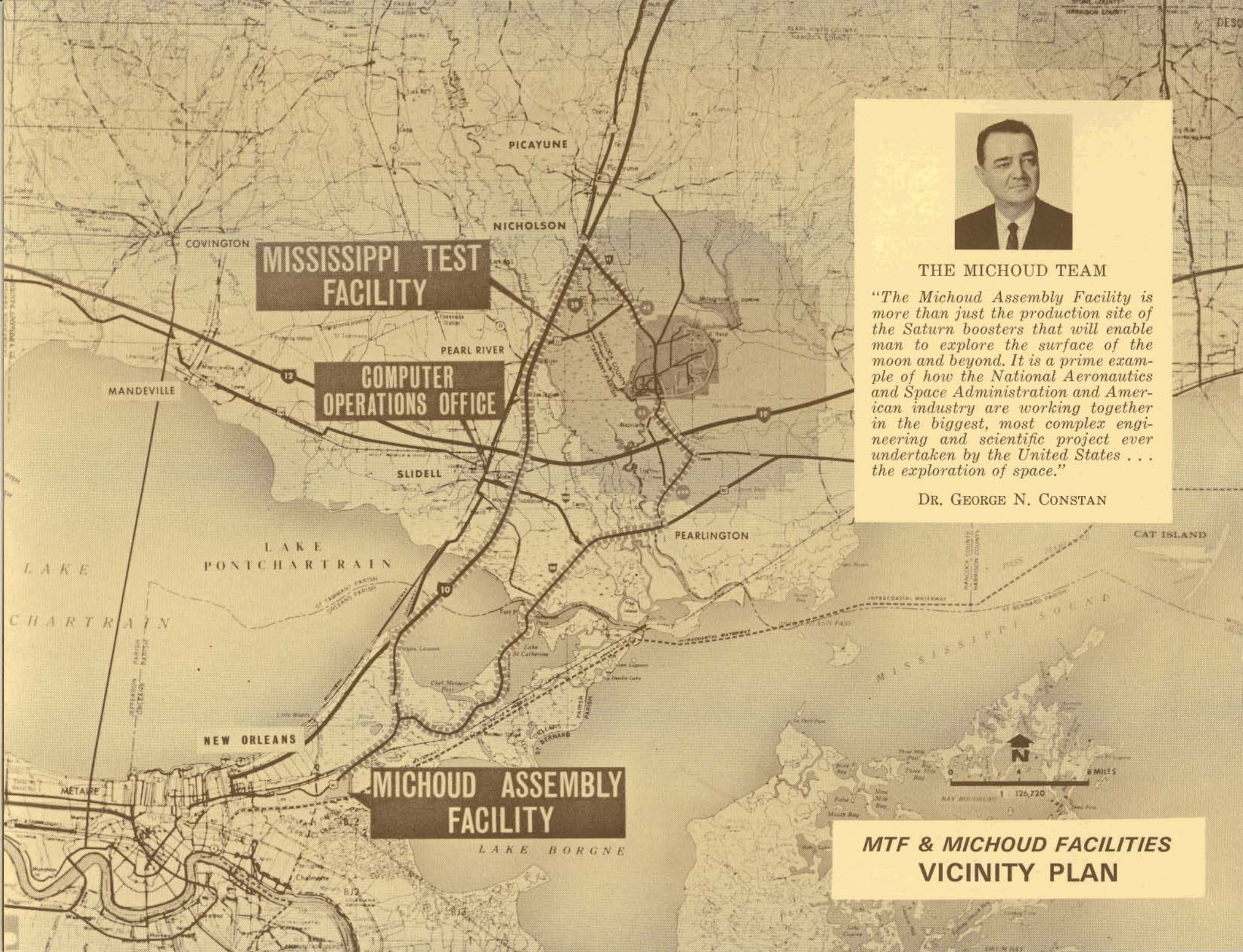
FROM MICHOUD TO THE MOON

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION



THE MICHOUD TEAM

"The Michoud Assembly Facility is more than just the production site of the Saturn boosters that will enable man to explore the surface of the moon and beyond. It is a prime example of how the National Aeronautics and Space Administration and American industry are working together in the biggest, most complex engineering and scientific project ever undertaken by the United States . . . the exploration of space."

DR. GEORGE N. CONSTAN

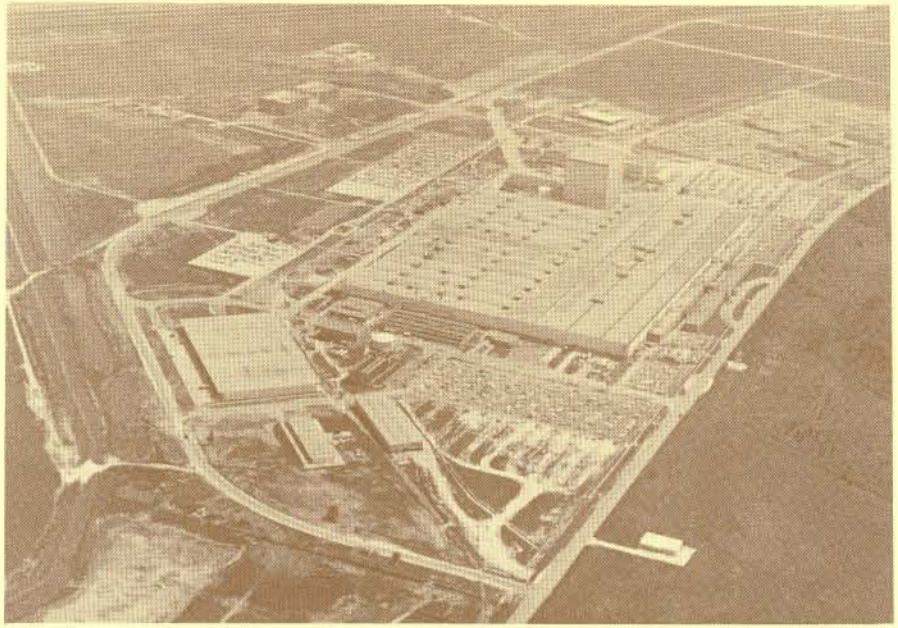
MTF & MICHOUD FACILITIES
VICINITY PLAN

MICHOUD ASSEMBLY FACILITY

HISTORY

Fifty years of progress is illustrated at the site of the National Aeronautics and Space Administration's Michoud Assembly Facility in New Orleans, La. Both the one-horse wagon, photographed in 1915, and the 1.5 million-pound-thrust Saturn I rocket booster are shown passing the same aged chimneys that frame the entrance to Michoud's Administration Building.

The uprated Saturn I (Saturn IB) and Saturn V first stages that will enable man to explore the surface of the moon and beyond are assembled at Michoud, a division of the George C. Marshall Space Flight Center at Huntsville, Ala. The facility is managed by Dr. George N. Constan.



FACILITIES

Until September 7, 1961, the 20-year-old Michoud Ordnance Plant had seen relatively little use. Then, after an intensive nation-wide survey, NASA announced it would use the facility for the fabrication of large space vehicle first stages.

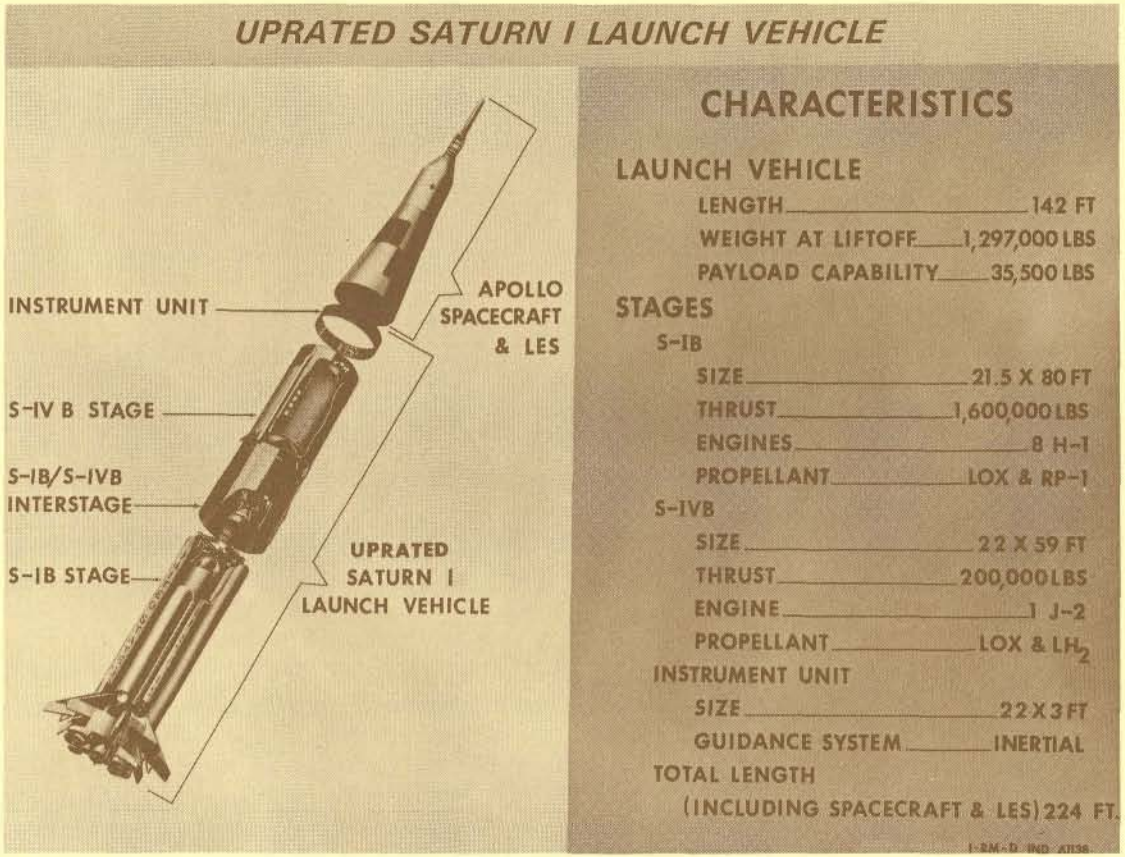
The plant was originally conceived as a shipyard during World War II. It was used briefly for the manufacture of cargo planes and later—during the Korean conflict—for the building of tank engines.

Three primary factors influenced the selection of Michoud: It offered several existing buildings, including a 43-acre manufacturing building; it was accessible by water, necessary in transporting large rocket stages; and sparsely inhabited land was available nearby for a static testing site.

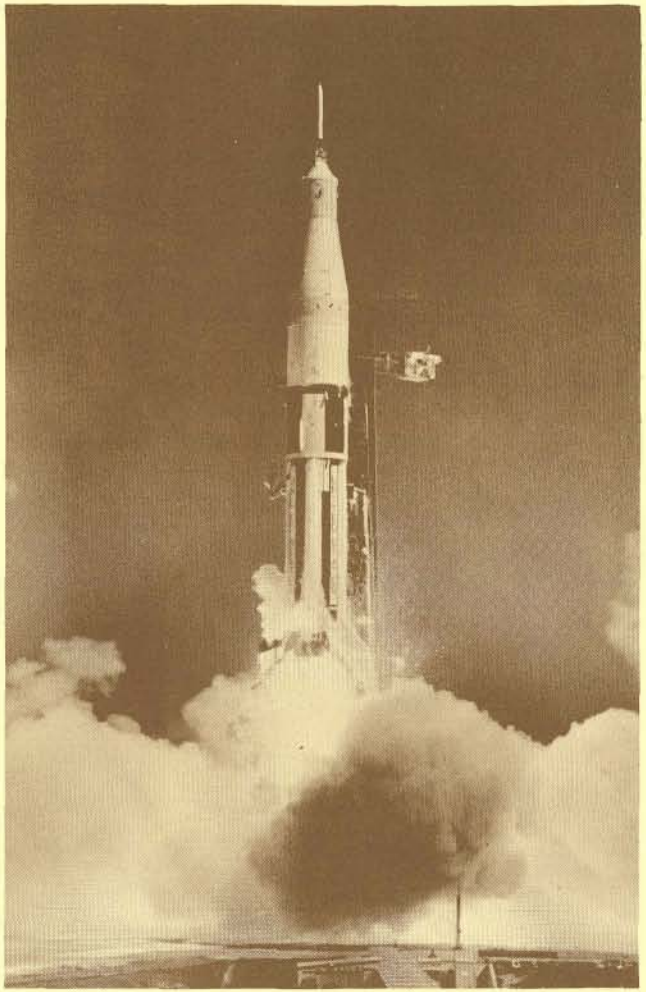
The 900-acre Michoud Assembly Facility is located on a triangular tract 15 miles east of downtown New Orleans off U. S. Route 90.

Support services to all NASA-contractor elements operating at Michoud are provided by the firm of Mason-Rust. These services include: Transportation, security, fire protection, photography, medical, food, supply, communications, custodial, plant engineering and maintenance, messenger and mail, reproduction and utilities.

UPRATED SATURN I



The two-stage uprated Saturn I (Saturn IB) space vehicle will launch manned Apollo spacecraft for astronaut training and spacecraft development preparatory to manned flights to the moon using the larger Saturn V.
Standing 224 feet tall, the uprated Saturn I is a "hybrid" vehicle, incorporating the first stage of the pioneering Saturn I and the third stage of the more powerful Saturn V. For this application, the Saturn I's first stage was reduced in weight by some 20,000 pounds, and its eight H-1 engines were increased in thrust from 188,000 to 200,000 pounds each.



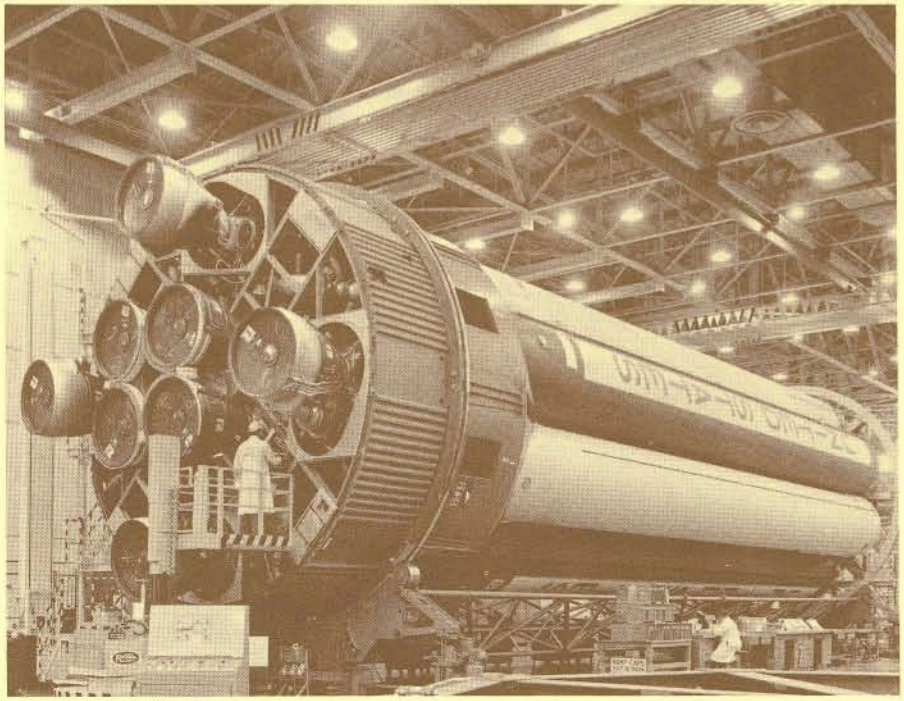
This launch of the two-stage uprated Saturn I (Saturn IB) on February 26, 1966, marked the beginning of the National Aeronautics and Space Administration's uprated Saturn I series of Apollo space flights. It was the first test in space of the spacecraft which will send Americans to explore the moon.

UPRATED SATURN I FIRST STAGE

The uprated Saturn I first stage—designated S-IB—is a refined version of the reliable Saturn I booster, all ten of which were successfully launched between October, 1961, and July, 1965.

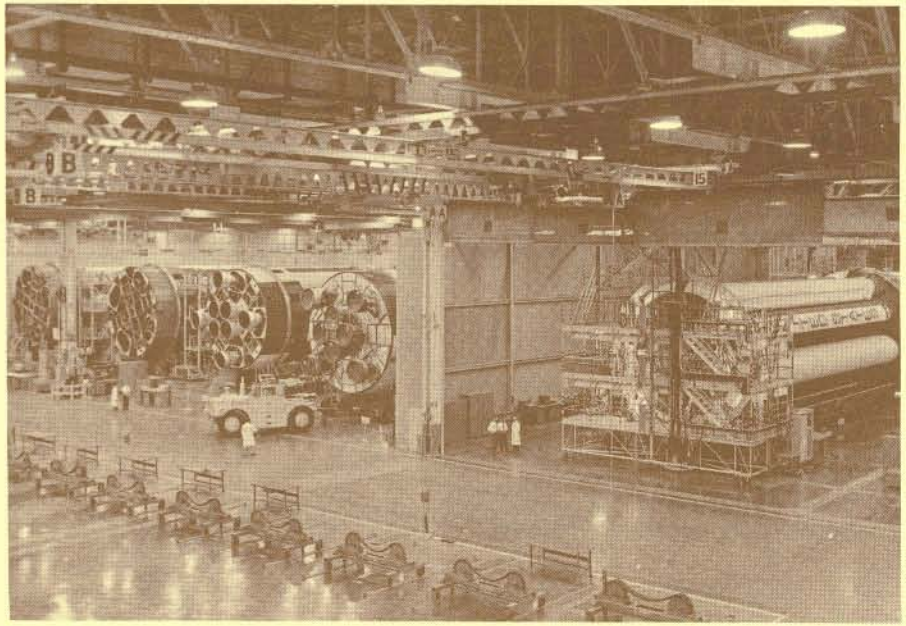
The newer Saturn I first stage measures 21 feet in diameter and 80 feet in height. It contains more than 900,000 component parts. Its eight engines develop a total thrust equivalent to 33 million horsepower.

The booster, built by the Chrysler Corporation Space Division, is comprised of eight 70-inch-diameter tanks assembled around a 105-inch-diameter tank. Four of the outer tanks contain RP-1 (kerosene) fuel and four carry liquid oxygen. The larger center tank contains only liquid oxygen. When fueled, the booster weighs about 1,000,000 pounds.



During flight, the booster engines will burn for two and one half minutes, consuming more than 100,000 gallons of propellants.

Uprated Saturn I first stages are static fired at the Marshall Space Flight Center, Huntsville, Ala., while Saturn V boosters will be static tested at Marshall's Mississippi Test Facility, Hancock County, Miss. Both stages will be launched from the NASA-Kennedy Space Center, Fla.

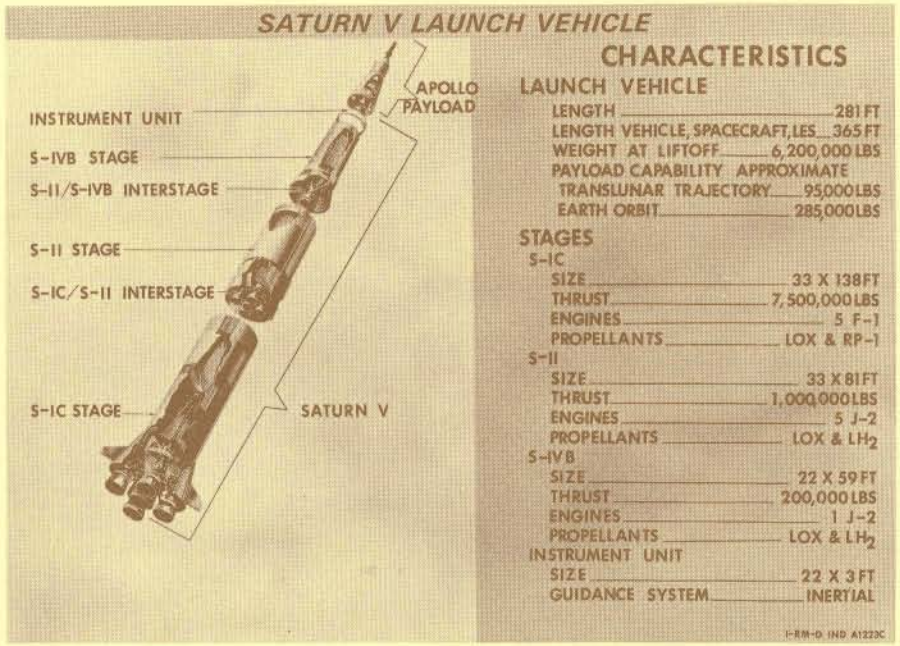


Five uprated Saturn I boosters are shown in final assembly and checkout positions in Michoud's Manufacturing Building.

Chrysler, which assembled the final two Saturn I first stages, is now producing the uprated Saturn I boosters.

Following assembly, the Saturn I first stages are moved to a functional checkout bay for tests of the boosters' mechanical, electrical, hydraulic and pneumatic systems.

SATURN V

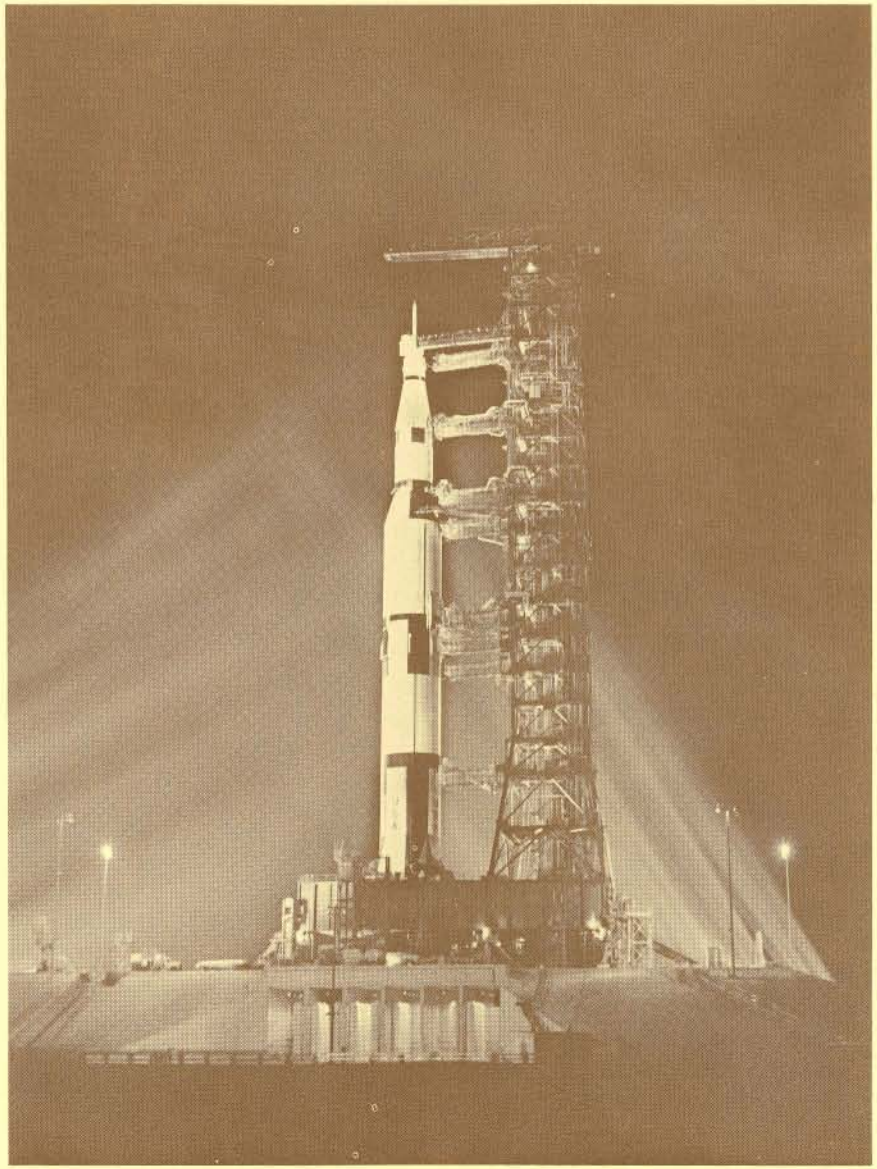


Establishment of a manned lunar landing as a national goal brought about the early need for a space vehicle much larger than the Saturn I. In January, 1962, following several months of extensive studies, NASA approved the development of an advance Saturn vehicle, designated Saturn V.

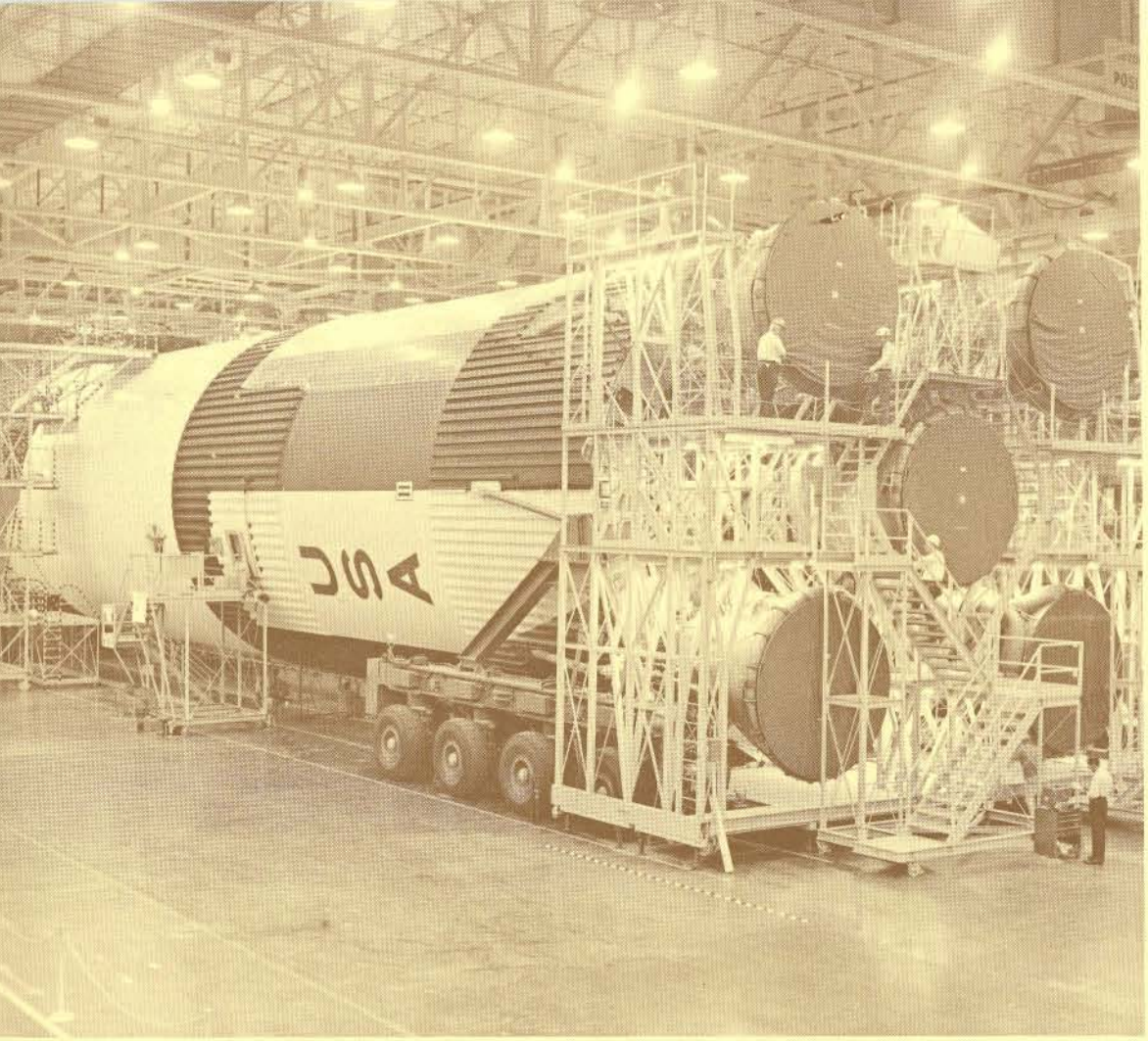
Standing 365 feet high, the three-stage Saturn V is taller than the Statue of Liberty. At lift-off, it will weigh more than six million pounds, which corresponds to the take-off weight of some 25 fully-loaded large jet airliners. Its three stages, firing in sequence, will burn only 17 minutes in the Apollo lunar mission.

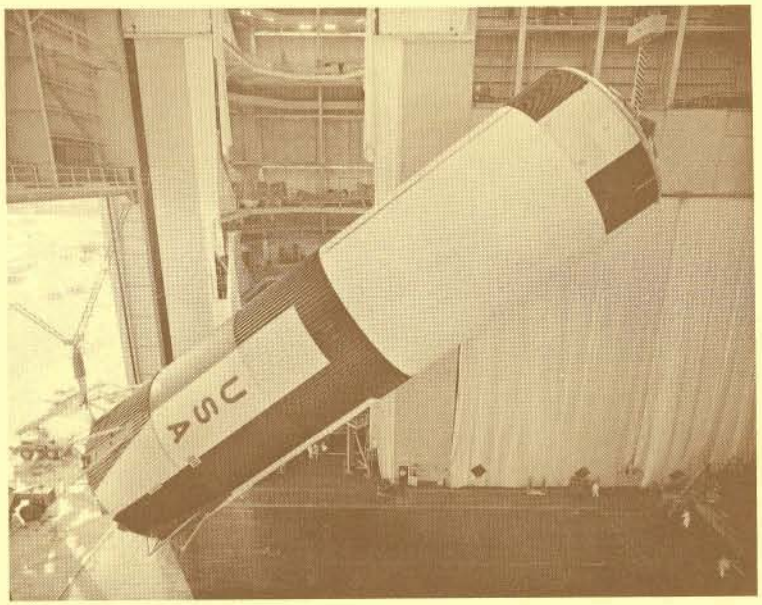
The Saturn V's payload, a 45-ton Apollo spacecraft, is equal in weight to 25 standard size, four-door automobiles.

At right, a full-scale Saturn V facilities checkout vehicle is shown assembled on its crawler transporter at the Kennedy Space Center.



SATURN V FIRST STAGE



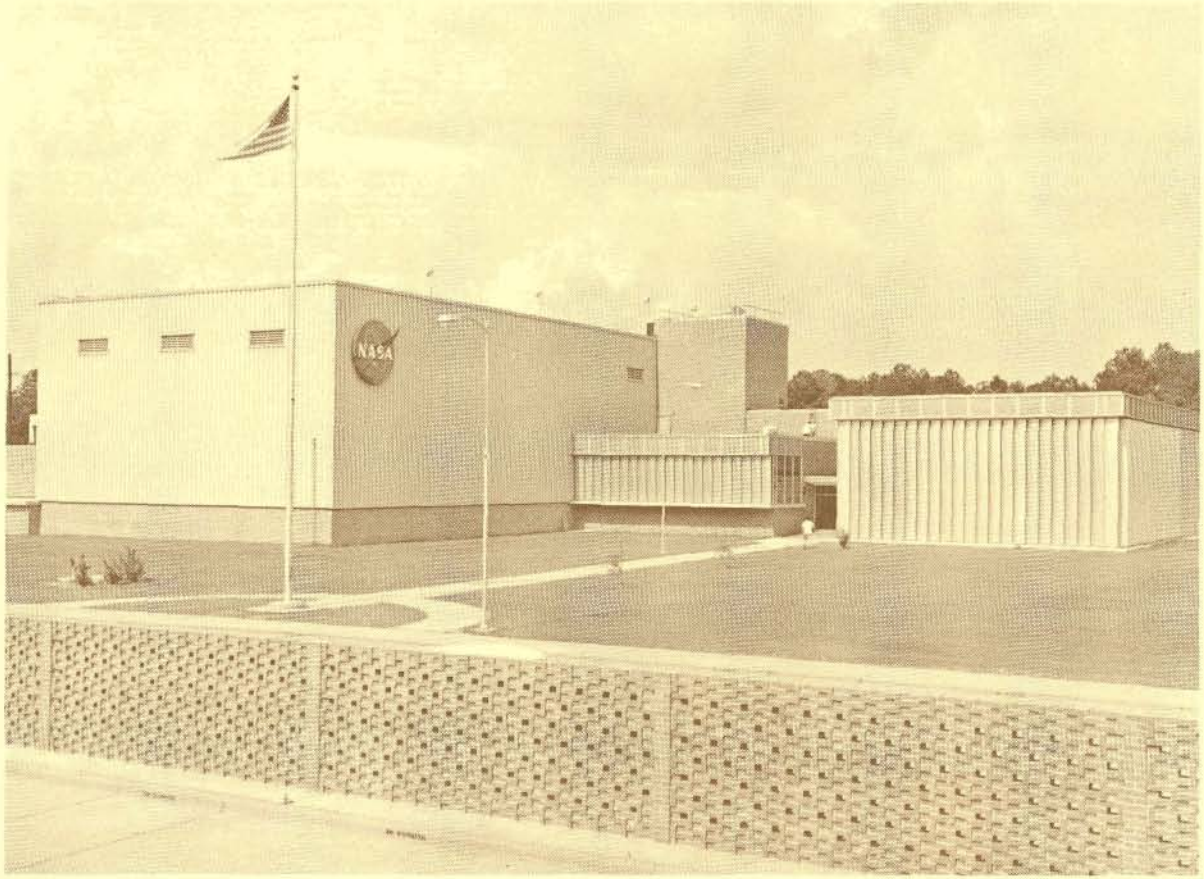


The first stage of the Saturn V—designated S-IC—is built at Michoud by The Boeing Company Launch Systems Branch. It measures 33 feet in diameter and 138 feet tall. Generating 7.5 million pounds of thrust at lift-off, it will boost the Apollo spacecraft on the first leg of the lunar voyage.

The first stage's two propellant tanks have a capacity of more than 500,000 gallons of liquid oxygen and RP-1 (kerosene) fuel. Powered by five, 1.5-million-pound-thrust F-1 engines, the booster will develop a total thrust equivalent to about 160 million horsepower. Fueled, the first stage will weigh in excess of 4.5 million pounds.

A Saturn V booster is removed from its assembly station in Michoud's 215-foot-tall Vertical Assembly Building. After vertical assembly, the booster is lowered onto a special transporter and removed to the Manufacturing Building for installation of engines, wiring and other internal components. It then undergoes a series of functional tests prior to static firing.

COMPUTER OPERATIONS OFFICE



Michoud's Computer Operations Office in nearby Slidell, La., is one of the largest high-speed electronic computer centers in the nation. The center, operated for NASA by the Range Systems Division of Ling-Temco-Vought, Inc., also supports NASA's Mississippi Test Facility (MTF) where the first two stages of the Saturn V rocket are static fired. The present system at Slidell includes operation and maintenance of some 20 digital and analog computers, a data transmission system, a data reduction system and related electronic equipment.

Computers are employed in NASA's space programs because of their enormous memory capability and lightning-like processing speed. Some of the computer applications in the Michoud and MTF operations include pre-launch performance evaluation, scientific programming, theoretical problem solving, inventory of components, personnel utilization, payroll, and record-keeping.

A digital computer solves problems by arithmetic processes, making very simple logical decisions. An analog computer is more versatile. For example, it can be used to simulate the flight performance of a space vehicle. This type of computer is shown above.

WATER TRANSPORTATION

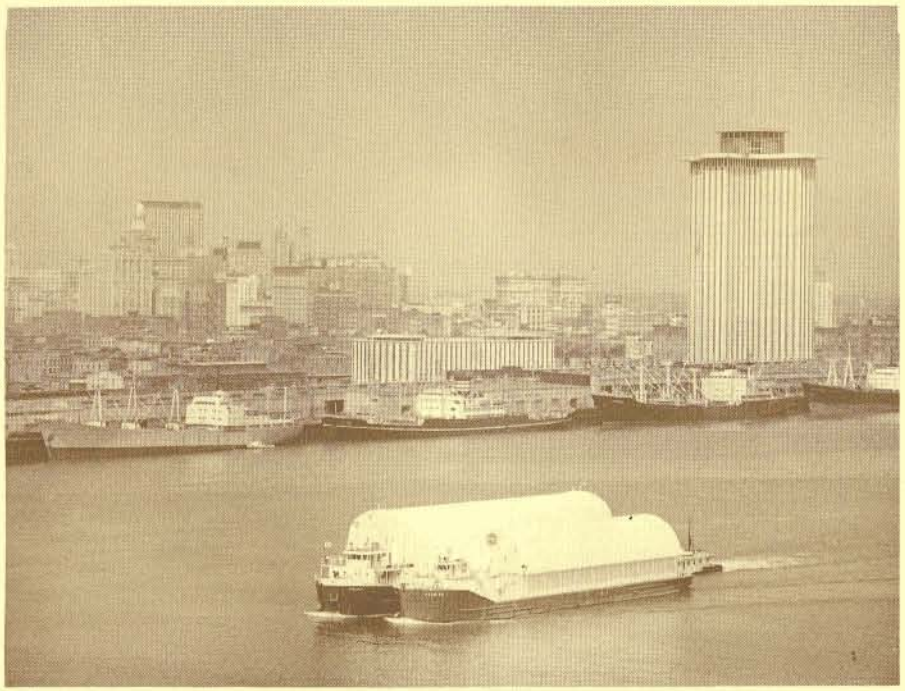
Water transportation is the only practical means of moving the mammoth Saturn launch vehicles. The boosters simply are too large for conventional road, rail, or air transport. The largest unit, the Saturn V first stage, is 138 feet long, 33 feet wide and weighs about 300,000 pounds empty.

Major manufacturing, test and launch areas for the boosters are NASA's George C. Marshall Space Flight Center, Huntsville, Ala., Michoud Assembly Facility, New Orleans, La.; Mississippi Test Facility (MTF), Hancock County, and Kennedy Space Center, Fla.

When an uprated Saturn I (Saturn I B) first stage is assembled at Michoud, it is sent on a 5-to-7-day barge trip to Huntsville for static firing tests. The barge travels up the Mississippi, Ohio and Tennessee Rivers, a trip of about 1,100 miles. After testing, the booster is returned to Michoud for refurbishing. It is then carried on a 5-day, 930-mile barge trip to the Kennedy Space Center.

SATURN BARGE ROUTE
Connecting MSFC, Michoud, MTF and KSC

First stages of Saturn V are manufactured at Michoud and barged 40 miles to MTF for static firing. They are then returned to Michoud for checkout before being shipped to Cape Kennedy.



Two of NASA's five special barges used to transport Saturn rocket stages from Michoud to static firing and launching sites in Alabama, Mississippi and Florida are shown passing the New Orleans skyline. The Poseidon, on the left, moves Saturn V first and second stages between Michoud, the Marshall Center and Cape Kennedy, while the Promise carries the uprated Saturn I first stages between the three installations. A third covered barge, the Palaemon, transports uprated Saturn I boosters between Michoud and Marshall. Two open-decked shuttle barges, the Little Lake and Pearl River, move Saturn V first and second stages from Michoud to MTF.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

FLIGHT RESEARCH CENTER
EDWARDS, CALIFORNIA
- X-15 flight research
- Testing of lunar landing vehicle.

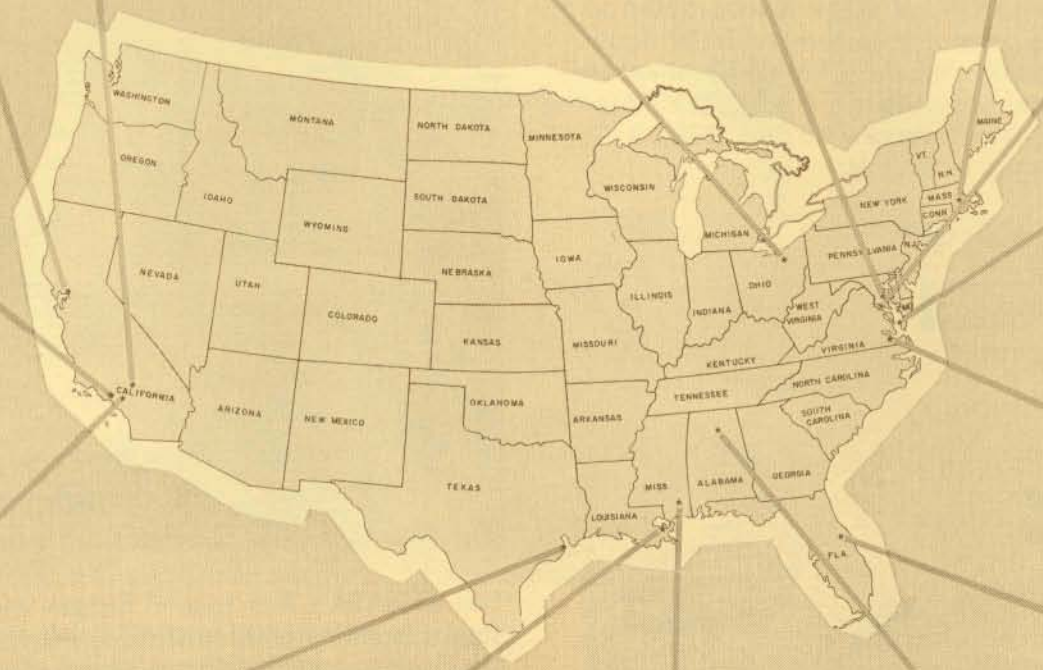
LEWIS RESEARCH CENTER
CLEVELAND, OHIO
- Initiates and conducts basic and applied research in propulsion and space flight.

GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND
- Scientific satellites
- Spacecraft design
- Tracking and data acquisition

ELECTRONICS RESEARCH CENTER
CAMBRIDGE, MASSACHUSETTS
- Provides technical assistance in electronics research in support of future space exploration.

AMES RESEARCH CENTER
MOFFETT FIELD, CALIFORNIA
- Life sciences including exobiology, environmental biology and biotechnology
- Research on hypersonic aircraft.
- Wind tunnel test on various re-entry shapes

NASA HEADQUARTERS
WASHINGTON, D.C.



WALLOPS STATION
WALLOPS ISLAND, VIRGINIA
- Satellite launches
- Development flights of new rocket vehicles
- Over 200 sounding rockets are launched each year

WESTERN OPERATIONS OFFICE
SANTA MONICA, CALIFORNIA
Responsible for West Coast NASA operations...
- Contract negotiations
- Contract administration
- Technical monitoring of contract execution.

LANGLEY RESEARCH CENTER
LANGLEY FIELD, VIRGINIA
- Spacecraft structures and materials
- Inflatable devices
- Aeronautical research
- Fluid mechanics

JET PROPULSION LABORATORY
PASADENA, CALIFORNIA
- Unmanned interplanetary flight
- Mariner
- Ranger
- Surveyor
- Deep Space Instrumentation Facility

KENNEDY SPACE CENTER
CAPE KENNEDY, FLORIDA
- Actual launch of manned and unmanned space vehicles

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
- Investigate man's capabilities in a space environment
- Project Mercury
- Project Gemini
- Project Apollo

MICHOUD ASSEMBLY FACILITY
MARSHALL SPACE FLIGHT CENTER
NEW ORLEANS, LOUISIANA
- Production site for Saturn rocket first stages.

MISSISSIPPI TEST FACILITY
MARSHALL SPACE FLIGHT CENTER
GAINSVILLE, MISSISSIPPI
- Perform static firing tests of Saturn V rocket stages.

MARSHALL SPACE FLIGHT CENTER
HUNTSVILLE, ALABAMA
- Development of launch vehicles, conducting related research and performing advance system studies for future space transportation concepts.

GEORGE C. MARSHALL SPACE FLIGHT CENTER

The Marshall Space Flight Center at Huntsville, Ala., provides heavy duty launch vehicles for the exploration of space. The Marshall Center, directed by Dr. Wernher von Braun, is an installation of the National Aeronautics and Space Administration.

Marshall's major task is to furnish the Saturn rockets that will be used in the nation's manned lunar exploration program. This is the greatest scientific and engineering project ever undertaken in peacetime by the United States. It is directed at the Washington level by NASA's Office of Manned Space Flight.

The Marshall Center occupies about 1,800 acres, and its facilities are valued at $235 million. It employs more than 7,000 persons, with a total annual payroll of $80,000,000. Most of the facilities and employees were transferred to NASA from the U. S. Army at Redstone Arsenal by direction of the President. The center was formally opened on July 1, 1960.

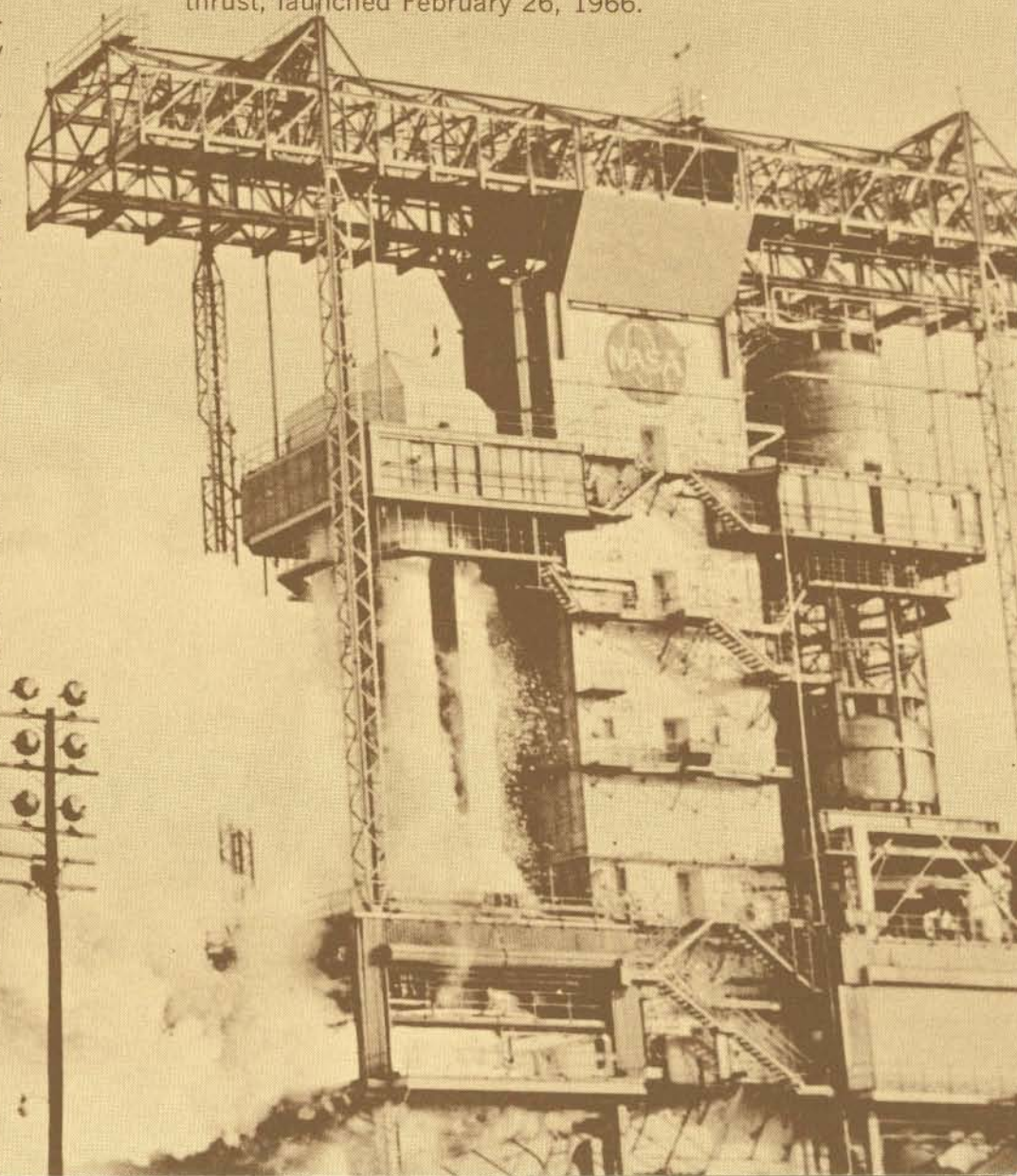
With its unique "in-house" facilities, Marshall is the nation's most complete establishment for the development of large rockets. It can carry a rocket program from conception of the idea through design, development, fabrication and flight testing. Because of the enormity of its tasks, however, more than 90 per cent of its budget is spent with private industries and research organizations.

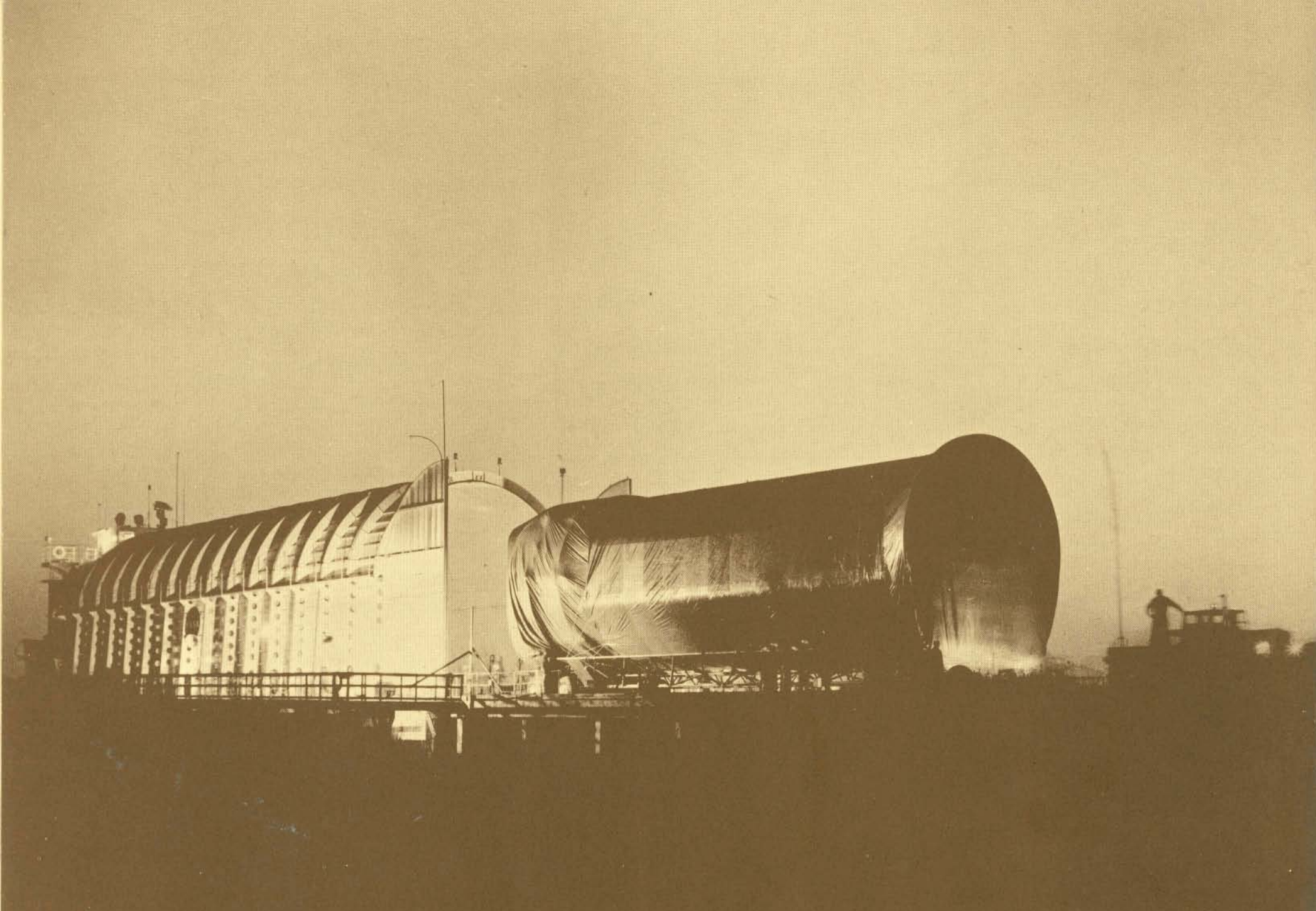
Marshall's current projects include the following: uprated Saturn I (Saturn IB) and Saturn V launch vehicles, related research in propulsion and launch vehicle technology and studies for advanced space transportation systems.

The engine development projects which Marshall is directing include the H-1 and F-1 engines, using the conventional liquid oxygen and kerosene fuel combination, and the J-2 engine, which uses the high energy propellant combination, liquid hydrogen and liquid oxygen.

Marshall Center personnel are pioneers in rocketry and space research. The group developed the Redstone, Jupiter, and Pershing ballistic missiles, and conducted several outstanding space projects, including the launching of the Free World's first:

a. Satellite of the Earth, Explorer I, January 31, 1958, by a Jupiter C.
b. Satellite of the Sun, Pioneer IV, March 3, 1959, by a Juno II.
c. Successful flight into space and recovery of animal life, monkeys Able and Baker, May 28, 1958, in a Jupiter nose cone.
d. Manned spacecraft, occupied by Astronaut Alan Shepard, May 5, 1961. This accomplishment was repeated July 21, 1961, with the launching of Astronaut Virgil I. Grissom, with Mercury-Redstones.
e. Rocket with thrust in excess of one million pounds, the Saturn I, launch October 27, 1961.
f. Two-stage uprated Saturn I (Saturn IB), 1.6-million-pound thrust, launched February 26, 1966.





MICHOUD ASSEMBLY FACILITY, GEORGE C. MARSHALL SPACE FLIGHT CENTER, NATIONAL AERONAUTICS AND SPACE ADMINISTRATION