reconnaissance survey

november 1981

MAN IN SPACE

RECONNAISSANCE SURVEY

MAN IN SPACE

Denver Service Center
National Park Service
U.S. Department of the Interior

CONTENTS

PREFACE

The extent of the American commitment to space exploration was illustrated in the late 1950s when the press corps turned out in full force to meet the original seven astronauts. In the next decade the National Aeronautics and Space Administration fought for and won appropriations to send a man to the moon by 1970, and in July of 1969 the feat was accomplished. But even as the world paid homage to this amazing technological success, the nation began to move on to new challenges. Left behind were the vast array of abandoned launch complexes and hardware that had supported early space flight.

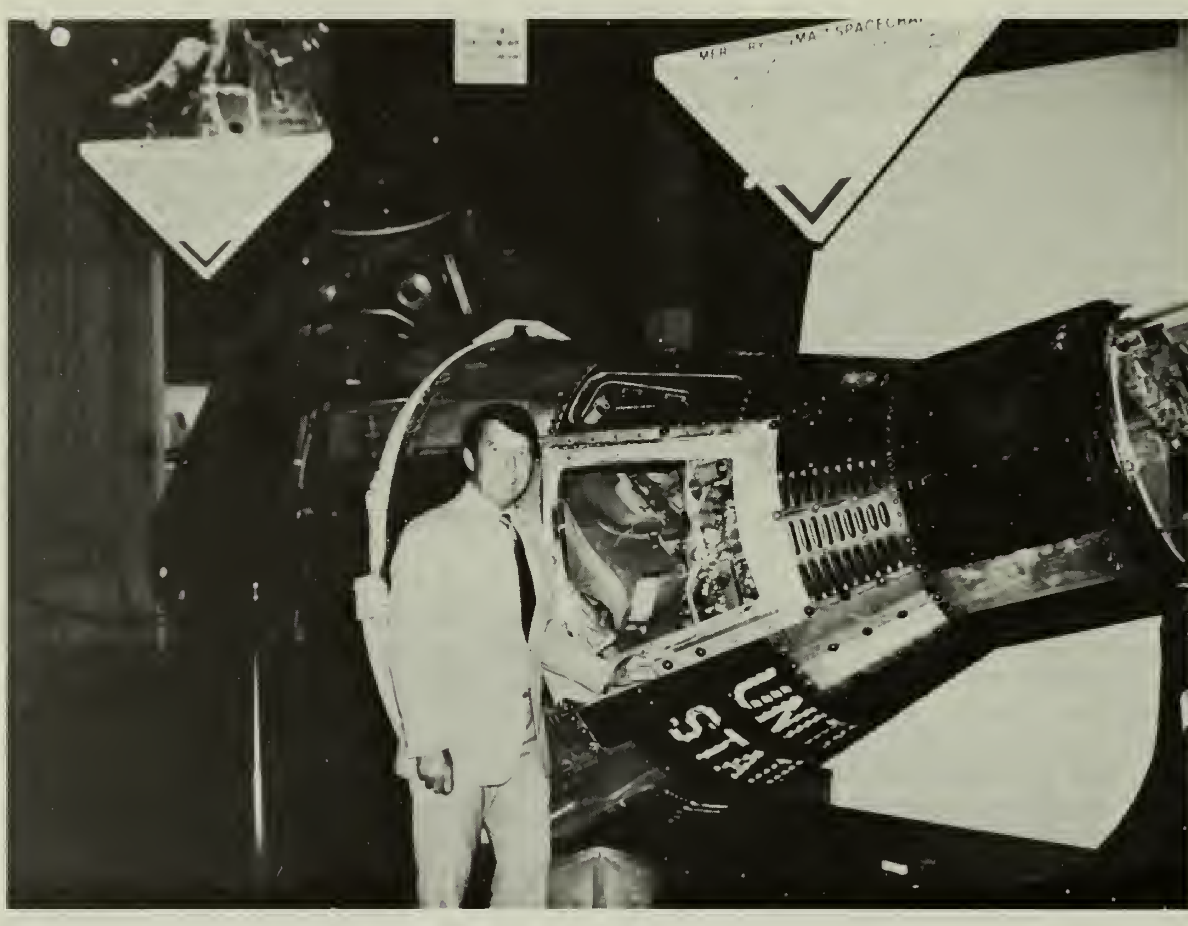
During the 1970s the abandoned facilities and equipment began to decay or rust away, and many of the structures were dismantled and salvaged for other purposes. Fortunately, during this period the Smithsonian Institution commenced a project that culminated in the Air and Space Museum in Washington, the repository for much of the space memorabilia of the 1950s and 1960s. Smaller museums were also established at major launch and test facilities to exhibit the rocketry and hardware of the "space race" days. Over the years all of these museums have done an excellent job of preserving space artifacts, and their efforts have been enthusiastically received. However, despite numerous preservation efforts, some of the most significant remaining features--the launch and test facilities that were the heart of the manned space program--are still unprotected.

As an active member of the National Park Service Advisory Board and Council since 1973, I was pleased to accept an assignment to aid the NPS reconnaissance team on a survey of what remains of the massive effort that has been designated "Man in Space." During our survey of the Cape Canaveral facilities, I saw my name in marble on a small slab at pad 14, the Mercury launch site. I felt crumbling rust on the Gemini erector and avoided walking under the remaining structure where the exciting Gemini launches took place. I felt remorse when I saw the flaking painted sign that commemorated my Apollo 7 launch--a sign that did not note that Gus Grissom, Ed White, and Roger Chaffee died there. Finally, I saw the pad where the lunar flights began and where the shuttles are now being launched.

There is a crying need to save some of the early launch and test facilities, and there are ways of financing such activities without unduly burdening taxpayers. The new museums illustrate some of the possibilities. The existing visitor facilities at the Kennedy Space Center are tremendously popular--nearly 2 million people visited the center and the cape in 1980. TWA Services, which operates the visitor center, is currently investing heavily in those facilities, with anticipation of rapid return and potential donation to NASA. The Alabama Space and Rocket Center at Huntsville is also a success--and an intriguing venture. That museum was financed by private business and state funds, and it is self-supporting. There I had a reunion with my Mercury spacecraft, "Sigma 7," and I saw countless pieces of original hardware. The director wanted to discuss expansion plans. These and numerous other projects can well serve as an example for preservation efforts being proposed.

But the time has come to establish national priorities and identify additional methods for preserving the early space facilities in ways that will intrigue earthbound backpackers as they reminisce about the lunar backpackers.

Walter Schirra, Jr.



Former astronaut Walter Schirra with "Sigma 7" at Alabama Space and Rocket Center

INTRODUCTION

In September 1980 Congress passed Public Law 96-344 to expand and improve the administration of the Historic Sites, Buildings, and Antiquities Act of 1935. Section 18 of that law required that the secretary of the interior, in consultation with the National Aeronautics and Space Administration, Department of Defense, and other concerned entities, conduct a study of sites and events associated with the theme "Man in Space." The purpose of the study, as defined by PL 96-344, was to "identify the possible locations, components, and features of a new unit of the national park system commemorative to this theme, with special emphasis to be placed on the internationally historic event of the first human contact with the surface of the moon." The legislation further requested that the study investigate methods for safeguarding identified locations, structures, and instrumentation features and for displaying and interpreting them to the visiting public.

This reconnaissance study documents the preliminary findings of the National Park Service study team concerning the historic features associated with the U.S. space program, in particular the first moon landing. The report includes an overview of the space program, a description of the major sites and facilities associated with the program, and an analysis of the significance and condition of those features. The "Options" section at the end of the report indicates the studies and interim stabilization work that the team feels are necessary to adequately preserve and interpret features that represent the substantial effort that went into making America's dream of space flight a reality.

RESOURCE DESCRIPTION

OVERVIEW

In the past few decades mankind has begun one of the greatest adventures in the history of the human race--the exploration of space. By coupling a new technology and an old tradition of exploration, men have orbited the earth, landed on the moon, and sent unmanned probes to the planets. This yearning to escape the confining bonds of the earth's gravity and atmosphere is an ancient dream of man. As early as the 2nd century A.D., the Greek writer Lucian of Samosata wrote of an imaginary journey to the moon. In 1865 Jules Verne published the classic account of a moon voyage in which earthlings are propelled to the moon by a giant cannon (US NASA, Swenson et al. 1976d, p. 3).

While some men were dreaming and writing about travel to the moon, others such as Johannes Kepler, Galileo Galilei, and Isaac Newton were laying scientific groundwork in the areas of mathematics, physics, and astronomy that would permit the actual deed to be achieved (US NASA, Swenson et al. 1976d, p. 5). By the early 20th century Samuel Pierpont Langley and the Wright brothers were experimenting with the actual mechanics of heavier-than-air flight. The Wright brothers were the first to succeed when on December 17, 1903, they carried out "the first [flight] in the history of the world in which a machine carrying a man had raised itself by its own power into the air in full flight, had sailed without reduction in speed, and finally landed at a point as high as that from which it started" (USDI, NPS, Butowsky 1980, p. 20).

After the 1903 flight the development of the airplane proceeded rapidly, and within a few years Congress established NACA, the National Advisory Committee for Aeronautics, "to supervise and direct the scientific study of the problems of flight, with a view to their practical solution" (US NASA, Anderson 1976, p. 3). Knowledge of aeronautical science and aviation technology increased dramatically under NACA guidance as witnessed by such achievements as the nonstop flight of Charles Lindbergh from New York to Paris in 1927.

NACA remained a small agency until World War II. During that war the United States faced the possibility of German-developed aircraft that could fly at speeds in excess of 400 miles an hour and at heights above 40,000 feet. To support Allied war efforts and compete with German technology, the U.S. initiated experiments that eventually led to the development of the X-1, the craft that exceeded the speed of sound on October 14, 1947. Within a decade after the end of the war, American jet-powered and rocket-powered aircraft had explored the upper limits of the atmosphere, flying at an altitude of 80,000 to 90,000 feet.

The next logical step was space flight beyond the earth's atmosphere. However, unlike the airplane, which could be powered by a reciprocating or a jet engine using atmospheric oxygen for its operation, a craft that would fly above the atmosphere required the development of rockets that would carry everything needed for propulsion and operate independently from the environment.

American efforts in rocketry had been advanced in the early 20th century by Robert H. Goddard, a pioneer in the field. Working in the 1920s and 1930s, Goddard compiled an impressive record of achievements. He carried out the first recorded launching of a liquid-propelled rocket (1926), adapted the gyroscope to guide rockets, installed movable deflector vanes in a rocket exhaust nozzle scope to guide rockets, patented a design for a multistage rocket, developed fuel pumps for liquid fuel motors, experimented with self-cooling and variable thrust motors, and developed automatic parachute deployment for recovering instrumented rockets.

While Goddard's achievements were considerable, he was not alone. In the same period interest in rocketry and space exploration developed in Europe and especially in Germany. Societies of rocket theorists and experimenters were established all over the continent. The most important of these societies, the German Society for Space Travel, conducted many rocket tests during the 1930s. By 1933 all German rocket experimentation was put under the control of the military, and progress advanced at a rapid rate. The Germans established vast research and testing facilities at Peenemuende and by 1943 developed a large rocket, the famous V-2, capable of flying over 200 miles with a speed of 3,500 miles per hour. This was the rocket used to bombard Allied targets late in the war.

In 1945 the American army captured an underground factory in the Harz Mountains that contained 100 partially assembled V-2 rockets. These rockets and about 125 German rocket specialists, including Werner von Braun, were sent to America to continue rocket research work.

From 1946 to 1951 more than 65 V-2 rockets were fired at the Army's White Sands proving ground in New Mexico. The rockets carried monkeys aloft on four occasions. One V-2, coupled with a WAC-Corporal rocket, achieved an altitude record of 244 miles in February 1949. In July 1950 another V-2/WAC-Corporal combination was launched from Cape Canaveral, Florida, the Air Force's newly activated long-range proving ground.

As experiments continued, the supply of V-2 rockets available for research was rapidly disappearing and new rockets were needed. In June 1950 the Army moved its team of 130 German rocket scientists and engineers from Fort Bliss at El Paso to the Army's Redstone Arsenal at Huntsville, Alabama, along with 800 military and General Electric employees. This team developed the Redstone rocket, which burned liquid oxygen and alcohol and had a thrust of 75,000 pounds. In the next five years 36 Redstone rockets were fired at Cape Canaveral to test structure, engine performance, and guidance, control, and tracking systems.

During the same period the Air Force was developing a separate rocket, the Atlas, which was designed to be America's first intercontinental ballistic missile. The Atlas would eventually develop a thrust of 360,000 pounds and would be able to boost a 1½-ton payload a distance of 6,300 miles.

While America was developing the Redstone and Atlas rockets, the Russians were working on rockets of their own. On August 26, 1957, Tass, the Soviet news agency, announced the successful launch of an intercontinental multistage ballistic rocket. This success was followed on October 4, 1957, by the launching of the world's first artificial space satellite, Sputnik 1.

In response to the Soviet achievement, the U.S. sought the immediate launch of an American satellite. The first launch attempt, in December 1957, failed; the second, completed by the Army test group headed by Werner von Braun on January 31, 1958, was successful. The first U.S. satellite, Explorer 1, returned useful data from space, revealing the existence of a deep zone of radiation--the "Van Allen Belt"--girdling the earth.

By 1958 many influential members of Congress and the Executive branch had come to support the concept of a new national space program. In April the administration submitted a bill calling for the establishment of a national aeronautics and space agency, and on July 29 President Eisenhower signed the bill into law (PL 85-568, the National Aeronautics and Space Act). On October 1 the National Aeronautics and Space Administration was officially established, and most of the nation's diverse programs and interests in space exploration were consolidated under its control. One of NASA's major responsibilities was the development and accomplishment of a program to put a man in orbit. In December the agency established Project Mercury, and in April 1959 it selected the first seven astronauts for the manned space program.

During 1959 and 1960 the American space program continued to grow both in terms of money and priority. However, in April 1961 the U.S. was again upstaged when Soviet cosmonaut Yuri Gagarin rode Vostock 1 into an orbit around the earth. The Soviet achievement shook Americans as had the satellite launch four years earlier. Alan Shepard's 15-minute suborbital flight less than a month later seemed minor in comparison.

Recognizing the impact of the Gagarin flight, President John Kennedy asked Vice President Lyndon Johnson to head a study to develop a space program that would surpass the Soviet effort. Johnson, along with representatives from NASA and industry, recommended a broad ten-year policy to provide major advances in the exploration of space, including manned space flight and planetary exploration and the development of a new family of boosters and satellites. President Kennedy accepted this recommendation and on May 25, 1961, proposed the following historic goal before a joint session of the Congress:

> Now is the time to take longer strides--time for a great new American enterprise--time for this nation to take a clearly leading role in space achievement, which in many ways may hold the key to our future on Earth. . . .
>
> I believe this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to the Earth. No single space project in

> this period will be more impressive to mankind, or more important for the long-range exploration of space; and none will be so difficult or expensive to accomplish (US NASA, Swenson et al. 1976d, p. 362).

President Kennedy had correctly assessed the mood of the American people. Support was widespread. The decision to land a man on the moon was endorsed by Congress virtually without dissent.

The American program to put a man in space and land on the moon now proceeded rapidly. The program was organized into three phases: Projects Mercury, Gemini, and Apollo. Project Mercury, the manned space program that had been initiated in 1958, was executed in less than five years. The primary objectives of the project were to place a manned spacecraft in orbital flight around the earth, to investigate man's performance capabilities in a weightless environment and his ability to function in space, and to safely recover both man and spacecraft. The craft used in the Mercury program was a one-man, bell-shaped vehicle 9.5 feet high and 6 feet across at its reentry heat shield base. It weighed approximately 4,250 pounds at liftoff and 2,400 pounds at recovery. The launch vehicle for the Mercury suborbital missions was a modified Redstone rocket generating 78,000 pounds of thrust at liftoff. A modified Atlas rocket whose three engines produced 367,000 pounds of thrust was employed for the Mercury orbital flights (US NASA n.d.[k], p. 11). Six missions were successfully completed under Project Mercury, including the first U.S. orbital flight by John Glenn in 1962, and the program laid a sound foundation for the technology of manned space flight.

Begun in 1964, Project Gemini was the intermediate step toward achieving a manned lunar landing, bridging the gap between the short-duration Mercury flights and the long-duration missions proposed for the Apollo program. Major objectives of Project Gemini included demonstration that man can perform effectively during extended periods in space both within and outside the protective environment of a spacecraft, development of rendezvous and docking techniques, and perfection of controlled reentry and landing procedures. The two-man Gemini spacecraft was also a bell-shaped vehicle; however, it was almost twice as heavy, 20 percent larger, and contained 50 percent more volume than the Mercury spacecraft. The launch vehicle was a modified Air Force Titan II rocket, which produced a thrust of 430,000 pounds at liftoff (US NASA n.d.[k], p. 11). The Gemini program provided the first American demonstration of orbital rendezvous and docking--a critical maneuver for a manned lunar landing.

Apollo, the largest and most ambitious of the manned space programs, had as its goal the landing of astronauts on the moon and their safe return to earth. The three-man Apollo spacecraft weighed 45 tons and consisted of three sections--the command, service, and lunar modules. Providing the muscle to launch the spacecraft was the Saturn family of heavy vehicles. Developing 1.5 million pounds of thrust at liftoff, Saturn I, the first in the line, demonstrated the feasibility of clustered rocket boosters and verified the operation of the vehicle guidance and control system. Saturn I was succeeded by Saturn IB, rated at 1.6 million pounds of thrust at liftoff (US NASA n.d.[k], pp. 12-13). Saturn IB rockets were used to launch the early unmanned Apollo test flights and the first manned flight, Apollo 7, which carried astronauts on a ten-day earth orbital mission.

Lunar missions, beginning in December 1968, used Saturn V launch vehicles. The Apollo/Saturn V space vehicle was 363 feet tall, weighed over 6 million pounds, and had 7.5 million pounds of thrust at liftoff (US NASA n.d.[k], pp. 12-13). The first three manned missions using this vehicle, Apollos 8, 9, and 10, marked the successful completion of all the complicated lunar orbital maneuvers--the first moon orbit, the first manned flight of a lunar module, and the separation, rendezvous, and docking of the lunar module with the command/service modules--paving the way for the moon-landing attempt.

On July 20, 1969, the goal of landing a man on the moon was achieved when Apollo 11 astronauts successfully executed history's first lunar landing. Commander Neil Armstrong and lunar module pilot Edwin Aldrin set foot on the surface, while pilot Michael Collins orbited in the command module. This "giant leap for mankind" was followed by six additional moon missions, during which extensive exploration and sample collection were successfully conducted. (A list of all U.S. manned space flights and their crews is included in appendix G of this report.)

Dr. Thomas Paine, NASA administrator when Apollo 11 made the first lunar landing, noted on the fifth anniversary of the mission:

> The fundamental significance of Apollo was that for the first time mankind has been given a vision of the thin biosphere that surrounds our beautiful blue planet, Earth, which as we now know, is the fragile home of all the life that so far has been detected in our solar system. And for the first time, terrestrial life that evolved here on this planet over billions of years has reached out to touch another world (US NASA n.d.[k], pp. 12-13).

SITES AND FACILITIES

The facilities that have served as part of the American space program are as diverse as the technological and engineering innovations of the 20th century. The program, and its most widely recognized accomplishment of landing men on the moon, grew out of a thirst for exploration as well as a healthy spirit of competition. The military applications of rocketry greatly accelerated research and development. The Air Force's long-range proving ground at Cape Canaveral and the Army's Redstone Arsenal at Huntsville were actively involved by 1950. With the launch of Sputnik 1 in 1957, these areas became an integral part of U.S. space efforts. The creation of the National Aeronautics and Space Administration in 1958 and the establishment of the Kennedy Space Center in 1962 signalled the beginning of an American commitment that was to lead to the development of diverse space exploration facilities throughout the United States and the world. A primary element in this commitment was the involvement of tens of thousands of private firms--from the McDonnell Douglas Corporation, prime contractor for the Mercury and

Gemini spacecrafts, to the Avica Company, which provided the flex lines for the lunar module. The contributions of all these firms have been critical to the overall success of the space program.

The features most directly associated with the space program of the 1950s and 1960s include the launch support structures at Cape Canaveral Air Force Station, where 19 manned vehicles and hundreds of unmanned satellites, experimental test rockets, lunar orbiting craft, and space probes were successfully launched; the larger and more advanced mobile launch facilities and assembly and test buildings at NASA's Kennedy Space Center, site of the Apollo moon missions and the more recent Skylab, Apollo-Soyuz, and space shuttle launches; and the mission control and flight test facilities at the Johnson Space Center in Houston. Other facilities, in particular NASA's Marshall Space Flight Center in Huntsville, have provided support in the testing and assembly of rockets and spacecraft. Together, these features constitute an invaluable resource for illustrating the history and evolution of early space flight. The four major sites and their historical functions are described below. All of these sites were visited by the reconnaissance study team.

Cape Canaveral Air Force Station

Cape Canaveral Air Force Station lies on a peninsula on the east coast of central Florida between the Atlantic Ocean and the Banana River inlet. It is adjacent to the John F. Kennedy Space Center and about 15 miles north of Patrick Air Force Base. Established as a proving ground in 1949, Cape Canaveral contains some of the earliest facilities associated with rocket experimentation and space exploration as well as an active space-age installation for current military and NASA programs. Within the boundaries are complete assembly and launch facilities for ballistic missiles and space vehicles along with storage and dispersing stations for fuels and oxidizers. A landing strip permits the airlift of launch vehicles direct from the manufacturer to the cape. A deep-water port along the southern edge provides access to NASA's complex 39 for barges bringing in the giant Saturn V rockets and also permits the servicing of eastern test range (ETR) tracking ships and Navy ships and submarines used in the Polaris and Poseidon programs.

The facilities active at Cape Canaveral during the 1950s and 1960s include some 30 launch complexes, the original mission control center, and numerous support structures. (A description of each of the major resources and its association with the U.S. space program is included in appendix B of this report.) Launch complexes that provided support for the Mercury program include 1 and 2, the heliport for Mercury manned launches; 3 and 4, which served as a medical support area during the manned launches (complex 3 was also the site of the first cape launch in 1950); 5/6, launch site for all of the Mercury/Redstone suborbital missions, including the first U.S. manned launch by Alan Shepard in 1961; 11, 12, and 13, built to support research and development of the Atlas family of rockets that were used in the Mercury manned orbital missions; and 14, launch site for all the Mercury/Atlas manned orbital flights, including the first U.S. orbital mission by John Glenn in 1962. The original mission control center, now deactivated, guided operations

Mercury/Redstone spacecraft and service structure,
Air Force Space Museum (complex 26B),
Cape Canaveral Air Force Station, 1981

Marker commemorating the first U.S. orbital flight by
John Glenn, complex 14,
Cape Canaveral Air Force Station, 1981

Marker commemorating the manned Gemini flights, complex 19, Cape Canaveral Air Force Station, 1981 for all the Mercury flights. Hangar S was used as crew quarters and contained the "clean rooms" for checking out the Mercury capsules. Complex 26, constructed for research and development of the Redstone rocket, was used to launch primates Ham, Gordo, Able, and Baker in tests that led to Alan Shepard's successful flight. This complex includes the Air Force Space Museum, an indoor/outdoor exhibit area that contains an extensive collection of historic rockets.

The major launch complex involved with the Gemini program was 19, the site of all ten manned orbital Gemini flights. Several other complexes, including 15, 16, and 20, were used to test the Titan launch vehicles that supported the Gemini program. The Cape Canaveral mission control center directed the first three Gemini flights; the function was then transferred to the Johnson Space Center in Houston.

The massive Apollo effort involved launch complexes 34 and 37 at Cape Canaveral. Complex 34 was built to support the Saturn I flight test program and was then modified to launch the Apollo/Saturn IB missions. The first successful manned Apollo flight with Walter Schirra, Donn Cunningham, and Walter Eisle was launched from complex 34 in October 1968. Complex 37 was also used in the Saturn I and IB test program; eight launches were made from this complex, including the first flight of an Apollo lunar module in early 1968. Later Apollo missions used the Saturn V booster rocket and were launched from nearby complex 39 at the Kennedy Space Center.

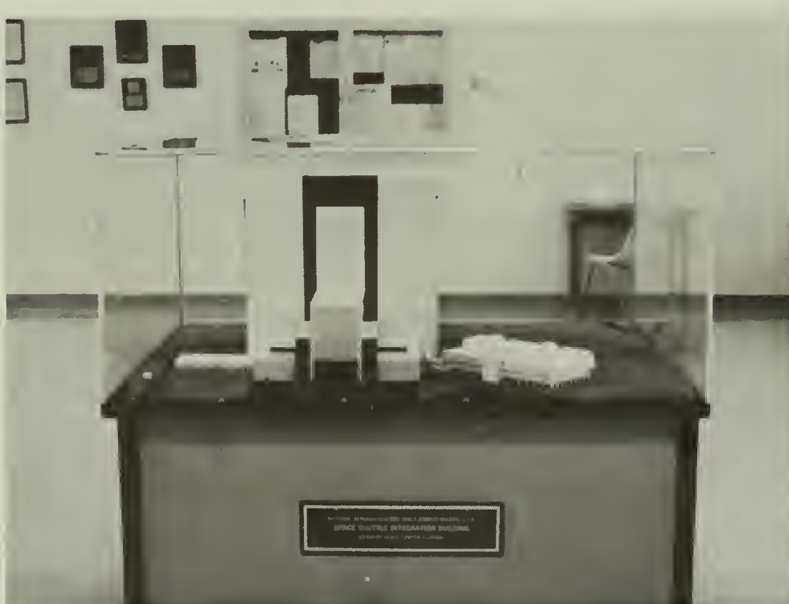
Many of the historic facilities at Cape Canaveral have been deactivated and dismantled; others have been remodeled for use in current programs. The need for immediate stabilization of facilities not now in use is evident throughout the site.

Kennedy Space Center

The John F. Kennedy Space Center is on the east coast of Florida immediately north and west of Cape Canaveral Air Force Station. Established in July 1962 as the Launch Operations Center, it was redesignated as the Kennedy Space Center in November 1963.

The space center site is about 34 miles long and varies in width from 5 to 10 miles. The original NASA purchase included more than 140,000 acres of land and water running from the southern tip of Cape Canaveral to Oak Hill. Since the agency was not in immediate need of the entire acreage, it invited the U.S. Fish and Wildlife Service to manage the natural areas. Merritt Island Wildlife Refuge was established as a result of this action. In 1975 Congress designated another part of the space center and an area of mangrove trees, beaches, and marshes immediately north of the center as Canaveral National Seashore. Thus, all of the land in the wildlife refuge and part of the land in the national seashore is either owned by NASA or managed subject to priority use by the space agency. Agreements have been reached with the Department of the Interior permitting recreational use of portions of the refuge and seashore on a noninterference basis. These areas are now open for day use (closed during NASA launches) and are considered important natural and

Rocket exhibit, visitor information center, Kennedy Space Center, 1981



Model of vehicle assembly building and launch control center, Kennedy Space Center, 1981

Model of space shuttle, Kennedy Space Center, 1981 recreational resources for the community and the nation (US NASA 1974a, p. 45; Ehrenhard 1976, pp. viii, 1).

The Kennedy Space Center is currently the major NASA launch organization for manned and unmanned space missions. As the lead center, it launches manned space vehicles, unmanned planetary spacecraft, and scientific, meteorological, and communications satellites. The center also serves as the launch site for the reusable space shuttle, which has opened a new era in space transportation. The space center mission includes the planning and directing of space vehicle assembly, preflight preparation of space vehicles and their cargo, test and checkout of launch vehicles, spacecraft, and facilities, coordination of tracking and data acquisition requirements, countdown and launch operations, and landing operations and refurbishment of the space shuttle for future missions. Supporting this primary mission are a host of technical and administrative functions, including design engineering, safety, quality assurance, documentation, supply, maintenance, computer operations, and communications (US NASA n.d.[a], p. 2).

Several facilities at the Kennedy Space Center played a role in the Apollo program and manned moon flights. (The major resources involved with the program are described in appendix B.) Complex 39 was designed to launch the huge Apollo/Saturn V spacecraft that eventually carried the first men to the moon. Other support structures critical in launch preparation included the operations and checkout building, where the modular Apollo craft was checked for systems integrity before being united with the launch vehicle; the vehicle assembly building (VAB) where the craft was assembled on the launch vehicle; the mobile launcher--platform and umbilical tower--that supported the craft before and during takeoff (a mobile launcher modified to handle the Saturn IB spacecraft now rests on the north side of the VAB); the mobile service structure; and the crawler-transporter, which carried the craft and its launcher from the VAB to the launch pad and the service structure from its parking area to the pad. The operations and checkout building also contained crew preparation areas, laboratories, medical facilities, and the Apollo mission high-altitude chambers, which were used to assemble and test the integrated command/service and docking modules in a simulated space environment. The flight crew support building housed the Apollo mission simulators used to train astronauts in flight conditions from earth launch to lunar landing and return (the mission simulators, now deactivated, are available for viewing by interested visitors). The launch control center next to the VAB directed prelaunch and launch operations for the Saturn IB and V vehicles.

The Kennedy Space Center contains a major visitor information center that is operated by TWA Services under contract with NASA. The visitor center provides tours of past and present launch sites and support buildings and has indoor/outdoor exhibits of spacecraft, rockets, and space equipment and products.

Most of the facilities at the Kennedy Space Center have been modified to support the space shuttle program and are still in active use. Active sites and facilities are generally not open to the public.

SIGNIFICANT EVENTS AT CAPE CANAVERAL AND KENNEDY SPACE CENTER LAUNCH COMPLEXES	LAUNCH COMPLEX								
	3	5/6	13	14	19	26	34	37 A & B	39 A & B
MANNED LAUNCHES		M		M	G		A		A
FIRST LAUNCH AT CAPE CANAVERAL	■								
FIRST U.S. SATELLITE LAUNCH						■			
FIRST MANNED LAUNCH		■							
FIRST MANNED EARTH ORBITAL LAUNCH				■					
FIRST MANNED GEMINI LAUNCH					■				
LUNAR ORBITER LAUNCHES			■						
FIRST SATURN I LAUNCH							■		
FIRST SATURN V LAUNCH									■
FIRST LUNAR MODULE LAUNCH								■	
FIRST MANNED APOLLO LAUNCH							■		
APOLLO II LAUNCH (MOON LANDING)									■
SKYLAB LAUNCHES									■
APOLLO-SOYUZ LAUNCH									■
FIRST SPACE SHUTTLE LAUNCH									■

M — Mercury Program Flights

G — Gemini Program Flights

A — Apollo Program Flights

Johnson Space Center

The Lyndon B. Johnson Space Center is on NASA Highway 1 about 2 miles east of the town of Webster and 20 miles southeast of Houston. Highway access to the site is along the Gulf Freeway (U.S. 75) and NASA 1. Additional JSC facilities are located at nearby Ellington Air Force Base (US NASA 1974a, p. 39).

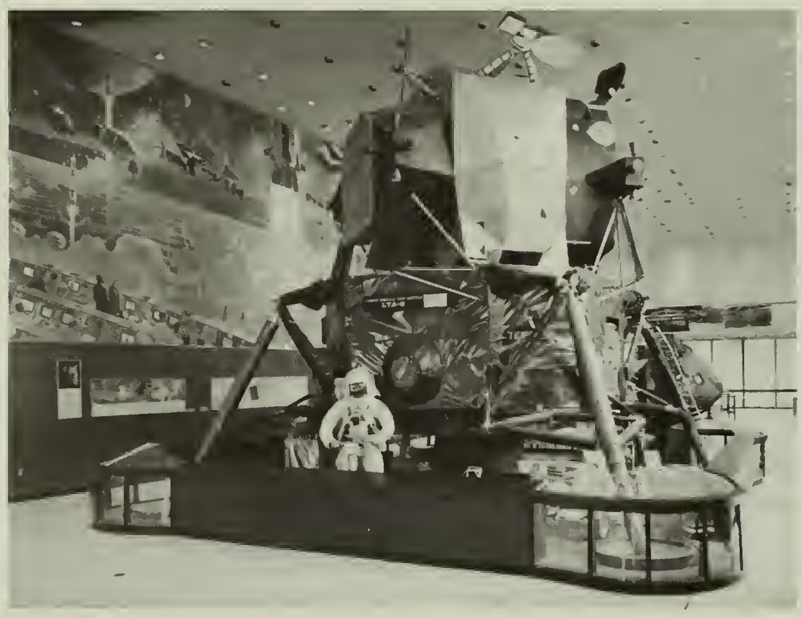
The idea for the Johnson Space Center (originally called the Manned Spacecraft Center) began in May 1961. At that time, President Kennedy, in keeping with his decision to accelerate the country's space program, approved the formation of a new installation for NASA and its manned space flight efforts. By August a NASA survey team had searched the country and investigated 26 possible sites for the installation. After completing evaluations, on September 19, 1961, NASA Administrator James E. Webb officially announced that the new Manned Spacecraft Center (MSC) would be established on a 1,020-acre tract near Houston. (The site was soon expanded to 1,620 acres with the purchase of an adjacent 600-acre tract.) Webb stated that selection of the Houston site had been influenced by recent decisions to expand the launch complex at the Atlantic missile range (of which Cape Canaveral is part) and to establish a fabrication facility for large booster and vehicle stages at the Michoud plant near New Orleans. The Manned Spacecraft Center, the Michoud operation, and the Atlantic missile range would be an integrated enterprise coordinating the development, manufacture, and operation of the manned space program.

Construction of facilities at MSC commenced in 1962, and the majority of the buildings and the basic utilities systems were completed by 1965 (US NASA 1980b, p. 5). Since its opening, the center has participated with other NASA installations in the Mercury, Gemini, and Apollo space programs and in post-Apollo activities. The Skylab space station, controlled from JSC, served as the base for evaluations of manufacturing methods in space, study of energy radiation from the sun, and study of the capability for space monitoring of the environment and resources on earth. JSC participated in the joint U.S./U.S.S.R. (Apollo-Soyuz) space mission in 1975. The center has played a major role in achieving the national goal of a space transportation system. It serves as the development center for the space shuttle and the operations center for the evolving transportation system (US NASA 1980b, p. 3).

Research and development activities at JSC related to manned space flight include

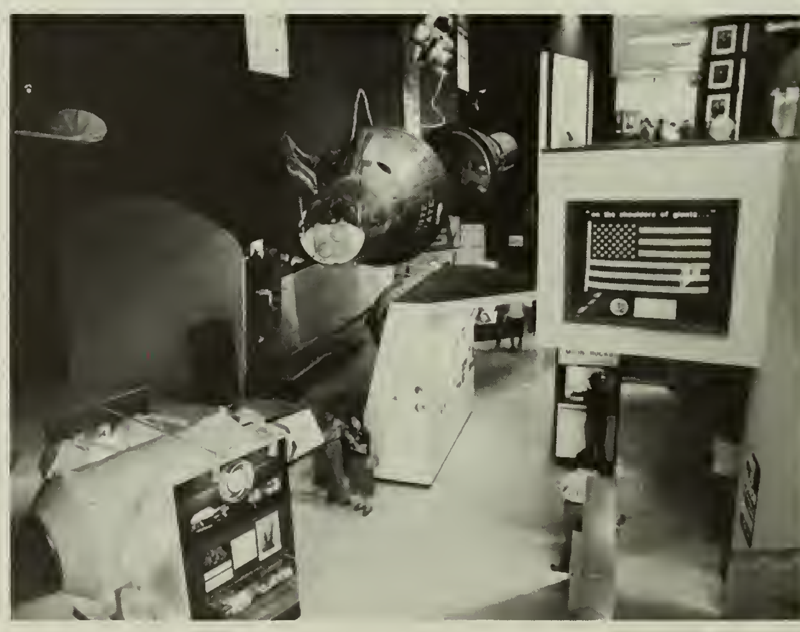
> design, manufacture, testing, qualification, and delivery of systems such as space suits, extravehicular activity systems, crew provisions, and crew support equipment
>
> astronaut training
>
> development of instrumentation, data management systems, and ground checkout systems used on manned spacecraft

Little Joe, Mercury/Redstone, and Saturn V rocket exhibit, Johnson Space Center



Visitor center exhibit, Johnson Space Center

Visitor center exhibit area, Johnson Space Center



analysis, development, and evaluation of spacecraft structures, materials, and thermal protection systems

testing and performance evaluation of spacecraft and spacecraft subsystems under simulated space and launch environmental conditions, including flammability tests on materials and components

planning and execution of manned and unmanned space environment simulation (thermal-vacuum) tests

planning and development of spaceborne-ground telemetry, communications, and tracking systems

development, evaluation, and qualification testing of small spacecraft propulsion engines, pyrotechnics, and electrical power systems and subsystems

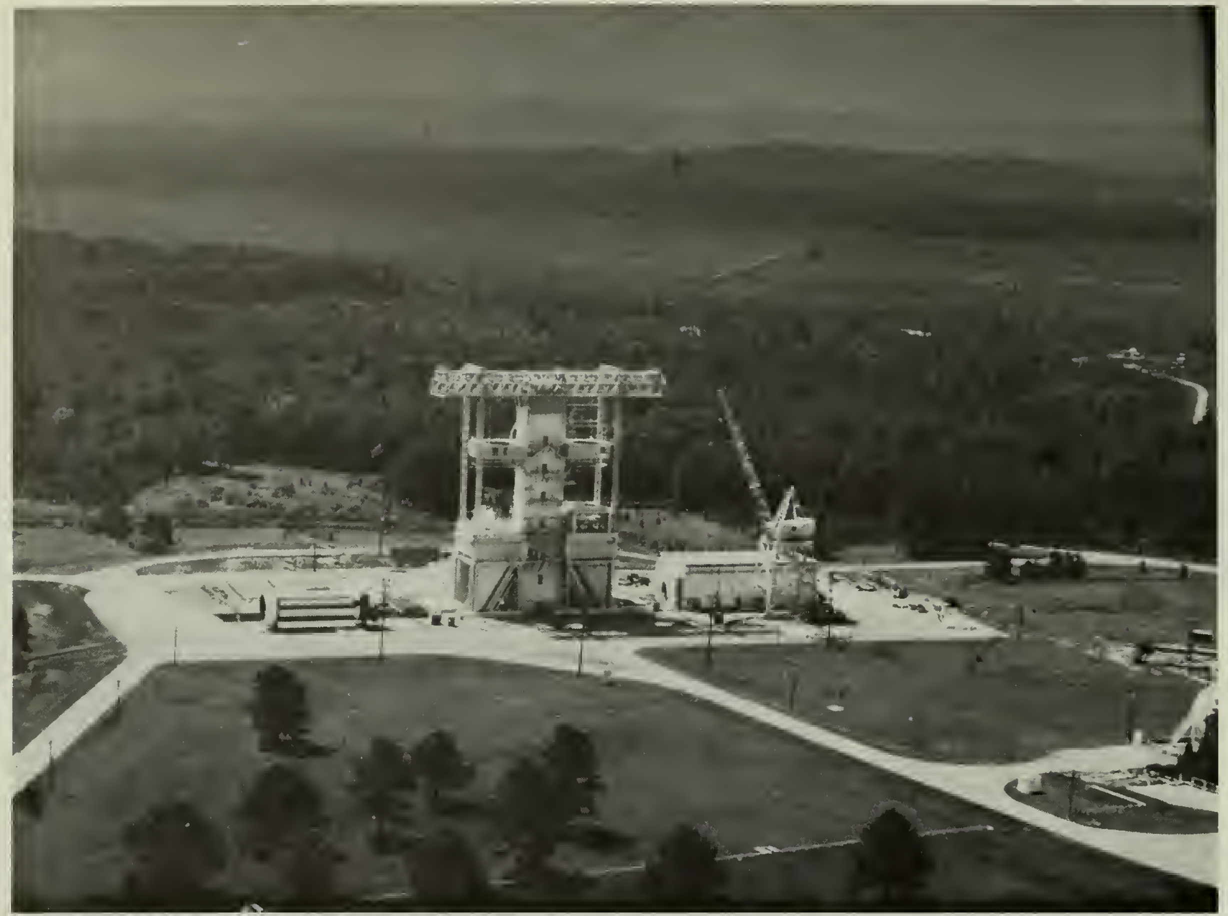
Facilities at the Johnson Space Center that supported the manned space program include the space environment simulation laboratory, which contained two man-rated chambers used to test the large, complex spacecraft of the Apollo program; the space environment effects laboratory, which had 11 smaller chambers for testing space hardware; the mission control center, which provided ground-based control from launch through recovery for nine Gemini and all Apollo missions (this facility contains the mission operations control rooms that were the principal command areas for flights); the lunar sampler building, with vaults and laboratories for storage of and research on moon samples; the flight acceleration facility, which included a circular centrifuge and chamber area with an environmentally controlled simulator to train astronauts and test equipment; and the mission simulation and training facility, which contained an Apollo mission simulator designed to familiarize crews with equipment, tasks, procedures, and emergency flight situations. The public affairs facility contains an auditorium and a lobby area with exhibits. Space center tours begin in this building.

All of the facilities at JSC are still in active use, but most have been substantially modified to support the space shuttle program. A more detailed description of the major facilities is included in appendix B.

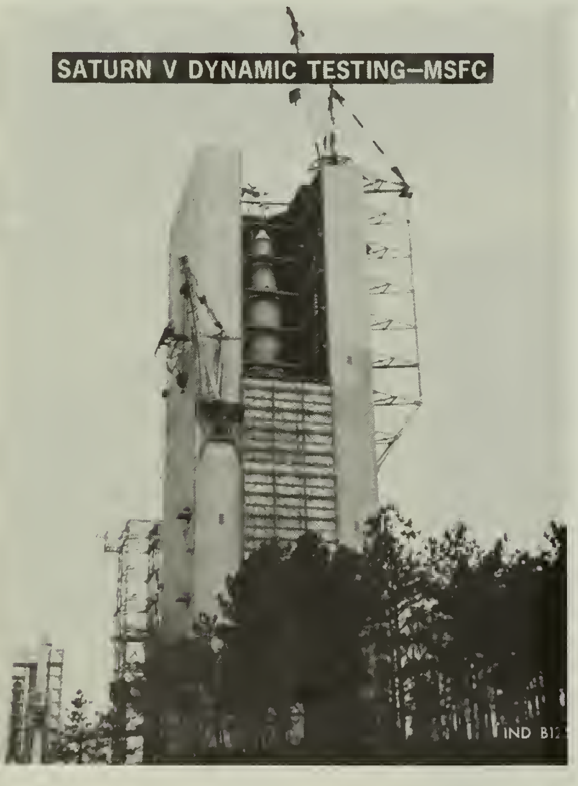
Marshall Space Flight Center and Alabama Space and Rocket Center

The George C. Marshall Space Flight Center lies within the Redstone Arsenal, which has common boundaries with the cities of Triana, Madison, and Huntsville, Alabama. NASA administers facilities and 1,840 acres of land at the site under a use permit with the Department of the Army. There is deep-water access from the Tennessee River and a loading dock 3 miles from the main NASA complex. The Louisville and Nashville Railroad and Southern Railway serve the site, and the Redstone airfield is less than a mile from the headquarters area.

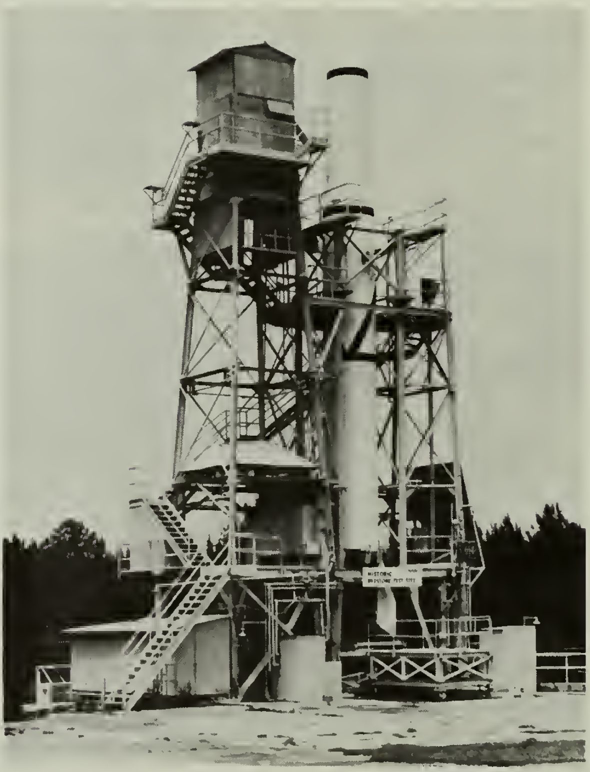
The primary mission of the Marshall Space Flight Center is the development and provision of space transportation systems, orbital systems, scientific payloads, and other systems for present and future



Saturn IB test stand, Marshall Space Flight Center



Saturn V dynamic test stand,
Marshall Space Flight Center



Redstone test stand,
Marshall Space Flight Center

space exploration. It is also responsible for directing operations at the Michoud Assembly Facility and the Slidell Computer Complex. The center contains four test stands used to examine various stages of Saturn rockets and the original stand for testing Redstone launch vehicles. It also includes a wide spectrum of technical facilities and equipment organized into laboratories. Many of these facilities are the only ones of their kind in the world (US NASA 1974a, p. 77). The more important facilities and structures associated with the effort to land a man on the moon are described in appendix B.

The Alabama Space and Rocket Center is adjacent to the Marshall Space Flight Center. The rocket center is state-run and financed largely through private donation. It serves as the official visitor information center for Marshall and for all U.S. Army missile programs at the Redstone Arsenal in Huntsville. Exhibits include an Apollo/Saturn V rocket, a Redstone rocket, a Mercury/Atlas rocket, and hardware from the Skylab and Spacelab programs. The center also has an Apollo command module, a lunar landing module, and Gemini and Mercury spacecraft on display. Other areas of the museum include a photo mural displaying important events in Werner von Braun's life, a display of an Apollo moon rock, and illustrations of different types of technology developed from the space program.

Other NASA Facilities

The following NASA facilities provided support for the manned space program of the 1960s and 1970s, but were only indirectly associated with the effort to land a man on the moon. These facilities, most of which are still actively involved in aeronautics and space-related functions, were not visited by the study team.

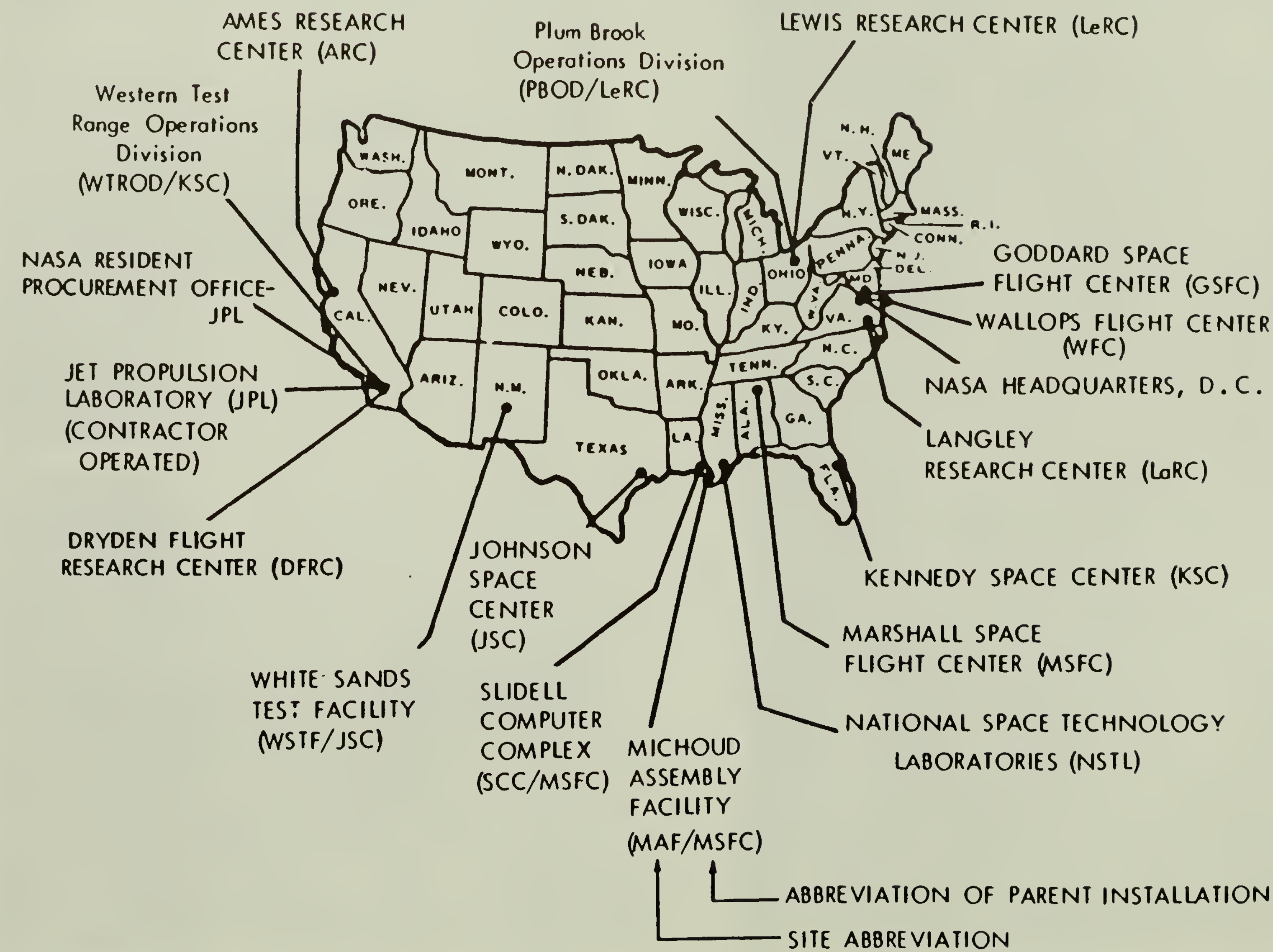
Ames Research Center. The Ames Research Center is at the south end of San Francisco Bay 35 miles southeast of San Francisco and 10 miles northwest of San Jose. Moffett Field, a naval air station, is contiguous to the south and east. The airfield runways are shared with the Navy.

Programs of the Ames Research Center are directed toward research and technology development in the fields of aeronautics, space science, life science, and spacecraft construction. Ames has specialized facilities for research, including wind tunnels (subsonic to hypersonic), motion-based flight simulators, advanced digital computation systems, experimental aircraft, and a variety of well-equipped ground-based and airborne laboratories (US NASA 1974a, p. 15).

Dryden Flight Research Center. The Hugh L. Dryden Flight Research Center, in the Mojave Desert about 60 miles northeast of the Los Angeles metropolitan area, is a division of the Ames Research Center. It occupies land at Edwards Air Force Base under U.S. Air Force permit.

The Dryden center was established as a major facility for aeronautical flight research. It provides research and testing on problems of aircraft and flight research vehicle takeoff and landing, low speed flight, supersonic and hypersonic flight, and flight vehicle reentry in order to

LOCATION OF NASA MAJOR AND COMPONENT INSTALLATIONS



verify predicted vehicle and flight characteristics, identify unexpected problems in actual flight, and correlate theoretical or wind tunnel research studies. The major research tools for conducting programs at the center are its aircraft. These range from Century fighters to advanced supersonic and hypersonic aircraft and aerospace flight research vehicles like the wingless-lifting-body vehicle. The center has special ground-based facilities, including a flight test range with two fully instrumented tracking stations; a high-temperature loads calibration laboratory, a unique national facility for ground-based testing of complete aircraft and structural components under the combined effects of loads and heat; a highly developed aircraft flight instrumentation capability; a flight system laboratory that has diversified capabilities for avionics system fabrication, development, and operations; and a remotely piloted research vehicle (RPRV) facility (US NASA 1974a, p. 21).

Goddard Space Flight Center. The Goddard Space Flight Center is 15 miles northeast of Washington, D.C., and 1 mile east of the Greenbelt, Maryland, exit of the Baltimore-Washington Parkway. The main portion of the center in the town of Greenbelt has 24 major buildings. In addition, Goddard occupies a remote site under permit from the Department of Agriculture, which contains the Goddard antenna test range and facilities for magnetic testing, optical tracking and ground plane testing, bi-propellant testing, and network testing and training.

The Goddard center conducts and is responsible for automated spacecraft and sounding rocket experiments in support of basic and applied research. In the area of applied sciences, the center has the mission of developing meteorological and advanced technology satellites and managing various satellite programs. Goddard also manages the spaceflight tracking and data network (STDN) and the NASA communications network (NASCOM), which track and acquire data and maintain communications with manned and automated spacecraft, administers the development and procurement of the Delta launch vehicle, and operates the Goddard Institute for Space Studies (US NASA 1974a, p. 27).

Jet Propulsion Laboratory. The Jet Propulsion Laboratory is a government-owned facility in Pasadena, California, that is staffed and managed by the California Institute of Technology under a NASA contract. In addition, JPL operates the Goldstone, California, deep space communication complex, a station of the worldwide deep space network (DSN); the Edwards Test Station, a facility at Edwards Air Force Base for propellant processing and testing; and the Table Mountain facilities, which include an observatory with 16- and 24-inch telescopes and an 18-foot radio telescope with a solar power test laboratory.

The Jet Propulsion Laboratory is engaged in activities associated with deep-space automated scientific missions, tracking, data acquisition, data reduction, and analysis required by deep space flight; advanced solid propellant and liquid propellant spacecraft engines; advanced spacecraft guidance and control systems; and integration of advanced propulsion systems into spacecraft. The laboratory designs and tests flight systems, including complete spacecraft, and provides technical direction to contractor organizations. JPL operates the worldwide deep space tracking and data acquisition network and maintains a substantial program to support present and future NASA flight projects and increase the capabilities of the laboratory (US NASA 1974a, p. 33).

KSC Western Test Range Operations Division. The KSC Western Test Range Operations Division is located at Vandenberg Air Force Base in Santa Barbara County, 6 miles west of Lompoc, California. Highway 246 connects Lompoc with the base.

WTROD range personnel provide launch operations management for all NASA, university, and government unmanned programs at the Air Force's western test range. This includes all operational aspects of integration, test, checkout, and launch of Scout and Delta vehicles. Unmanned launch operations are accomplished through a host-tenant agreement with the Air Force, which owns the real property occupied by NASA. Staff also provide technical, logistic, and administrative support to other NASA elements located at the range.

The major WTROD facilities are the engineering and operations building, spacecraft support facilities, data acquisition facilities, space launch complex 2, Scout launch vehicle facilities, Thor/Agena and Delta launch pads, dynamic balance facility, and associated structures (US NASA 1974a, p. 51).

Langley Research Center. Langley Research Center in Hampton, Virginia, is approximately 100 air miles south of Washington, D.C., between Norfolk and Williamsburg. The center occupies two areas divided by the runway facilities of Langley Air Force Base. The runways, some utilities, and certain other facilities are used jointly by NASA and the Air Force. In addition, there is a NASA tract near the city of Newport News, Virginia, which contains the space radiation effects laboratory and a large area of marshland near Langley under permit to NASA for use as a model drop zone.

A substantial percentage of the center's research work is development of advanced concepts and technology for future aircraft, with particular emphasis on environmental effects, performance, range, safety, and economy. Work continues in the development of technology for helicopters and avionic systems for reliable operations in future terminal areas and in the improvement of supersonic flight capabilities for both transport and military aircraft. The center works with the aviation industry to help solve problems concerning aircraft design and load requirements and to improve flight operations. Finally, Langley has complete responsibility for NASA's Viking spacecraft (US NASA 1974a, p. 57).

Lewis Research Center. The Lewis Research Center is on the west side of the Cleveland Hopkins Airport in Cuyahoga County, Ohio. It includes laboratory buildings, shops, wind tunnels, space environment tanks, and other specialized facilities built for conducting research on advanced propulsion and power-generating systems and designed to simulate flight conditions. The center is oriented to advancing the technology of chemical and electric rockets, air-breathing engines, and electric power systems for a wide spectrum of power requirements. This involves work on turbojet engines, supersonic aircraft, high energy chemicals, and electric rocket engines. The center also conducts research on power systems for converting chemical and solar energy into electricity. The major effort in space power is on turboelectric, thermoelectrical, and thermonic energy conversion systems (US NASA 1974a, p. 65).

Michoud Assembly Facility. The Michoud Assembly Facility is just off U.S. 90 about 15 miles east of downtown New Orleans. The site is on the Gulf Intracoastal Waterway and has deep-water access from the Mississippi River. Railroad spurs run into the site from the main Louisville and Nashville Railroad line.

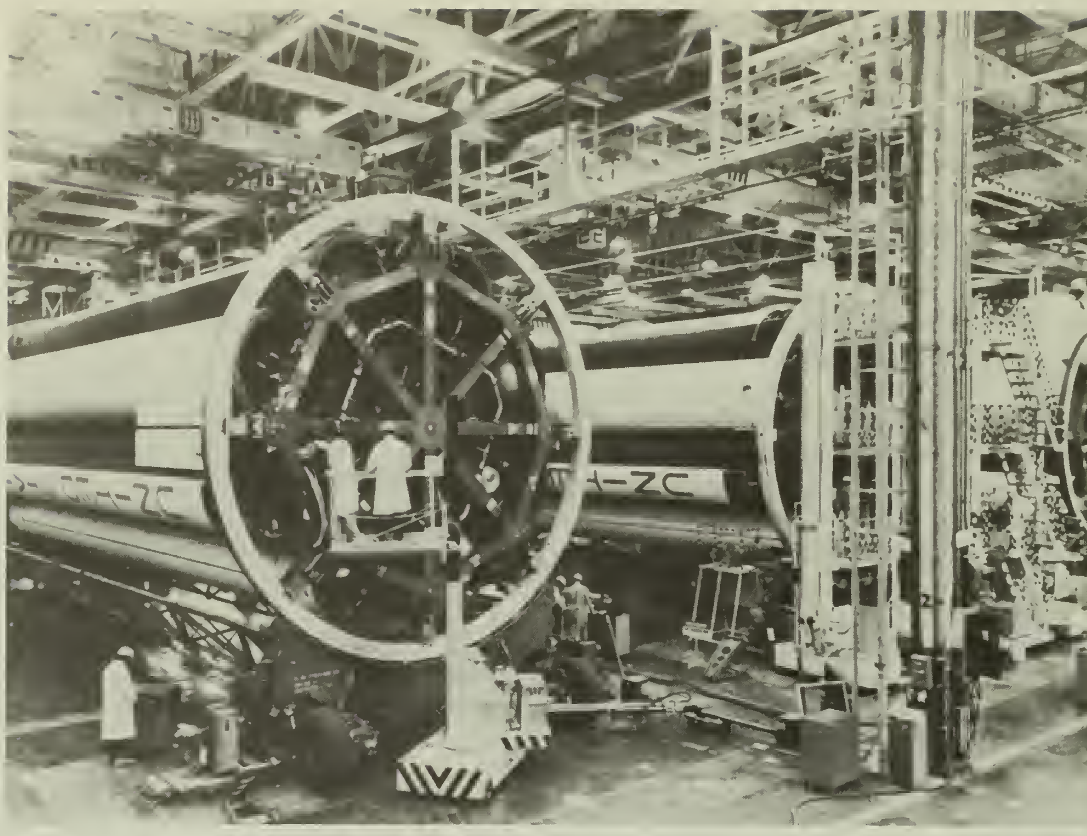
The primary mission of the Michoud Assembly Facility is systems engineering, engineering design, manufacture, fabrication, assembly, and related work for Saturn boosters and space shuttle elements. There are 32 buildings on the site with an area of about 3.5 million square feet. The largest structure is the completely air-conditioned main manufacturing building, which has almost 2 million square feet (43 acres) of floor space.

The Marshall Space Flight Center exercise overall management control of the MAF. A support contractor provides administrative and technical services, and prime contractors offer space shuttle production capability (US NASA 1974a, p. 83).

National Space Technology Laboratories. The National Space Technology Laboratories facility, formerly named the Mississippi Test Facility, is a separate NASA field installation approximately 55 miles northeast of downtown New Orleans in Hancock and Pearl River counties, Mississippi, and St. Tammany Parish, Louisiana. The site has deep-water access for transporting oversize cargo from the East Pearl River and Intracoastal Waterway.

The present mission at the NSTL is to support space shuttle main engine and orbiter propulsion system testing and to provide NASA and other government agencies at the site with capabilities necessary to conduct remote-sensing environmental and related research and technical activities. Support service contractors provide institutional, administrative, and technical services. Stage contractors are responsible for conducting tests on the stands. The test stands include a dual-position stand (one position activated) for testing the Saturn V first stage and two stands for testing the Saturn V second stage. These stands have been modified for space shuttle program activities. The complex also includes industrial laboratory and engineering facilities (US NASA 1974a, p. 89).

Plum Brook Operations Division. The Plum Brook Operations Division is approximately 3 miles south of Sandusky, Ohio. It maintains facilities for the large-scale testing of nuclear propulsion components in NASA's nuclear test reactor and for full-scale static and dynamic tests of completed space vehicles and propulsion components. In addition to the nuclear reactor, there are space power, spacecraft propulsion research, hypersonic tunnel testing, rocket dynamics and control, altitude rocket testing, dynamics testing, and cryogenic propellant testing facilities and laboratories for turbine testing, hydrogen pump research, cryogenic hydraulics testing, and fluorine and turbopump testing. Termination of nuclear propulsion and power programs resulted in the closing of the



Stage assembly, Michoud Assembly Facility

Test stand, National Space Technology Laboratories reactor facility in 1973, and most NASA activities at Plum Brook ended in 1974 (US NASA 1974a, p. 71).

Slidell Computer Complex. The Slidell Computer Complex is about 22 miles northeast of the Michoud Assembly Facility and 20 miles southwest of the National Space Technology Laboratories in St. Tammany Parish, Louisiana. The complex, when acquired by NASA from the Federal Aviation Agency in 1962, already contained a large office building and several smaller support buildings well suited for computer operations, and it was adapted for this purpose. The complex is primarily responsible for fulfilling the computational requirements of NASA and the contractor-operated plants at Michoud and NSTL in the areas of scientific, management, and engineering automated data processing and static and flight test data reduction evaluation. The Marshall Space Flight Center exercises overall management of the complex (US NASA 1974a, p. 95).

Wallops Flight Center. The Wallops Flight Center is on the Delmarva peninsula of eastern Virginia about 40 miles southeast of Salisbury, Maryland. It includes three separate areas--the main base, the Wallops Island launching site, and the Wallops mainland site--plus a large area of marshland. On the island are rocket storage buildings, blockhouses, assembly shops, and launch sites. The mainland site houses the radar and optical tracking sites.

The Wallops center is responsible for planning, applied research, and development of scientific payloads, instrumentation, facilities, and techniques for rocketborne experiments, aeronautical and terminal area research projects, and ecological studies. It prepares, assembles, launches, tracks, and acquires scientific information from space vehicles. Wallops personnel also assist scientific research teams with their projects and develop special types of instrumentation and equipment to complete missions and manage NASA research projects.

A portion of the center's effort is devoted to NASA's program of international cooperation in space research. Foreign countries are provided with training programs for their personnel, assistance in activation of launch sites, and technical assistance in launching experiments and range operations (US NASA 1974a, p. 101).

White Sands Test Facility. The White Sands Test Facility is 5½ miles north of U.S. 70 on the western edge of the U.S. Army White Sands missile range near Las Cruces, New Mexico. The site is occupied under a use agreement between NASA and the Department of Defense. In addition, land has been withdrawn from the public domain for WSTF use under Department of the Interior public land order. The Johnson Space Center exercises overall management of the facility.

WSTF was established for hazardous testing associated with Apollo propulsion and power systems. It now supports space shuttle propulsion system, power system, and material testing and serves as the alternate site for storage of returned lunar rocks. On a supplemental funding basis, WSTF supports other NASA centers, other government agencies, and industrial firms. WSTF serves as range sponsor for NASA programs at the White Sands missile range.

WSTF has five fully equipped and operational propulsion test stands in two geographically separated areas. Laboratory functions and major test article preparation tasks are performed in area 200, which includes two high-bay work areas, a complex of fully equipped analytical, environmental, and calibration support laboratories, and test facilities for material testing, component failure analysis, electronics burn-in and screening testing, precision cleaning, and related disciplines (US NASA 1974a, p. 107).

RESOURCE ANALYSIS

SIGNIFICANCE

The many sites, structures, and objects associated with the space program were evaluated for national significance by applying the following criteria, as stated in the National Park Service "Management Policies" (1978):

> Properties at which events occurred that have significantly contributed to, are identified prominently with, or outstandingly represent, the broad cultural, political, economic, military, or social history of the Nation, and from which an understanding and appreciation of the larger patterns of our American heritage may be gained.
>
> Objects that figured prominently in nationally significant events; or that were prominently associated with nationally significant persons; or that outstandingly represent some great idea or ideal of the American people; or that embody distinguishing characteristics of a type specimen, exceptionally valuable for a study of a period style or method of construction, or that are notable as representations of the work of master workers or designers.

Although resources achieving importance within the past 50 years are not normally considered of national significance, the accomplishment of landing a man on the moon is so broadly recognized as one of the greatest achievements of mankind that its importance--and the critical need to preserve remaining resources associated with the event--transcends such time constraints.

Because of the number and extent of the features that supported early space flight, the study team used a ranking system to guide evaluations. Two categories, or levels, of significance were identified: primary and secondary. Primary significance was attributed to sites or facilities directly associated with manned and test launches or astronaut training. Thus, all manned and test launch sites were included in this category. Support and training areas were considered to be of primary significance if they were critical to the successful completion of a manned launch. Primary resources are identified below.

Sites or facilities of secondary significance were defined as those indirectly associated with the manned space program, including facilities important for research and development and testing communications. Examples include facilities at the Marshall Space Flight Center, X-15 test area of Edwards Air Force Base, Jet Propulsion Laboratory, Michoud Assembly Facility, and National Space Technology Laboratories and those of various private contractors around the country whose work in the development, manufacturing, and assembly of machinery proved invaluable to successful efforts.

Features of primary significance were considered most suitable for telling the story of the space program and eliciting the highest degree of interest from potential visitors. These resources were evaluated against additional criteria (see the Suitability/Feasibility Criteria table) to determine which were most feasible for preservation and interpretation. The study team recommendations were developed primarily from this analysis.

Key among the features of primary significance are extant facilities at Cape Canaveral Air Force Station and Kennedy Space Center, which served as America's "spaceport" from the time of the first manned launch out of the earth's atmosphere to the landing of a man on the moon.

Cape Canaveral Air Force Station is the site of the launch complexes used for the Mercury, Gemini, and early Apollo flights. Of special importance are the following:

Complex 3 - Site of the first cape launch in 1950.

Complexes 5/6 - Used for all Mercury/Redstone flights, including the first two U.S. manned flights by Alan Shepard and Virgil Grissom in 1961.

Complex 13 - Site of the lunar orbiter launches used in selecting lunar landing sites. The complex contains as complete an array of support facilities as any existing launch site, and it closely resembles complex 14, from which all manned orbital Mercury/Atlas missions were launched.

Complex 14 - Used for Mercury/Atlas launches, including all four manned Mercury orbital flights by John Glenn, Scott Carpenter, Walter Schirra, and Gordon Cooper. It was later the site of several Atlas/Agena launches.

Complex 19 - Used for all 12 Gemini flights, ten of which were manned.

Complex 26 - Launch site for the first U.S. satellite, Explorer 1, in January 1958. The existing mobile service structure at pad 26B is the oldest at the cape and illustrates the state of engineering in the early "space race" days. The area includes the Air Force Space Museum with exhibits of rockets, missiles, and capsules.

Complex 34 - Site of the first Saturn I launch in 1961 and the first manned Apollo flight in 1968. A fire during a ground test in 1967 took the lives of astronauts Virgil Grissom, Edward White, and Roger Chaffee.

Complex 37 - Used for the Saturn rocket tests (Saturn I and IB stages) and the first launch of a lunar module.

Hanger S - Housed astronaut suit room, crew quarters, medical facilities, and clean rooms used to checkout Mercury capsules. This was the first facility used by the astronauts.

Original mission control center - Used for all Mercury and first three Gemini flights (function then taken over by the Johnson Space Center). This facility is especially valuable in comparison with present-day facilities and equipment.

Features of primary significance at the Kennedy Space Center include a number of active facilities:

Complex 39, pads A and B - Site of the launch of Apollo 11--the first manned craft to land on the moon--as well as subsequent moon flights and the Apollo-Soyuz launch.

Vehicle assembly building (VAB) - Houses assembly, test, checkout, and protective storage facilities for launch vehicles and spacecraft. Assembly of Saturn V and IB vehicles was performed here, readying them for launch.

Launch control center (LCC) - Originally designed to control prelaunch and launch operations of the Saturn V and Saturn IB vehicles. Each of the equipped firing rooms has approximately 450 consoles containing the controls and displays required during spacecraft checkout.

Apollo mission simulators (in the flight crew support building) - Used for astronaut training in techniques necessary to fly to the moon, land, and return safely.

High-altitude chambers - Used for assembly and test of the command/service module and docking module in a simulated space environment. These facilities were critical to the moon missions.

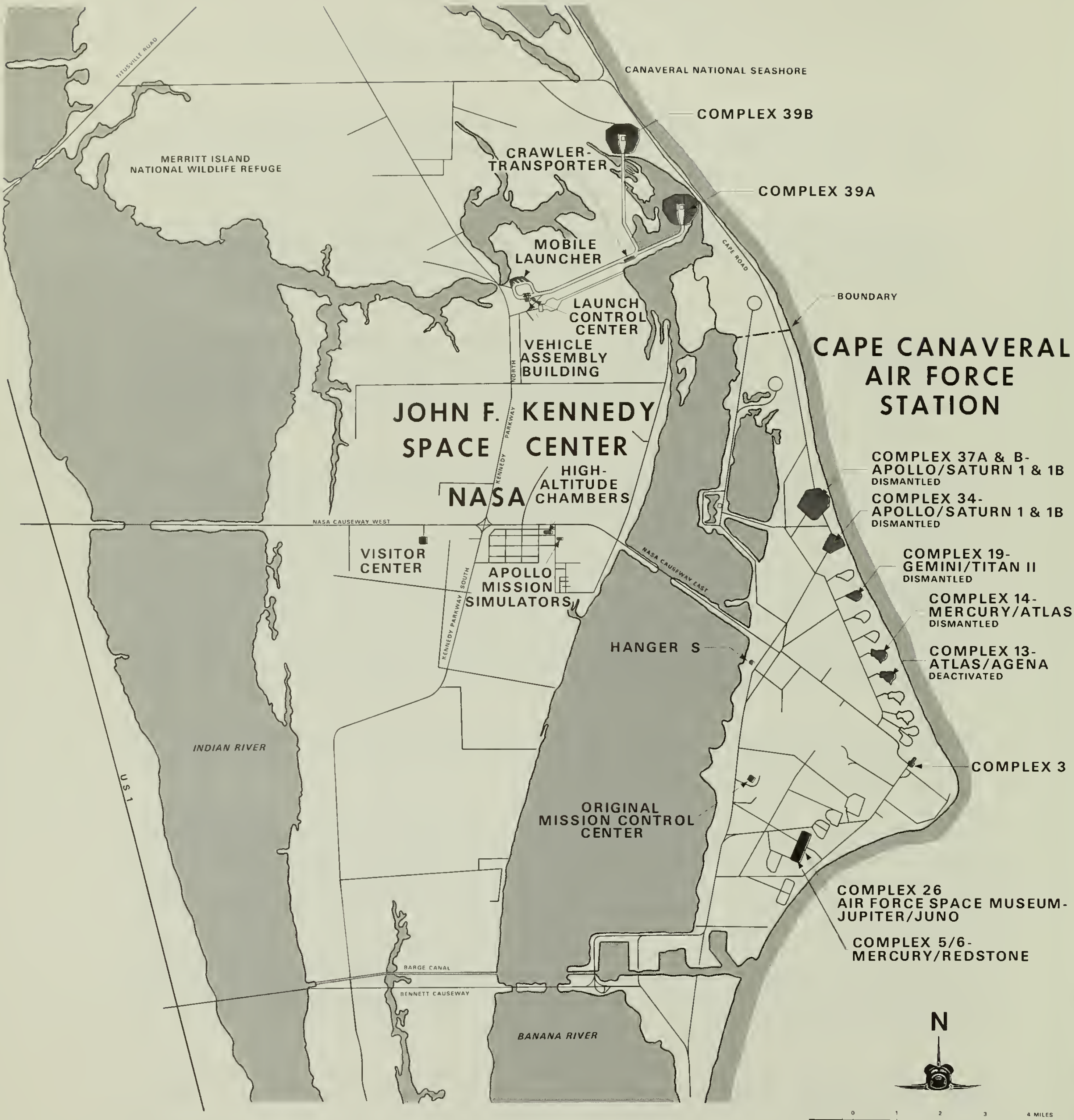
Mobile launcher - The umbilical tower and launch platform for the Saturn V, Saturn IB, and Apollo spacecraft.

Crawler-transporter - Used to transport the mobile launcher from the VAB to the launch pad and the mobile service structure (now cannabalized) to and from the pad.

Facilities at the Johnson Space Center that are of primary significance include the mission operations control room and the space environment simulation laboratory that were used for the Apollo flights. As the principal command and decision area for flights after liftoff, the mission operations control room processed and displayed critical information for determining the continuation, alteration, or termination of space flights. The space environment simulation laboratory was used to test spacecraft and hardware in a simulated, harsh space environment. Complex spacecraft for the Apollo and later programs were tested here.

THEME REPRESENTATION

Man in Space features were also evaluated for their representation of the cultural themes identified in Part One of the National Park System Plan, History (USDI, NPS 1972). That plan was formulated to provide criteria



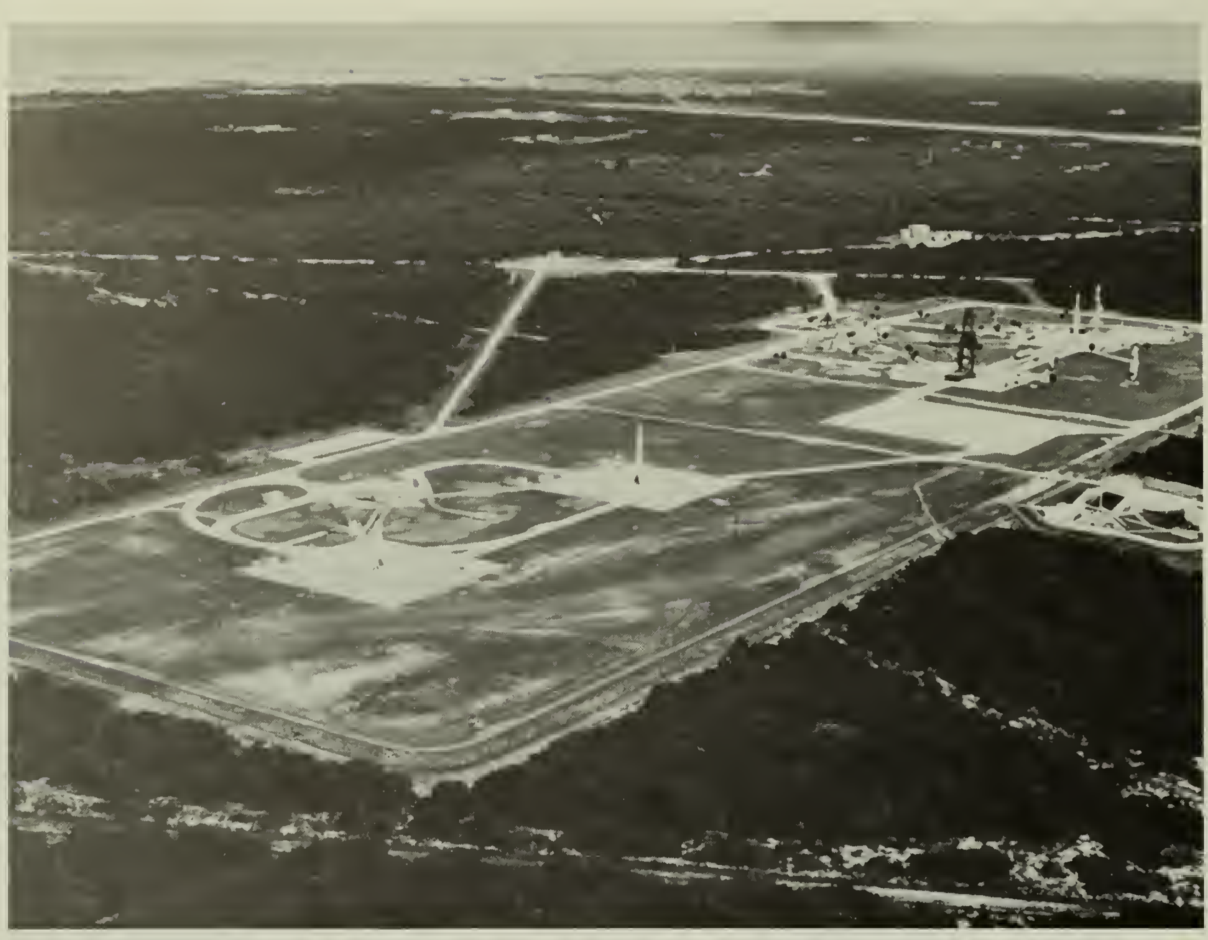
PRIMARY RESOURCES

KENNEDY SPACE CENTER AND CAPE CANAVERAL AIR FORCE STATION

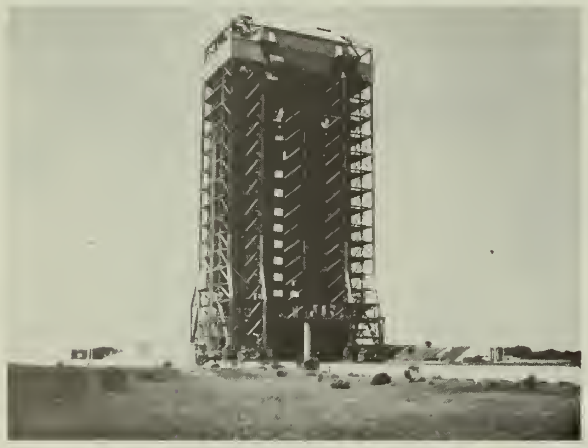
SUITABILITY/FEASIBILITY CRITERIA FOR RESOURCES OF PRIMARY SIGNIFICANCE	CAPE CANAVERAL AIR FORCE STATION										KENNEDY SPACE CENTER							JOHNSON SPACE CENTER	
	LAUNCH COMPLEX 3	LAUNCH COMPLEX 5/6	LAUNCH COMPLEX 13	LAUNCH COMPLEX 14	LAUNCH COMPLEX 19	LAUNCH COMPLEX 26	LAUNCH COMPLEX 34	LAUNCH COMPLEX 37 A & B	ORIGINAL MISSION CONTROL CENTER	HANGAR S	LAUNCH COMPLEX 39 A & B	VEHICLE ASSEMBLY BUILDING (VAB)	LAUNCH CONTROL CENTER (LCC)	APOLLO MISSION SIMULATORS	HIGH-ALTITUDE CHAMBERS	MOBILE LAUNCHER	CRAWLER-TRANSPORTER	MISSION OPERATIONS CONTROL ROOM	SPACE ENVIRONMENT SIMULATION LAB
RESOURCE TYPE																			
1. SITE	■	■	■	■	■	■	■	■			■								
2. FACILITY/STRUCTURE	■	■	■	■	■	■	■	■	■	■	■	■	■	■		■	■	■	■
3. OBJECT/ARTIFACT	■	■	■	■	■	■	■	■	■		■				■				■
ASSOCIATION WITH MAN IN SPACE THEME																			
1. MANNED LAUNCH		■		■	■		■				■								
2. TEST LAUNCH/FLIGHT	■		■	■		■	■	■			■								
3. ASTRONAUT TRAINING										■				■	■				■
4. RESEARCH/DEVEL./TESTING														■	■				■
5. EQUIPMENT ASSEMBLY												■				■	■		
6. FLIGHT CONTROL		■		■	■	■	■	■	■				■					■	
7. TRACKING/COMMUNIATIONS																		■	
PROTECTION STATUS																			
1. DYNAMIC/ACTIVE										■	■	■	■			■	■	■	
2. INACTIVE	■													■	■				■
3. ABANDONED		■	■	■	■	■	■	■	■										
4. CURRENT INTERP. USE		■				■			■										
5. NATIONAL REGISTER LIST.											■								
INTEGRITY* (percent completeness, condition, original fabric, location, and workmanship)	C	A	B	D	C	A	C	C	A	D	A	A	A	A	A	A	A	A	A
FEASIBILITY FOR PRESERVATION (cost, structural stability, projected use)	■	■	■	■	■	■	■	■	■					■	■				?
SUITABILITY FOR INTERPRETATION (accessibility, safety, scale, security)	■	■	■	■	■	■	■	■	■		?	?	?	■	?	?	?	?	■

* Degree of Original Integrity Remaining:
A = 90-100%
B = 70-89%
C = 40-69%
D = less than 40%

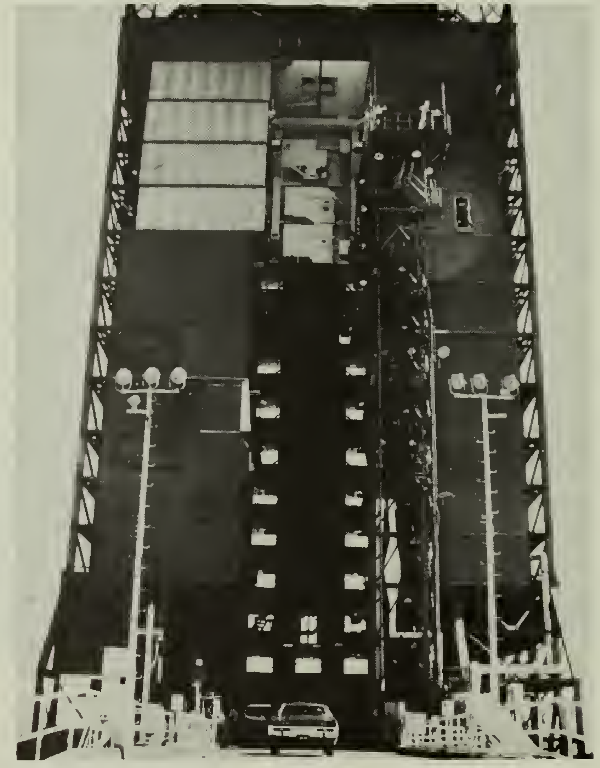
Note: All resources indicated are unique in the United States and some are the only ones of their kind in the world.



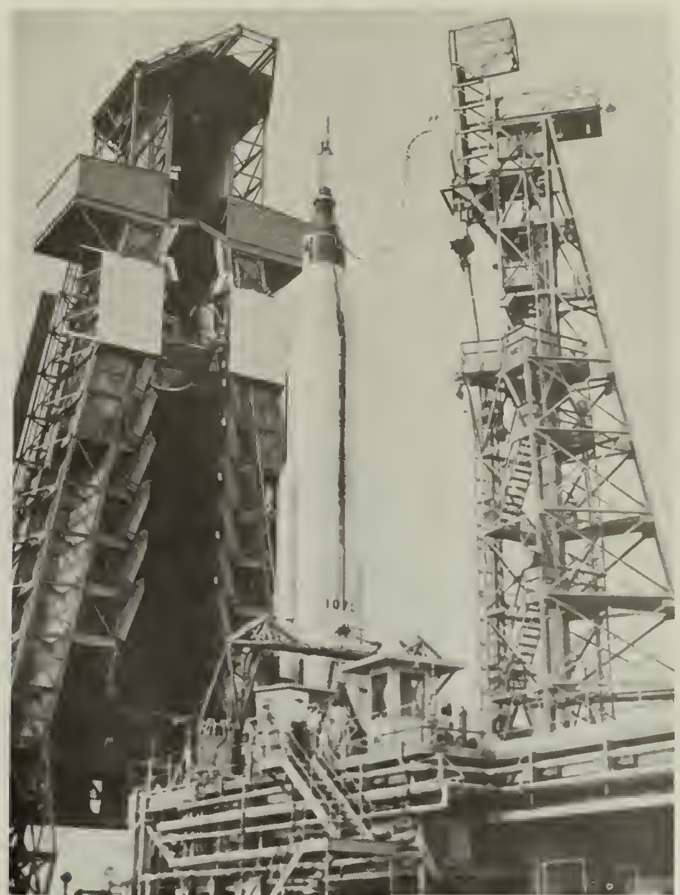
Complex 5/6 and NASA Space Museum, left, and complex 26 and Air Force Space Museum, right, 1981



Complex 13, service structure, south view, 1981

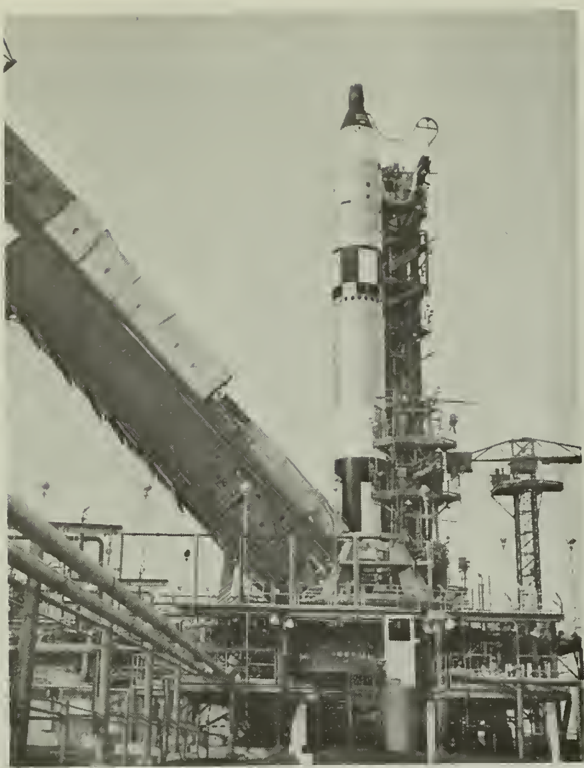


Complex 13, service structure, north view, 1981

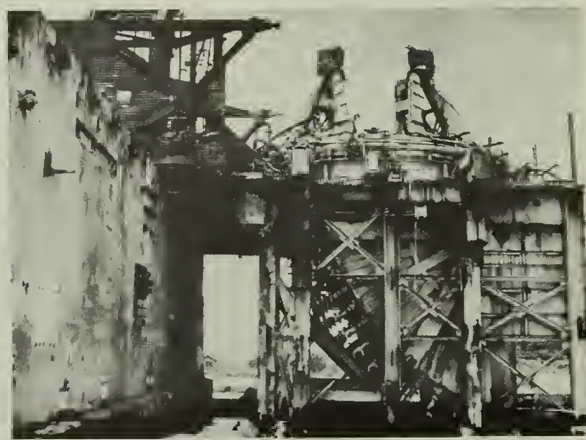


Complex 14, prelaunch check of Mercury/Atlas spacecraft, 1962

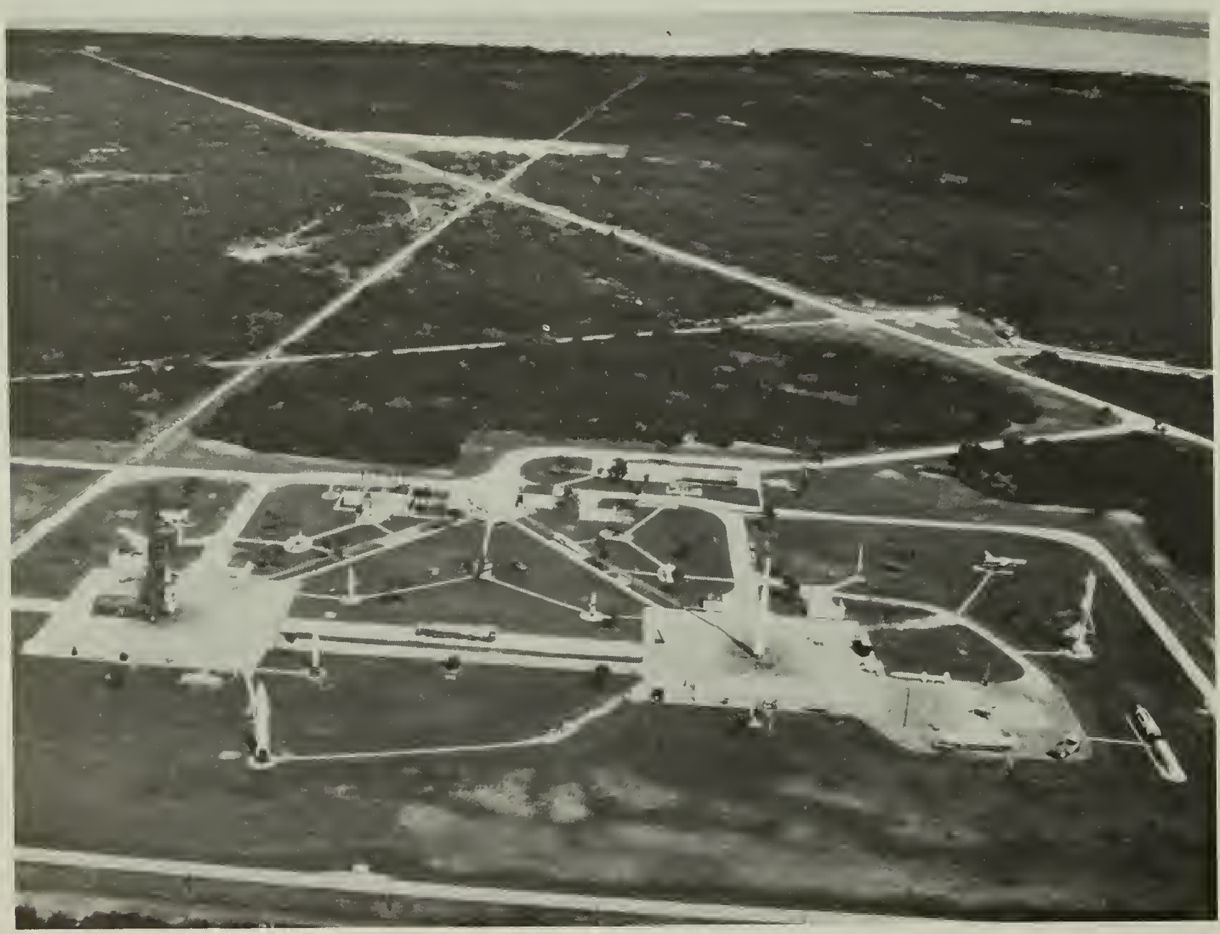
Complex 14, launch remains, 1981



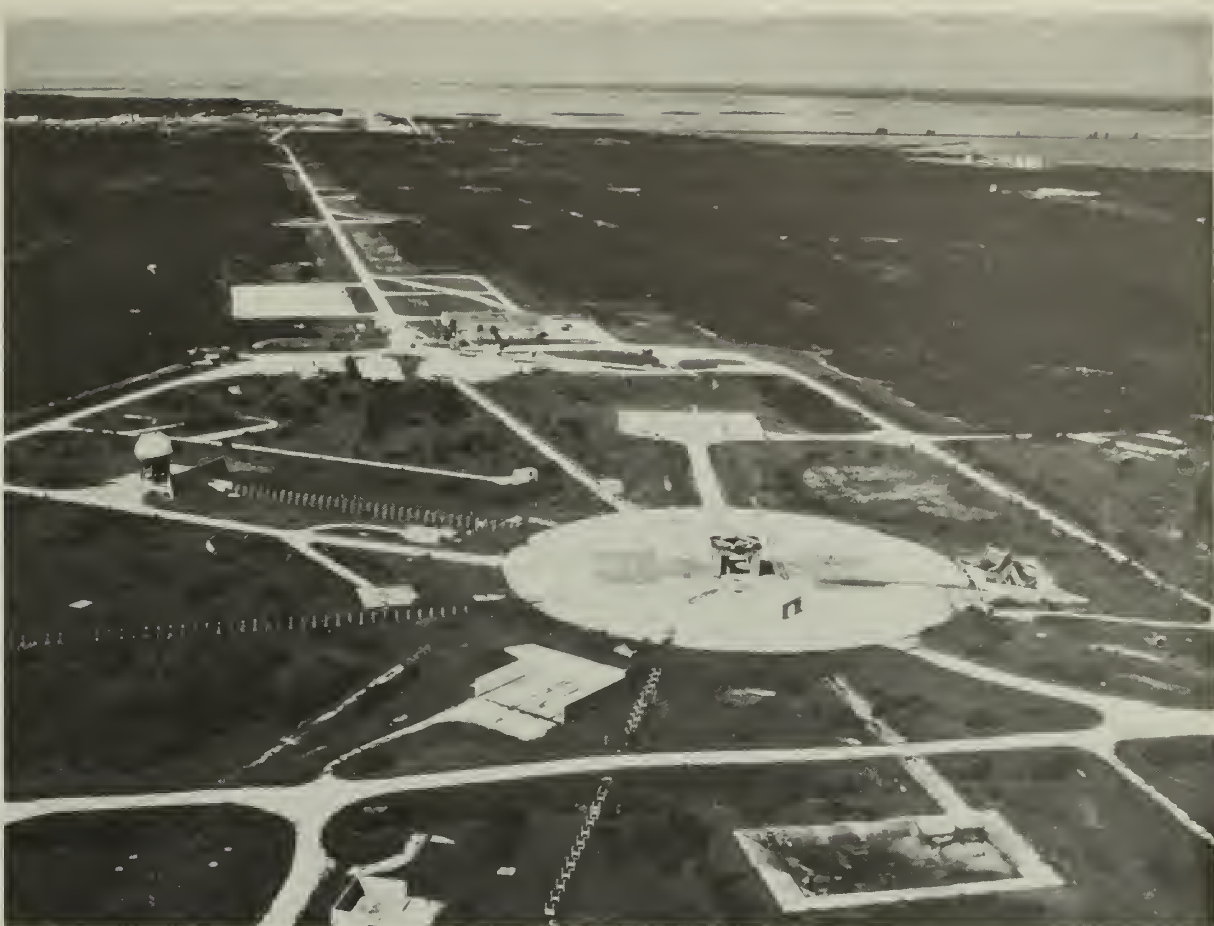
Complex 19, prelaunch lowering of service structure (erector), 1965



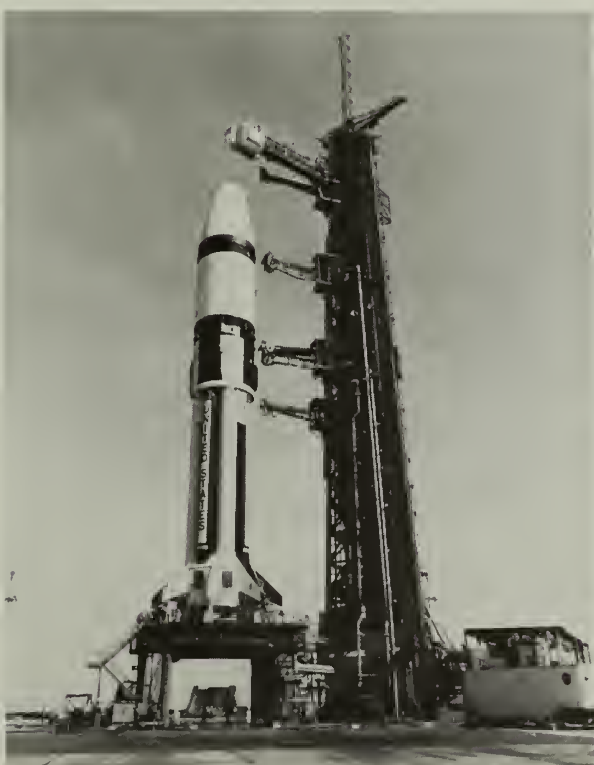
Complex 19, remains of launch stand, 1981



Complex 26, pad, left, Air Force Space Museum, right



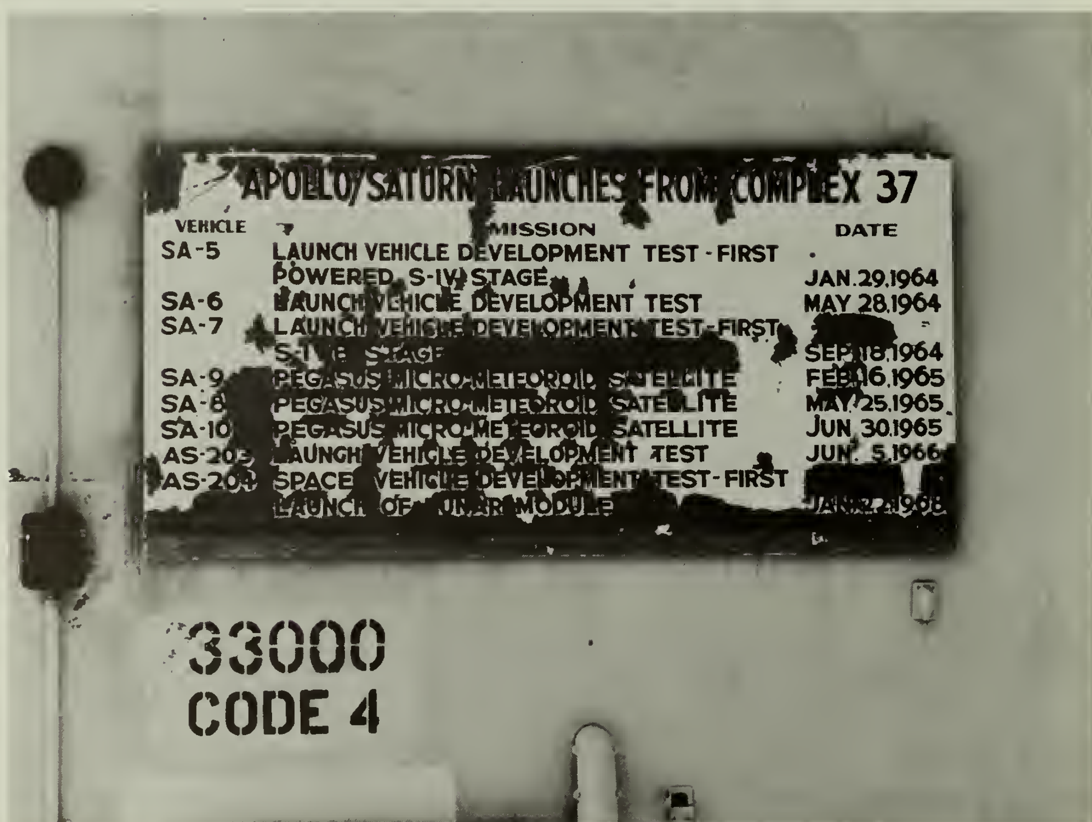
Complex 34, southwest view, 1981



Complex 34, Apollo 7 checkout, 1968

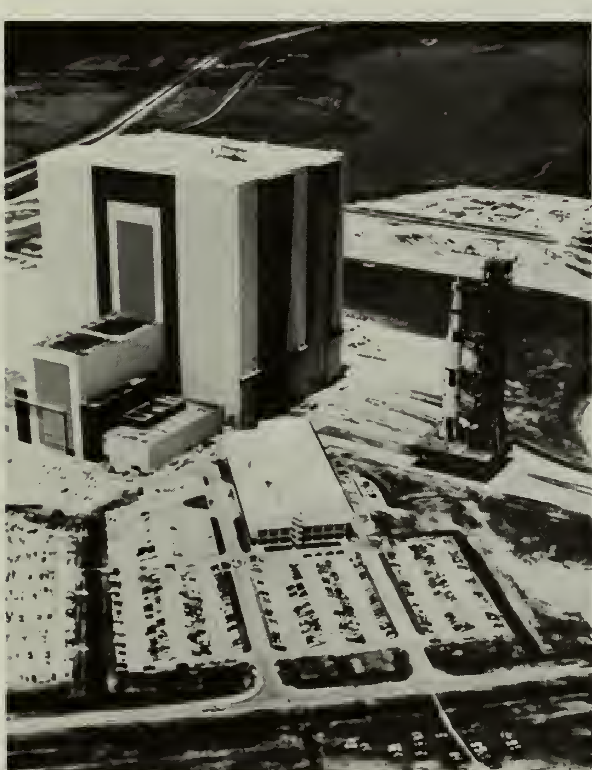
Complex 34, abandoned launch stand support, 1981

Complex 37, concrete base of umbilical tower, 1981



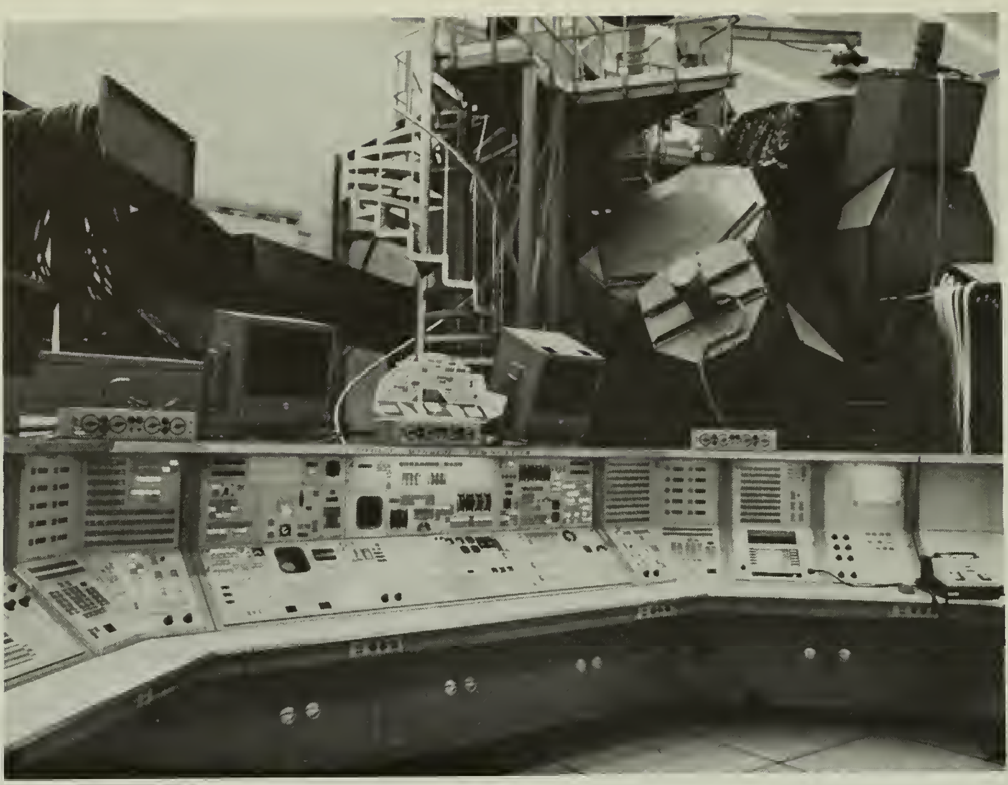
Complex 37, Apollo/Saturn launch "scoreboard" at blockhouse, 1981

Complex 39, pad A, with vehicle assembly building in background, 1981

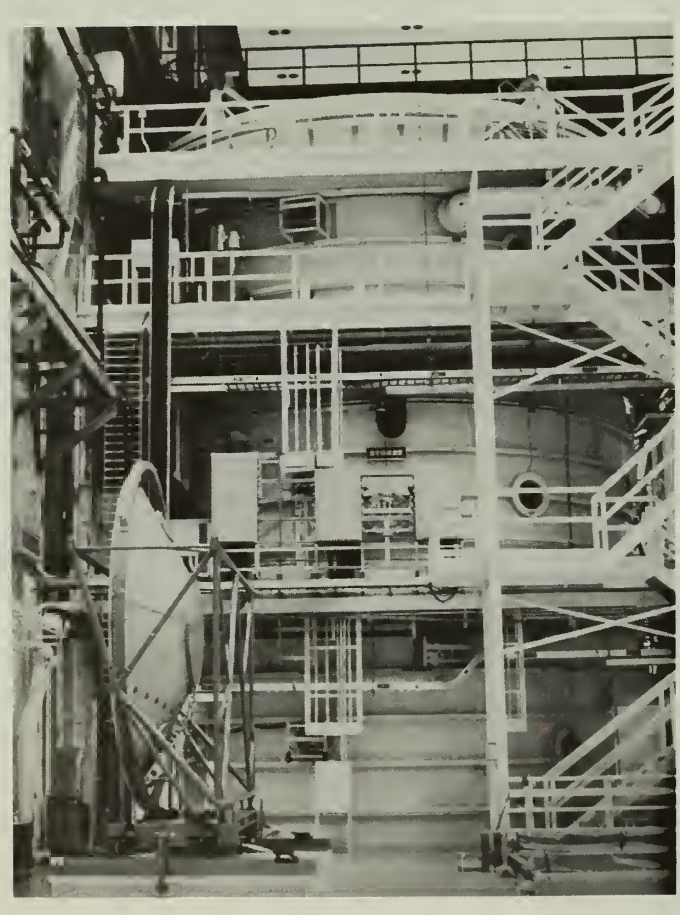


Vehicle assembly building and launch control center (foreground), with Apollo 11 spacecraft en route to complex 39, 1969

Launch control center, firing room (one of four), 1981



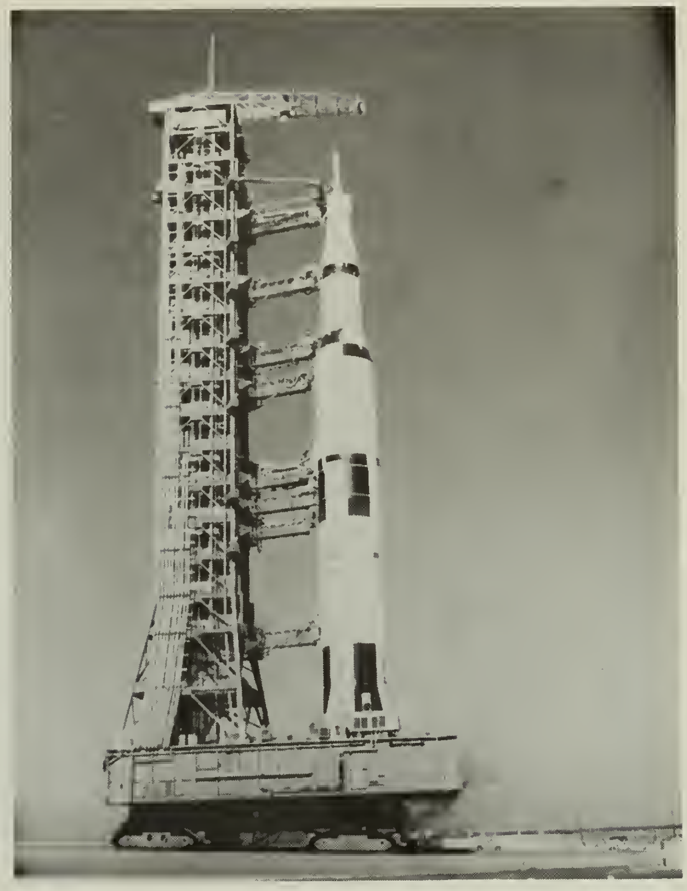
Apollo mission simulator 2, 1968



KENNEDY SPACE CENTER

High-altitude chamber, 1981

KENNEDY SPACE CENTER

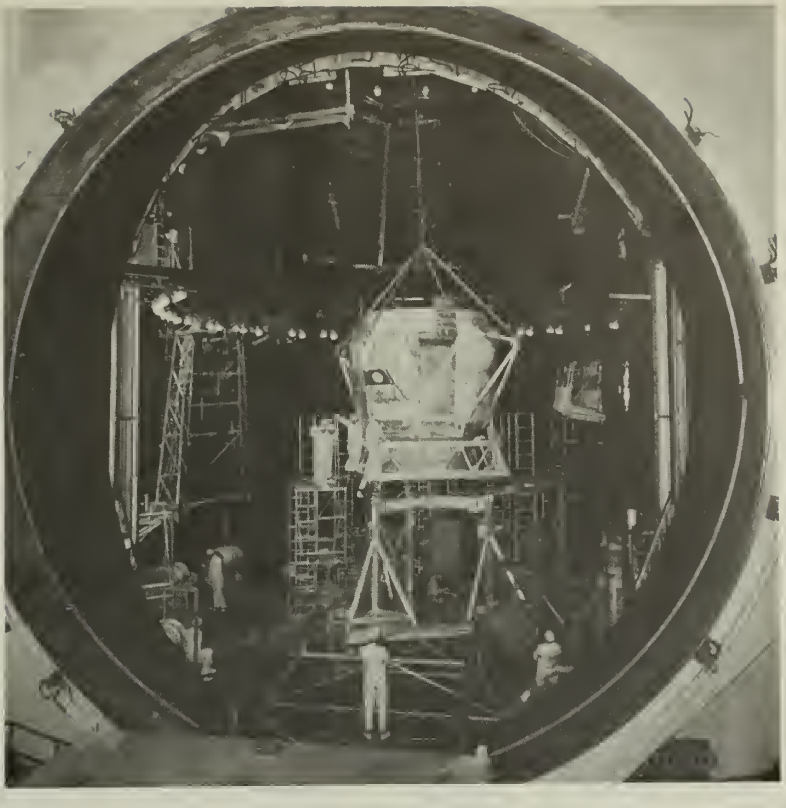


Mobile launcher (platform and umbilical tower) and Apollo 11 spacecraft on crawler-transporter being rolled to complex 39, 1969

Crawler-transporter, 1981

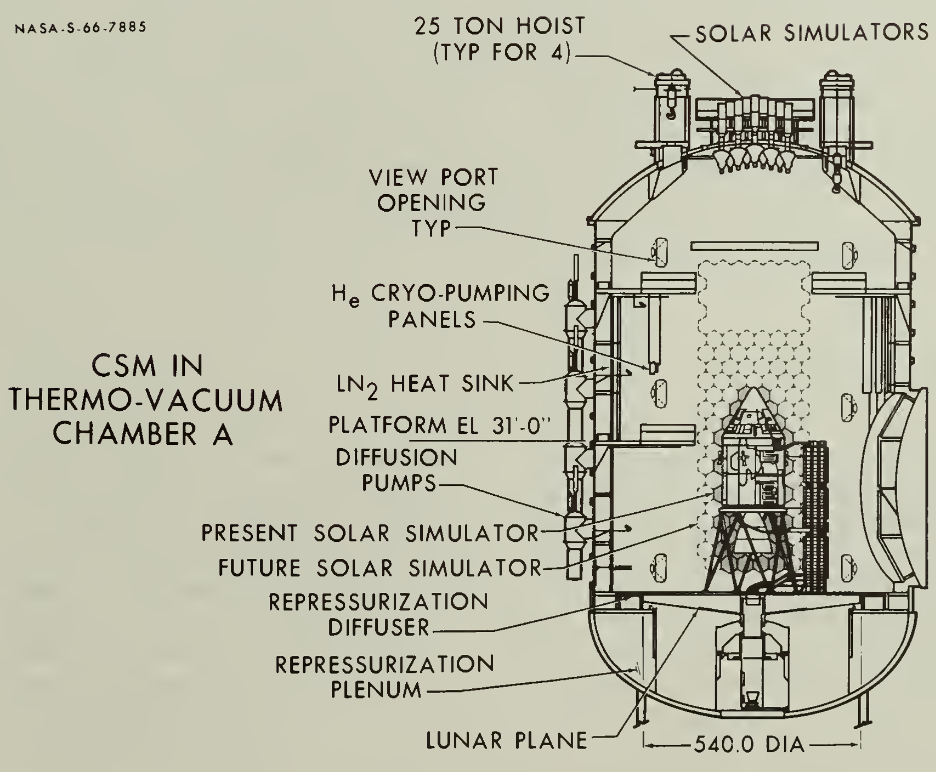
Mission operations control room, mission control center, 1968

Mission operations control room, mission control center, 1969



Space environment simulation laboratory, chamber A

JOHNSON SPACE CENTER



Space environment simulation laboratory, chamber A diagram for evaluating an area's potential for inclusion in the National Park System. While it is not within the scope of this study to consider additions to the system, the themes contained in the plan are useful for determining the significance of resources.

The first part of the NPS Plan outlines the aspects of our nation's heritage that merit National Park System representation and indicates those that are not currently represented. Aspects are identified by theme, subtheme, and facet. Based on the study team analysis, the manned space program features represent one theme, three subthemes, and four facets:

Theme 7: America At Work
- Subtheme c: Science and Invention
  - Facet 7: Scientific Exploration
  - Facet 8: Transportation
- Subtheme d: Transportation and Communication
  - Facet 1: Transportation
    - Subfacet d: Space
- Subtheme f: Engineering
  - Facet 2: Transportation Systems

Overall, the theme "America at Work" is one of the most poorly represented in the National Park System (subtheme "Science and Invention," 38 percent; "Transportation and Communication," 33 percent; "Engineering," 17 percent; total theme representation, only 23 percent). Further, of the facets represented by the Man in Space features, "Scientific Exploration," "Space Transportation," and "Transportation Systems" currently have no NPS representation, and "Transportation" (facet c8) is represented only by Wright Brothers National Memorial. Thus, the sites and facilities remaining from the early manned space program could make a significant contribution in illustrating these aspects of our cultural heritage.

CURRENT STATUS

The U.S. space program, especially during the 1960s when most activities occurred, has been based on a rapidly evolving technology. This has led to the abandonment or adaptation of many facilities whose value to the effort lasted only until new systems were designed for more advanced missions. Facilities that have been adapted or reworked to meet changing needs have, for the most part, lost their original integrity. Hangar S at Cape Canaveral is a prime example. Evidence of the building's use as crew quarters, suit room, and clean rooms for checking of the Mercury capsules has virtually disappeared as the hangar has been remodeled for offices, storage, and payload testing. Other features important to the Man in Space theme that are still in active use include launch complex 39, the vehicle assembly building, launch control center, mobile launcher, crawler-transporter, and flight crew support building at Kennedy Space

Center, and the mission operations control room at the Johnson Space Center. Alterations to these structures have occurred or are likely to occur as a result of ongoing programs. The potential for visitor access to many of these features is limited, primarily for security reasons, and although they may have played a direct and significant role in the efforts to land a man on the moon, the opportunities for preservation and interpretation are uncertain.

Other facilities directly related to the early manned space program are on standby or deactivated status (no future use currently scheduled), but still retain their original integrity. For example, the space environment simulation laboratory at the Johnson Space Center remains almost exactly as it was during the Apollo program. While future alterations to these facilities are possible, they would appear to be more useful in support of periodic test needs as part of future space efforts. Such uses would likely be compatible with preservation and interpretation.

Perhaps the most interesting features analyzed by the study team were the series of abandoned launch complexes at Cape Canaveral Air Force Station. Used since the early days of rocket testing, these sites and facilities represent the most easily recognizable links with historic activities--the long series of unmanned and manned launches and the step-by-step systematic approach during the 1950s and 1960s that ultimately led to the 1969 landing. Many of the sites, along with full-scale models of the various rockets and spacecraft, are available to visitors as part of the visitor center tours of the Cape Canaveral and Kennedy Space Center areas.

The launch complexes, unfortunately, are the most threatened significant features remaining from the period preceding the manned moon landing. The corrosive environment of Cape Canaveral is one of the most destructive in the world. Proximity to the Atlantic Ocean and the lack of physical barriers allow ocean breezes to coat the huge steel and concrete structures with salt. The result has been rapid deterioration where protective maintenance is not provided. A private contractor, Pan American Airways, performs periodic maintenance for the Air Force, primarily on active complexes. The only abandoned complexes currently given attention are 5/6 and 26. Pittsburgh 104 primer and a special orange topcoat are used when needed, usually every 4 to 7 years. A new polyurethane paint, expected to give a minimum of 5 years' protection before trouble spots develop, is also being used on an experimental basis.

Launch complexes 39 and 41 are being maintained by the Kennedy Space Center. The current program involves sandblasting the service structure down to "white" metal and applying an inorganic zinc-rich paint with epoxy tiecoat and urethane topcoat. (Topcoating is required where acids from engine combustion fall on the structure.) The Materials Testing Branch of the KSC has been conducting protective coating research since 1970. Their reports show that an inorganic zinc-rich paint without a topcoat resists corrosion better than a topcoated one. Tests have shown that this procedure has worked effectively for over ten years; expected life appears to be 15 to 20 years.

Launch complex 13 appears to be the most complete group of facilities remaining, and it also is one of the best preserved. Work here has been especially effective in maintaining the structural integrity and appearance of the service structure.

Despite the harsh and unforgiving salt air environment, the technology and materials exist to maintain key facilities. Examples of costs that would be involved in repairing and preserving complexes 5/6, 26, and 13 are presented in appendix C.

OPTIONS FOR FURTHER ACTION

Although this study has attempted to identify the remaining features that were most directly associated with the moon landing, there are additional concerns that should be addressed. These include further evaluation of the importance of all space program features and identification of possible ways of protecting and interpreting significant resources.

A detailed inventory and analysis should be prepared to investigate the qualifications of the vast number of space program features for national historic landmark designation. This study should place emphasis on the many support facilities that are indirectly related to the manned moon landing (secondary significance), but have been extremely valuable to the overall space effort. The relationship of these resources to the themes, subthemes, and facets of the NPS Plan should be evaluated.

A second study should present a complete range of alternatives for preserving and interpreting resources determined to be significant in the reconnaissance and theme studies. The alternatives study should identify appropriate private and public entities that may be able to contribute to management. A major objective of the study should be to indicate those situations where private enterprise may best be able to do the job. This may be most effectvely accomplished by involving various private entities, NASA, the Air Force, the National Park Service, other government agencies, or a combination of the above in the preparation of the study. As part of the task, the team should also indicate some of the most cost-effective methods of preservation and interpretation. One possibility that was discussed during this study was the use of detailed models and exhibits for key facilities where stabilization and maintenance of full-scale structures would be cost-prohibitive.

The need to protect abandoned facilities like the launch complexes cannot be overemphasized. These significant resources will be damaged beyond repair, precluding opportunities for preservation and interpretation, unless additional maintenance is provided.

APPENDIXES

A: LEGISLATION

B: MAJOR SITES AND FACILITIES

C: STRUCTURAL ENGINEER'S ANALYSIS, RECOMMENDATIONS, AND COST ESTIMATES FOR KEY FACILITIES AT CAPE CANAVERAL

D: NATIONAL REGISTER FORMS FOR REDSTONE TEST STAND, SATURN V ROCKET, AND LAUNCH COMPLEX 39

E: NEWSPAPER ARTICLES ON CANAVERAL/KENNEDY COMPLEX

F: NASA TRACKING AND DATA ACQUISITION STATIONS

G: U.S. MANNED SPACE FLIGHT LOG

Public Law 96-344
96th Congress

An Act

To improve the administration of the Historic Sites, Buildings and Antiquities Act of 1935 (49 Stat. 666).

Sept. 8, 1980
[S. 2680]

Man in Space commemoration. Study.

SEC. 18. The Secretary shall conduct, in consultation with the National Aeronautics and Space Administration, the Department of Defense, and any other entities considered by the Secretary to be appropriate, a study of locations and events associated with the historical theme of Man in Space. The purpose of such study shall be to identify the possible locations, components, and features of a new unit of the national park system commemorative to this theme, with special emphasis to be placed on the internationally historic event of the first human contact with the surface of the moon. The study shall investigate practical methodologies to permanently safeguard from change the locations, structures, and at least symbolic instrumentation features associated with this theme, and to display and interpret these for visitor appreciation. Governmental entities controlling these locations, structures, and features are hereby requested to preserve them from destruction or change during the study and congressional review period insofar as is possible. A comprehensive report derived from this study, including potential action alternatives, shall be submitted to the Committee on Interior and Insular Affairs of the United States House of Representatives and to the Committee on Energy and Natural Resources of the United States Senate no later than one complete fiscal year after the effective date of this section.

Report to congressional committees.

"Secretary."

SEC. 19. As used in this Act, except as otherwise specifically provided, the term "Secretary" means the Secretary of the Interior.

Effective date.

SEC. 20. Authorizations of moneys to be appropriated under this Act shall be effective on October 1, 1980. Notwithstanding any other provision of this Act, authority to enter into contracts, to incur obligations, or to make payments under this Act shall be effective only to the extent, and in such amounts, as are provided in advance in appropriation Acts.

Approved September 8, 1980.

B: MAJOR SITES AND FACILITIES

Cape Canaveral

The major source used for Cape Canaveral facility descriptions was Kennedy Space Center Historical Note Utilization of Cape Kennedy Launch Complexes (US NASA 1972b, pp. 3-11). Other sources included On the Shoulders of Titans (US NASA, Hacker and Grimwood 1977, pp. 194-195) for complex 14; Launch Complex 34 Fact Sheet (US NASA n.d.[c]) for complex 34; Launch Complex 37 Fact Sheet (US NASA n.d.[d]) for complex 37; vol. 2 of the Technical Facilities Catalog (US NASA 1974b, chp. 9, p. 123) for Hangar S; and Air Force Eastern Test Range (USDAF 1971, p. 13) for Port Canaveral.

Launch Complexes 1 and 2. Complexes 1 and 2 were constructed for the Snark winged missile program and were also used for the Matador combat training launch program. From 1961 to 1963 the pads were used as a heliport to support the Mercury manned launches.

Launch Complexes 3 and 4. Complexes 3 and 4 were built for the Bomarac interceptor missile. Complex 3 was also used to launch the Bumper rocket, and complex 4 served as a temporary launch facility for the first Redstone missile research and development program. After completion of the Bomarac program, some of the facilities were converted as a medical support area for the Mercury manned launches.

Launch Complex 5/6. Complex 5/6 is a dual-pad facility with a shared blockhouse. It was constructed for the Redstone missile flights and was subsequently used to launch the Jupiter C, Juno I, Juno II, and Mercury/Redstone missiles. Explorers 3, 4, 5, and 7 were launched from pad 5 by Juno II vehicles. All of the Mercury/Redstone suborbital flights, both unmanned and manned, were launched from complex 5/6, the most famous being the launch of Alan Shepard in "Freedom 7" on May 5, 1961, and the launch of Gus Grissom in "Liberty Bell 7" on July 21, 1961. These launches were under the control of a NASA team headed by Dr. Kurt H. Debus. During the Apollo program, the complex was programmed to be the launch site of the Little Joe II rocket; however, it was never modified for this purpose. The blockhouse now houses a small NASA Space Museum. Complex 5/6 and the NASA Space Museum are now grouped with launch complex 26 and the Air Force Space Museum (see Launch Complex 26).

Launch Complex 11. Complex 11 was built to accommodate the needs of the Atlas research and development program.

Launch Complex 12. Complex 12, also built to support the Atlas research and development program, was the site of two unsuccessful NASA Pioneer lunar missions using Atlas/Able rockets in 1960. The complex was later modified to launch the Atlas/Agena rocket and transferred to the control of NASA. It served as the launch site for all Ranger missions, Mariners 1, 2, 4, and 5, and many other launches.

Launch Complex 13. Complex 13, the third site constructed for the Atlas research and development program, was later modified to launch the

Atlas/Agena rocket and was assigned to NASA. The complex was used for five lunar orbiter missions and the Mariner 3 mission. When the Atlas/Centaur rocket was developed, complex 13 was returned to the Air Force; it was deactivated in 1978.

Complex 13, which closely resembles complex 14 (site of the manned Mercury orbital launches), is the only remaining site that illustrates the support facilities required in the Mercury/Atlas flights. The service structure at 13, when compared with the structure at 26B, indicates the changes from Mercury/Redstone to Mercury/Atlas launches. Further, the complex 13 service structure is the only one still standing (except active facilities at complex 39) that is associated with the manned space program.

Launch Complex 14. Complex 14 was originally built to accommodate research and development of the Atlas rocket and was the launch site for NASA's Pioneer lunar attempt in 1959. In 1960 the complex was assigned to NASA for use in the Mercury program. The Atlas/Big Joe flight and all Mercury/Atlas flights were launched from this site. In 1965-66 complex 14 was used to launch the Atlas/Agena configuration in conjunction with the target vehicle launches for Gemini flights.

A Mercury 7 monument--a symbol of the planet Mercury superimposed over the number 7--has been placed at the entrance to complex 14. Within the complex at the entrance to the service structure is a marble monument to John Glenn. The monument reads:

> From this site, Complex 14 at Cape Canaveral Air Force Station, astronaut John Glenn, Jr. became the first American to orbit the earth. His three-orbit flight on Feb. 20, 1962 was followed by longer flights by Scott Carpenter, Walter Schirra, and Gordon Cooper to complete project Mercury, America's first steps on the path to space.

Complex 14 also contains a reinforced-concrete blockhouse that is now empty.

Launch Complex 15. Complex 15 was built for the Air Force to test the Titan I rocket. No NASA missions were ever launched from this complex.

Launch Complex 16. Complex 16 was constructed for the Titan I research and development program and was also used for Army Pershing missile tests. It was later assigned to NASA and rebuilt as a test stand for static firing of the Apollo service module propulsion engine. The complex was deactivated in 1969.

Launch Complex 17. Complex 17 was built for the Thor intermediate range ballistic missile research and development program. It was later modified to accommodate Delta space vehicles, which are still regularly used by NASA to launch communication and weather satellites. The complex is still in active use. Satellites launched from complex 17 include Syncom, Relay, Telstar, Early Bird, the interplanetary monitoring probe, the orbiting solar observatory, Pioneer, the Tiros and Essa weather series, Echo, Explorer, the geodetic orbiting satellite, Intelsat, NATO satellites, Skynet, and biosatellites.

Launch Complex 18. Complex 18 was used by the Navy and NASA to launch the Vanguard rocket. The Vanguard succeeded in putting the second American satellite in orbit in March 1958.

Launch Complex 19. Complex 19 was the launch site for ten Gemini manned oribital flights. The launch stand, launch ramp, and erector (service structure) are still in place in the service area. When the complex was active, there was an air-conditioned dust-free white room on top of the launch erector stand that enclosed the Gemini spacecraft before launch. This room maintained constant humidity to provide a controlled environment for the spacecraft and the upper stage of the booster. Next to the erector was an umbilical tower 31 meters high with seven booms supporting 31 cables and lines to the spacecraft, which fed electrical power, propellants, and other needs until the moment of the launch. A reinforced-concrete blockhouse near the launch site served as the control center for the launch until the rocket cleared the tower.

In the later Gemini launches, the Agena target vehicle used for rendezvous and docking attempts with Gemini spacecraft was launched from nearby complex 14.

Launch Complex 20. Complex 20 was constructed for the Titan II research and development program and was later modified to accommodate the needs of the Titan III program. The site was also programmed for use in the Air Force X-20 Dynasoar manned spacecraft project but was never used for this purpose.

Launch Complexes 21 and 22. Complexes 21 and 22 near the Cape Canaveral lighthouse were used in the research and development of the Mace/Madador missile. The Mace, as well as other aerodynamic cruise missiles like the earlier Snark and Matador, was built to fly in the atmosphere and required air for engine operation.

Launch Complex 25. Complex 25 was built near the southern end of the cape to support the Polaris research and development program. It was later modified to support research and development of the Poseidon missile.

Launch Complex 26. Complex 26 is a dual-pad, single blockhouse complex that was constructed for the Redstone research and development program. It was later used for Jupiter research and development and was then modified for the launching of the Juno I and II missiles. Explorer 1, the first U.S. satellite, was launched by a Juno I rocket from pad 26B on January 31, 1958, and many other early NASA launches in the Explorer series were launched there. Pad 26A was the site of the launch of primates Ham, Gordo, Able, and Baker in tests that paved the way for Alan Shepard's Mercury suborbital flight. Pad 26B still contains the original service structure, blockhouse, and most of the equipment used in the early launches. Launch complex 26 was used until 1963 as part of the NATO training program for Italian and Turkish missile crews using the Jupiter missile.

The Air Force Space Museum at complex 26, including the blockhouse, an exhibit hall, and an outdoor rocket exhibit area, is part of the Kennedy

Space Center tour. The museum collection contains old and modern missiles, including the Atlas, Thor, Titan, Jupiter, and many others. More than 70 missiles representing all stages of rocket development are on display. The displays have been prepared by the Air Force, NASA, companies, and individual volunteers.

Launch Complex 29. Complex 29 was used in the Polaris research and development program.

Launch Complex 30. Complex 30 supported the Pershing missile research and development program.

Launch Complexes 31 and 32. Complexes 31 and 32 were constructed for the Minuteman/ICBM research and development program. Each complex has two pads and one blockhouse. Two of the four pads were constructed as conventional flat pads and two as ballistic missile silos. The complexes were later modified to support changes in the Minuteman missile.

Launch Complex 34. Complex 34 was planned and constructed for the Saturn I booster flight test program. Following the fourth successful Saturn I launch, the complex was modified to support the Saturn IB/Apollo spacecraft. Complex 34 was the first launching site in the world built expressly for the peaceful exploration of space.

The remaining features on the site are the launch stand, blockhouse, and propellant facilities. The launch stand is a large steel and concrete platform from which the rocket was launched. At the time of the launch, two large flame deflectors were moved into place under the platform to divert the rocket's flame from the base of the structure. Next to the stand was the large umbilical tower that maintained the link between the rocket and the ground equipment until the moment of launch. A launch service structure for assembly, service, and shelter of the space vehicle was also used to erect and check out the vehicle while on the launch stand. The service structure was on wheels and could be moved back 600 feet from the stand during a launch.

Some distance from the launch stand was the blockhouse (launch control center), a dome-shaped building made of reinforced-concrete, 120 feet in diameter. This building housed the various launch supervision and controlling monitors for the Saturn vehicle until the rocket cleared the tower, when the mission control assumed command.

The service structure and umbilical tower were salvaged between 1970 and 1972. Only the launch platform remains at the pad. The nearby blockhouse is in good condition and contains much of the original electronic equipment.

Launch Complex 36. Complex 36 was built as an Atlas/Centaur launch facility for NASA. It was constructed as a single pad/single blockhouse complex. Later a second pad, 36B, was constructed to support Atlas/Centaur launches. This complex is still actively used by NASA to launch weather and communication satellites.

Launch Complex 37. Complex 37 was the site of eight Saturn 1 and 1B launches, including the launch of Apollo 5 with the first flight of an Apollo lunar module (unmanned) on January 22, 1968. It consisted of pads A and B, each containing a launch stand and umbilical tower. Structures common to the pads included the blockhouse (launch control center), operations support building, propellant storage and transfer facilities, and a mobile self-propelled service structure riding on 1,200 feet of steel rails between the two launch stands. The 300-foot-high service structure extended to a distance of 330 feet.

Much of the complex, including the service tower, has been dismantled or destroyed. The blockhouse, which contained the main firing and test supervision facilities, is still in place, although the interior is empty. It measures 110 feet in diameter by 37 feet high and is constructed of reinforced concrete.

Launch Complexes 40 and 41. Complexes 40 and 41 were constructed to support the Air Force Titan IIIC program. Several Air Force communication satellites were launched from these pads. Complex 41 was also the site of the launch in 1975 of the two Viking spacecrafts to Mars using modified Titan IIID/Centaur rockets. Other satellites launched from these complexes include two Helios satellites and two NASA applications technology satellites. These complexes are still in active use.

Launch Complex 43. Complex 43 is used to launch Loki weather rockets.

Original Mission Control Center. The mission control center at the cape was used for all Mercury flights and the first three Gemini flights. The center took over flight control when the rocket left the pad, and followed through until splashdown. This function was transferred to the new mission control center at the Johnson Space Center after Gemini III. The TWA bus tour now includes a stop at the original mission control center; a narrative tape and lighted consoles are used to interpret the facility.

Hanger S. Hanger S is a permanent concrete/metal building that was used by astronauts in the Mercury program for crew quarters, suit room, and medical facilities. The hanger also contained clean rooms on each side of the building, which were used to check out the Mercury capsules. The building, constructed in 1957, is still in active use by NASA and has been extensively reconditioned on the inside to provide office space for NASA personnel.

Port Canaveral. Port Canaveral, which is located near the south gate of the Cape Canaveral Air Force Station, supports nuclear submarines equipped with Polaris and Poseidon fleet ballistic missiles for test launchings. The heavily instrumented ships of the Air Force eastern test range and commercial vessels also operate out of this deep-water port. During the Apollo era, Port Canaveral provided an access point for barges bringing the large Saturn V rockets to complex 39.

John F. Kennedy Space Center

The primary source used for Kennedy Space Center facility descriptions was vol. 2 of the Technical Facilities Catalog (US NASA 1974b, chp. 9, pp. 3-91). John F. Kennedy Space Center (US NASA n.d.[k], p. 29) was referenced for the description of the visitor information center.

Vehicle Assembly Building (VAB)--High Bay. The VAB high bay is a steel-framed, metal-covered structure, 418 feet long by 513 feet wide by 524 feet high. It provides four high-bay cells for vertical assembly, checkout, and protective storage of launch vehicles and spacecraft. Two of the cells were outfitted for assembly and checkout of Saturn V launch vehicles during the Apollo program. One cell was outfitted for assembly and launch of Saturn 1B launch vehicles, and the remaining cell was not outfitted. The outfitted cells contained five extensible platforms to provide access and service connections to the rocket stages and spacecraft. Each high-bay cell was provided with a doorway for ingress and egress of the mobile launcher (platform and umbilical tower) and assembled launch vehicle atop the crawler-transporter. The assembly cell doors, 456 feet high by approximately 150 feet wide, were a series of electrically operated, horizontal-rolling, and vertical-lift sections. The building contained approximately 10,000 tons of air-conditioning capacity. Chilled and hot water for air-conditioning and compressed air were obtained from the adjacent utility annex. High-pressure gas was furnished from a remote gas facility.

Vehicle Assembly Building--Low Bay. The VAB low bay is 256 feet long by 437 feet wide by 209 feet high at its center section. The low bay housed assembly and test facilities for various stages of the Saturn V and Saturn 1B vehicles used in the Apollo effort. When the stages arrived at the low bay, a 175-ton capacity bridge crane was used for moving the stages into the checkout cells. There were four active checkout cells, each with three work platforms for checking out the stages. The building configuration was designed to accommodate four additional cells, for a total of eight. The main exterior door on the south end of the low bay is 55 feet wide by 94 feet high.

Shops and clean room facilities were provided in the low bay for checkout of the instrumentation for the Saturn V and Saturn 1B vehicles. The shop areas have been modified to house institutional-type shops for the space center and additional shuttle shops--rocket and air-breathing engine shop, line replaceable unit avionics shop, and line replaceable unit maintenance shop.

Upon completion of checkout in the low bay, the stages and instrumentation units were delivered to the VAB high bay for mating with the booster stage of the Saturn V or Saturn 1B vehicle.

The entire VAB has been modified to accommodate the space shuttle program and is not open to the general public.

Operations and Checkout Building. This facility is a multistory structure containing approximately 601,748 square feet of usable floor space. The building is more than 100 feet high in the high-bay area and is constructed of concrete and steel with a masonry exterior.

Apollo spacecraft were delivered to the operations and checkout building by special rubber-tired transporters, which brought the spacecraft into low-bay and high-bay areas to check the systems integrity. Once they were completely checked out and integrity was established, they were taken to the VAB for assembly on the launch vehicle.

Accommodations for astronaut preflight activities were included in the vicinity of spacecraft checkout operations. These included a crew preparation area, a technical and briefing area, transient quarters, and a biomedical area.

The building contained instrumentation facilities for receiving, evaluating, and recording data from spacecraft during simulated and actual flights. It also contained clean rooms, a malfunction laboratory, a calibration laboratory, biomedical and biochemical laboratories, acceptance checkout equipment, a quick look data station, and assembly and test areas.

There were three 27½-ton bridge cranes, two integrated test stands, and two high-altitude chambers in the assembly and test areas.

The operations and checkout building is still in active use and has been reconfigured to accommodate the needs of the space shuttle program. The only areas that still retain their Apollo-era configuration are the high-altitude chambers. These chambers, located in the high bay, were used for assembly and test of the integrated command/service module and docking module in a simulated space environment. The chambers have an overall height of 58 feet and a diameter of 34 feet, with a 28-foot clearance for working inside the chamber. The chambers are capable of reaching a test altitude of 250,000 feet within 1 hour and can be repressurized in 16 to 30 minutes normally or in 2 minutes under emergency conditions. Sixteen pumps are used in various configurations to reach the desired altitude. The high-altitude chambers are not being used, but it is too expensive to remove them.

Flight Crew Support Building. The flight crew support building is a concrete frame and block curtain wall structure with a gross area of approximately 44,200 square feet. Of this total, approximately 15,000 square feet is on the second floor at the east end of the building. The building contains a two-story, high-bay area of approximately 11,000 square feet, which houses the Apollo mission simulators formerly used to train astronauts. These facilities are scheduled to be dismantled. The high-bay area is currently used for viewing by tourists and other interested visitors. The remaining area is office and engineering space.

Crawler-Transporter. The crawler-transporter was used to transport the mobile service structure and the combined mobile launcher/launch vehicle in preparation for Apollo flights. The mobile launcher traversed the crawlerway from the VAB to the launch pad. The mobile service structure was transported from its parking area to and from the launch pad. The crawler-transporter had the capability of lifting, transporting, and lowering the mobile launcher or the mobile service structure without the aid of auxiliary equipment. It also supplied limited electrical power to the mobile launcher and the mobile service structure during transit.

There are two crawler-transporters at the space center, both still in active use in support of the space shuttle program. Each consists of a rectangular chassis supported through a suspension system by four dual-tread crawler trucks. The overall length is 131 feet, and the overall width is 114 feet; the unit weighs approximately 5.5 million pounds. The crawler-transporter is powered by self-contained diesel electric generator units. Electric motors in the crawler trucks propel the vehicle. Electric motor-driven pumps provide hydraulic power for steering and suspension control. Air-conditioning and ventilation are provided where required. Control cabs are located at each end. The control function of a cab depends on the direction of travel. The leading cab in the direction of travel has complete control of the vehicle.

Maximum speed of the crawler-transporter is 2 mph when unloaded, 1 mph when loaded on a level grade, and 0.35 mph when fully loaded on a 5 percent grade. The crawler-transporter has a 500-foot minimum turning radius and is capable of positioning the mobile launcher or the mobile service structure on the facility support pedestals within ±2 inches.

Mobile Launcher. Three mobile launchers at complex 39 functioned as the platform and umbilical tower for the Saturn V and Saturn 1B launch vehicles in the Apollo program. Each launch platform was a two-story steel structure, 25 feet high by 160 feet long by 136 feet wide; the umbilical tower (LUT) extended 380 feet above the deck of the platform. The mobile launchers were positioned in the VAB high bay during assembly and checkout of the launch vehicle stages. They were stationed at the pad for fueling and launching and at the parking area for modification and refurbishment of launch vehicles.

The mobile launcher (without vehicle) weighed approximately 10.5 million pounds. Three levels in the base provided approximately 12,000 square feet of floor space. The structure supported umbilical service arms, 18 work platforms, and two elevators with a load capacity of 2,500 pounds each. A 25-ton hammerhead crane at the 380-foot level rotated 360 degrees in either direction at 1 rpm. The launcher was supported by ground-mount mechanisms at each service location. In addition, four extensible columns were provided at the pad to absorb the dynamic loads generated by a shutdown before liftoff. Three tail service masts provided support for electrical cables and drain and fill, hydraulic, and pneumatic lines.

Two of the mobile launchers have been drastically modified to serve as mobile launcher platforms for space shuttle vehicles. Major modifications consist of removing the umbilical tower; relocating hold-down points and exhaust holes; and removing or modifying electrical, pneumatic, propellant, instrumentation, fire protection, and safety systems. The third launcher, still configured to support the Saturn IB launch vehicle, is currently stationed north of the VAB.

Mobile Service Structure. The mobile service structure was designed to accommodate the Saturn V and Saturn 1B launch vehicles and spacecraft for Apollo. The structure was used at the launch pad for inspection and malfunction operations of the launch vehicle stage, fueling and checkout operations for the spacecraft, final ordnance hookup, and final verification for the spacecraft. The structure was further designed to accommodate associated electrical and ground support equipment. Platform access was afforded by two self-propelled platforms serving the launch vehicle and three stationary but repositionable platforms serving the spacecraft. Two of the space platforms were enclosed and air-conditioned.

The overall height of the structure was 402 feet above grade. The structure base was 133 feet by 130 feet long. There was a 52-foot cantilevered frame for platform support overhanging the launch deck of the structure. In addition to stairs, access to platforms and tower landings from the base structure was provided by two 5,000-pound capacity passenger/freight elevators with speeds of 600 feet per minute. Access from ground level to the base structure was provided by stairs, one man-lift, and one elevator with a 500-pound capacity and a speed of 200 feet per minute.

The mobile service structure has not been used recently and was dismantled and disposed of during this study.

Launch Control Center. The launch control center (LCC) is connected to the adjacent vehicle assembly building by an enclosed companionway. This facility is a reinforced-concrete building on a mat foundation. It is 385 feet long by 166 feet wide by 76 feet high, with a total of 213,250 square feet of floor space. The building was designed to control the prelaunch and launch operations of the Saturn V and Saturn 1B vehicles in the Apollo program. It has since been modified and refurnished to support space shuttle launches and is still in active use.

Office, shop, and laboratory areas are located primarily on the first two floors of the structure. The telemetry checkout station is on the second floor. It has a net area of 5,614 square feet and serves as a telemetry relay station as well as a checkout for various stages of the spacecraft. Four firing bays are located on the third floor, one for each of the high-bay cells in the VAB; however, only three of the bays are outfitted. The outfitted firing bays house equipment for launch operations and closed circuit television for supervision and control of all launch operations. Each of the equipped firing rooms has approximately 450 consoles containing the controls and displays required during spacecraft checkout. Fifteen display systems are required in each firing room. The firing rooms include a raised floor that permits delivery of cooling air to all operating equipment and provides adequate space for equipment interconnections and cabling. The side of the firing rooms facing the launch pads provides direct visual observation.

Launch Complex 39. Complex 39 consists of launch pads A and B. The basic configuration of each pad is circular, with a diameter of 3,000 feet. At the top of the pad, the elevation is approximately 40 feet above the surrounding grade. Service roads at the perimeter of each installation provide access to propellant facilities, camera sites, and other support equipment. The built-up portion of each pad is heavily reinforced concrete and steel. Concrete and steel support piers for the mobile launcher and arming tower are built up from the hardstand.

A transportable wedge-type flame deflector to protect the launch vehicle and platform is positioned in a cutout below the launch vehicle. Below ground to the west of the hardstand is the pad terminal connection room, which provides all connections between the mobile launcher, pad facilities, and LCC equipment. Support facilities, including propellant storage tanks, holding and burn ponds, and a high-pressure gas storage facility, are located nearby. Gas from the converter/compressor between the VAB and pad areas is received and stored in the gas storage facility for use during vehicle checkout and launch. Camera sites cover launches from six different positions.

Pads A and B have been extensively modified to accommodate space shuttle launches. Modifications include construction of a fixed, 185-foot-high service and access tower; modification of existing and construction of new flame deflectors; construction of payload changeout rooms attached to the service access tower; and modifications and additions to propellant piping and storage, various electrical systems, and operational intercom and television systems.

Visitor Information Center. The visitor information center at the space center is operated by TWA Services under contract with NASA. The facility currently attracts over 1,700,000 visitors annually. The visitor center has outdoor and indoor exhibits of spacecraft and rockets, plus displays of space equipment, facilities, and products. Space movies and space science demonstrations are scheduled periodically throughout the day.

Adjacent to the exhibit areas are a gift shop, where photo supplies and souvenirs are available, and the Carousel Cafeteria. A fleet of 25 Greyhound buses (plus 15 on standby) currently provide visitors with an opportunity to view most of the past and present launch sites, the vehicle assembly building, and an authentic Apollo/Saturn V space vehicle. The two-hour tours start and end at the visitor information center.

Among the outdoor exhibits are Mercury/Redstone, Mercury/Atlas, and Gemini/Titan II space vehicles and various rockets including a Saturn 1B and a Juno I similar to the vehicle that launched Explorer I, the first U.S. satellite. Also displayed are an F-1 engine used in the first stage of the Saturn V and a full-scale model of a lunar module.

A one-tenth scale model of Saturn V is displayed indoors. This rocket is the most powerful U.S.-built rocket, which launched Apollo astronauts to the moon and put the Skylab space station in earth orbit. Transparent sections enable you to see the fuel tanks, engines, pumps, and control systems. Also displayed indoors are a lunar rover, astronaut space suits, a lunar rock, and scale models of the Skylab space station and the space shuttle. Various exhibits explain space flight principles, research, and activities. Mercury, Gemini, and Apollo spacecraft that flew missions may also be viewed.

An $8.2 million expansion of the KSC visitor center is currently proposed by TWA Services.

Lyndon B. Johnson Space Center

The following sources were used for descriptions of Johnson Space Center facilities: Thermal Vacuum Laboratories User Guide (US NASA 1981c, pp. 4-10) for the space environment simulation laboratory; Mission Control Center (US NASA n.d.[g], pp. 2-8) for the control center; Lunar Sampler Building (US NASA n.d.[e], p. 2) for that structure; Manned Spacecraft Center (US NASA n.d.[f], pp. 14-27) for the flight acceleration facility, project management building, and auditorium and public affairs facility; and Shuttle Mission Simulator (US NASA n.d.[j]) and vol. 2 of the Technical Facilities Catalog (US NASA 1974b, chp. 8, pp. 90-92) for the mission simulation and training facility.

Space Environment Simulation Laboratory. This building contains an active laboratory complex that is used to simulate the harsh environment of space. The laboratory complex includes the space environment simulation laboratory (SESL), the space environment effects laboratory (SEEL), and support facilities. The SESL contains two large man-rated chambers, instrumentation and data systems, and other associated support facilities. The SEEL houses 11 smaller chambers with similar support systems and areas. The two largest chambers have been used to test large, complex spacecraft that were flown for the Apollo, Skylab, Apollo-Soyuz, and shuttle programs.

Chamber A is the largest of the JSC thermal-vacuum test facilities. Its usable test volume and high-fidelity space simulation capabilities are adaptable to thermal-vacuum tests of a wide variety of test articles. The major structural elements of the chamber are the rotatable floor, an access door, and dual manlocks. The floor can be rotated by manual control (±180 degrees) about its vertical axis at continuously variable angular velocities up to a maximum of 0.8 rpm. Test articles are normally inserted into the chamber by means of overhead cranes and a dolly and track structure that extends from the high-bay area into the chamber. The dual manlocks provide a means for the test crew to move from ambient air pressure to the thermal-vacuum environment and back. They also provide for the maintenance of rescue crewmen at convenient intermediate pressures during manned test operations. When the inner door is bolted, either of the manlocks can be used as an altitude chamber for independent tests.

Chamber B, the smaller man-rated chamber, has the same basic capability as chamber A and can accommodate a variety of smaller scale tests more economically and with faster response. Major structural elements of the chamber are the removable top head, the fixed chamber floor, and a dual manlock at floor level. Two rolling bridge cranes are used to remove the chamber top and to insert large test articles. The dual manlock provides easy access to the test articles as well as a means of transporting crewmen to the test environment and back during manned tests. The manlock can also be used as an altitude chamber for independent tests. In addition, one manlock is equipped with a water deluge system and other features that permit manned operations with oxygen-rich residual atmospheres. A solar simulation array is mounted on the top head of the chamber to accommodate test requirements.

Both of these chambers were used to investigate a wide variety of design and development problems for Apollo-era hardware in a hostile space environment. These tests were designed to accurately determine such factors as operating temperatures, fluid leak rates, changes in absorptive or emissive properties of thermal coatings, changes in electrical or mechanical properties of material, and properties of lubricating films and surfaces. The completion of these tests was essential to the success of the Apollo program.

The space environment effects laboratory contains ten small thermal-vacuum chambers and one ambient pressure-temperature chamber that offer a wide range of performance capabilities for smaller space hardware.

Mission Control Center. The mission control center is an active facility. The three-story structure consists of a mission operations wing (MOW), operations support wing (OSW), and an interconnecting lobby wing. The MOW contains systems and equipment required to support the mission control function. The OSW contains office, laboratory, and technical support areas for the flight operations directorate. The lobby wing provides additional office space and dormitory facilities utilized by flight controllers during space flights of extended duration. The mission control center is supported by an emergency power building that houses standby electrical power and air-conditioning systems in the event that primary sources fail.

The basic function of mission control is to increase flight safety and mission performance by providing the flight crew with ground-based sources of information during normal or alternate missions and during mission emergencies. The center provides centralized control of all NASA manned space flight missions. It exercises full mission control from launch through recovery and technical management in the areas of vehicle systems, flight dynamics, life systems, flight crew activities, recovery support, and ground systems operations. In addition, flight controllers are also deployed to remote stations to aid in analyzing the data and, in certain instances, to make command decisions.

Principal systems on the first floor are the real time computer complex and the communications systems. These systems support the dual mission facilities and systems located on the second and third floors. The communications system provides the interface between the mission control center in Houston and the manned space flight network and the launch site.

Principal areas on the second floor are the mission operations control room (MOCR), the staff support rooms (SSR), the simulation facilities, and the master digital command system. The MOCR is the principal command and control center, staffed with key mission operations teams responsible for overall management of the flight.

Principal areas on the third floor are the MOCR, the SSR, the recovery control room, the meteorological area, and the display and timing area. The MOCR and SSR are exact duplications of the areas on the second floor. The recovery control room, the meteorological area, and the display and timing areas support the dual mission facilities and systems on the second and third floors.

The MOCR on the second floor is the principal command and decision area in the MCC. Critical information related to spacecraft, launch vehicle, and ground systems, as well as aeromedical parameters from the worldwide stations, ships, and aircraft, is processed and displayed within the MOCR. Based on an analysis of this continuous flow of information, personnel in this room must assess the spacecraft flight status and progress, and then, in time-critical periods, determine the continuation, alteration, or termination of the space flight.

The mission control center was used to monitor nine Gemini and all Apollo flights as well as the Skylab, Apollo-Soyuz, and space shuttle flights of recent years. This is an ongoing NASA facility and is currently being modified to accommodate flights of the shuttle. The third floor of the facility has been turned over to the Air Force and is in the process of being converted into a secure area from which Air Force shuttle flights will be monitored. The second floor of the facility housing the mission control operations room will shortly be divided into two rooms to accommodate increasing numbers of shuttle flights.

<u>The Lunar Sampler Building</u>. The lunar sampler building consists of storage vaults for samples, laboratories for sample preparation and study, a vault for all sample data and records, and machinery to supply nitrogen to the cabinets and to maintain the clean environments of the sample laboratories and vaults. The vaults are designed to protect the collection of samples from theft or damage by natural hazards such as tornadoes and hurricanes. Two vaults are used, one to store samples that have never been out of the sample laboratories, and the other for those that have been returned by investigators after their analysis. In that way, "pristine" samples can never become mixed with "used" samples.

Adjacent to the sample laboratory is a special experiment room for tests and measurements on particularly large or rare lunar specimens.

On the first floor below the sample vaults is the data vault where records on the samples are assembled, stored, and used. Photographs needed to record the work done on the lunar samples are also stored in this area. In addition, the first floor contains simulation laboratories in which procedures and techniques can be tested before they are used on actual lunar samples and new techniques can be developed for use with samples yet to be collected from other parts of the solar system.

<u>The Flight Acceleration Facility</u>. During the years leading to the first Apollo mission to the moon, this building housed the flight acceleration facility. It contained a circular centrifuge and chamber area. The centrifuge was used to provide an environmentally controlled dynamic simulator to train astronauts and test equipment. Tempratures within the gondola were controllable from 50 to 200 degrees Fahrenheit. The centrifuge's regular gondola measured 12 feet in diameter and weighed 8,000 pounds. The centrifuge could produce loads of between 20 and 30 g for short periods.

After the conclusion of the Apollo program, this building was modified to provide a weightless environment training facility for the space shuttle. The centrifuge was removed from the building, and a water tank capable of holding a full-size model of the cargo area of the shuttle was installed. Shuttle astronauts now train in this tank to become familiar with the dynamics of body motion under weightless conditions.

Mission Simulation and Training Facility. This building originally contained the Apollo mission simulator crew training facility. The Apollo mission simulator was a primary training system that prepared Apollo astronauts for flights to the moon. It stood 30 feet high and weighed approximately 40 tons. The simulator was designed to familiarize Apollo crews with equipment, crew tasks, mission procedures, and emergency flight situations.

The building also housed the lunar mission simulator that was designed to train the astronauts to land on the moon. After the completion of the Apollo program, this equipment was removed, and parts of it were reused to support the space shuttle program. The building currently houses the shuttle mission simulator. The shuttle mission simulator was developed to support flight crew and flight controller training for the shuttle orbital missions. Simulation capability provides for training activities in all facets of the shuttle vehicle operations and in all systems tasks associated with the major flight phases: prelaunch, ascent, abort, orbit, rendezvous, docking, payload handling, undocking, deorbit, entry, approach and landing, and rollout. These systems include the orbiter vehicles' main engines, solid rocket engines, external tank, and support equipment and interfaces required to achieve the shuttle objectives, including interface with the mission control center.

Project Management Building. This building provides office space for the executive management group, program offices, personnel, security, and other administrative services. It is not open to the public.

Auditorium and Public Affairs Facility. This building consists of two separate parts connected by a covered walkway. The southern part of the facility contains an 800-seat auditorium and a lobby area with displays. The regular space center tour begins in this building. The public can see moon rocks, a collection of actual space hardware, astronaut Gordon Cooper's Mercury space capsule, and the Apollo 17 spacecraft. The northern portion of the facility contains the public affairs office, a newsroom, a press television studio, and other related public services and affairs offices.

Marshall Space Flight Center

The primary source used for Marshall Space Flight Center facilities was vol. 3 of Technical Facilities Catalog (US NASA 1974b, chp. 10, pp. 235-265). The National Register form for the Redstone test stand (Alabama Historical Commission 1975, pp. 2-4) provided material on that facility.

Uprated Saturn I Stage Static Test Tower. The uprated Saturn I stage static test tower is a two-position test stand, approximately 175 feet high and 600 feet at the base. Each position of the tower can static fire 1.6 million pounds of thrust stages for engines utilizing liquid oxygen/kerosene propellants and can accommodate stages 82 feet long and 22 feet in diameter. Control and instrumentation are provided by the east blockhouse. Analog tape units, digital systems, oscillograph recorders, and strip charts are available.

This building has been modified to accommodate the space shuttle program and is currently on standby status.

Saturn IB Dynamic Test Stand. Vehicles are suspended within the stand with springs and cables in such a manner as to make it similar to a free beam or seismic mass. Vibration loads can be induced in the pitch, yaw, or longitudinal axis to obtain resonance frequencies and bending modes. Checkout of vertical mechanical mating features between stages can also be investigated. The test stand is 204 feet high, not including a 50-foot-high stiff leg derrick, and has a 100-foot by 60-foot base. An elevator provides access to nine of the ten levels. Instrumentation can be provided by the east area blockhouse.

This building is still in its original configuration and is currently on standby status.

Saturn IC Stage Static Test Tower. The Saturn IC stage static test tower is a 406-foot-high vertical stand, including the derrick boom. The superstructure is 267 feet high and 162 feet at the base. The foundation of the stand is keyed into bedrock approximately 45 feet below grade. Capability for static firing of 7.5-million-pound thrust stages is provided. All control and instrumentation requirements are provided by the west area blockhouse. Analog tape units, digital systems, oscillograph recorders, and strip charts are available.

This building has been modified to accommodate static testing of the external tank of the space shuttle and is currently in active use by the Marshall Space Flight Center (will be on standby after December).

Saturn IVB Test Stand. The Saturn IVB test stand is a two-position LOX/hydrogen facility. Both positions are open steel structures, one which includes a Saturn IVB battleship stage and J-2 engine. The engine exhaust is deflected by a water-cooled flame deflector. The stand is capable of accepting stages up to 60 feet long and 22 feet in diameter, and thrust up to 300,000 pounds. A 3,200-square-foot terminal building, providing mechanical and electrical technican work areas, is located adjacent to the stand.

This building has been modified to accommodate testing for the space shuttle and is currently on standby status.

Saturn V Dynamic Test Stand. The vehicle in the test stand rests on four hydrodynamic supports that provide 6-degree-of-freedom movement required for the dynamic testing of large space vehicles. Vibration loads can be induced in the pitch, yaw, or longitudinal axis to obtain resonance frequencies and bending modes. Checkout of vertical mechanical mating features between stages can also be investigated. The facility was modified to structural load-test/pressure-test the Skylab orbital workshop.

The test stand is 360 feet high, excluding the 64-foot stiff leg derrick, and has a base area of 98 feet by 98 feet. A terminal building at the base of the stand can serve as a control room or limited instrumentation center. The facility is connected by a tunnel to the east area blockhouse. An elevator provides access to 15 of the 16 levels.

This building is currently in use and has been modified to accommodate the space shuttle program.

Redstone Test Stand. The Redstone test stand is an iron framework structure made from salavaged materials. The stand is 75 feet high and about 33 by 22 feet at its base. A concrete foundation covers 726 square feet. The blockhouse, used for observations and for receiving telemetered data during tests, was constructed from three surplus chemical steel tanks covered by a mound of dirt. The three tanks contain 1,500 square feet of usable space for the test engineers. The initial construction cost was $25,000.

Constructed in 1953 by the U.S. Army and later transferred to NASA, the Redstone test stand was important in the early development of rocket engines and propulsion systems capable of space flight. It was the first static firing facility constructed in the test area now controlled by NASA's Marshall Space Flight Center, and it is important as the birthplace of modern liquid rocket propulsion and testing at the center. Subsequent facilities in Marshall's test area led to development of the Saturn rockets used in Apollo and Skylab flights.

The basic Redstone missile for which the stand was a major test site had its origin in 1950 when the Ordnance Guided Missile Center at Redstone Arsenal was asked by the Army chief of ordnance to perform a feasibility study on a 500-mile-range rocket. The Redstone medium range ballistic missile that evolved from a five-year research and development program was 70 inches in diameter and 69 feet long. Its power plant was rated at 75,000 pounds thrust.

From this test program, other versions of the Redstone evolved, including the Jupiter C and the Mercury/Redstone.

The Jupiter C was the basis for a detailed proposal for an orbiting earth satellite. This proposal, called "A Minimum Satellite Vehicle Based Upon Components Available From Missile Development of the Army Ordnance Corps," was prepared in 1955. It stated that the Army could launch a satellite within a short time using hardware then available.

After the U.S.S.R. opened the space age by orbiting Sputnik 1, the Huntsville group was directed to go ahead. The feat was accomplished on January 31, 1958, by adding a single solid rocket motor as a fourth stage to the Jupiter C and attaching a scientific payload at its forward end.

NASA requested ten Redstones for its first manned program, Mercury. For Mercury, the Redstone propellant tank was lengthened by 6 feet (same as the Jupiter C) and the standard Redstone engine thrust was increased to 78,000 pounds thrust. This vehicle became known as Mercury/Redstone, and nine of them were tested in the Redstone test stand. Two of the Mercury/Redstone vehicles were eventually used to carry men into space. By that time, the space program had grown, and more sophisticated test sites were necessary.

The site has been phased out of the active test program and all usable equipment removed.

The Redstone test stand was listed on the National Register of Historic Places as being nationally significant in 1976. It was also designated as an Alabama historic engineering landmark in 1979.

C: STRUCTURAL ENGINEER'S ANALYSIS, RECOMMENDATIONS, AND COST ESTIMATES FOR KEY FACILITIES AT CAPE CANAVERAL

Evaluation of the facilities at Cape Canaveral Air Force Station was limited to observations focusing on safety and structural condition. The following recommendations are not stringent. However, based on preliminary observations, the sooner proposed maintenance work is performed on the structures, the less costly preservation would be in the long run. The service structure at complex 26B is in most immediate need of attention. In addition, interim maintenance work at complex 13 would aid in deferring future expenses if it is later decided to preserve and interpret this facility.

Launch Complexes 5/6 and 26

Perspective. Launch complex 5/6, specifically pad 5, was used for all Mercury/Redstone flights. The service structure has since been demolished (date unknown). The existing service structure at pad 26B, which appears to be identical to that used at pad 5, gives a perspective of the state of engineering in the early "space race" days.

The blockhouses at 5/6 and 26 are identical reinforced-concrete structures shaped like arrows facing their pads. Blockhouse 26 is the only known blockhouse that has had an abortive launch fall on it (there was minor damage and no injuries). Both blockhouses have some launch equipment in the firing rooms and displays in their outer passages.

Throughout and around complex 26 are exhibits of rockets, missiles, and capsules.

Preliminary Evaluation. The following conditions were observed:

> Blockhouses: The reinforced-concrete blockhouses are in relatively good shape and will remain so for an indefinite time. The only noticeable problem is the spalling off of interior paint on the wall from the floor line up to grade.
>
> Exhibits: Most exhibits are in good shape; however, several need attention, such as the corroded tailfins of the Redstone rocket at pad 26B.
>
> Service structure, 26B: This structure was painted approximately ten years ago. It currently is fenced off to keep people from accidently being hit by pieces of flying metal that periodically blow off the structure during high winds. These pieces of metal are separated from the structure by corrosion of the floor members, grating, and railings. The main structural members of the service structure are in reasonable shape but will need attention soon, especially at connection points. The most severe problem is the rusting out of secondary members for flooring and railings and the floor grating itself. In addition, equipment room walls, floor, and roof made up of steel plate are corroded through in places. If corrective measures are not undertaken soon, the extent of

secondary member loss coupled with primary member connection risk will make the structure unsafe.

Recommendations. The following improvements or restoration activities are recommended at complexes 5/6 and 26:

Blockhouses: Normal maintenance should be continued.

Exhibits: An evaluation of each should be made in a field inventory. A maintenance program should be prioritized for repair and restoration where needed.

Service structure, 26B: Extensive restoration (involving such work as replacement of some components and field repairs of others) of secondary structural members should be made. The entire structure should be sandblasted and painted with inorganic zinc-rich paint. All floor grating and railing components should be replaced with fiberglass counterparts where feasible.

See cost estimates at the end of this appendix.

Launch Complex 13

Perspective. Complex 13 closely resembles complex 14, where all the manned Mercury/Atlas missions were launched (one exception is that the service structure at 13 is box-shaped whereas the one at 14 was trapezoidal). A comparison of the service structures at 13 and 26B shows the changes in facilities that supported the Mercury/Atlas versus the Mercury/Redstone launches. Because of the larger size and volatile characteristics of the Atlas, the blockhouse at 13 is located farther from the pad and is constructed differently than the one at 26B. The facilities at complex 13 were last used in 1978.

Preliminary Evaluation. The following conditions were noted:

Blockhouse: The reinforced-concrete blockhouse is in fairly good shape. The interior is void of equipment; the observation platform on top is in questionable condition.

Launch stand and ramp: The interior has been cannibalized, but the structure is intact; some utility lines show corrosion.

Service structure: The structure was last painted in 1978. Corrosion is evident at the base of the structure, primarily the base plates and a few structural members.

Recommendations. The following activities are recommended at complex 13.

Blockhouse: An evaluation of the observation platform should be made.

Launch stand and ramp: Periodic maintenance should be performed.

Service structure: Corrosive trouble spots should be repaired.

See cost estimates at the end of this appendix.

Launch Complex 14

Perspective. Complex 14 was used for all Mercury/Atlas launches and the Atlas/Agena launches.

Preliminary Evaluation. The following observations were made:

Blockhouse: This reinforced-concrete structure is in relatively good shape.

Launch stand and ramp: Only the steel and concrete skeletal structure remain. The launch stand was salvaged in 1979. The last bay of the ramp has one primary column missing. Due to corrosion of one remaining column on the northwest side, this bay poses a definite safety hazard.

Service structure: Due to corrosion, the structure was toppled by explosives in 1975; it was salvaged before 1979.

Recommendations. No recommendations are made for the blockhouse. Temporary supports should be placed at the last bay of the ramp or it should be salvaged.

Launch Complex 19

Perspective. Complex 19 was used for all 12 Gemini flights, ten of which were manned.

Preliminary Evaluation. The following conditions were observed:

Blockhouse: The reinforced-concrete structure is in fairly good shape.

Launch stand: Support structures are corroded, especially the web stiffeners, anchor plates, and bolts.

Launch ramp: The north third of the ramp shows signs of distress. Primary steel framing under the deck is twisted and distorted in places. All structural members are corroded. Part of the deck is composed of steel grate with cast-in-place concrete. Railings are loose and corroded. The ramp is essentially unsafe.

Service structure (erector): The fold-back structure hinged at the stand is currently lying on its side. There has been excessive corrosion on secondary members and at connections of primary members, and primary elements are corroded where ponding is allowed.

Recommendations. The service structure and ramp should be salvaged.

Launch Complex 34

Perspective. The complex was first used for developmental test flights of the Saturn rocket. Also, the first manned Apollo flight was launched from this facility.

Preliminary Evaluation. The following conditions were noted:

Blockhouse: The reinforced-concrete structure is in good condition. The launch consoles are in place from former TWA (NASA) bus tours.

Launch stand: The reinforced-concrete skeletal structure remains.

Service structure: The service structure and umbilical tower were salvaged between 1970 and 1972.

Recommendations. None

Launch Complex 37

Perspective. The complex was used for developmental tests for the Saturn rocket, including the first launch of the lunar module.

Preliminary Evaluation. The following observations were made:

Blockhouse: The reinforced-concrete structure is in good shape.

Service structure: The structure was salvaged in 1973.

Launch pads: The umbilical towers were salvaged in 1973. Only the concrete umbilical tower pedestals and support rooms remain.

Recommendations. None

Hangar S

Perspective. The south side of Hangar S was used by the astronauts in the Mercury program for crew quarters, suit room, and medical facilities. The clean rooms on each side of the hangar were used to check out Mercury capsules. Crew quarters, suit rooms, and medical facilities have since been adapted as engineering offices. The clean rooms are currently used for special storage and satellite payload testing.

Evaluation and recommendations. None

Mission Control Center

Perspective. The mission control center at Cape Canaveral was used for all Mercury flights and the first three Gemini flights. The structure is currently maintained by the Air Force and is interpreted on the TWA bus tour.

Evaluation and recommendations. None

Corrosive Environment of Cape Canaveral

Corrosion is a constant and unyielding problem at the cape. Because the steel service structures are close to the Atlantic Ocean and there are no physical barriers, ocean breezes essentially coat them with salt. Existing maintenance at the cape (all complexes except 39 and 41) is handled by a private contractor, Pan American Airways. When a launch complex is active, corrosive trouble spots and paint burnoffs on the service structure are handled between launchings. The entire structure is painted when needed (usually every four to seven years). Pan Am currently uses Pittsburg 104 primer with a V766 International Orange topcoat. They are trying a new polyurethane paint (a topcoat paint) expected to give a minimum of five years of wear before trouble spots develop.

The Kennedy Space Center maintains complexes 39 and 41. Their current maintenance program involves sandblasting the service structures down to "white" metal and applying an inorganic zinc-rich paint with epoxy tiecoat and urethane topcoat.

The Materials Testing Branch of the KSC has been conducting research on protective coatings since 1970 (US NASA 1971, 1978b, c). Based on their research reports, an inorganic zinc-rich paint applied to a sandblasted "white" carbon metal achieves the best protection. Tests have shown that the above has worked effectively for over ten years, and its expected life appears to be 15 to 20 years.

A nontopcoated inorganic zinc-rich paint resists corrosion better than a topcoated one because it allows the paint to "throw" itself across surface abrasions and scratches. A topcoat is generally used if additional resistance to certain chemicals is required (for example, acid formed from engine combustion).

The recommended interim solution for patching trouble spots is to remove corrosion by abrasion (e.g., wire brush) and apply an organic zinc-rich paint.

Cost Estimates

Complexes 5/6 and 26. The following are preliminary cost estimates for stabilization and repair of launch complexes 5/6 and 26, including the NASA Space Museum and the Air Force Space Museum.

Restoration of the service structure at complex 26B would involve sandblasting, rebuilding, and painting. Minor repairs to exhibits and museums would include cleaning, painting, and restoration.

Service Structure 26B		
Materials		
Steel	$ 10,000	
Fiberglass grating 1,800 square feet @ $10	18,000	
Paint 500 gallons @ $30	15,000	
Sand	2,000	
Miscellaneous materials	5,000	
Miscellaneous hardware	10,000	
		$ 60,000
Labor		
8,000 manhours @ $20	160,000	
30% taxes and insurance	48,000	
		208,000
Equipment		
180 days sandblasting @ $100	18,000	
120 days welding @ $100	12,000	
20 days crane @ $400	8,000	
Scaffolding	40,000	
		78,000
Subtotal		$346,000
15% overhead and bond		51,900
		397,900
10% Profit		39,790
		437,690
1-year inflation @ 15%		65,654
		$503,344
Service structure 26B restoration costs (rounded off)		$505,000
plus		
Exhibit repair		50,000
Miscellaneous cleaning and painting		50,000
Approximate Total		$605,000

Estimated yearly utility and maintenance costs: $45,000

Complex 13. Stabilization and repair of launch complex 13 would include cleaning and partial renovation of the blockhouse, partial restoration of the workrooms and repair of the utility lines at the launch ramp, and repair of the corroded areas on the service structure.

Blockhouse		
Cleaning and repair	$ 20,000	
Install console equipment	20,000	
Repair observation deck	8,000	
Repair periscopes	4,000	
Miscellaneous	5,000	
		$ 57,000
Launch Ramp		
Clean and paint selected areas	10,000	
Weatherproof	5,000	
Partial restoration	20,000	
Utility line repair	20,000	
		55,000
Service Structure		
Clean launch pad area	20,000	
Sandblast and paint corroded areas	30,000	
		50,000
Subtotal		$162,000
15% overhead and bond		24,300
		186,300
10% Profit		18,630
		204,930
1-year inflation @ 15%		30,740
		235,670
Approximate Total		$236,000

Form No. 10-300 (Rev. 10-74)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

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NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

SEE INSTRUCTIONS IN *HOW TO COMPLETE NATIONAL REGISTER FORMS*
TYPE ALL ENTRIES -- COMPLETE APPLICABLE SECTIONS

1 NAME

HISTORIC
Interim Test Stand

AND/OR COMMON
Redstone Test Stand

2 LOCATION

STREET & NUMBER
West Test Area

_NOT FOR PUBLICATION

CITY, TOWN
Redstone Arsenal

__ VICINITY OF

CONGRESSIONAL DISTRICT

STATE	CODE	COUNTY	CODE
Alabama	01	Madison	089

3 CLASSIFICATION

CATEGORY	OWNERSHIP	STATUS	PRESENT USE	
_DISTRICT	X PUBLIC	X OCCUPIED	_AGRICULTURE	_MUSEUM
_BUILDING(S)	_PRIVATE	_UNOCCUPIED	_COMMERCIAL	_PARK
X STRUCTURE	_BOTH	_WORK IN PROGRESS	_EDUCATIONAL	_PRIVATE RESIDENCE
_SITE	PUBLIC ACQUISITION	ACCESSIBLE	_ENTERTAINMENT	_RELIGIOUS
_OBJECT	_IN PROCESS	X YES: RESTRICTED	X GOVERNMENT	_SCIENTIFIC
	_BEING CONSIDERED	_YES: UNRESTRICTED	_INDUSTRIAL	_TRANSPORTATION
		_NO	_MILITARY	_OTHER:

4 OWNER OF PROPERTY

NAME
Marshall Space Flight Center

STREET & NUMBER
NASA

CITY, TOWN
Redstone Arsenal

__ VICINITY OF

STATE
Alabama

5 LOCATION OF LEGAL DESCRIPTION

COURTHOUSE, REGISTRY OF DEEDS, ETC.
Office of the Judge of Probate

STREET & NUMBER
Madison County Courthouse

CITY, TOWN
Huntsville

STATE
Alabama

6 REPRESENTATION IN EXISTING SURVEYS

TITLE
None

DATE

_FEDERAL _STATE _COUNTY _LOCAL

DEPOSITORY FOR SURVEY RECORDS

CITY, TOWN

STATE

7 DESCRIPTION

CONDITION		CHECK ONE	CHECK ONE
X EXCELLENT	__ DETERIORATED	X UNALTERED	X ORIGINAL SITE
__ GOOD	__ RUINS	__ ALTERED	__ MOVED DATE______
__ FAIR	__ UNEXPOSED		

DESCRIBE THE PRESENT AND ORIGINAL (IF KNOWN) PHYSICAL APPEARANCE

Basically an iron framework structure made from salvaged materials, the stand is 75 feet high and about 33 by 22 feet at its base. A concrete foundation covers 726 square feet. The blockhouse, used for observations and for receiving telemetered data during tests, was constructed from three surplus chemical steel tanks covered by a mound of dirt. The three tanks contain 1,500 square feet of usable space for the test engineers. Initial construction cost was $25,000.

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RECEIVED
DATE ENTERED

The National Aeronautics and Space Administration was created October 1, 1958. NASA requested 10 Redstones for its first manned program, Mercury. For Mercury, the Redstone propellant tank was lengthened by six feet (same as the Jupiter C) and the standard Redstone engine thrust was increased to 78,000 pounds thrust. This vehicle became known as Mercury-Redstone and nine of them were tested in the Redstone Test Stand.

Two of the Mercury-Redstone vehicles were eventually used to carry men into space. Alan Shepard, on May 5, 1961, was pilot in the Freedom 7 spacecraft and the mission was a complete success. Astronaut Virgil I. Grissom followed with a flight on July 21, 1961.

There were a total of 364 firings in the Redstone Test Stand with the last one occuring in October, 1961. By that time, the space program had grown and more sophisticated test sites were necessary. The site has been phased out of the active test program and all usable equipment removed.

The importance of the Redstone Test Stand's mission to early space flights was summarized by the first director of the Marshall Space Flight Center, Dr. Wernher Von Braun, in a 1963 magazine article in which he stated, "In rocket development, there is no substitute for numerous static firings and closely monitored test flights."

"Once the engines of a launch vehicle are ignited and it lifts off the pad, there is no turning back for repairs. The assurance that it will fly must be built in beforehand, by extensive ground testing." The Redstone Test Stand was an early leader in the "man-rating" of space vehicles.

Question: What are specific technical advances brought about by the Redstone Stand and the Redstone launch vehicle?

For a period of several months, the Redstone Test Stand was the only launch vehicle static firing stand in the U.S. Other static firing facilities at that time were for engines only. Consequently, many of the procedures for static firing of complete stages and vehicles were pioneered and developed at this site.

Specific technical advances were made in launch pneumatics; thrust measurements; propellant fill procedures, including automatic liquid oxygen topping; vehicle handling; engine launch ignition procedures; systems leak check procedures, and others. Advances were made not only in operational procedures, but also in the specialized equipment necessary to this unique task.

Advances were also made in this instrumentation necessary to gather data in the blockhouse while tests were underway. Initial efforts were also made here toward building a flight dymanics model of the "pogo" effects during a rocket launch.

At this stand, using the Mercury Redstone launch vehicle, the "manrated" procedures and the acceptance firing philosophy were initiated. The Mercury-Redstone vehicle which carried America's first astronaut into space, was tested here before its historic flight. Methods of double-checking and in-depth inspection for man-rating of systems were developed here which were used later in the Saturn program.

Vehicles tested in the Redstone Stand made many historic space flights. These include the use of the first guidance system, first long-range firing of a U.S. ballistic missile, first recovery intact of a man-made object from space, first U.S. earth satellite, and the first American launched into space.

Question: What else is in the Redstone Test area which we want included in the historic site selection?

The blockhouse should be included because it was used for observations and for receiving data during tests.

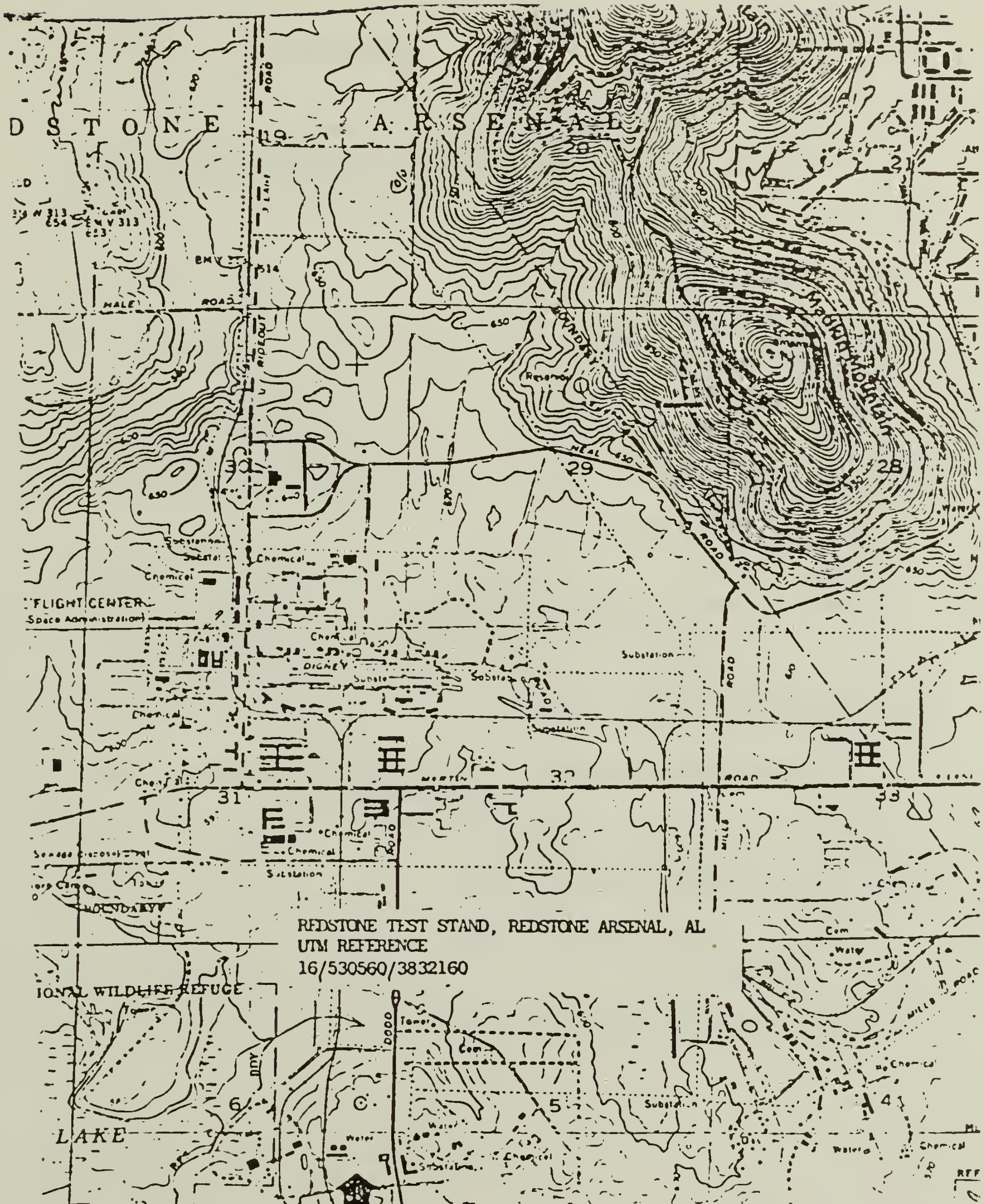
Another test stand is also located in the area, adjacent to the Redstone Stand, and should be included. For its first series of tests it was labeled the Jupiter "Hop" Test Stand and later, in a second test series was modified and known as the Sound Suppression Stand. Although its construction came after the Redstone Stand and although it was not as prominent in early launch vehicle development, it contained unique features.

In its first configuration, it was the only known test stand in which a vehicle could be launched and then captured after traveling about one foot. Investigations were made into the critical periods of engine ignition and liftoff to determine the effectiveness of various disconnect systems, such as fluids and pneumatic lines. The first few inches of a launch is a critical time and studies under varying conditions were conducted at this site.

The final use of the stand was in studies of a system to suppress the rocket engine's noise. Although this system was never needed, it was available should sound levels in the area have exceeded local tolerance levels during the many static firings conducted at the Marshall Center.

Question: What has NASA done to prepare the area as a historic site?

The Redstone Test Site, which had become badly rundown and littered over the years, has been cleared up and landscaped. The exterior of both stands and the blockhouse has been painted. A large sign has been installed explaining the historic significance of the site and a Redstone vehicle has been refurbished and installed in the Redstone Stand.


D S T O N E
A R S E N A L
FLIGHT CENTER
Space Administration
IONAL WILDLIFE REFUGE
LAKE
WHEELER NATIONAL WILDLIFE REFUGE
REDSTONE TEST STAND, REDSTONE ARSENAL, AL
UTM REFERENCE
16/530560/3832160

10-300 (Rev. 10-74)

PHO5C3 584

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

FOR NPS USE ONLY	
RECEIVED	SEP 6 1977
DATE ENTERED	[illegible]

SEE INSTRUCTIONS IN *HOW TO COMPLETE NATIONAL REGISTER FORMS*
TYPE ALL ENTRIES -- COMPLETE APPLICABLE SECTIONS

1 NAME

HISTORIC
Saturn V Space Vehicle

AND/OR COMMON
Saturn V Space Vehicle

2 LOCATION

STREET & NUMBER
Tranquility Base — NOT FOR PUBLICATION

CITY, TOWN
Huntsville — VICINITY OF

CONGRESSIONAL DISTRICT
5

STATE	CODE	COUNTY	CODE
Alabama	01	Madison	08[illegible]

3 CLASSIFICATION

CATEGORY	OWNERSHIP	STATUS	PRESENT USE	
_DISTRICT	X PUBLIC	_OCCUPIED	_AGRICULTURE	X MUSEUM
_BUILDING(S)	_PRIVATE	X UNOCCUPIED	_COMMERCIAL	_PARK
X STRUCTURE	_BOTH	_WORK IN PROGRESS	_EDUCATIONAL	_PRIVATE RESIDENCE
_SITE	PUBLIC ACQUISITION	ACCESSIBLE	_ENTERTAINMENT	_RELIGIOUS
_OBJECT	_IN PROCESS	X YES: RESTRICTED	X GOVERNMENT	_SCIENTIFIC
	_BEING CONSIDERED	_YES: UNRESTRICTED	_INDUSTRIAL	_TRANSPORTATION
		_NO	_MILITARY	_OTHER:

4 OWNER OF PROPERTY

NAME
National Air and Space Museum, Smithsonian Institution (On extended loan to Alabama Space and Rocket Center)

STREET & NUMBER

CITY, TOWN
Washington — VICINITY OF

STATE
D.C.

5 LOCATION OF LEGAL DESCRIPTION

COURTHOUSE, REGISTRY OF DEEDS, ETC.
Office of the Judge of Probate

STREET & NUMBER
Madison County Courthouse

CITY, TOWN
Huntsville

STATE
Alabama

6 REPRESENTATION IN EXISTING SURVEYS

TITLE

DATE

_FEDERAL _STATE _COUNTY _LOCAL

DEPOSITORY FOR SURVEY RECORDS

CITY, TOWN

STATE

DESCRIPTION

CONDITION		CHECK ONE	CHECK ONE
__EXCELLENT	__DETERIORATED	X UNALTERED	__ORIGINAL SITE
X GOOD	__RUINS	__ALTERED	X MOVED DATE________
__FAIR	__UNEXPOSED		

DESCRIBE THE PRESENT AND ORIGINAL (IF KNOWN) PHYSICAL APPEARANCE

The Saturn V Space Vehicle is located in the Rocket Park of the Alabama Space and Rocket Center and consists of three tank-type propellant stages and payload. The vehicle is exhibited horizontally, one stage on allow boy type trailer, others on cradles.

Primarily materials: aluminum alloys, stainless steel and titanium.

Length: 365 feet.

Weight: 6,200,000 pounds.

First Stage: 33' diameter by 138'; five F-1 engines.
Assembled by Marshall Space Flight Center and Boeing Aircraft Corporation.

Second Stage: 33' diameter by 81'; five J-2 engines.
Assembled by North American Rockwell.

Third Stage: 22' diameter by 59'; 1 J-2 engine.
Assembled by McDonnell-Douglas.

Pay Load: (1) Apolo Command Module - cone-shaped, 10'7" high, 12'10" diameter.
Habitable volume - 210 cubic feet.
Weight - 13,000 pounds.

(2) Service Module: Cylinder-shaped, 22'7" high, 12'10" diameter.
Weight - 55,000 pounds.
Assembled by North American Rockwell.

Cost: $15,010,000.00

8 SIGNIFICANCE

PERIOD	AREAS OF SIGNIFICANCE -- CHECK AND JUSTIFY BELOW			
_PREHISTORIC	_ARCHEOLOGY-PREHISTORIC	_COMMUNITY PLANNING	_LANDSCAPE ARCHITECTURE	_RELIGION
_1400-1499	_ARCHEOLOGY-HISTORIC	_CONSERVATION	_LAW	_SCIENCE
_1500-1599	_AGRICULTURE	_ECONOMICS	_LITERATURE	_SCULPTURE
_1600-1699	_ARCHITECTURE	_EDUCATION	_MILITARY	_SOCIAL/HUMANITARIAN
_1700-1799	_ART	_ENGINEERING	_MUSIC	_THEATER
_1800-1899	_COMMERCE	_EXPLORATION/SETTLEMENT	_PHILOSOPHY	_TRANSPORTATION
X 1900-	_COMMUNICATIONS	_INDUSTRY	_POLITICS/GOVERNMENT	X OTHER (SPECIFY)
		_INVENTION		Space Exploration

SPECIFIC DATES 1964 BUILDER/ARCHITECT

STATEMENT OF SIGNIFICANCE

On July 16, 1969 a Saturn V Space Vehicle rose from the launch pad carrying astronauts Armstrong, Aldrin, and Collins toward mankind's first expedition to the surface of the moon Since stages of the Saturn V are not recovered after use, a Saturn which has actually flown a mission will never be available to the public. The test stages located at the Alabama Space and Rocket Center are full operational units of the eventual flight stages and provide a realistic view of the vehicle which carried the first men to the moon and placed the first U.S. space station into orbit.

The design, development and manufacture of the Saturns was the responsibility of the NASA-Marshall Space Flight Center at Huntsville, Alabama, which at the time, was under the leadership of Dr. Werhner von Braun. Dr. von Braun headed a nation-wide team drawn from industry, government, and the educational community which provided the expertise to produce the Saturn.

The decision to develop the Saturn V was officially announced on January 10, 1962. It was the first large vehicle in the U.S. space program to be conceived and developed for a specific purpose - the lunar landing. NASA formally assigned the task of developing the Saturn V to the Marshall Space Flight Center on January 25, 1962. Launch responsibility was committed to the Kennedy Space Center in Florida.

Marshall Center designers decided that a three-stage vehicle would best serve the immediate needs for a lunar landing mission and would serve well as a general purpose space exploration vehicle. The Saturn V provided the U.S. with the capability to put into earth orbit some 280,000 pounds of payload or send 95,000 pounds to the moon. During a seven year period, a total of 13 Saturn V vehicles were launched, including two unmanned test flights; ten Apollo flights; and one flight which carried the Skylab space station to earth orbit. The Saturn V performed successfully in all missions.

In producing the Saturn V, the Marshall Center assembled test stages for use in dynamic testing and to check our facilities being prepared for the Saturn. Three of these main stages and the instrument unit, following the end of the development phase, were turned over to the Smithsonian Institute, which, in turn, made arrangements for the permanent displays near the Marshall Center and the Alabama Space and Rocket Center.

These stages are displayed end-to-end so as to resemble a complete vehicle. They have been in place since 1969 and until recently were the only full scale representation of a Saturn V available to the public. In 1976 a full scale Saturn was assembled at the Kennedy Space Center.

10 GEOGRAPHICAL DATA

ACREAGE OF NOMINATED PROPERTY 44'x370'

UTM REFERENCES

	ZONE	EASTING	NORTHING		ZONE	EASTING	NORTHING
A	1 6	5 3 1 5 2 0	3 8 4 0 7 4 0	B			
C				D			

VERBAL BOUNDARY DESCRIPTION

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

STATE	CODE	COUNTY	CODE
STATE	CODE	COUNTY	CODE

11 FORM PREPARED BY

NAME / TITLE

Edward O. Buckbee, Director

ORGANIZATION: Alabama Space and Rocket Center

DATE: August 23, 1977

STREET & NUMBER: Tranquility Base

TELEPHONE

CITY OR TOWN: Huntsville

STATE: Alabama 35807

12 STATE HISTORIC PRESERVATION OFFICER CERTIFICATION

THE EVALUATED SIGNIFICANCE OF THIS PROPERTY WITHIN THE STATE IS

NATIONAL X STATE ___ LOCAL ___

As the designated State Historic Preservation Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service.

STATE HISTORIC PRESERVATION OFFICER SIGNATURE Milo B. Howard, Jr.

TITLE SHPO Alabama DATE August 29, 1977

FOR NPS USE ONLY

I HEREBY CERTIFY THAT THIS PROPERTY IS INCLUDED IN THE NATIONAL REGISTER

DATE 11/22/78

DIRECTOR, OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION

ATTEST DATE

KEEPER OF THE NATIONAL REGISTER

GPO

FLORIDA
Launch Complex 39
Congressional District No. 5
Louis Frey

Form 10-300 (Rev. 6-72)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY – NOMINATION FORM

(Type all entries – complete applicable sections)

FOR NPS USE ONLY
ENTRY DATE: MAY 24 1973

RECEIVED FEB 13 1973 NATIONAL REGISTER

1. NAME

COMMON: Launch Complex 39

AND/OR HISTORIC: America's First Spaceport

2. LOCATION

STREET AND NUMBER: John F. Kennedy Space Center, NASA

CITY OR TOWN: Kennedy Space Center

CONGRESSIONAL DISTRICT: Fifth District

STATE: Florida | CODE: 12 | COUNTY: Brevard | CODE: 009

3. CLASSIFICATION

CATEGORY (Check One)	OWNERSHIP	STATUS	ACCESSIBLE TO THE PUBLIC
☐ District ☐ Building	☒ Public	☒ Occupied	Yes:
☒ Site ☐ Structure	☐ Private	☐ Unoccupied	☒ Restricted
☐ Object	☐ Both	☐ Preservation work in progress	☐ Unrestricted
	Public Acquisition: ☐ In Process ☐ Being Considered		☐ No

PRESENT USE (Check One or More as Appropriate)

☐ Agricultural	☒ Government	☐ Park	☐ Transportation	☐ Comments
☐ Commercial	☐ Industrial	☐ Private Residence	☐ Other (Specify)	
☐ Educational	☐ Military	☐ Religious		
☐ Entertainment	☐ Museum	☒ Scientific		

4. OWNER OF PROPERTY

OWNER'S NAME: John F. Kennedy Space Center, NASA

STREET AND NUMBER:

CITY OR TOWN: Kennedy Space Center | STATE: Florida | CODE: 12

STATE: Florida

5. LOCATION OF LEGAL DESCRIPTION

COURTHOUSE, REGISTRY OF DEEDS, ETC: Brevard County Courthouse

STREET AND NUMBER:

CITY OR TOWN: Titusville | STATE: Florida | CODE: 12

COUNTY: Brevard

6. REPRESENTATION IN EXISTING SURVEYS

TITLE OF SURVEY: Launch Complex 39 Siting Survey

DATE OF SURVEY: 1962 | ☒ Federal ☐ State ☐ County ☐ Local

DEPOSITORY FOR SURVEY RECORDS: John F. Kennedy Space Center, NASA

STREET AND NUMBER:

CITY OR TOWN: Kennedy Space Center | STATE: Florida | CODE: 12

FOR NPS USE ONLY — ENTRY NUMBER — DATE: MAY 24 1973

SEE INSTRUCTIONS

7. DESCRIPTION

CONDITION	(Check One)					
	☐ Excellent	☒ Good	☐ Fair	☐ Deteriorated	☐ Ruins	☐ Unexposed
	(Check One)			(Check One)		
	☐ Altered	☒ Unaltered		☐ Moved	☒ Original Site	

DESCRIBE THE PRESENT AND ORIGINAL (if known) PHYSICAL APPEARANCE

Launch Complex 39 is a part of the John F. Kennedy Space Center, NASA, a United States Government installation in Brevard County, Florida. Located partly on the northern end of Merritt Island and partly on the narrow coastal strip to the eastward, the low-lying land on which the Complex is sited is mainly marsh land. About 11.5 million cubic meters (over 15 million cubic yards) of fill were dredged from nearby land and water areas to provide a base on which the Complex was built between November, 1962 and October, 1968. Principal structures on the Complex include:

The Vehicle Assembly Building, one of the world's largest buildings in volume;

The Launch Control Center, housing the electronic equipment used to control and direct test and launch operations;

Three Mobile Launchers, on which the space vehicles are erected and tested within the Vehicle Assembly Building, then moved to the pads for launching;

A Mobile Service Structure, providing access for servicing the space vehicles while on the launch pads;

Two Transporters (or Crawlers), used to lift and move the Mobile Service Structure;

The Crawlerway, a wide, heavy-duty roadbed on which the Transporters move;

Launch Areas A and B, each including an elevated launch pad, storage tanks for propellants, and the necessary hydraulic, pneumatic, mechanical, and electronic servicing and control equipment.

At the present time, Launch Complex 39 is in much the same configuration as when it was completed, and in which it was used to launch the Apollo manned lunar landing missions. Since it is an operational spaceport, the requirements of future space programs may cause changes to be made in existing structures, or new facilities to be added. 1973

There are no fences or other physical boundaries separating Launch Complex 39 from the rest of the Kennedy Space Center. However, the coordinates given in Item 10 describe a rectangle within which lies the entire Complex.

Guided bus tours, leaving from a Visitor's Information Center on the John F. Kennedy Space Center, permit the general public to view the structures on Launch Complex 39.

SEE INSTRUCTIONS

8. SIGNIFICANCE

PERIOD (Check One or More as Appropriate)

- [ ] Pre-Columbian
- [ ] 15th Century
- [ ] 16th Century
- [ ] 17th Century
- [ ] 18th Century
- [ ] 19th Century
- [x] 20th Century

SPECIFIC DATE(S) (If Applicable and Known) Completed October, 1968

AREAS OF SIGNIFICANCE (Check One or More as Appropriate)

- Aboriginal
  - [ ] Prehistoric
  - [ ] Historic
- [ ] Agriculture
- [x] Architecture
- [ ] Art
- [ ] Commerce
- [x] Communications
- [ ] Conservation
- [ ] Education
- [x] Engineering
- [x] Industry
- [ ] Invention
- [ ] Landscape Architecture
- [ ] Literature
- [ ] Military
- [ ] Music
- [ ] Political
- [ ] Religion/Philosophy
- [x] Science
- [ ] Sculpture
- [ ] Social/Humanitarian
- [ ] Theater
- [x] Transportation
- [ ] Urban Planning
- [x] Other (Specify) Space Exploration

RECEIVED FEB 5 1973 NATIONAL REGISTER

STATEMENT OF SIGNIFICANCE

Launch Complex 39 is the location where man's first voyage from Earth to another celestial body began at 9:32:0634 A.M., Eastern Daylight Time, July 16, 1969.

The Apollo 11 lunar landing mission of Astronauts Neil A. Armstong, Edwin E. Aldrin, Jr., and Michael Collins was launched from Mobile Launcher 1 atop the elevated pad at Launch Area A. The assembly of the Apollo-Saturn space vehicle for the Apollo 11 mission on Mobile Launcher 1 in High Bay 1 of the Vehicle Assembly Building began on February 1, 1969, and was completed on April 14. A Transporter lifted the Mobile Launcher and space vehicle and moved it along the Crawlerway to the elevated pad at Launch Area A on May 20. Terminal Countdown began at 8:00 P.M. EDT, July 10. All prelaunch checkout test, countdown, and launch were directed and controlled from Firing Room 1 of the Launch Control Center.

First Launch from Launch Complex 39 was the unmanned Earth-orbital Apollo 4 mission, launched November 9, 1967. Other historic space flights in the Apollo manned lunar landing program from Launch Complex 39 were:

Two manned circumnavigations of the Moon; Apollo 8, launched December 21, 1968, and Apollo 10, launched May 18, 1969.

One manned Earth-orbital flight, Apollo 9, launched March 3, 1969.

Five successful manned lunar landing missions; Apollo 11, Apollo 12, launched November 14, 1969; Apollo 14, January 31, 1971; Apollo 15, July 26, 1971; Apollo 16, April 16, 1972.

One manned lunar landing mission, Apollo 13, successfully launched April 11, 1970, but forced to abort the mission due to spacecraft problems. The crew returned safely to Earth.

The final mission in the Apollo manned lunar landing program, Apollo 17, is scheduled to be launched from Launch Complex 39 on December 6, 1972.

SEE INSTRUCTIONS

Form 10-300a
(July 1969)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES

INVENTORY - NOMINATION FORM

(Continuation Sheet)

STATE	
Florida	
COUNTY	
Brevard	
FOR NPS USE ONLY	
ENTRY NUMBER	DATE
MAY 2 3 1973	

(Number all entries)

8. SIGNIFICANCE -2-

In 1966, Launch Complex 39 was named as the Outstanding Civil Engineering Achievement by the American Society of Civil Engineers. A plaque presented by the Society is mounted in the lobby of the Launch Control Center.

FEB 5 1973

GPO 921-724

Form 10-300a
(July 1969)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES
INVENTORY - NOMINATION FORM

(Continuation Sheet)

STATE	
Florida	
COUNTY	
Brevard	
FOR NPS USE ONLY	
ENTRY NUMBER	DATE
MAY 2 6 1973	

(Number all entries)

9. BIBLIOGRAPHY

Bidgood, Clarence. "Saturn V Checkout Facilities at Merritt Island Launch Area." American Institute of Aeronautics and Astronautics. Space Flight Testing Conference, Cocoa Beach, Florida, March 18-20, 1963. New York, 1963.

Debus, Kurt H. "Launch Operations Support in the Saturn V/Apollo Program." American Astronautical Society. Tenth Annual Meeting, New York, N.Y., May 4-7, 1964. Preprint.

Petrone, Rocco A. "Saturn/Apollo Launch Operations Plan." American Institute of Aeronautics and Astronautics. Space Flight Testing Conference, Cocoa Beach, Florida, March 18-20, 1963. New York, 1963.

GPO 921-724

9. MAJOR BIBLIOGRAPHICAL REFERENCES

SEE ATTACHED SHEET

10. GEOGRAPHICAL DATA

LATITUDE AND LONGITUDE COORDINATES DEFINING A RECTANGLE LOCATING THE PROPERTY — OR — LATITUDE AND LONGITUDE COORDINATES DEFINING THE CENTER POINT OF A PROPERTY OF LESS THAN TEN ACRES

CORNER	LATITUDE (Degrees Minutes Seconds)	LONGITUDE (Degrees Minutes Seconds)
NW	28° 36' 48"	80° 40' 16"
NE	28° 38' 12"	80° 37' 14"
SE	28° 36' 11"	80° 35' 28"
SW	28° 34' 08"	80° 38' 40"

LATITUDE (Degrees Minutes Seconds)	LONGITUDE (Degrees Minutes Seconds)
° ' "	° ' "

APPROXIMATE ACREAGE OF NOMINATED PROPERTY: Approximately 7,000

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

STATE:	CODE	COUNTY	CODE
STATE:	CODE	COUNTY:	CODE
STATE:	CODE	COUNTY:	CODE
STATE:	CODE	COUNTY:	CODE

RECEIVED FEB 1973 NATIONAL REGISTER

11. FORM PREPARED BY

NAME AND TITLE: George M. Hawkins, Chief Documentation & Data Management Branch

ORGANIZATION: John F. Kennedy Space Center, NASA

DATE: 8/10/72

STREET AND NUMBER:

CITY OR TOWN: Kennedy Space Center

STATE: Florida

CODE: 12

12. STATE LIAISON OFFICER CERTIFICATION

As the designated State Liaison Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service. The recommended level of significance of this nomination is:

National ☒ State ☐ Local ☐

Name: Robert Williams

Title: State Liaison Officer

Date: January 3, 1973

NATIONAL REGISTER VERIFICATION

I hereby certify that this property is included in the National Register

Robert Utley

Director, Office of Archeology and Historic Preservation

Date: 5/24/73

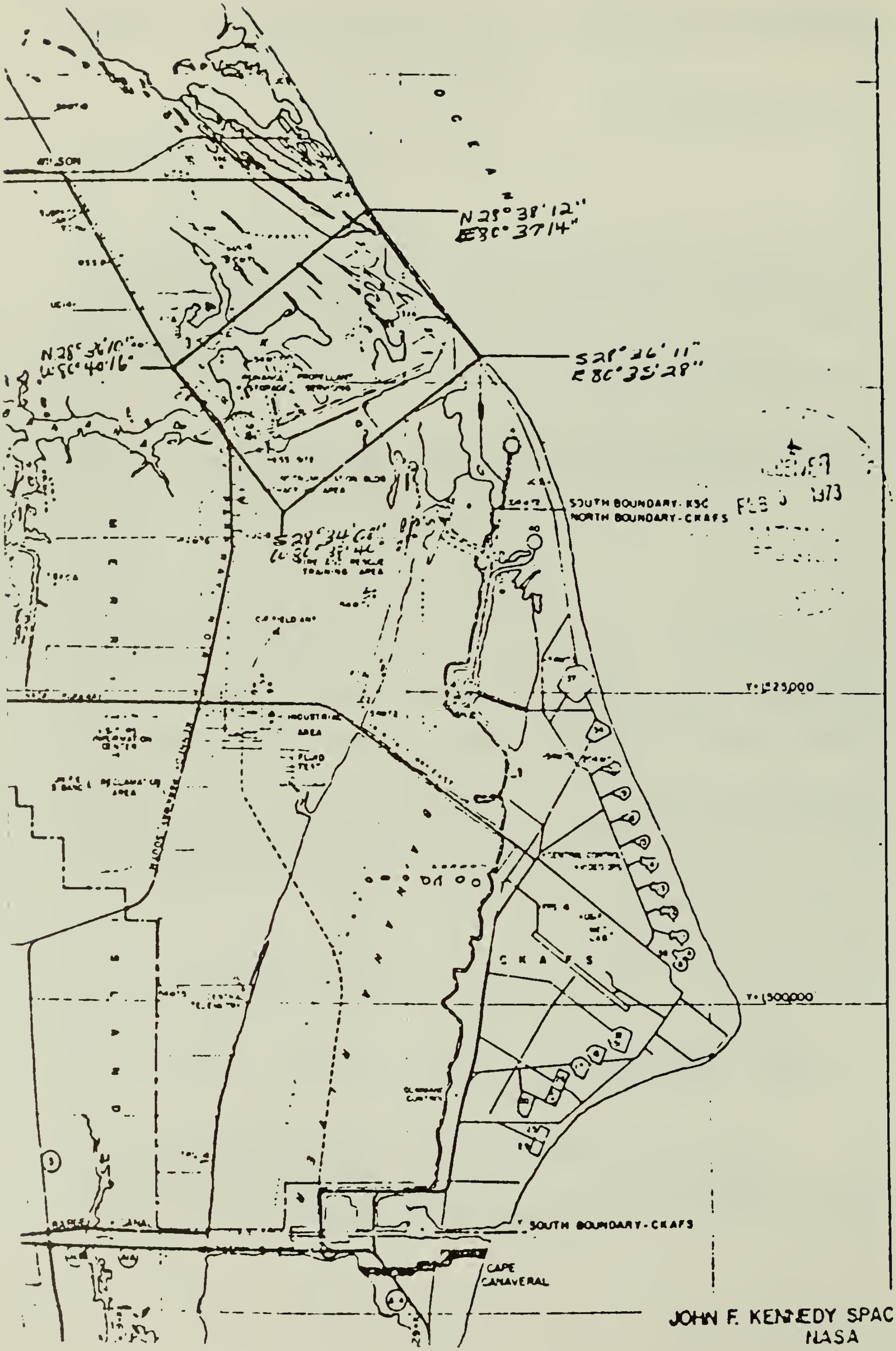
ATTEST:

Keeper of the National Register

Date: 5 23 73

SEE INSTRUCTIONS

GPO 931-894



JOHN F. KENNEDY SPACE CENTER
NASA

Old gantries

Valuable towers of history may avoid the scrapheap

• Pads should be saved, Editorial, 8A

By DAVID BAILEY
TODAY Aerospace Editor

Just 15 months ago, the wind whistled through the rusty orange grid-work of Cape Canaveral's abandoned Complex 13 as Air Force officials debated what to do with its deteriorating hulk.

Its towering gantry, once the focal point of a nation on its way to the moon, was valued only by the pound — as scrap.

Now Complex 13 and a few other surviving launch sites at Cape Canaveral Air Force Station are on their way to becoming historic monuments.

First ignored and then dynamited as hazards, the imposing towers that pointed America toward the moon and stars fell one by one during the 1970s, when America's interest was turned toward Southeast Asia and problems closer to home.

Of 34 launch pads at the Cape, only nine are still in use. Of those not in use, only three remain intact.

Gone is Complex 19, where 20 men were placed into orbit as part of the Gemini program.

Gone is Complex 14, the pad that was the starting place of John Glenn's ride into orbit.

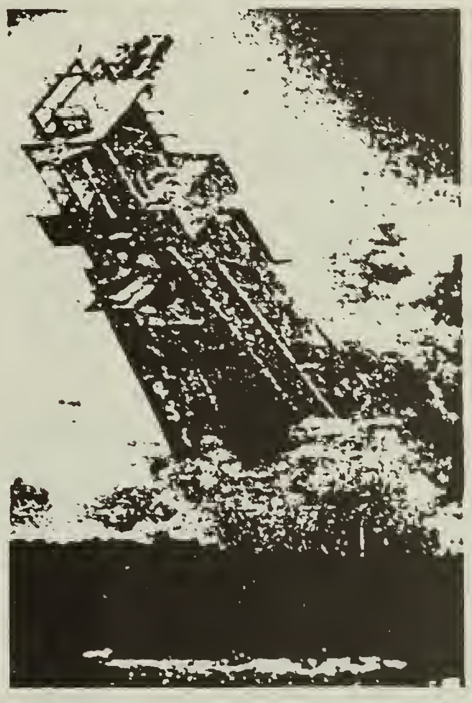
Gone are Complexes 34 and 37, where 15 Saturn rockets were launched and where three astronauts gave their lives in a effort to put man on the moon.

But now there is growing hope for the remaining launch towers and for other valuable Indian and pioneer sites at Cape Canaveral.

"I have a pretty good feeling about it," said Maj. Jerome Ashman, commander of Cape Canaveral Air Force Station. "I think that within the constraints of the budget we're going to do everything we can to preserve these sites."

Two separate efforts are under way to save historical sites at the Cape — one ordered by Congress and one requested by

See GANTRIES, Back Page This Section



TODAY—UPI

IT'S TOO LATE FOR COMPLEX 14
... Glenn rocketed to history from site

Canaveral National Seashore
P.O. Box 2583
Titusville, Florida 32780

TODAY, Monday, August 24, 1981

Gantries may avoid scrapheap

GANTRIES, From 1A

the Air Force.

After TODAY newspaper, its readers and The Missile, Space and Range Pioneers called upon the Air Force to take stock of its historical resources and do something about preserving them, Air Force civil engineers asked the Department of Interior last spring to help them survey the Cape.

The department is responsible for recommending property for inclusion in the National Register of Historic Places, America's list of property officially deemed worth preserving.

Initially, officials with the department's Heritage Conservation and Recreation Service — part of the National Park Service — estimated a survey of Cape Canaveral, Patrick Air Force Base and six tracking sites would cost the Air Force $125,000 to $200,000.

But Air Force officials balked at the price tag.

"We went back to them and said that's awful steep. How can it be pared down?" said Air Force spokesman Don Engle.

As a result, Wilfred Husted, a park service archaeologist, came to Florida for a three-day preliminary visit. Husted identified three areas of interest at the Cape: some Indian sites, some early pioneer sites and the launch complexes.

Husted also decided Patrick Air Force Base and the six tracking sites could be eliminated from the survey.

"We've sent them a new cost estimate," Husted said, "and if all goes well, they'll approve the estimate. It's down considerably. If they have the money, I think they'll let us do the work."

"A couple of years ago we weren't sure how to proceed," Engle said. "We're far enough down the road that the criteria and facilities are being identified, and I'd say we're halfway there."

The other effort involves a committee appointed by Congress to study whether a Man-in-Space division of the National Park Service should be created to commemorate America's landing a man on the moon.

In July, ex-astronaut Wally Schirra, Richard McCollough, a park service planner, and three other park officials visited the Cape and Kennedy Space Center.

The KSC and Cape visit was the first stop on a tour that also included Marshall Space Flight Center in Huntsville, Ala., and Johnson Space Center in Houston.

After visiting all four sites, McCollough, head of the park service's project, said the official report is now being written.

McCollough said it was too early yet to say whether the committee would recommend that a Man-in-Space division of the park service be set up.

The committee, however, was interested in and concerned about what it saw at the Cape.

"Some of the launch complexes are what we saw as most significant and what we are most in danger of losing," he said.

"If the park service is going to get involved at any of these sites," McCollough said, "the Cape site makes the most sense for two reasons: because the resources there are most directly associated with Man-in-Space, and because we already have an existing facility at Cape Canaveral National Seashore."

McCollough was particularly interested in Complex 13, an Atlas-Agena launch site, where five lunar orbiters that mapped the surface of the moon were launched during 1966 and 1967. It was from these moon maps that the landing sites for later Apollo missions were selected.

"In terms of preservation . . . Complex 13 is probably one of the best to bring visitors in and show them what a full-scale launch complex looked like," McCollough said.

The other launch site still intact is Complex 26, the site where America launched its first satellite, Explorer I, in 1958. The Air Force has taken steps to stabilize the launch tower until it decides what to do with the site.

"The Air Force is maintaining the status quo," Ashman said. "We're doing some painting and washing. The worst parts are being touched up."

Should the Department of Interior determine that Complex 26 or any other complex is eligible for the National Register of Historic Places, the Air Force would be required to go through a review process before altering the site.

"It does not guarantee that the gantry will be there forever more," Husted said, "but it does guarantee that the historical resource will be considered in the decision-making process."

Canaveral National Seashore
P.O. Box 2583
Titusville, Florida 32780

Editorials TODAY

"Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof; or abridging the freedom of speech, or of the press; or the right of the people peaceably to assemble, and to petition the government for a redress of grievances."

— First Amendment to the U.S. Constitution

Vince Spezzano, Publisher | Buddy Baker, Executive Editor | Anne Saul, Managing Editor | Nick White, Editorial Page Editor

Cape's launch complexes should be preserved

Someday man's reach for the stars will be ranked in history books right alongside the voyages made by early explorers such as Columbus and Drake. It therefore is only appropriate that the launch pads from which early space flights originated are preserved for future generations.

For 20 years most of those launch pads have been slowly disintegrating at Kennedy Space Center. Of the 34 complexes at the Cape, only nine are still in use. Of the 25 not in use, only three are still intact. The others have been destroyed or allowed to disintegrate in the elements.

Last summer this newspaper, many of our readers and the Missile, Space and Range Pioneers organization launched a campaign to have the launch complexes designated as historic sites. More than a year later, much progress has been made toward that goal.

Two separate efforts are under way to preserve the launch sites. U.S. Air Force officials are going ahead with plans to have the Cape surveyed for possible inclusion on the National Register of Historic Places.

The original estimated cost of the survey caused the Air Force to look askance at the idea at first, but a plan for a scaled-down verson of the survey is in the works.

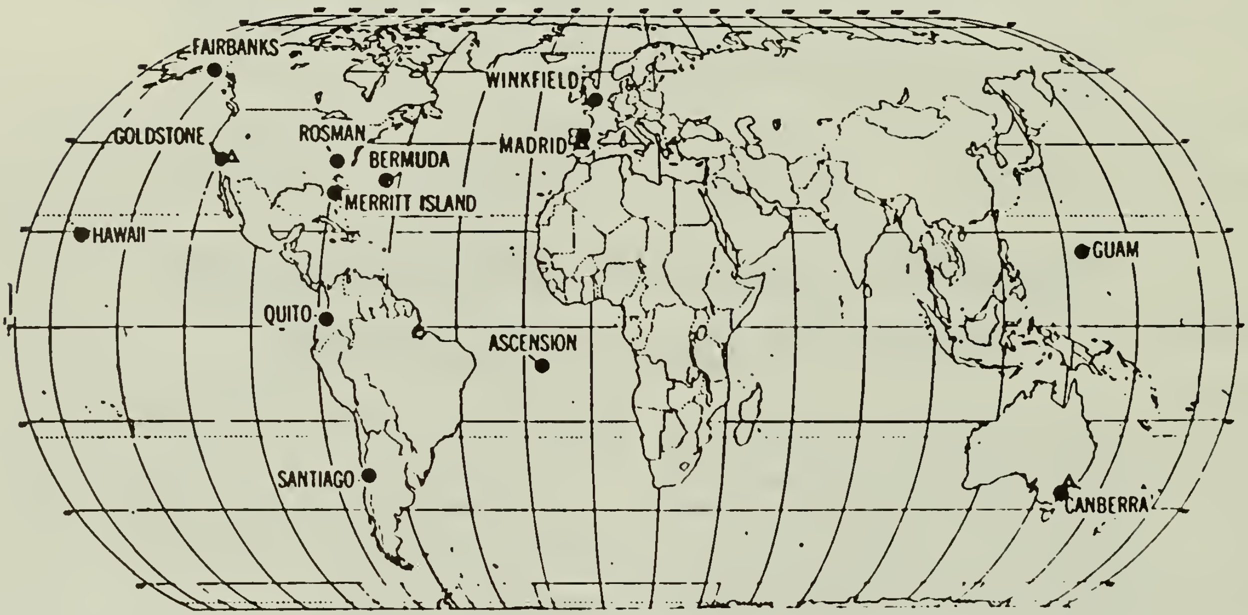
At the same time a congressional committtee is studying the Cape with an eye toward setting up a Man-in-Space division of the National Park Service. The new bureau would be devoted exclusively to the space program.

With luck, one or both of these efforts will lead to a formal program to preserve the operational launch complexes and to refurbish some no longer in use.

Some pads deserve special attention. Examples are Complex 26, where our first satellite, Explorer 1, was launched into orbit, and Complex 13, from which lunar orbiters were launched in the mid 1960s.

These facilities are just as important in their own way as Plymouth Rock or Independence Hall. It is gratifying to see this project finally getting the attention it deserves.

NASA TRACKING & DATA ACQUISITION STATIONS



LEGEND

● SPACEFLIGHT TRACKING & DATA NETWORK STDN| FACILITIES

▲ DEEP SPACE NETWORK DSN FACILITIES

G: U.S. MANNED SPACE FLIGHT LOG

Mission	Launch Complex	Pilot(s)	Date	Mission elapsed time (hr:min:sec)	Cumulative U.S. manned hours in space (hr:min:sec)
Mercury/Redstone 3	5/6	Shepard	May 5, 1961	00:15:22	00:15:22
Mercury/Redstone 4	5/6	Grissom	July 21, 1961	00:15:37	00:30:59
Mercury/Atlas 6	14	Glenn	Feb. 20, 1962	04:55:23	05:26:22
Mercury/Atlas 7	14	Carpenter	May 24, 1962	04:56:05	10:22:27
Mercury/Atlas 8	14	Schirra	Oct. 3, 1962	09:13:11	19:35:38
Mercury/Atlas 9	14	Cooper	May 15 and 16, 1963	34:19:49	53:55:27
Total - Project Mercury					53:55:27
Gemini/Titan 3	19	Grissom, Young	Mar. 23, 1965	04:53:00	63:41:27
Gemini/Titan 4	19	McDivitt, White	June 3 to 7, 1965	97:56:11	259:33:49
Gemini/Titan 5	19	Cooper, Conrad	Aug. 21 to 29, 1965	190:55:14	641:24:17
Gemini/Titan 7	19	Borman, Lovell	Dec. 4 to 18, 1965	330:35:31	1302:35:19
Gemini/Titan 6A	19	Schirra, Stafford	Dec. 15 and 16, 1965	25:51:24	1354:18:07
Gemini/Titan 8	19	Armstrong, Scott	Mar. 16, 1966	10:41:26	1375:40:59
Gemini/Titan 9A	19	Stafford, Cernan	June 3 to 6, 1966	72:21:00	1520:22:59
Gemini/Titan 10	19	Young, Collins	July 18 to 21, 1966	70:46:39	1661:56:17
Gemini/Titan 11	19	Conrad, Gordon	Sept. 12 to 15, 1966	71:17:08	1804:30:33
Gemini/Titan 12	19	Lovell, Aldrin	Nov. 11 to 15, 1966	94:34:31	1993:39:35
Total - Gemini Program					1939:44:08
Apollo/Saturn 7	34	Schirra, Eisele, Cunningham	Oct. 11 to 22, 1968	260:09:03	2774:06:44
Apollo/Saturn 8	39A	Borman, Lovell, Anders	Dec. 21 to 27, 1968	147:00:42	3215:08:50
Apollo/Saturn 9	39A	McDivitt, Scott, Schweickart	Mar. 3 to 13, 1969	241:00:54	3938:11:32
Apollo/Saturn 10	39B	Stafford, Young, Cernan	May 18 to 26, 1969	192:03:23	4514:21:41
Apollo/Saturn 11	39A	Armstrong, Collins, Aldrin	July 16 to 24, 1969	195:18:35	5100:17:26
Apollo/Saturn 12	39A	Conrad, Gordon, Bean	Nov. 14 to 24, 1969	244:36:25	5834:06:41
Apollo/Saturn 13	39A	Lovell, Swigert, Haise	April 11 to 17, 1970	142:54:41	6262:50:44
Apollo/Saturn 14	39A	Shepard, Roosa, Mitchell	Jan. 31 to Feb. 9, 1971	216:01:57	6910:56:35
Apollo/Saturn 15	39A	Scott, Worden, Irwin	July 26 to Aug. 7, 1971	295:11:53	7796:32:14
Apollo/Saturn 16	39A	Young, Mattingly, Duke	April 16 to 27, 1972	265:51:05	8594:05:29
Apollo/Saturn 17	39A	Cernan, Evans, Schmitt	Dec. 7 to 19, 1972	301:51:59	9499:41:26
Total - Apollo Program					7506:01:31
Skylab SL-2	39B	Conrad, Kerwin, Weitz	May 25 to June 22, 1973	672:49:49	11518:10:53
Skylab SL-3	39B	Bean, Garriott, Lousma	July 28 to Sept. 25, 1973	1427:09:04	15799:38:05
Skylab SL-4	39B	Carr, Gibson, Pogue	Nov. 16, 1973 to Feb. 8, 1974	2017:15:32	21851:24:41
Total - Skylab Program					12351:43:15
Apollo-Soyuz	39B	Stafford, Brand, Slayton	July 15 to 24, 1975	217:28:23	22503:49:50
Total - ASTP Program					652:25:09

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STUDY TEAM AND CONSULTANTS

STUDY TEAM

Walter Schirra, Jr., Special Adviser/Member, National Park System Advisory Board and Council

Richard McCollough, Project Manager/Landscape Architect/Urban Planner, National Park Service, Denver Service Center

Harry Butowsky, Historian, National Park Service, Washington Office

Robert Welton, Structural Engineer, National Park Service, Denver Service Center

Frederick Babb, Acting Chief of Planning, Southeast/Southwest Team, National Park Service, Denver Service Center

Donald Guiton, Superintendent, Canaveral National Seashore

CONSULTANTS

Representatives from the Denver Service Center and Canaveral National Seashore have consulted with or gathered information from the following agencies, institutions, organizations, and individuals.

Project General

Monte Wright, Director, NASA History Office, Washington
Alex Roland, Historian, NASA History Office, Washington
Lee Saegesser, Archivist, NASA History Office, Washington
Walter Flint, Assistant Curator for Space Sciencies, Smithsonian Air and Space Museum, Washington
Norman Willis, NASA, Washington
Edward Buckbee, Director, Alabama Space and Rocket Center, Huntsville

Staff of Merritt Island National Wildlife Refuge, Pan American Airways, and TWA Services

Kennedy Space Center (NASA)

John Ross, Public Affairs Office
Frank Jerrett, Historian
Ken Nail, Archivist

Cape Canaveral Air Force Station

Major Jerome Ashman, Commander
Albert Hutchinson, Assistant to the Cape Commander

Johnson Space Center (NASA)

Hal Stall, Director of Public Affairs
Charles Biggs, Chief, Public Services Branch, Office of Public Affairs
John Lawrence, Public Affairs Office
Glenn Spenser, Civil Engineer
Ed Ezell, Historian
Les Garver, Photo Office

Marshall Space Flight Center (NASA)

Jack Lee, Deputy Director
Erich McInnis, Assistant Executive Officer
Robert G. Sheppard, Director, Management Services
William F. Taylor, Director, Test Laboratory
Charles Adams, Facilities Office
Kenneth Hill, Test Laboratory
Edward Schorsten, Public Affairs Office

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As the nation's principal conservation agency, the Department of the Interior has basic responsibilities to protect and conserve our land and water, energy and minerals, fish and wildlife, and parks and recreation areas, and to ensure the wise use of all these resources. The department also has major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

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