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MILITARY SATELLITE PROGRAM

FOR QUARTER ENDING 31 DECEMBER 1958

RCS DD-SD (M) 242

UNCLASSIFIED

DECLASSIFIED IAW E.O. 12958
REVIEWED
BY D. Beal
DATE 2/8/88

Prepared By
Air Force Ballistic Missile Division
Headquarters Air Research And Development Command
UNITED STATES AIR FORCE
Post Office Box 262
Inglewood, California

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WDPCR - 58 - 10
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MILITARY SATELLITE PROGRAM

GLOSSARY

DISCOVERER FLIGHTS

DISCOVERER I:

Scheduled Launch Date: 10 January 1959
Booster: THOR #160, IRBM
Gross Weight: 113,700 lbs
Payload Weight: 70 lbs
Altitude: 220 Statute miles
Payload: Telemetry
Subsystems: Test of Booster/Vehicle Orbital Capability

Second Stage: DISCOVERER Vehicle
On-Orbit Weight: 1,328 lbs
Fuel: JP-4, Inhibited Red Fuming Nitric Acid
Flight Characteristics: Ballistic trajectory to Orbit

DISCOVERER II:

Scheduled Launch Date: 11 February 1959
Booster: THOR #163, IRBM
Gross Weight: 113,802 lbs
Payload Weight: 70 lbs
Altitude: 220 Statute miles
Payload: Telemetry
Subsystems: Test of Booster/Vehicle Orbital Capability

Second Stage: DISCOVERER Vehicle
On-Orbit Weight: 1,328 lbs
Fuel: JP-4, Inhibited Red Fuming Nitric Acid
Flight Characteristics: Ballistic trajectory to Orbit

DISCOVERER III:

Scheduled Launch Date: 18 March 1959
Booster: THOR #170, IRBM
Gross Weight: 114,906 lbs
Altitude: 195 Statute miles
Payload: Mark I biomedical recovery capsule
Subsystems: A, B, C, D, L
Second Stage: DISCOVERER Vehicle

Fuel: Unsymmetrical Di-Methyl Hydrazine/Inhibited Red Fuming Nitric Acid
On-Orbit Weight: 1,651 lbs
Payload Weight: 195 lbs
Flight Characteristics: Ballistic ascent trajectory with Orbital boost at Apogee

DISCOVERER PROGRAMS

PROGRAM I - ENGINEERING TESTS:

This program will include the demonstration of orbital capability of the DISCOVERER/THOR combination, design concepts, engineering tests of subsystem combinations, orbital stabilization, and the functioning of the tracking and communications system.

PROGRAM II - BIOMEDICAL RECOVERY CAPSULES:

The objectives of the Biomedical Recovery Capsule Program are to recover living specimens from orbital flight and to study the psycho-physiologic response of specimens to conditions of launch, orbit and recovery.

SUBSYSTEMS:

SUBSYSTEM "A": Air Frame
SUBSYSTEM "B": Propulsion
SUBSYSTEM "C": Auxiliary Power
SUBSYSTEM "D": Guidance
SUBSYSTEM "E": Ground/Space Communications
SUBSYSTEM "I": Data Processing
SUBSYSTEM "J": Geophysical
SUBSYSTEM "K": Personnel
SUBSYSTEM "L": Biomedical

PROPULSION:

XLR81-Ba-3 — Rocket Engine
Fuel: JP-4
Oxidizer: Inhibited Red Fuming Nitric Acid
265 Sec. Specific Impulse
15,150 lb Thrust

XLR81-Ba-5 — Rocket Engine
Fuel: Unsymmetrical Di-Methyl Hydrazine
Oxidizer: Inhibited Red Fuming Nitric Acid
277 Sec. Specific Impulse
15,150 lb Thrust

BIOMEDICAL CAPSULES:

MARK I — 195 lb Recovery Unit (Mice)

MARK II — 279 lb Recovery Unit (Small primate)

SENTRY FLIGHTS

SENTRY program flight schedules and objectives are being realigned, and no approved schedules are available at this time.

SENTRY PROGRAMS

VISUAL RECONNAISSANCE

SUBSYSTEMS:

SUBSYSTEM "A": Air Frame
SUBSYSTEM "B": Propulsion
SUBSYSTEM "C": Auxiliary Power
SUBSYSTEM "D": Guidance
SUBSYSTEM "E": Visual
SUBSYSTEM "F": Ferret
SUBSYSTEM "H": Ground/Space Communications
SUBSYSTEM "I": Data Processing
SUBSYSTEM "J": Geophysical
SUBSYSTEM "K": Personnel

FERRET RECONNAISSANCE

BOOSTER:

ATLAS ICBM

SENTRY PROPULSION:

BELL AIRCRAFT XLR81-Ba-5 Engine
277 Sec. Specific Impulse
15,150 lb thrust
Fuel: Unsymmetrical Di-Methyl Hydrazine
Oxidizer: Inhibited Red Fuming Nitric Acid

MIDAS FLIGHTS

The MIDAS program is undergoing realignment, and flight schedules are not available.

[redacted] [redacted]

[redacted]

AIR FORCE BALLISTIC MISSILE DIVISION
HEADQUARTERS
AIR RESEARCH AND DEVELOPMENT COMMAND
Post Office Box 262
Inglewood, California

WDPCR

9 January 1959

MILITARY SATELLITE PROGRAM PROGRESS REPORT
Quarter Ending 31 December 1959
RCS DD-SD(M) 242

FOREWORD

This is the first report submitted since reorientation of the Military Satellite program by the Advanced Research Projects Agency in November, 1958. The new program objectives for the SENTRY and MIDAS programs have not yet been approved, so specific progress toward approved objectives cannot be reported at this time. Development plans are now being written for the reoriented programs for submission to the Advanced Research Projects Agency and the Air Staff.

B. A. SCHRIEVER
Major General, USAF
Commander

[redacted]

WDPCR-58-10

[redacted]

[redacted]

I. DISCOVERER PROJECT

A. DISCOVERER FLIGHTS

1. DISCOVERER FLIGHT I

The first launch is now scheduled for 13 January 1959.

The first DISCOVERER flight was rescheduled from December to 13 January 1959. Flight operation crews are taking advantage of this additional time for further intensive training.

Difficulties with the facilities checkout and operation caused postponement of the first flight, but are now being corrected.

Difficulties were encountered with the checkout of the THOR booster on the launch pad and the operation of blockhouse launch control and monitoring equipment. The booster checkout delay was caused by minor discrepancies in the booster and booster checkout equipment. Discrepancies were found in the guidance system checkout console for the DISCOVERER vehicle. An alternate procedure for the DISCOVERER guidance system checkout has been devised and system checkouts are continuing.

The first flight payload will consist of telemetry.

The first flight will carry a payload consisting of telemetry to provide data on performance of the booster and the orbit vehicle, and data concerning the space environment.

2. DISCOVERER FLIGHT II

DISCOVERER II is scheduled for launch on 11 February 1959. Flight configuration and objectives are the same as DISCOVERER I.

The second DISCOVERER launch is scheduled for 11 February 1959. The configuration, payload, and flight objectives are essentially the same as for the first flight. The first two flights will employ JP-4 fuel for satellite propulsion, with inhibited red ruming nitric acid as the oxidizer.

[redacted]

B. FACILITIES AND SITES

1. LAUNCH

All equipment for the first two flights is in place.

All vehicle checkout and ground support equipment required for the first two flights is in place at Vandenberg Air Force Base and checked out.

2. TRACKING

The ground station network is ready for the first flight.

The DISCOVERER ground station network is ready for the first flight. The interim Control Center at Palo Alto, including the interlocking computer, are operationally ready. All tracking stations are ready and interstation communication links, voice and teletype, are fully installed. The computer program, including provision for orbital tracking data from Space Track stations, was satisfactorily checked out. Equipment calibration and missile tracking exercises were conducted at all stations, and system runs successfully accomplished.

The DISCOVERER network tracked the THOR demonstration missile launched from Vandenberg Air Force Base with excellent results.

The THOR Weapon System demonstration missile fired from Vandenberg Air Force Base on 16 December was successfully tracked by the DISCOVERER communications system with the exception of the Alaskan stations, which were out of range. The data acquired by the DISCOVERER network was better than that from any other tracking network. This was the first test of the network for tracking a missile in flight, and the results were very gratifying.

[redacted]

C. GENERAL

1. SATELLITE AIRFRAME

The first two flight test vehicles are at Vandenberg and ready for launch on the established schedule.

The first two flight test vehicles have been successfully subjected to hot firings at the Santa Cruz Test Base with all flight equipment installed and operating. Both vehicles were accepted by the Air Force and are at Vandenberg Air Force Base. Final adjustments for flight have been accomplished.

The third flight will now use the higher performance UDMH configuration engine.

Flight objectives now require the use of higher-performance UDMH fueled vehicles on the third flight rather than the fifth, as originally scheduled. The satellite airframe design has been modified for compatibility with this engine.

The vehicles are marked as "ARPA DISCOVERER".

Vehicle markings have been changed so as to identify the vehicles only as "ARPA DISCOVERER".

Design refinements are under study.

Various investigations are underway to further refine the present design and reduce the weight of the DISCOVERER vehicles. Aluminum wiring is being studied as a substitute for the copper wire now used. The weight of the wiring harness could be reduced 30 percent if the substitution proves practical.

Major tests of hardware completed satisfactorily.

Major hardware testing has been satisfactorily completed, including DISCOVERER/THOR separation tests, tank corrosion tests, destruct tests, and qualification tests of many major components.

[redacted]

[redacted]

2. SATELLITE PROPULSION SYSTEM

Engine production is on schedule.

Engine deliveries are on schedule. As of 26 December, ten engines were delivered, two of JP-4 and eight of UDMH configuration.

Variable performance of UDMH engines is under investigation.

Performance variations among UDMH fueled engines have caused postponement of the engine reliability program until the cause has been determined. Fuel and oxidizer temperature deviation could be the cause of the variations. A study is underway to determine how propellant temperatures affect engine performance.

The UDMH engine qualification program is underway.

The manufacturer is conducting a UDMH engine qualification program, using a test installation simulating installation in the flight test vehicle. Engine firings began in late November and eight hot firings have been conducted to date, of which the last two were 120 seconds duration each.

3. AUXILIARY POWER SUBSYSTEM

Static power inverter design problems have been solved.

Difficulties with static (electronic) power inverters have been essentially eliminated. Satisfactory 400 and 2000 cycle static inverters have been developed for the second and subsequent flights. Inverter deliveries are somewhat behind schedule due to design changes, but immediate requirements are being met. Efforts will continue toward further refinement of the static inverter design. A conventional rotary inverter of proven performance but greater weight will be used on the first flight.

4. SATELLITE GUIDANCE AND CONTROL SYSTEM

Guidance and control systems for the first four flights are available.

Guidance and control equipment is on hand for the first four flights. Design refinements are being made in the equipment for use on subsequent flights for increased performance and reliability.

5. BIOMEDICAL RECOVERY PROGRAM

The third flight vehicle is being readied on schedule.

Modification and checkout of the third flight vehicle is substantially completed. This vehicle will be shipped to Santa Cruz test site during January for a hot firing of the modified, UDMH burning engine. The March launch date is expected to be met.

The first and second biomedical capsules have been received by Lockheed Aircraft Company.

The first biomedical recovery capsule has been received (Figure 1) and is being used for training and checkout purposes (Figure 2). The second capsule, for use in the first biomedical flight, has also been received. This second capsule will be installed in the third DISCOVERER vehicle at Santa Cruz Test Base.

The first four biomedical vans have been received at Vandenberg Air Force Base, and the remaining three are virtually completed. Biomedical flight countdown procedures have been completed.

Six biomedical air recovery tests have been completed with good results..

Six attempts have been made to air recover dummy biomedical capsules dropped from B-47 aircraft.

[redacted]

The six capsules were equipped with the silvered parachute, the radar target chaff, and the radio homing beacon. The first test consisted of two drops from 40,000 feet altitude. RC-121 radar tracking aircraft successfully located and tracked both capsules throughout their entire descent, vectoring the C-119 recovery aircraft to the precise intercept area.

The first biomedical capsule was recovered by the C-119 on the sixth attempt at an altitude of 7,500 feet. The second capsule was recovered on the first pass at 13,000 feet. Of the other four drops made, three of the capsules were recovered successfully. The fourth capsule was lost due to failure of the capsule-borne radio homing beacon.

The Hawaii Recovery Control Center is being readied.

Space has been acquired at Hickam Field, Hawaii, for the DISCOVERER Recovery Operations Control Center. The Control Center is being readied for use and will be available on schedule for the third flight. A full recovery system rehearsal will be conducted in conjunction with the March launch of DISCOVERER III.

II. SENTRY PROGRAM

A. SENTRY FLIGHTS

The SENTRY program has been reoriented, and new development plans are being prepared to establish program objectives and schedules.

Because of the ARPA-directed SENTRY program reorientation, specific program objectives and firing schedules are not yet completely developed nor approved.

[redacted]

Development plans are being prepared by AFBMD based on results of briefings presented to ARPA and the Air Staff on 16-17 December. When the new development plans are approved, specific progress toward new objectives will be reported.

The THOR boosted flights have been redesignated as the DISCOVERER program.

The general result of the program reorientation has been separation of the THOR boosted and ATLAS boosted flights into the DISCOVERER and SENTRY programs, respectively. Both programs will utilize the same basic satellite vehicle, although on-orbit weights will vary due to payload differences and booster capabilities.

B. <u>FACILITIES AND SITES</u>

1. <u>LAUNCH</u>

The contract for the Point Arguello launch complex was awarded on 30 December. The contract for the Guided Missile assembly building at Vandenberg Air Force Base is expected to be let by 5 February.

The contract for the launch complex at Point Arguello was awarded on 30 December. Plans and specifications for the construction of the guided missile assembly building were forwarded to the Los Angeles District Engineer on 10 November. Permission to advertise was withheld pending studies by ARPA concerning the location of the facility. However, siting on Vandenberg Air Force Base, as designed, was approved by ARPA on 19 December 1958 and funds are in the process of being released. Bid advertising will be completed in time to permit contract award on 5 February 1959.

Construction of the permanent tracking and data acquisition station at Vandenberg Air Force Base is under contract with completion scheduled for August 1959.

The contract for the permanent tracking and data acquisition station at Vandenberg Air Force Base was awarded on 8 December. Completion is scheduled for August 1959.

Construction at the Hawaii station will be completed in June 1959.

The construction required to complete the Hawaii tracking and data acquisition station is scheduled for completion in June 1959.

Design of the Northwest, Central, and Northeast stations is in a deferred status.

Design of the Northwest, Central, and Northeast tracking and data acquisition stations has been placed in a deferred status pending realignment of the technical concept of the program, as directed by ARPA.

C. GENERAL

1. SUBSYSTEMS

a. AUXILIARY POWER

The comments pertaining to DISCOVERER airframe, propulsion, auxiliary power, and guidance are applicable to the SENTRY program. Reference pages 3, 4, and 5.

Development of advanced auxiliary power supplies has been accelerated. Emphasis is being placed on solar and nuclear systems.

Development of Advanced Auxiliary Power systems (APU) has been accelerated. Emphasis is being placed on solar and nuclear systems, but high-energy storage battery systems are being developed for a back-up capability.

Solar-power unit design is about one-third complete.

The detail design of the Solar APU for the SENTRY vehicle is one-third complete. This unit will provide a minimum of 200 watts average continuous power under least favorable conditions and 600 watts under most favorable conditions. Design of the Solar APU Telemeter, which will transmit data on Solar APU operation for the lift of the unit, has begun.

High energy batteries are also being designed for backup of the Solar-Nuclear programs.

The design concept for a high energy Hydrogen-Oxygen battery auxiliary power system has been completed and detailed design criteria are being established. The design output is 250 watts, but much higher output is expected. A high-energy Borohydride-Oxygen battery is also under development. A 5-watt laboratory unit is completed and plans are completed for a 100-watt prototype unit.

B. VISUAL RECONNAISSANCE

Development of visual reconnaissance equipment is well advanced.

Current planning is for launch of photo-reconnaissance SENTRY satellites into 300 mile high circular polar orbits from Vandenberg Air Force Base. The airborne and ground components of the visual reconnaissance system are in an advanced state of development.

The developmental model of the visual subsystem payload was successfully tested.

The developmental model of the complete payload of this subsystem was operated successfully during this report period. The first photographs attained resolution exceeding 140 lines per millimeter. Thermal tests revealed no problems in maintaining the 70° F temperature desired for processing of the film within the satellite. An electronic visual reconnaissance capability is also under study.

[redacted] [redacted]

C. SATELLITE FERRET RECONNAISSANCE

Ferret launches will be from Vandenberg Air Force Base.

Current planning is for launch of ferret-equipped SENTRY satellites into circular, 300-mile altitude polar orbits from Vandenberg Air Force Base using ATLAS boosters.

Flight testing of prototype ferret system components, installed in an aircraft, will begin soon.

Flight testing of prototype ferret components will begin in January using a modified DC-3 aircraft. The design of this ferret equipment (F-1) makes maximum use of commercially available components for earlier availability. The system will be tested in flights over radars in the New York City area.

Thermal environment tests of ferret equipment were satisfactory.

Ground testing of F-1 ferret equipment is proceeding satisfactorily. Thermal mockup tests reveal no serious temperature problems. The equipment was subjected to conditions simulating noon-to-midnight and twilight orbits.

Development of the ferret (F-2) equipment is on schedule.

All work on the ferret (F-2) equipment is on schedule. In comparison to the F-1 series where early availability was the prime consideration, the F-2 series is designed for reduced weight, increased performance, and greater reliability.

Report Completed on Soviet Bloc Radar

Haller, Raymond and Brown, Inc., subcontractors for high-altitude electronic reconnaissance research, completed a comprehensive report on intelligence and analysis work to date. The report covers an analysis of Soviet Bloc electronic signal environment and various aspects of the effect on a satellite-borne electronic reconnaissance system. An estimate was made of non-communication radiators for the period 1965-1970. Also included are multiple intercept

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probabilities for new mathematical models, radar density estimates for the 1960-1962 period, and an analysis of the precision needed to identify an individual radar.

D. DATA HANDLING

Basic concepts for ground data handling systems are established.

The basic concepts for ground data handling systems for all three reconnaissance systems have been established in detail. Development and acquisition of ground data handling equipment has begun.

This subsystem is on schedule.

Development of the Data Processing System is proceeding on schedule. A detailed report reflecting the initial systems design, stage of hardware development, and immediate future plans was prepared and submitted to the Rome Air Development Center.

A system design inspection will be held in early March.

A System Design Review of the Data Processing System was held on 13-14 November at the Ramo-Wooldridge Denver facility. A system design inspection will be held at the Ramo-Wooldridge Denver facility in early March. An integrated picture of the Data Processing System will be presented to the Air Force at the time of this inspection.

Equipment specifications for photo-optical data processing equipment were completed.

Specifications for the Data Processing System photo-optical equipment were submitted for review to the Rome Air Development Center. They will then be issued to the contractor for equipment procurement. Performance specifications for the initial configurations of the ferret, photo data reduction and communications subsystems have been prepared for submission to the Rome Air Development Center.

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[redacted] [redacted]

III. MIDAS PROJECT

A. SUBSYSTEMS

The infrared attack alarm system is redesignated as MIDAS.

The former SENTRY infrared Attack Alarm System (Subsystem "G") has been redesignated Missile Defense Alarm System (MIDAS) and is now a separate program. Studies are in progress to reorient this program and achieve early orbital flight tests.

Successful tests of infrared emanations from rocket engines have been made at the Air Force Missile Test Center.

During this reporting period, flights of infrared instrumented B-47 aircraft were performed to gain data on the infrared emanations from ballistic missiles launched from the Air Force Missile Test Center. After initial instrumentation troubles were corrected, the tests were successful. The rocket engine of the ATLAS 10B was tracked by infrared for the entire powered flight.

Two MIDAS infrared scanners are nearing completion.

Two flight configuration MIDAS infrared scanners are nearly completed. Testing and evaluation of the units should begin in early 1959.

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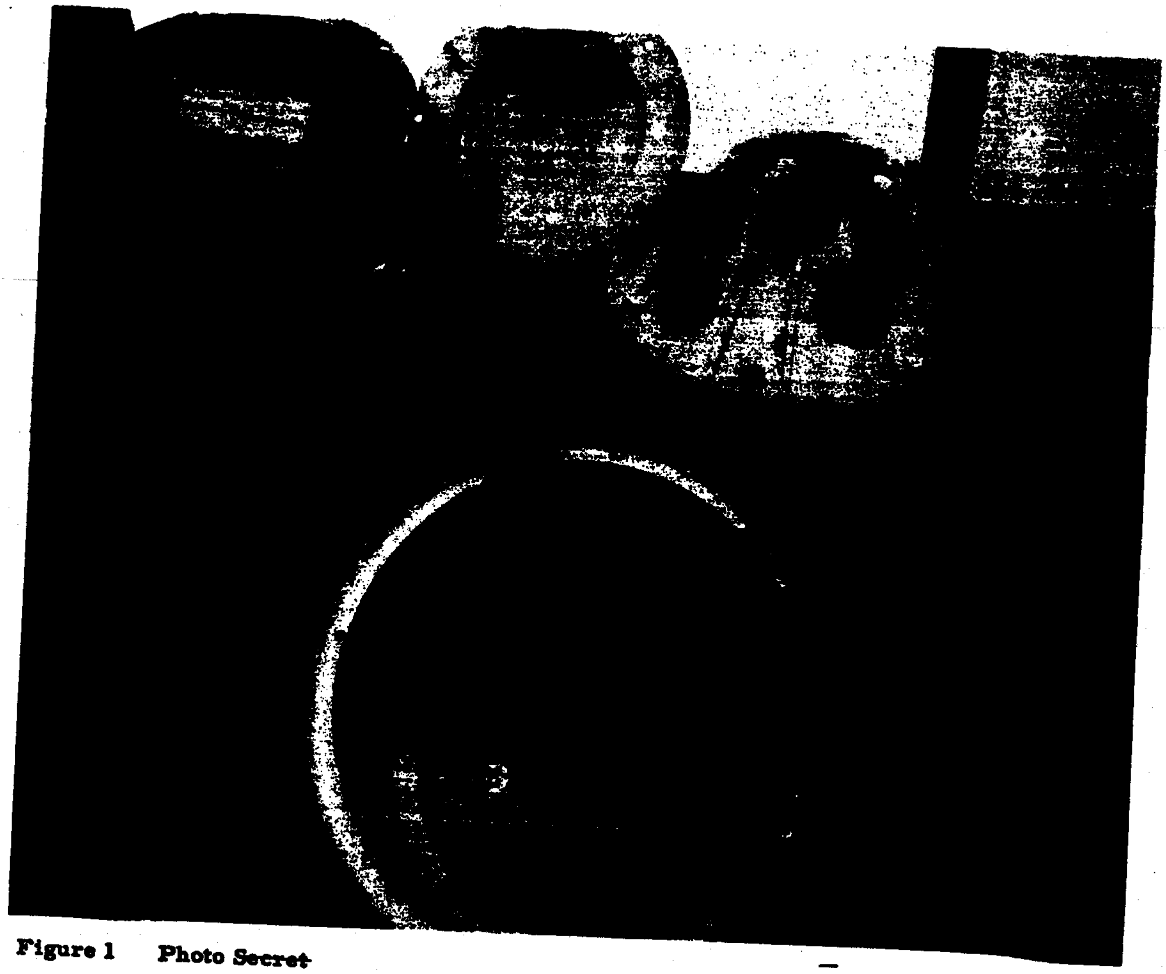

Figure 1 Photo Secret

Caption Unclassified

Disassembled component assemblies of DISCOVERER Biomedical Recovery Capsule. This Mark I Capsule weighs one hundred ninty-four pounds and will be fitted to JP-4 powered DISCOVERER satellites for flights three and four early in 1959.

(WDPCR-58-10)

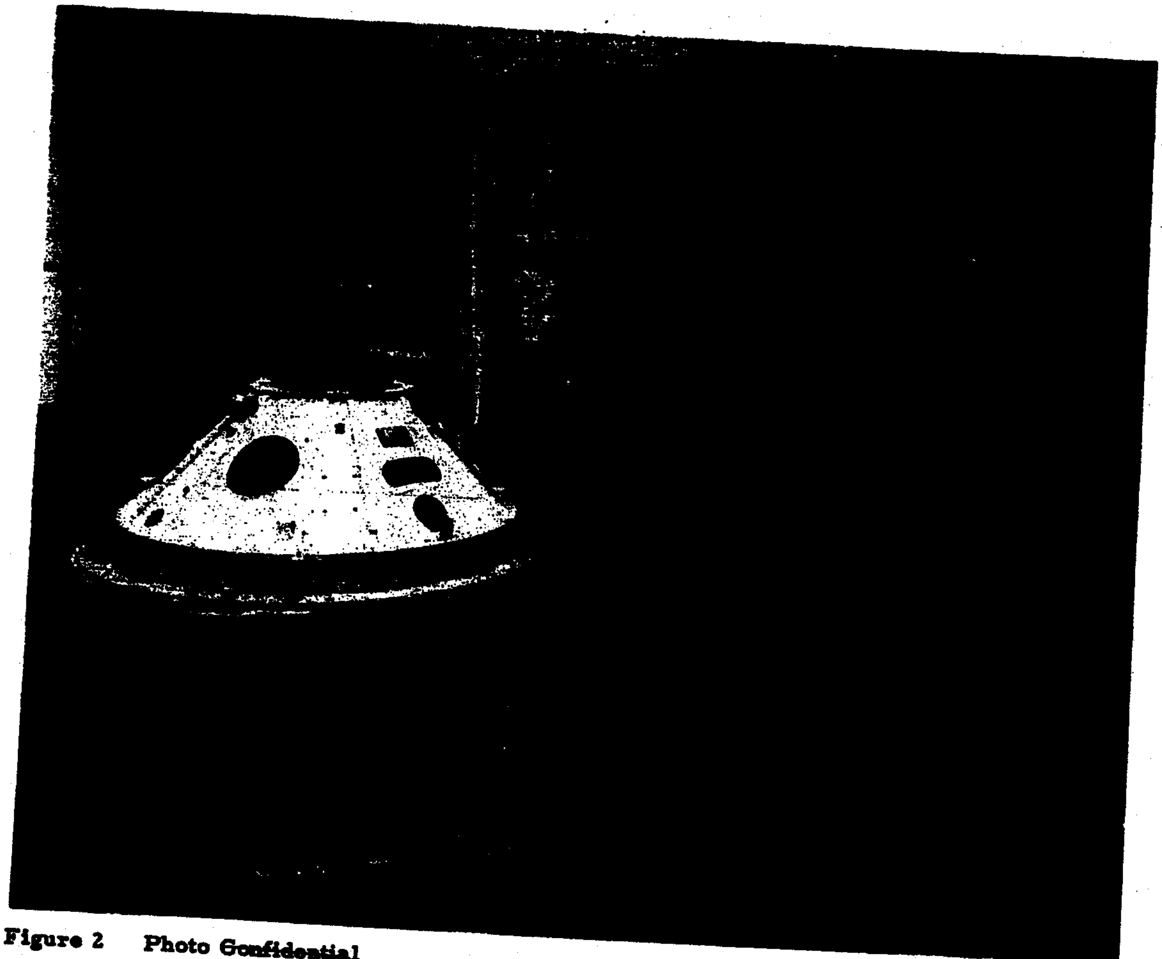

Figure 2 Photo ~~Confidential~~

Caption Unclassified

Mark I Biomedical Recovery Capsule standing beside Laboratory Checkout Console. Space-environmental tests are conducted to determine heat and radiation characteristics as they are likely to affect the space-borne animals and equipment.

(WDPCR-58-10)

Figure 3 **Photo Unclassified**

Caption Unclassified

A portion of the checkout console for the DISCOVERER satellite. This equipment is installed in the blockhouse adjoining launch pad 4 at Vandenberg Air Force Base. (WDPCR-58-10)

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Figure 4 **Photo Unclassified**

Caption Unclassified

Thor booster lowered to horizontal position for mating with the DISCOVERER satellite flight test vehicle.
(WDPCR-58-10)

UNCLASSIFIED

Figure 5 **Photo Unclassified**

Caption Unclassified

Transporter-erector being raised preparatory to lowering Thor missile 160 for mating with DISCOVERER satellite flight test vehicle.

(WDPCR-58-10)

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Figure 6 **Photo Unclassified**

Caption Unclassified

United States Air Force Thor missile 160, booster for the first DISCOVERER satellite, on launch pad during checkout prior to mating with the satellite vehicle seen at the right.
(WDPCR-58-10)

Figure 7 **Photo Unclassified**

Caption Confidential

Mating of first DISCOVERER flight test vehicle to Thor missile. The satellite and its integral second stage weighs approximately 7,000 pounds at launch. Orbiting weight of the satellite after fuel exhaustion is approximately 1,300 pounds. (WDPCR-58-10)

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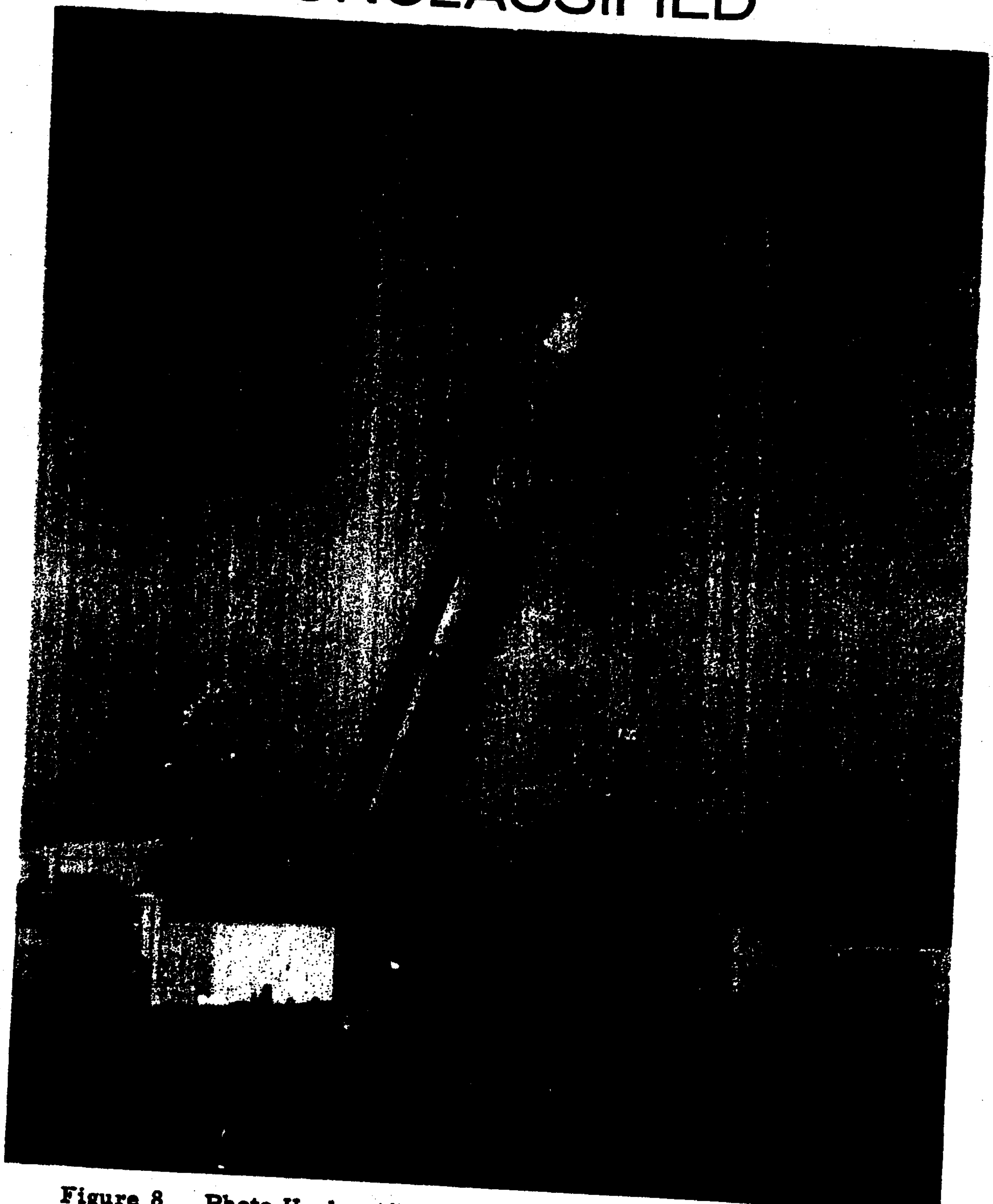

Figure 8 Photo Unclassified Caption Unclassified

First DISCOVERER flight test vehicle being raised to launch position on pad 4 Vandenberg Air Force Base. After fueling, the 78 foot booster-satellite vehicle will weigh more than 100,000 pounds.

(WDPCR-58-10)

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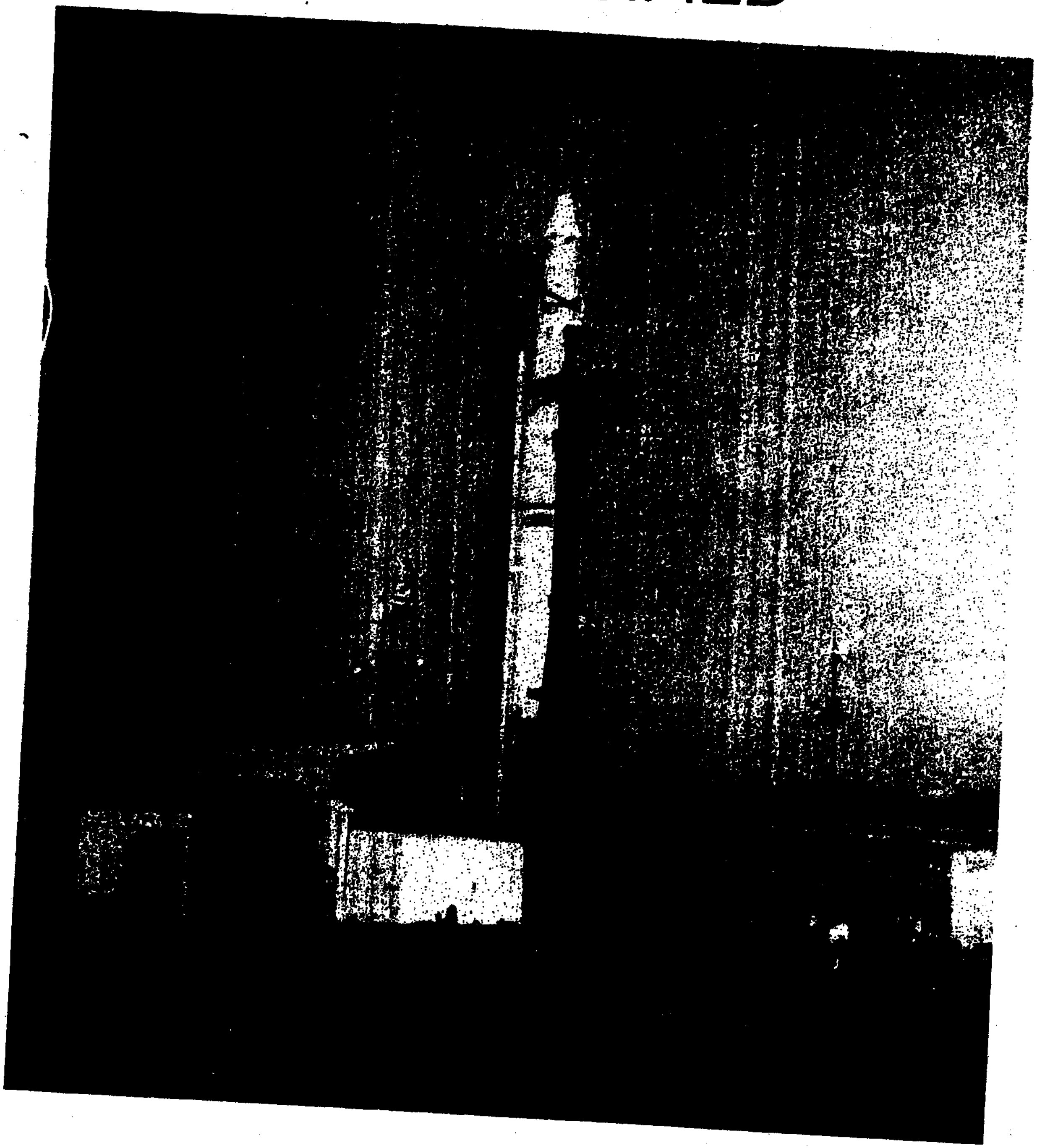

Figure 9 Photo Unclassified Caption Unclassified

First DISCOVERER satellite mated to first stage Thor missile 160, Vandenberg Air Force Base. The 78 foot booster-satellite will be launched vertically and inclined into an south-southwest trajectory leading to its orbit about the earth. (WDPCR-58-10)

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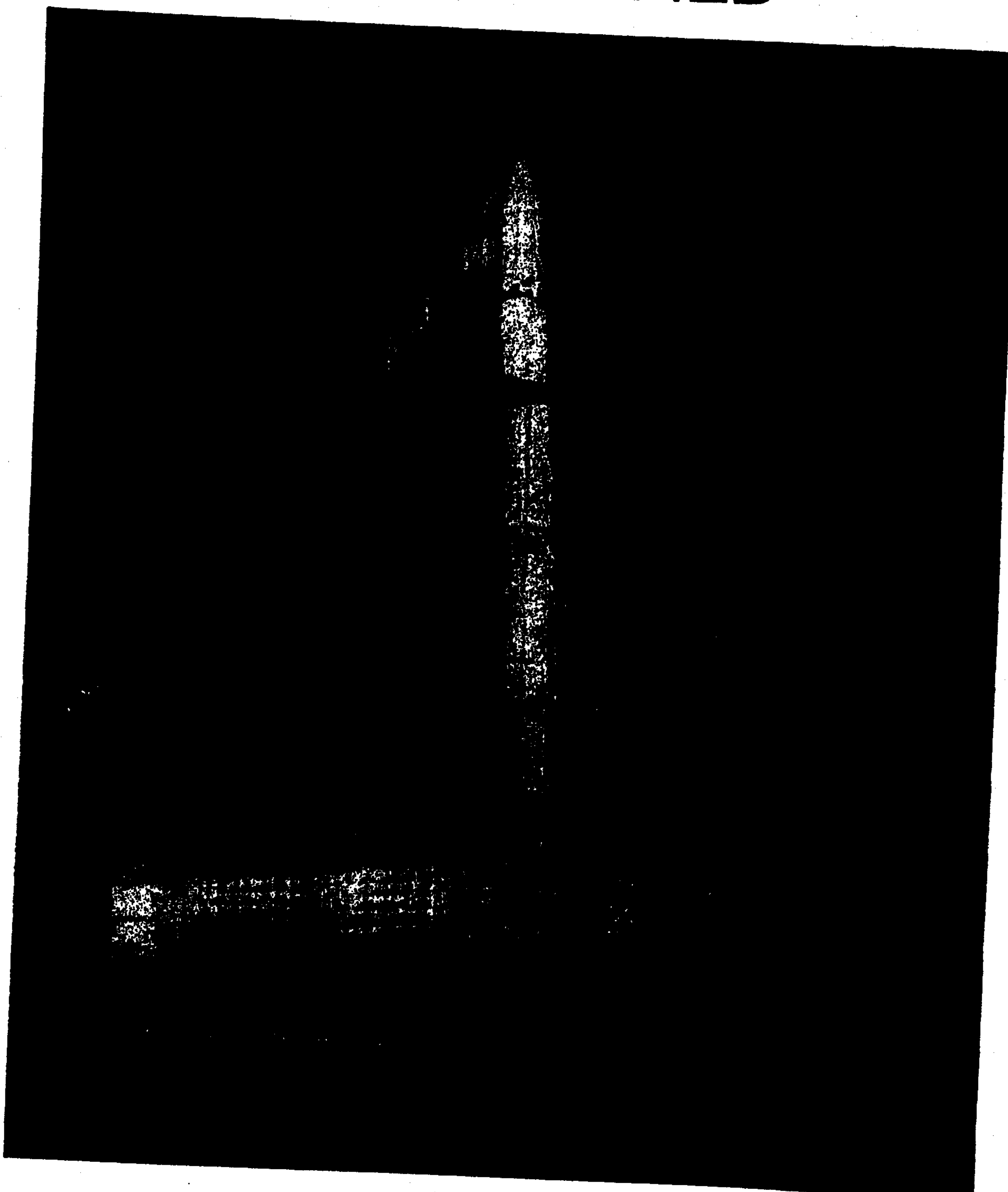

Figure 10 Photo Unclassified Caption Unclassified

First Discover satellite and its Thor booster on launch pad 4, Vandenberg Air Force Base. Technicians are held aloft by huge "cherry picker" cranes while working on umbilical connections in preparation for fueling. (WDPCR-58-10)

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MILITARY SATELLITE PROGRAM

FOR QUARTER ENDING 31 MARCH, 1959

RCS DD-SD (M) 242

Prepared By

Air Force Ballistic Missiles Division
Headquarters Air Research And Development Command
UNITED STATES AIR FORCE
Air Force Unit Post Office
Inglewood 45, California

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

WDPCR

8 April 1959

MILITARY SATELLITE PROGRAM PROGRESS REPORT
Quarter Ending 31 March 1959
RCS DD-SD(M) 242

FOREWORD

2d report
1st for period ending Dec 58

During the quarter covered by this report, the administrative actions required to separate the DISCOVERER Program from the SENTRY Program, in compliance with ARPA Order No. 48-59, were completed. A new DISCOVERER Development Plan was published on 30 January 1959 and presented to the Advanced Research Projects Agency on 4 February 1959. Approval of this plan by ARPA was announced in Amendment #1 to ARPA Order No. 48-59, dated 16 February 1959. A Development Plan for the reoriented SENTRY Program was published on 30 January and presented to ARPA on 4 February 1959. ARPA approval was announced in Amendment #8 to ARPA Order No. 9-58, dated 16 February 1959.

Also completed was the reorganization of the MIDAS Program structure. A new MIDAS Development Plan was published on 30 January. ARPA approval of Program Phase I was announced in Amendment #1 to ARPA Order No. 38-59, dated 2 March 1959.

for B. A. SCHRIEVER
Major General, USAF
Commander

WDPCR-59-18
Copy [redacted] of [redacted] Copies

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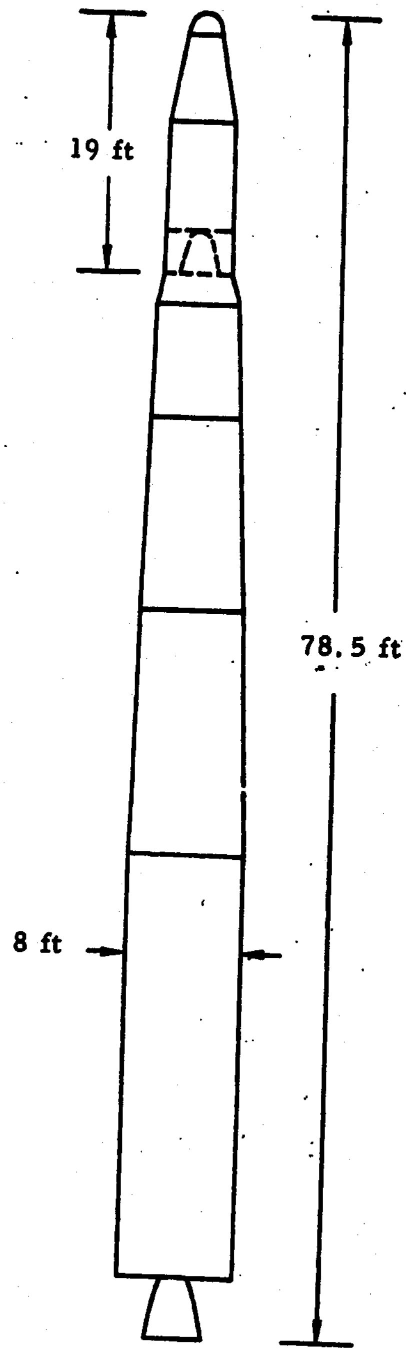
DISCOVERER



Combined Booster and Orbit Stage	-	114,591 lb
Orbit Stage	-	8,619 lb

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DISCOVERER

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DISCOVERER GLOSSARY

DISCOVERER FLIGHTS

DISCOVERER I:

Date Launched: 28 February 1959
Booster: THOR #163, IRBM
Gross Weight: 113,802 lbs.
Payload Weight: 70 lbs.
Altitude: 220 Statute miles
Payload: Telemetry
Subsystems: Test of Booster/Vehicle Orbital Capability.

Second Stage: DISCOVERER Vehicle
On-Orbit Weight: 1,328 lbs.
Fuel: JP-4, Inhibited Red Fuming Nitric Acid
Flight Characteristics: Ballistic trajectory to Orbit.

PROGRAM VEHICLE III (170-1018)

Scheduled Launch Date: 14 April 1959
Booster: THOR #170, IRBM
Gross Weight: 114,566 lbs.
Altitude: 313 Statute miles
Payload: Mark I biomedical recovery capsule.
Subsystems: A, B, C, D, L Recovery System test

Second Stage: DISCOVERER Vehicle
Fuel: Unsymmetrical Di-Methyl Hydrazine/Inhibited Red Fuming Nitric Acid.
On-Orbit Weight: 1,634 lbs.
Payload Weight: 145 lbs.
Flight Characteristics: Ballistic trajectory to orbit.

PROGRAM VEHICLE IV (174-1020)

Scheduled Launch Date: 21 May 1959
Booster: THOR #174, IRBM
Gross Weight: 114,388 lbs
Altitude: 311 Statute miles
Payload: Mark I biomedical recovery capsule.
Subsystems: A, B, C, D, L Recovery System

Second Stage: DISCOVERER Vehicle
Fuel: Unsymmetrical Di-Methyl Hydrazine/Inhibited Red Fuming Nitric Acid
Payload Weight: 195 lbs.
Flight Characteristics: Ballistic trajectory to orbit.
On-Orbit Weight: 1,634 lbs.

DISCOVERER PROGRAMS

PROGRAM I - ENGINEERING TESTS:

This program will include the demonstration of orbital capability of the DISCOVERER/THOR combination, design concepts, engineering tests of subsystem combinations, orbital stabilization, and the functioning of the tracking and communications system.

PROGRAM II - BIOMEDICAL RECOVERY CAPSULES:

The objectives of the Biomedical Recovery Capsule Program are to recover living specimens from orbital flight and to study the psycho-physiologic response of specimens to conditions of launch, orbit and recovery.

SUBSYSTEMS:

Subsystem "A": Airframe
Subsystem "B": Propulsion
Subsystem "C": Auxiliary Power
Subsystem "D": Guidance
Subsystem "H": Ground/Space Communications
Subsystem "J": Geophysical
Subsystem "K": Personnel
Subsystem "L": Biomedical

PROPULSION:

XLR81-Ba-3 Engine:

Fuel: JP-4
Oxidizer: Inhibited Red Fuming Nitric Acid
263 Sec. Specific Impulse
15,150 lb. Thrust

XLR81-Ba-5 Engine:

Fuel: Unsymmetrical Di-Methyl Hydrazine
Oxidizer: Inhibited Red Fuming Nitric Acid
277 Sec. Specific Impulse
15,150 lb. Thrust

BIOMEDICAL CAPSULES:

MARK I: 195 lb Recovery Unit (Mice)

MARK II: 279 lb Recovery Unit (Small Primate)

[redacted]

[redacted]

[redacted]

I. DISCOVERER PROJECT

A. DISCOVERER FLIGHTS

1. DISCOVERER I-163-1022

The flight of DISCOVERER I-163-1022 attained almost all flight objectives. Evidence indicates the vehicle entered an orbit very near the planned orbit.

DISCOVERER I-163-1022 was successfully launched from Vandenberg Air Force Base at 1349 hours PST on 28 February (Figures 1, 2, 3, and 4). THOR booster burnout and separation occurred two minutes and 41 seconds after liftoff, and the ARPA DISCOVERER began the coast to altitude. Five minutes and 37 seconds after liftoff the DISCOVERER vehicle engine fired, accelerating the vehicle into orbit at a velocity of 25,820 feet per second. Telemetered data acquired between launch and orbital injection indicate that all vehicle subsystems performed within specified limits. Computer operations subsequently determined that the achieved orbit deviated from a precisely polar plane by only a few seconds of arc. Additional calculations established that the orbit of DISCOVERER I had an apogee of 570 statute miles, a perigee of 103 statute miles, and initial period of 95.4 minutes.

A firm radar lock-on was not obtained but many ground stations reported contacts with the orbiting vehicle.

A firm radar lock-on was not obtained during the orbital lifetime of DISCOVERER I. However, DISCOVERER ground stations established short contacts on the precise frequency of the satellite beacon. Repeated contacts were made by General Electric, Ithaca, New York, with a satellite body

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with orbital plane and period conforming to the planned DISCOVERER orbit. Detailed studies are being conducted to determine why neither radar lock-on nor telemetered data could be obtained after satellite engine burning.

Contractor is investigating possible errors in calculations for orbit insertion angle.

It has been found that calculations from which the orbital insertion angle was computed contain an assumption capable of producing second-order error. This possibility is being studied to determine the possible effect on orbit eccentricity and calculations of apogee and perigee.

2. PROGRAM VEHICLE II (170-1018)

Launch of Program Vehicle 170-1018 is currently planned for 14 April. This vehicle will carry a biomedical recovery capsule without live specimens aboard. Program Vehicle 1018, scheduled for this launch, is now at Vandenberg Air Force Base. Prior to delivery to Vandenberg, the vehicle successfully underwent acceptance testing at the Santa Cruz Test Base. This included firing of the UDMH-fueled engine with all vehicle flight equipment aboard.

B. FACILITIES AND SITES

1. LAUNCH

Launch equipment required for the next launch is in place and operative.

All vehicle checkout and ground support equipment required for the April launch is in place and checked out.

2. **TRACKING**

The tracking and control network performed satisfactorily during the first flight.

Performance of the tracking and control station network was satisfactory during the first flight test. The ground network for the first flight included five tracking and telemetry stations; Vandenberg Air Force Base, Point Mugu, Annette Island (Figures 5, 6, 7, and 8), Chiniak Alaska, and Point Kaena, Hawaii. Also included were a telemetry ship 800 miles downrange, a computer center at Palo Alto, and control centers for test operations at Palo Alto and Vandenberg Air Force Base.

Telemetered data from the first flight were of excellent quality.

Telemetered data were received from DISCOVERER I for approximately 514 seconds after liftoff. Performance of vehicle internal instrumentation was satisfactory during this interval, and processing of the data received was accomplished without difficulty. Exceptionally good data were acquired by the Point Mugu station. This station also achieved radar tracking in excess of 1,000 miles downrange. Ground based space-ground communications equipment proved to be adequate. The downrange telemetry ship acquired only a very weak signal, apparently due to faulty telemetry antenna operating technique aboard the ship. The operating technique is being revised for the second launch.

Ground network operations were successfully directed and integrated from Palo Alto.

For reasons unknown, communications could not be established with the vehicle. However, the DISCOVERER control center and tracking stations continued operations in the search mode for approximately ten days after the launch. The

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overall operation was successfully integrated and directed from the Palo Alto Control Center, and network performance was satisfactory.

C. GENERAL

1. SATELLITE AIRFRAME

Circuitry of all DISCOVERER vehicles was checked out to prevent recurrance of malfunction encountered in first launch attempt.

The first attempt to launch a DISCOVERER vehicle resulted in an abort (Figures 9, 10, 11 and 12). The abort was caused by inadvertent firing of the satellite pyrotechnics during the countdown, due to an improperly wired circuit. Disposition of this vehicle has not yet been determined. Because of this accident, a special team was organized to check and verify the wiring circuitry of all DISCOVERER vehicles.

DISCOVERER vehicles are being readied for a succession of planned launches.

Program Vehicle 170-1018, scheduled for flight on 14 April, is checked out and has been delivered to Vandenberg Air Force Base. Program vehicles 1020 and 1023 are undergoing system runs at the Santa Cruz Test Base preparatory to acceptance testing. Six DISCOVERER vehicles are in the Palo Alto modification and checkout center for processing, after which they will be delivered to Santa Cruz. Assembly of additional vehicles at the Sunnyvale manufacturing facility is progressing on schedule.

Satellite airframe flight test objectives were successfully achieved.

Data from the first flight have verified the adequacy of design of the satellite structure and equipment installation. Accelerometer data revealed that design loads were not exceeded during the monitored portion of the flight. No vibration problems

[redacted]

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or significant bending moments were noted. Operation of the separation system was very satisfactory.

Dual explosive bolts have been designed for the separation system of Program Vehicle 170-1018.

Design of a dual explosive bolt separation system for Program Vehicle 170-1018 has been completed to provide increased reliability. In later vehicles, pin pullers will replace the explosive bolts for even greater reliability.

2. SATELLITE PROPULSION SYSTEM

Propulsion system flight test objectives were successfully achieved.

All available data from the first flight indicate that satellite propulsion system performance was slightly higher than nominal but well within specifications. Positive evaluation is impossible because telemetered turbine speed measurement data were not received. Based on tracking data and other evidence, propulsion system performance has been estimated as: firing duration, 96.3 seconds; thrust, 15,850 lbs; and specific impulse 270. No significant problems were encountered during the countdown, launch, or orbital boost.

A reliability program for UDMH-fueled engines has been initiated.

A reliability program has been underway at Bell Aircraft for refinement of the UDMH-fueled satellite engine. The series of test firings performed to date has revealed only one problem area, a shift in engine thrust. Several contributing factors have been discovered, but cause of the total thrust shift is still being sought.

A series of UDMH engine test firings have been completed.

Prior to initiation of the reliability program a series of 26 UDMH engine firings had been successfully completed at Bell Aircraft.

[redacted] [redacted]

Boosters: 6. Following is a list of the currently programmed DISCOVERER-

Vehicle Number	THOR Booster Number
1019	160
1022	163
1018	170
1020	174
1023	179
1029	192
1025	200
1028	206
1051	212
1050	218
1052	223
1054	231
1055	234
1053	237
1056	241
1057	246
1058	253
1061	258
1062	261

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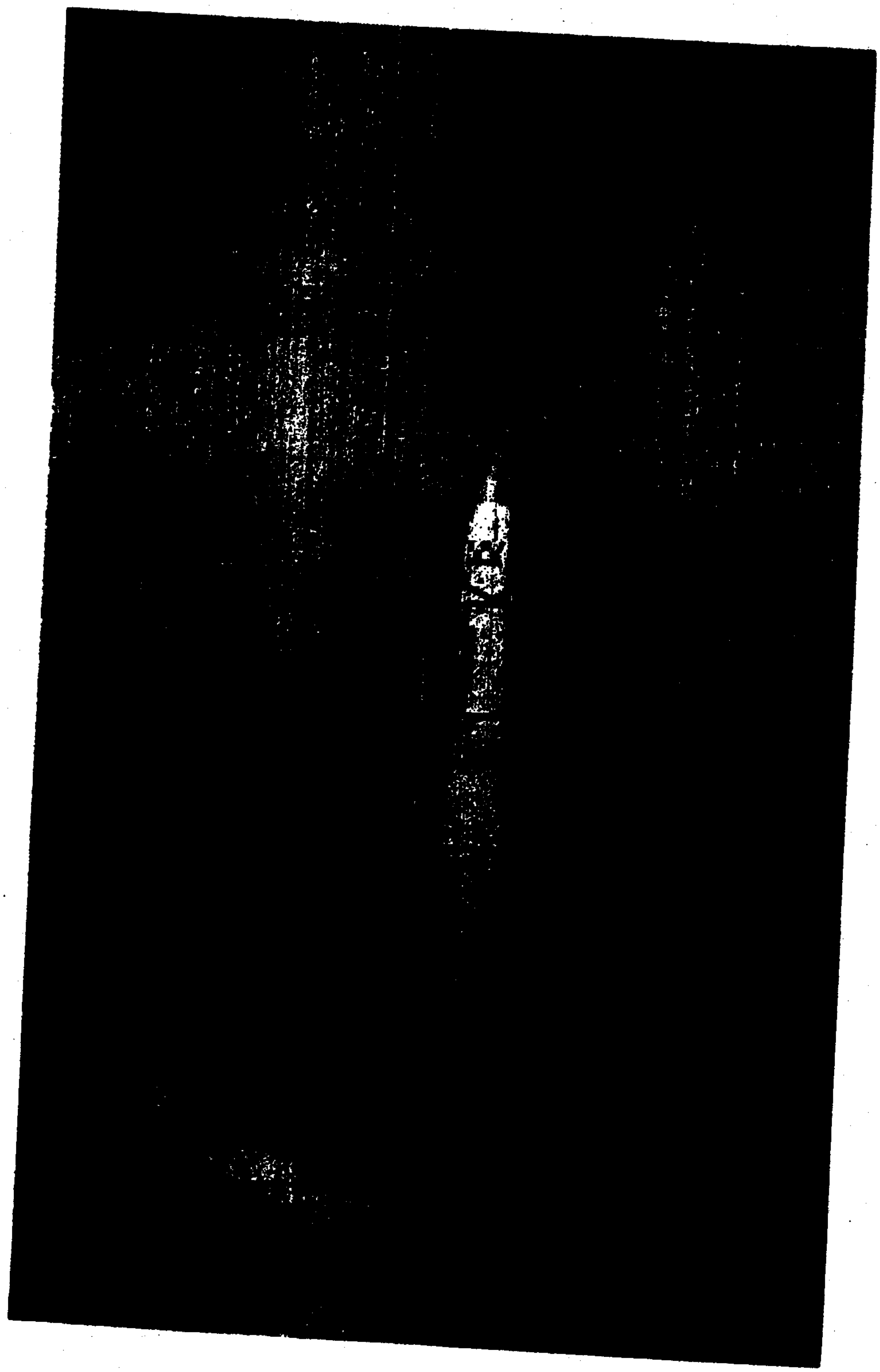

Figure 1

THOR engine start during Vehicle 1022 launching, 28 February 1959

Figure 2

DISCOVERER/THOR rising clear of launching complex - Vehicle 1022

however, and the resulting oscillations were damped out. Subsequent vehicle position indicates that the gyro references may have shifted during the engine ignition period.

DISCOVERER I timer operation was satisfactory.

Correct "D" timer start is indicated by the correct sequencing of subsequent events. Data indicate that the horizon scanner shroud was ejected as planned, and the horizon scanner was operative during the coast phase. Guidance system events at start of orbital boost are being further investigated, but flight objectives for the guidance system are considered achieved.

5. BIOMEDICAL RECOVERY PROGRAM

Hardware, support forces, and personnel training needed for the recovery program are essentially complete.

The equipment and support forces required for the recovery program are essentially complete. Training of personnel in capsule recovery procedures has been completed (Figures 13, 14, 15, and 16). The Hawaiian Control Center is ready for direction of the capsule recovery forces. At Vandenberg Air Force Base, the biomedical van complex has been checked out for use with biomedical flights.

The 14 April launch will contain a recovery capsule without live specimens.

The vehicle planned for launch on 14 April (170-1018) will contain a recovery capsule without live specimens aboard. Track plates and photographic film will be added to provide radiation level measurements.

A recovery capsule containing live specimens was successfully tested under simulated orbital conditions.

In February, a Mark I (mice) capsule was subjected to a simulated complete countdown and orbital flight test with live

3. AUXILIARY POWER SUBSYSTEM

A study has been initiated with the objective of overall improvement of the auxiliary power units.

A technical study is being conducted to obtain general improvement of the DISCOVERER power conversion equipment. While present performance of this equipment is excellent based on the present state of art, continued progress in efficiency and weight reduction is essential. Present overall efficiency of the unit, based on a flight vehicle twenty-four-hour battery system run, is 63 percent. A nominal effort should increase overall efficiency to 70 percent, with the design objective remaining at 80 percent efficiency.

A project has been initiated for design of a new battery.

The Eagle Picher Company has been issued a subcontract for design of a new type primary battery. Production estimates indicate this battery will be available for the tenth and following flights.

Modifications are planned to improve inverter efficiency.

Design changes will be incorporated in the 400 cycle design inverters, which should provide a 5 percent to 10 percent increase in efficiency. The first modified inverter is scheduled for delivery in early April for use on the earliest possible vehicle.

4. SATELLITE GUIDANCE AND CONTROL SYSTEM

Guidance system function was satisfactory during the first flight except for a brief period during satellite engine start.

The flight control subsystem of DISCOVERER I performed within established limits except for a short period during satellite engine ignition. Analysis of telemetered data indicated several shocks during engine start, and the engine pitched downward, sharply, without apparent command. The system responded to control signals,

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for recovery of the capsule from Program Vehicle 170-1018. Forces taking part in this exercise consisted of four RC-121 aircraft, eight C-119 recovery aircraft, and three destroyers. Two drops were made from B-47 aircraft at high altitude. Radar acquisition of the first descending capsule was obtained at 103 nautical miles. Pickup aircraft were vectored to the capsule. An attempted air recovery failed when the recovery gear contacted too low on the parachute. The capsule broke loose and was lost in the sea. Radar acquisition of the second capsule was positive, and pickup aircraft were vectored to the area. Since this was planned as a sea recovery test, air recovery was not attempted. The capsule descended to the ocean and was recovered by one of the destroyers 13 minutes after it landed.

Use of balloons for capsule reentry tests are planned.

Plans are being formulated to carry a Mark II (primate) capsule to 100,000 feet by use of a high altitude balloon. This test will gather data concerning the capabilities of the retro and spin rockets of the capsule, as well as the capsule parachute. The capsule, modified for test purposes, will be carried aloft by the balloon while being tracked by theodolites from the ground. Data will be telemetered on possible dispersion effects of the rocket motors and deployment of the parachute.

[redacted]

mice aboard. The test took place in the High Altitude Simulation Chamber at Sunnyvale. The capsule was in simulated orbit for 27 hours, equal to 18 orbital passes. Seventeen passes will be made in the biomedical flight. The capsule was subjected to the range of thermal conditions to be encountered in orbit while continuous viability readings were taken on the specimens. The capsule was then removed from the chamber and kept sealed for another eight hours to simulate sea recovery delay. In all, 35 hours passed before the specimens were removed from the life compartment for examination. They proved to be tired but physically unharmed.

The initial primate recovery capsule was delivered to Lockheed for simulated orbital testing.

The initial flight article of the recovery capsule designed to return a primate from space was delivered to Lockheed Missiles Systems Division. Testing similar to that of the Mark I capsule will be performed immediately in the Sunnyvale chamber, using a live primate. Data to be collected will include electrocardiogram readings and temperature profiles.

Dress rehearsals for air and sea recovery forces were conducted during this period.

Recovery forces were trained during this quarter by dropping dummy recovery capsules from B-47 aircraft at high altitudes. The capsules were subsequently recovered by the air or sea recovery forces in respective trials of their capabilities. The drops were made off Hawaii. These forces are now considered ready for recovery of a capsule from orbit. This training culminated in an exercise on 1 March, timed to coincide with the first flight, designed as a rehearsal

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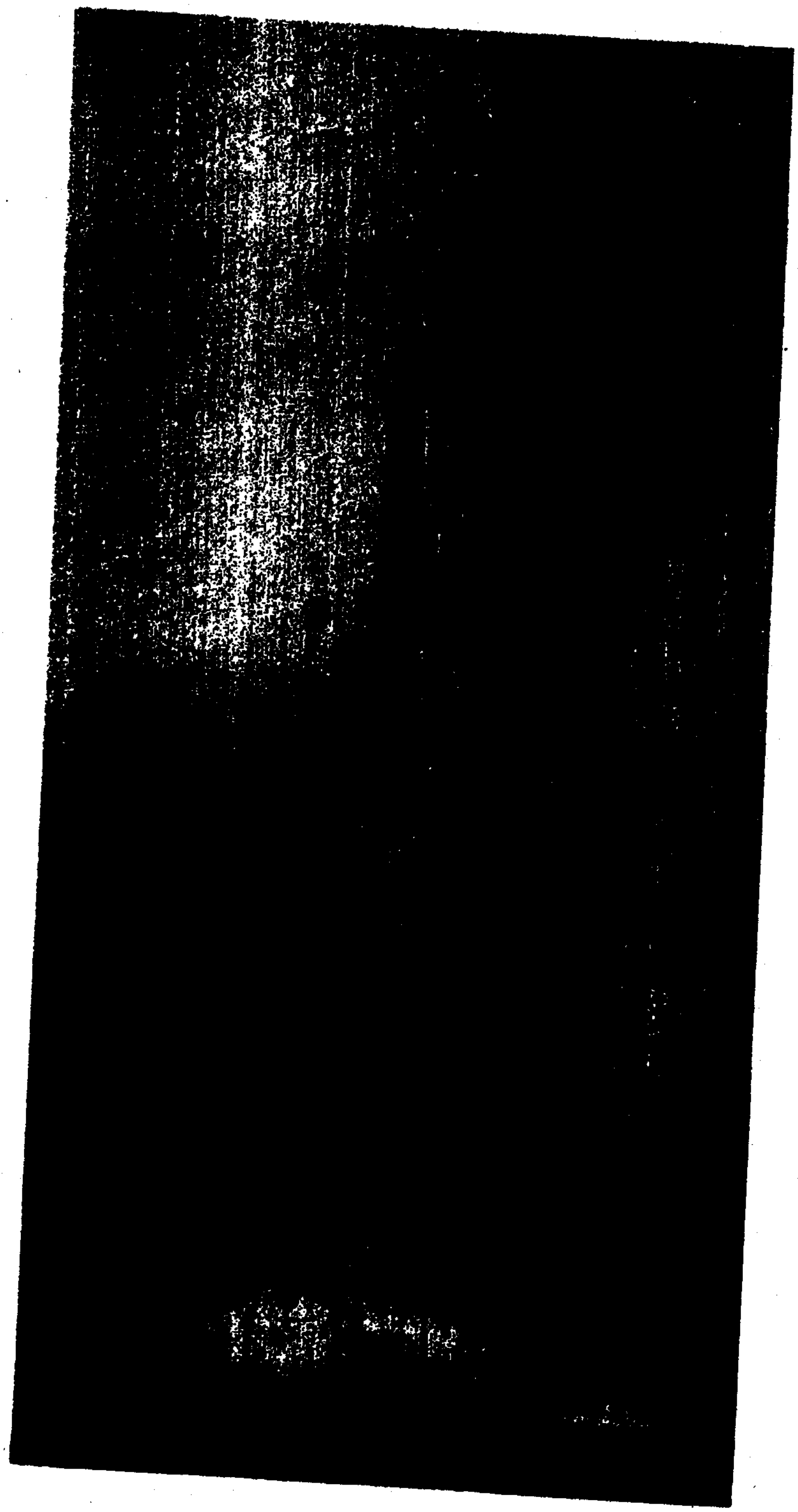

Figure 3

DISCOVERER/THOR rising clear of launching complex - Vehicle 1022

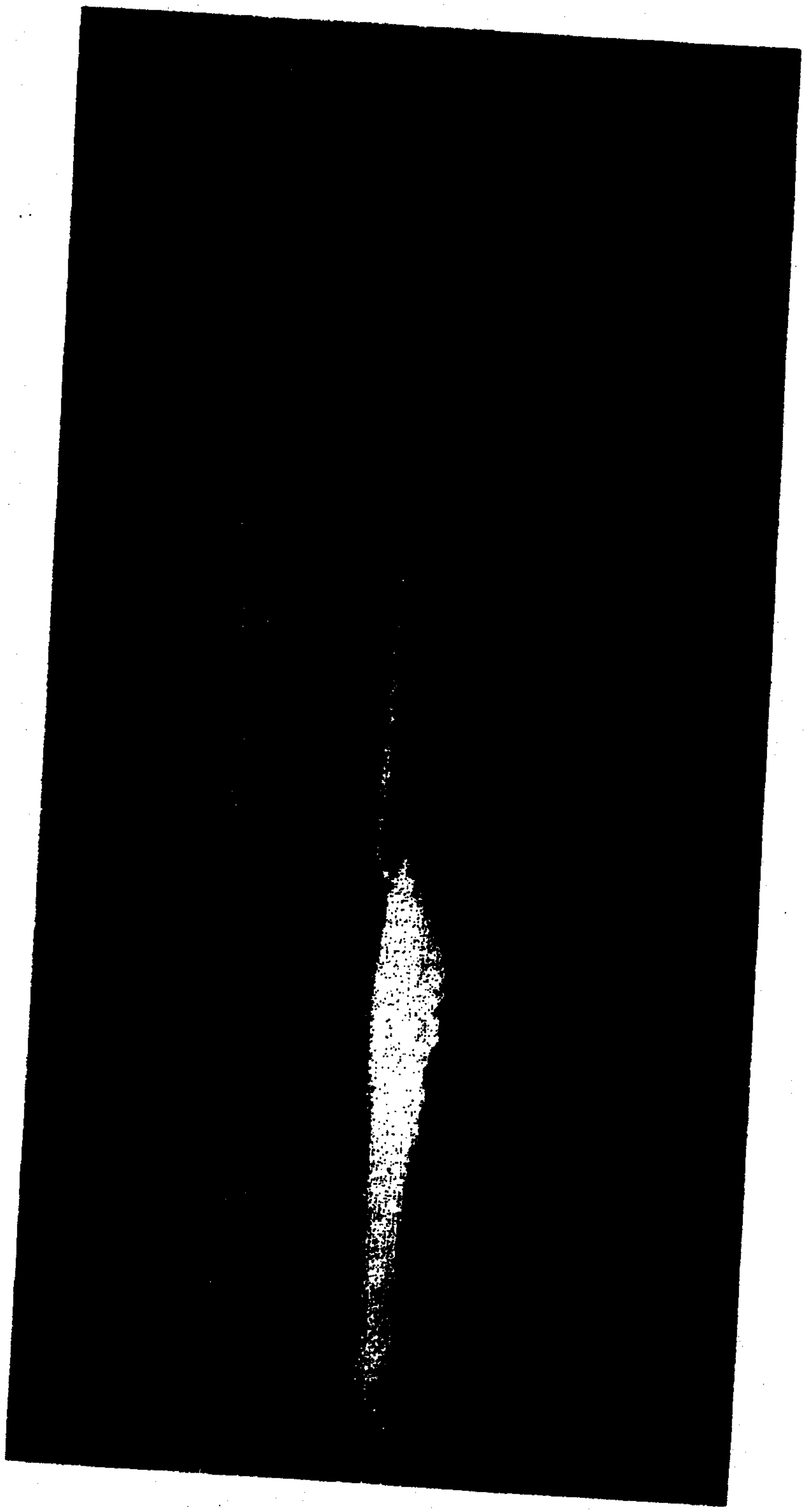

Figure 4

DISCOVERER/THOR at beginning of pitch-over program - Vehicle 1022

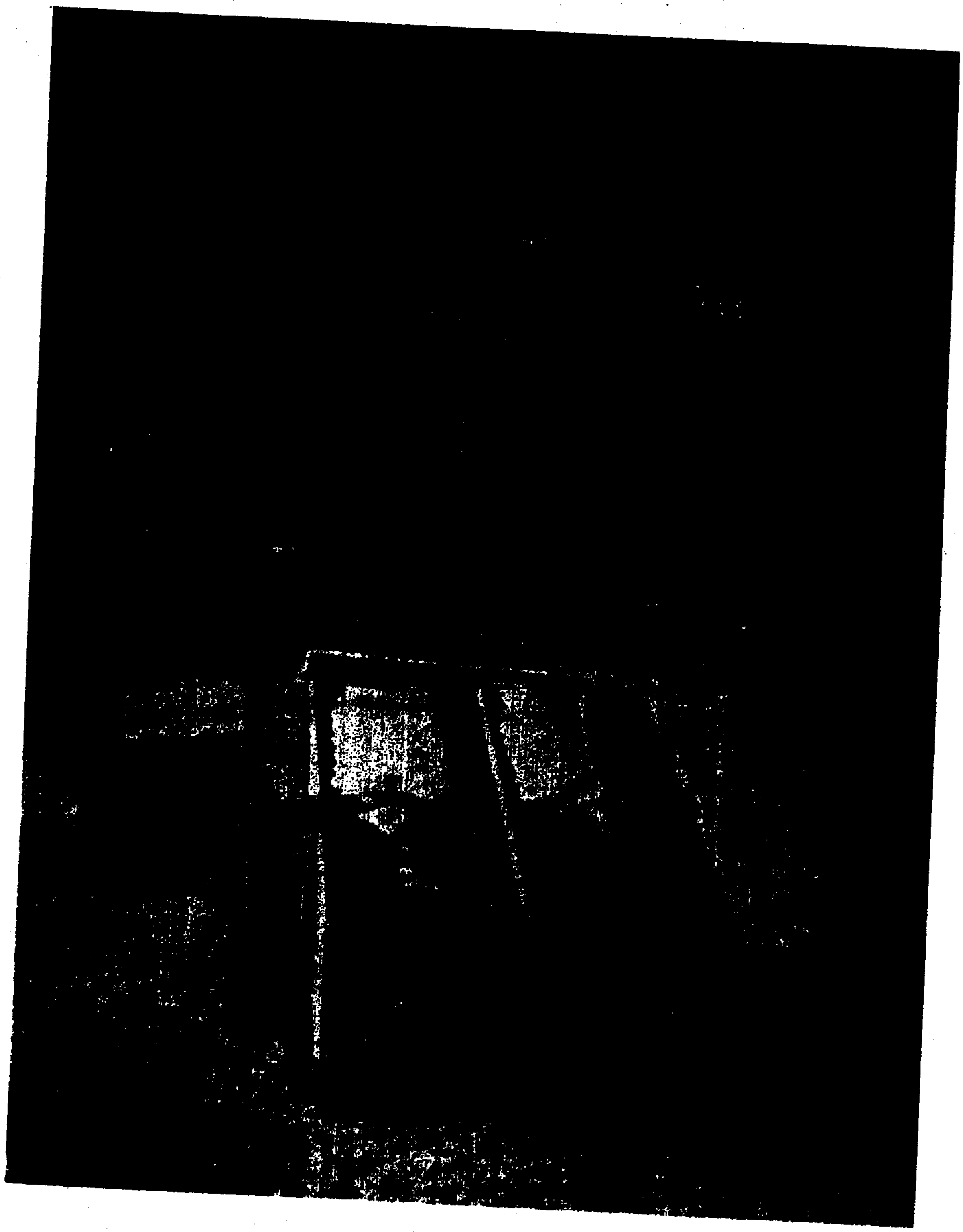

Figure 5

Annette, Alaska, receiving area vans; showing from left to right: maintenance and storage van, instrumentation van, telemetry van.

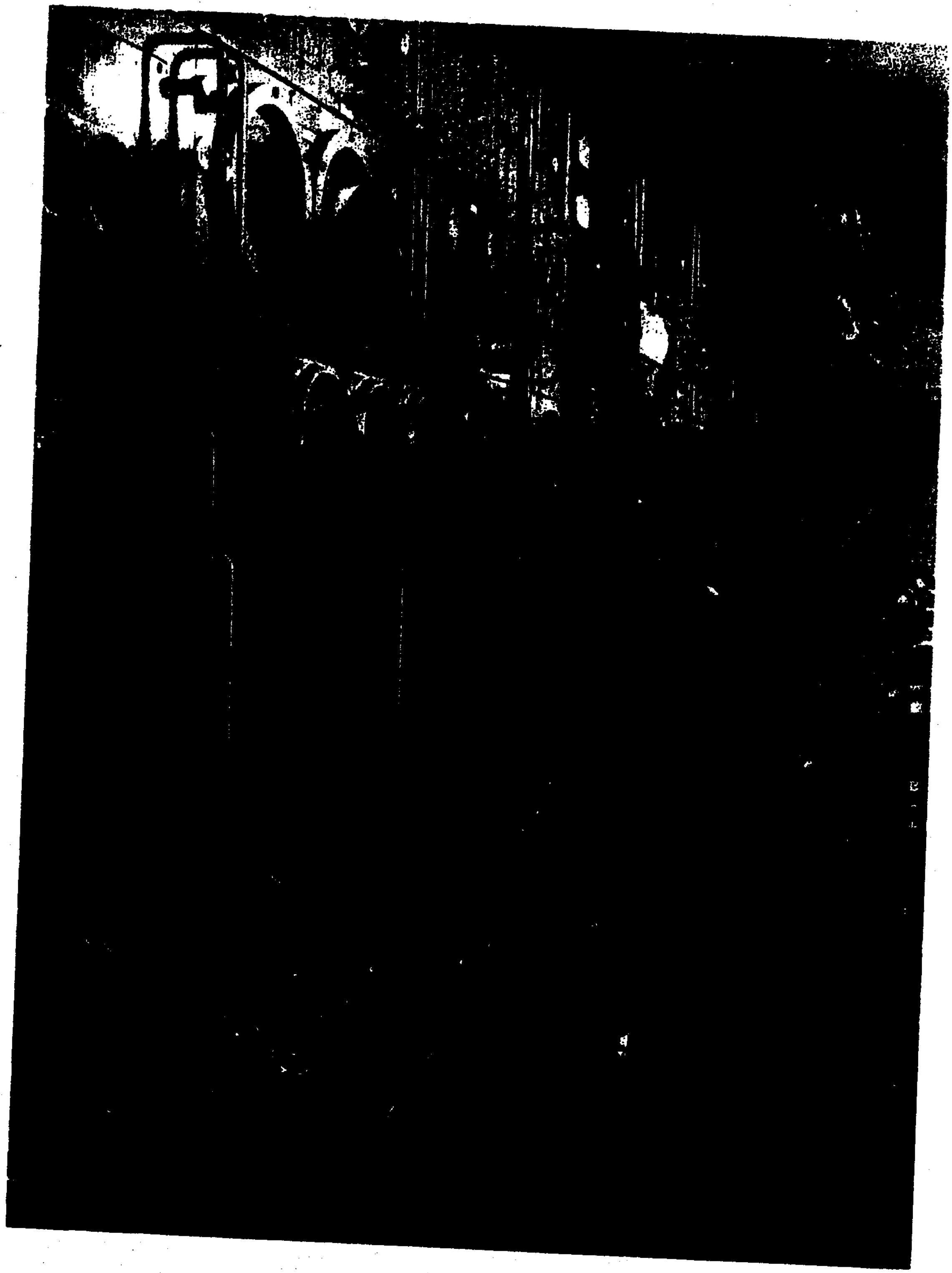

Figure 6

Interior of radar tracking van - Annette, Alaska.

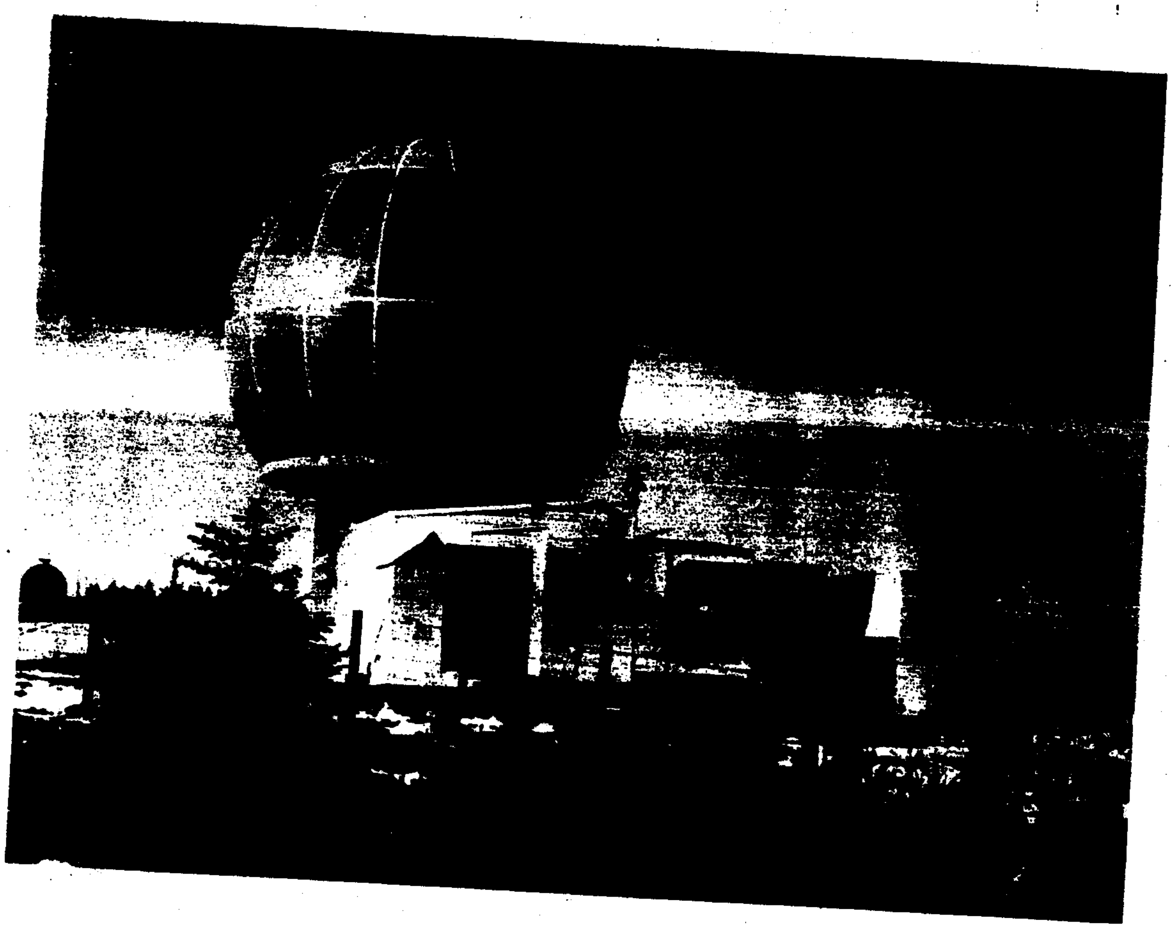

Figure 7

VERLORT radome and radar van - Annette, Alaska

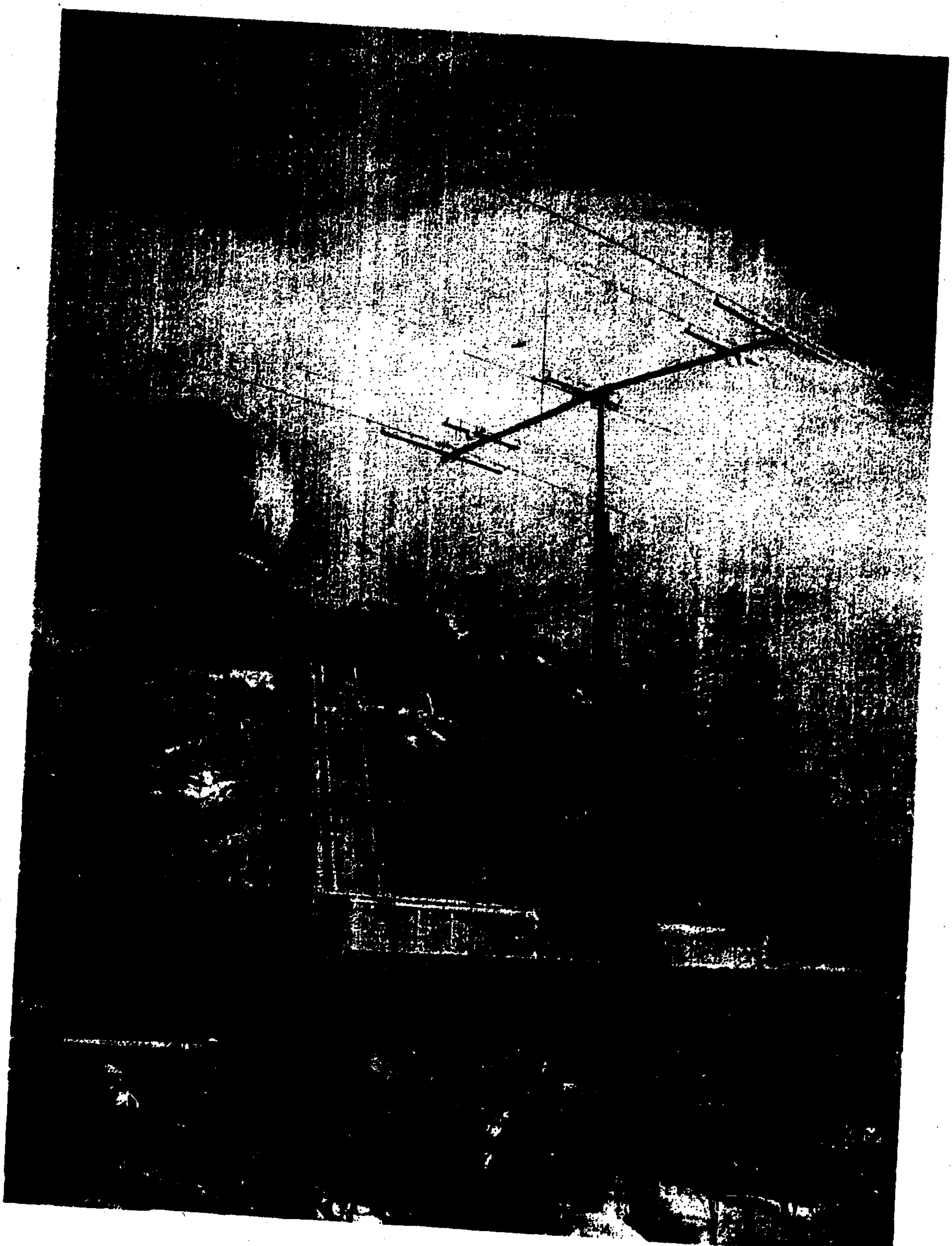

Figure 8

Receiving station and tri-helix T/M radome - Annette, Alaska

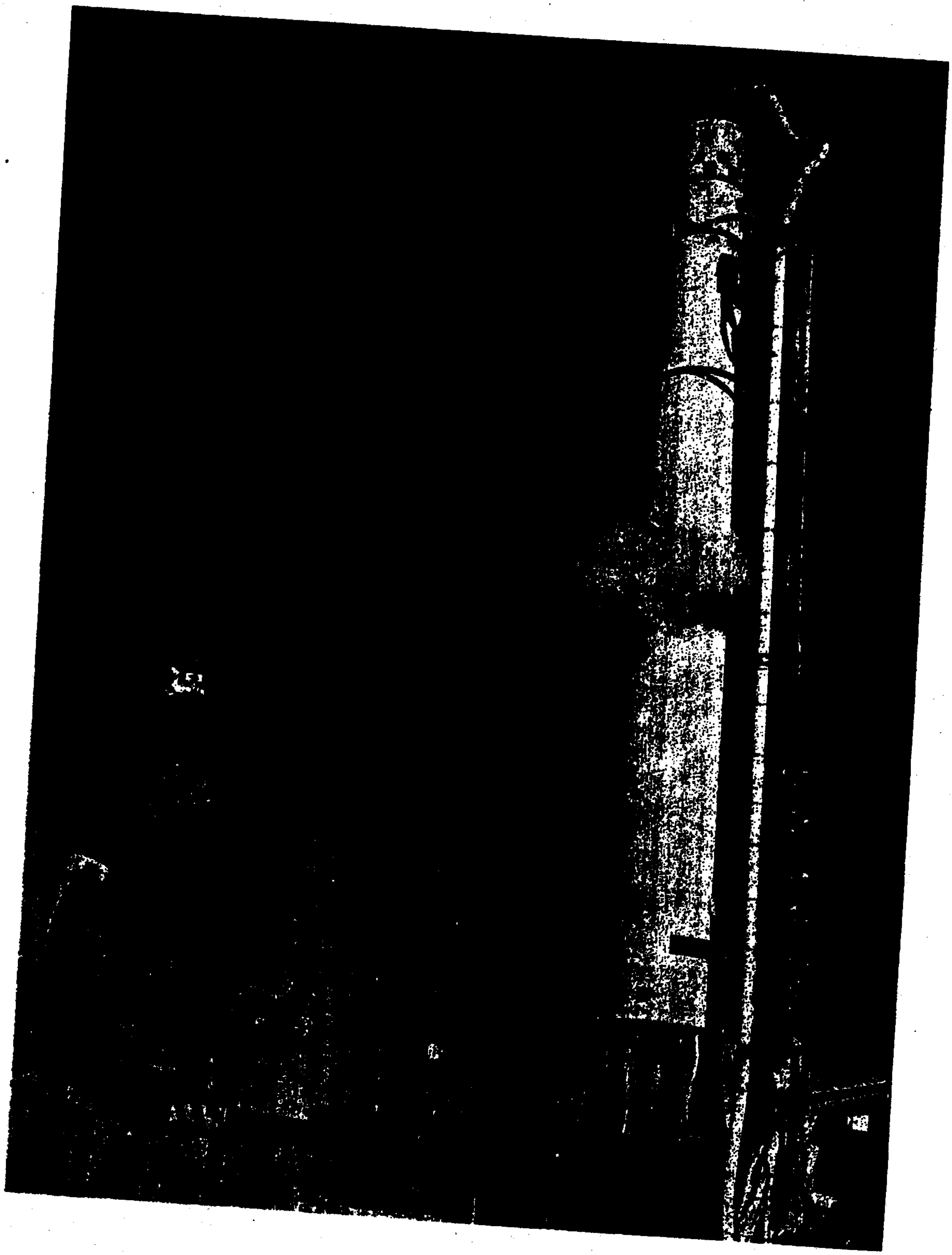

Figure 9

Prelaunch propellant loading - Vehicle 1019

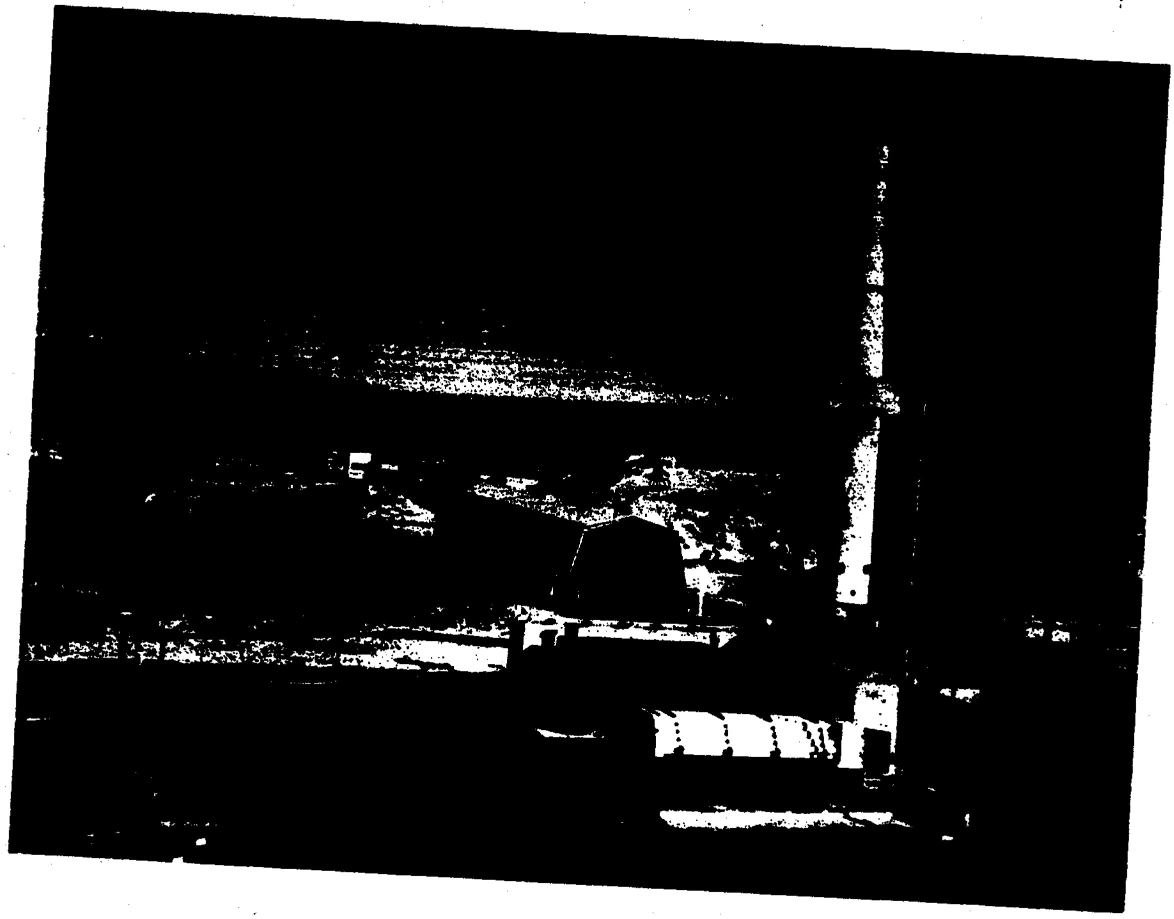

Figure 10

Prelaunch propellant loading - Vehicle 1019

Figure 11

Right ullage rocket and Bell engine - Vehicle 1019, damaged during attempted launch on 21 January.

Figure 12

Damage to the left side of DISCOVERER/THOR adapter - Vehicle 1019 after launch abort, 21 January.

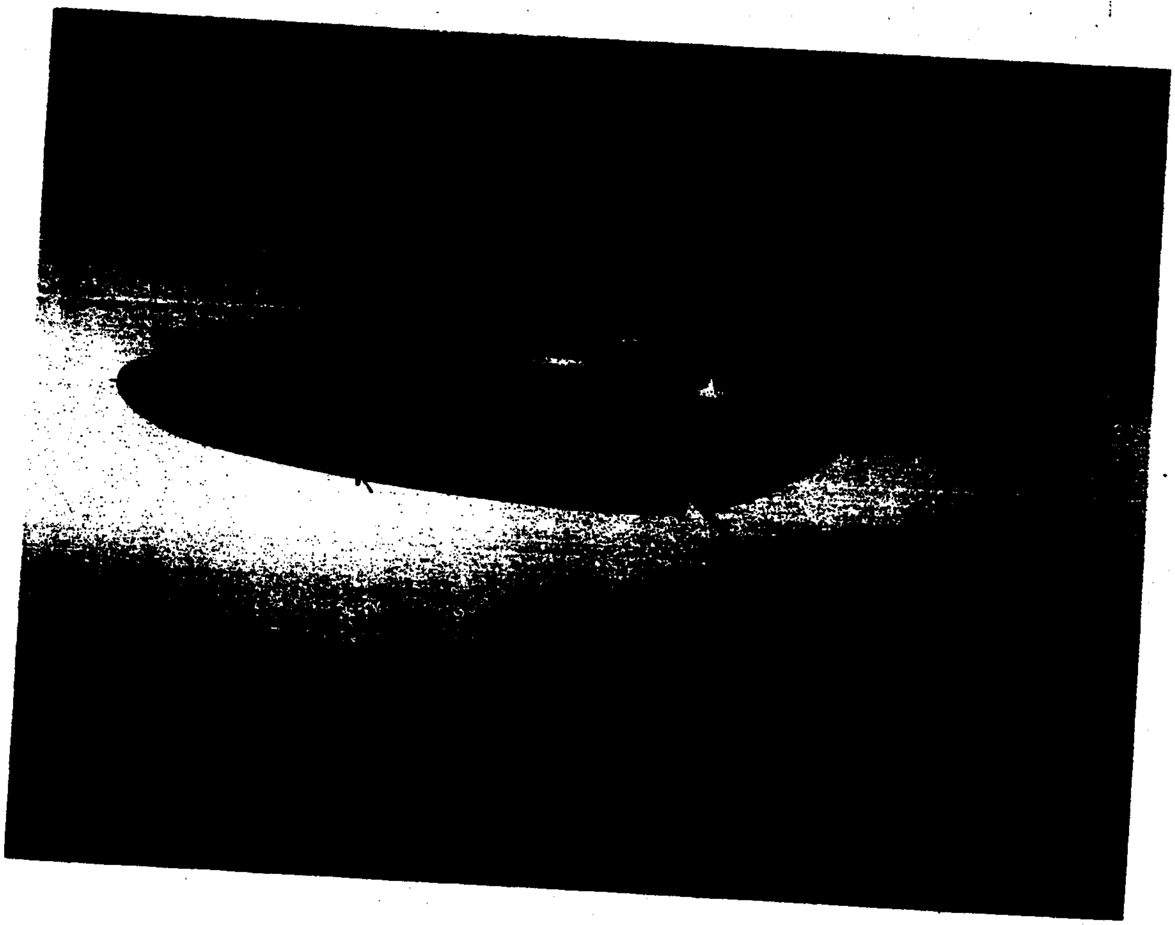

Figure 13

C-119 air pickup plane

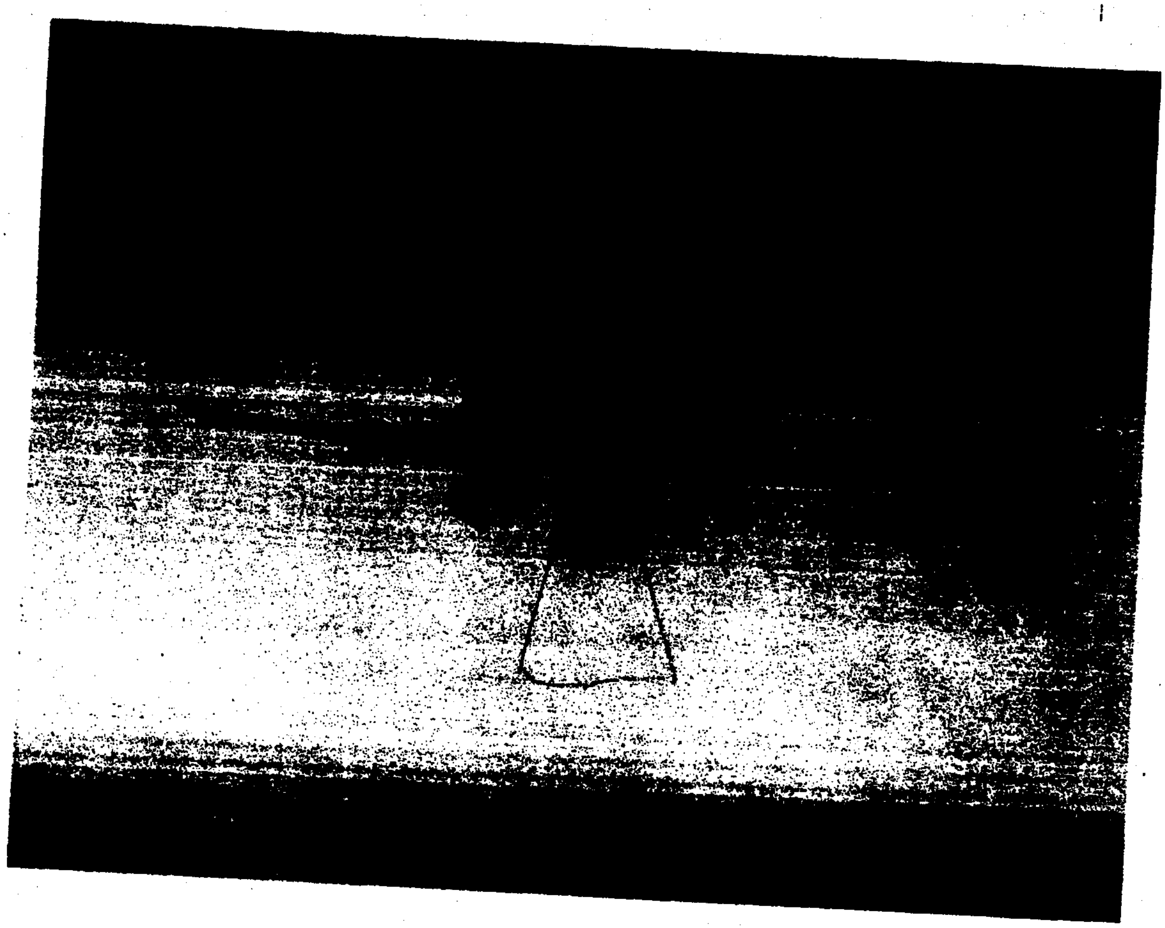

Figure 14

C-119 air pickup plane

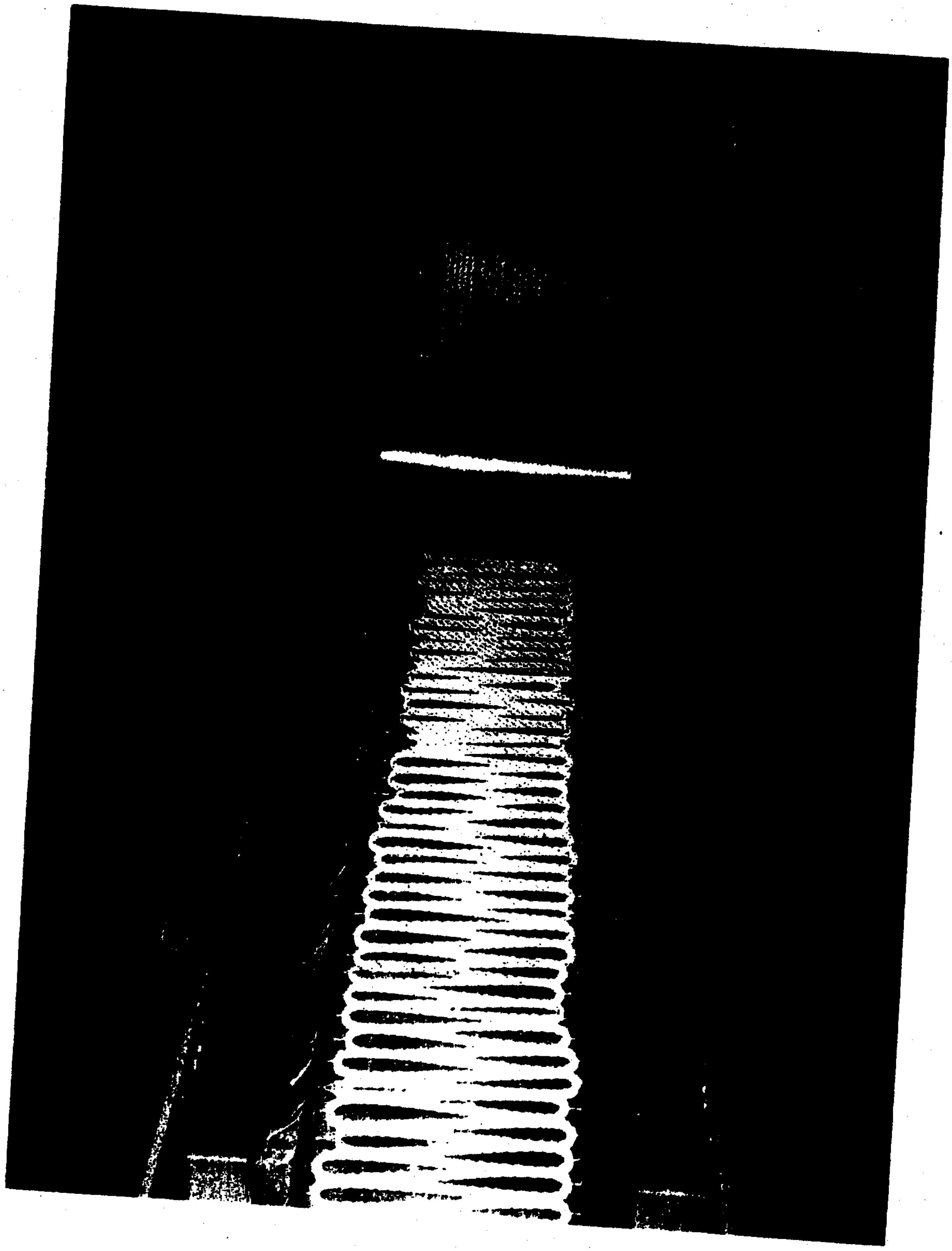

Figure 15

Winch and tie-down trough arrangement for recovery rigging in C-119 air pickup plane.

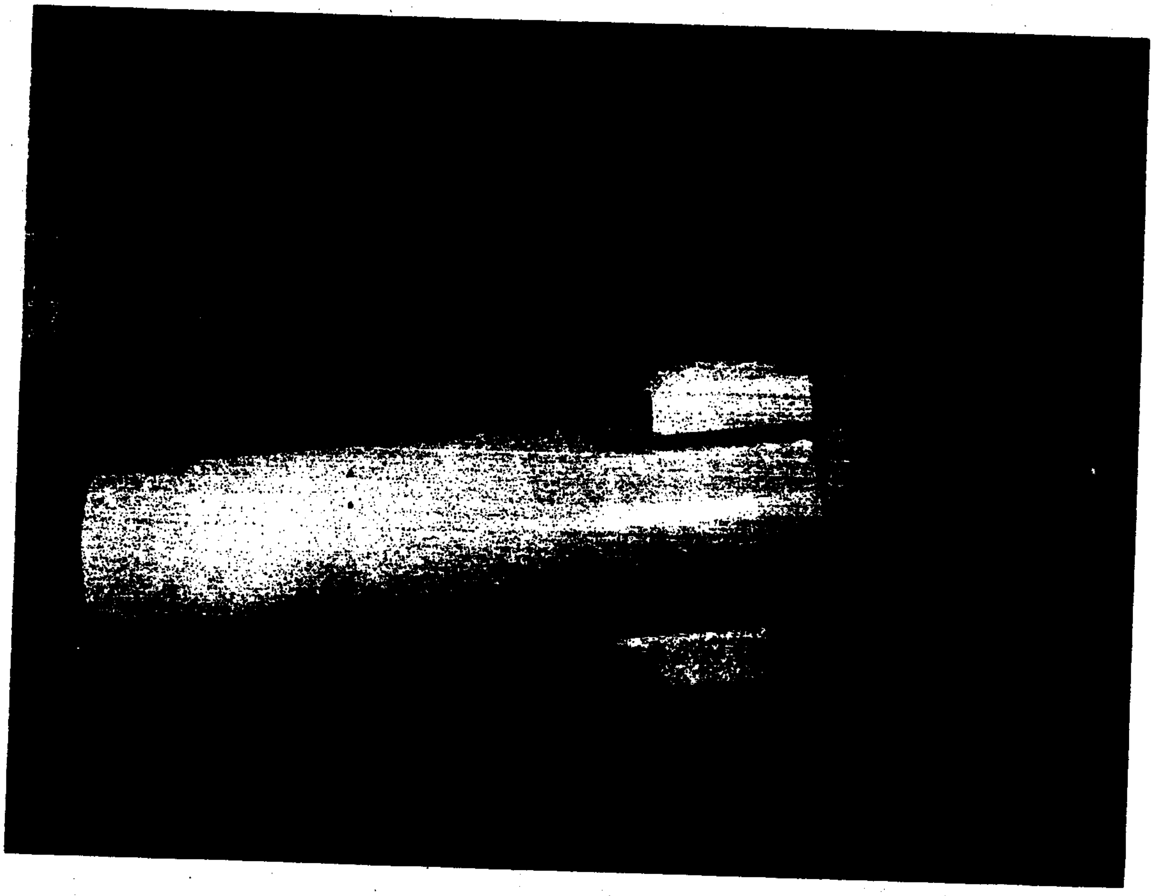

Figure 16

Typical "bomb" with dummy recovery capsule as used for B-47 air drops

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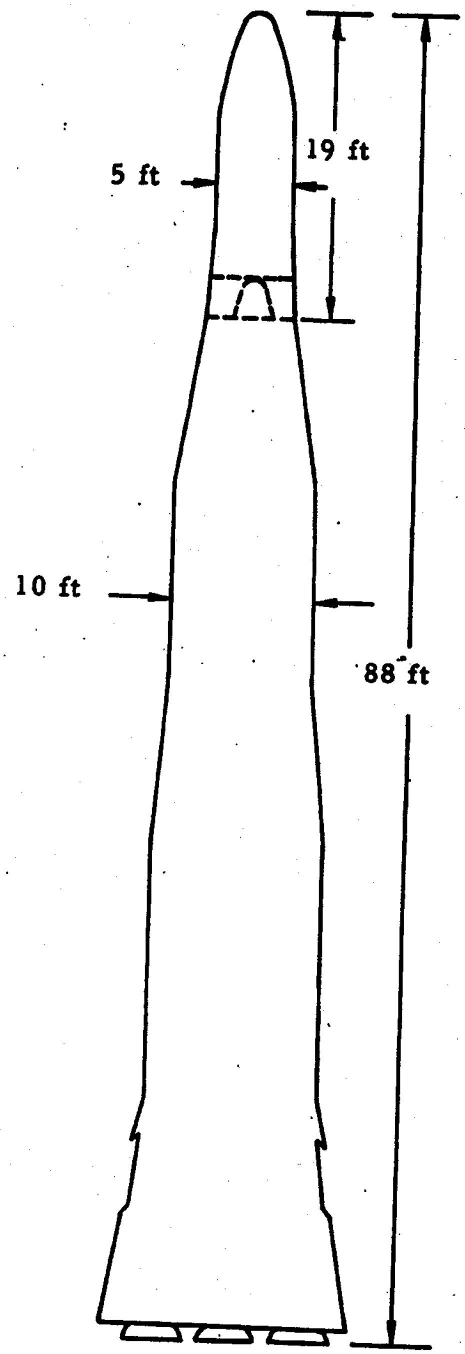
SENTRY



Combined Booster and Orbit Stage

[redacted] [redacted]

SENTRY

[redacted] [redacted]

SENTRY GLOSSARY

SENTRY FLIGHTS

The following are nominal values for early SENTRY flights.

Scheduled Launch Date: April 1960
Booster: ATLAS ICBM SM65-D
Gross Weight: 272,600 lbs.
Payload Weight: 3,400 lbs. (Variable)
Altitude: 300 Statute miles
Payload: Visual-Readout
Visual-Recovery
Ferret
Subsystems: A, B, C, D, E, F, H, L.

Second Stage: SENTRY Vehicle
Fuel: Unsymmetrical Di-Methyl Hydrazine/Inhibited Red Fuming Nitric Acid
On Orbit Weight: 5,000 lbs.
Payload Weight: 3,400 lbs.
Flight Characteristics: Ballistic trajectory to orbit.

SENTRY PROGRAMS

READOUT PROGRAM

VISUAL

This program includes the satellite-borne equipments required to collect intelligence in the visible spectrum; process and store this information; convert stored images to video signals for transmission to the ground. This program also includes the related ground based equipment required to receive the output of the satellite-borne data link, and conver the signal into photographic form for intelligence use.

FERRET

The electronic reconnaissance program (Ferret) consists of the satellite-borne equipment required to collect information from radiation in the region of the electromagnetic spectrum between 30 to 40,000 mc/sec. This information is stored, filtered, and, at the proper time, reconverted into electrical signals for transmission to the ground. This program also includes related ground based equipment required for in-flight calibration and vehicle equipment adjustment; engineering evaluation of equipment performance; decoding of reconnaissance data; and time and vehicle position for further data processing.

RECOVERY PROGRAM - VISUAL

The visual recovery program will provide, initially, two separate payloads. The first of these payloads will be designed to obtain photographic coverage of mapping accuracy, and the other payload will be designed to obtain high resolution reconnaissance information. In each case, the data will be returned to the earth in the recovery capsule portion of the satellite vehicle.

SUBSYSTEMS

Subsystem "A": Airframe
Subsystem "B": Propulsion
Subsystem "C": Auxiliary Power
Subsystem "D": Guidance
Subsystem "E": Visual Reconnaissance
Subsystem "F": Ferret Reconnaissance
Subsystem "H": Ground/Space Communications
Subsystem "I": Data Processing
Subsystem "J": Geophysical
Subsystem "K": Personnel

PROPULSION

XLR81-Ba-5 ENGINE

277 Sec. Specific Impulse
15,150 lbs. Thrust
Fuel: Unsymmetrical Di-Methyl Hydrazine/
Inhibited Red Fuming Nitric Acid

[redacted]

II. SENTRY PROJECT

A. SENTRY FLIGHTS

The SENTRY program has not reached the flight stage. The reorientation of this program was completed and approved by ARPA.

A reoriented SENTRY program was prepared during this quarter in accordance with instructions from ARPA. The new SENTRY Development Plan was published on 30 January and presented to ARPA on 4 February 1959. ARPA approval of the reoriented program was announced in Amendment #8 to ARPA Order No. 9-58, dated 16 February 1959.

The new program calls for development of two types of reconnaissance payloads.

The reoriented program calls for development of a reconnaissance capability utilizing polar orbiting satellites. Two payloads will be developed for the satellites, a visual system providing photographic coverage of foreign activity and a ferret payload for detection of electronic signals of interest. The intelligence so gathered will be used within the military community for national defense purposes.

A new requirement for recovery of photographic payload has been established.

Included in the new program is a requirement for development of a capability for deorbiting and recovering a photographic payload. This recovery capability is in addition to the capability for electronic readout of the visual data over a space-ground link.

Some flights will also have dual payloads.

Also new is a requirement for a satellite vehicle carrying both visual and ferret components. This vehicle will be employed for initial SENTRY development flights.

A total of 22 SENTRY flights are scheduled.

The present SENTRY program calls for 22 ATLAS ICBM-boosted flights between April 1960 and November 1961. The first three flights, scheduled for April, June, and August 1960, will carry dual visual-ferret components. Six visual flights with readout payload, eight visual flights with photographic recovery payload, and five ferret flights are planned.

B. FACILITIES AND SITES

1. LAUNCH

Completion of launch complex #1, Point Arguello, will be on schedule barring unforeseen delays.

The Navy was queried on 14 March concerning an apparent lag in construction of launch complex #1 at Point Arguello. The query requested status of construction and information concerning availability of facilities for joint occupancy of the blockhouse by 15 July, the first launch stand by 15 August, and the second launch stand by 15 October. A Navy reply, dated 19 March, indicated these dates will be met provided no further changes are required.

2. TRACKING AND DATA ACQUISITION

Contract for the New Boston facility will be awarded in April.

Plans and specifications for the New Boston, New Hampshire, tracking and data acquisition station are being advertised, and the contract should be awarded during April.

Design of the Ottumwa, Iowa, station is underway.

The Ottumwa, Iowa, tracking and data acquisition station is under design. Plans and specifications are scheduled for completion in July 1959.

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Development Control Center, Sunnyvale, California, is being advertised for contract.

The plans and specifications for the Development Control Center, Sunnyvale, California, are currently being advertised for construction contract. The bid opening date will be 9 April.

C. GENERAL

1. SUBSYSTEMS

The comments pertaining to DISCOVERER airframe, propulsion, auxiliary power, and guidance are generally applicable to the SENTRY program.

a. AUXILIARY POWER

Program for development of nuclear auxiliary power has been accelerated.

The feasibility of using one of the nuclear auxiliary power systems developed by the Atomic Energy Commission in SENTRY vehicles is being investigated. Several of these, based on different operational principals, are considered possibilities. Selection criteria will include weight, active life, development schedule, reliability and radiation hazard. A site is being chosen for a nuclear test facility for SENTRY development activities. Existing test facilities are also being investigated.

b. VISUAL RECONNAISSANCE

The visual reconnaissance payload will have an electronic readout capability.

The Eastman Kodak Company is developing a satellite-borne visual reconnaissance system with a capability for electronic transmission of the photographic images to ground stations. The satellite-borne equipment includes a camera using strip film exposed and developed in orbit. The

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film processing takes place in a chamber having closely controlled temperature conditions. Readout equipment scans the developed photographic negative, converts the image to a video signal, and transmits it to the ground by wide-band data link. Ground equipment records the signals on magnetic tape, and simultaneously displays the reconverted photographic images as a light-modulated line on a kinescope. The lines are photographed with a 35mm continuous-strip camera which records the images in positive form.

Visual system breadboard mockup was successfully operated for five days.

A breadboard mockup of the visual readout system was fabricated and subjected to a successful five day continuous run, under typical operational cycles. Components included were the vehicle camera, processor and electronics, a suitably attenuated coaxial cable (simulating the satellite-to-ground data link), the ground reconstruction electronics, and the ground primary record camera.

A simpler and lighter lens has been developed for the payload camera.

The readout payload camera has a lens of 36 inches focal length capable of photographing a strip of earth 17 miles wide and resolving objects of 20 feet on the ground. The original lens was designed for f2.5 aperture. However, development of faster film now permits use of a lens having an aperture of f4. This smaller aperture permits a smaller, lighter, and simpler lens. The first f4 lens has undergone preliminary testing with performance better than design requirements.

[redacted]

The visual readout payload dimensions have been established.

The overall size and configuration of the visual reconnaissance readout payload have been definitized. Weight will be approximately 1,000 lbs, length, 60 inches, and base diameter, 55 inches.

Recovery mapping payload is being designed.

A recovery mapping payload is being designed. This payload will obtain location information with an error less than 1,000 feet with respect to the North American datum. Lockheed Missiles Systems Division is completing the Preliminary Design Analysis Report on the mapping camera system. The camera system for this payload will be provided to LMSD as Government Furnished Equipment and will be developed under contract by the Wright Air Development Center.

Recovery reconnaissance payload is being designed for five foot ground resolution.

The recovery reconnaissance payload is being designed to obtain selective photographic coverage at a five foot ground resolution. LMSD is completing the Preliminary Design Analysis Report on the recovery reconnaissance payload system, and it is expected that the report will be reviewed by the Air Force and ARPA on 27 April 1959.

DISCOVERER flights will test effects of radiation on photographic emulsions.

Radiation is capable of "exposing" photographic emulsions even though they are protected from light. Film packages will be placed aboard DISCOVERER recovery capsules to determine the extent of radiation effect on film in the on-orbit environment. This information is considered critical to the visual reconnaissance program.

Radiation effects on magnetic tape are also being investigated.

Samples of prerecorded magnetic tape are being subjected to radiation to determine the effect on both the recorded data and the tape.

C. SATELLITE FERRET RECONNAISSANCE

Eight ferret flights are planned through 1961.

The ferret payload equipment will measure and store electronic signal parameters over foreign territory, and transmit this data to ground, on command, over friendly territory. The first ferret flights will note significant changes in signal parameters; significant redeployment of emitters, intensified electronic signal activity, unusual absence of signals; and jamming activities including changes in the jamming level. Later, ferret flights will intercept emitters such as frequency jumpers, jittered pulse-repetition-frequency radars, carrier wave systems, radio teletype, and voice communications. Three dual visual-ferret flights and five all-ferret flights are planned between May 1960 and November 1961.

Three ferret systems are being developed.

Development of the ferret payload equipment has been undertaken in three phases. The first (F-1) phase stressed early availability, and many off-the-shelf components were used. The second phase (F-2) will modify and refine the F-1 equipment for weight savings. The F-3 phase will stress a highly sophisticated system of wider capability and better position accuracy.

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The prototype F-1 equipment has been successfully tested in flights over the New York area.

The first prototype of the F-1 flight package was installed in a DC-3 aircraft and subjected to seven data gathering flights over the New York area. The flight conditions simulated orbital velocity and altitude. The flight tapes were then processed on the ground readout equipment mockup. (This ground data processing mockup has been operated for 1700 hours at a 25 percent duty cycle without malfunction.) Data from early flights revealed several system malfunctions which were corrected. The later flights revealed completely satisfactory operation of both air and ground equipment.

The second F-1 prototype has been completed.

The second prototype of the F-1 payload has been completed and is being subjected to systems checkout.

The program reorientation emphasized the development of the F-2 equipment.

The recent program reorientation emphasized development of an F-2 orbital flight package for mid-1960 launch. Development of the F-2 equipment is on schedule. A prototype F-2 payload is fabricated and installed in the payload structural framework in preparation for shock and vibration tests.

Development of F-3 equipment is on schedule.

Preparation of breadboard models of the F-3 equipment is on schedule. Work has started on the high speed counter. A preliminary design of the analog recording system was completed.

D. DATA HANDLING

Basic visual-ferret data handling systems have been integrated.

The data handling systems for the visual and ferret systems have been integrated into a single dual-capability data handling system. Description of the various functions within the system are being prepared. The equipment required to perform these functions will then be determined.

Development of communications equipment is on schedule.

The SENTRY vehicle data link transmitter was completed in prototype form. System runs to determine performance of the vehicle wide-band data transmitter for the visual application were highly successful. Signals from the vehicle transmitter were purposely attenuated to simulate space-to-ground signal degradation, and a prototype of the ground receiver was inserted in the simulated link. The clarity of test pictures received on a TV type monitor indicated very satisfactory performance of all equipment in the link.

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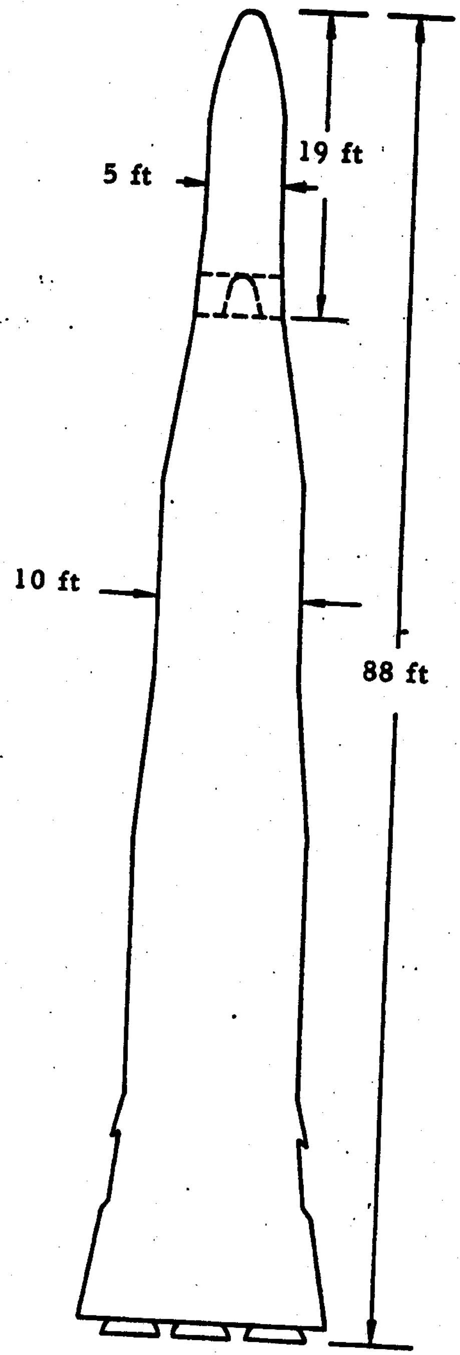
MIDAS



Combined Booster and Orbit Stage

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MIDAS

[redacted]

MIDAS GLOSSARY

MIDAS FLIGHTS

The following are nominal values for early MIDAS flights:

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Booster: ATLAS ICBM SM65-D
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Payload Weight: 3,400 lbs. (Variable)
Altitude: 250 - 350 Statute miles
Payload: Infrared ("G")
Subsystems: A, B, C, D, G, H

Second Stage: MIDAS Vehicle
Fuel: Unsymmetrical Di-Methyl Hydrazine/Inhibited Red Fuming Nitric Acid
On Orbit Weight: 5,000 lbs.
Payload Weight: 3,400 lbs.
Flight Characteristics: Ballistic trajectory to orbit.

PHASE I

Phase I of the development program consists of four flights, starting in November 1959 and continuing at the rate of one flight every other month through May 1960. These flights will originate from the Atlantic Missile Range and will attain an operational altitude of 300 to 400 statute miles. A nominal launch azimuth of 108° has been selected.

Primary objectives of the initial flight are to test and evaluate:

a. The infrared system.
b. The orbital vehicle and adapter systems.
c. The booster system (ATLAS).
d. Ground handling, checkout and launch systems.
e. Vehicle subsystems and communications.
f. Ground tracking and command systems.

Flight 2 will continue the testing and evaluation of Infrared Reconnaissance System components, techniques, and system operation. Solar cell performance will be tested as well as other basic systems required to demonstrate the orbital capability of the SENTRY vehicle.

SUBSYSTEMS

Subsystem "A": Airframe
Subsystem "B": Propulsion
Subsystem "C": Auxiliary Power
Subsystem "D": Guidance
Subsystem "G": Infrared Reconnaissance
Subsystem "H": Ground/Space Communications
Subsystem "K": Personnel

PROPULSION

XLR81-Ba-5 ENGINE

277 Sec. Specific Impulse
15,150 lbs. Thrust
Fuel: Unsymmetrical Di-Methyl Hydrazine/Inhibited Red Fuming Nitric Acid

[redacted]

III. MIDAS PROJECT

Reprogramming actions have been completed, and ARPA approval for MIDAS Phase I received.

Reorganization of the MIDAS program structure has been completed. A new MIDAS Development Plan was published on 30 January. The program was presented to ARPA on 28-29 January. Amendment #1 to ARPA Order No. 38-59, dated 2 March 1959, announced approval of the Phase I program.

The MIDAS project will provide early warning of Ballistic Missile attack.

The MIDAS program (Missile Defense Alarm System) will space a series of reconnaissance satellites around the earth in polar orbits. The payload will consist of infrared detection scanners capable of sector scanning of selected portions of the earth by program or command. The infrared emanations from ballistic missiles would be detected and the information simultaneously relayed to far north readout stations. The information would then be relayed directly to ZI intelligence and operations centers. This early warning would provide time for the alert of retaliatory forces. Additional capabilities for the project will eventually be investigated; such as, ICBM tracking and prediction, air-breathing vehicle detection and tracking, and ground surveillance.

Development is divided into three phases.

The MIDAS project will be accomplished in three phases. Phase I will consist of four ATLAS-boosted flights from the Atlantic Missile Range. Phase II calls for six ATLAS-boosted flights from the Pacific Missile Range. Phase III will place operational MIDAS satellites in polar orbits from the Pacific Missile Range.

[redacted]

The first launch is scheduled for November 1959.

MIDAS program schedules call for the initial Phase I launch in November 1959, and launches every other month. The initial Phase II launch is scheduled for July 1960, with subsequent launches following every other month. Phase III operational flights will begin with two in July 1961, and three each month thereafter until June 1962, when two flights are scheduled.

A. <u>SUBSYSTEMS</u>

1. <u>INFRARED SCANNERS</u>

Infrared scanner improvements are being sought.

The possibility of improving the infrared scanners for the early MIDAS flights is being investigated. Changes to scanner focal plane assembly and electronics may provide increased sensitivity.

A contract was let for a study of the feasibility of an infrared precision tracking system.

Baird-Atomic, Inc., has taken a contract for study of the feasibility of an infrared precision tracking system. The contract includes design and fabrication of laboratory equipment necessary to demonstrate their conclusions. This contractor is also developing a backup infrared scanner package for MIDAS.

A system for increased infrared sensitivity is being evaluated.

Infrared Industries, Inc., is evaluating a field condensing system for use with the infrared scanner package. Smaller detectors and a considerable increase in sensitivity should be achieved if the expected results materialize. This will permit the use of higher operational altitudes, providing equal coverage with fewer satellites.

Environmental testing has been successfully concluded.

Environmental testing of the infrared-scanner thermal/mechanical equivalent was successfully concluded. No design changes were indicated by these tests.

The target measurements program has been completed.

Eastman Kodak has completed the target measurements program. This program involved flights of B-47 aircraft near ascending ballistic missiles for infrared emanation measurement. The final report is expected to be received in early May.

B. AUXILIARY POWER UNIT

A subcontractor has been selected as an alternate source for solar cells in the program for development of solar power collector elements.

Based on proposals submitted to Lockheed, the International Rectifier Corporation has been selected as an alternate producer of solar collector elements. These are associated with the full-scale solar auxiliary power unit for the MIDAS system under development by the prime contractor (Figures 17, 18, 19, 20, and 21).

An APU backup program is being prepared.

Specifications and task statements are being prepared for initiation of a solar auxiliary power system backup program. This backup is desirable due to the urgent requirement for auxiliary power in the MIDAS program.

Linearity check of solar APU telemeter was satisfactory.

System linearity checks were made of the solar APU telemeter, and the unit was well within specifications. This telemeter will monitor operation of the solar auxiliary power unit on early flights.

Aft equipment rack is being designed for satellite vehicle.

A new aft-equipment rack is being designed to support the extendable solar cell array to be used in the third flight vehicle.

C. **BOOSTER**

Insulating blanket is being designed to protect MIDAS satellite from low temperatures from missile liquid oxygen tanks.

Low temperatues in the MIDAS aft equipment rack resulting from proximity to the ATLAS liquid oxygen tank were investigated. It was concluded the temperatures were unacceptably low. Convair will design a thermal insulating blanket for the forward dome of the liquid oxygen tank for ATLAS/MIDAS vehicles.

D. **SATELLITE GUIDANCE SYSTEM**

Guidance and control equipment is being designed for MIDAS satellites.

The guidance computers for the first two MIDAS vehicles will be identical to those used in the DISCOVERER program. The computer package is being redesigned for later MIDAS flights. The new configuration will mount the sequence timer separately from the computer, providing improved computer accessibility.

More efficient flight controls electronic assembly has been designed for MIDAS.

The flight controls electronic assembly was redesigned for the MIDAS vehicle. The new design uses rate network circuitry instead of rate gyros, resulting in a smaller, lighter unit.

E. **SATELLITE PROPULSION SYSTEM**

A successful simulated high altitude start of the Bell liquid rocket engine was achieved.

The MIDAS flight program requires approximately a 2,000 mile orbital altitude. To achieve this altitude the Bell satellite engine must have a dual firing and altitude restart capability. The development of a dual burning engine is generally applicable to all high altitude orbital requirements. All future satellite programs will benefit from this effort. Simulated altitude tests of this engine were conducted at Arnold Engineering

Development Center to verify high altitude restart capabilities. The first high altitude restart was performed successfully at a simulated altitude of 120,000 feet.

F. FACILITIES AND SITES

Launch equipment is being prepared at the Atlantic Missile Range for the first MIDAS flight.

Work on the umbilical mast for the Phase I MIDAS launches is underway at the Atlantic Missile Range. All parts except the boom proper have been delivered.

[redacted]

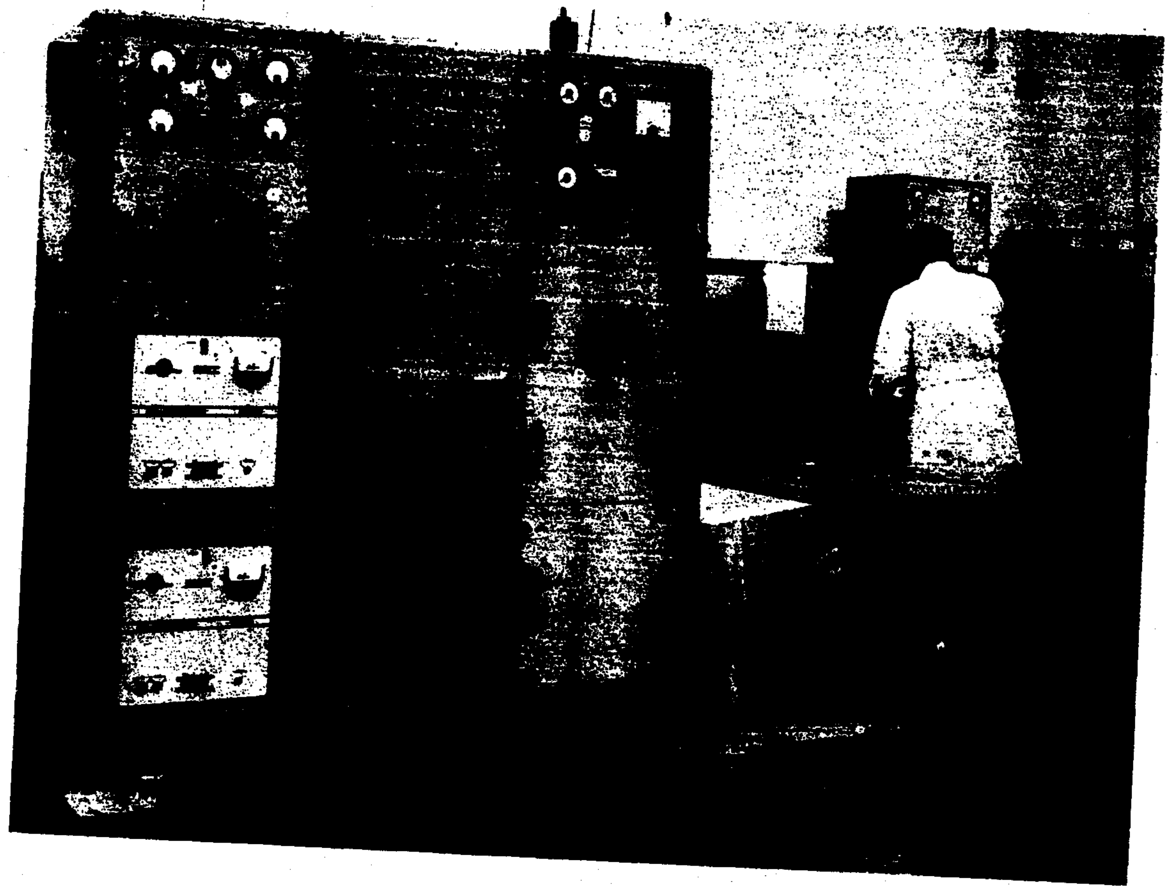

Figure 17

MIDAS solar collector checkout console

Figure 18

MIDAS solar collector checkout console rear view; back open

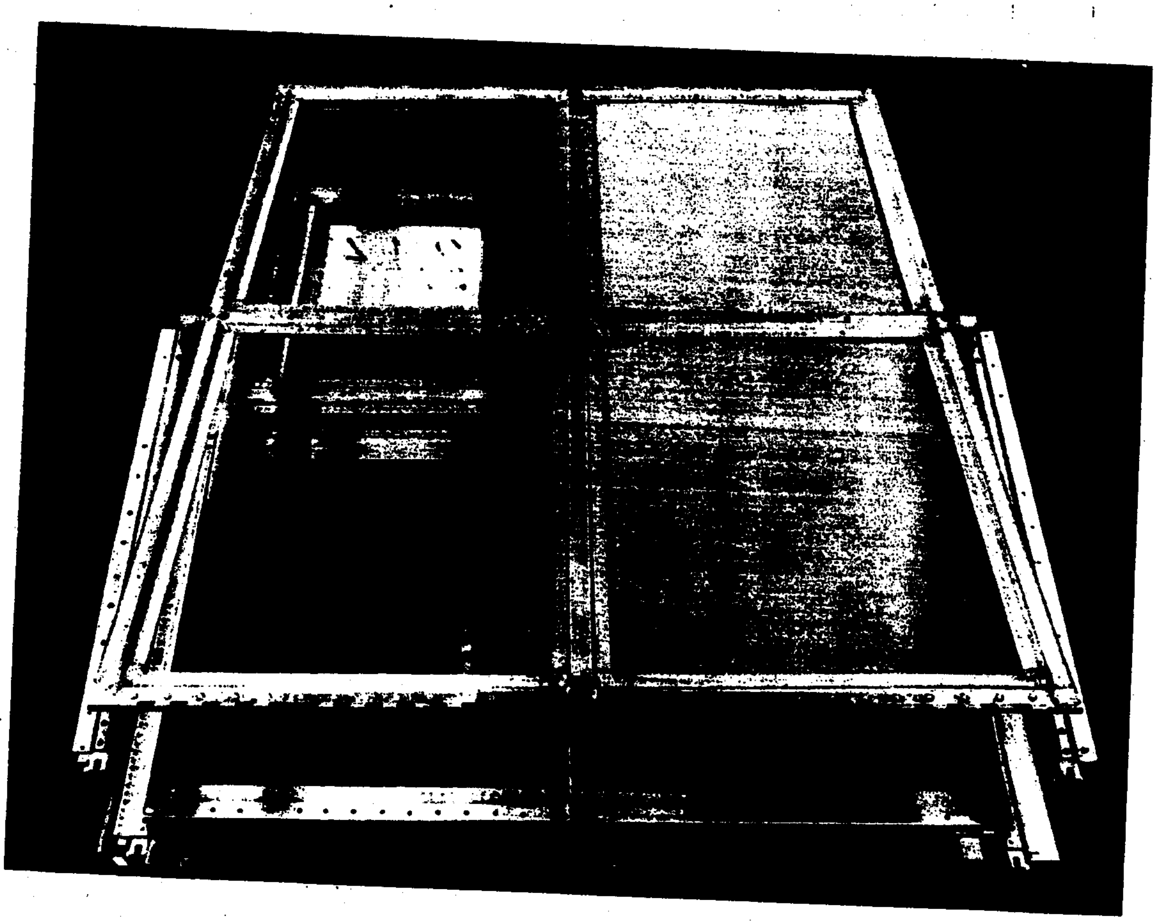

Figure 19

MIDAS solar collector mockup - folded position

Figure 20

MIDAS solar collector mockup - extended position.

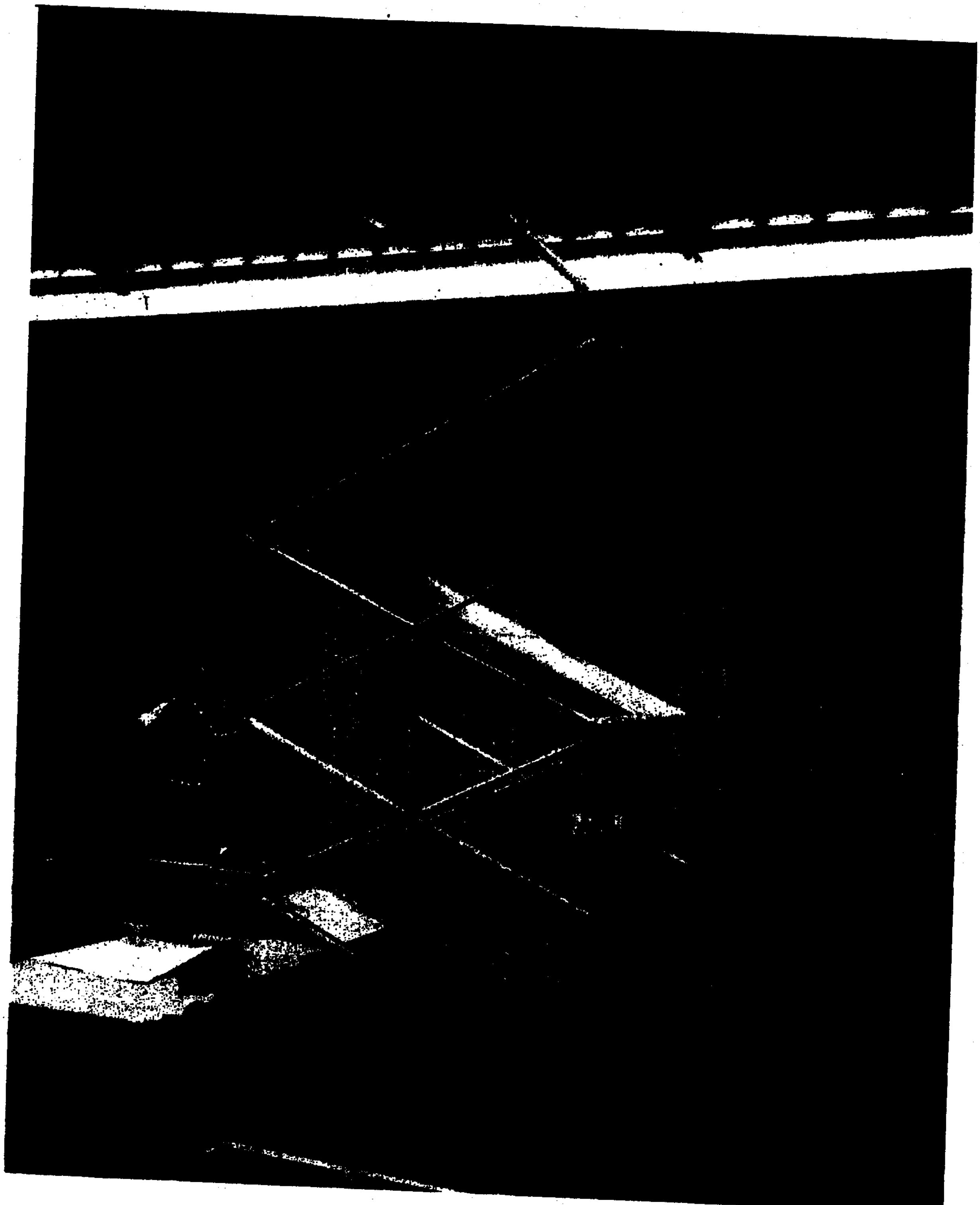

Figure 21

MIDAS solar collector mockup - partially folded position.

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AIR RESEARCH AND DEVELOPMENT COMMAND
UNITED STATES AIR FORCE
Air Force Unit Post Office
Los Angeles 45, California

Assistant for Programming
WDPCR

9 March 1959

SUBJECT: Military Satellite Program Progress Report
Month of February 1959

TO: Director
Advanced Research Projects Agency
Washington 25, D. C.

1. **GENERAL**

The development plans for the reoriented DISCOVERER, SENTRY, and MIDAS programs were briefed to the Advanced Research Projects Agency (ARPA) and the Air Staff on 2 and 3 February. Amendment 1 to ARPA Order 48-59, dated 16 February, released total DISCOVERER program funding. Amendment 8 to ARPA Order 9-58, dated 16 February, released total SENTRY program funds. Additional incremental funding was released for the MIDAS program; however, the MIDAS program has not yet been approved.

2. **DISCOVERER PROGRAM**

a. Vehicle 1022 underwent a complete systems test at Vandenberg Air Force Base on 4 February and was then transported to the launch complex. A final system checkout was completed at the launch complex on 18 February. On 19 February, a pre-launch dress rehearsal was successfully conducted in preparation for the launch planned for 25 February.

b. An attempt was made to launch DISCOVERER 1-163-1022 on 25 February. The launch was postponed after approximately twelve hours of countdown due to difficulty with the liquid oxygen tank pressurization system of the THOR booster. The DISCOVERER portion of the countdown was accomplished without serious delay.

c. A second attempt took place on 28 February, resulting in a successful launch. The countdown proceeded with minor delays, and launch took place at 1349 hours. Liftoff, first-stage boost, and DISCOVERER separation were very smooth and took place as programmed. Telemetry transmitter tracking information was received at Vandenberg Air Force Base until T plus 536 seconds. Radar control was maintained by the Vandenberg Air Force Base and Point Mugu radars until T plus 506 and T plus 521 seconds,

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respectively. The first orbital pass was not confirmed; however, sporadic airborne beacon signals acquired on later passes confirmed that DISCOVERER went on orbit. Preliminary information indicates that the primary objectives of DISCOVERER I flight were attained. A detailed report of this flight will appear in the next report.

d. DISCOVERER I-160-1019 could not be repaired and checked out prior to the scheduled launch date for DISCOVERER I-163-1022. The vehicle was stored at the Lockheed Sunnyvale facility, and effort concentrated on preparation for launch of vehicle 1022. A decision was made to consider the vehicle 1019 abort as a flight test and to proceed with the planned flight schedule.

e. A successful hot firing of vehicle 1018 took place at the Sunnyvale Test Base on 21 February, and the vehicle was delivered to the Vandenberg Air Force Base launch site. This will be the first DISCOVERER with the biomedical recovery capsule payload. A successful fifty-hour biomedical capsule test was performed during this period, simulating an entire mission. Included were twenty-seven hours in a thermo-vacuum chamber at Sunnyvale, and eight hours of flotation simulating conditions in event of unsuccessful air pickup. Sensors and instrumentation were provided for compartment temperature and pressure, and the biomedical (mice) specimens. The mice survived with no apparent ill effects. Workability of the biomedical recovery capsule was satisfactorily demonstrated. The six medical vans at Vandenberg Air Force Base were also readied for the first biomedical payload operations.

f. The Hawaiian Control Center is now ready for recovery operations. Minor communications difficulties, uncovered in the January simulation exercises, were located in the control console circuitry and corrected.

g. Systems tests of vehicle 1020 were satisfactorily accomplished at the Palo Alto Modification and Checkout Center. The vehicle was then delivered to the Santa Cruz Test Base for a hot-system run.

h. DISCOVERER vehicles 1023, 1025, 1028, and 1029 are now at the Lockheed Missile Systems Division Modification and Checkout Center.

i. Construction bids for an addition to the SM-75-1 Missile Assembly (RIM) Building and a prefabricated type shop building, will be opened on 25 February. The construction completion date is 15 May 1959.

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j. As requested by ARPA TWX 955243, following is the current list of program flights together with associated booster and vehicle numbers:

Program Flight		
1	THOR 160	Vehicle 1019
2	THOR 163	Vehicle 1022
3	THOR 170	Vehicle 1018
4	THOR 174	Vehicle 1020
5	THOR 179	Vehicle 1023
6	THOR 192	Vehicle 1029
7	THOR 200	Vehicle ~~1025~~ 1028
8	THOR 206	Vehicle ~~1028~~ 1051
9	THOR 212	Vehicle ~~1051~~ 1050
10	THOR 218	Vehicle ~~1050~~ 1052
11	THOR 223	Vehicle ~~1052~~ 1054
* 12		Vehicle 1054
* 13		Vehicle ~~1055~~ 1053
* 14		Vehicle 1053
* 15		Vehicle 1056

(* THOR Boosters for flights 12 through 15 have not yet been identified.)

3. **SENTRY PROGRAM**

a. Three additional flight tests of the prototype F-1 ferret equipment were made over the New York area in February. Results indicate steadily improved performance of the F-1 vehicle and ground data handling equipment. The improvement in performance is due to modifications resulting from the initial flight test program. The F-2 equipment is proceeding on schedule.

b. The breadboard of the 36 inch camera system was operated continuously for five days under typical operational cycles. Included were the vehicle camera, vehicle processor, vehicle electronics, coaxial cable (acting as a data link), ground reconstruction electronics, and primary record camera. Design was started on the service test model of the visual payload to ensure that reoriented program schedules are met.

c. A 70mm film package will be installed on several DISCOVERER flights to determine the affect of radiation on photographic emulsions. The National Institute of Health, Bethesda, Maryland, will assist in construction of nuclear radiation packages and subsequent data analysis.

d. The construction contract for the SENTRY/ATLAS Guided Missile Assembly Building at Vandenberg Air Force Base was awarded 12 February. Construction completion is scheduled for 19 October 1959.

e. A construction contract for the Data Acquisition and Processing Building was awarded 20 February. Contract completion is scheduled 15 December 1959. This is the final item to be placed under contract for the Vandenberg Air Force Base Tracking and Data Acquisition Station.

f. The design for the Tracking and Data Acquisition Station at New Boston, New Hampshire, is complete. Advertising for construction is being delayed pending release of funds.

g. Preparation of Construction Plans and Specifications for the Tracking and Data Acquisition Station at Ottumwa, Iowa, is currently being initiated.

h. The design of the Development Control Center at Sunnyvale, California, is complete. The construction contract is scheduled to be awarded during April 1959.

4. **MIDAS PROGRAM**

a. Preparation of the Atlantic Missile Range launch facility for the Phase 1 portion of the MIDAS program is proceeding.

b. Environmental testing of the infrared scanner thermal/mechanical equivalent is continuing in the Lockheed Missile Systems Division, Sunnyvale, thermal/altitude chamber. Preliminary test results are satisfactory. After completion of these tests the scanner will be tested and evaluated further in the modification and checkout area.

c. Technical discussions and contract negotiations were concluded with Infrared Industries, Inc., Boston, Massachusetts. This firm will develop detector cells to be used in infrared reconnaissance satellites. These cells are expected to have an increase in sensitivity by a factor of five over cells under development by other subcontractors.

d. Aerojet-General is engaged in improvement of their infrared reconnaissance scanner, initially developed for the satellite attack alarm application.

R. Curtin for

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WDPCR

10 February 1959

SUBJECT: Military Satellite Program Status Report for the Month ending 31 January 1959

TO: Director
Advanced Research Projects Agency
Washington 25, D. C.

1. The development plans for the realigned DISCOVERER, SENTRY and MIDAS programs have been completed.

2. DISCOVERER PROGRAM

a. An unsuccessful attempt to launch the first DISCOVERER satellite took place on 21 January. The ullage rockets accidentally fired during the countdown, causing a short circuit which started the guidance timer. The timer caused the separation bolts, retro rockets, and nose cone pin pullers to fire. The DISCOVERER vehicle and THOR booster suffered damage. An incident investigation committee has been established to determine the cause of the malfunction and recommend corrective action.

b. THOR 163 and the DISCOVERER vehicle scheduled for the second flight will be used for the next launch attempt in late February.

c. System checkout of flight test vehicle #3 has been accomplished, with the biomedical recovery capsule installed.

d. Biomedical capsule separation was tested, with excellent results.

e. A radiation test package will be incorporated in the payload of the third flight.

f. The Hawaiian biomedical recovery control center is now operational. A successful training exercise was carried out on 23 January. Two capsules were dropped from B-47 aircraft; both were air recovered.

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g. The UDMH engine test program is progressing in a satisfactory manner. Several technical problems were encountered, but solutions should be obtained without delay to the program.

h. All DISCOVERER ground stations were in readiness for the 21 January launch.

3. **SENTRY PROGRAM**

a. Visual subsystem components were tested as a unit. Output of the entire chain resulted in resolution of 80 lines per millimeter. The data link did not degrade the end result at this level of resolution. Moderate design changes are planned to obtain the desired resolution of 100 lines per millimeter.

b. Ferret equipment deliveries are on schedule. Flight tests of the Ferret-1 equipment yielded satisfactory results.

c. A preliminary study defined the facilities, ground support equipment and operating procedures required for nuclear auxiliary power-equipped vehicles. Maximum use of existing equipment was stressed.

d. Plans and specifications for SENTRY launch complex #1, Vandenberg Air Force Base, were completed and construction bids received.

4. **MIDAS PROGRAM**

a. The proposed MIDAS program will be undertaken in three phases:

(1) Phase I: Four ATLAS-boosted flights from the Air Force Missile Test Center (AFMTC).

(2) Phase II: Six ATLAS-boosted flights from Vandenberg Air Force Base.

(3) Phase III: Operational Missile Defense Alarm System flights from Vandenberg Air Force Base.

b. Phase I flights are planned as follows:

FLIGHT	LAUNCH DATE	ORBIT WEIGHT
1	November 1959	5,295 lbs*
2	January 1960	5,295 lbs*
3	March 1960	4,902 lbs*
4	May 1960	4,902 lbs*

* Includes 69 lb nose cap jettisoned after satellite is in orbit.

[redacted]

[redacted]

[redacted]

c. A schedule for modification of Pad 14 at the Air Force Missile Test Center (AFMTC), to meet MIDAS requirements, has been established.

d. A development contract was let with Baird-Atomic, Inc., for a second source, and approach for infrared payload components. This will not duplicate the Aerojet-General program.

e. Site selection criteria for MIDAS ground stations has been established.

5. Several problems have continued to hamper progress in the Military Satellite Program, as follows:

a. Program Instability. Lack of clear-cut program direction and timely decisions have caused serious program instability. This instability culminated in reorientation of the program in December 1958. This problem can be alleviated by early coordinated Air Force and ARPA approval of the reoriented programs.

b. Funding. This program has been largely funded on almost a month-to-month basis. This situation has resulted in considerable contractor dissatisfaction, has forced inefficient practices, and has created difficulty in financial management of the program. This problem can be alleviated by funding on a programmed basis, at least quarterly.

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