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THE THOR HISTORY

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ABSTRACT

This history is intended as a quick orientation source and as a ready-reference for review of the Thor and its systems. The report briefly states the development of Thor, summarizes and chronicles Thor missile and booster launchings, provides illustrations and descriptions of the vehicle systems, relates their genealogy, explains some of the performance capabilities of the Thor and Thor-based vehicles used, and focuses attention to the exploration of space by Douglas Aircraft Company, Inc. (DAC).

PREFACE

The purpose of The Thor History is to survey the launch record of the Thor Weapon, Special Weapon, and Space Systems; give a systematic account of the major events; and review Thor's participation in the military and space programs of this nation.

The period covered is from December 27, 1955, the date of the first contract award, through May, 1963.

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Contract Award

The Douglas Aircraft Company was awarded the research and development contract for the Thor intermediate-range ballistic missile (IRBM) Weapon System 315A (WS-315A) on December 27, 1955.

Background

The United States Air Force had been given the responsibility for intercontinental ballistic missile programs, and later, for IRBM programs as well. The ICBM programs were proceeding favorably, but such extended-range (5,000-mile) missiles were still years away from being operational. Just over the horizon, Red Russia was brightening the sky with mushrooming thermonuclear experiments, and developing rocket propulsion systems capable of carrying the lethal payloads over very great distances.

The United States had an immediate deterrent force, the Strategic Air Command (SAC), but it was a question whether bombers alone would be sufficient to keep Red Russia in check. Some weapon within easy retaliatory range was needed. The deterrent missile would have to be capable of hitting a target 1,500 nautical miles away, and its reflex action had to be fast--15 minutes from the start of the countdown.

The nominal range of 1,500 nautical miles excluded effective deployment in continental North America. The range limitation posed the problem of obtaining international agreements which would permit the overseas deployment of the weapon system.

In an atmosphere of military urgency and intense international concern, bold thinking and correct decisions had to be made quickly to overcome the many problems. Such decisions required not only confident but experienced minds.

Basic Organization and Objectives

Douglas was selected because it had a background of missile experience which started in 1941, and a record of accomplishments which inspired confidence.

Associated with Douglas in the project under the over-all direction of the Ballistic Missile Division of the ARDC were the following contractors:

> Rocketdyne Division of North American Aviation Corporation, for the propulsion system.
>
> A. C. Spark Plug Division of General Motors Corporation, for the guidance system.
>
> General Electric Company, for the nose cone.
>
> Sandia Corporation, for the warhead.

The United States Air Force placed contracting responsibilities under the Ballistic Missile Office of the Air Materiel Command. The Ramo-Wooldridge Corporation through its Guided Missile Research provided technical direction. Douglas, as associate contractor, was given the responsibility for fabricating the airframe, developing the ground-support equipment, and integrating the system.

Basic Developmental Philosophy

As associate contractor, Douglas had to coordinate, not only with other associate contractors, but also with the diverse activities of hundreds of vendors and subcontractors.

New research and development concepts had to be evolved. It was customary to develop the missile first, and then introduce the ground-support equipment as each piece was needed. Such development was inexpensive and very safe, both in the attainment of the final design and the preservation of reputations--but, it would take this nation five or more years to do the job. The gravity of the international situation demanded a compressed, tight schedule.

A concept was evolved to meet the development problem. It was called "concurrency." One of its strongest advocates at that moment of history was Bernard A. Schriever (at that time Major General) in command of the USAF, Ballistic Missile Division.

"Concurrency" was the bold philosophy of doing all things necessary to be ready for the operational use of the system while the weapon was still under development. If the risk was properly calculated, years were chopped off the schedule--if not, the men who chanced it had placed their careers on the chopping block.

The development had to be done quickly. The program was clearly on a "maximum risk" basis. This meant that the first objective was gross performance, and that total operational reliability could only be secondary.

Needed scientific or engineering "breakthroughs" had to be done within the year. This posed problems. For example, how can you tell an inventor to invent by a forecast date? Or, how can you tell him that there is no time allowed in the schedule for a mistake?

One decision that was made early in the program was to freeze the missile configuration design; another, was to intensify the development and testing program. These two decisions, in conjuction with a well-coordinated team of contractors, made it mandatory to design and manufacture right the first time. It meant constructing facilities while the components they would test were still on the drawing boards.

Even the ground-support equipment (GSE) was designed and placed in volume production so that it would be available as the missile approached operational status. The ground-support equipment and the missile were designed to be transportable in the C-124 and C-133, in order to expedite overseas deployment.

With the need for speed important, the United States Air Force, relying heavily on the extensive Douglas missile design and production experience, decided to manufacture the first Thor with production tooling, skipping the customary prototype stage.

Douglas and the United States Air Force jointly financed a static test firing facility for the IRBM at Sacramento, California. The site was leased, with an option to buy, from Aerojet General Corporation. The static test firing permitted the checking out and testing of the precise missile systems as an integrated unit without expending a missile.

Although Thor posed problems of a nature and magnitude never before encountered, their solutions under a tight time schedule contributed greatly to company prestige in the missile field.

Early Research and Development Launches

On October 26, 1956, just 10 months after the contract was signed, Douglas delivered the first Thor missile.

It was on January 25, 1957, only 13 months from the contract date, that the first Thor stood on the pad at the Air Force Missile Training Center (AFMTC), Cape Canaveral, Florida. Everyone enjoys reporting a success. However, the first Thor malfunctioned. Just as it lifted from the pad, the liquid oxygen start tank ruptured. Yet, short as the flight was, it was not a total failure. Scientific equipment recorded data which proved that the basic missile concept was valid.

Early firings of the "crash" program were chiefly concerned with research and technological investigations in order to achieve the initial operational capability of a tactical system within the shortest time. It was the fifth missile, Serial Number 105, that accomplished the first completely successful flight. Soon successes began to eclipse the so-called "failures."

Missile Serial Number 109 proved we could deliver the IRBM punch. The high acceleration flight pushed downrange more than 2,000 nautical miles. It was Serial Number 113, with the new inertial guidance system, that gave an excellent performance in directing the missile to its target.

The series of Thor missile research and development firings from Cape Canaveral yielded information vital to all of the nation's ballistic missile programs.

Figure 1 is a photograph of an early R & D launching. Also, see the footnote[1] below.

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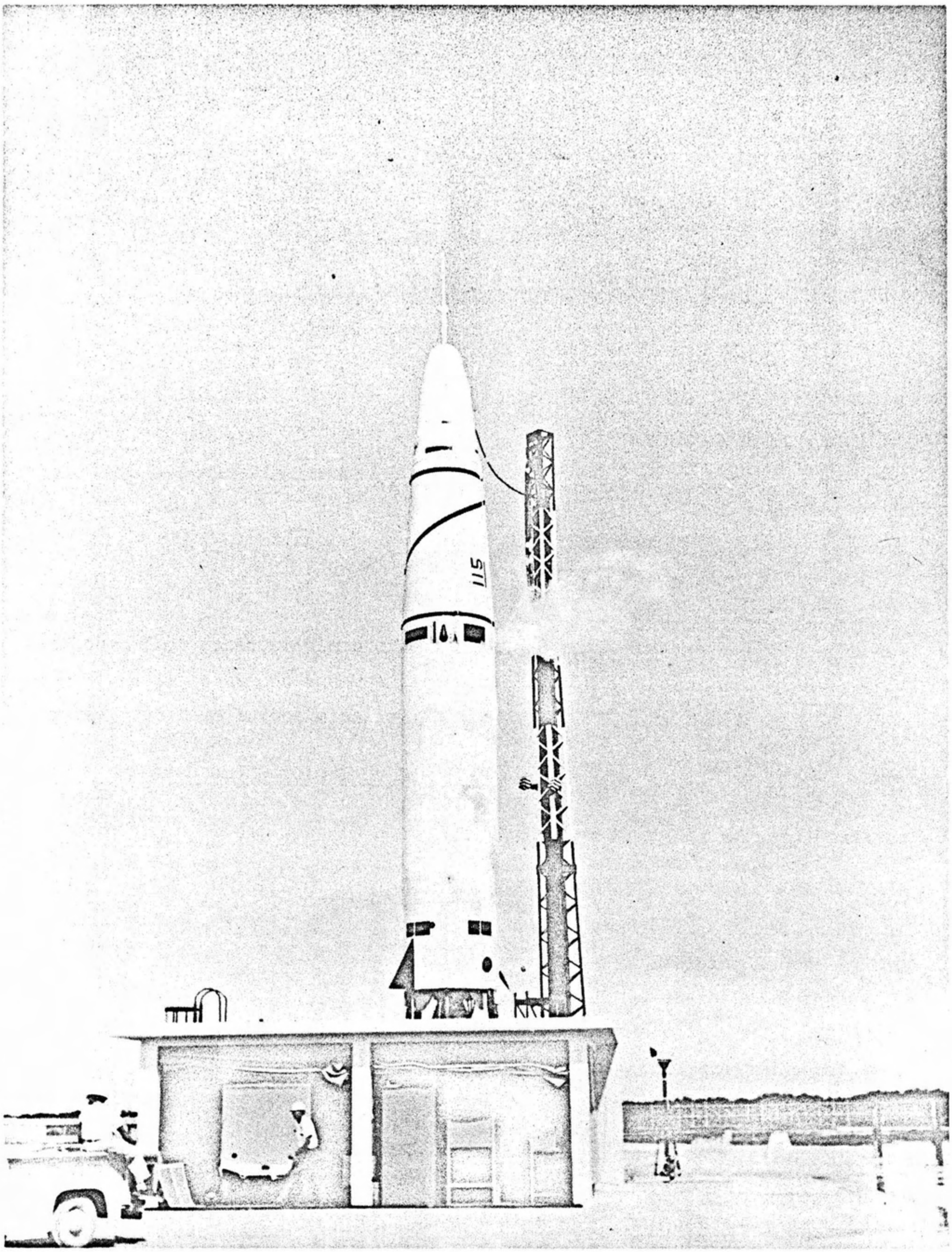
[1]At the reader's option, the reading of this text may be coordinated with the various recapitulations and illustrations in the Appendix of this history. These visual aids and data pertain to: models, missiles, boosters, space vehicle systems, programs, payloads, and satellites or probes.



R & D MISSILE PREPARES FOR LAUNCH

FIGURE 1

Transition to ICBM with Space Capabilities--Multi-Stage Vehicles

The Thor IRBM aided in the development of the ICBM program in many ways. It also aided in development of this nation's space program.

For example, the United States Air Force needed a reliable booster to test a newly developed ablative nose cone at ICBM re-entry distances and speeds. This scientific and technical inquisitiveness led to three Advanced Re-entry Test Vehicle (RTV) launchings. On April 23, 1958, the first attempt was made to launch the two-stage vehicle, designated as Thor Able. It malfunctioned, but those launched on July 9 and July 23 of that year were successful. The nose cones were propelled more than 5,000 nautical miles downrange with almost unbelievable accuracy. That was the first time re-entry was achieved with a full scale ICBM nose cone at the ICBM speed and range. In fact, those two special weapon system versions were the first United States ballistic missiles to achieve a surface range greater than 5,000 nautical miles.

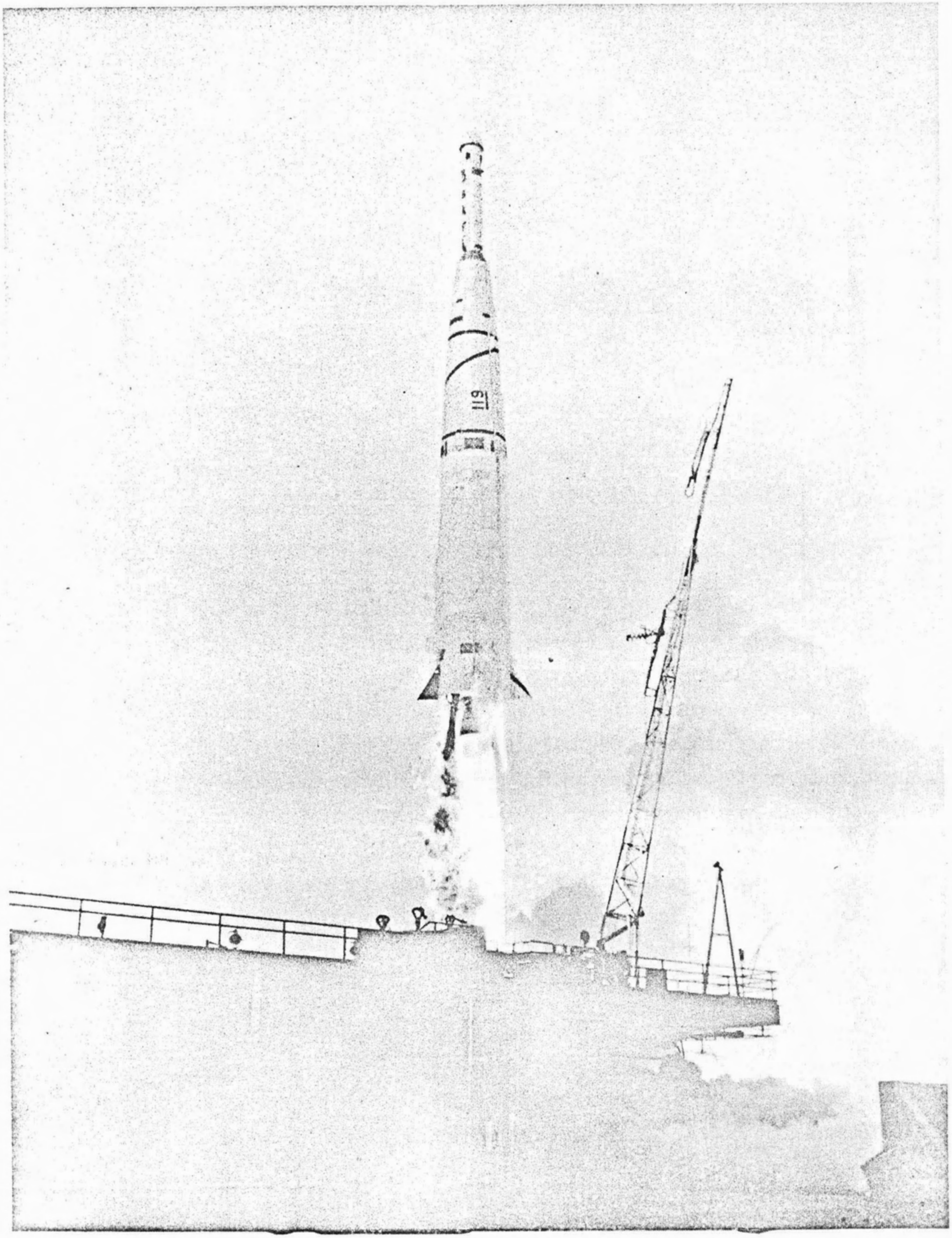
Figure 2 is a photograph of the Thor Able special weapon system.

Besides aiding in determining further development of ICBM nose cones, the re-entry test vehicles served as precursors of Thor as a booster of multi-stage space vehicles. The RTVs were not considered to be launched by the R & D weapon system (WS-315A), but by a special weapon system--Thor Able--with long range and space capabilities.

The Thor IRBM was the first stage, or booster, for a second-stage Able, a liquid-propellant propulsion system developed by the Aerojet General Corporation.

Subsequent recovery of a nose cone confirmed that the ablative technique could withstand extreme re-entry conditions.

Because of successes such as these, Thor was selected, and its program expanded to include the production of missiles and boosters having long range and space capabilities. Thor became the United States' first double-programmed system. That choice was made even before the vehicle was declared operational as a military weapon.



THOR ABLE, FORERUNNER OF THOR MULTI-STAGE VEHICLES,
LAUNCHES ICBM NOSE CONE

FIGURE 2

Initial Lunar and Space Probes

Another system evolved during the R & D phase. The United States Air Force, operating under management of the Defense Department's Advanced Research Projects Agency (ARPA), began a space probe program. On August 17, 1958, the Thor Able I, a space system of four stages, made an unsuccessful attempt to orbit the moon.

On October 11, 1958, the Thor Able I space system dispatched a Space Technology Laboratories' payload, approximately 78,000 nautical miles into the vastness of space. That was the greatest distance attained by any United States probe up to that time. The Thor Able I space system is shown in Figure 3.

Another Probe followed, but was unsuccessful due to a third-stage failure.

Initial Operational Capability--AMR and PMR

Despite those extraterrestrial activities placed upon the Thor by the space race, Weapon System 315A's R & D program had come to fruition. On November 5, 1958, the Initial Operational Capability (IOC) program commenced with the first launch attempt of the DM-18A (Douglas Model-18A).[1] Although the launching aborted, the innovation of DM-18A and the IOC program marked the end of any further R & D launches of the DM-18. The next IOC launch, November 26, 1958, was a success. System reliability began to improve sharply.

Until this time, all launchings had been conducted from the AFMTC, Cape Canaveral, over the Atlantic Missile Range (AMR).

The date, December 16, 1958, has special significance. The Thor was chosen as the initial ballistic missile to be fired from the new Vandenberg Air Force Base (VAFB) missile facility on the West coast. Furthermore, that date marked the first combat training launch (CTL) of a Thor by an Air Force

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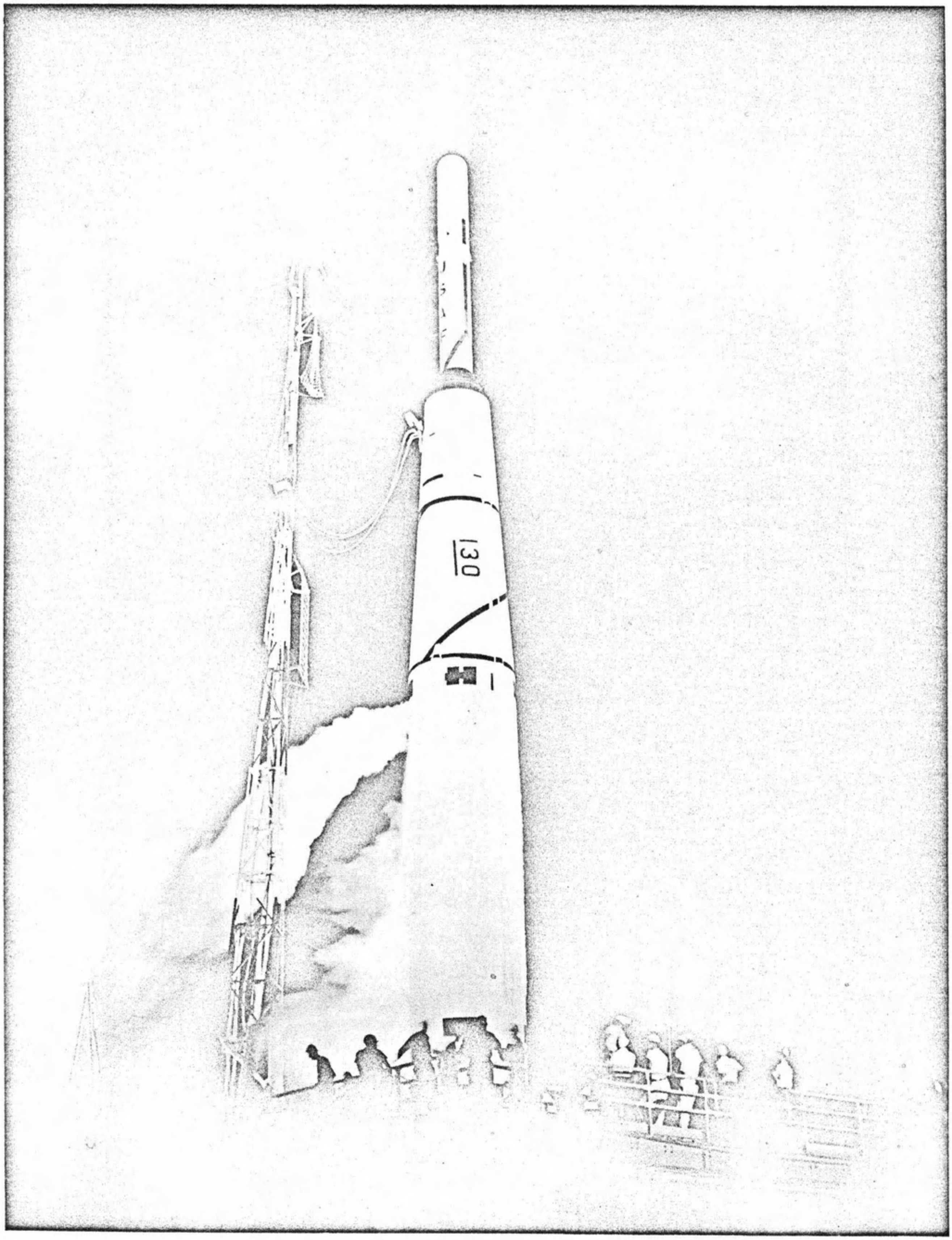
[1] Missile DM-18 is designated as XSM-75 by the Air Force; it means: Experimental Strategic Missile. The Air Force designation SM-75 means: Strategic Missile, the equivalent of Douglas' identification of the operational DM-18A.



THOR ABLE I LAUNCHES SPACE PROBE TO RECORD DISTANCE IN SPACE

FIGURE 3

Strategic Air Command crew. The launch was a success. On the same day, another successful Thor liftoff was scored at the AFMTC on the East coast.

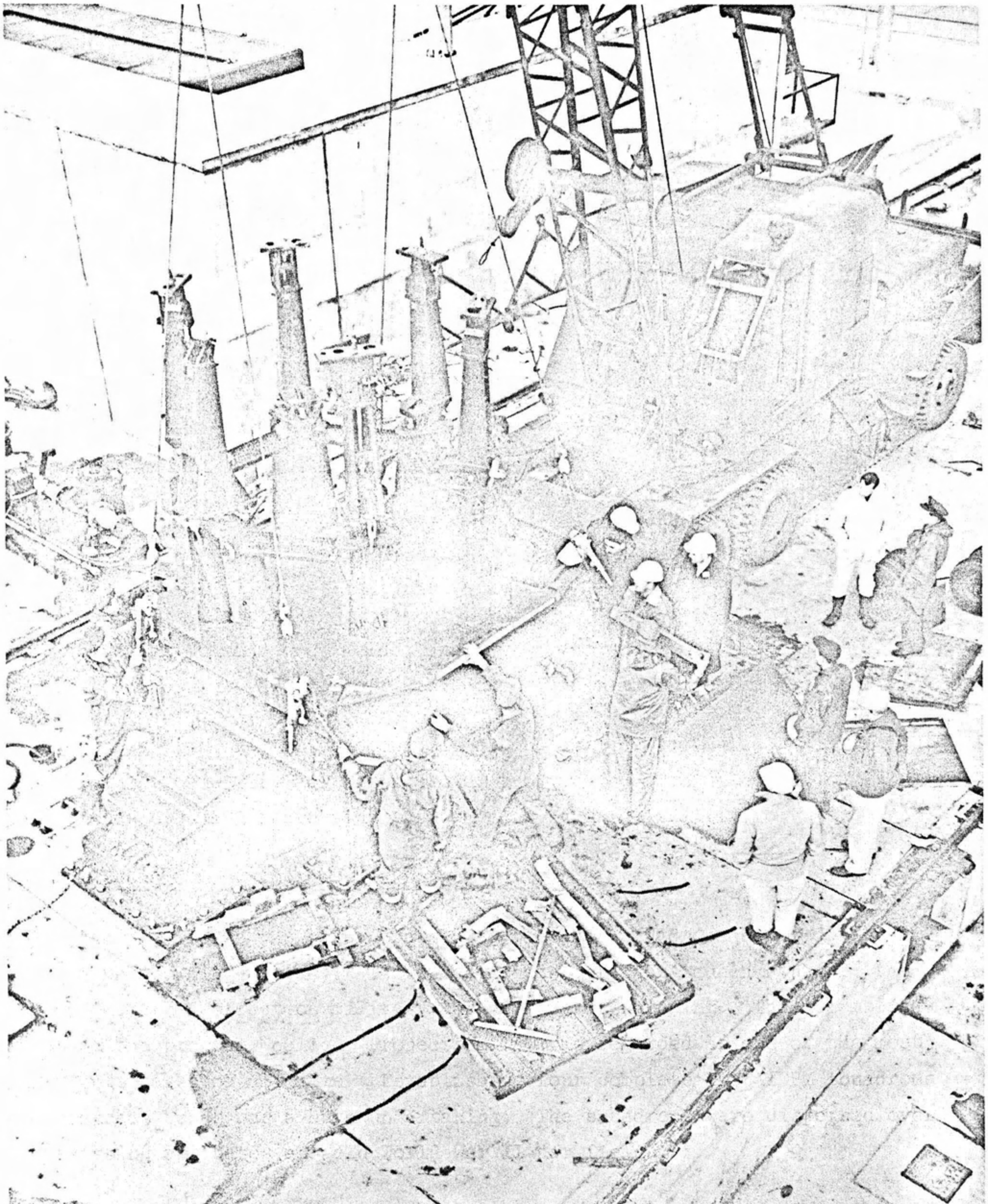
The British Royal Air Force soon joined Douglas, the the United States Air Force, in IOC and CTL Thor firings over two ranges, with the cumulative experience steadily increasing the weapon system reliability.

Overseas Deployment in the UK--Project Emily

The Royal Air Force was being trained to man Thor squadrons being deployed in the United Kingdom (UK). The establishment of Thor launch sites in the UK had a marked effect on military and diplomatic thinking. The accomplishment of the program, called "Project Emily," is regarded as one of the most difficult tasks of all time. Establishing four complete Thor IRBM squadrons at overseas bases was a huge undertaking. The squadrons were dispersed over 20 existing air bases and old World War II air fields.

The United States Air Force had contracted with Douglas for the Thor installation program in the UK. Actual work of constructing the bases was done by the British (see Figure 4) from blueprints supplied by the United States. Certain parts, such as the launch complex, limited tolerances to one-eighth of an inch both in line and level. Living quarters, both permanent and mobile, were constructed for the workmen as well for the 1,000 RAF men who made up the maintenance and launch crews at each complex. Douglas provided the design blueprints and equipped the launch complexes as they were completed. Work included installation of liquid oxygen and fuel storage and transfer systems, missile shelters, launch control trailers, erecting mechanisms, and maintenance and testing facilities. Missiles began to arrive in the UK in September of 1958. Autumn also saw the arrival of support equipment accompanied by a contingent of nearly 400 Douglas personnel as technical assistants to the British in the construction and initial operation of the bases.

Installation of 60 operational Thor emplacements at four widely separated squadron locations in the UK was completed by Douglas, USAF, and the British ahead of schedule. Thor was the first United States long-range ballistic missile deployed overseas.



THOR INSTALLATION IN THE UK WAS COMPLETED BY DOUGLAS, USAF, AND THE BRITISH AHEAD OF SCHEDULE

FIGURE 4

Combat Training Launches and the RAF

Combat training launches during the period from January 1959 through June 1961, reflected the excellent results obtained from Douglas- and USAF-trained and supported RAF crews. They scored 16 successes out of 18 launches. With each successive launch, the amount of Douglas and USAF launch crew support steadily diminished. Then complete launch operations were performed exclusively by approximately 50 RAF personnel. Thor program proficiency was clearly demonstrated by RAF crews. Although total readiness time allows for no more than 15 minutes, RAF crews launched Thors in less than that.

Here is another keyhole view of the reliability that Douglas builds into the hardware it makes. Some Thor missiles had been deployed on operational pads in the UK under the usual alert conditions for periods from 18 to 24 months. (Figure 5 is an RAF Thor.) They were returned to VAFB for combat training launches. The RAF crew's successful launching of those "old" missiles is a strong attestation of the soundness and management of the Thor Weapon System development and production programs.

Concurrent Programs

Indeed, the year 1959 reveals an excellent profile of Douglas system management conducting concurrent programs, nationally and internationally. These are, broadly speaking, some of the programs:

Manufacturing and assembly at Santa Monica.

Static and captive tests at Sacramento.

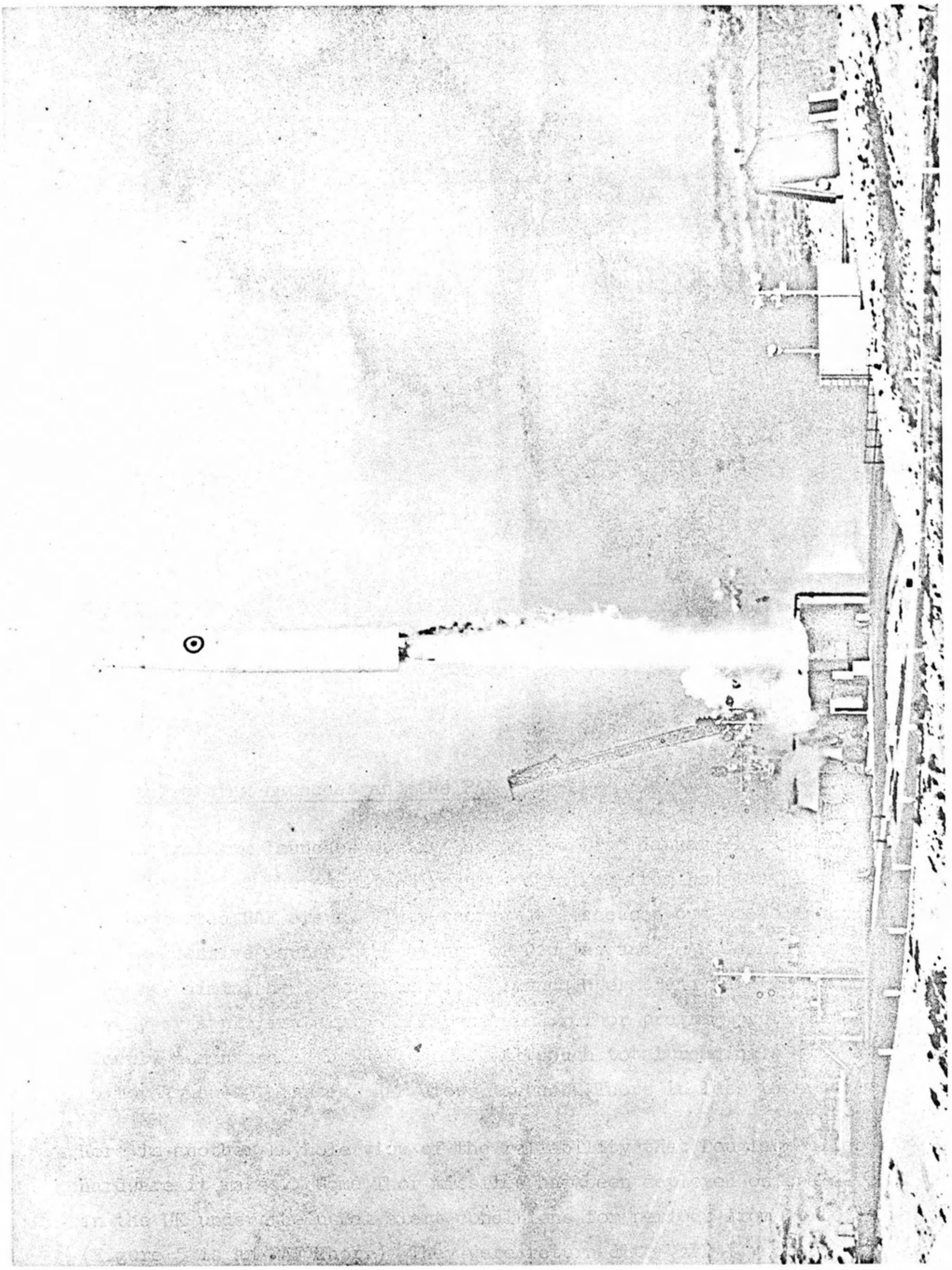
Missile flight testing and space vehicle launching at the AMR.

Space vehicle and both Strategic Air Command and Royal Air Force training launches at the PMR.

Deployment of four operational Thor squadrons in the UK.

Precisely Guided Re-entry Test Vehicles

The year of 1959 was also milestoned by six special multi-stage weapon system launches. The first vehicle, launched January 23, 1959, malfunctioned; but the other five, launched through June 11, 1959, were all successful. These



RAF CREWS LAUNCH THORS IN LESS THAN 15 MINUTES

FIGURE 5

precisely guided re-entry test vehicles (PGRTV) were lofted by the Thor Able II special weapon system. The boosters, designated DM1812-4, were tactical Thor missiles modified to increase capabilities and precision guidance. Of the five successful launches, the one of April 8, 1959, shown in Figure 6, resulted in the first recovery of a Thor-boosted nose cone from the sea.

Space Age Workhorse

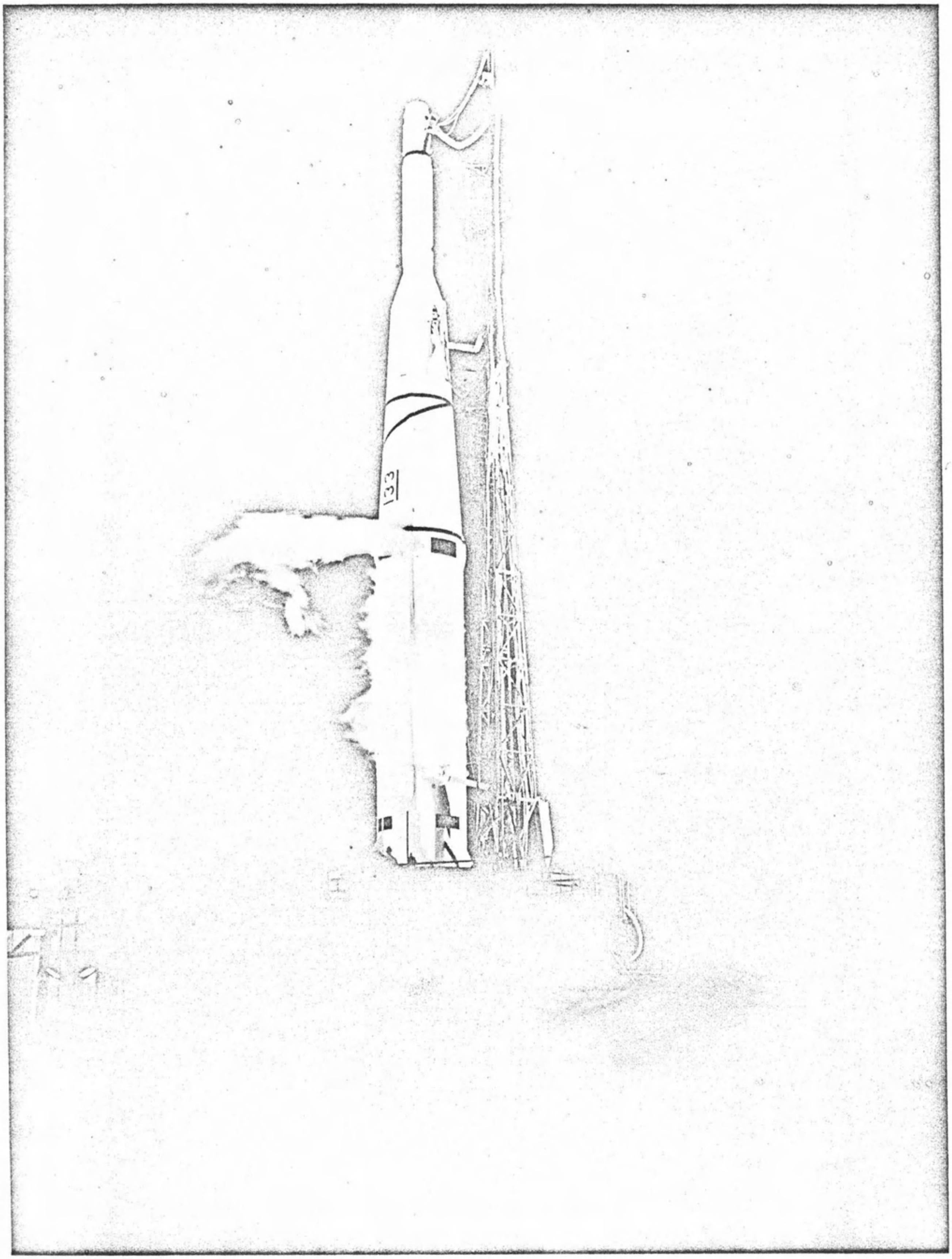
Concurrent with the special weapon system firings in 1959, were Douglas' space efforts. As a result of the Thor Weapon System's proven reliability, system hardware and Douglas management capabilities were enlisted immediately upon the entry of the United States into the space race. Employment of the basic Thor as a first-stage for various space vehicles provided Douglas with a background of successful participation in most of this country's space accomplishments; and the participation continues. More United States satellites and space probes have employed a Thor Booster launched by Douglas crews than all other booster-vehicles combined. By the end of 1959, the Thor had clearly demonstrated its right to the title "Workhorse of the Space Age."

Satellites with Recoverable Data Capsules

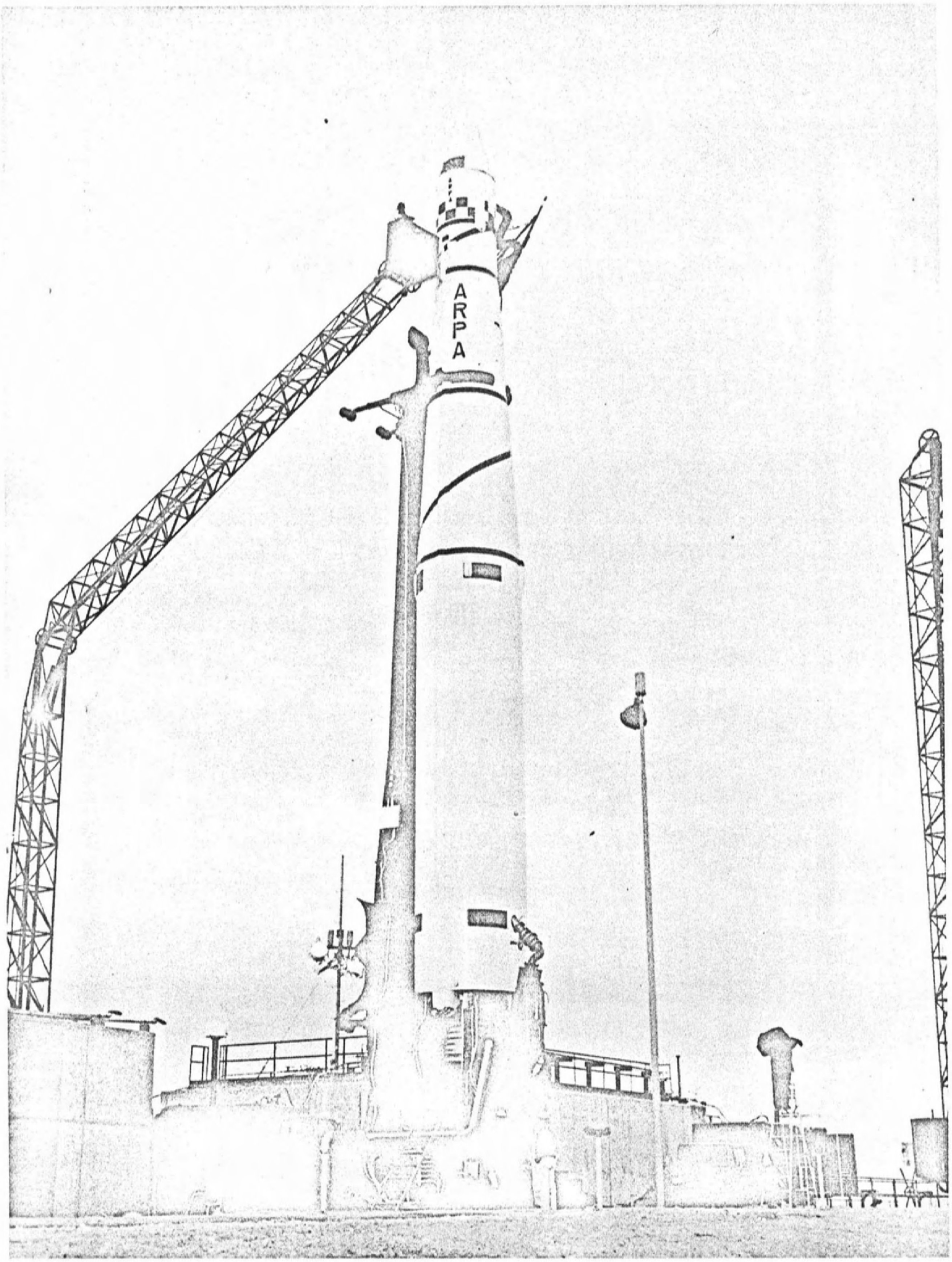
After the Thor Able and Thor Able I launchings, Douglas entered the Military Satellite program in 1959, with a space system identified as the Thor Agena A. This program was also under the Advanced Research Projects Agency. Figure 7 is a photograph of such a system. The Thor booster was DM1812-3. Lockheed provided the second-stage Agena A. From the first launch on February 28,1959, the Thor booster was consistently successful. The purpose of the program was to provide a scientific data-gathering earth satellite system capable of ejecting a recoverable research capsule from the orbiting satellite. The Government furnished payload which was Thor-boosted August 10,1960, is the first known payload to have its data capsule recovered from orbit. The Thor Agena A launchings of payloads concluded with a launching on September 13,1960.

The "Paddlewheel" Photographs the Earth

Again, the year of 1959 witnessed still another space system, the Thor Able III.



THOR ABLE II LAUNCHES PGRTV – FIRST THOR-BOOSTED
NOSE CONE RECOVERED FROM THE SEA
FIGURE 6



THOR AGENA A PREPARES TO LAUNCH A PAYLOAD

FIGURE 7

The system's booster was the DM1812-6, the powerful first stage of a four-stage vehicle. Space Technology Laboratories (STL) provided the instrumentation package. The payload was placed in an elongated orbit, and the instrumentation gathered vital space environmental data. Figure 8 is a photograph of the Thor Able III space vehicle system. The satellite it launched is called "Paddlewheel." It returned electronic pictures of the earth from space.

Navigational and Meteorological Satellites

Remember the Thor Able II special weapon system with the precisely guided re-entry test vehicle? It was drafted into the space race, too. On September 17, 1959, (Figure 9) the Thor Able II "space" system attempted to orbit a navigational aid communications satellite. The Thor booster, DM1812-2, successfully lifted off, but the orbit was not achieved because the third stage failed to ignite.

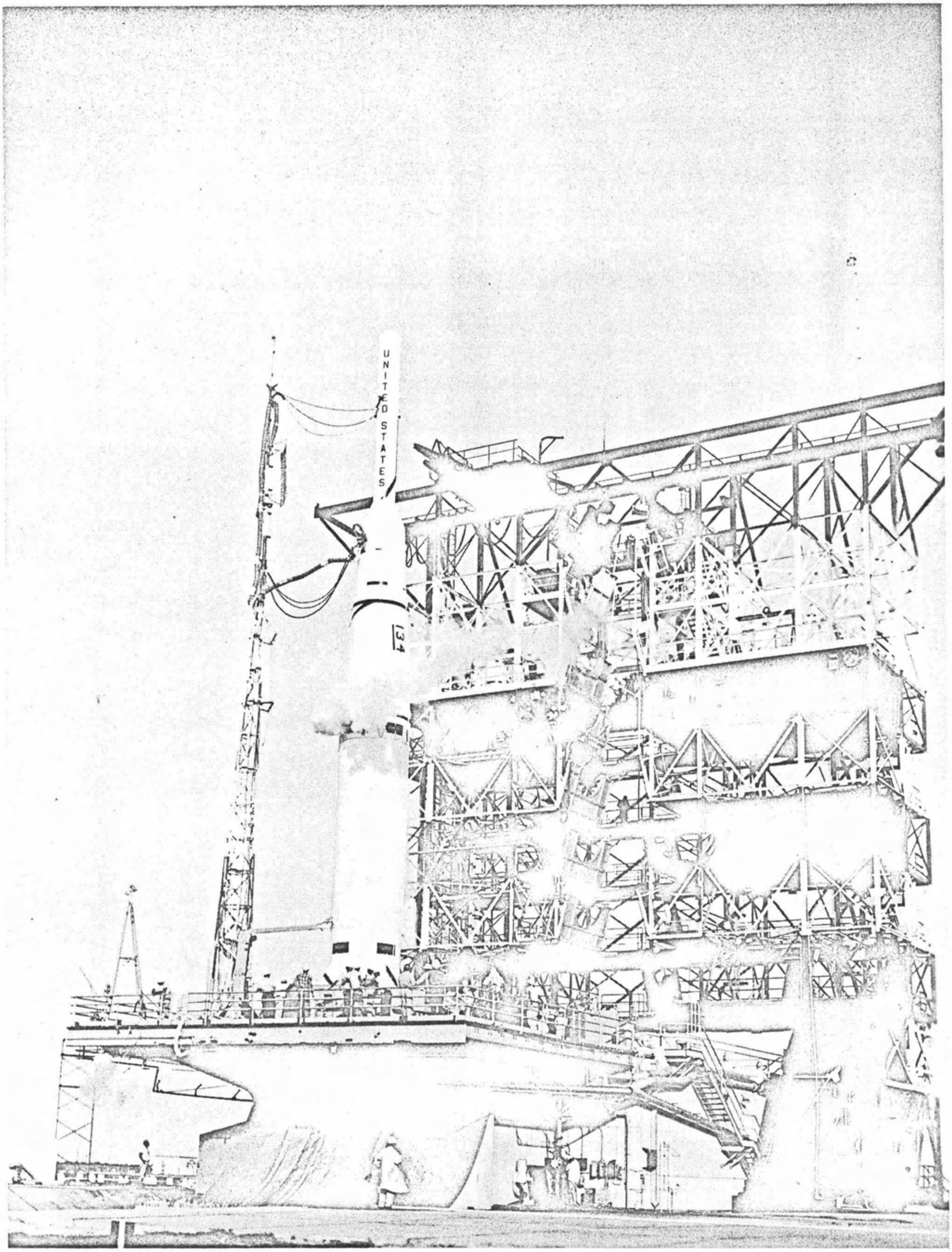
The crew returned to the launch pad at the AFMTC, determined to use another Thor Able II space system in launching the TIROS 1. T-I-R-O-S stands for: Television and Infra-Red Observation Satellite. It is a meteorological payload developed by the Radio Corporation of America for weather observation experiments sponsored by the National Aeronautics and Space Administration (NASA). On April 1, 1960, TIROS 1 was launched into an orbit that was the most accurate achieved by any United States satellite to that date.

Combat Training Launches and Continued Reliability

In the meantime, combat training launches of the Thor Weapon System were conducted through 1960 and 1961. All launches were successful. The launch crews brought home the perfect report card (100 per cent) for Thor's launch reliability.

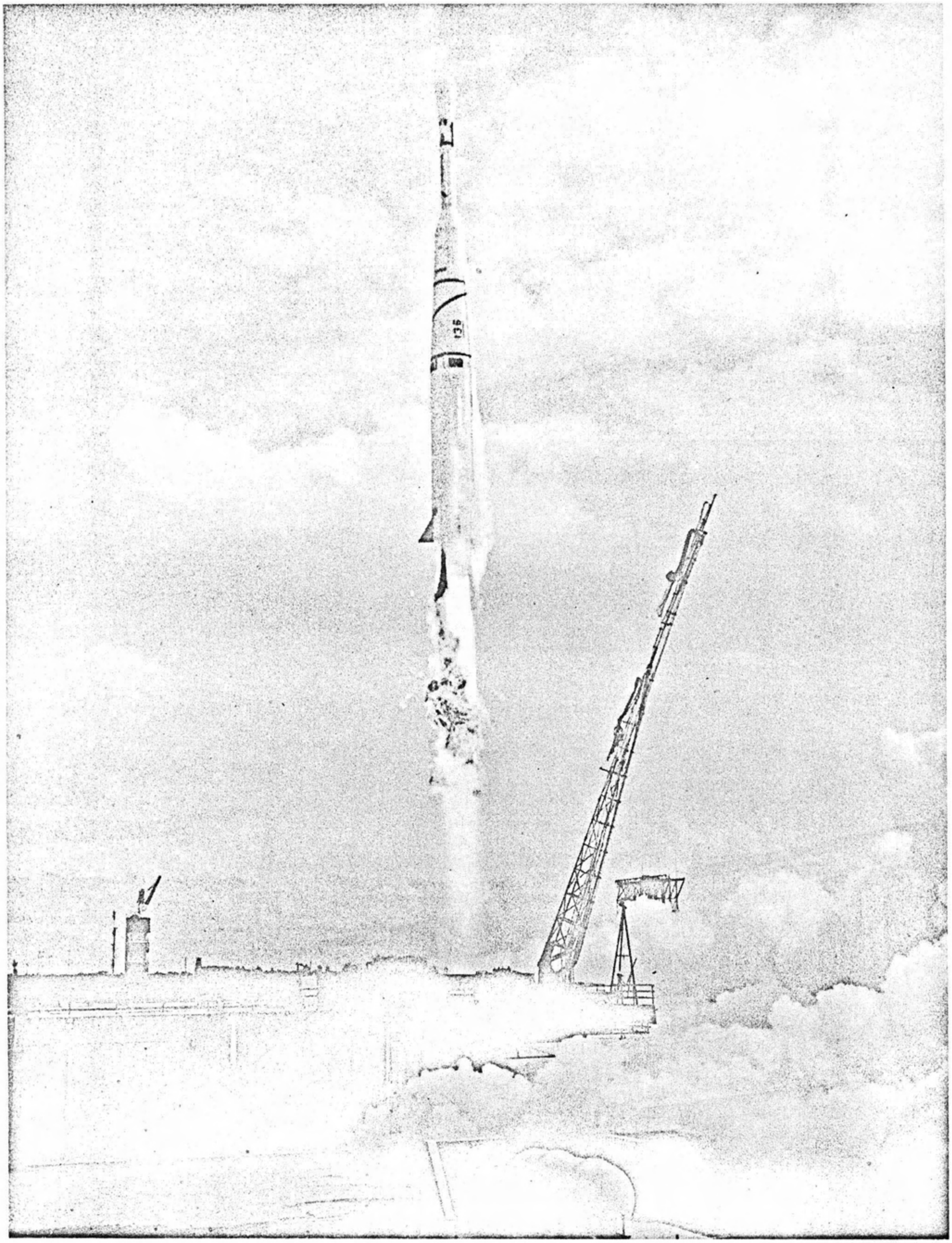
Test of MB-3 Block II Engine and GS Nose Cones

Three DM-18A missiles were modified and renumbered as Thor missile test vehicle DM-18C. These IOC vehicles, allocated to R & D usage, had two objectives: test and evaluation of the MB-3 Block II engine and the new GE nose



THOR ABLE III PREPARES TO LAUNCH

FIGURE 8



THOR ABLE II (STV), SUCCESSFULLY LAUNCHED BY THOR; ON
SECOND TRY ACHIEVED MOST ACCURATE U.S. ORBIT TO THAT DATE

FIGURE 9

cone. The launches in January and February, 1960, were all successful, and the objectives were met.

Interplanetary Space Probe

Perhaps the major event for the year of 1960 was the launching of a Space Probe. Figure 10 shows the Thor Able IV, the three-stage space vehicle system, which was used to boost the space probe. The Thor booster was the DM1812-6A. STL provided the instrumentation package which the Thor Able IV launched on March 11, 1960. The payload achieved a heliocentric orbit between the Earth and Venus. It transmitted data over a record distance of 22,500,000 statute miles from the earth until June 26, 1960. That was the longest direct radio transmission man had ever achieved.

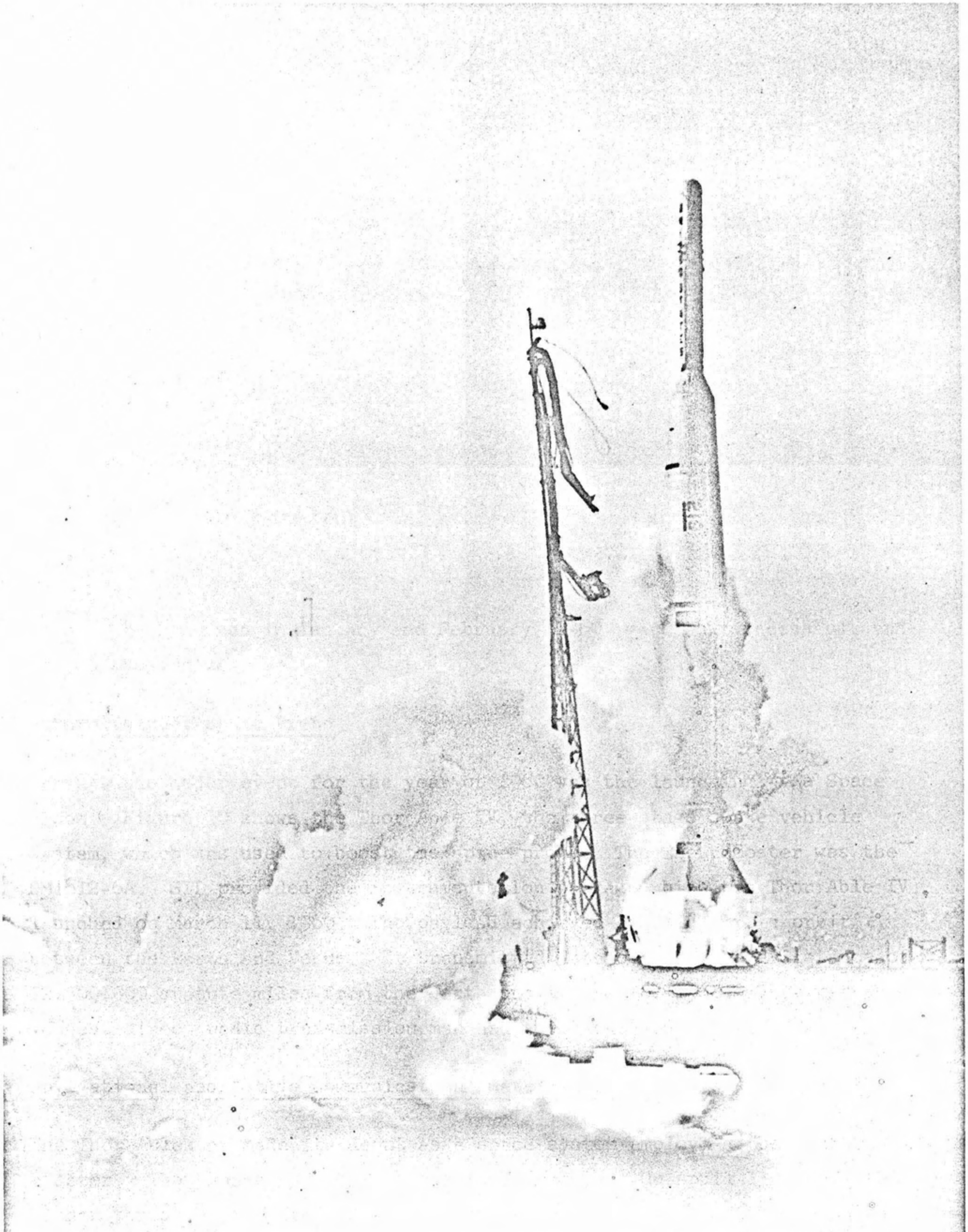
Navigational and Active Communications Satellites

The Thor Ablestar made its debut as a space system employing the Thor DM-21A booster. That space system is shown in Figure 11. On April 13, 1960, this higher thrust engine orbited a navigational aid satellite of the Advanced Research Project Agency and the United States Navy.

A Thor Ablestar system was responsible for a space milestone on June 22, 1960, when it placed two satellites in orbit simultaneously, the first time this feat had been accomplished. One payload was a navigational aid satellite, and the other, a radiation detection device. That launch is sometimes called the "Piggy-back."

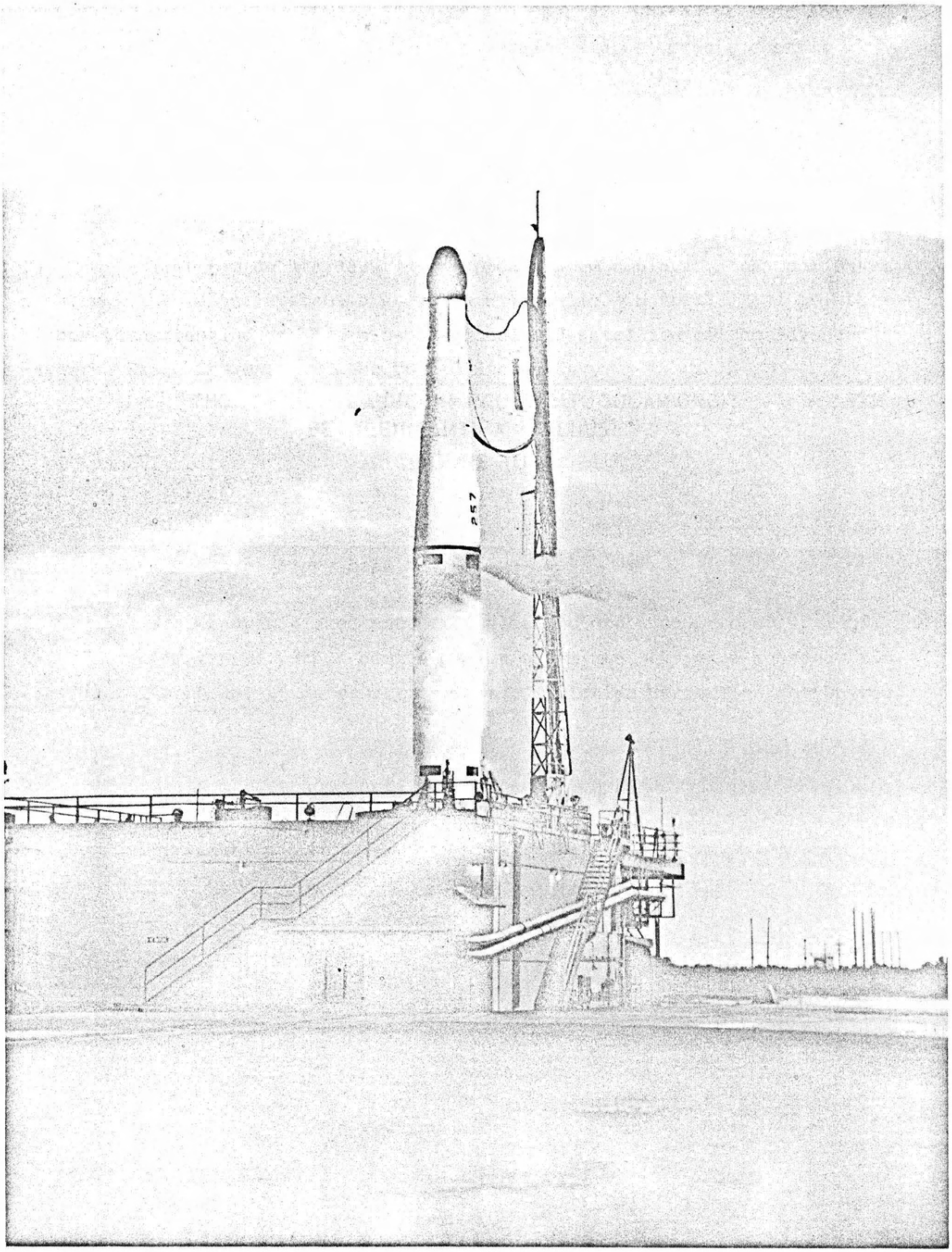
A Thor Ablestar system placed another payload in orbit on October 4, 1960. During the first orbit, this communication satellite relayed a message from President Eisenhower to Secretary of State, Christian Herter, at the United Nations.

The Thor Ablestar can accommodate many types of payloads.



THOR ABLE IV LAUNCHES PROBE INTO SOLAR ORBIT
BETWEEN EARTH AND VENUS

FIGURE 10



THOR ABLESTAR MADE ITS DEBUT BY ORBITING NAVIGATIONAL SATELLITE

FIGURE 11

Satellites and Space Probes

On April 1, 1959, the National Aeronautics and Space Administration entered into a contract with Douglas to develop, fabricate, test and launch twelve three-stage Thor Delta vehicles for diverse orbital and space probe missions. The first stage is a modified DM-18A, redesignated the DM-19 booster. As prime contractor, Douglas is also responsible for the other two stages. The payloads are supplied by NASA.

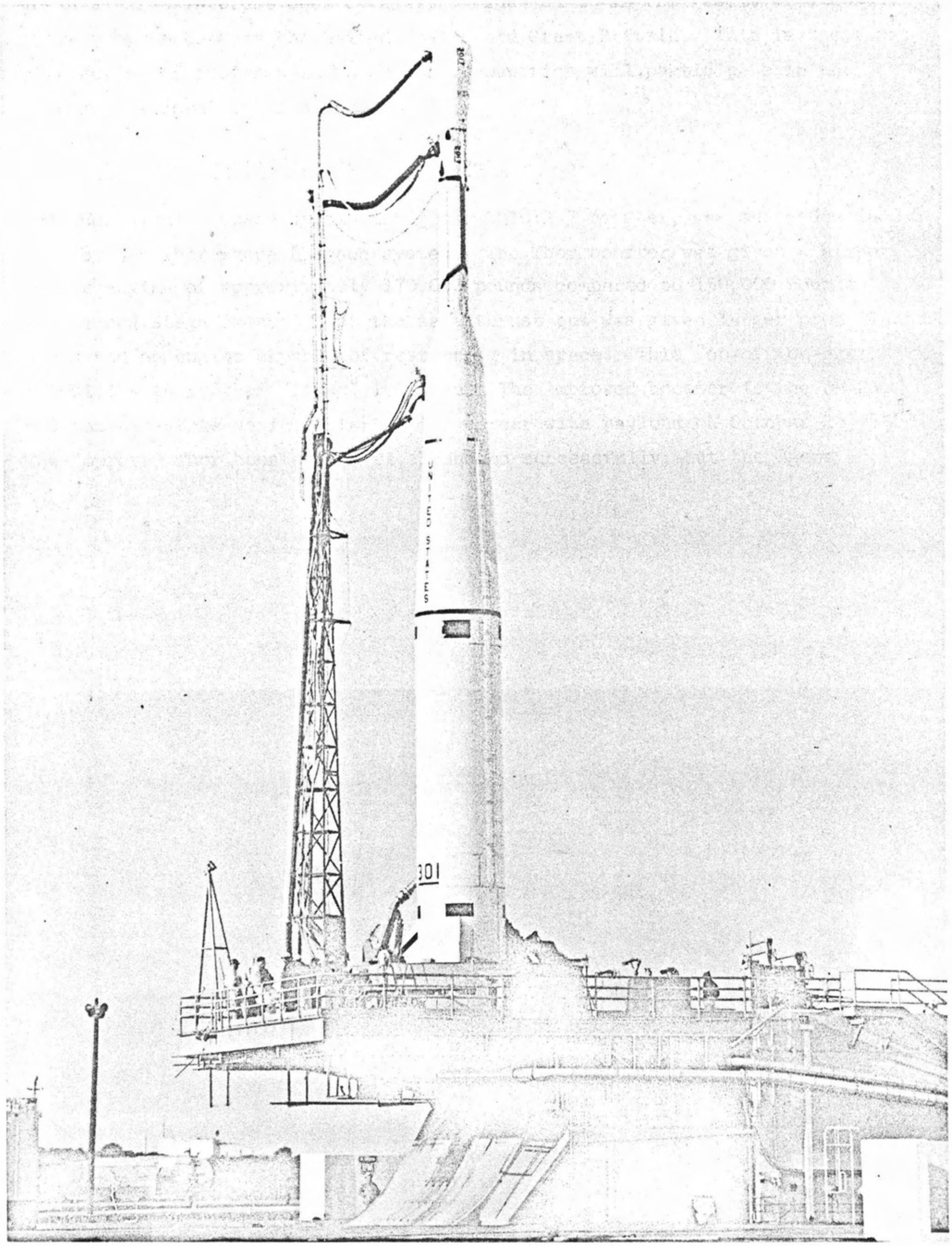
On May 13, 1960, the first Thor Delta space system was successfully launched, but the Echo satellite failed to achieve orbit due to a second-stage coast attitude control malfunction at an 800-mile altitude.

On August 12, 1960, the Thor Delta space system successfully launched the Echo I, a plastic sphere 100 feet in diameter, which effectively demonstrated the utility of passive communications satellites. Orbit was achieved and the satellite was dramatically visible to observers on earth.

Since then, the Thor Delta space system (Figure 12) has successfully launched TIROS A-2; Explorer X (P-14); TIROS A-3; Explorer XII (S-3); TIROS A-4; "OSO," the Orbiting Solar Observatory (S-16); and Ariel, "UK-1" (S-51), the world's first international satellite. The "UK-1" is the result of a cooperative program between the United States and Great Britain. This is the first of a series of programs in which other countries will participate in the peaceful exploration of space.

Improved Space System for Capsule Recovery

The Thor Agena A space system using the DM1812-3 booster, was succeeded in 1960 by the Thor Agena B space system. The Thor booster was given a higher thrust engine of approximately 170,000 pounds compared to 150,000 pounds. The second-stage Agena B kept the same thrust but was given larger propellant tanks and an engine capable of restarting in space. This "on-off-on-again" capability is another "first" in space. The improved booster is the DM-21, and the two-stage vehicle started its career with payload on October 26, 1960. The improved Thor booster, DM-21, launched successfully, but the Agena B



THOR DELTA POINTS AN ORBITING SOLAR OBSERVATORY AT SPACE

FIGURE 12

failed to separate and the orbit was not achieved.

On November 12, 1960, the Thor Agena B space system successfully launched and orbited a payload. The capsule was recovered in the air.

Since then, there have been many successful recoveries of capsules. Figure 13 is a photograph of the Thor Agena B system. The program continues. Its purpose is to provide a scientific data-gathering earth satellite system capable of ejecting a recoverable research capsule from the orbiting satellite.

Applications Vertical Test Program (AVT)

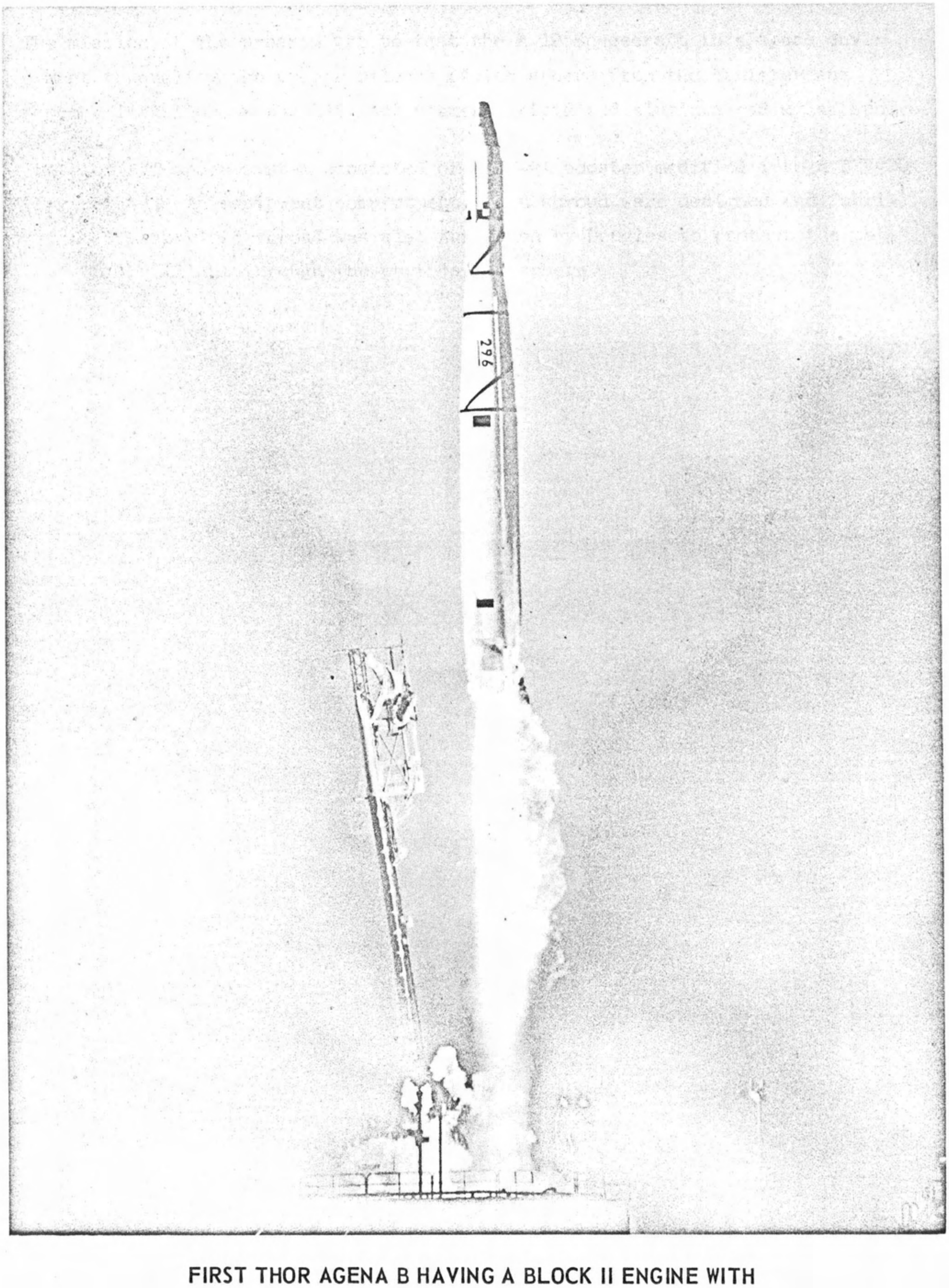
NASA sponsored the Applications Vertical Test Program, commonly referred to as the "Big Shot." On June 30, 1961, Douglas was named prime contractor. This responsibility entailed the design, procurement, testing, production, checkout, and launching of the test vehicle. It also included the ejectable data capsule and the integration of the government-furnished TY system into the launch vehicle.

NASA's Goodard Space Flight Center (GSFC) was responsible for program management of the vehicle and payload design, checkout, and launch.

NASA's Langley Research Center (LRC) designed, fabricated, and ground tested the payload. LRC was also responsible for the coordination and evaluation of the vertical test results.

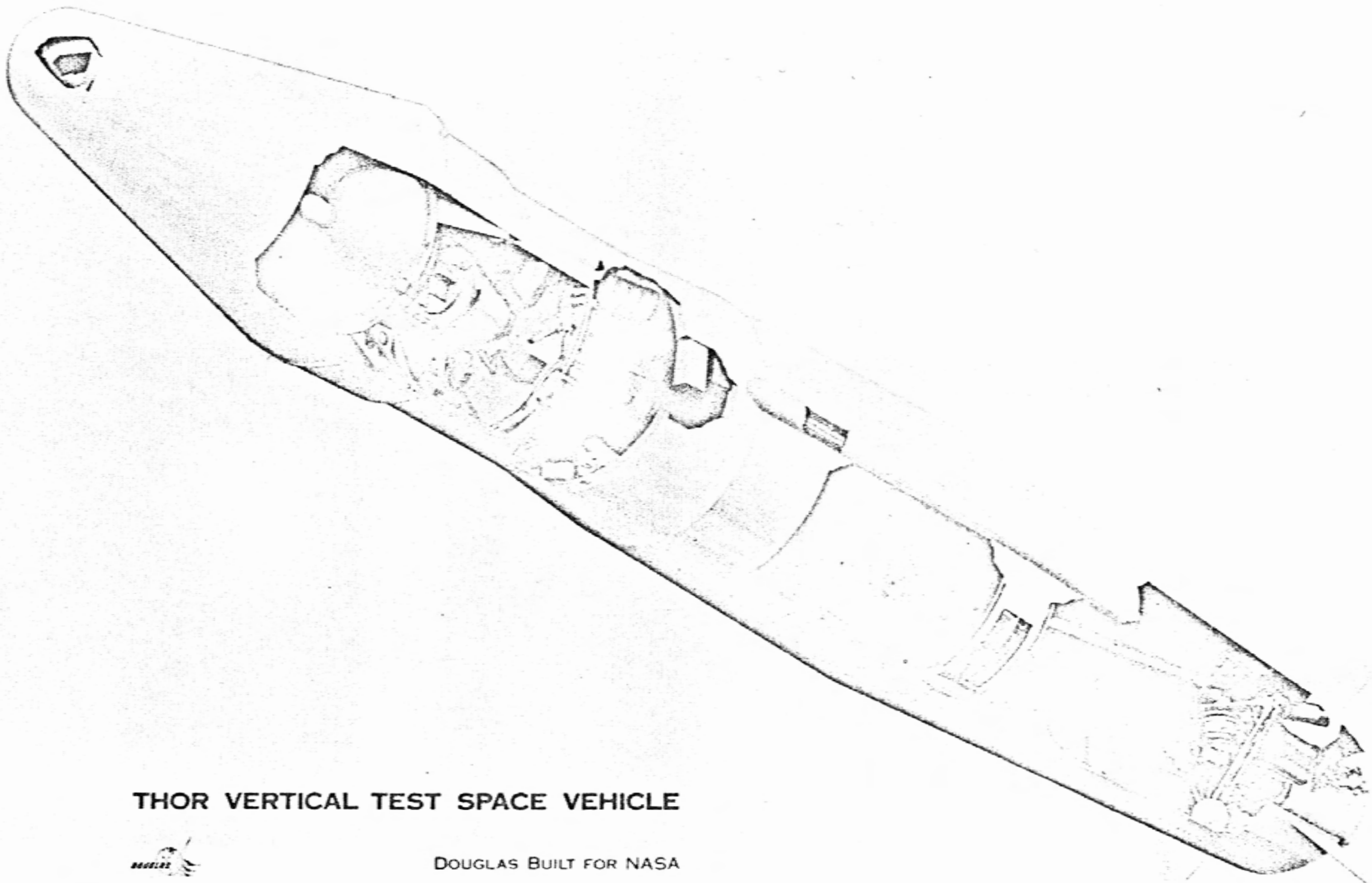
The mission of the program was to test the A-12 Spacecraft in a space environment to qualify the proper release of the sphere from the canister and propoer inflation of the 135-foot diameter rigidized aluminum and mylar sphere.

The Thor AVT space system consisted of a DM-21 booster modified into a DSV-2D (Figure 14). An equipment compartment and a shroud were designed and fabricated. The payload shroud was also furnished by Douglas to protect the payload during flight through the earth's atmosphere.



FIRST THOR AGENA B HAVING A BLOCK II ENGINE WITH
INCREASED THRUST, AND SECOND STAGE IN-FLIGHT RESTART CAPABILITY

FIGURE 13



THOR VERTICAL TEST SPACE VEHICLE

DOUGLAS BUILT FOR NASA

THOR AVT PIONEERS FOR WORLD COMMUNICATIONS SATELLITES

FIGURE 14

On January 15, 1962, the Thor AVT space system was launched on a lofted ballistic trajectory. The spacecraft canister was successfully ejected from the vehicle after the main and vernier engine shutdown.

After engine shutdown, the attitude of the vehicle was controlled by a coast phase attitude control system so that the television and motion picture cameras in the equipment compartment were trained on the spacecraft for the duration of the test.

These cameras, mounted in the forward end of the vehicle, recorded the separation of the canister, opening of the canister, and inflation of the sphere.

For reasons as yet undetermined, the 135-foot sphere inflated too rapidly and ripped.

The TV camera relayed clear pictures of the separation of both the sphere and the data capsule. In fact, the Thor AVT, or "Big Shot," accomplished the first known live TV relay and the first known direct recording from live TV transmission at the record altitude of 1,000 nautical miles.

The 16-mm motion picture camera was ejected from the spacecraft and parachuted into the sea. The camera was recovered, and the films gave exceptionally clear pictures of the separation. The image was of the highest quality consistent with the state of the art.

The recovery of the encapsulated camera established a record of that date, because it reached the highest known altitude in an unmanned suborbital ballistic trajectory before its descent to the sea and subsequent recovery.

NASA considered the test effort very successful.

Associated future test programs will include an orbital launch to check the long-term rigidity of the sphere. Later, the sphere will be incorporated into the Rebound program, where it will be used to develop precise orbiting placement techniques.

Improved Space System for Satellites and Probes

The Thor Delta space system that used the DM-19 booster is presently being succeeded by the DSV-3A[1] and DSV-3B space systems, both commonly referred to as the "Improved Thor Deltas."

The DSV-3A, Improved Thor Delta, is a three-stage research vehicle. The first stage is a modified DM-21 booster, redesignated DSV-3A, and given a higher thrust of approximately 170,000 pounds compared to 150,000 pounds.

The DSV-3B, Improved Thor Delta, is similar to the DSV-3A. Some of the major differences are in the Douglas second stage. The DSV-3B second stage is 36 inches longer, uses IRFNA instead of WIFNA as the oxydizer and uses Bell Telephone Laboratories' (BTL) 600 Series radio guidance system rather than the BTL 300 Series system used in the DSV-3A.

Both Improved Thor Deltas are three-stage space vehicles to be used to impart the necessary velocity and control to various payload packages for space probes and earth orbital missions.

Summary

Douglas has acquired vast experience in the over-all engineering, tooling, manufacturing, laboratory and static testing, inspection and quality assurance, flight testing, deployment and operational support. The effectiveness of the use of this experience is reflected in Douglas' systems and integration management capabilities, and is measured quantitatively by the reliability record of its operational products. Some of this information is tabulated in the appendix to this history.

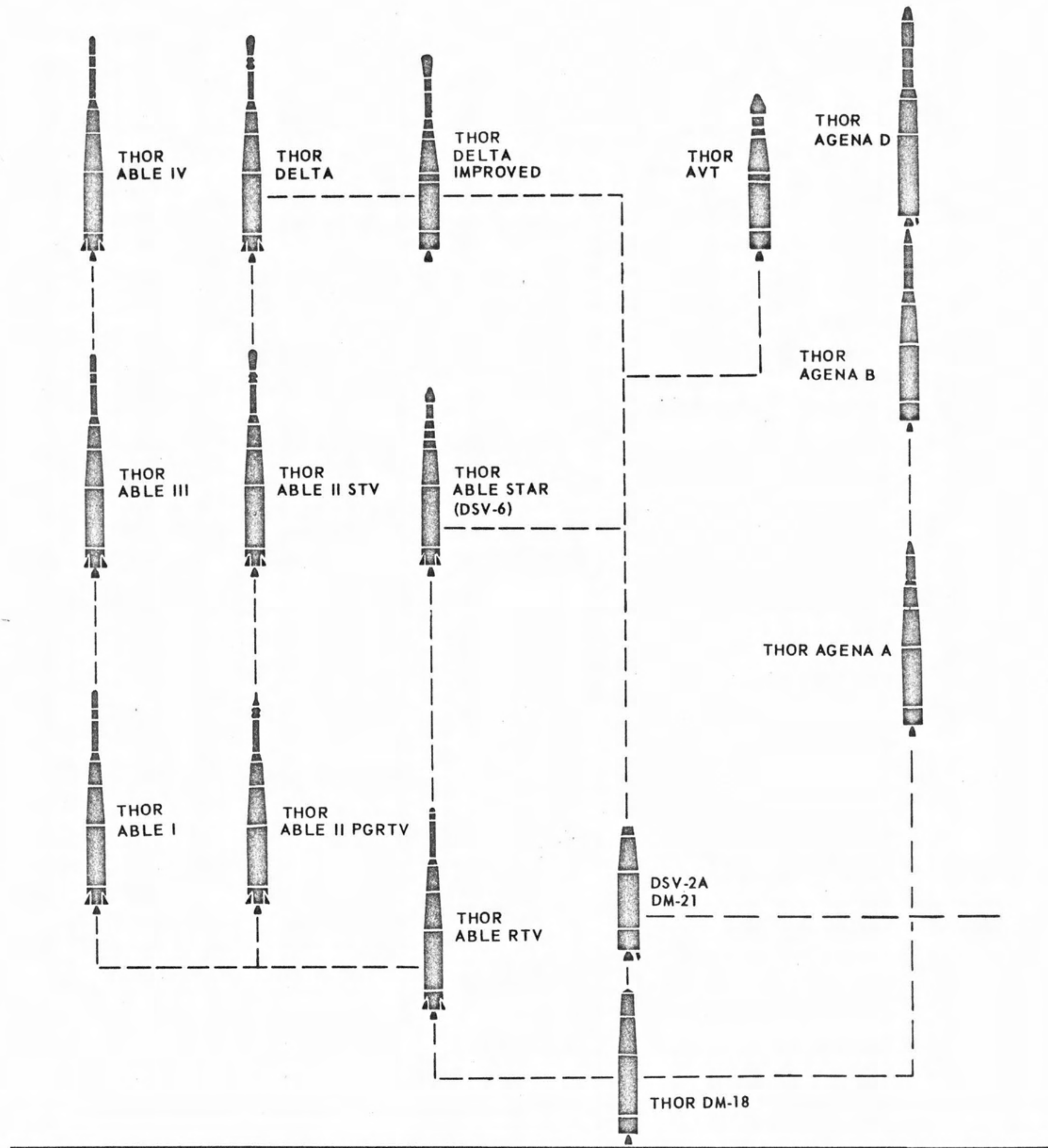
The reliability performance of the basic Thor booster is high and progressively increasing in both military and space applications. Despite the fact that the basic Thor has been subject to (1) internal and external configuration changes, (2) engine changes, (3) the use of different guidance systems,

[1] DSV-3A means: Douglas Space Vehicle-3A.

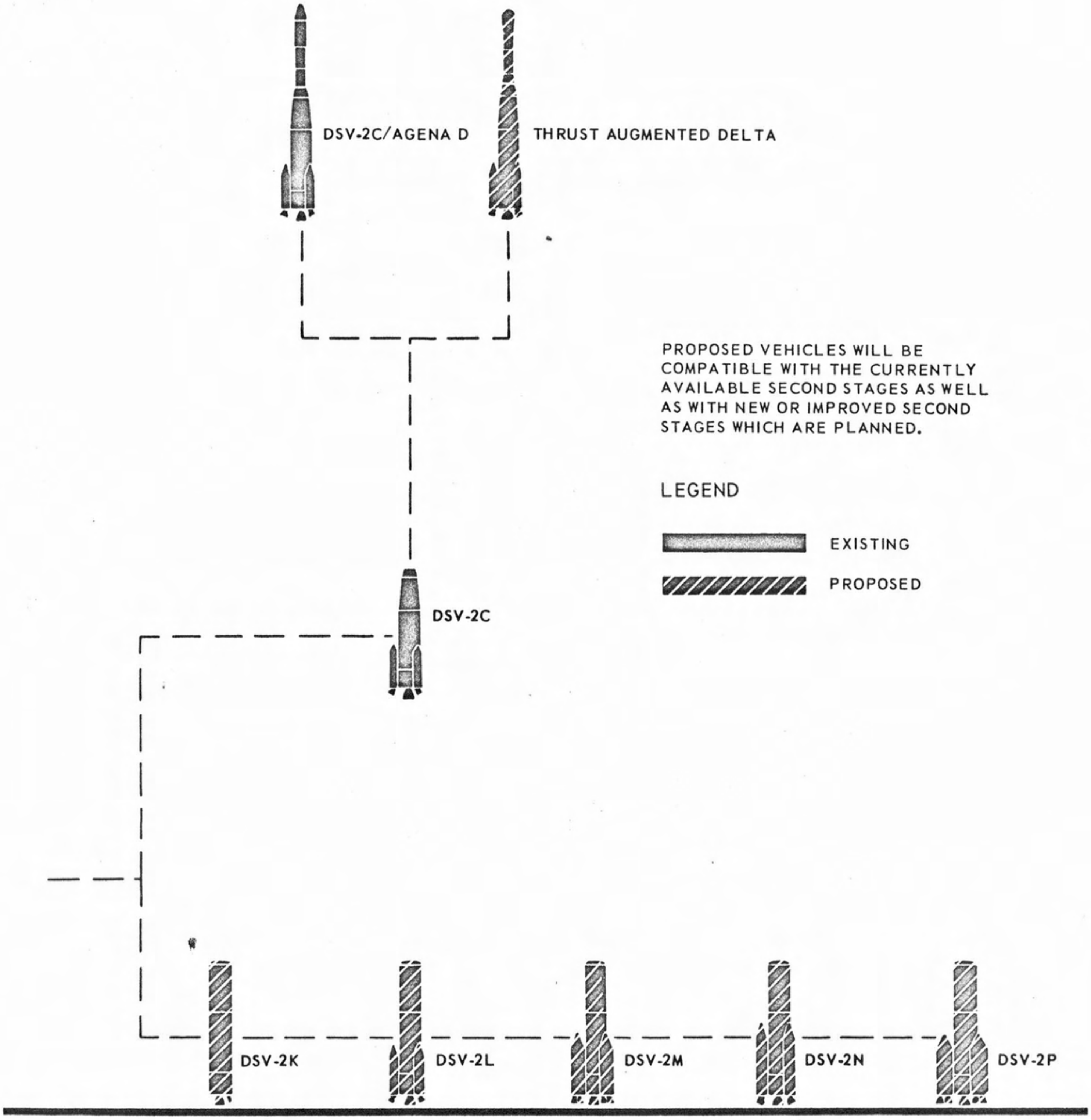
(4) the mating with and separation from various upper stages, (5) various trajectory shaping requirements, and (6) the resulting influences on flight environments by these changes--the Thor booster systems have established an over-all reliability record unmatched in the Free World.

APPENDIX I

Thor "Family Tree"

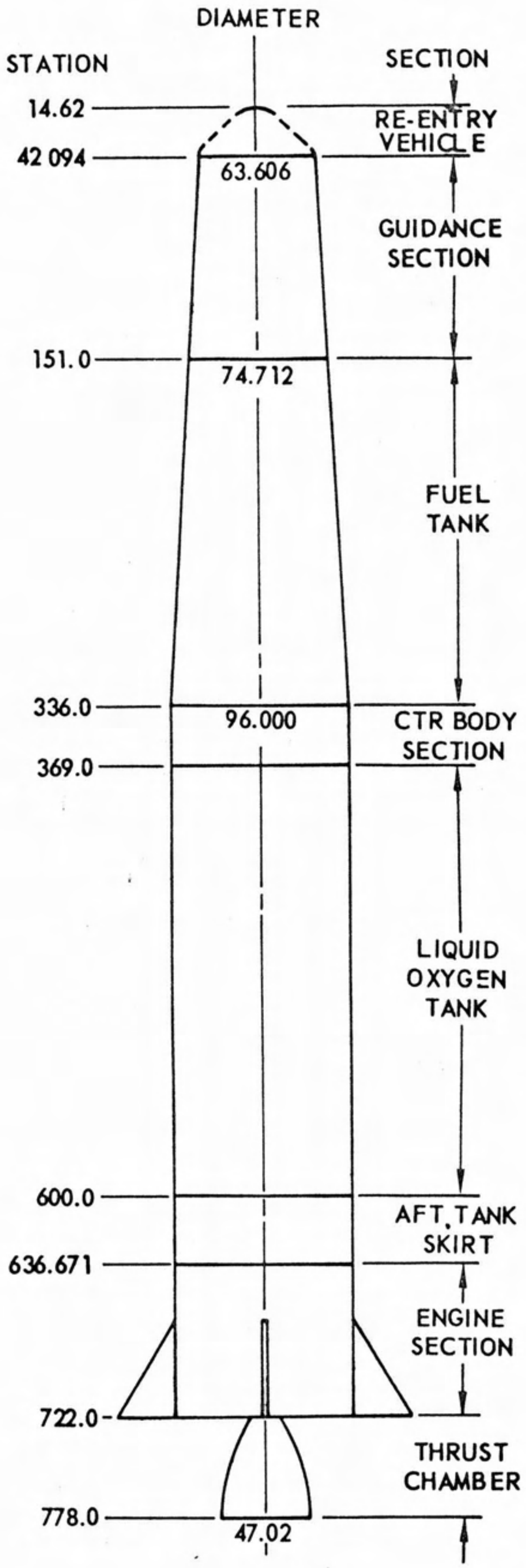


THOR "FAMILY TREE"


DSV-2C/AGENA D
THRUST AUGMENTED DELTA
PROPOSED VEHICLES WILL BE COMPATIBLE WITH THE CURRENTLY AVAILABLE SECOND STAGES AS WELL AS WITH NEW OR IMPROVED SECOND STAGES WHICH ARE PLANNED.
LEGEND
EXISTING
PROPOSED
DSV-2C
DSV-2K
DSV-2L
DSV-2M
DSV-2N
DSV-2P

APPENDIX 2

Configuration Sketches and Identifications



MODEL: DM-18

SYSTEM: Thor WS-315A (115A)

SPONSOR: Air Force

MISSION: Research and Development Program

DESCRIPTION:

The DM-18 Thor booster, was used for the first 18 research and development vehicles launched as a single-stage IRBM, comprised of the sections designated in the accompanying sketch.

The guidance section is modified, effective booster S/N 120. Either ACSP or BTL guidance system is used. The CEA flight controller is used.

Thrust is provided by the Rocketdyne MB-1 (135,000-pound thrust) and MB-1 Basic (150,000-pound thrust) propulsion system consisting of one main and two vernier rocket engines, each having a thrust of 1,000 pounds. The system uses RP-1 fuel and liquid oxygen.

Directional control is effected by gimballing of the main and vernier engine thrust chambers. Fins are mounted on the engine section.

Two ARL solid propellant retrorockets are used to separate the re-entry vehicle from the booster.

PAYLOAD:

DAC dummy nose cone with flight test boom.

MODEL: DM-18 (continued)

CONTRACTORS:

Integration - DAC

Airframe - DAC

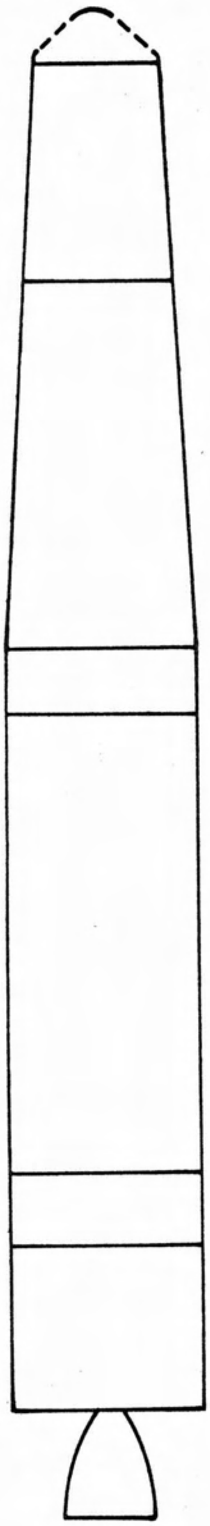
Guidance - ACSP

Re-entry - GE

Propulsion - R/NAA

FOR REFERENCE, CITE:

DAC drawing 560230 (Secret).



MODEL: DM-18A

SYSTEM: Thor WS-315A and WS-115A

SPONSOR: Air Force

MISSION: Initial Operational Capability Program

DESCRIPTION:

This is the original IOC* Thor Ballistic Missile, a single-stage booster identical to the DM-18 but using anti-vortex filters instead of vanes and quick-fill flanges for fuel and liquid oxygen.

This booster is powered by the Rocketdyne MB-3 Basic and MB-3 Block I propulsion system of 150,000-pound thrust and two vernier engines, each having a thrust of 1,000 pounds. Fins are not installed. The system uses RP-1 fuel and liquid oxygen.

The ACSP inertial guidance system is used.

PAYLOAD:

Mark II re-entry vehicle (GE).

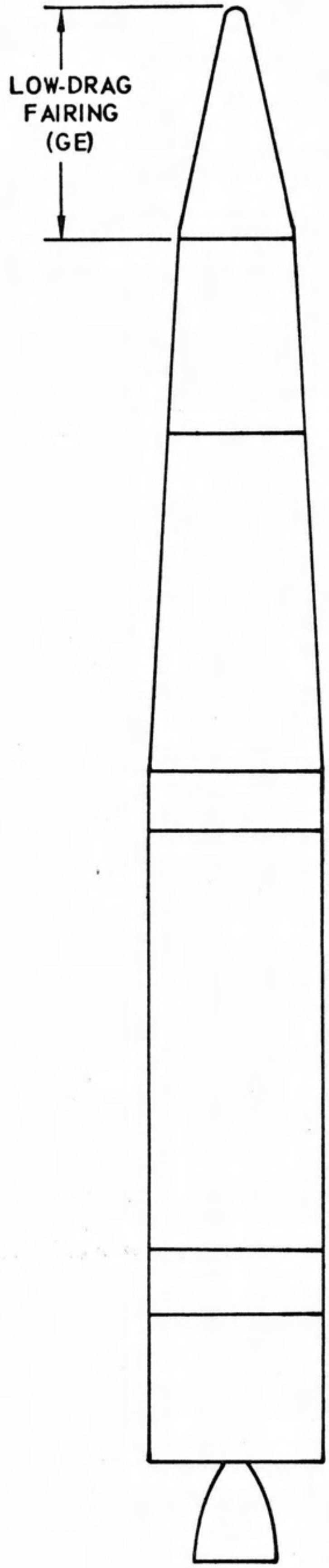
CONTRACTOR:

Prime - DAC

FOR REFERENCE, CITE:

Drawing 5727000-503 (Conf.)

*Initial Operational Capability.



MODEL: DM-18C

SYSTEM: Thor WS-315A

SPONSOR: Air Force

MISSION: Test Vehicle to Demonstrate Range Improvement.

DESCRIPTION:

The DM-18C is identical to DM-18A except for more powerful engine and use of the General Electric low-drag nose fairing. This effort included three launches.

Power is developed by a Rocketdyne MB-3, Block II, (165,000-pound thrust--sea level-stabilized) propulsion system, and two vernier engines each having a thrust of 1,000 pounds. The system uses RP-1 fuel and liquid oxygen.

PAYLOAD:

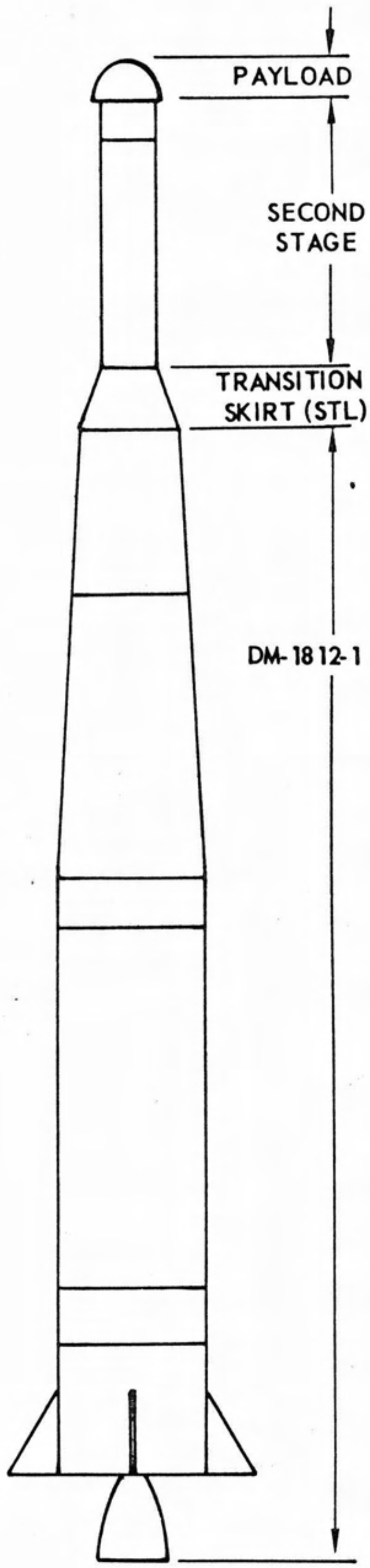
Mark II Re-entry Vehicle (GE).

CONTRACTOR:

Prime - DAC

FOR REFERENCE, CITE:

DAC drawing 5844194.



MODEL: DM1812-1

SYSTEM: Thor Able

SPONSOR: Air Force

MISSION: Special Weapon to Test Full Scale ICBM Nose Cone at ICBM Speed and Range.

DESCRIPTION:

The DM1812-1 (3 launches) is a modified DM-18 with relocated gyros and the nose cone and guidance removed, used as the first stage of a two-stage vehicle. The first-stage main engine has a 150,000-pound thrust and two vernier engines each have a thrust of 1,000 pounds. The system uses RP-1 fuel and liquid oxygen.

The second stage is an STL-modified Vanguard with an AGC AJ10-40 propulsion system. No guidance is used.

PAYLOAD:

Advanced ICBM Re-entry Test Vehicle (STL).

CONTRACTORS:

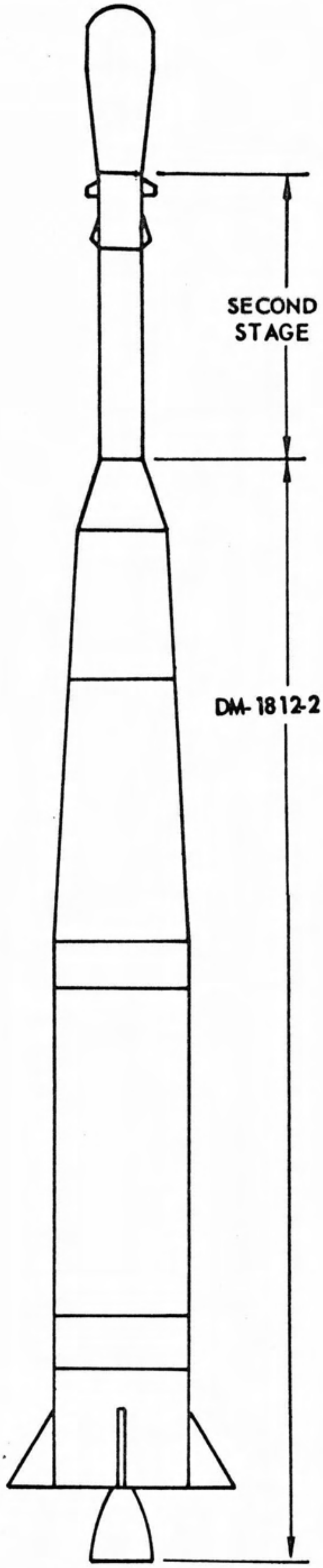
Prime - STL

First Stage - DAC

Second Stage - AGC

FOR REFERENCE, CITE:

DAC drawing 5729179 for DM-18 modifications.



MODEL: DM1812-2

SYSTEM: Thor Able II (STV)

SPONSOR: ARPA (Transit); NASA (Tiros)

MISSION: To Orbit a Navigational Satellite and a Metoergological (Tiros) Satellite.

DESCRIPTION:

The DM1812-2 (2 launches) is modified by the addition of fins and an interstage transition section. The guidance system and nose cone are removed. It is a first-stage booster of a three-stage Special Test Vehicle (STV). The first-stage main engine has a 150,000-pound thrust and the two vernier engines each ahve a thrust of 1,000 pounds. The system uses RP-1 fuel and liquid oxygen.

The second stage is a Douglas-modified AGC Vanguard using an AJ10-42 liquid propulsion system and the BTL radio guidance system. It uses UDMH or WIFNA, and develops a 7,575-pound thrust.

The third stage uses a spin-stabilized ABL X-248-A7 solid propoellant rocket motor. Retro-rockets are used to separate the second and third stages.

PAYLOAD:

Special Test Vehicles (STV):
Tiros (RCA)

CONTRACTOR:

Prime - DAC for SSD/STL
First Stage - DAC
Second Stage - AGC
Third Stage - ABL

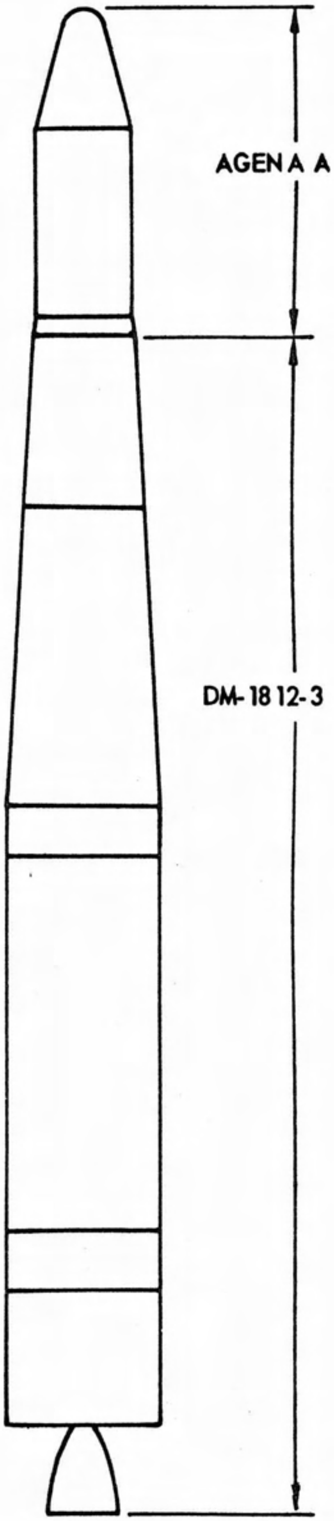
MODEL: DM1812-2 (continued)

ASSOCIATE CONTRACTORS:

R/NAA and BTL

FOR REFERENCE, CITE:

DAC drawing 5842054 (Conf.); Douglas report SM-35705 (Conf.).



MODEL: DM1812-3

SYSTEM: Thor Agena A

SPONSOR: ARPA:AIR FORCE

MISSION: Orbit of Data-Gathering Earth Satellite System under the Discoverer Program

DESCRIPTION:

The DM1812-3 is the first stage of a two-stage space vehicle (fifteen launches). It is a DM-18A with the nose cone and guidance removed and the installation modified. The main engine has a 150,000-pound thrust and the two vernier engines each have a thrust of 1,000 pounds.

The second stage is a Lockheed 2205 Agena A powered by a Bell Aircraft Hustler liquid-propellant engine. The guidance system is in the second stage.

PAYLOAD:

Earth satellites which eject recoverable data capsules from orbit.

CONTRACTORS:

Prime - LMSD

First Stage - DAC

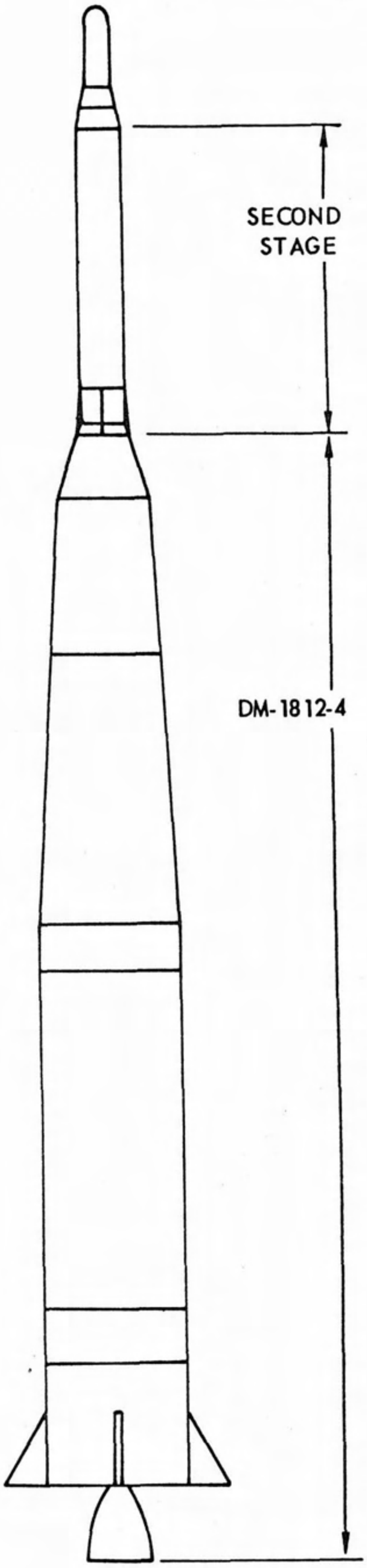
Second Stage - LMSD

ASSOCIATE CONTRACTOR:

R/NAA and BAC

FOR REFERENCE, CITE:

DAC drawing 3696695; Douglas Report SM-38447.



MODEL: DM1812-4

SYSTEM: Thor Able II (PGRTV)

SPONSOR: Air Force

MISSION: Special Weapon Test for the Recovery of Precisely Guided Nose Cones

DESCRIPTION:

The DM1812-4 (6 launches) is a modified DM-18 with interstage transition skirt added and the nose cone and guidance removed. It is used as the first stage of a two-stage vehicle. The main engine has a 150,000-pound thrust and the two vernier engines each have a thrust of 1,000 pounds.

The second stage is a modified Vanguard with an AGC AJ10-42 propulsion system and BTL guidance.

PAYLOAD:

GE or AVCO PGRTV nose cone. (Precisely Guided Re-entry Test Vehicle.)

CONTRACTOR:

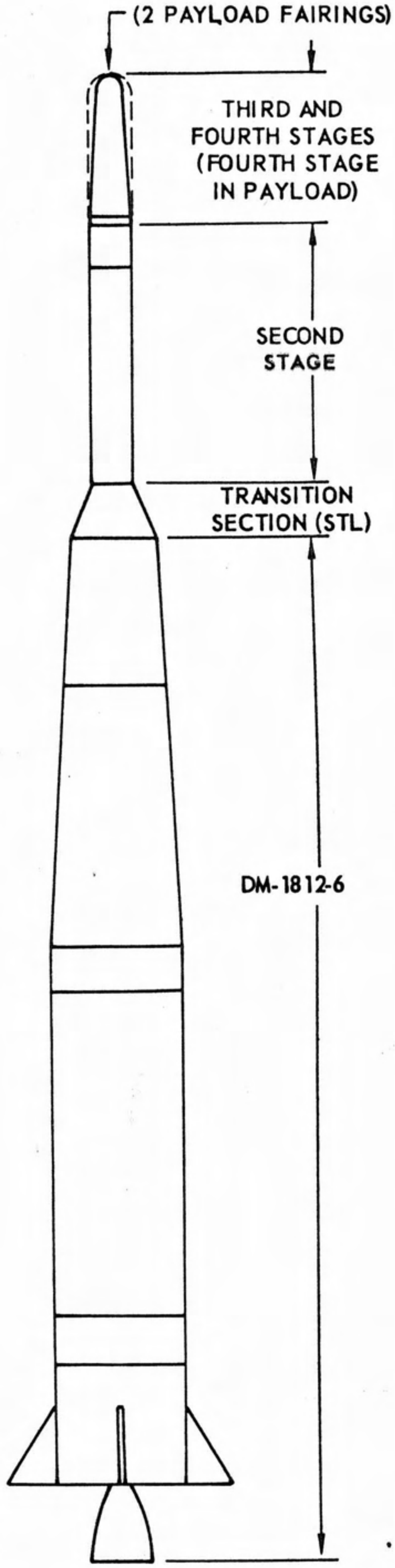
Prime - DAC

First Stage - DAC

Second Stage - AGC

FOR REFERENCE, CITE:

DAC drawing 5696816.



MODEL: DM1812-6

SYSTEM: Thor Able I & Thor Able III

SPONSOR: Air Force/NASA (Able I); NASA (Able III)

MISSION: For Lunar and Space Probes, and for Orbiting an Instrumented Satellite

DESCRIPTION:

The DM1812-6 is a DM-18 modified by gyro relocation and removal of the nose cone and guidance. It is used as the first stage for Able I (3 launches) and Able III (1 launch). Both are four-stage vehicles; both are STL projects. The first stage is powered by a MB-3 Basic engine of 150,000-pound thrust, and two vernier engines, each having a thrust of 1,000 pounds.

The Able I uses the AGC AJ10-41 propulsion system, with no guidance in the second stage; a spin-stabilized ABL X-248 solid propellant third stage and an injection rocket in the fourth stage.

The Able III has an AGC AJ10-101A propulsion system with no guidance, a spin-stabilized ABL X248-A4 solid propellant motor; and an ARL 1KS 420 solid propellant motor, with optional ground command firing capability; as second, third and fourth stage respectively.

PAYLOAD:

Military payloads and Explorer VI (Able III). Both STL instrumentation packages.

MODEL: DM1812-6 (continued)

CONTRACTOR:

Prime - STL

First Stage - DAC

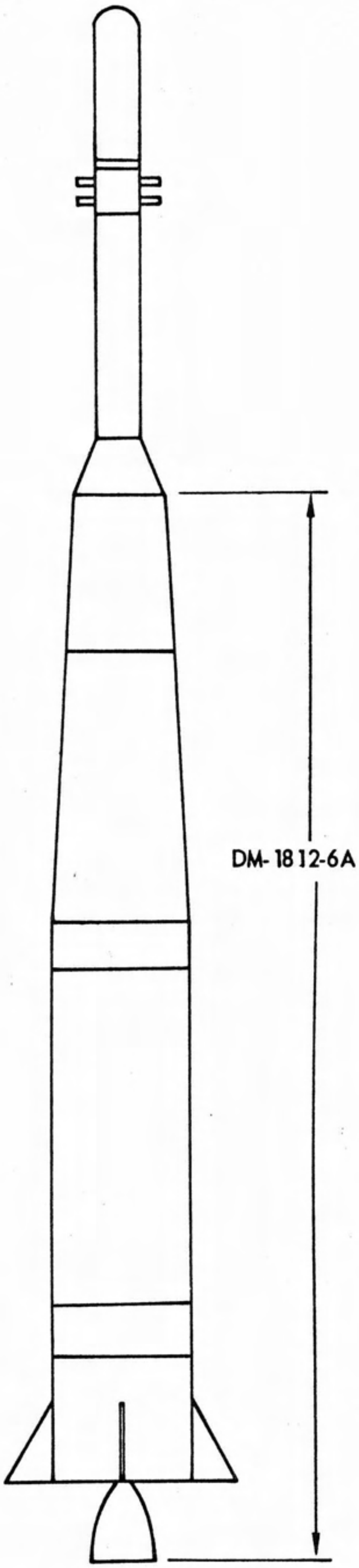
Second Stage - AGC

Third Stage - ABL

Fourth Stage - Thiokol (Thor Able I)
- ARL (Thor Able III)

FOR REFERENCE, CITE:

DAC drawing 5696814 (Conf.)



MODEL: DM1812-6A

SYSTEM: Thor Able IV

SPONSOR: NASA

MISSION: Solar Orbit Satellite

DESCRIPTION:

The DM1812-6A is a DM-18A modified by the addition of fins and the removal of the nose cone and guidance. It is the first-stage booster of a three-stage vehicle (one launch). The main engine develops a 150,000-pound thrust, and the two vernier engines each have a thrust of 1,000 pounds.

The second and third stages are identical to the Able III configuration but with STL-supplied radio guidance in the second stage.

PAYLOAD:

STL instrumentation package.

CONTRACTOR:

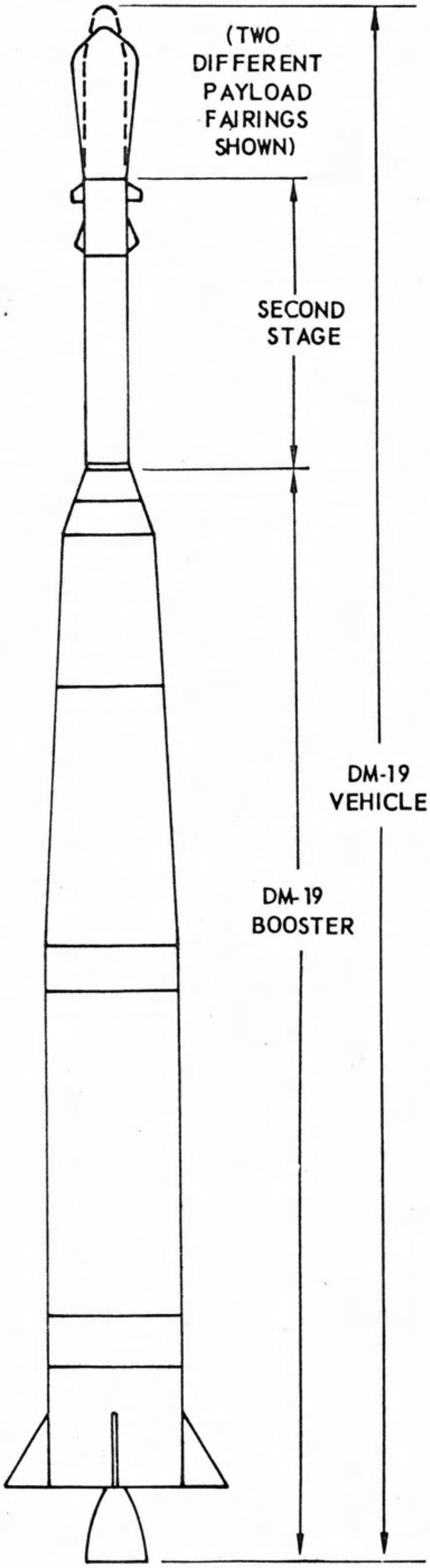
Prime - STL
First Stage - DAC
Second Stage - AGC
Third Stage - ABL

ASSOCIATE CONTRACTOR:

R/NAA

FOR REFERENCE, CITE:

DAC drawing 5696814-501 (Conf.)



MODEL: DM-19

SYSTEM: Thor Delta

SPONSOR: NASA

MISSION: Diverse Orbital and Space Probe Missions

DESCRIPTION:

The first stage of the three-stage DM-19 vehicle is a modified DM-18A with the nose cone, guidance and gyros removed; and the fins and interstage transition section added. The main engine develops a 150,000-pound thrust, and has two vernier engines, each having a thrust of 1,000 pounds. The system uses RP-1 fuel and liquid oxygen.

The second stage is powered by an AGC AJ10-118 liquid propellant propulsion system; and includes BTL radio guidance, a new flight controller using MIG gyros, coast phase attitude control system, and a spin table. It uses UDMH or WIFNA propellant.

The third stage is an ABL X-248-A5 solid propellant motor which is spin-stabilized during powered flight.

PAYLOAD:

Various earth satellites and space probes.

CONTRACTORS:

Prime - DAC

All Stages - DAC

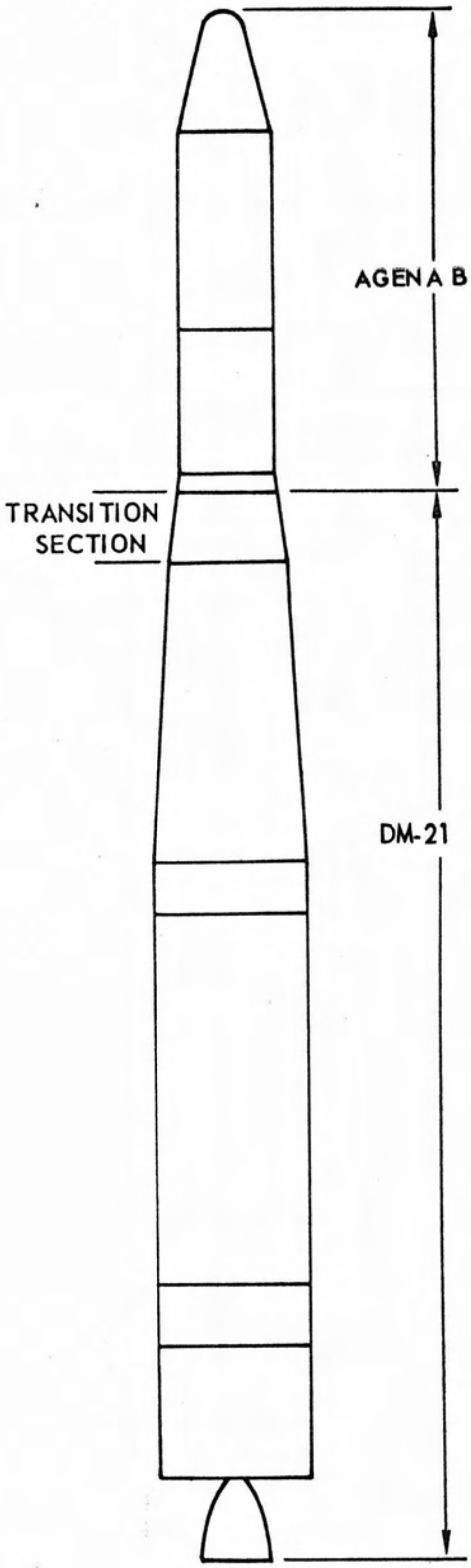
MODEL: DM-19 (Continued)

ASSOCIATE CONTRACTORS:

R/NAA, AGC, BTL and ABL

FOR REFERENCE, CITE:

DAC drawing 5843787 (Conf.); Douglas Reports SM-35567, SM-38447, SM-36022 (all Conf.).



MODEL: DM-21

SYSTEM: Thor Agena B

SPONSOR: Air Force, NASA

MISSION: Orbit of Recoverable Research Capsules

DESCRIPTION:

The DM-21 is a DM-18C with nose fairing removed; the guidance section replaced by a shorter and lighter transition section. The propulsion system produces a thrust of approximately 170,000 pounds. The system uses RJ-1 fuel and liquid oxygen.

Second stage is a Lockheed BAC 8096 Agena B, similar to the Agena A, but with longer propellant tanks and an in-flight restart capability.

PAYLOAD:

(AF) - Recoverable research capsule or non-recoverable payload; (NASA) - various space satellites proposed.

CONTRACTORS:

Prime - LMSC
First Stage - DAC
Second Stage - LMSC

ASSOCIATE CONTRACTORS:

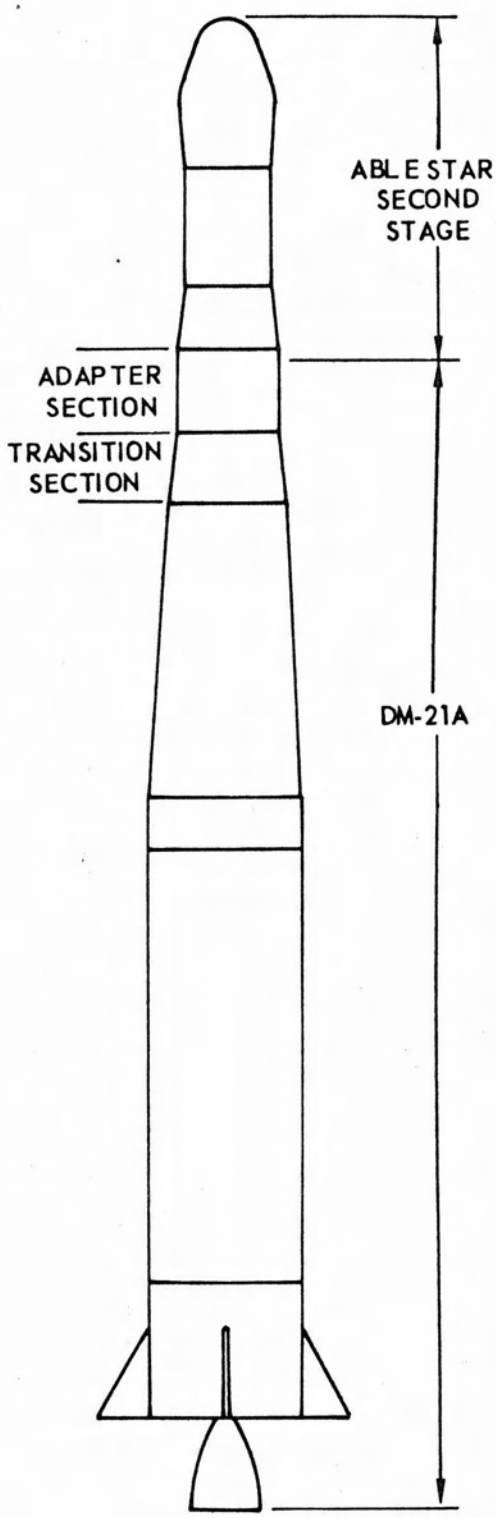
R/NAA

Originally a modification of the DM-18A, a new drawing "package" was released to create the DM-21 as a basic booster for space applications as differentiated from the IOC.

MODEL: DM-21 (continued)

FOR REFERENCE, CITE:

DAC drawings 5844442, 5864277; Douglas Report SM-38447 (Conf.).



MODEL: DM-21A

SYSTEM: Thor Ablestar

SPONSOR: ARPA; Army; Navy; Air Force; NASA

MISSION: Orbit of Various Earth Satellites

DESCRIPTION:

The DM-21A is essentially a DM-21 with a new adapter section, forward of the transition section, to accept the Ablestar. It is used as a first stage of a two-stage vehicle. The main engine develop a thrust of 150,000-pounds, and the two vernier engines each develop a thrust of 1,000 pounds. Fins were used only for the first launching.

The second stage is an AGC AJ10-104 with an in-flight restart capability. The Aerospace-AGC guidance system is used.

PAYLOAD:

Navigational aid satellite and
Communications satellite
(ARPA and Navy)

Composite--(Navy)

ANNA--(Army, Navy, NASA, Air Force)

CONTRACTORS:

Technical Management - AF:SSD

System Engineering - Aerospace Corporation

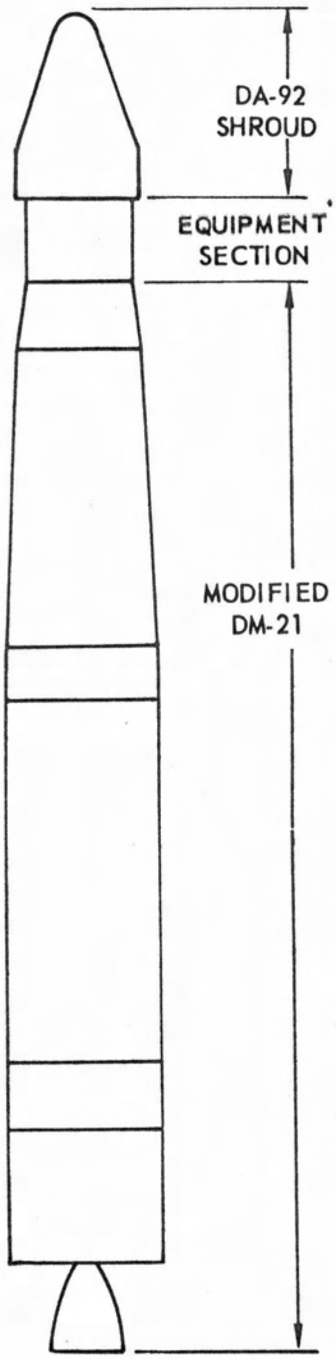
First Stage - DAC

Second Stage - AGC

ASSOCIATE CONTRACTOR: R/NAA

FOR REFERENCE, CITE:

DAC drawing 5844451; Douglas Report SM-38447.



MODEL: DSV-2D

SYSTEM: Thor AVT, commonly called "Big Shot" (formerly Super Shotput)

SPONSOR: NASA

MISSION: Test of Communications Balloon Inflation in Suborbital Ballistic Flight Path.

DESCRIPTION:

The DSV-2D is a modified DM-21 with an equipment compartment, forward of the transition section, which supports the payload. It is a single-stage vehicle. The main engine develops a 167,000-pound thrust, and the two verniers, each develop a thrust of 1,000 pounds.

The equipment compartment contains motion picture and television cameras to record balloon inflation. The DA-92 fairing shrouds the payload. No guidance is used. The coast phase attitude control systems is employed during both TV and motion picture camera operation time.

PAYLOAD:

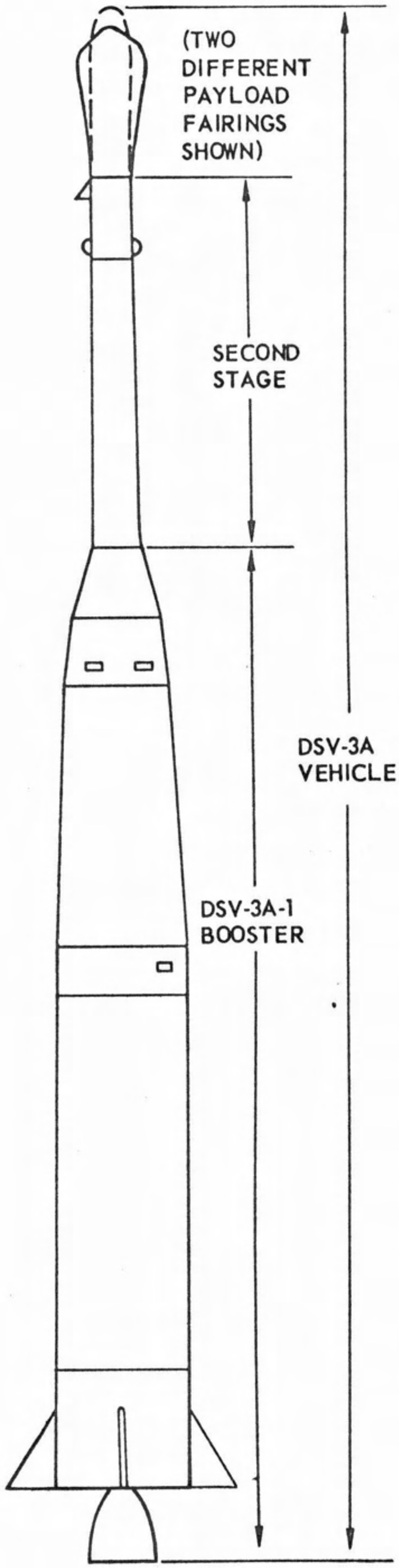
A-12 Spacecraft, including an Echo II canister, inflatable passive communications balloon (Grumman).

CONTRACTORS:

Prime - DAC

FOR REFERENCE, CITE:

DAC drawing 5884020.



MODEL: DSV-3A

SYSTEM: Thor Delta

SPONSOR: NASA:GSFC

MISSION: Diverse Orbital and Space Probe Missions

DESCRIPTION:

The first stage of a three-stage vehicle is a modified DM-21 booster with the propellant drip shield removed. The transition section structure is modified to accommodate the interstage transition structure attachment. A pressure diaphragm is added to protect the first-stage electrical components from the effects of the second-stage engine exhaust. The tunnel installation is modified to accommodate the relocation of the rate gyros. The MB-3 Block II engine has a thrust of 170,000 pounds. The two vernier engines each have a thrust of 1,000 pounds. The system uses RJ-1 fuel and liquid oxygen.

The second stage is powered by a AGC AJ10-118 liquid propellant propulsion system, has a coast phase attitude control system and is controlled inflight by a BTL 300 Series radio guidance system. The system used UDMH and WIFNA propellant and develops a thrust of 7,575 pounds.

The third stage is powered by an Allegany Ballistics Laboratory (ABL) X248-A5DM solid propellant motor which is spin-stabilized during powered flight. This motor produces 2800 pounds of thrust.

MODEL: DSV-3A (continued)

PAYLOAD:

Various earth satellites and space probes.

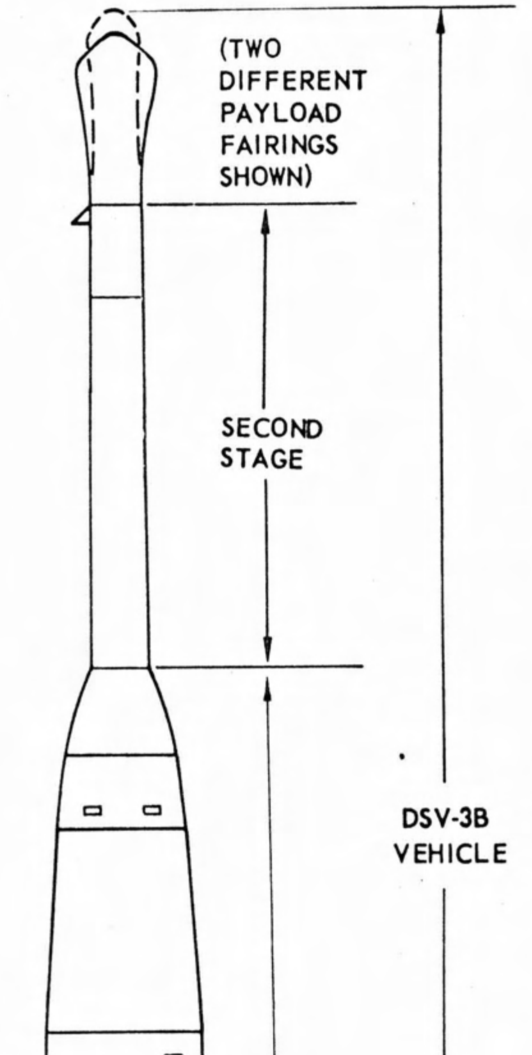
CONTRACTOR:

Prime - DAC

All Stages - DAC

FOR REFERENCE, CITE:

DAC drawing 5843787, and 1A20706; DS-2324.



MODEL: DSV-3B

SYSTEM: Thor Delta

SPONSOR: NASA:GSFC

MISSION: Diverse Orbital and Space Probe Missions

DESCRIPTION:

The first stage of a three-stage vehicle is a DSV-2A (DM-21) booster with the propellant drip shield removed. The transition section structure is modified to accommodate the interstage transition structure attachment. A pressure diaphragm is added to protect the first-stage electrical components from the effects of the second-stage engine exhaust. The tunnel installation is modified to accommodate the relocation of the rate gyros. The system uses RJ-1 fuel and liquid oxygen. The MB-3 Block II engine has a thrust of 170,000 pounds. The two vernier engines each have a thrust of 1,000 pounds.

The second stage is powered by a AGC AJ10-118D liquid propellant propulsion system, has a coast phase attitude control system, and is controlled inflight by a BTL 600 series radio guidance system. The stage has been lengthened 36 inches over the DSV-3A in order to increase the tank propellant capacity. The system uses UDMH and IRFNA propellant and develops a thrust of 7,575 pounds.

MODEL: DSV-3B (Continued)

DESCRIPTION: (Continued)

The third stage may be powered by either of two Allegany Ballistics Laboratory (ABL) solid propellant motors, both of which are spin stabilized. One choice is the X248-ADM which produces 2800 pounds thrust. The other is the X258 with a thrust of 5080 pounds.

PAYLOAD:

Various earth satellites and space probes.

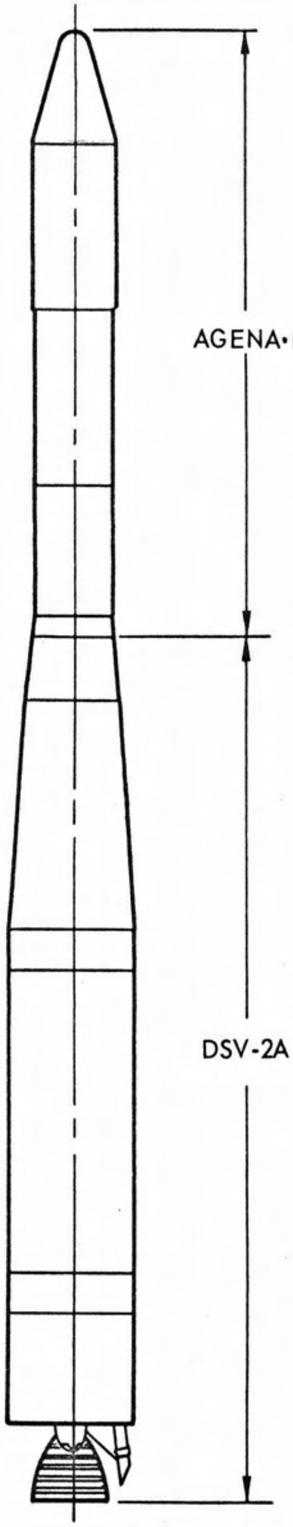
CONTRACTORS:

Prime - DAC

All stages - DAC

FOR REFERENCE, CITE:

DAC Drawing 1A21340 and 1A20706 DS-2325.



MODEL: DSV-2A

SYSTEM: Thor Agena D

SPONSOR: AIR FORCE

MISSION: Earth Orbiting Satellites

DESCRIPTION:

The DSV-2A is essentially the same vehicle as the DM-21 with a transition section compatible with the Agena D. The propulsion system consisting of an MB-3 Block II main engine which produces a stabilized sea level thrust of 170,000 pounds and two 1,000 pounds thrust vernier engines operates on liquid oxygen and RJ-1.

The second stage is a Lockheed Model 30205 Agena D powered by a 16,000 pound vacuum thrust Bell 8096 liquid propellant engine which burns UDMH and IRFNA and has an inflight restart capability. BTL radio/inertial guidance if employed is located in the second stage.

PAYLOAD:

A.F. and NASA satellites

CONTRACTOR:

Prime - LMSC

First Stage - DAC

Second Stage - LMSC

ASSOCIATE CONTRACTORS:

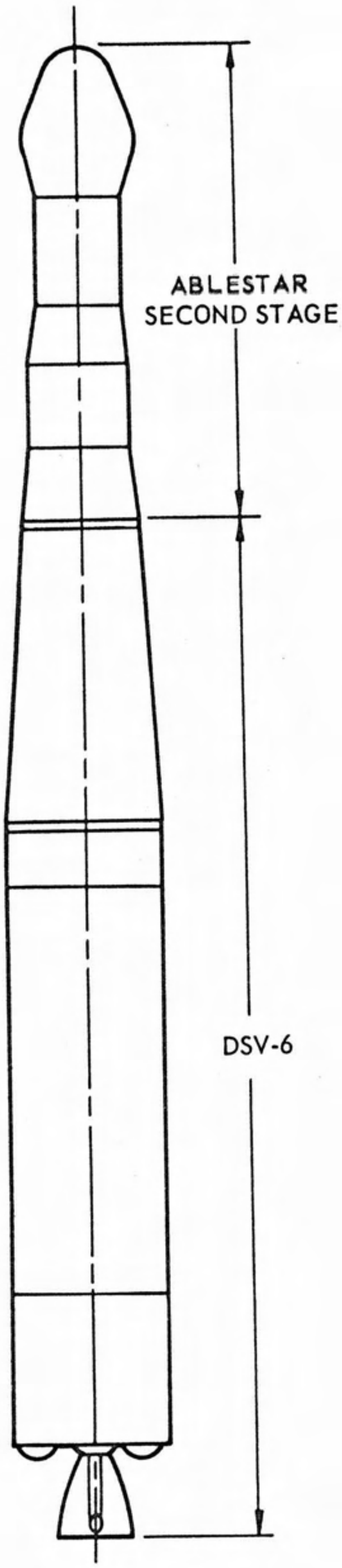
R/NAA

BTL

FOR REFERENCE, CITE:

DAC drawing 5864277;

DAC Specification DS-2344



MODEL: DSV-6

SYSTEM: Thor Ablestar

SPONSOR: NAVY AND AIR FORCE

MISSION: Orbit Various Earth Satellites

DESCRIPTION:

The DSV-6 is essentially a DM-21 with a modified transition section and an adapter section designed to accommodate the Ablestar second stage. The Rocketdyne MB3 Blk II main engine develops a stabilized sealevel thrust of 170,000 pounds and each of the two vernier engines produce 1000 pounds thrust. Fins may be installed on the engine section structure if the mission profile so requires.

The second stage Ablestar is powered by a liquid propellant AGC AJ10-104 using IFRNA and UDMH. It produces a vacuum thrust of 7900 pounds and has an inflight restart capability. An Aerospace - AGC guidance system is employed.

PAYLOAD:

Navigation Satellites

CONTRACTORS:

Technical Management - AF: SSD
System Engineering - Aerospace Corporation
First Stage - DAC
Second Stage - AGC

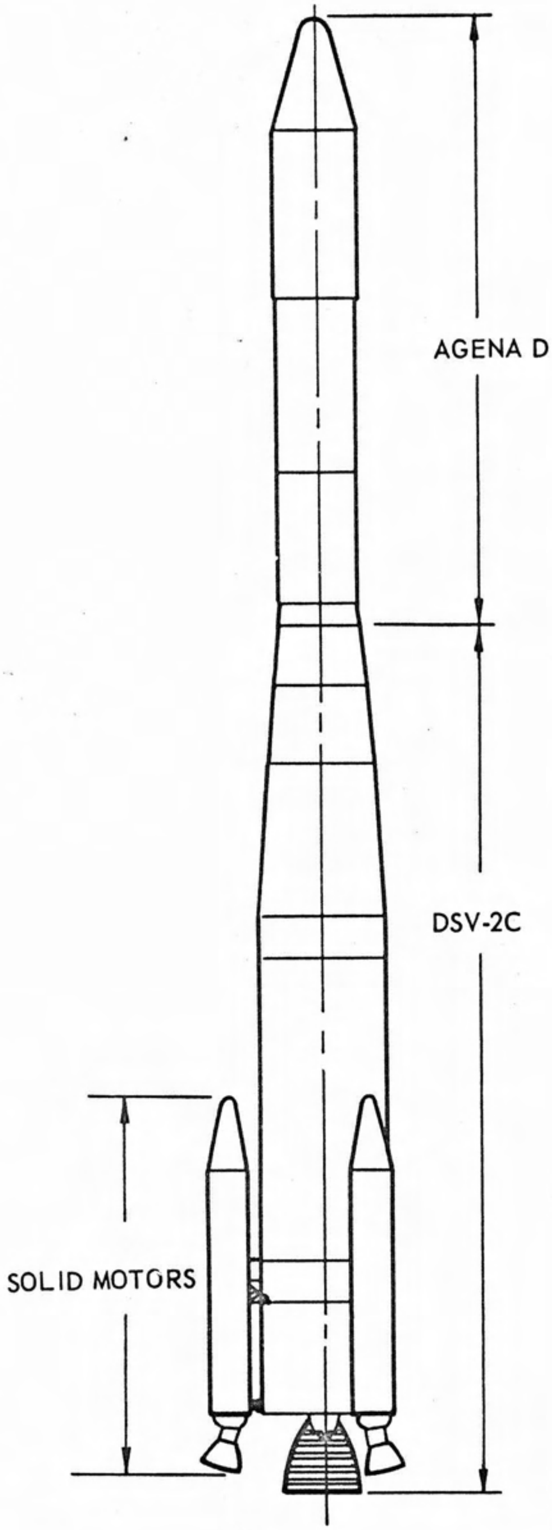
ASSOCIATE CONTRACTOR:

R/NAA

FOR REFERENCE, CITE:

DAC drawing 1A 39735;

DAC specification DS-2342 (c)



MODEL: DSV-2C

SYSTEM: Thor Agena D

SPONSOR: AIR FORCE

MISSION: Earth Orbiting Satellites

DESCRIPTION:

The DSV-2C is essentially a DSV-2A with three (3) Thiokol XM-33-52 solid propellant rocket motors mounted around the aft end of the airframe.

The solid motors are jetisoned after burn out at a time determined by range safety considerations.

Minor changes in the engine section structure and in the control circuitry have been made to accomodate the solid motors.

See description of DSV-2A for further information

FOR REFERENCE, CITE:

DAC drawings 1A 48435 and 1A 36317; DAC specification DS-2345(c)

News From McDONNELL DOUGLAS CORPORATION

FROM: Florida Test Center External Relations, 269-4100 Ext 7313

DOUGLAS NEWS BUREAU Santa Monica, California 90406
(213) 399-9311, extension 2566

February 1969

TOS-G
DELTA 67

MISSION DESCRIPTION

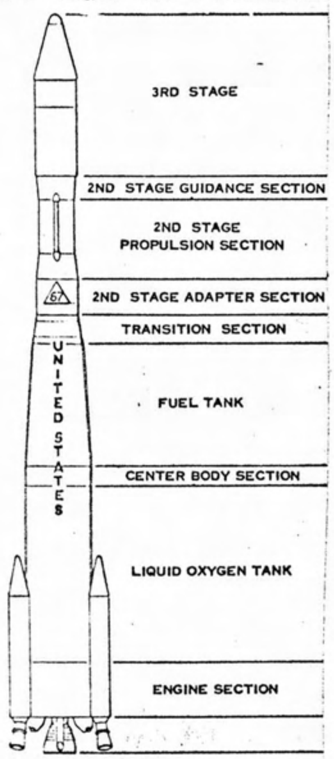
The TOS-G mission will be the 67th flight in the Delta program. Primary mission objective is to place the spacecraft in the desired circular earth orbit.

TOS-A through TOS-F spacecraft were launched from the Western Test Range utilizing various Delta launch vehicle configurations. TOS-G will be launched from the Eastern Test Range with a DSV-3E thrust augmented Delta (TAD) configuration.

The TOS-G vehicle will be launched from Complex 17, Pad B, on a launch azimuth of 115 degrees, and will be rolled to a flight azimuth of 108 degrees. First stage powered flight time is approximately 150 seconds with burnout of the three solid boosters occuring 39 seconds after liftoff. Second stage powered flight duration is approximately 368 seconds, followed by a 561 second coast phase. A third stage solid motor burn time of approximately 30.8 seconds will inject the spacecraft into the following sun-synchronous orbit:

Apogee	790 n.mi. (Nominal)
Perigee	790 n.mi. (Nominal)
Inclination	101.80 deg (Nominal) (78.20 deg retrograde)

DSV-3E Launch Vehicle



TOS-G SEQUENCE OF EVENTS

TIME-SEC	EVENTS
T = 0.0	Programmer Start (Stage I)
+2.0	Roll Rate 1 On
+4.0	Pitch Rate 1 On Yaw Rate 1 On
+9.67	Pitch Rate 1 Off Yaw Rate 1 Off Roll Rate 1 Off
+10.0	Pitch Rate 2 On
+45.0	Arm Solid Motor Separation
+50.0	Solid Motor Separation Roll Control Gain Change
+64.67	Pitch Rate 2 Off
+65.0	Pitch Rate 3 On
+80.0	Roll Rate 2 On Yaw Rate 2 On Start Stage I Guidance
+89.67	Pitch Rate 3 Off Yaw Rate 2 Off Roll Rate 2 Off
+90.0	Resume Yaw Rate 2 Resume Roll Rate 2 Pitch and Yaw Control Gain Change Enable Pitch and Yaw Vernier Control
+100.0	Yaw Rate 2 Off Roll Rate 2 Off
+105.0	Uncage Stage II Roll Gyro
+124.0	Enable Stage II Ignition and Pyrotechnic Power
+139.0	MECO Enable
+146.0	End BTL/WECO Guidance
+150.74	MECO Start Stage II Programmer Blow Blast Bands
+154.0	Stage II Separation Engine Start Sequence 1)
+158.0	Jettison Fairing (Sequence 2)
+159.0	Yaw Rate 1 On

SEQUENCE OF EVENTS (Cont'd)

TIME	EVENTS
+172.0	Yaw Rate 1 Off
+175.0	Pitch Rate 1 On
+177.0	Start Stage II Guidance
+300.0	Pitch Rate 1 Off
+450.0	VCS Channel 2 Initiate
+504.0	Arm Oxid Probe and TPS (Sequence 4)
+518.0	End Stage II Guidance
+522.0	Command SECO Switch to Coast Control Hydraulics Off
+570.0	Turn Off BTL/WECO (Sequence 3)
+599.0	Coast Phase Pitch Rate 1 On
+698.0	Coast Phase Pitch Rate 1 Off
+709.0	Coast Phase Yaw Rate 1 On
+808.0	Coast Phase Yaw Rate 1 Off
+1068.0	Spin Rockets (Sequence 5)
+1069.0	Ignition Wire Cutters
+1070.0	Stage III Separation Bolts Fire Retros (Sequence 6)
+1083.0	Stage III Ignition
+1113.8	Stage III Burnout
+1228.0	Payload Separation
+1230.0	Release Yo Weight

DSV-3E VEHICLE DESCRIPTION

CHARACTERISTIC	SOLID BOOSTERS	STAGE I (S/N 20225)	STAGE II (S/N 20225)	STAGE III (S/N 20240)
Length - ft.	19.7	59.6	16.45	4.87
Diameter - ft.	2.6	8	4.56	1.635
Engine Type	Solid	Liquid	Liquid	Solid
Manufacturer	Thiokol	Rocketdyne	Aerojet	U.T.C.
Designation	TX-354-5	MB3-III	AJ10-118E	FW-4D
Number of Engines	3	1 M.E., 2 V.E.	1	1
Specific Impulse	237.6	252.4	273	286.1
Thrust - Pounds/Engine	52,150	170,000	7,750	5507
Thrust Duration - Sec.	39	150	384	30.2
Propellant or Fuel	TP-H7036	RJ-1	UDMH	UTP-3096A
Oxidizer	---	LOX	IRFNA	---
Gases	---	GN_2	He, GN_2	---
Gas Pressure - PSIG		3000	4350, 4000	---

APPENDIX 3

Thor Launch Record, Weapon and Space Systems

THOR LAUNCH RECORD

WEAPON SYSTEM	TOTAL	SUCCESS	MALFUNCTION	% SUCCESS
DM-18 R&D	18	6	12	33
DM-18A IOC	28	21	7	75
DM-18C R&D	3	3		100
TOTAL DEVELOPMENT	49	30	19	61
DM-18A COMBAT TRAINING LAUNCHES CTL	22	19	3	86
TOTAL WEAPON SYSTEM	71	49	*22	69
SPACE				
BALLISTIC				
DM-1812-1 ABLE RTV	3	2	1	67
DM-1812-4 ABLE PGRTV	6	5	1	83
DSV-2D AVT	2	2		100
DSV-2E SPECIAL BALLISTIC	8	5	3	63
TOTAL SPACE BALLISTIC	19	14	5	74
ORBITAL AND PROBE				
DM-1812-6A ABLE I & ABLE II	4	3	1	75
DM-1812-6 ABLE IV	1	1		100
DM-1812-2 ABLE II	2	2		100
DM-21A ABLE STAR	11	8	3	73
DM-1812-3 AGENA	15	13	2	87
DM-21 AGENA	51	50	1	98
DSV-2C AGENA	4	3	1	75
DM-19 DELTA	12	12		100
DSV-3A DELTA	2	2		100
DSV-3B DELTA	4	4		100
TOTAL ORBITAL AND PROBE	106	98	8	92
TOTAL SPACE	125	112	13	90
GRAND TOTAL THOR SYSTEMS	196	161	*35	82

* INCLUDES 14 PARTIAL SUCCESSES OF DM-18 AND DM-18A

SEQUENCE NUMBER	WEAPON OR SPACE SYSTEM	RESULTS	MODEL DESIGNATION	VEHICLE SERIAL #	PROGRAM OR PAYLOAD	DATE	LOCATION OF LAUNCH
1	WS-315A	M	DM-18	101	R&D	1-25-57	AMR
2	WS-315A	PS	DM-18	102	R&D	4-19-57	AMR
3	WS-315A	M	DM-18	103	R&D	5-21-57	AMR
4	WS-315A	PS	DM-18	104	R&D	8-30-57	AMR
5	WS-315A	S	DM-18	105	R&D	9-20-67	AMR
6	WS-315A	M	DM-18	107	R&D	10-3-57	AMR
7	WS-315A	PS	DM-18	108	R&D	10-11-57	AMR
8	WS-315A	S	DM-18	109	R&D	10-24-57	AMR
9	WS-315A	PS	DM-18	112	R&D	12-7-57	AMR
10	WS-315A	S	DM-18	113	R&D	12-19-57	AMR
11	WS-315A	PS	DM-18	114	R&D	1-28-58	AMR
12	WS-315A	PS	DM-18	120	R&D	2-28-58	AMR
13	WS-315A	M	DM-18	121	R&D	4-19-58	AMR
14	Thor Able	M	DM-1812-1	116	Adv. RTV	4-23-58	AMR
15	WS-315A	S	DM-18	115	R&D	6-4-58	AMR
16	WS-315A	S	DM-18	122	R&D	6-13-58	AMR
17	Thor Able	S	DM-1812-1	118	Adv. RTV	7-9-58	AMR
18	WS-315A	PS	DM-18	123	R&D	7-12-58	AMR
19	Thor Able	S	DM-1812-1	119	Adv. RTV	7-23-58	AMR
20	WS-315A	PS	DM-18	126	R&D	7-26-58	AMR
21	WS-315A	S	DM-18	117	R&D	8-6-58	AMR
22	Thor Able I	M	DM-1812-6A	127		8-17-58	AMR
23	Thor Able I	S	DM-1812-6A	130		10-11-58	AMR
24	WS-315A	M	DM-18A	138	IOC	11-5-58	AMR
25	Thor Able I	S	DM-1812-6A	129		11-8-58	AMR
26	WS-315A	S	DM-18A	140	IOC	11-26-58	AMR
27	WS-315A	PS	DM-18A	145	IOC	12-5-58	AMR
28	WS-315A	S	DM-18A	146	IOC	12-16-58	AMR
29	WS-315A	S	DM-18A	151	CTL	12-16-58	PMR
30	WS-315A	PS	DM-18A	149	IOC	12-30-58	AMR
31	Thor Able II	M	DM-1812-4	128	PG RTV	1-23-59	AMR
32	WS-315A	PS	DM-18A	154	IOC	1-30-59	AMR

S - Success PS-Partial Success M-Malfunction O-Orbit R-Recovery

SEQUENCE NUMBER	WEAPON OR SPACE SYSTEM	RESULTS	MODEL DESIGNATION	VEHICLE SERIAL #	PROGRAM OR PAYLOAD	DATE	LOCATION OF LAUNCH
33	Thor Able II	S	DM-1812-4	131	PG RTV	2-28-59	AMR
34	Thor Agena A	S-O	DM-1812-3	163		2-28-59	PMR
35	Thor Able II	S	DM-1812-4	132	PG RTV	3-21-59	AMR
36	WS-315A	S	DM-18A	158	IOC	3-21-59	AMR
37	WS-315A	S	DM-18A	162	IOC	3-26-59	AMR
38	Thor Able II	S-R	DM-1812-4	133	PG RTV	4-8-59	AMR
39	Thor Agena A	S-O	DM-1812-3	170		4-13-59	PMR
40	WS-315A	S	DM-18A	161	CTL	4-16-59	PMR
41	(WS-315A)WS-155A	S	DM-18A	176	IOC	4-23-59	AMR
42	WS-315A	S	DM-18A	164	IOC	4-25-59	AMR
43	(WS-315A)WS-115A	S	DM-18A	187	IOC	5-12-59	AMR
44	Thor Able II	S-R	DM-1812-4	135	PG RTV	5-20-59	AMR
45	(WS-315A)WS-115A	S	DM-18A	184	IOC	5-22-59	AMR
46	Thor Agena A	S	DM-1812-3	174		6-3-59	PMR
47	Thor Able II	S	DM-1812-4	137	PG RTV	6-11-59	AMR
48	(WS-315A)WS-115A	S	DM-18A	191	CTL	6-16-59	PMR
49	(WS-315A)WS-115A	S	DM-18A	198	IOC	6-25-59	AMR
50	Thor Agena A	S	DM-1812-3	179		6-25-59	PMR
51	(WS-315A)WS-115A	PS	DM-18A	194	IOC	6-29-59	AMR
52	(WS-315A)WS-115A	M	DM-18A	203	IOC	7-21-59	AMR
53	(WS-315A)WS-115A	S	DM-18A	202	IOC	7-24-59	AMR
54	(WS-315A)WS-115A	S	DM-18A	175	CTL	8-3-59	PMR
55	(WS-315A)WS-115A	S	DM-18A	208	IOC	8-5-59	AMR
56	Thor Able III	S-O	DM-1812-6	134		8-7-59	AMR
57	Thor Agena A	S-O	DM-1812-3	192		8-13-59	PMR
58	(WS-315A)WS-115A	S	DM-18A	204	IOC	8-14-59	AMR
59	(WS-315A)WS-115A	PS	DM-18A	190	CTL	8-14-59	PMR
60	Thor Agena A	S-O	DM-1812-3	200		8-19-59	PMR
61	(WS-315A)WS-115A	S	DM-18A	216	IOC	8-27-59	AMR
62	(WS-315A)WS-115A	S	DM-18A	217	IOC	9-12-59	AMR
63	(WS-315A)WS-115A	S	DM-18A	228	CTL	9-17-59	PMR
64	Thor Able II	S	DM-1812-2	136		9-17-59	AMR

S-Success   PS-Partial Success   M-Malfunction   O-Orbit   R-Recovery

SEQUENCE NUMBER	WEAPON OR SPACE SYSTEM	RESULTS	MODEL DESIGNATION	VEHICLE SERIAL #	PROGRAM OR PAYLOAD	DATE	LOCATION OF LAUNCH
65	(WS-315A)WS-115A	S	DM-18A	222	IOC	9-22-59	AMR
66	(WS-315A)WS-115A	S	DM-18A	235	IOC	10-6-59	AMR
67	(WS-315A)WS-115A	S	DM-18A	239	CTL	10-6-59	PMR
68	(WS-315A)WS-115A	S	DM-18A	221	IOC	10-10-59	AMR
69	(WS-315A)WS-115A	S	DM-18A	220	CTL	10-21-59	PMR
70	(WS-315A)WS-115A	S	DM-18A	230	IOC	10-28-59	AMR
71	(WS-315A)WS-115A	S	DM-18A	238	IOC	11-3-59	AMR
72	Thor Agena	S-O	DM-1812-3	206		11-7-59	PMR
73	(WS-315A)WS-115A	S	DM-18A	181	CTL	11-12-59	PMR
74	(WS-315A)WS-115A	S	DM-18A	244	IOC	11-19-59	AMR
75	Thor Agena A	S-O	DM-1812-3	212		11-20-59	PMR
76	WS-115A	PS	DM-18A	254	IOC	12-1-59	AMR
77	WS-115A	S	DM-18A	265	CTL	12-1-59	PMR
78	WS-115A	M	DM-18A	185	CTL	12-14-59	PMR
79	WS-115A	S	DM-18A	255	IOC	12-17-59	AMR
80	Spec. Tst. Veh.	S	DM-18C	256	IOC	1-14-60	AMR
81	WS-115A	S	DM-18A	215	CTL	1-21-60	PMR
82	Thor Agena A	M	DM-1812-3	218		2-4-60	PMR
83	Spec Tst. Veh	S	DM-18C	259	IOC	2-9-60	AMR
84	Spec Tst. Veh	S	DM-18C	263	IOC	2-19-60	AMR
85	Thor Agena A	M	DM-1812-3	223		2-19-60	PMR
86	WS-115A	S	DM-18A	272	CTL	3-2-60	PMR
87	Thor Able IV	S-O	DM-1812-6A	219		3-11-60	AMR
88	Thor Able II	S-O	DM-1812-2	148	Tiros	4-1-60	AMR
89	Thor Able Star	S-O	DM-21A	257		4-13-60	AMR
90	Thor Agena A	S-O	DM-1812-3	234		4-15-60	PMR
91	Thor Delta	S	DM-19	144	Echo	5-13-60	AMR
92	Thor Able Star	S-O	DM-21A	281		6-22-60	AMR
93	WS-115A	S	DM-18A	233	CTL	6-22-60	PMR
94	Thor Agena A	S	DM-1812-3	160		6-29-60	PMR
95	Thor Agnea A	S-O-R	DM-1812-3	231		8-10-60	PMR
96	Thor Delta	S-O	DM-19	270	Echo I	8-12-60	AMR

S-Success PS-Partial Success M-Malfunction O-Oribt R-Recovery

SEQUENCE NUMBER	WEAPON OR SPACE SYSTEM	RESULTS	MODEL DESIGNATION	VEHICLE SERIAL #	PROGRAM OR PAYLOAD	DATE	LOCATION OF LAUNCH
97	Thor Agena A	S-O-R	DM-1812-3	237		8-18-60	PMR
98	Thor Able Star	M	DM-21A	262		8-18-60	AMR
99	Thor Agena A	S-O-R	DM-1812-3	246		9-13-60	PMR
100	Thor Able Star	DM-21A	DM-21A	293		10-4-60	AMR
101	WS-115A	S	DM-18A	186	CTL	10-11-60	PMR
102	Thor Agena B	S	DM-21	253		10-26-60	PMR
103	Thor Agena B	S-O-R	DM-21	297		11-12-60	PMR
104	Thor Delta	S-O	DM-19	245	Tiros A-2	11-23-60	AMR
105	Thor Able Star	M	DM-21A	283		11-30-60	AMR
106	Thor Agena B	S-O-R	DM-21	296		12-7-60	PMR
107	WS-115A	S	DM-18A	267	CTL	12-13-60	PMR
108	Thor Agena B	S-O	DM-21	258		12-30-60	PMR
109	Thor Agena B	S-O	DM-21	298		2-17-61	PMR
110	Thor Agena B	S-O	DM-21	261		2-18-61	PMR
111	Thor Able Star	S-O	DM-21A	313		2-21-61	AMR
112	Thor Delta	S-O	DM-19	295	Explorer X(P-14)	3-25-61	AMR
113	WS-115A	S	DM-18A	243	CTL	3-29-61	PMR
114	Thor Agena B	S	DM-21	300		3-30-61	PMR
115	Thor Agena B	S-O	DM-21	307		4-8-61	PMR
116	Thor Agena B	S	DM-21	302		6-8-61	PMR
117	Thor Agena B	S-O-R	DM-21	303		6-16-61	PMR
118	WS-115A	S	DM-18A	276	CTL	6-20-61	PMR
119	Thor Able Star	S-O	DM-21A	315		6-28-61	AMR
120	Thor Agena B	S-O-R	DM-21	308		7-7-61	AMR
121	Thor Delta	S-O	DM-19	286	Tiros A-3	7-12-61	AMR
122	Thor Agena B	M	DM-21	322		7-21-61	PMR
123	Thor Agena B	S	DM-21	309		8-4-61	PMR
124	Thor Delta	S-O	DM-19	312	Explorer XII(S-3)	8-15-61	AMR
125	Thor Agena B	S-O-R	DM-21	323		8-30-61	PMR
126	WS-115A	S	DM-18A	165	CTL	9-6-61	PMR
127	Thor Agena B	S-O-R	DM-21	310		9-12-61	PMR
128	Thor Agena B	S-O	DM-21	324		9-17-61	PMR

S-Success M-Malfunction O-Orbit R-Recovery

SEQUENCE NUMBER	WEAPON OR SPACE SYSTEM	RESULTS	MODEL DESIGNATION	VEHICLE SERIAL #	PROGRAM OR PAYLOAD	DATE	LOCATION OF LAUNCH
129	Thor Agena B	S-O-R	DM-21	328		10-13-61	PMR
130	Thor Agena B	S-O	DM-21	329		10-23-61	PMR
131	Thor Agena B	S-O	DM-21	330		11-5-61	PMR
132	Thor Agena B	S-O-R	DM-21	326		11-15-61	PMR
133	Thor Able Star	S-O	DM-21A	305		11-15-61	AMR
134	WS-115A	S	DM-18A	214	CTL	12-5-61	PMR
135	Thor Agena B	S-O-R	DM-21	325		12-12-61	PMR
136	Thor Agena B	S	DM-21	327		1-13-62	PMR
137	Thor AVT	S	DSV-2D	337	Big Shot, 1	1-15-62	AMR
138	Thor Able Star	S	DM-21A	311		1-24-62	AMR
139	Thor Delta	S-O	DM-19	317	Tiros A-4	2-8-62	AMR
140	Thor Agena B	S-O	DM-21	332		2-21-62	PMR
141	Thor Agena B	S-O-R	DM-21	241		2-27-62	PMR
142	Thor Delta	S-O	DM-19	301	OSO(S-16)	3-7-62	AMR
143	WS-115A	M	DM-18A	229	CTL	3-19-62	PMR
144	Thor Agena B	S-O	DM-21	331		4-18-62	PMR
145	Thor Delta	S-O	DM-19	320	Ariel(UK-1)(S-51)	4-26-62	AMR
146	Thor Agena B	S-O	DM-21	333		4-28-62	PMR
147	Thor Ballistic	S	DSV-2E	177	Spec. Ballistic	5-2-62	AMR
148	Thor Able Star	M	DM-21A	314		5-10-62	AMR
149	Thor Agena B	S-O	DM-21	334		5-15-62	PMR
150	Thor Agena B	S-O	DM-21	336		5-29-62	PMR
151	Thor Agena B	S-O	DM-21	335		6-1-62	PMR
152	Thor Ballistic	S	DSV-2E	199		6-4-62	PMR
153	Thor Agena B	S-O	DM-21	343		6-18-62	PMR
154	WS-115A	S	DM-18A	269	CTL	6-18-62	PMR
155	Thor Delta	S-O	DM-19	321	Tiros A-5	6-19-62	AMR
156	Thor Ballistic	M	DSV-2E	193		6-20-62	PMR
157	Thor Agena B	S-O	DM-21	339		6-22-62	PMR
158	Thor Agena D	S-O	DM-21	340		6-27-62	PMR
159	Thor Ballistic	S	DSV-2E	195		7-8-62	PMR
160	Thor Delta	S-O	DM-19	316	TSX-1	7-10-62	AMR

S-Success M-Malfunction O-Orbit R-Recovery

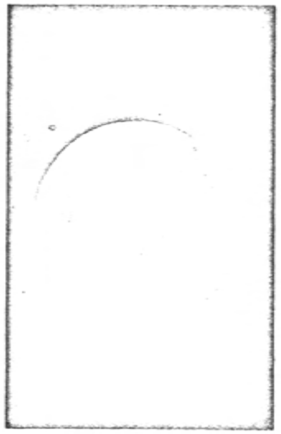
SEQUENCE NUMBER	WEAPON OR SPACE SYSTEM	RESULTS	MODEL DESIGNATION	VEHICLE SERIAL #	PROGRAM OR PAYLOAD	DATE	LOCATION OF LAUNCH
161	Thor AVT	S	DSV-2D	338	Big Shot 2	7-18-62	AMR
162	Thor Agena B	S-O	DM-21	342		7-22-62	PMR
163	Thor Ballistic	M	DSV-2E	180		7-25-62	PMR
164	Thor Agena B	S-O	DM-21	347		7-27-62	PMR
165	Thor Agena D	S-O	DM-21	344		8-1-62	PMR
166	Thor Agena D	S-O	DM-21	349		8-28-62	PMR
167	Thor Agena B	S-O	DM-21	348		9-1-62	PMR
168	Thor Agena B	S-O	DM-21	350		9-17-62	PMR
169	Thor Delta	S-O	DM-19	318	Tiros A-6(F)	9-18-62	AMR
170	Thor Agena B	S-O	DM-21	341	NASA S-27	9-28-62	PMR
171	Thor Agena D	S-O	DM-21	351		9-29-62	PMR
172	Thor Delta	S-O	DSV-3A	345	S-3A	10-2-62	AMR
173	Thor Agena B	S-O	DM-21	352		10-8-62	PMR
174	Thor Ballistic	M	DSV-2E	156		10-15-62	PMR
175	Thor Ballistic	S	DSV-2E	141		10-26-62	PMR
176	Thor Agena D	S-O	DM-21	353		10-26-62	PMR
177	Thor Delta	S-O	DSV-3A	346	S-3B	10-27-62	AMR
178	Thor Able Star	S-O	DM-21A	319		10-31-62	AMR
179	Thor Ballistic	S	DSV-2E	226		11-1-62	PMR
180	Thor Agena B	S-O	DM-21	356		11-5-62	PMR
181	Thor Agena B	S-O	DM-21	367		11-24-62	PMR
182	Thor Agena D	S-O	DM-21	361		12-4-62	PMR
183	Thor Agena D	S-O	DM-21	365		12-12-62	PMR
184	Thor Delta	S-O	DSV-3B	355	Relay 1	12-13-62	AMR
185	Thor Agena D	S-O	DM-21	368		12-14-62	PMR
186	Thor Agena D	S-O	DM-21	369		1-7-63	PMR
187	Thor Agena D	S-O	DM-21	363		1-16-63	PMR
188	Thor Delta	S-O	DSV-3B	358	Syncom 1	2-14-63	AMR
189	Thor Agena D	M	DSV-2C	354		2-28-63	PMR
190	Thor Agena D	S	DSV-2C	360		3-18-63	PMR
191	Thor Agena D	S-O	DM-21	376		4-1-63	PMR
192	Thor Delta	S	DSV-3B	357	Explorer 17	4-2-63	AMR
193	Thor Agena D	S	DM-21	372		4-26-63	PMR
194	Thor Delta	S-O	DSV-3B	366	Telstar	5-7-63	AMR
195	Thor Agena D	S-O	DSV-2C	364		5-18-63	PMR
196	Thor Agena D	S	DSV-2C	362		6-12-63	PMR

S-Success M-Malfunction O-Orbit

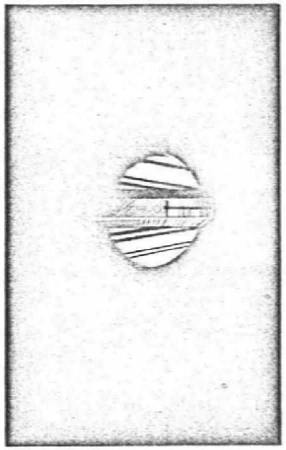
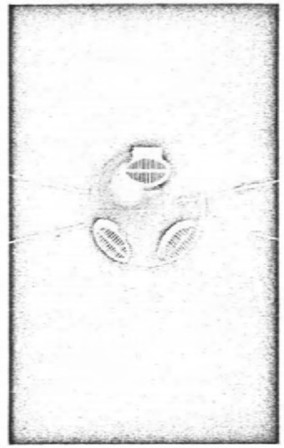
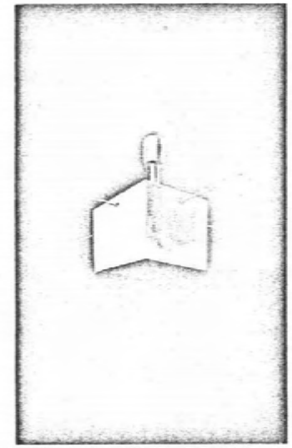
APPENDIX 4

Thor-Boosted Space Satellites and Probes

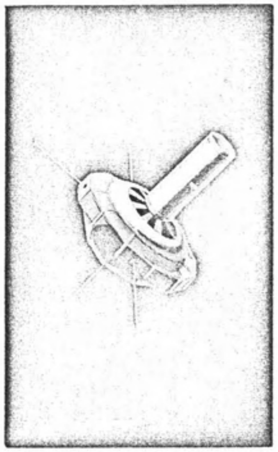
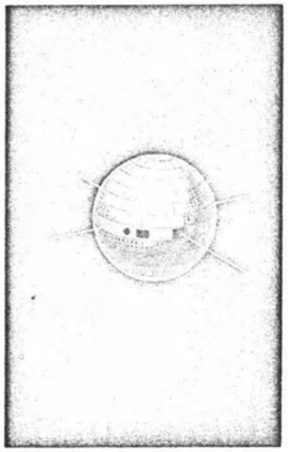
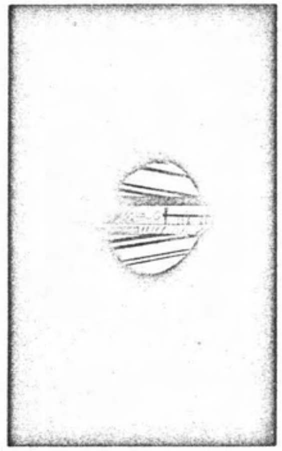
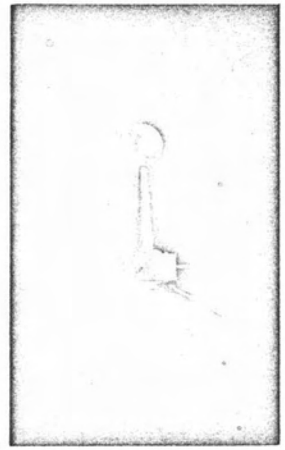
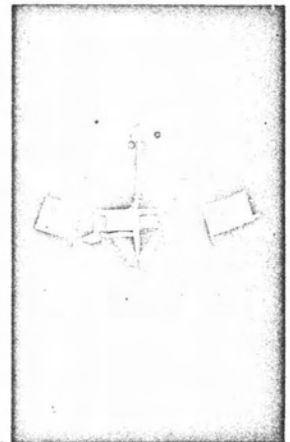
THOR-BOOSTED
SPACE SATELLITES AND PROBES

					
DESCRIPTION	LUNAR EXPLORATION	EXPLORATION OF RADIATION BELTS	DEEP SPACE PROBE	PASSIVE COMMUNICATIONS SATELLITE	METEOROLOGICAL SATELLITE
WEIGHTS (LBS)	90	142	43	137	270/286
ORBIT (N MI)	LUNAR PROBE	136/22,800	VENUS PROBE	900	380
BOOSTER	THOR ABLE I	THOR ABLE III	THOR ABLE IV	THOR DELTA	THOR ABLE THOR DELTA
CONTRACTING AGENCY	A F	A F	A F	NASA	NASA
IN ORBIT TO DATE	1	1	1	1	6

THOR-BOOSTED
SPACE SATELLITES AND PROBES

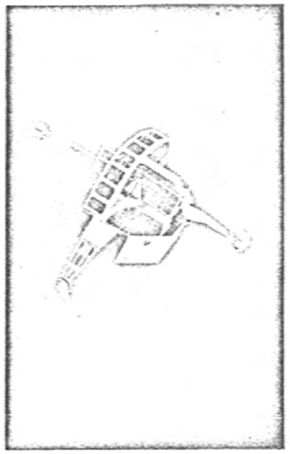
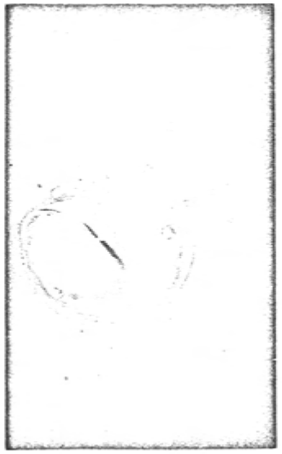
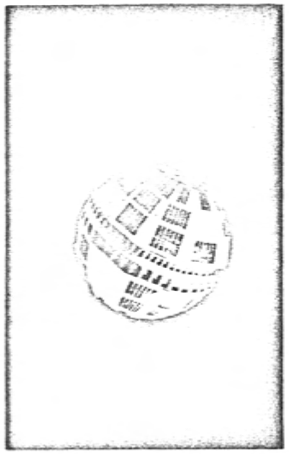
					
DESCRIPTION	NAVIGATIONAL SATELLITE	X-RAY RADIATION STUDY SATELLITE	IONOSPHERIC RADIO WAVE ATTENUATION STUDY SATELLITE	VAN ALLEN BELT RADIATION STUDY SATELLITE	GEODETIC SURVEY SATELLITE
WEIGHT	192 350	40 58	55 58	40 56	36
ORBIT (N MI)	460 550	460 550	500	460 550	500 550
BOOSTER	THOR ABLE II THOR ABLESTAR	PIGGYBACK THOR ABLESTAR	PIGGYBACK THOR ABLESTAR	PIGGYBACK THOR ABLESTAR	PIGGYBACK THOR ABLESTAR
SPONSORING AGENCY	US NAVY	US NAVY	US NAVY	US NAVY (U OF IOWA)	US ARMY
IN ORBIT TO DATE	5 (FLASHING LIGHT EXPERIMENT ALSO CARRIED ON ONE SATELLITE)	3	1	2	1

THOR-BOOSTED
SPACE SATELLITES AND PROBES

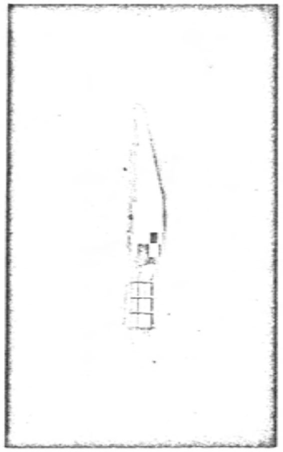
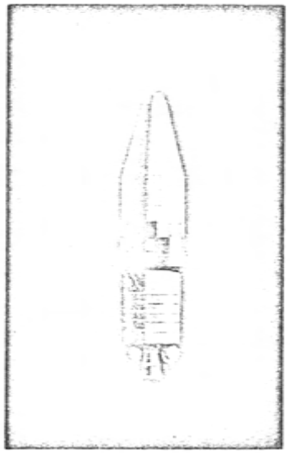
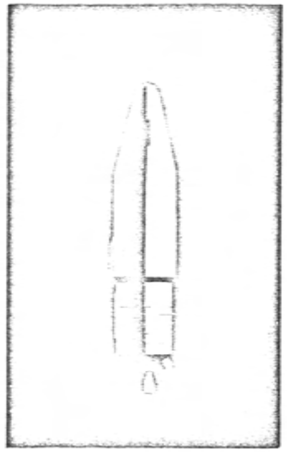
    

DESCRIPTION	NAVIGATIONAL & SYSTEMS TEST SATELLITE	COMMUNICATIONS SATELLITE	COMPOSITE MILITARY SATELLITE	MAGNETOMETER PROBE	ENERGETIC PARTICLES SATELLITE
WEIGHT	238	500	350	78	83
ORBIT (N MI)	490/625	510/670	600	95/97,500	157/41,800
BOOSTER	THOR ABLESTAR	THOR ABLESTAR	THOR ABLESTAR	THOR DELTA	THOR DELTA
SPONSORING AGENCY	US NAVY	US NAVY	ARMY/NAVY/NASA AIRFORCE	NASA	NASA
IN ORBIT TO DATE	1	1	1	1	1

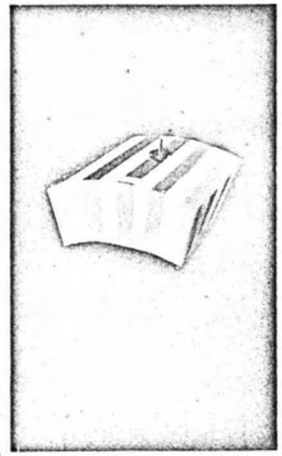
THOR-BOOSTED
SPACE SATELLITES AND PROBES

					
DESCRIPTION	ORBITING SOLAR OBSERVATORY	ATMOSPHERIC STRUCTURE SATELLITE	ACTIVE COMMUNICATIONS SATELLITE	SYNCHRONOUS ORBIT COMMUNICATIONS SATELLITE	ACTIVE COMMUNICATIONS SYSTEM
WEIGHT	446	375	125	125	170
ORBIT (N MI)	300 CIRCULAR	135-325	600-3,000	19,380 CIRC.	500-3,000
BOOSTER	THOR DELTA	THOR DELTA	THOR DELTA	THOR DELTA	THOR DELTA
CONTRACTING AGENCY	NASA	NASA	NASA	NASA	NASA
IN ORBIT TO DATE	1	1	1	1	2

THOR-BOOSTED
SPACE SATELLITES AND PROBES

					
DESCRIPTION	ORBITING 2ND STAGE WITH RECOVERABLE DATA CAPSULE	ORBITING 2ND STAGE WITH RECOVERABLE DATA CAPSULE		METEOROLOGICAL SATELLITE	STUDY STRUCTURE OF IONOSPHERE
WEIGHT	245/330 1300/1700	300 2150		650	275
ORBIT (N MI)	125/430	125/430		600 CIRCULAR	540 CIRCULAR
BOOSTER	THOR AGENA A	THOR AGENA B	AGENA D	THOR AGENA B	THOR AGENA B
CONTRACTING AGENCY	A F	A F	A F	NASA	NASA
IN ORBIT TO DATE	10	33	12	0	1

THOR-BOOSTED
SPACE SATELLITES AND PROBES



DESCRIPTION	ELECTRON MEASUREMENT SATELLITE	POLAR ORBITING GEOPHYSICAL OBSERV.	ORBITING SOLAR OBSERVATORY	AMATEUR RADIO	IMP
WEIGHT	155	900	N/A	10	
ORBIT (N MI)	200-550	140-500	N/A	135/263	
BOOSTER	THOR DELTA	THOR AGENA B	THOR AGENA B	PIGGYBACK THOR AGENA B	
CONTRACTING AGENT	NASA	NASA	NASA	A F	
IN ORBIT TO DATE	1	0	0	2	0

APPENDIX 5

Thor-Boosted Payload, Orbit, and Trajectory Data

THOR-BOOSTED PAYLOAD, ORBIT, AND TRAJECTORY DATA

NAME & CODE	LAUNCH U.T.	DESCENT U.T.	INCLI-NATION	NODAL PERIOD	PERIGEE APOGEE (N.MI.)	ECCEN-TRICITY	SCIENTIFIC & TOTAL WEIGHT (LBS)	DIA. X LENGTH	LAUNCH AGENCY	LAUNCH VEHICLE	LAUNCH SITE
59 ETA	08:42 10-11-58	PARTIAL SUCCESS	-	-	ALT. 78,000	-	S-39.6 T-51.1	29 X 30 IN.	USAF	THOR ABLE I	AMR
59 BETA	21:49:15 2-8-59	5 DAYS 3-5-59	87°.0	95.9 MIN.	86 525	.0587	S-245 T-1300	5 X 19.2 FT.	USAF	THOR AGENA	PMR
59 GAMMA	21:18 4-13-59	13 DAYS 4-26-59	89°.8	90.5 MIN.	123 191	.0094	S-245 T-1610	27 X 33 IN CAPSULE	USAF	THOR AGENA	PMR
59 DELTA 2	14:23 8-7-59	PRIOR TO JUL. 61	46°.9	766.4 MIN.	135 22,850	.7610	T-142	26 X 29 IN.	USAF	THOR ABLE III VAN-GUARD	AMR
59 EPSILON 2	19:00:08 8-13-59	548 DAYS 2-11-61	78°.94	109.2 MIN.	113 1189	.1306	S-195	27 X 33 IN CAPSULE	USAF	THOR AGENA	PMR
59 ZETA	19:24:41 8-19-59	62 DAYS 10-20-59	84°.0	95.3 MIN.	120 466	.0464	S-300 T-1700	27 X 33 IN CAPSULE	USAF	THOR AGENA	PMR
59 KAPPA	20:28:41 11-7-59	19 DAYS 11-26-59	81°.64	94.55 MIN.	90 460	.0498	S-300 T-1700	27 X 33 IN CAPSULE	USAF	THOR AGENA	PMR
59 LAMBDA	19:25:24 11-20-59	104 DAYS 3-8-60	80°.65	103.66 MIN.	102 903	.1015	S-300 T-1700	27 X 33 IN CAPSULE	USAF	THOR AGENA	PMR
60 ALPHA	13:00:07 3-11-60	SOLAR ORBIT	3°.35*	311.64 DAYS	.8061* .9951	.1040	S-43.0 T-94.8	26 IN. SPHERE	USAF	THOR ABLE	AMR
TIROS I 60 BETA 2	11:40:09 4-1-60	-	48°.41	99.16 MIN.	372 407	.0045	S-270	42 X 19 IN.	WEA. BUR	THOR ABLE	AMR
60 GAMMA 2	12:02:35 4-13-60	-	51°.28	95.84 MIN.	207 409	.0269	S-265	36 IN. SPHERE	US NAVY USAF	THOR ABLE STAR	AMR
60 DELTA	20:20:37 4-15-60	11 DAYS 4-26-60	80°.1	92.31 MIN.	95 330	.0323	S-300 T-1700	27 X 33 IN CAPSULE	USAF	THOR AGENA	PMR
60 ETA 1	05:54:08 6-22-60	-	66°.77	101.60 MIN.	339 559	.0294	S-223	36 IN. SPHERE	US NAVY USAF	THOR ABLE STAR	AMR
60 ETA 2	05:54:08 6-22-60	-	66°.77	101.64 MIN.	332 570	.0308	S-42	20 IN. SPHERE	US NAVY USAF	THOR ABLE STAR	AMR
60 THETA	20:37:54 8-10-60	96 DAYS 11-14-60	82°.85	94.13 MIN.	140 379	.0319	S-300 T-1700	27 X 33 IN CAPSULE	USAF	THOR AGENA	PMR
ECHO I 60 IOTA 1	09:39:43 8-12-60	-	47°.22	118.24 MIN.	819 912	.0108	T-137.4	100 FT. SPHERE	NASA	THOR DELTA	AMR
60 KAPPA	19:58:07 8-18-60	29 DAYS 9-16-60	79°.65	94.54 MIN.	97 435	.0452	S-300 T-1700	27 X 33 IN CAPSULE	USAF	THOR AGENA	PMR
60 MU	22:13:39 9-13.60	35DAYS 10-18-60	80°.9	94.23 MIN.	109 396	.0405	-	-	USAF	THOR AGENA	PMR
60 NU 1	17:50:07 10-4-60	-	28°.3	106.85 MIN.	508 670	.0196	S-300 T-505	51 IN. SPHERE	US NAVY USAF	THOR ABLE STAR	AMR
60 OMICRON	20:42:33 11-12-60	47 DAYS 12-24-60	81°.86	96.45 MIN.	102 535	.0579	S-300 T-2100	-	USAF	THOR AGENA	PMR
TIROS II 60 Pi1	11:13:03 11-23-60	-	48°.34	98.19 MIN.	330 403	.0096	T-280	-	NASA	THOR DELTA	AMR
60 SIGMA	20:21 12-7-60	116 DAYS 4-2-61	80°.82	93.81 MIN.	124 369	.0333	S-300 T-2100	-	USAF	THOR AGENA	PMR
60 TAU	20:36:51 12-20-60	34 DAYS 1-23-60	82°.80	92.98 MIN.	114 341	.0311	T-2100	5 X 25 FT.	USAF	THOR AGENA	PMR
61 EPSILON 1	20:25:02 2-17-61	-	80°.91	95.41 MIN.	173 415	.0324	S-300 T-2150	27 X 33IN CAPSULE	USAF	THOR AGENA	PMR
61 ZETA	22:58 2-18-61	426 DAYS 4-20-62	80°.74	97.86 MIN.	134 578	.0589	T-2100	5 X 25 FT.	USAF	THOR AGENA	PMR
61 ETA	03:35:04 2-22-61	36 DAYS 3-30-61	28°.38	96.22 MIN.	94 539	.0592	S-304 T-2100	-	US NAVY USAF	THOR ABLE STAR	AMR

*INCLINATION TO ECLIPTIC PERIHELION & APHELION IN ASTRONOMICAL UNITS

THOR-BOOSTED PAYLOAD, ORBIT, AND TRAJECTORY DATA

NAME & CODE	LAUNCH U.T.	DESCENT U.T.	INCLI-NATION	NODAL PERIOD	PERIGEE APOGEE (N.MI)	ECCEN-TRICITY	SCIENTIFIC & TOTAL WEIGHT (LBS.)	DIA. X LENGTH	LAUNCH AGENCY	LAUNCH VEHICLE	LAUNCH SITE
EXPLORER X 61 KAPPA	15:17:04 3-25-61	–	32°.9	83.53 HOURS	96 97300	.9325	T-78	24 X 36 IN.	NASA	THOR DELTA	AMR
61 LAMBDA 2	14:21:08 4-8-61	–	81°.94	101.49 MIN.	119 793	.0866	S-300	27 X 33IN CAPSULE	USAF	THOR AGENA	PMR
61 XI	23:05:41 6-16-61	26 DAYS 7-12-61	82°.11	90.87 MIN.	121 214	.0136	S-300 T-2100	27 X33 IN CAPSULE	USAF	THOR AGENA	PMR
61 OMICRON 1	04:23 6-29-61	–	66°.78	103.65 MIN.	466 546	.0098	S-175 T-1600	–	US NAVY USAF	THOR ABLE STAR	AMR
61 OMICRON 2	04:23 6-29-61	–	66°.78	103.84 MIN.	466 555	.0110	S-55 S-40	–	US NAVY USAF	THOR ABLE STAR	AMR
61 PI	23:30 7-7-61	151 DAYS 12-5-61	82°.94	95.08 MIN.	128 435	.0417	S-300 T-2100	27 X33IN CAPSULE	USAF	THOR AGENA	PMR
TIROS III 61 RHO 1	10:25:04 7-12-61	–	47°.90	100.32 MIN.	399 447	.0061	S-225	–	WEA.BUR	THOR DELTA	AMR
EXPLORER XII 61 UPSILON	03:33 8-16-61	–	33°.04	26.4 HOURS	156 41,600	.8525	T-83	26 X 5½ IN.	NASA	THOR DELTA	AMR
61 PSI	20:00:06 8-30-61	11DAYS 9-10-61	82°.14	91.51 MIN.	82 282	.0292	T-300 S-2100	27 X33IN CAPSULE	USAF	THOR AGENA	PMR
61 OMEGA 1	19:59:23 9-12-61	90 DAYS 12-11-61	82°.58	92.41 MIN.	19 298	.0025	T-300 S-2100	27 X33IN CAPSULE	USAF	THOR AGENA	PMR
61 A-BETA	21:00:14 9-17-61	39 DAYS 10-26-61	82°.70	90.95 MIN.	133 212	.0127	S-300 T-2100	27 X 33 IN CAPSULE	USAF	THOR AGENA	PMR
61 A-GAMMA 1	19:22:34 10-13-61	31 DAYS 11-13-61	81°.69	90.84 MIN.	126 208	.0118	S-300 T-2100	27 X 33 IN CAPSULE	USAF	THOR AGENA	PMR
61 A-EPSILON 1	20:00:31 11-5-61	–	82°.67	97.12 MIN.	121 560	.0575	S-300 T-2100	27 X 33 IN CAPSULE	USAF	THOR AGENA	PMR
61 A-ZETA 1	21:22:46 11-15-61	18 DAYS 12-3-61	81°.63	89.95 MIN.	129 161	.0054	S-300 T-2100	5 X 25 FT.	USAF	THOR AGENA	PMR
61 A-ETA 1	22:25:39 11-15-61	–	32°.30	105.58 MIN.	503 607	.0120	T-200	–	US NAVY USAF	THOR ABLE STAR	AMR
61 A-ETA 2	22:25:39 11-15-61	–	32°.43	105.64 MIN.	487 625	.0172	T-240	–	US NAVY USAF	THOR ABLE STAR	AMR
61 A-KAPPA 1	20:40:22 12-12-61	86 DAYS 3-8-62	81°.21	91.84 MIN.	132 252	.0187	S-300 T-2100	27 X 33 IN CAPSULE	USAF	THOR AGENA	PMR
OSCAR 61 A-KAPPA 2	20:40:22 12-12-61	50 DAYS 1-31-62	81°.21	91.79 MIN.	134 263	.0182	T-10	12" X 14" X 6" BOX	USAF	THOR AGENA	PMR
62 BETA 1 TIROS D (IV)	12:43:46 2-8-62	–	48°.32	100.29 MIN.	383 456	.0103	T-285	–	WEA. BUR. NASA	THOR DELTA	AMR
62 DELTA 1	2-21-62	16 DAYS 3-9-62			NOT AVAILABLE				USAF	THOR AGENA	PMR
62 EPSILON 1	19:39:21 2-27-62	22 DAYS 3-21-62	82°.23	90.22 MIN.	122 192	.0112	S-300 T-2100	5 X 25 FT.	USAF	THOR AGENA	PMR.
62 ZETA 1 OSO (S-16)	16:06:19 3-7-62	–	32°.82	95.93 MIN.	299 322	.0030	T-458	44 IN. X 37 IN.	NASA	THOR DELTA	AMR
62 LAMBDA 1	4-18-62	40 DAYS 5-28-62	73°.04	89.5 MIN.	109 163	.0073	–	–	USAF	THOR AGENA	PMR
62 OMICRON 1 ARIEL (S-51)	18:00 4-26-62	–	53°.87	100.91 MIN.	218 655	.0574	–	–	UK NASA	THOR DELTA	AMR
–	4-28-62	27 DAYS 5-26-62	73°.07	90.0 MIN.	97 200	.0141	–	–	USAF	THOR AGENA	PMR
62 SIGMA	5-15-62	–	82°.32	94.1 MIN.	157 348	.0196	–	–	USAF	THOR AGENA	PMR

THOR-BOOSTED PAYLOAD, ORBIT, AND TRAJECTORY DATA

NAME & CODE	LAUNCH U.T.	DESCENT U.T.	INCLI-NATION	NODAL PERIOD	PERIGEE APOGEE (N.MI.)	ECCEN-TRICITY	SCIENTIFIC & TOTAL WEIGHT (LBS)	DIA. X LENGTH	LAUNCH AGENCY	LAUNCH VEHICLE	LAUNCH SITE
62 PHI	5-30-62	12 DAYS 6-11-62	74°.10	89.6 MIN.	104 162	.0093	-	-	USAF	THOR AGENA	PMR
62 CHI 1	6-2-62	26 DAYS 6-28-62	74°.26	90.5 MIN.	114 212	.0135	-	-	USAF	THOR AGENA	PMR
62 CHI 2 OSCAR 2	6-2-62	19 DAYS 6-21-62	74°.26	90.5 MIN.	112 209	.0137	10	12"x 14"x 6" BOX	USAF	THOR AGENA	PMR
62 OMEGA	6-18-62	-	82°.13	92.3 MIN.	204 212	.0029	-	-	USAF	THOR AGENA	PMR
62 A-ALPHA TIROS E	12:19:01 6-19-62	-	58°.10	100.5 MIN.	318 525	.0251	225	-	NASA	THOR DELTA	AMR
62 A-BETA	6-23-62	10 DAYS 7-7-62	75°.09	89.6 MIN.	117 163	.0064	-	-	USAF	THOR AGENA	PMR
62 A-GAMMA	6-28-62	18 DAYS 9-14-62	76°.04	93.6 MIN.	122 372	.0351	-	-	USAF	THOR DELTA	PMR
62 A-EPSILON TELSTAR 1	08:85 7-10-62	-	44°.78	157.5 MIN.	513 3040	.2421	170	-	NASA	THOR DELTA	AMR
62 A-ETA	7-21-62	24 DAYS 8-14-62	70°.31	90.43 MIN.	113 213	.0131	-	-	USAF	THOR AGENA	PMR
62 A-THETA	7-28-62	27 DAYS 8-24-62	70°.00	90.64 MIN.	120 210	.0123	-	-	USAF	THOR AGENA	PMR
62 A-KAPPA	8-2-62	24 DAYS 8-26-62	82°.20	90.73 MIN.	112 224	.0157	-	-	USAF	THOR AGENA	PMR
62 A-SIGMA	8-2 -62	12 DAYS 9-10-62	65°.15	90.4 MIN.	97 221	.0106	-	-	USAF	THOR AGENA	PMR
62 A-UPSILON	9-1-62	-	82°.84	94.4 MIN.	182 370	.0221	-	-	USAF	THOR AGENA	PMR
62 A-CHI	9-17-62	63 DAYS 11-19-62	81°.87	93.4 MIN.	111 367	.0349	-	-	USAF	THOR AGENA	PMR
62 A-PSI TIROS F	08:53 9-18-62	-	58°.29	98.7 MIN	378 399	.0025	285	-	NASA	THOR DELTA	AMR
62 B-ALPHA ALOUTTE	9-29-62	-	80°.52	105.5 MIN.	540 552	.0017	319	-	CANADA NASA	THOR AGENA	PMR
62 B-BETA	9-29-62	15 DAYS 10-14-62	65°.41	90.32 MIN.	104 210	.0148	-	-	USAF	THOR AGENA	PMR
62 B-GAMMA EXPLORER 14	22:11:14 10-2-62	-	32°.95	36.25 HRS.	152 53320	.8947	89	-	NASA	THOR DELTA	AMR
62 B -EPSILON	10-9-62	38 DAYS 11-16-62	81°.96	90.95 MIN.	113 231	.0162	-	-	USAF	THOR AGENA	PMR
62 B-KAPPA	10-26-62	-	71°.44	147.98 MIN.	100 3010	.2920	-	-	USAF	THOR AGENA	PMR
62 B-LAMBDA EXPLORER 15	22:15 10-27-62	-	18°.01	315.4 MIN.	176 9511	.5646	-	-	NASA	THOR DELTA	AMR
62 B-MU	10-31-62	-	50°.13	107.8 MIN.	582 647	.0068	-	-	AF, NASA NAVY ARMY	THOR ABLE STAR	AMR
62 B-OMICRON	11-5-62	28 DAYS 12-3-62	74°.95	90.72 MIN.	111 218	.0149	-	-	USAF	THOR AGENA	PMR
62 B-RHO 1	11-24-62	19 DAYS 12-13-62	65°.14	89.98 MIN.	112 148	.0100	-	-	USAF	THOR AGENA	PMR
62 B-SIGMA	12-4-62	4 DAYS 12-8-62	65°.19	89.2 MIN.	103 126	.0065	-	-	USAF	THOR AGENA	PMR
62 B-TAU 1	12-13-62	-	70°.28	155.4 MIN.	120 1525	.1653	-	-	USAF	THOR AGENA	PMR

THOR-BOOSTED PAYLOAD, ORBIT, AND TRAJECTORY DATA

NAME & CODE	LAUNCH U.T.	DESCENT U.T	INCLI-NATION	NODAL PERIOD	PERIGEE APOGEE (N.MI.)	ECCEN-TRICITY	SCIENTIFIC & TOTAL WEIGHT (LBS)	DIA. X LENGTH	LAUNCH AGENCY	LAUNCH VEHICLE	LAUNCH SITE
62 B– UPSILON RELAY 1	82:30 12-13-62	-	47°.77	184.9 MIN.	700 4030	.2863	-	-	NASA	THOR DELTA	AMR
62 B – PHI	12-14-62	25 DAYS 1-8-63	70°.92	90.47 MIN.	113 214	.0139	-	-	USAF	THOR AGENA	PMR
63–2A	1-7-63	17 DAYS 1-24-63	82°.23	90.53 MIN.	106 205	.0136	-	-	USAF	THOR AGENA	PMR
63–3A	1-16-63	-	81°.97	94.66 MIN.	272 297	.0029	-	-	USAF	THOR AGENA	PMR
63-4 A SYNCOM 1	05:35 8-14-63	-	33°.51	1426.5 MIN	18484 20013	.0338	-	-	NASA	THOR DELTA	AMR
63-7A	4-1-63	25 DAYS 4-26-63	75°.40	90.69 MIN.	114 217	.0144	-	-	USAF	THOR AGENA	PMR
63-9A (S-6) EXPLORER 17	02:00:02 4-3-63	-	57°.63	96.35 MIN.	142 505	.0485	-	-	NASA	THOR DELTA	AMR
63-13A TELSTAR 2	11:38:03 5-7-63	-	42°.75	224.8 MIN.	525 5830	.4009	-	-	NASA	THOR DELTA	AMR
63-16A	5-18-63	-	74°.53	91.13 MIN.	85 277	.0268	-	-	USAF	THOR AGENA	PMR
-	6-13-63	-	81°.87	90.67 MIN.	107 224	.0173	-	-	USAF	THOR AGENA	PMR

APPENDIX 6

Abbreviations

ABBREVIATIONS

ABL	Allegany Ballistics Laboratory
ACSP	A.C. Spark Plug Division, General Motors Corporation
AFMTC	Air Force Missile Training Center
AF:SSD	Air Force: Space Systems Division
AGC	Aerojet General Corporation
AMC	Air Materiel Command
AMR	Atlantic Missile Range
APL	Applied Physics Laboratory, John Hopkins University
ARDC	Air Research and Development Command
ARL	Atlantic Research Laboratories
ARPA	Advanced Research Projects Agency
AVT	Applications Vertical Test
BAC	Bell Aircraft Company
BMD	Ballistic Missile Division
BMO	Ballistic Missile Office
BTL	Bell Telephone Laboratories
CEA	Control Electronics Assembly
CTL	Combat Training Launch
DAC	Douglas Aircraft Company
DM	Douglas Model
DSV	Douglas Space Vehicle
GE	General Electric Company
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
ICBM	Intercontinental Ballistic Missile
IOC	Initial Operational Capability
IRBM	Intermediate-Range Ballistic Missile
IRFNA	Inhibited Red Fuming Nitric Acid
LMSC	Lockheed Missiles and Space Company
LMSD	Lockheed Missiles and Space Division
LRC	Langley Research Center
NASA	National Aeronautics and Space Administration
OSO	Orbiting Solar Observatory

ABBREVIATIONS (Continued)

P & W	Pratt & Whitney
PGRTV	Precisely Guided Re-entry Test Vehicle
PMR	Pacific Missile Range
RAF	Royal Air Force
RCA	Radio Corporation of America
R & D	Research and Development
RJ-1	Ramjet-1
R/NAA	Rocketdyne--Division of North American
RP-1	Rocket Propellant-1
RTV	Re-entry Test Vehicle
SAC	Strategic Air Command-USAF
SM	Santa Monica
SM	Strategic Missile
SSD	Space Systems Division, Air Force Systems Command
STL	Space Technology Laboratories, Inc.
TIROS	Television and Infra-Red Observation Satellite
UDMH	Unsymmetrical Dimethyl-Hydrazine
UK	United Kingdom
USAF	United States Air Force
VAFB	Vandenberg Air Force Base
WIFNA	White Inhibited Fuming Nitric Acid
WS	Weapons System
XSM	Experimental Strategic Missile

News From MCDONNELL DOUGLAS CORPORATION

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(213) 399-9311, extension 2566

DELTA VEHICLE LAUNCH RECORD

DELTA NUMBER	MISSION	RESULTS	LAUNCH DATE
1	Echo	failed	May 13, 1960
2	Echo I	successful	Aug.12, 1960
3	TIROS II	successful	Nov. 23, 1960
4	Explorer X (P-14)	successful	Mar. 25, 1961
5	TIROS III	successful	July 12, 1961
6	Explorer XII (S-C)	successful	Aug. 16, 1961
7	TIROS IV	successful	Feb. 8, 1962
8	OSO I	successful	Mar. 7, 1962
9	Ariel-I (UK-1)	successful	Apr. 26, 1962
10	TIROS V	successful	June 19, 1962
11	Telstar I	successful	July 10, 1962
12	TIROS VI	successful	Sept. 18, 1962
13	Explorer XIV (S-3A)	successful	Oct. 2, 1962
14	Explorer XV (S-3B)	successful	Oct. 27, 1962
15	Relay I	successful	Dec. 13, 1962
16	Syncom I	successful	Feb. 14, 1963
17	Explorer XVII	successful	April 2, 1963
18	Telstar II	successful	May 7, 1963
19	TIROS VII	successful	June 19, 1963
20	Syncom II	successful	July 26, 1963
21	Explorer XVIII (IMP-1)	successful	Nov. 26, 1963
22	TIROS VIII	successful	Dec. 21, 1963
23	Relay II	successful	Jan. 21, 1964
24	Beacon Explorer (S-66)	failed	Mar. 19, 1964
25	Syncom III	successful	Aug. 19, 1964
26	Explorer XXI (IMP-2)	successful	Oct. 3, 1964
27	Explorer XXVI (Energetic Particles Explorer-D)	successful	Dec. 21, 1964
28	TIROS IX	successful	Jan. 22, 1965
29	OSO II	successful	Feb. 3, 1965
30	Early Bird	successful	Apr. 6, 1965
31	Explorer XXVIII (IMP-3)	successful	May 29, 1965
32	TIROS X	successful	July 1, 1965
33	OSO-C	failed	Aug. 25, 1965
34	Explorer XXIX (GEOS I)	successful	Nov. 6, 1965
35	Pioneer VI (solar orbit)	successful	Dec. 16, 1965
36	ESSA I	successful	Feb. 3, 1966
37	ESSA II	successful	Feb. 28, 1966
38	Explorer XXXII (Atmosphere Explorer-B)	successful	May 25, 1966
39	Explorer XXXIII (AIMP)	successful	July 1, 1966
40	Pioneer VII (solar orbit)	successful	Aug. 17, 1966
41	ESSA III	successful	Oct. 2, 1966 (WTR)

(more)

DELTA NUMBER	MISSION	RESULTS	LAUNCH DATE
42	Intelsat IIA	successful	Oct. 26, 1966
43	Biosatellite (BIOS I)	successful	Dec. 14, 1966
44	Intelsat IIB	successful	Jan. 11, 1967
45	ESSA IV	successful	Jan. 26, 1967 (WTR)
46	OSO III	successful	Mar. 8, 1967
47	Intelsat IIC	successful	Mar. 22, 1967
48	ESSA V	successful	Apr. 20, 1967 (WTR)
49	Explorer XXXIV (IMP-6)	successful	May 24, 1967 (WTR)
50	Explorer XXXV (IMP-5) (lunar orbit)	successful	July 19, 1967
51	Biosatellite (BIOS II)	successful	Sept. 7, 1967
52	Intelsat IID	successful	Sept. 27, 1967
53	OSO IV	successful	Oct. 18, 1967
54	ESSA VI	successful	Nov. 10, 1967 (WTR)
55	Pioneer VIII (solar orbit) (TTS-1 piggyback satellite placed in earth orbit)	successful	Dec. 13, 1967
56	Explorer XXXVI (GEOS B)	successful	Jan. 11, 1968 (WTR)
57	Explorer XXXVIII (RAE-A)	successful	July 4, 1968 (WTR)
58	ESSA VII	successful	Aug. 16, 1968 (WTR)
59	Intelsat III	failed	Sept. 18, 1968
60	Pioneer IX (solar orbit) (TETR communications satellite placed in earth orbit)	successful	Nov. 8, 1968
61	HEOS-A	successful	Dec. 5, 1968
62	ESSA VIII	successful	Dec. 15, 1968 (WTR)
63	Intelsat III (Atlantic)	successful	Dec. 18, 1968
64	OSO V	successful	Jan. 22, 1969
65	ISIS-A	successful	Jan. 29, 1969 (WTR)
66	Intelsat III (Pacific)	successful	Feb. 5, 1969

(WTR--Western Test Range--all other launches from Cape Kennedy)

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