ Single restart capability
- ④ Dual burn capability
- ⑤ Changes in payload weight affect fuel and oxidizer weights, but not total weight.

- Number of successful flights.
- Not tested because of first stage failure.
- ⬡ Number of launches attempted.
- ◌ Percentage of success.

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Performance Summary — POSSIBLE COMBINATIONS OF EXISTING OR PROGRAMMED BOOSTERS



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