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"Instrumentation Report on Nike Apache
Flights 14.194 CA and 14.195 CA"

by R. W. Conrad and J. R. Lease

dated December 1964

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ABSTRACT

This report, issued by GSFC's Sounding Rocket Instrumentation Section, contains all pertinent engineering data on actual flight instrumentation and describes the flight of two Nike Apache payloads. The purpose of these flights was to gather scientific information on electron temperature and density, as well as wind profile. Intention of the report is to illustrate the function and performance of instrumentation supplied by this Section and not to present an analysis of either data or vehicle performance.

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INSTRUMENTATION REPORT FOR NIKE APACHE

FLIGHTS 14.194 CA AND 14.195 CA

By

R. W. Conrad

and

J. R. Lease

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SUMMARY

This report is one of a series issued by the Sounding Rocket Instrumentation Section. It contains pertinent engineering data on actual flight instrumentation, and documents the flight preparation of Nike Apache payloads 14.194 CA and 14.195 CA.

The purpose of the flights was to gather scientific information on electron temperature and density, as well as wind profile.

It is the intention of this report to illustrate the function and performance of instrumentation and telemetry equipment and not to present an analysis of either scientific data or vehicle performance.

Author →

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INSTRUMENTATION REPORT FOR NIKE APACHE
FLIGHTS 14.194 CA and 14.195 CA

INTRODUCTION

The purpose of Nike Apache Payloads 14.194 CA and 14.195 CA was to compare the electron density profile with the wind profile and to measure electron temperature. Electron temperature and density were measured by the Langmuir probe technique during the ascent portion of the trajectory. The wind profile was measured by the vapor trail technique on the descent portion of the trajectory.

Nike Apache Flights 14.194 CA and 14.195 CA were fired from Wallops Island, Virginia, on 8 and 7 October 1964 respectively.

PERSONNEL

Dr. L. G. Smith and Mr. J. F. Bedinger represented Geophysics Corporation of America; Dr. Smith was responsible for the telemetry and instrumentation portions of the payload, and Mr. Bedinger was responsible for the sodium and trimethylaluminum (TMA) payloads. Messers. R. W. Conrad and J. R. Lease, representing NASA/GSFC, provided range support. Mr. Roger Navarro was the Wallops Island Range Project Engineer.

RESPONSIBILITIES

Sounding Rocket Instrumentation Section conducted the integration tests and provided only field support for the launchings.

PAYLOAD

The payload consisted of experiment, instrumentation, telemetry, an antenna system, and pyrotechnics, all of which were supplied and installed by GCA.

EXPERIMENTATION

Both payloads (see Figures 1 through 5), supplied by GCA, consisted of two principal sections. The Langmuir probe, magnetometer, and baroswitch were located in the conical nose cone and a 14-inch cylindrical section. Quadraloop antennas and an explosive umbilical were mounted on the cylindrical extension.

Vapor experiments were contained in separate cylindrical canisters. The sodium canister, housing the solid sodium chemicals, was 14-3/8 inches long, whereas the liquid trimethylaluminum (TMA) canister was 18-5/8 inches long. Each experiment (sodium and TMA)

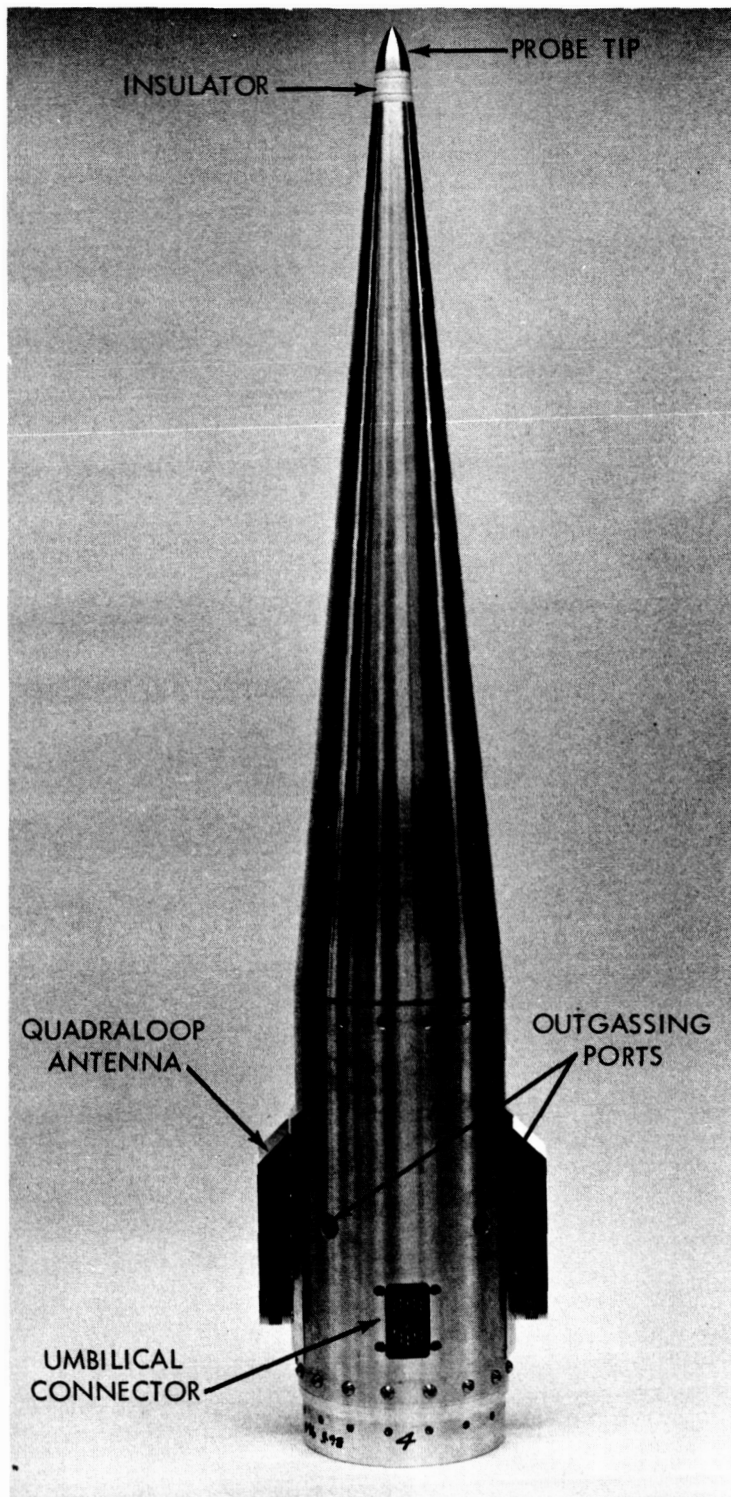


Figure 1. Instrumentation Sections for Payloads 14.195CA or 14.195CA Assembled for Flight.

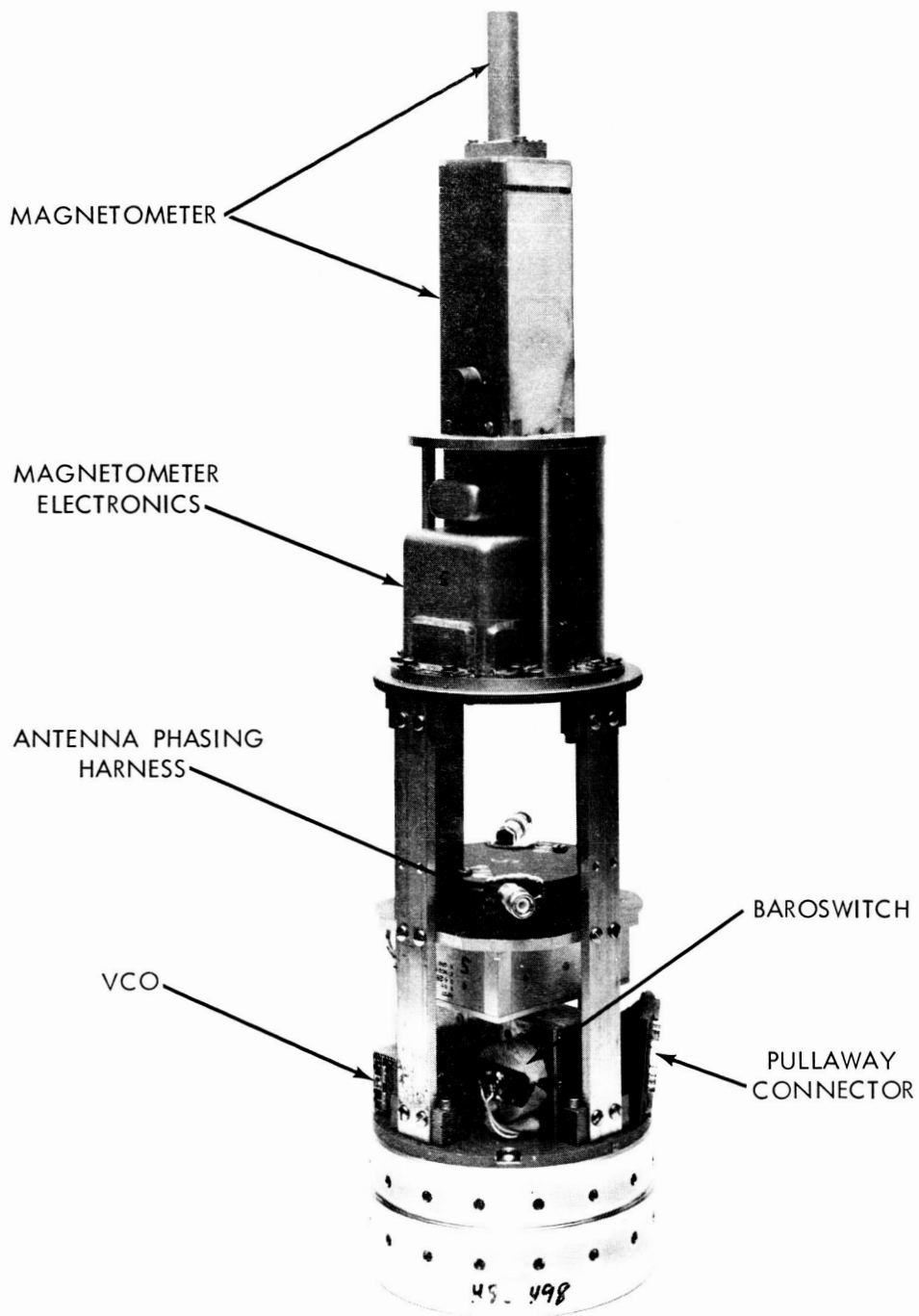


Figure 2. Exposed Payload showing Instrumentation, Experiment, and Telemetry.

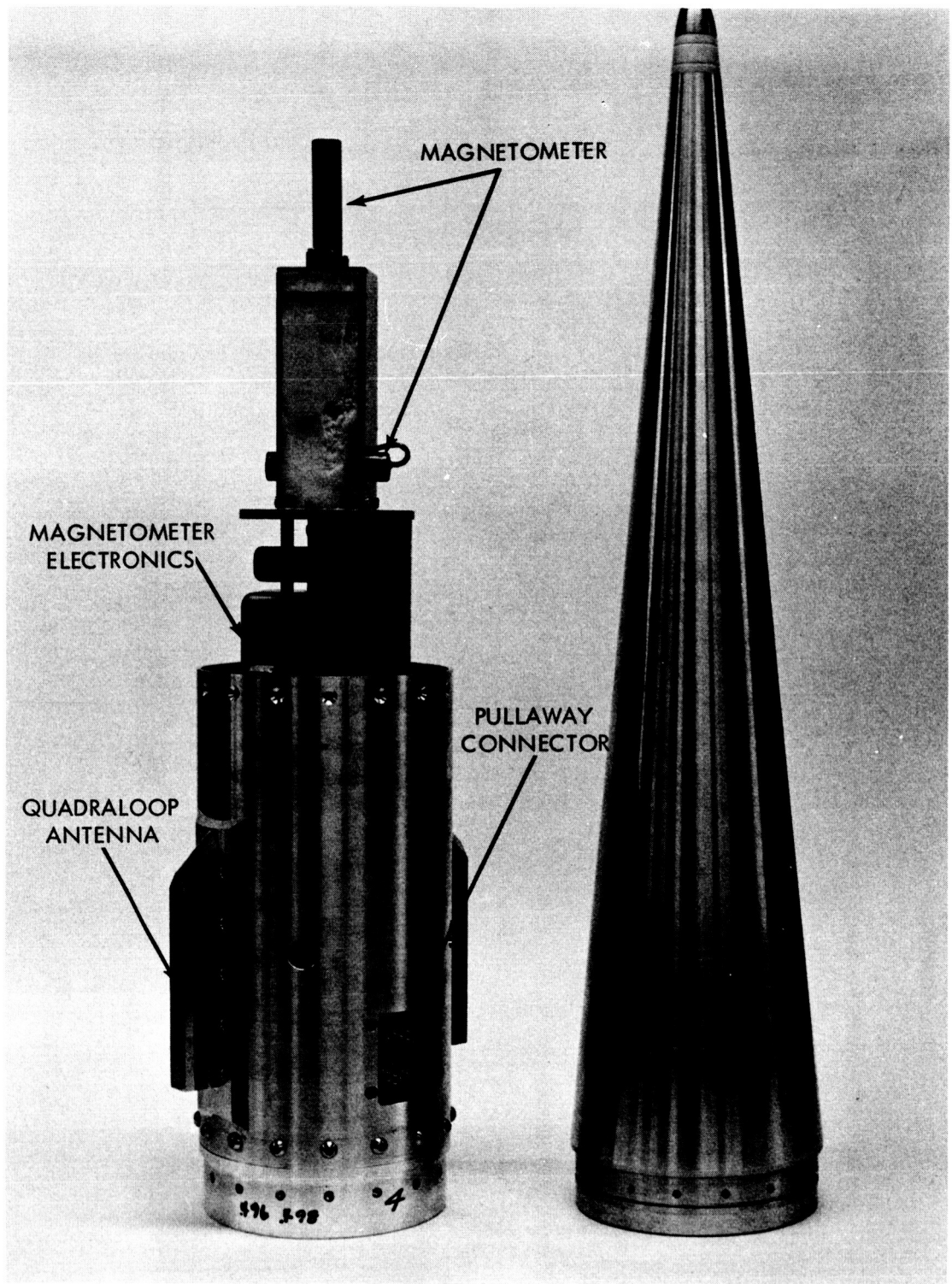


Figure 3. Typical Payload with Nose Cone detached.

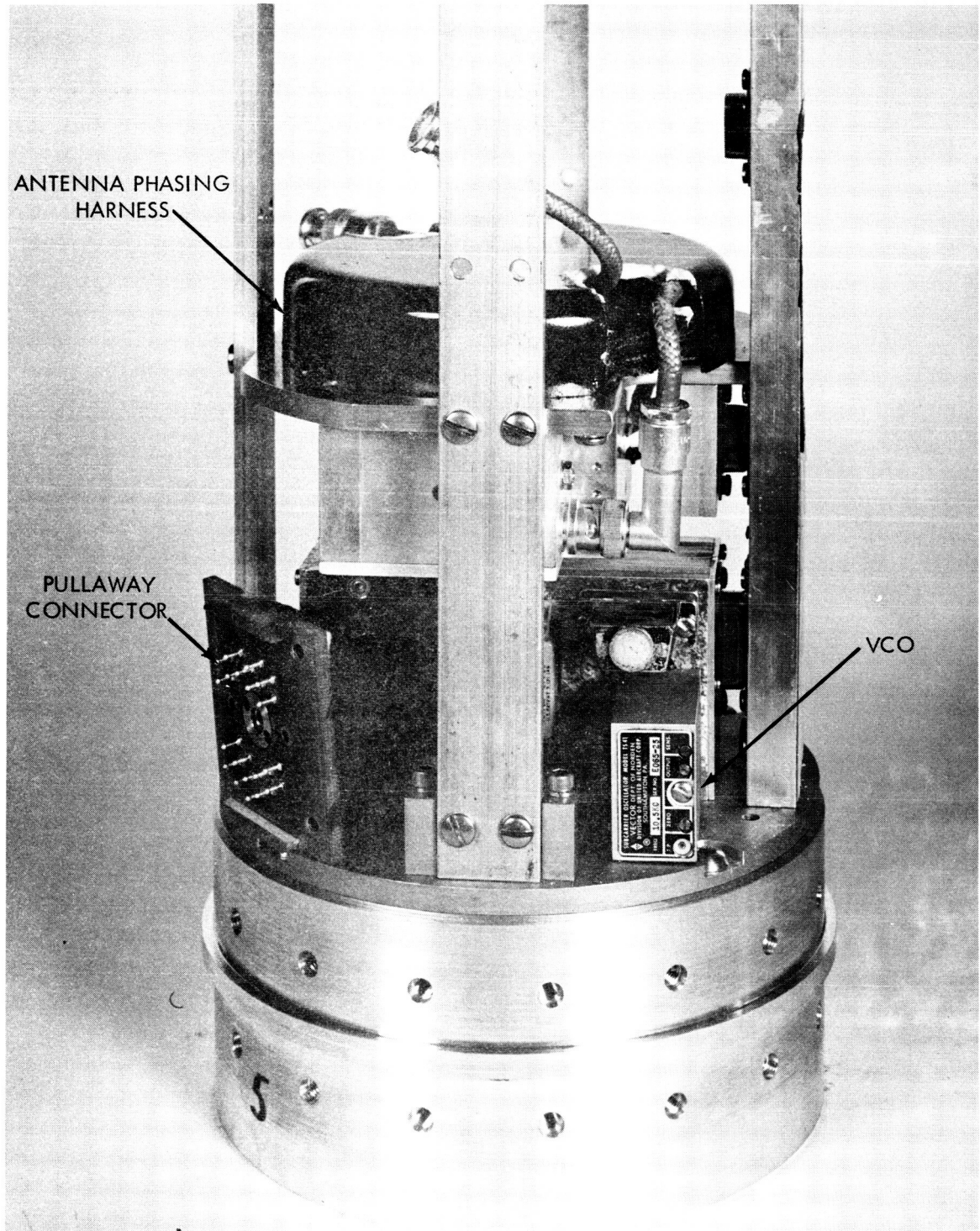


Figure 4. Base of Payload.

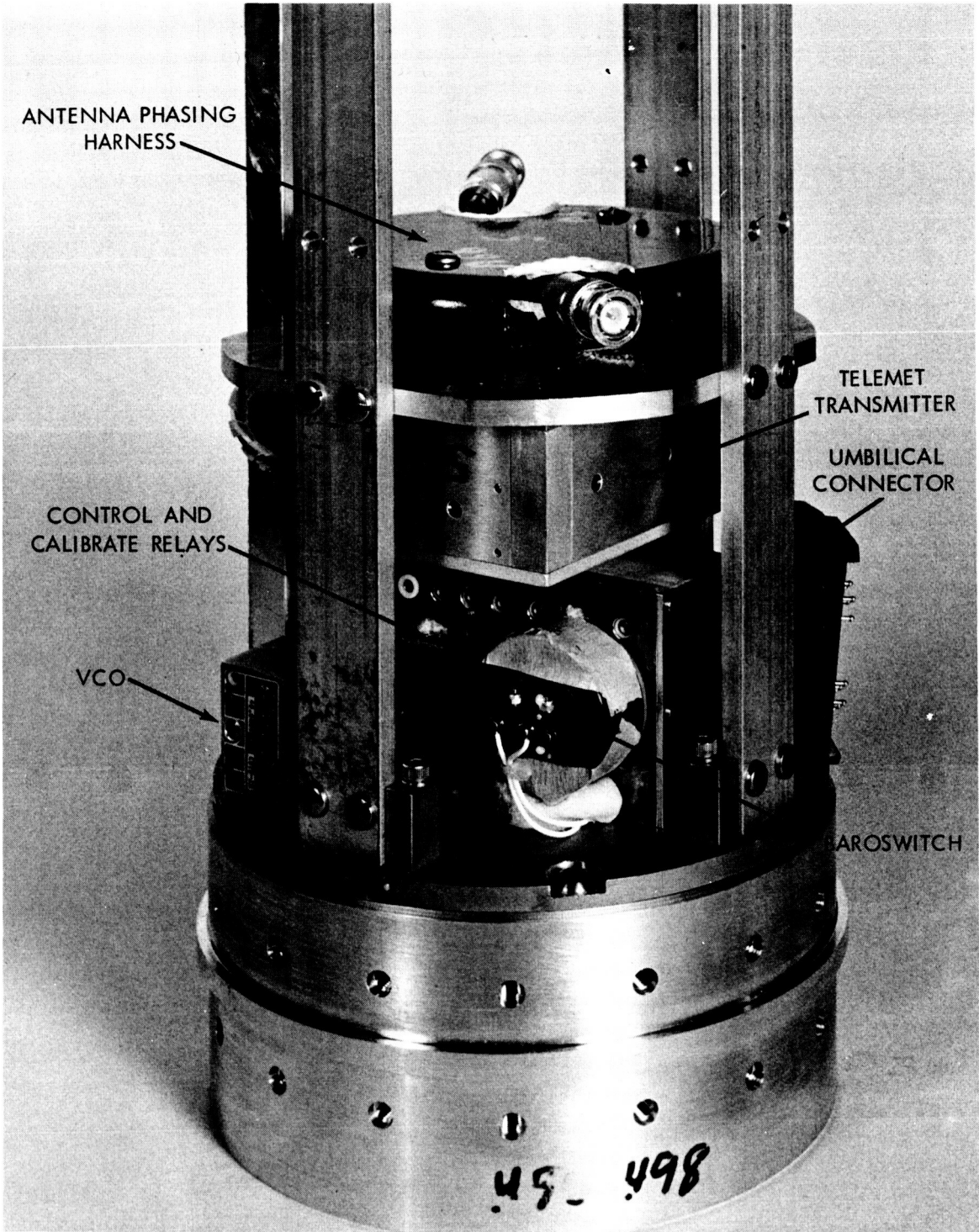


Figure 5. Base of Payload rotated 180°.

contained its own 11-inch instrumentation canister, housing experiment timers and explosive umbilicals. The sodium experiment was contained in Nike Apache 14.194 CA and was identical to many previous sodium vapor payloads, whereas the TMA payload, designated Nike Apache 14.195 CA, was being launched for the first time.

TELEMETRY

The telemetry transmitter used was a Telemet, 2-watt, FM/FM carrier with an RF link of 244.3 mcs.

Data channel allocations for both payloads were as follows:

FREQ (Kcs)	DEVIATION (%)	IRIG CHANNEL	FUNCTION
40.0	± 15	C	*Langmuir Probe
10.5	± 7 1/2	12	**Lateral Magnetometer and Baroswitch

* A 500-cps signal, equal to about two percent of band edge voltage, was mixed with the probe sweep data, and had the appearance of intermodulation.

** Baroswitch operation was added to magnetometer data causing a DC offset when the switch closed at 75,000 feet.

Telemeter video deviation for payload 14.194 CA was measured at ±130 kcs peak and for payload 14.195 CA, was measured as ±125 kcs peak. When the VCO's are set up for approximately equal signal-to-noise ratios, the 40-kcs VCO deviated the transmitter ±112 kcs and the 10.5-kcs VCO deviated the transmitter at ±38 kcs. Instantaneous peak transmitter deviation occasionally exceeded the aforementioned values whenever the mixed signals were at the same maximum simultaneously. No video distortion was noted on either payload.

Payload 14.194 CA G-timer was programmed to release the sodium vapor at T +180 seconds. Payload 14.195 CA G-timer was programmed to release the TMA vapor at T +251 seconds. In both payloads, redundant G-timers were flown, adjusted to operate 10 seconds after the primary G-timer. (NOTE: The telemetry signal was expected to be lost while sodium vapor was being ejected from the payload.) This results from the metallic portion of the sodium vapor clouding and/or coating the Quadraloop antenna during vapor release.

ANTENNA SYSTEM

Two Quadraloop antennas were mounted on the 14-inch cylinder and were used to radiate telemetered information to the ground stations.

PYROTECHNICS

Figures 6 and 7 illustrate the overall wiring diagrams for both the sodium and TMA payloads. Contained within these schematics are the pyrotechnics used in these payloads. The vapor payloads were considered to be very dangerous pyrotechnics and had to be handled with extreme caution.

MECHANICAL LAYOUT

Payload configuration for Nike Apaches 14.194 CA and 14.195 CA are illustrated in Figures 8 and 9, respectively. Note that the only physical difference between the two configurations is that the TMA canister is 4-1/4 inches longer than the sodium canister.

INTEGRATION

Telemetry integration checks and tests for both payloads were conducted at GSFC's Beltsville facility. In addition, the pyrotechnic circuits were checked. All checks and tests were normal with no malfunctions or problems.

Following a successful integration on 25 September, the payload was packed and transported to the Wallops Island launch facility.

FIELD OPERATIONS

R. W. Conrad and J. R. Lease arrived at Wallops Island on Tuesday, 29 September 1964. Telemetry payloads for Nike Apaches 14.194 CA and 14.195 CA were checked out using GSFC Telemetry Station A. All tests were satisfactory.

The TMA vapor did not arrive until late in the afternoon on Wednesday, 30 September, too late for a twilight launch. Nike Apache 14.194 CA was scheduled to be launched first, although GCA desired to launch the TMA experiment first since it was untried. Dr. Davis scheduled two of his payloads, 14.158 GE and 14.159 GE, to be launched 10 minutes after the vapor Nike Apaches, to study possible correlation between wind and magnetic field. (For information pertaining to Nike Apache Flights 14.158 GE and 14.159 GE, refer to Instrumentation Report X-671-64-302.)

Possibility of an evening launch was cancelled at the 1300Q weather briefing due to low clouds over camera stations (Dover, Delaware; Andrews AFB, Maryland; Dam Neck, Virginia, and A.P. Hill, Virginia; see Figure 10.)

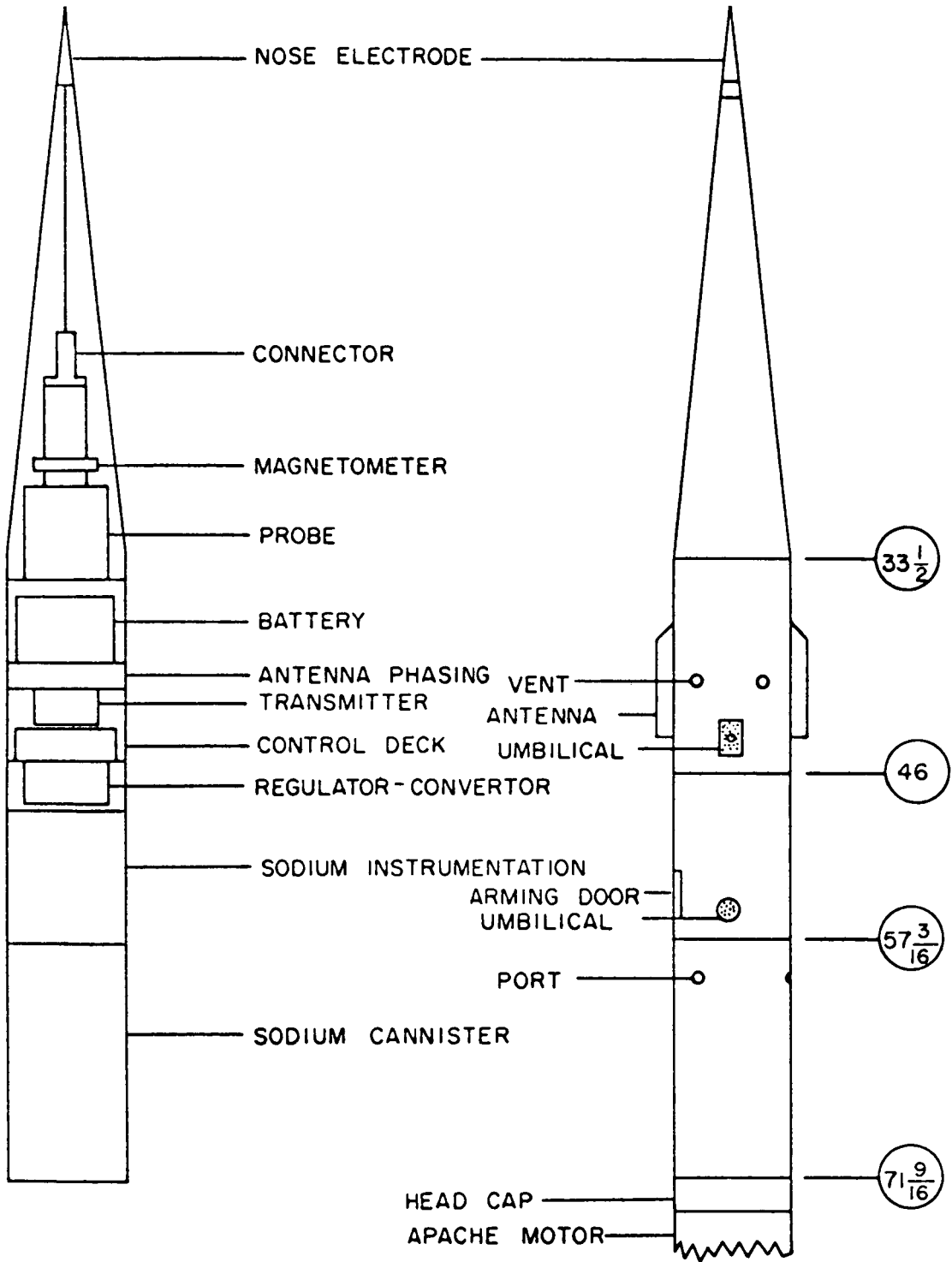


Figure 8. Nike Apache Flight 14.194CA Payload Configuration

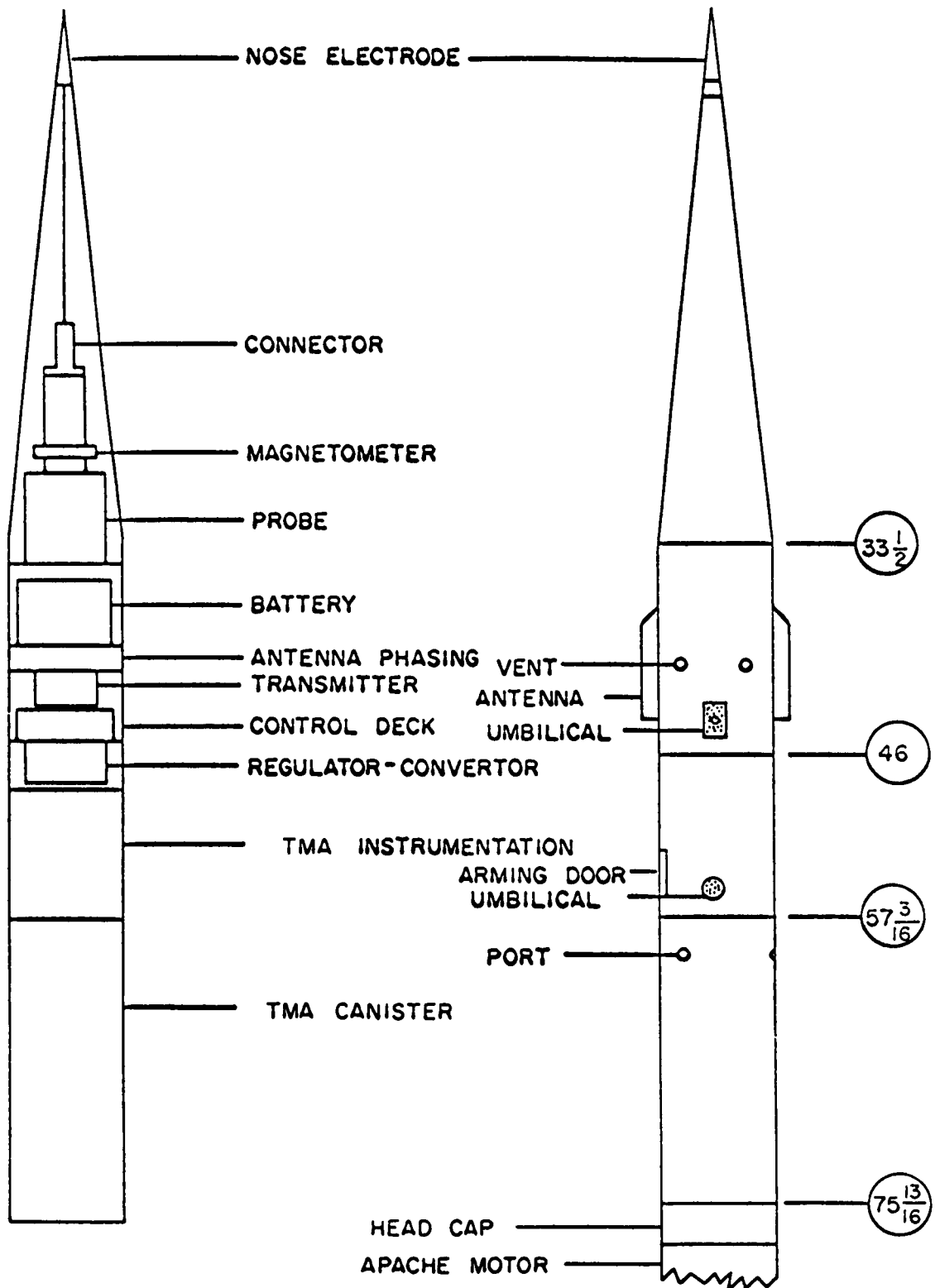


Figure 9. Nike Apache Flight 14.195CA Payload Configuration

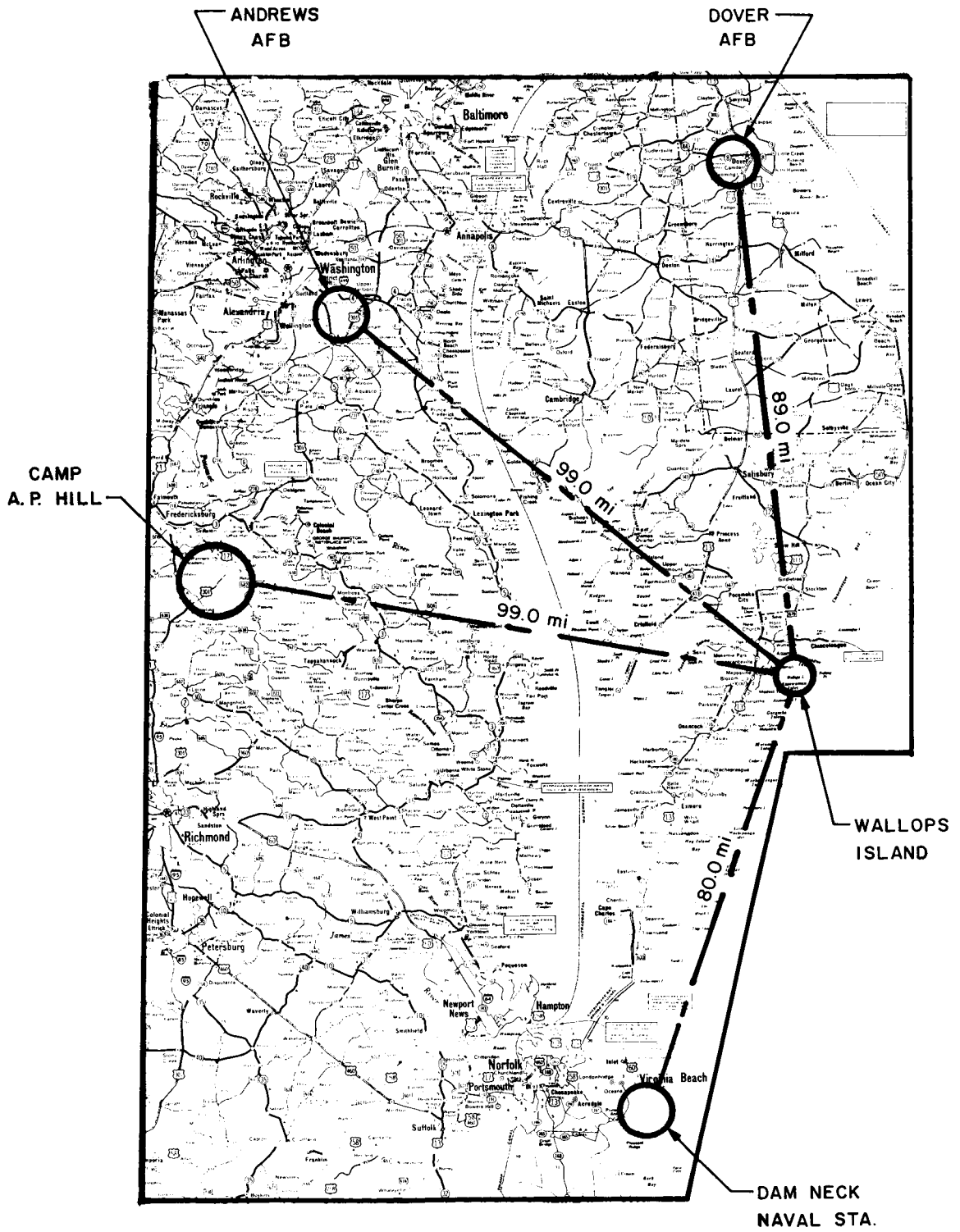


Figure 10. Location of Camera Sites.

Launching of the coordinated Nike Apaches, rescheduled for the following morning, was cancelled at the 2000Q weather briefing, also for excessive cloud coverage. Thursday night-Friday morning launches were probable and scheduled.

These launchings were cancelled at Thursday's 1400Q weather briefing. The TMA payload arrived this date and was then scheduled for launching before the sodium payload.

A practice countdown was started at 1400Q on Friday, 2 October. The countdown proceeded through the horizontal checks before being scrubbed at 1600Q due to weather conditions.

Launches were attempted and cancelled on October 3, 4, 5, and 6 due to weather problems.

Wednesday (7 October), morning launch was cancelled due to cloud coverage at the camera sites, at T -5 minutes. All checks on Nike Apaches 14.195 CA and 14.158 GE (accompanying) were completed.

Countdown for an evening launch on Wednesday commenced and Flight 14.195 CA was launched at 1904Q. Preliminary analysis of data received indicated that the data was good (according to Dr. Smith of GCA). Accompanying experiment aboard Nike Apache 14.158 GE was unsuccessful as the rocket's second stage did not ignite.

Sodium vapor Flight 14.194 CA was launched on Thursday, 8 October at 0623Q. Telemetry level was good until sodium release, resulting in a loss of signal for 1 minute 48 seconds. Accompanying Nike Apache Flight 14.158 GE was launched as scheduled.

HORIZONTAL AND VERTICAL CHECKOUT PROCEDURES

Instrumentation pre-checks and horizontal and vertical tests were conducted at Wallops Island. No major problems were encountered. However, since accompanying Nike Apache's 14.158 GE and 14.159 GE were to be fired ten minutes behind these payloads (respectively), special checkout procedures were required to ensure no interference between payloads when operated from the same launch area. This was necessary since the DOVAP airborne units required a long warm-up time, necessitating that they be ON and operating when the first payloads were launched. Transmitted carrier frequencies, and their harmonics (DOVAP 36.8/73.6 mcs, telemetry 240.2 mcs), differed enough so that no interference was noted.

Horizontal and vertical configurations are shown in Figures 11 and 12.

FIRING DATA

Associated Nike Apache Flights 14.158 GE and 14.159 GE, carrying magnetometer experiments, were flown in conjunction with the Nike Apache probe-vapor Flights 14.194 CA and 14.195 CA. These concurrent launchings checked for possible correlation of wind data with magnetic field data. The comparison flights were scheduled ten minutes apart.

Nike Apache Flight 14.195 CA, carrying the TMA, was launched on 7 October 1964 at 2304+00Z with telemetry splash at 2310+48Z. Sodium vapor Nike Apache Flight 14.194 CA was launched on 8 October 1964 at 1023+00Z with telemetry splash at 1029+36Z.

Nike Apache 14.195 CA payload experienced no telemetry dropouts. Telemetry from the Nike Apache 14.194 CA payload was very weak between T +3 minutes 50 seconds and T +5 minutes 38 seconds, corresponding to the sodium vapor release period. Splash occurred at 6 minutes 36 seconds.

Data was recorded by Wallops Island Main Base telemetry stations and GSFC ground stations A and C. Recorded data (tapes) have been sent to R. W. Conrad at GSFC's Beltsville facility.

CONCLUSION

Instrumentation and rocket performance for both flights were satisfactory. Preliminary indications were that the Langmuir probe operated properly and should yield good electron temperature and density data.

For Flight 14.194 CA, the sodium vapor, released near apogee, formed an oblong, glowing, pinkish-orange cloud, well defined against a cloudless sky (at Wallops Island), with only slight illumination from the moon in its crescent phase. The vapor cloud, its shape altered by the effects of upper air winds, remained visible at Wallops Island for more than 10 minutes. Optical conditions were good at three of the four optical stations located within a 100-mile radius of Wallops Island, with only the Dam Neck Naval Training Station (Virginia) site reporting obscuring cloud cover.

The TMA, released during the descent portion of Flight 14.195 CA, formed a conical, glowing, bluish-green cloud, sharply defined against a cloudless sky (at Wallops Island), with only slight illumination from the moon in its crescent phase. The vapor, changing shape in response to upper air winds, was visible at Wallops Island for more than 15 minutes. Optical conditions were good at three of the four optical stations, with only the Dam Neck Training Station (Virginia) site reporting obscuring cloud coverage.

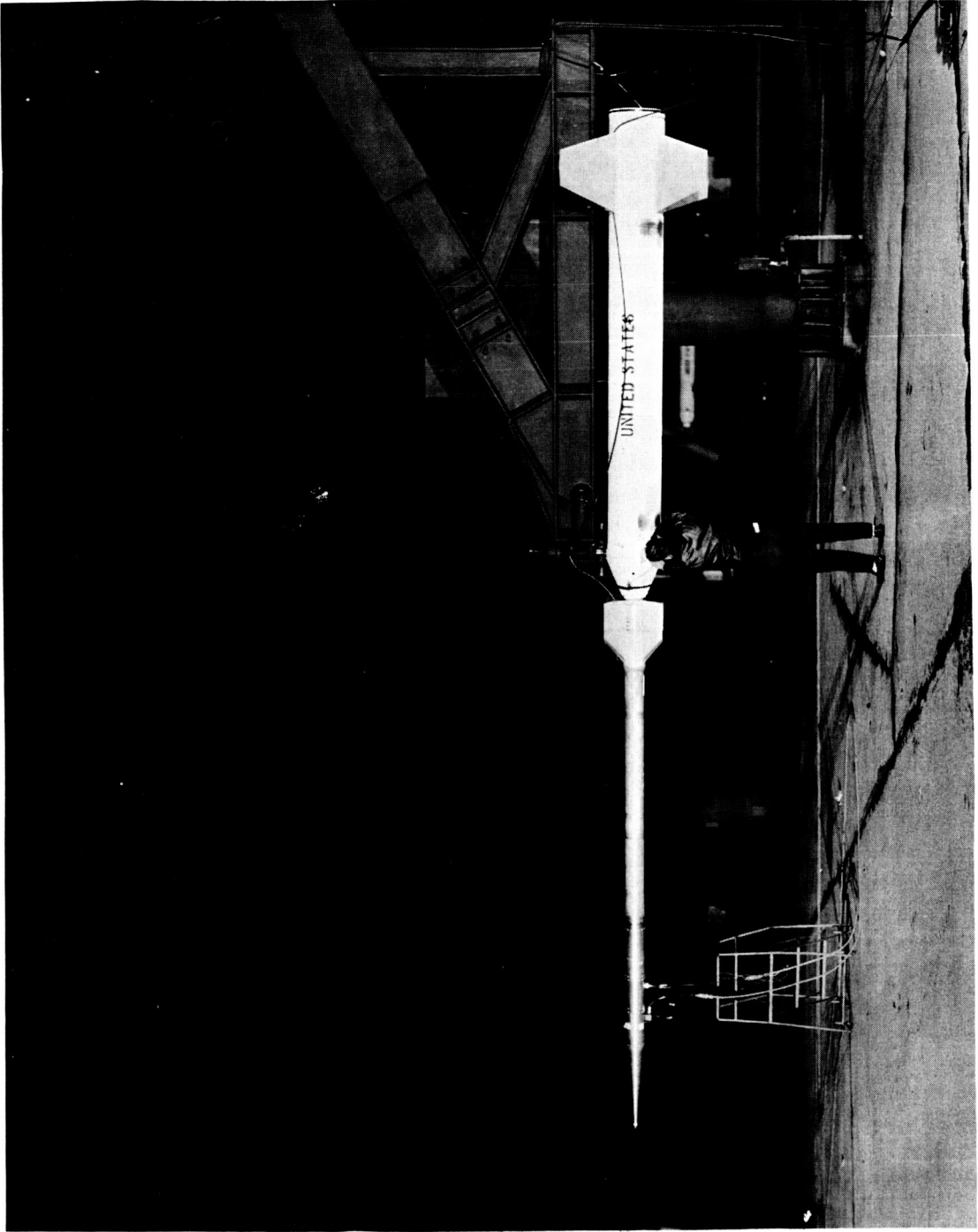


Figure 11. Nike Apache Flight 14. 195 GE in the Horizontal Position

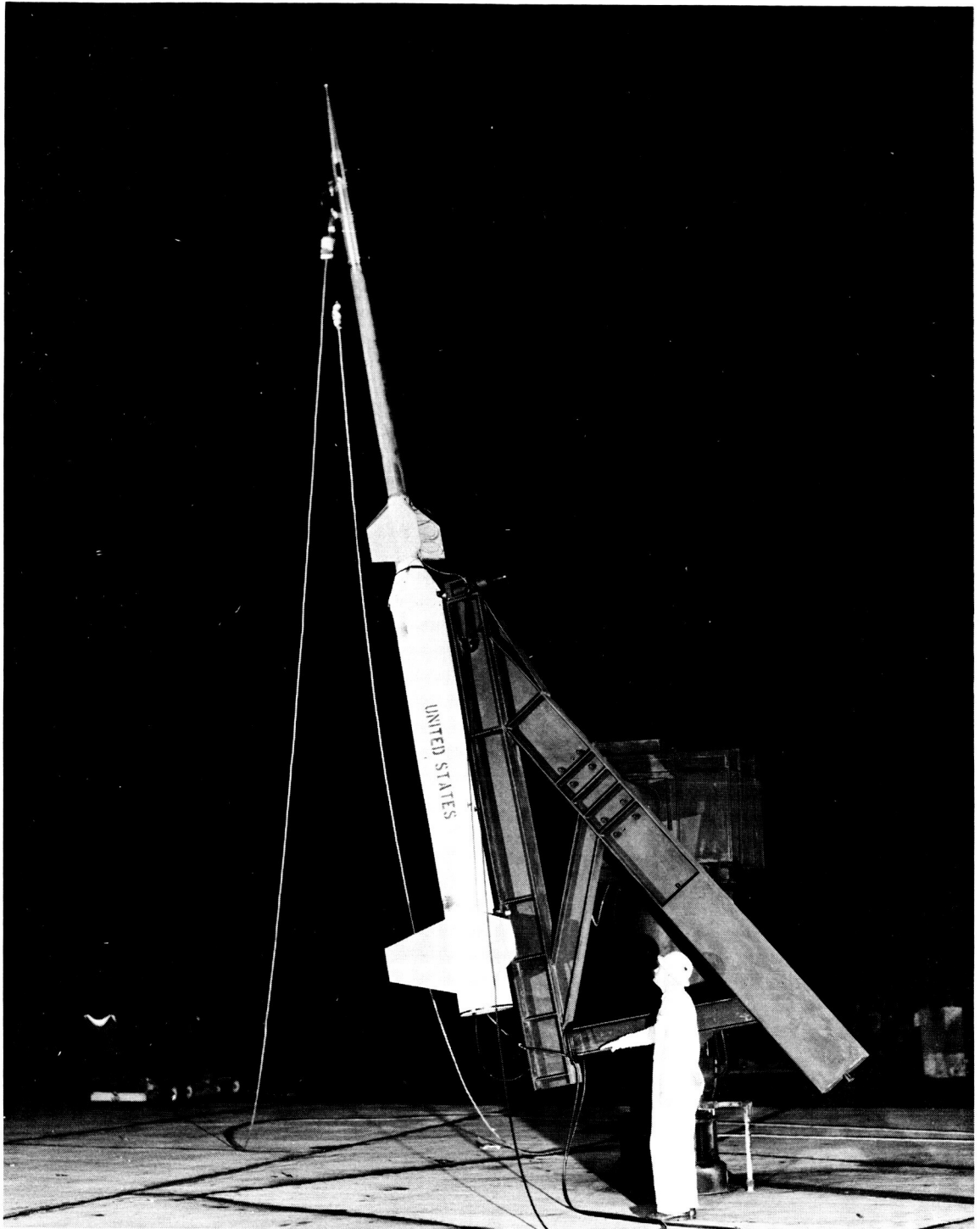


Figure 12. Nike Apache Flight 14.195 GE in the Vertical Position