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MILITARY RECONNAISSANCE SATELLITE PROGRAM

PROGRESS REPORT

QUARTER ENDING 30 SEPTEMBER 1958

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ADVANCED RESEARCH PROJECTS AGENCY

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MILITARY RECONNAISSANCE SATELLITE PROGRAM

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QUARTER ENDING 30 SEPTEMBER 1958

Department of Defense

Washington 25, D.C.

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ADVANCED RESEARCH PROJECTS AGENCY
WASHINGTON 25, D. C.

October 30, 1958

MEMORANDUM FOR THE SECRETARY OF DEFENSE

SUBJECT: Report of Progress in the Military Reconnaissance Satellite Program During the Quarter Ending September 30, 1958

This transmits the report of progress in the Military Reconnaissance Satellite Program for the quarter ending September 30, 1958.

The Weapons System 117L has been redesignated the SENTRY Satellite System. The SENTRY System includes all the former WS 117L subsystems and facilities except the infra-red Very Early Warning Satellite System which is being conducted as a separate program.

Progress in development of each of the subsystems now comprising the SENTRY System is presented in summary format in the attached report. Highlights of major accomplishments during the quarter are included in the accompanying draft of your letter of transmittal of the report to the President.

Roy W. Johnson
Director

1 Incl
Report, subject
as above

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THE SECRETARY OF DEFENSE
WASHINGTON

October 31, 1958

Dear Mr. President:

I am forwarding herewith the report of progress in the Military Reconnaissance Satellite Program during the quarter ending September 30, 1958. This program is under the management direction of the Advanced Research Projects Agency, Department of Defense.

The Weapons System 117L has been redesignated the SENTRY Satellite System. The SENTRY System includes all the former WS 117L subsystems and facilities, except the infra-red Very Early Warning Satellite System which is being conducted as a separate program.

The first SENTRY test vehicle is scheduled for launch from Vandenberg Air Force Base on December 6, 1958. An increase in allowable payload in the ATLAS-boosted SENTRY vehicle from approximately 3,500 to 5,000 pounds has been achieved through use of higher performance fuel. Noteworthy progress was also made during the quarter in development of new and highly successful components for the ferret reconnaissance subsystem.

The biomedical program, which has the objective of reentry and recovery of a biomedical package from orbit, is progressing on schedule.

With great respect, I am

Faithfully yours,

(Signed) Donald A. Quarles
Acting

1 Incl
Report, as stated

The President

The White House

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BRIEF OF PROGRESS

During the Quarter Ending September 30, 1958

Weapons System 117L has been redesignated SENTRY. The SENTRY program reported in this issue includes all activities previously reported under Weapons System 117L, except the infra-red Very Early Warning satellite system which is being conducted as a separate program.

Progress on the SENTRY program continued on schedule during the quarterly period ending September 30, 1958. Preparations are underway to launch THOR-boosted SENTRY Vehicle No. 1 from Vandenberg Air Force Base on December 6, 1958.

Design criteria for the ATLAS-boosted SENTRY have been altered to increase total vehicle weight and on-orbit weight. A change in the type of fuel to be used in the ATLAS-boosted SENTRY has resulted in an allowable gross weight increase from 9,300 to 11,600 pounds and an on-orbit weight increase from approximately 3,500 to 5,000 pounds.

All subsystem development proceeded on schedule. All components of the auxiliary power subsystem for SENTRY Vehicle No. 1 were received and acceptance tested by Lockheed Missile Systems Division. Lockheed also received and tested all components of the guidance and control subsystem for THOR-boosted SENTRY Vehicle No. 1, and a number of components of this subsystem for THOR-boosted SENTRY Vehicle No. 2. Equipment development for the biomedical program is on schedule. Detailed plans were established for reentry from orbit and recovery of the biomedical package and an air recovery test program for this package is now underway.

Facility design of the launch complex for the ATLAS boosters at Vandenberg Air Force Base is scheduled for completion on November 15, 1958. Interim tracking and telemetry facilities were beneficially occupied at Vandenberg Air Force Base and the Naval Air Missile Test Center, California; Kaena Point, Hawaii; and Annette Island and Kodiak Island, Alaska.

TOPICAL SUMMARY

FLIGHT TEST PROGRAM

First THOR-boosted SENTRY Flight Test Scheduled for December 6, 1958

A detailed plan for the first THOR-boosted SENTRY satellite flight has been prepared and launching is now rescheduled for December 6, 1958--two weeks later than originally planned. This rescheduling will not affect the overall SENTRY program.

Final Firing Tests to be Conducted on First Vehicle in October 1958

Modification and checkout operations on the first THOR-boosted flight test vehicle were completed at Lockheed Missile Systems Division during September 1958. The vehicle was shipped from the Lockheed plant at Palo Alto to the Hazard Test Base at Santa Cruz where it will undergo hot firing tests prior to shipment in October 1958 to the launch site at Vandenberg Air Force Base.

Launching Facility being Readied

Installation of launch and blockhouse equipment for the THOR launch complex at Vandenberg Air Force Base began the week of August 18, 1958. A facility checkout vehicle is being used for installation check-out pending the arrival of the first SENTRY flight vehicle.

SATELLITE AIRFRAME SUBSYSTEM

THOR-boosted Vehicle No. 1 Completed

Final design of the first two THOR-boosted SENTRY satellite flight vehicles was completed during the quarter and equipment installation design is underway on the remaining vehicles. THOR-boosted SENTRY Satellite Vehicles No. 1 and 2 underwent modification and checkout at the Lockheed Missile Systems Division, where the spun aluminum tanks were replaced in Vehicle No. 1. Failure of a vibration absorbing bellows under extended vibration tests was remedied by replacement with a steel bellows possessing better vibration characteristics. Modification and checkout operations on THOR-boosted Vehicle No. 1 were completed in September 1958. Checkout on THOR-boosted Vehicle No. 2 is still underway.

ATLAS-boosted Vehicle to carry Larger Payload

The ATLAS-boosted SENTRY satellite vehicles were redesigned to allow for the increased payload resulting from increase in ATLAS booster performance. Better propulsion performance in the ATLAS-boosted SENTRY vehicle will also be provided by the unsymmetrical di-methyl hydrazine (UDMH) engine.

SATELLITE PROPULSION SUBSYSTEM

All JP-4 Engines for THOR-boosted Vehicles Completed

All JP-4 engines to be used in the THOR-boosted SENTRY vehicles have been completed, acceptance tested, and delivered to Lockheed by the Bell Aircraft Corporation. Performance of these engines was well within specifications.

UDMH Engine will increase SENTRY Payload

Unsymmetrical di-methyl hydrazine engines will be used in the ATLAS-boosted SENTRY vehicles. These UDMH engines will permit an increase in the gross weight of the ATLAS-boosted SENTRY vehicle from 9,300 to 11,600 pounds. Orbit weight will thereby be increased from 3,500 to 5,000 pounds. The ATLAS boosters to be used with SENTRY vehicles are being strengthened to carry these higher loads.

First UDMH Engine for ATLAS-boosted Vehicle Delivered

Two full duration firings of the prototype UDMH engine during September 1958 gave evidence that engine performance was within specifications. As a result, assembly operations were completed on the first UDMH flight engine and the engine was delivered to the Lockheed Missile Systems Division.

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AUXILIARY POWER SUBSYSTEM

First Nuclear Power Unit to be Delivered January ~~1960~~ 1961

The delivery of the secondary nuclear auxiliary power unit No. 1, SNAP I (Subsystem Nuclear Auxiliary Power), to the Lockheed Missile Systems Division for ground-test was rescheduled to January 1, 1961. The programmed delivery date of 1963 for the SNAP II remains unchanged.

7

SNAP I Shielding Weight is within Boost Capabilities

A shielding feasibility study was completed by Lockheed and shielding weight requirements for SNAP I and SNAP II were found to be within boost capabilities for visual and ferret reconnaissance missions of one year duration. Further evaluation of SNAP I is being carried out as to its ability to fulfill all requirements.

Solar Battery Tests Continuing

Plans for solar battery tests in connection with the ATLAS-boosted engineering prototype testing program are proceeding satisfactorily.

GUIDANCE AND CONTROL SUBSYSTEM

All Guidance Components for THOR-boosted SENTRY have been Received

Work on the guidance and control subsystem for the THOR-boosted SENTRY program is on schedule. All components of the guidance and flight control subsystem for the THOR-boosted SENTRY vehicle No. 1, and a number of components for the THOR-boosted SENTRY vehicle No. 2, were received by Lockheed and subjected to acceptance and checkout testing. An attitude damping unit for controlling the satellite in orbit will be used for the first time on the THOR-boosted SENTRY vehicle No. 2.

VISUAL RECONNAISSANCE SUBSYSTEM

Airborne Film Processor Tests Highly Successful

The present configuration of the airborne film processor has successfully completed a 45-day continuous life test. This design is presently planned for the first visual

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flights. It is a pre-soaked web processor type which carries a monobath developer solution on the web material. The web is brought into contact with the exposed film and processing takes place while the two are in contact. The processor does not require solution storage tanks, valves, or plumbing and gives promise of being a highly reliable item. The first model of the high-speed 35 millimeter processor for the ground station has been delivered and is being readied for testing. A development model of the film readout equipment built by the Columbia Broadcasting System for Eastman Kodak is undergoing tests at the Eastman Kodak Company. Continued test of the development model of the electronic readout equipment disclosed minor problems which are now being corrected in the design for manufacturing. Quality control has been emphasized in manufacture of scanning tubes resulting in elimination of minor problem areas. Electronic equipment associated with the film readout equipment has been packed to meet environmental requirements.

Data Link Ground Equipment Delivered for Testing

The experimental models of the operations console for tracking stations and the subsystem checkout equipment for the vehicle assembly area are completed and under test. A breadboard model of the data link used to transmit visual information from vehicle readout equipment to ground readout equipment was completed by the subcontractor and delivered to Eastman Kodak Company for test. Tests will utilize development models of airborne and ground readout equipment.

FERRET RECONNAISSANCE SUBSYSTEM

Significant Progress Made in Ferret Subsystem

Significant progress has been made during the quarter in subsystem component development and in studies essential to successful operational employment of the ferret subsystem. All components of the initial ferret satellite payload have been assembled into a breadboard model. This assembly has been successfully subjected to a series of performance checkout tests. Prototype models of this equipment are scheduled for October 1958 delivery.

Mockup of Advanced Ferret Subsystem Completed

A full scale mockup of the components of the more advanced model of the ferret subsystem was completed. This mockup is being used to study optimum placement of the components in the SENTRY vehicle for determination of satellite payload configuration. Tests of the available components of the more advanced ferret subsystem show promise.

Successful completion of a breadboard model of a magnetic tape recorder with an unusual automatic stop-start mechanism represents a significant achievement. This recorder will be used as the ferret information storage device in the SENTRY satellite.

A backward wave oscillator which will provide rapid electronic scanning of any portion of the radio frequency band desired has successfully passed environmental tests. It will be a satellite-borne component of the advanced ferret system.

One Phase of Signal Density Mapping Program Completed

One phase of the program of signal density mapping of various strategic areas of the earth was completed from information obtained from intelligence sources. The effort is directed toward plotting location and emission characteristics of known radars on maps of appropriate scale. This will provide a yardstick to confirm known radar sources and assist in correlation of newly detected sources when the flight program is initiated.

COMMUNICATIONS SUBSYSTEM

Major Communications Equipment now being Delivered

Deliveries of major items of equipment for the communications subsystem are on schedule. Equipment is being delivered to telemetry sites and tracking and acquisition stations. Shakedown tests of the downrange telemetry ship to be used in the launch program at Vandenberg Air Force Base are scheduled for October 1958. A 60-word-per-minute teletype communications check of the ground communications system is also scheduled for October 1958.

BIOMEDICAL RECOVERY PROGRAM

Mockup of Biomedical Recovery Capsule Completed

All biomedical equipment development is on schedule. A mockup of the biomedical recovery capsule has been completed. The first biomedical recovery capsule is scheduled for delivery by General Electric in October 1958. The Air Force School of Aviation Medicine is acting as technical consultant to the Lockheed Aircraft Corporation on all biomedical aspects of the capsule design and will supply and train test animals to be used in the program.

FACILITIES AND SITES

Launch Facilities

Design for ATLAS Launching Complex for SENTRY Nearing Completion

Final design of the ATLAS launch complex for launching SENTRY vehicles at Vandenberg Air Force Base is progressing. A slight delay in completion of the design will result from changes in facility design criteria. Design completion is now scheduled for November 15, instead of November 1, 1958.

Assembly Building

Missile Assembly Building Plans Finished for Review

An in-progress review of final construction plans for the guided missile assembly building was held early in September 1958. Submittal

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of completed plans and specifications incorporating all review changes is scheduled for November 7, 1958.

Tracking, Control Telemetry and Data Acquisition Facilities

Tracking Station Construction, Equipping and Occupancy Progressing on Schedule

Interim tracking and telemetry facilities at Vandenberg Air Force Base were beneficially occupied. Completion of design of the permanent test tracking facility was delayed owing to a change of criteria affecting the data acquisition and processing building. It is planned to contract for the entire station, less the data acquisition and processing building, and to contract separately for that structure.

Interim tracking and telemetry facilities were beneficially occupied at the Naval Air Missile Test Center, Point Mugu, California.

Interim tracking and telemetry facilities at Kaena Point, Oahu Island, Hawaii, were beneficially occupied and equipping was underway. The contract to complete the tracking station was awarded during September 1958.

Design of the Northwest tracking and data acquisition station at Fort Stevens, Tongue Point, Oregon, progressed satisfactorily. Completion is scheduled for October 20, 1958.

Tracking and telemetry facilities at Annette Island, Alaska, and at Cape Chiniak, Kodiak Island, Alaska, are beneficially occupied.

The New Boston Bombing Range, Grenier Air Force Base, New Hampshire, was approved as the Northeast tracking and data acquisition station. The architect-engineer for design of this station was selected in September 1958. Design will be accomplished by site and climatic adaptation of the Northwest tracking and data acquisition station plan.

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The former Naval Air Station at Ottumwa, Iowa, was approved as the site of the Central tracking and data acquisition station.

Because of recent changes in the weights of certain radars to be utilized at all tracking and data acquisition stations, redesign of their supporting structures will be necessary.

STATUS OF FUNDS

As of September 30, 1958
(in millions)

Fiscal Year 1958 and Prior Years Program	Fiscal Year 1959 Program	Fiscal Year 1959 Obligations
$84. 1	$215.0	$51.8

DESCRIPTIVE DETAIL

I. Recovery Techniques for the Biosatellite Capsule.

An air recovery test program is underway, and detailed plans have been established for recovery of the biomedical package. The biomedical recovery system will operate in the following manner. On the seventeenth pass over Alaska, a ground signal to the satellite programmer will command the satellite (orbiting in a horizontal nose-first attitude) to pitch down on the eighteenth pass. The biomedical recovery capsule is then separated from the SENTRY satellite. A set of two spin rockets is fired and the biomedical recovery package is spun at approximately 60 rpm for stabilization. The retro-rocket is then fired. After the retro-rocket is fired, a set of two additional spin rockets is fired to counteract the original rotation, and the biomedical recovery capsule is permitted to right itself aerodynamically. The retro-rocket and spin rockets are jettisoned simultaneously after burnout. During reentry into the atmosphere, the biomedical capsule is protected by ablative material. At approximately 50,000 feet a reflective parachute is opened. The remainder of the ablative material is jettisoned and chaff is released. A radio beacon of greater than 50-mile range and a flashing light, visible for 10 miles during the day and 50 miles at night, are turned on. Lockheed RC-121 (Constellation) radar aircraft track the descending package and guide Fairchild C-119 aircraft to the recovery point. Recovery is made by the C-119 at or below approximately 10,000 feet by means of a cable loop with hooks which snag the parachute canopy, after which a winch will draw the collapsed parachute and capsule into the aircraft. In the event that air recovery is not successful, surface vessels will provide backup for water recovery.

II. Propulsion Test Vehicle Assemblies.

Early in the planning of the SENTRY program, a decision was made to fabricate two propulsion test vehicle assemblies to provide a test vehicle backup. The soundness of this decision was demonstrated during September, when two failures occurred in propulsion test vehicle assembly units. The first failure involved the explosion of a high pressure helium sphere on the third hot firing of the unit. This sphere was constructed of laminated fiberglas and had previously been subjected to two hot-firing cycles without incident. Fiberglas spheres were used as an interim measure pending completion of titanium spheres which will be used on the final vehicles. Damage resulting from the explosion was minor, and the propulsion test vehicle assembly was repaired for resumption of the propulsion test vehicle assembly test program. The second failure occurred in the second propulsion test vehicle assembly on September 19, 1958, when an explosion and burning of the engine damaged the unit beyond repair. Only minor damage was sustained by the test stand and repairs are underway. An evaluation of cause for the failure has not been completed. Another vehicle is being assembled using spare components.

III. Redesign for Increase in Orbit Weight.

Design criteria for ATLAS-boosted SENTRY vehicles were altered to increase the total weight and on-orbit weight. Increases in ATLAS booster performance above that anticipated and increased performance of the SENTRY vehicle resulting from use of unsymmetrical di-methyl hydrazine as a fuel allowed an increase in the gross weight of the SENTRY vehicle from 9,300 to 11,600 pounds. The allowable increase in the gross weight of the SENTRY vehicle permits an increase of the on-orbit weight from approximately 3,500 to 5,000 pounds. ATLAS boosters to be used with SENTRY vehicles are being strengthened to carry these higher loads.

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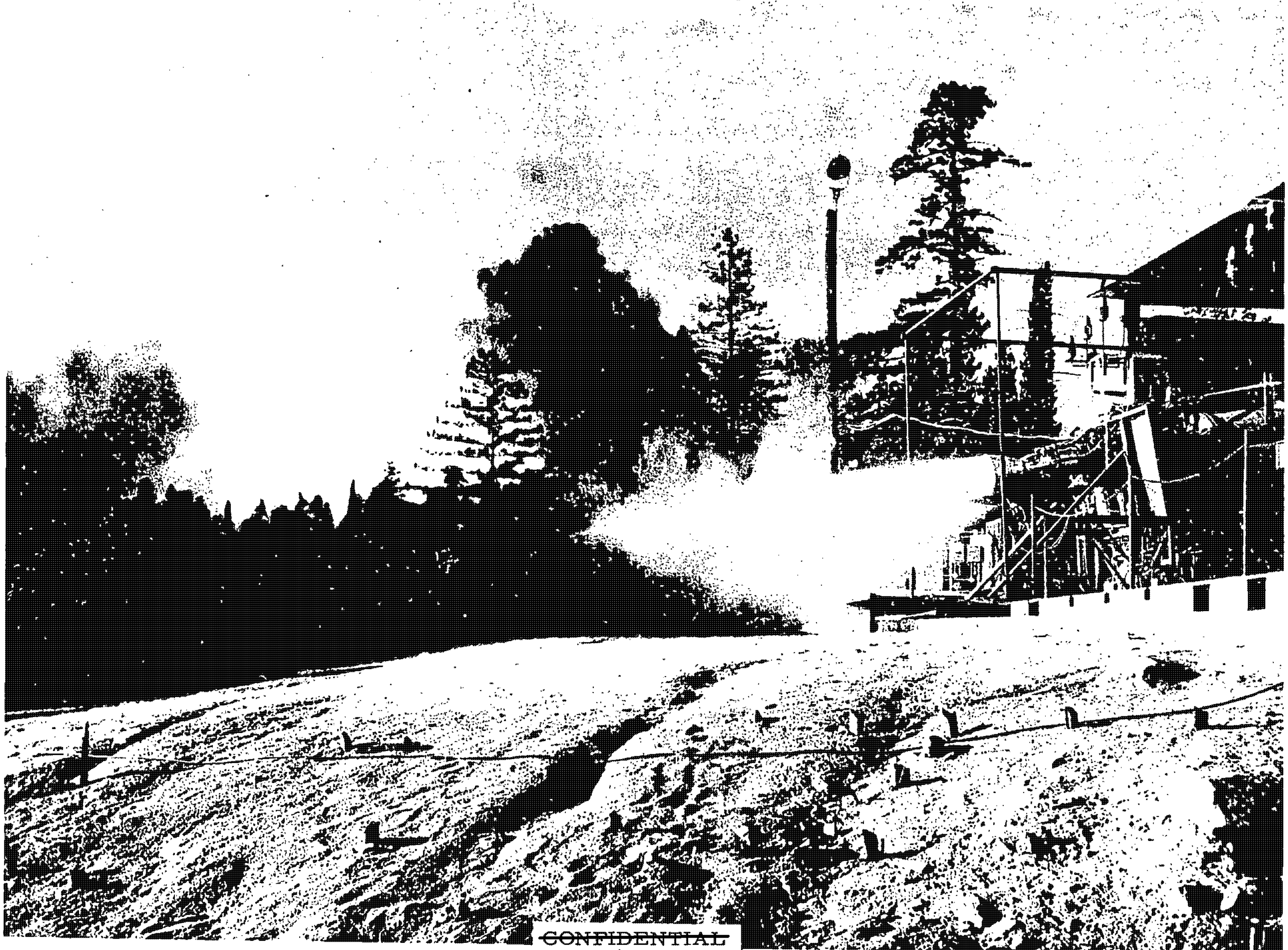

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FIGURE 1. THOR-boosted vehicle engine serial No. 1 undergoing one of the ten hot firings conducted with the engine during September 1958 at the Santa Cruz Test Base.

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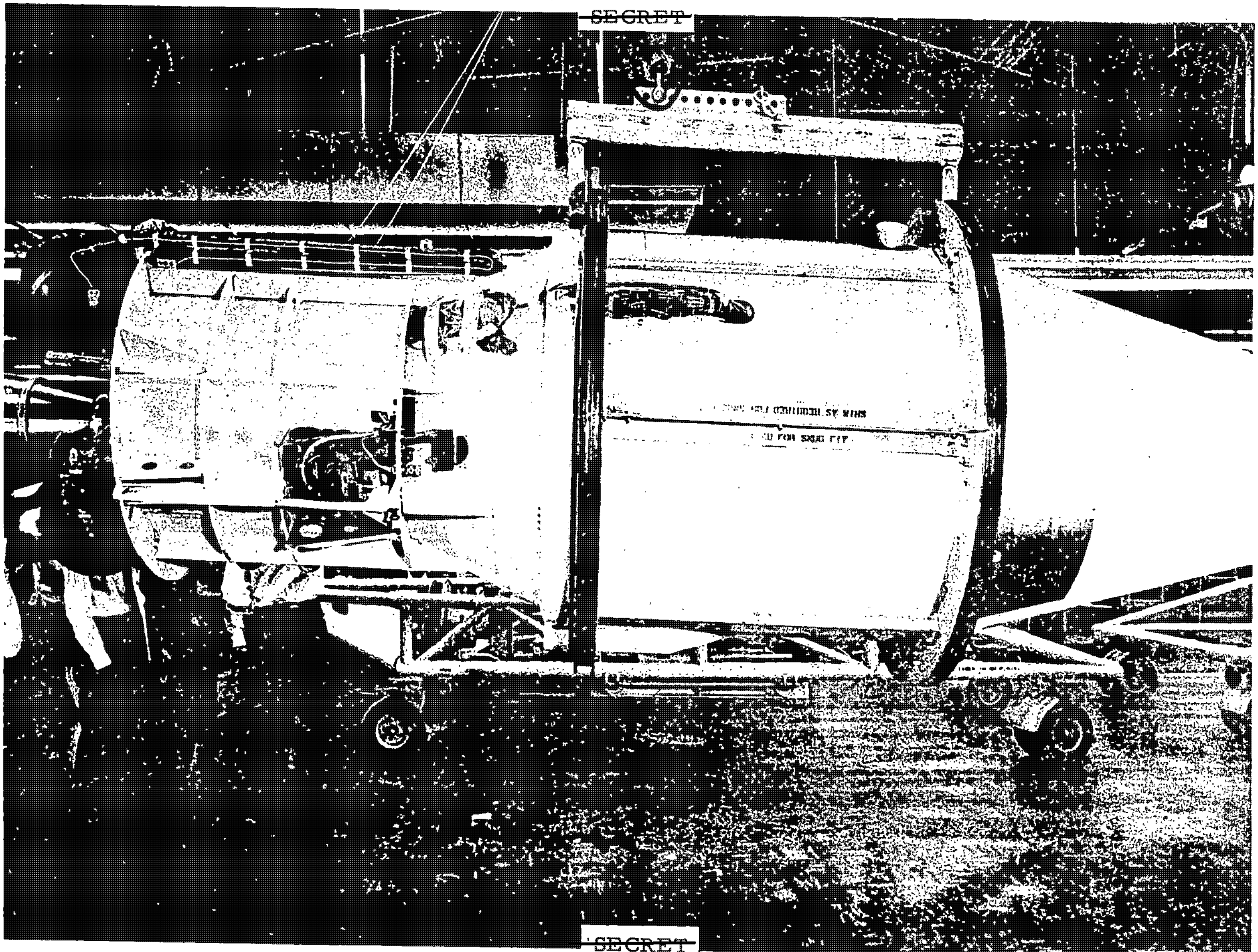

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FIGURE 2. First SENTRY flight test satellite is shown here on a transporter-erector. Final design of the first two THOR-boosted SENTRY flight vehicles has been completed, and equipment installation is now underway on the remaining vehicles.

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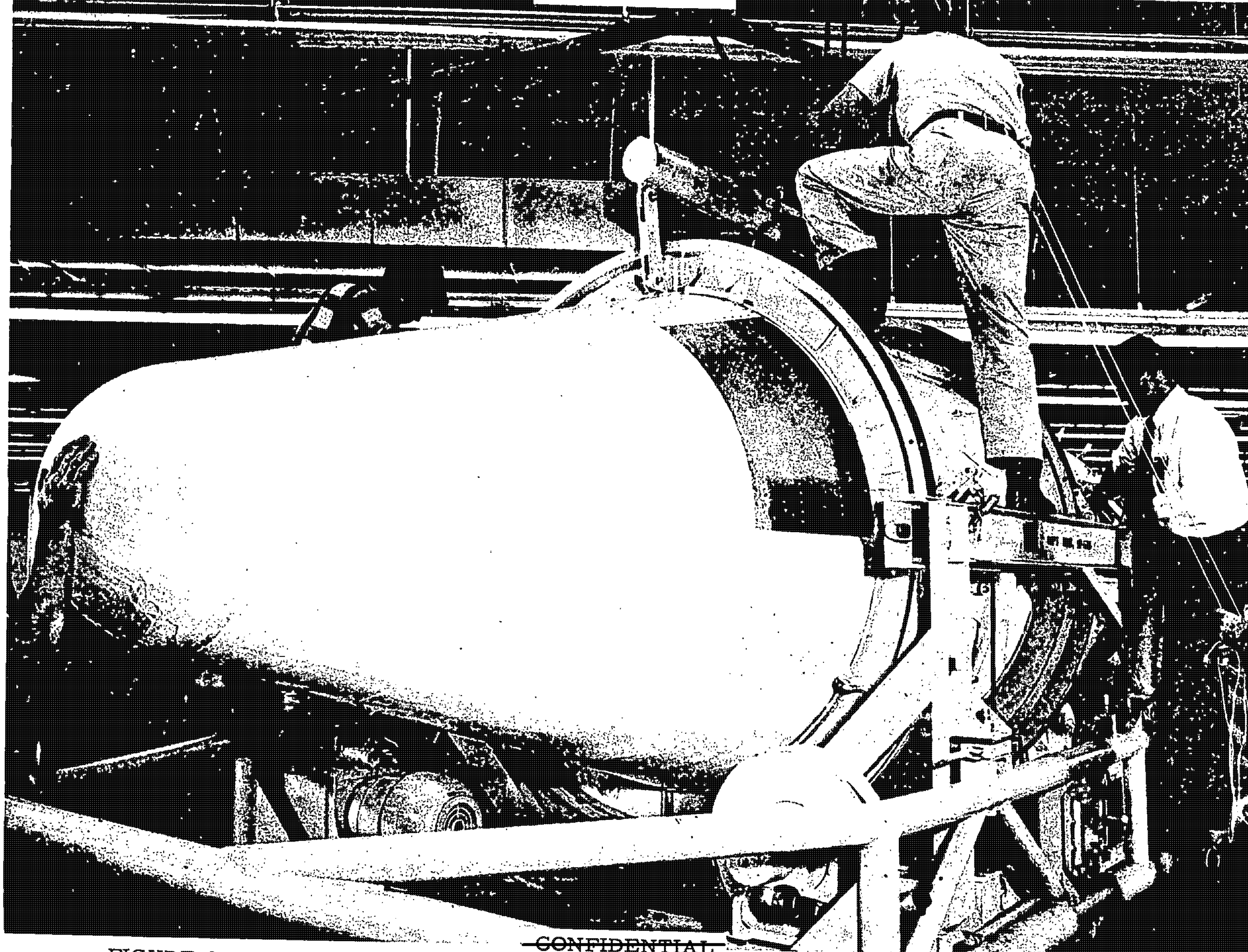

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FIGURE 3. First SENTRY flight test satellite ready for shipment to the Santa Cruz Test Base.

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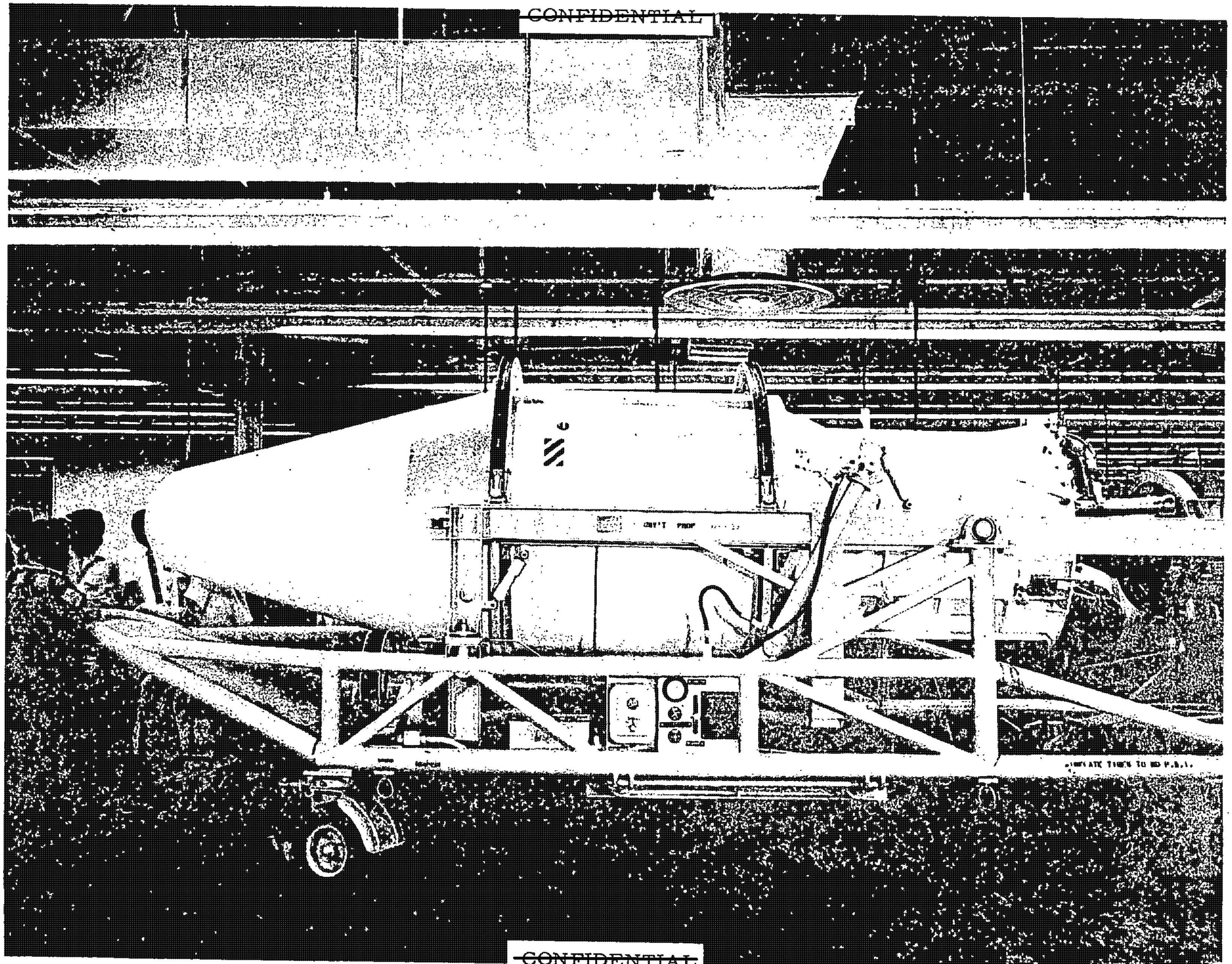

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FIGURE 4. Side view of the first SENTRY flight test satellite on its transporter-erector.

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