CAPE CANAVERAL AIR FORCE STATION HAER No. FL-8-AV
MISSION CONTROL CENTER
(Building No. 1385, Mercury Control Center)
Mission Control Road, east of Samuel C. Phillips Parkway
Cape Canaveral
Brevard County
Florida

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Southeast Region
Department of the Interior
Atlanta, GA 30303

HISTORIC AMERICAN ENGINEERING RECORD

CAPE CANAVERAL AIR FORCE STATION
MISSION CONTROL CENTER
(Building No. 1385, Mercury Control Center)
HAER No. FL-8-AV

Location: Mission Control Road, East of Samuel C. Phillips Parkway
Cape Canaveral
Brevard County
Florida

U.S.G.S. 7.5. minute Cape Canaveral, Florida, quadrangle,
Universal Transverse Mercator coordinates:
17.540867.3148574

Date of Construction: 1956-1958 (original); 1959-1960 (addition); 1962-1963 (addition)

Architect: U.S. Army Corps of Engineers (original); Burns and Roe, Inc. (1959-60 addition); Pan American World Airways, Inc. (1962-63 addition)

Builder: Carlson-Ewell (original); unknown for additions

Present Owner: National Aeronautics and Space Administration (NASA)
Kennedy Space Center, FL 32899-0001

Present Status: Demolished

Significance: The Mission Control Center (or Mercury Control Center) was listed as a contributing resource to the Cape Canaveral Air Force Station, National Historic Landmark District on April 16, 1984. The district is considered significant at the national level under National Register of Historic Places (NRHP) Criterion A in the areas of Communications, Science, and Space Exploration, and under Criterion C in the area of Engineering. The period of significance was given as “1949 to present.” The Mercury Control Center was considered a contributing resource for its use during Project Mercury, the first U.S. space program, and the first four flights of the Gemini Program. The Mission Control Center housed the flight controllers whose duty was to take over flight control after lift-off and follow it through until splashdown. Additionally, it supported vehicle checkout, spacecraft tracking, and astronaut training.

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Introduction

On October 4, 1957, the Union of Soviet Socialist Republics (USSR) launched the first man-made Earth satellite, Sputnik 1; on November 3, 1957, the USSR placed Sputnik II, carrying a dog named Laika, into orbit. This sparked a wave of interest in space exploration among the American public, and less than two weeks after the launch of Sputnik II, Senator Lyndon B. Johnson called for, and chaired, an examination of the American space effort.[1] On February 6, 1958, the United States (U.S.) Congress formed the Committee on Space and Astronautics to frame legislation for a national space program.[2] On July 29, 1958, President Dwight D. Eisenhower signed the National Aeronautics and Space Act into law. Subsequently, as per this Act, the National Aeronautics and Space Administration (NASA) was officially activated on October 1, 1958 to carry out all nonmilitary space projects.[3] In support of these efforts, NASA used several facilities at the Cape Canaveral Air Force Station (CCAFS) in Florida. This included Building No. 1385, which was used as the Mission Control Center for Project Mercury and the early flights of the Gemini Program, as well as various launch complexes, which were used in support of the first three manned space programs, Mercury, Gemini, and Apollo.

Cape Canaveral Air Force Station

With the increasing concern over Soviet missile and nuclear development after World War II, the U.S. Department of Defense (DoD) created the Committee on Long Range Proving Grounds in October 1948. One of their first duties was to select a suitable missile test site. Four locations were examined, including an area near Washington State, with tracking stations in the Aleutian Islands of Alaska; the Naval Air Missile Test Center at Point Mugu, California; the Naval Air Station at El Centro, California; and Cape Canaveral, Florida, which was near the existing Banana River Naval Air Station (now Patrick Air Force Base [AFB]).[4] Cape Canaveral was eventually selected for several critical reasons. First, the government already owned land at the Cape, and the undeveloped nature of the remaining land made it less expensive to acquire. In addition, its isolated location enhanced security for research and development. Furthermore, the launch area was accessible via water, easing the logistics of transporting heavy rockets and

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[1] Roger D. Launius, *NASA: A History of the U.S. Civil Space Program* (Malabar, Fla.: Krieger Publishing Company, 2001), 29.
[2] James M. Grimwood, *Project Mercury: A Chronology* (Washington, D.C.: NASA, Office of Scientific and Technical Information, 1963).
[3] As part of NASA's establishment, its predecessor, the National Advisory Committee for Aeronautics (NACA), was deactivated and all of its personnel and facilities were transferred to NASA. Grimwood; Launius.
[4] Harry A. Butowsky, *National Historic Landmark Federal Agency Nomination, Cape Canaveral Air Force Station* (Washington, D.C.: National Park Service, 1983), 8-2. For ease of discussion, the name Patrick AFB will be used throughout the context.

building supplies. Operationally, missiles could be launched over the Atlantic Ocean and tracked from islands. Also, Florida's temperate climate allowed year round operation of a missile site.[5]

In May 1949, President Harry S Truman signed the legislation to officially establish the Joint Long Range Proving Ground at Cape Canaveral, with Patrick AFB as the support base. Although the entire facility was initially under the cooperative use of the Army, Navy, and Air Force, the Air Force, by a directive of the DoD, ultimately assumed responsibility for the Range. Subsequently, on May 16, 1950, the Cape Canaveral missile range was redesignated as the Long Range Proving Ground, the first of many subsequent name changes.[6]

Construction at the southern tip of Cape Canaveral commenced in July 1950, under the direction of the Jacksonville District of the U.S. Army Corps of Engineers (ACOE). These activities included the construction of Port Canaveral and Launch Complexes (LC) 1, 2, 3, and 4.[7] Although not fully completed, the Army conducted the first successful launch, a Bumper rocket from LC-3, on July 24, 1950. Construction of LC-3 was completed by 1951. By 1952, LC-4 was finished, followed closely by LC-1 and LC-2 in 1953.[8]

During the late 1940s and early 1950s, Air Force activities at CCAFS focused on winged cruise missile research and development as a deterrent force in the weapons race between the U.S. and the USSR. The earliest launch pads (LC-1, LC-2, LC-3, LC-4, LC-9, LC-10, LC-21, and LC-22), located at the southern tip of the Cape, were used for firing experimental winged missiles including the Lark, Matador, Navaho, Snark, Bomarc, Bull Goose, and Mace. Support buildings, including a communications building, a water plant, a fire fighting unit, electrical substations, a skid strip for the landing and reuse of the missiles, and Hangars C and O, were constructed near these original launch pads.[9]

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[5] Initially, the committee's first choice was El Centro, but the Mexican government would not agree to allow U.S. missiles to fly over its Baja region. Great Britain, on the other hand, was willing to not only allow the U.S. to fly missiles over the Bahamas, but also to lease land on the island to the U.S. for tracking stations. David Barton and Richard S. Levy, *An Architectural and Engineering Survey and Evaluation of Facilities at Cape Canaveral Air Force Station, Brevard County, Florida* (Resource Analysts, Inc., March 16, 1984), 3-4; Charles D. Benson and William B. Faherty, *Moonport: A History of Apollo Launch Facilities and Operations* (Washington, D.C.: NASA, Scientific and Technical Information Office, 1978); Butowsky, *Cape Canaveral Air Force Station*, 8-2; Cliff Lethbridge, "The History of Cape Canaveral," *Spaceline.org*. 2000.

[6] Lethbridge, "Cape Canaveral." For ease of reference, it will be referred to as Cape Canaveral Air Force Station throughout the text.

[7] Construction included the launch pads as well as their support buildings. Butowsky, *Cape Canaveral Air Force Station*, 7-3 and 7-4; Lethbridge, "Cape Canaveral."

[8] On June 30, 1951, the Cape received its first military designation: the Florida Missile Test Range. Butowsky, *Cape Canaveral Air Force Station*, 8-3; Lethbridge, "Cape Canaveral."

[9] Barton and Levy, 6, 25; E.R. Bramlitt, *History of Canaveral District 1950-1971.* South Atlantic Division, U.S. Army Corps of Engineers, 1971; Jacob Neufeld, *The Development of Ballistic Missiles in the United States Air Force, 1945*-1960 (Washington, D.C.: USAF, Office of Air Force History, 1990), 239.

In 1952, the USSR detonated their first thermonuclear device. Additionally, intelligence reports indicated that they were also developing long-range missiles. Not to be outdone, the U.S. began to advance their ballistic missile development, and by 1955, Air Force officials convinced President Eisenhower to assign the intercontinental ballistic missile (ICBM) development program the highest national priority. Subsequently, the DoD approved two intermediate range ballistic missile (IRBM) programs: the Air Force's Thor program and the Army/Navy's Jupiter program. Both were developed simultaneously and were assigned an equal national priority.[10]

This drive to develop more accurate and powerful weapons led to the construction of numerous additional launch complexes along the Cape. Many of the earliest launch complexes were adapted to new uses, such as support structures, for these facilities.[11] Since the government maintained programs for both ICBMs and IRBMs, launch complexes for both types of missiles were constructed at Cape Canaveral. Over time, the southern area of the Cape was developed for launching IRBMs (Redstone, Pershing, Polaris/Poseidon, and Thor) and included launch complexes 5, 6, 17, 18, 25, 26, 29, and 30. The northern area of the Cape was developed for launching ICBMs and space launch vehicles (Atlas, Titan, Saturn) and included complexes 11, 12, 13, 14, 15, 16, 19, 20, 34, 36, and 37.[12]

In 1955, President Eisenhower announced that the U.S. would launch an unmanned satellite as part of the nation's participation in the International Geophysical Year, which was planned for July 1957 through December 1958. Initially, the U.S. Navy's (USN) Project Vanguard was chosen to complete this task. Although the Vanguard made use of the reliable Viking rocket, the first test flight did not occur until December 8, 1956, with the second test flight launching on May 5, 1957; both lifted off from CCAFS. After the successful Soviet launches of Sputnik I (October 4, 1957) and Sputnik II (November 3, 1957), and the failure of the third Vanguard test flight, President Eisenhower and the DoD approved the Army's Explorer Project, which was under its Development Operations Division led by Dr. Wernher von Braun.[13] The U.S.

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[10] Neufeld, 143-48, 242.

[11] Complexes constructed for one type of missile were rarely reused to launch another type of missile because they were not configured structurally, electronically, or for safety concerns for the new larger and more powerful missile.

[12] Barton and Levy, 4, 9; Denise P. Messick, Cynthia G. Rhodes, and Charles E. Cantley, *45th Space Wing Cultural Resource Management Plan*, Technical Report No. 386 (Stone Mountain, Ga.: New South Associates, 1996), 95; James N. Gibson, *Nuclear Weapons of the United States: An Illustrated History* (Atglen, Pa.: Schiffer Publishing, Ltd., 2000).

[13] Benson and Faherty, 1-2. Dr. Wernher von Braun was one of 115 German rocket engineers and scientists who were brought to the U.S. after World War II as part of Project Paperclip. They were part of the group at Germany's Peenemünde site, who were responsible for developing the V-1 "buzz bomb" and the V-2 ballistic missile. They were originally stationed at Fort Bliss, Texas and tested the rockets at the White Sands Proving Ground in New Mexico. In October 1949, the group was transferred to the Redstone Arsenal in Huntsville, Alabama where they became the Army Ballistic Missile Agency (ABMA). Andrew J. Dunar and Stephen P. Waring, *Power to Explore: A History of Marshall Space Flight Center 1960-1990* (Washington, D.C.: NASA History Office, 1999), 8-22.

successfully entered the space race with the launch of the Army's scientific satellite Explorer I from CCAFS on January 31, 1958, using a four stage Jupiter C missile named Juno I.[14]

Realizing that the military's involvement in the space program would jeopardize the goal of using space for peaceful purposes, the President's Science Advisory Committee urged that a centralized agency be created to oversee the scientific exploration of space. Thus, NASA was established as a civilian agency with the mission of carrying out scientific aeronautical and space exploration, both manned and unmanned.[15] Forming the core of this new agency was the National Advisory Committee for Aeronautics (NACA), which had been a leader in flight research since 1915. NACA also had long working relationships with the different U.S. military branches, and the ability to take that research and apply it to civilian applications. Above all, the group had the advantage of a "peaceful, research-oriented image."[16]

Soon after the creation of NASA, Navy personnel and facilities associated with Project Vanguard and over 400 scientists from the Naval Research Laboratory were reassigned to NASA, as was the Army-affiliated Jet Propulsion Laboratory of the California Institute of Technology. Initially working with NASA as part of a cooperative agreement, President Eisenhower officially transferred a large portion of the Army's Development Operations Division, including the team led by von Braun to NASA in March 1960. At the same time, Eisenhower named the Huntsville NASA installation the Marshall Space Flight Center, and designated the Missile Firing Laboratory at Cape Canaveral as the Launch Operations Directorate of NASA. At this time, several Army facilities at CCAFS were given to NASA, including various offices and hangars, as well as LC-5/6, -26, and -34.[17]

Between 1958 and 1968, CCAFS would directly support NASA's early manned space programs: Mercury, Gemini and Apollo. Project Mercury was the first program, and was active from December 1958 through May 1963. During this time, six missions launched from LC-5, including the first U.S. suborbital ballistic flight of Alan Shepard (May 5, 1961) with a Redstone rocket, and ten launched from LC-14, including the first U.S. orbital flight of John Glenn (February 20, 1962) with an Atlas rocket. The Cape also provided facilities for the tracking network, including the original Mercury Control Center (MCC) and Hangar S for simulators and

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[14] Launius, 21-28.

[15] The Department of Defense, especially the Air Force, would continue with defense related missile and satellite development. R. Cargill Hall, "Civil-Military Relations in America's Early Space Program." In *The U.S. Air Force in Space: 1945 to the 21st Century, Proceedings of the Air Force Historical Foundation Symposium, Andrews AFB, Maryland, September 21-22, 1995*, ed. R. Cargill Hall and Jacob Neufeld (Washington, D.C.: USAF, USAF History and Museums Program, 1998), 30; Barton and Levy, 20.

[16] Roger E. Bilstein, *Testing Aircraft, Exploring Space: An Illustrated History of NACA and NASA* (Baltimore: The Johns Hopkins University Press, 2003), 50-58.

[17] The Missile Firing Laboratory was the launch team of the ABMA. It was led by Dr. Kurt Debus, another German rocket scientist brought to the U.S. through Project Paperclip, see footnote 13. Benson and Faherty, 15; Dunar and Waring, 70.

astronaut quarters. The Gemini Program, which extended from January 1962 through November 1966, used LC-14 for seven launches and LC-19 for twelve launches, including the first manned Gemini mission on March 23, 1965, using a Titan rocket.[18]

The Apollo Program, which used von Braun's powerful Saturn rocket, required the construction of LC-34 and LC-37 towards the northern tip of Cape Canaveral. Test flights of the Saturn rocket started at LC-34 in October 1961, and in January 1962, NASA announced that the Saturn would be the moon launch vehicle. Over the next few years, NASA utilized both launch complexes for research and development of the Saturn rocket. LC-37 supported five launches; LC-34 saw eight launches, including the first manned flight (Apollo 7). Additionally, LC-34 saw the first major tragedy of the U.S. space program. During a simulation flight, three astronauts–Virgil Grissom, Edward White, and Roger Chaffee–lost their lives in an oxygen fire in the cockpit on January 27, 1967, an event later commemorated as Apollo 1. The Apollo 7 launch from LC-34 on October 11, 1968, was the last manned space mission to lift-off from CCAFS. Since then, all manned flights have launched from LC-39 at the Kennedy Space Center.[19]

Project Mercury

In the summer of 1958, as Congress debated legislation for a U.S. space initiative, Dr. Hugh Dryden, Director of NACA, contacted Dr. Robert R. Gilruth, head of the flight research section of Langley Aeronautical Laboratory (now Langley Research Center) in Hampton, Virginia, and Dr. Abe Silverstein, director of the Lewis Flight Propulsion Laboratory (now Glenn Research Center), to formulate a space program.[20] Almost immediately, Gilruth began to focus on manned spaceflight, and convened a group of associates who compiled the basics of what would become Project Mercury. Not long after President Eisenhower signed the National Aeronautics and Space Act of 1958, Gilruth and Silverstein urged Dryden to create a special group to implement a manned space program. Eight days following the activation of NASA, the Space Task Group (STG) was created to implement this program, with Gilruth as Project Manager.[21] Program approval for a manned space program was granted by NASA's first administrator, Dr. T. Keith Glennan, on October 7, 1958.

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[18] William A. Lockyer, Jr., *A Summary of Major NASA Launchings: October 1, 1958-September 30, 1973.* KSC Historical Report No. 1. John F. Kennedy Space Center: KSC Historical Services, 1973.
[19] Barton and Levy, 31; Harry A. Butowsky, *Reconnaissance Survey: Man in Space* (Washington, D.C.: National Park Service, 1981), 5-6.
[20] See footnote 3.
[21] The STG was formally created through a November 5, 1958 memorandum by Floyd Thompson, acting director of Langley. It would eventually become the Manned Spacecraft Center (1961), which then became the Lyndon B. Johnson Space Center (1973). Grimwood.

The STG drew on the previous work of NACA and others to draft the tenets for a manned space program, and create a working plan for carrying it out. The goals of the project were to "(1) Place a manned spacecraft in orbital flight around the Earth. (2) Investigate man's performance capabilities and his ability to function in the environment of space. (3) Recover the man and the spacecraft safely."[22] On November 26, 1958, the program was designated Project Mercury on the suggestion of Silverstein.[23] Over the course of the program, NASA successfully designed a vehicle that could survive the conditions of space, as well as atmospheric reentry; hired and trained the first U.S. astronauts; developed a worldwide tracking network; created mission control procedures that became the protocol for all future programs; and launched twenty-six missions (manned and unmanned).

The Mercury Capsule

In June 1958, engineers at Langley, under the direction of Maxime Faget, had begun to develop preliminary specifications for a manned satellite vehicle, which would become the Mercury capsule. They drew on concepts that had previously been developed such as a blunt nose reentry configuration; and developed new principles, such as the use of a contour couch to help the astronaut withstand high-gravity (high-G) loads.[24] Additionally, Faget examined the use of a tractor rocket for an escape device; this concept would eventually be reworked into the Mercury escape tower.[25] By the end of the summer, Faget's team was conducting tests with model capsules made in-house to research a parachute system, thermal protection devices, attitude control, posigrade and retrograde rockets, and the capability of landing safely in the water.

On November 7, 1958, a conference was held at Langley to introduce the preliminary concepts of the capsule to potential bidders. Although the STG invited contractors to submit alternate configurations, five requirements for the capsule design were imposed on the companies. These

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[22] Walter C. Williams, Kenneth S. Kleinknecht, William M. Bland, Jr., and James E. Bost, "Project Review." *Mercury Project Summary Including the Results of the Fourth Manned Orbital Flight, May 15 and 16, 1963 [SP-45]* (Washington, D.C.: NASA, Office of Scientific and Technical Information, 1963), 2.

[23] Mercury was the Roman name for the Greek god, Hermes. He was principally the messenger for Jupiter, and was equipped with winged sandals, a helmet, and a caduceus. Around 160 AD, he was used by the Greek savant, Lucian of Samosata, in a tale of a man who angers the gods by traveling to the Moon, which prompts them to have Mercury retrieve the man and deposit him back on Earth. This story sparked Theodore von Karman, a Hungarian aeronautics engineer, to speak of Mercury "in terms of the 'reentry' problem and the safe return of man to Earth" in his book, *Aerodynamics: Selected Topics in the Light of Their Historical Development,* published in 1954. Loyd S. Swenson, Jr., James M. Grimwood and Charles C. Alexander, *This New Ocean: A History of Project Mercury* (Washington, D.C.: NASA, Office of Technology Utilization, 1966), 1, 132. The name "Project Mercury" was used officially for the first time in a policy speech by Glennan on December 17, 1958, which coincidentally corresponded with the 55th anniversary of the Wright brother's first flight. Grimwood.

[24] H. Julian Allen of Ames Aeronautical Laboratory (now Ames Research Center) in Moffett Field, California, developed the blunt nose principle for reentry vehicles in June 1952; Faget developed the contour couch in April 1958. Swenson, et al., 59-61; Grimwood.

[25] Swenson, et al, 102-103; Grimwood.

included a reliable launch-escape system; the use of drag braking as the reentry mode; the use of a retrorocket system to bring the capsule out of orbit; an emphasis on a water landing; and the capability of the astronaut to manually control the vehicle's attitude.[26] On November 14, copies of the STG's "Specifications for Manned Space Capsule" were mailed to those companies that had expressed an interest in the contract following the conference, with bids due on December 11.[27] After an exhaustive review, McDonnell Aircraft Corporation of St. Louis, Missouri, was chosen on January 9, 1959, as the prime contractor for the Mercury capsule.[28]

Due to the rapid pace of Project Mercury, the STG had adopted a policy of simultaneous development and testing, so that by the time the contract was signed, the only set parameters of the vehicle were its external configuration, with the exception of its antenna, and the contour couch for the astronaut.[29] Therefore, while McDonnell proceeded with the design and construction of a full-scale model capsule, their research department, as well as engineers from NASA, initiated an expansive range of tests to fully develop and qualify the spacecraft.[30] These tests were categorized as either ground or flight tests. Ground tests, which typically occurred in wind tunnels, vacuum chambers, or altitude chambers, were used to determine such elements as structural properties, heat protection systems, and systems design, as well as qualify various components of the capsule. Flight tests confirmed the aerodynamic properties of the vehicle, the design of the parachute system, and the design of the launch-escape system, and provided data relating to aerodynamic heating.[31]

Despite the continued testing, McDonnell conducted a Mock-Up Inspection Board meeting at their plant on March 17-18, 1959, where they presented their initial set of capsule specifications and a full-scale model to the STG and other interested parties. Based on the various demonstrations and consultation meetings, thirty-four alterations were recommended, of which twenty-five were authorized immediately; the other nine required further study.[32] Work progressed on the capsule incorporating these changes, and on May 12-13, another Mock-Up Inspection Board conference was held, which resulted in further changes to the design. A third mock-up occurred on September 10-11, 1959, in which the astronauts participated after having spent several months learning about the capsule. As pilots, they had some design changes of their own, including a new instrument panel, a forward window, and an explosive side egress hatch.

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[26] John H. Boynton, E.M. Fields and Donald F. Hughes, "Spacecraft Systems Development and Performance." *Mercury Project Summary Including the Results of the Fourth Manned Orbital Flight, May 15 and 16, 1963 [SP-45]* (Washington, D.C.: NASA, Office of Scientific and Technical Information, 1963), 40.
[27] Swenson, et al., 120-122.
[28] Grimwood. The company was officially notified on January 12, and the contract was signed on February 5; Swenson, et al., 137.
[29] Swenson, et al., 141.
[30] Boynton, et al., 44. Upon signing the contract, McDonnell promised NASA that the initial design specifications as well as a full-scale model would be completed by March 17, 1959, Swenson, et al., 138.
[31] Boynton, et al., 44-47.
[32] Swenson, et al., 148.

These were incorporated into the spacecraft, and finally, on January 25, 1960, the first production type spacecraft (a structural shell only) was delivered to STG at Langley. The first capsule for a manned mission was delivered to Cape Canaveral on December 9, 1960.[33]

The original contract with McDonnell called for the construction of twelve capsules; shortly thereafter, the number of capsules was modified to twenty. Each successive capsule was essentially similar in the basics: the size, major systems types, and control features remained the same. However, each spacecraft also had its individualistic elements, the most noteworthy of which was the astronaut's couch. Designed to help the astronaut withstand the high-G forces of acceleration and reentry, each astronaut had his own custom-fitted couch. Other changes to the capsule came about from continuing research and development, such as the explosive side hatch added for the second suborbital ballistic mission; or in preparation for new flight requirements, such as providing enough fuel and oxygen for the last mission, which was extended from the generic three orbits to twenty-two orbits.[34]

The Boosters

Within days of NASA's activation, and prior to the formation of the STG, those in charge had their eyes on four launch vehicles: the Air Force's Atlas rocket, the Army's Redstone rocket and its descendent, the Jupiter rocket, and their own Little Joe rocket.[35] Later in the program, the Scout rocket, designed by NASA for the Air Force, was added to the list of potential launch vehicles.[36] Of the eventual twenty-six test and operational Mercury missions, seven used a Redstone rocket; ten used an Atlas rocket; eight used a Little Joe rocket; and one used a Scout rocket.[37]

Redstone

The Redstone rocket was originally developed as an IRBM by the U.S. Army Ordnance Guided Missile Center (OGMC), based at the Redstone Arsenal in Huntsville, Alabama. On February 1, 1956, the further development of the Redstone was assigned to the newly activated ABMA, a department of the OGMC, under the direction of Dr. von Braun and also stationed at Redstone Arsenal.[38] ABMA was also charged with the development of the Jupiter rocket, an advanced version of the Redstone. As a product of the Army, the Redstone rocket was a "field-mobile

[33] This capsule did not contain the explosive side hatch or the front window. Grimwood; Walter M. Schirra, Jr. (with Richard N. Billings), *Schirra's Space* (Boston: Quinlan Press, 1988), 66.
[34] Swenson, et al., 137-138; Williams, et. al., 3-4.
[35] Throughout 1956, NACA had studied the use of existing ballistic missiles for manned spaceflight. Grimwood.
[36] Swenson, et al., 152.
[37] NASA KSC, "Manned Missions." *Mercury website*. 2000; NASA KSC, "Unmanned Missions." *Mercury website*. 2000.
[38] See footnote 13.

missile," designed with the capability of being launched by combat troops. The first test launch of the rocket occurred on August 20, 1953 at CCAFS under the direction of ABMA's Missile Firing Laboratory; it was declared operational in June 1958. Once all in-house testing of the Redstone was complete, a production contract was awarded to the Chrysler Corporation.[39]

Langley personnel first visited ABMA on October 6, 1958, to open a discussion on using the Redstone and Jupiter rockets for the manned satellite program; a follow-up visit was held on December 2 of that year. On January 16, 1959, the STG placed an order with ABMA for eight Redstone and two Jupiter rockets. The Redstone rockets would be used for flight tests, as well as the suborbital ballistic flights of Project Mercury; the Jupiter rocket was eventually dropped from the program.[40]

Like the Atlas rocket, a series of modifications were required for the Redstone in order for it to meet the necessary performance requirements and to "man-rate" the vehicle. These changes included an elongation of the fuel tanks; a change in the fuel formula; the installation of an Abort Sensing and Implementation System to initiate the spacecraft's escape system; and adaptations to strengthen the rocket's structure.[41] The first mission that used a Redstone rocket launched on November 21, 1960; the last mission to use a Redstone was MR-4 on July 21, 1961.

Atlas

The Atlas rocket was originally developed by Convair in the late 1940s as the MX-774 ballistic missile; its first test launch occurred on July 13, 1948, at the White Sands Proving Ground in New Mexico, despite the cancellation of Convair's contract with the Air Force. Following the start of the Korean War, the contract was renewed on January 23, 1951 as the MX-1593 project, and that August, the Air Force approved the manufacturer's name of "Atlas" for the rocket. The final design for the missile was set as of December 1954, and in January 1955, a long-term continuation contract for its manufacture was signed between the Air Force and Convair.[42] On June 11, 1957, the first launch attempt of an Atlas was conducted at CCAFS; the rocket exploded shortly after launch. The first successful launch of the Atlas occurred on January 10, 1958.

The Atlas was the first ballistic missile NACA considered for use in a manned space program, named in their original program outline of March 12, 1958. On October 17-18, 1958, Langley personnel visited the Air Force's Atlas plant in Inglewood, California, to discuss the procurement of Atlas rockets for the space program. Subsequently, on November 24, 1958,

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[39] Cliff Lethbridge, "Redstone Fact Sheet." *Spaceline.org*. 2000.
[40] Grimwood.
[41] Joachim P. Kuettner and Emil Bertram, "Mercury-Redstone Launch-Vehicle Development and Performance." *Mercury Project Summary Including the Results of the Fourth Manned Orbital Flight, May 15 and 16, 1963 [SP-45]* (Washington, D.C.: NASA, Office of Scientific and Technical Information, 1963), 69-71.
[42] Cliff Lethbridge, "Atlas Program Background Fact Sheet." *Spaceline.org*. 1998.

Langley officially asked the Air Force to provide one vehicle for preliminary testing for use in Project Mercury. The STG eventually placed an order for ten Atlas rockets, which were used in test flights and all of the orbital missions.[43]

Since the Atlas was designed as a ballistic missile, a series of modifications were required to "man-rate" the vehicle. Such changes included the relocation of the missile's retrorockets to the spacecraft; new guidance antennas to ensure a maximum strength radar signal; the installation of an Abort Sensing and Implementation System to initiate the spacecraft's escape system in the case of a catastrophic failure; and adaptations to strengthen the rocket's structure.[44] The first Atlas launched for Project Mercury supported the "Big Joe" flight on September 9, 1959. Nine other missions in this program used Atlas rockets, including the four manned orbital flights.[45]

Little Joe

The Little Joe rocket was developed by Faget and Paul Purser, another Langley engineer, in January 1958. Unlike the Atlas and Redstone rockets, this was a solid fuel launch vehicle designed specifically for the research and development phase of a manned space program. After further development, a briefing was held at Langley on October 21, 1958, for prospective manufacturers. The contract for the construction of the rocket's frame was awarded to North American Aviation on December 29, 1958; the motors would be supplied by the STG and installed at Wallops Island, Virginia. The first two Little Joe frames were delivered to Wallops Island on May 28, 1959, with the initial launching of a Little Joe on August 21 of that year. Just over a month later, North American Aviation delivered the last Little Joe frame to the STG, although the final Little Joe flight would not occur until April 28, 1961.[46]

The Astronauts

With the establishment of NASA, President Eisenhower made the decision that the first astronauts should be military test pilots.[47] On October 27, 1958, NASA formed a special Committee on Life Sciences to oversee the selection of astronauts; Dr. W. Randolph Lovelace II, a flight surgeon who had served in the Air Force, was appointed as Chairman.[48] Over the course

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[43] Grimwood.
[44] Lt. Colonel C.L. Gandy, Jr. and Major I.B. Hanson, "Mercury-Atlas Launch-Vehicle Development and Performance." *Mercury Project Summary Including the Results of the Fourth Manned Orbital Flight, May 15 and 16, 1963 [SP-45]* (Washington, D.C.: NASA, Office of Scientific and Technical Information, 1963), 91-96.
[45] See pages 17-21 for more details on the Project Mercury missions.
[46] Grimwood; Swenson, et. al., 208-213.
[47] Chris Kraft, *Flight, My Life in Mission Control* (New York: Penguin Putnum Inc., 2001), 85; Swenson, et al., 160.
[48] Dr. Lovelace was appointed by Glennan. The other committee members, chosen by Gilruth, were Charles Donlan, a senior management engineer; Warren North, a test pilot engineer; Stanley White and William Argerson, flight surgeons; Allen Gamble and Robert Voas, psychologists; and George Ruff and Edwin Levy, psychiatrists. Grimwood; NASA. "Introduction." *The 40th Anniversary of the Mercury Seven*.

of two months, the committee discussed and established a list of seven preliminary qualifications that a candidate was required to meet. These included a bachelor's degree or equivalent in physical science or engineering; a graduate of a military test pilot school; younger than 40 years in age; no taller than 5'-11"; superb medical and physical condition; at least 1,500 hours of flying time; and a qualified jet pilot.[49] On January 21, 1959, the search for prospective astronauts began. The Committee screened the service records of 508 military personnel and found that 110, including fifty-eight Air Force pilots, forty-seven Navy aviators, and five Marines, met the minimum standards.[50]

After a series of written tests and interviews administered during the beginning of February, the list was cut to thirty-two potential candidates, who subsequently underwent rigorous physical testing at the Lovelace Clinic in Albuquerque, New Mexico. The thirty-one candidates who passed these tests then traveled to the Aeromedical Laboratory of the Wright Air Development Center in Dayton, Ohio, for physical endurance tests and psychological measurements. From this group, the Committee chose eighteen finalists, from which the "Mercury Seven" were selected by Gilruth, Charles J. Donlan, a senior NASA engineer and Gilruth's assistant, Warren J. North, a NASA test pilot and engineer, and Stanley C. White, an Air Force flight surgeon.[51]

On April 15, 1959, Glennan announced the names of the seven astronauts at a press conference in Washington, D.C. They included Captain L. Gordon Cooper, Jr., Captain Virgil I. "Gus" Grissom, and Captain Donald K. "Deke" Slayton of the Air Force; Lieutenant M. Scott Carpenter, Lieutenant Commander Alan B. Shepard, Jr., and Lieutenant Commander Walter M. Shirra, Jr. of the Navy; and Lieutenant Colonel John H. Glenn, Jr. of the Marines. Officially, they were assigned to the STG at Langley AFB.[52] From the outset, the seven astronauts were completely immersed in all aspects of Project Mercury. Gilruth assigned each astronaut a specialty area, which they studied in depth, attended regular meetings and then reported all developments to the other astronauts.[53] In addition, not only did they have to be prepared to fly

[49] Robert B. Voas, "Project Mercury Astronaut Training Program." Presented at the Symposium on Psychophysiological Aspects of Space Flight, 26-27 May 1960, San Antonio, Texas, p. 2.
[50] Grimwood.
[51] Grimwood; Kraft, *Flight*, 85; NASA. "Introduction;" Schirra, 61.
[52] Grimwood. There were also crew quarters in Hangar S at Cape Canaveral ("Hangar S Includes the Crew Quarters." *Space News Roundup* (1, 3), November 29, 1961, 2). Of the seven Mercury astronauts, only Slayton would not fly a Mercury mission.
[53] The individual assignments were as follows: Carpenter - navigation and navigational aids; Cooper - Redstone launch vehicle; Glenn - crew space (i.e., cockpit) layout; Grissom - automatic and manual attitude control systems; Schirra - life support systems, which included the flight suit; Shepard - tracking and recovery operations; and Slayton - Atlas launch vehicle. Voas, 6; Schirra, 65; Grimwood.

the spacecraft, if necessary, they were also expected to perform various in-flight tasks, such as systems checks, and ground-based tasks, including serving as Capsule Communicators.[54]

Worldwide Tracking Network

Shortly before becoming NASA, NACA had begun to study tracking and ground instrumentation networks for a manned satellite program. As part of this research, an arbitrary decision was made "to be in contact with the Mercury capsule at least every fifteen minutes."[55] Given the limits of existing technology, the STG eventually realized that a worldwide network of stations was needed. To assist the STG with the development of this network, NASA Headquarters established the Tracking and Ground Instrumentation Unit (TAGIU) at Langley in February 1959, to be aided by the communications center at Goddard Space Flight Center, Greensbelt, Maryland. To them fell the responsibility for planning the network, securing agreements with the appropriate foreign governments, and contracting the physical work. A preliminary plan was presented to prospective bidders on April 2, 1959, during an informational session. On May 21, the Center released the official "Specifications for Tracking and Ground Instrumentation System for Project Mercury," with all bids due by June 22.[56] Seven proposals were submitted, and on July 13, Western Electric Company (WEC) of New York City was announced as the prime contractor for the work.[57] Working with WEC would be Bendix Corporation, Burns and Roe, Inc., International Business Machines Corporation (IBM), and Bell Telephone Laboratories, Inc.[58]

A preliminary estimate in November 1959, placed the cost of the entire Worldwide Tracking Network (WWTN) at $41 million.[59] The plans for the WWTN included a main control center at Cape Canaveral–with two accessory stations on Grand Bahama Island and Grand Turk Island–a back-up control center in Bermuda, a central computer station at Goddard, and fourteen smaller tracking stations. Several key factors played a role in the decision of where the stations would be

[54] The Mercury missions were essentially controlled through automated capsule systems from the Mercury Control Center, unless the flight plan called for the astronaut to complete a task manually. Additionally, there were instances throughout the program when the astronaut had to initiate manual control of the spacecraft. Kraft, *Flight*, 91-94.
[55] Kraft, *Flight*, 79.
[56] Grimwood; Swenson, et. al., 146-147, 214-221; Kraft, *Flight*, 89.
[57] The seven companies who submitted bids were Western Electric Company, Aeronutronics, Radio Corporation of America, Pan American Airways, Brown and Root, Chrysler Corporation, and Philco Corporation. The latter had completed some preliminary studies for the STG. The actual contract was not signed until January 11, 1960; Grimwood; Kraft, *Flight*, 95.
[58] Bendix Corporation was in charge of search radars, telemetry equipment, and display consoles for each site; Burns and Roe, Inc. handled the construction of all buildings, roads, towers, and other structural components at all sites; IBM provided the computers for the MCC, Goddard, and Bermuda sites; and Bell Telephone Laboratories, Inc. developed the MCC layout, all operations consoles, and an operations procedures trainer. It should be noted that Bell Laboratories was later replaced by Philco Corporation. Grimwood; Kraft, *Flight*, 95; Swenson, et al., 217.
[59] Grimwood.

located, the most important of which was to have maximum coverage of the capsule during a three-orbit mission. Additionally, the STG wanted to use existing facilities when possible, and it was preferable that all new stations be positioned within "American-friendly countries."[60]
By April 29, 1960, all agreements with the DoD and foreign countries for either the use of existing facilities or the construction of a new facility were in place. Six stations would be located within the U.S., two U.S. Naval ships would be modified and used as stations within the Atlantic and Indian Oceans, and ten stations would be situated within foreign countries. Eight existing facilities were used or expanded for use, including Cape Canaveral, Florida; Kauai, Hawaii; Point Arguello, California; White Sands, New Mexico; and Eglin, Florida in the U.S.; Woomera, Australia; and the accessory stations at Grand Bahama Island and Grand Turk Island. New facilities were built in Corpus Christi, Texas; Bermuda; Grand Canary Island; Kano, Nigeria; Zanzibar; Muchea, Australia; Canton Island; and Guaymas, Mexico. All of the stations were operational by March 31, 1961.[61]

The control center at Cape Canaveral was added on to an existing receiver building, and eventually became known as the Mercury Control Center (MCC).[62] As the command center for the network, the MCC had eight primary functions. As described by Christopher Kraft in a speech to the Society of Experimental Test Pilots, the functions of the MCC included directing all aspects of the capsule's flight; monitoring the aeromedical status of the astronaut and the systems status of the capsule; making all decisions to abort a mission; determining the proper procedures following an abort decision; commanding the reentry of the capsule in both normal and emergency situations; keeping the astronauts and all tracking stations informed of the mission's progress; coordinating and maintaining the flow of communications between all tracking stations; and informing the recovery forces following the decision to have the capsule reenter the atmosphere.[63] These functions were facilitated by fourteen flight controllers, as follows:

- Operations Director, a NASA employee who supervised the overall operations for the flight and made the official decision to launch or scrub based on the recommendation of the Flight Director.
- Flight Director, a NASA employee who supervised and directed all the activity within the MCC. The Flight Director also oversaw the pre-launch countdown, made recommendations to hold or scrub the launch, and made the decision to abort after launch or have the capsule make an early re-entry.

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[60] Grimwood; Christopher C. Kraft, Jr., "Some Operational Aspects of Project Mercury." Presented at the Annual Meeting of the Society of Experimental Test Pilots, October 9, 1959, Los Angeles, California, 4-5; John Catchpole, *Project Mercury: NASA's First Manned Space Programme* (Chichester: Praxis Publishing Limited, 2001), 117-118.
[61] Grimwood; Catchpole, 119.
[62] See pages 23-24 for the discussion of the construction of the MCC.
[63] Kraft, "Operational Aspects," 6-7.

- Flight Dynamics Officer, a NASA employee who advised the Flight Director as to pre-launch readiness, and monitored the launch trajectory and orbital insertion.
- Capsule Communicator (CapCom), a NASA astronaut who monitored all pre-launch, launch, flight, and reentry communications with the astronaut.
- Flight Surgeon, a military doctor employed by NASA who observed the condition of the astronaut during all phases of the mission and made recommendations to the Flight Director as to a launch abort or early reentry.
- Capsule Environment Monitor, a NASA employee who monitored the capsule's environmental systems during the pre-launch phase and the flight, and advised the Flight Director as to a launch abort or early re-entry.
- Capsule Systems Monitor, a NASA employee who observed the capsule systems (other than environmental) during all phases of a mission and made recommendations to the Flight Director as to a launch abort or early re-entry.
- Retrofire Controller, a NASA employee who advised the Flight Director as to the duration of the mission based on the orbital insertion conditions; established the time of retrofire for proper re-entry; advised the appropriate range station to command a reset of the retrofire timer with the agreement of the Flight Director; and, in the case of a launch abort, determined the time of retrofire for capsule impact in a designated recovery area.
- Recovery Status Monitor, an officer from the Navy who reported to the Flight Director as to the readiness of the recovery force; monitored the force's status throughout the mission; and advised the force of the mission's progress, the expected time of reentry and the predicted impact area.
- Missile Telemetry Monitor, an employee of Convair (the Atlas manufacturer) who monitored the missile and advised the Flight Director of any situation that might require a launch abort.
- Network Status Monitor, an employee of the DoD who reported to the Flight Director as to the readiness of the Cape; monitored the Range throughout the mission; and advised the Range on the mission's progress.
- Range Safety Observer, an employee of the Cape who observed the activity within the MCC throughout the flight; advised the Range safety control center of any potential abort; and advised the Flight Director of an imminent violation of Range safety criteria and the possible abort action by the Cape's Range safety control center.
- Network Commander, an officer of the Air Force who commanded the Mercury Rrange and ordered the appropriate actions to rectify any Range Station malfunction.
- Recovery Task Force Commander, an officer of the Navy who commanded the Recovery Operations.[64]

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[64] WEC, *Flight Controller, Mercury Control Center, Operation Manual* (New York: Western Electric Company, Inc., no date), 8-13.

In addition, the MCC at the Cape had an Operations and Procedures Officer, who essentially served as the "Flight Director's wingman."[65] Typically a NASA employee, this person was responsible for developing the procedures for each console for each particular flight, and to ensure the procedures were being followed. The Operations and Procedures Officer typically oversaw the transmission of teletype communications as well.[66]

The network station at Bermuda was considered the secondary control center for Project Mercury, and had "the responsibility for continuing or aborting the mission" as the capsule left the range of the Cape. The Bermuda station had essentially the same layout and capabilities as the MCC, including the ability to determine if a satisfactory orbit was achieved, to predict the point of impact upon reentry, and, if necessary, to give the order to abort a mission.[67] Bermuda, however, retained less than half of the flight controller positions than at the MCC, which included a Flight Supervisor, a Flight Dynamics Officer, a CapCom, a Flight Surgeon, a Capsule Environmental Monitor, and a Capsule Systems Monitor. In addition to these positions, the station also had a Maintenance and Operating Supervisor.[68]

Aside from the MCC and the Bermuda station, the stations in the WWTN were relatively small. All of them, with the exception of White Sands and Eglin, were equipped with voice and telemetry equipment. In addition, all stations in the U.S., as well as the one in Muchea, had direct voice communications with the MCC. The stations at Muchea, Kauai, Guaymas, and Point Arguello also were equipped with a command capability in the event of an emergency situation, and typically had an astronaut stationed there during a mission to serve as the CapCom. In addition, these stations could transmit accurate radar information to Goddard. Typically, the fourteen remote stations had four flight controllers: the Flight Supervisor, who could also act as the CapCom; a doctor to make aeromedical observations; an engineer trained in all aspects of the capsule's onboard systems; and a radio/teletype officer to transmit all communications back to the MCC.[69]

The Mercury Missions

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[65] Eugene Kranz, *Failure Is Not An Option* (New York: Berkley Publishing Group, 2000), 34.
[66] Kranz, 24, 34; Kraft, *Flight*, 101.
[67] WEC, *Introduction to Project Mercury and Site Handbook* (New York: Western Electric Company, Inc., 1960), 4-1.
[68] WEC, *Introduction*, 4-28. Following Project Mercury and the construction of the technically advanced Mission Control Center in Houston, the Bermuda station essentially became another tracking station in the network, a role it served until circa 1997. During this time, it also had the responsibility of monitoring the launch trajectory of the spacecraft in order to support the Mission Control Center in the decision to go for orbit or abort the mission. Keith Archibald Forbes, "Bermuda's History from 1952 to 1999." *Bermuda Online*. Updated July 8, 2010.
[69] For the Mercury-Redstone flights, which did not orbit the Earth, the remote stations were not used. For all orbital flights, typically, there were two astronauts in the MCC to serve as the CapCom and a back-up, one in Muchea, one in Kauai, one in Guaymas, and one in Point Arguello. For the later manned missions, which landed in the Pacific Ocean, one of the astronauts served as a CapCom on the retrieval ship.

There were twenty-six missions launched as part of Project Mercury, all of which occurred between August 1959 and May 1963. Each of these flights fell into one of three mission categories: research and development, qualification, or manned. Of the twenty-six missions, seven were considered research and development, thirteen were classified as qualification, and six were manned flights. Seventeen of the missions, including all of the manned flights, launched from CCAFS; the remaining nine lifted-off from Wallops Island, Virginia. Despite the pace of Project Mercury, the U.S. was unable to beat the Russians, who had successfully launched cosmonaut Yuri Gagarin on April 12, 1961.

Research and Development

The first six missions of Project Mercury were for research and development purposes. Five of these used a Little Joe rocket and were launched at Wallops Island; one used an Atlas vehicle and was launched at the Cape. Three of the Little Joe (LJ) flights–LJ-1 on August 21, 1959, LJ-1A on November 4, 1959, and LJ-1B on January 21, 1960–tested the abort system at maximum dynamic pressure; LJ-1B carried along a rhesus monkey named "Miss Sam."[70] The other two launches–LJ-6 on October 4, 1959, and LJ-2 on December 4, 1959–tested the capsule aerodynamics and integrity, and verified the escape system at high altitude, respectively. The former was partially successful; the latter, which used another rhesus monkey named "Sam," was a full success.[71] The Atlas flight was launched from LC-14 at CCAFS on September 9, 1959. Titled BJ-1 (Big Joe 1), its objective was to test the ablative heat shield, and was successful, although the exact reentry conditions were not simulated.[72] The last research and development flight of Project Mercury did not occur until March 24, 1961. This mission, designated MR-BD (Mercury-Redstone Booster Development), launched from CCAFS with a boilerplate spacecraft, in an effort to perfect the booster; the flight was successful.[73]

Qualification

Similar to the research and development flights, nearly all of the thirteen qualification missions occurred sequentially. Of these, four used a Redstone rocket, five used an Atlas rocket, three used a Little Joe rocket, and one used a Scout rocket. The first of these tests occurred on May 9, 1960, at Wallops Island. Designated BA-1 (Beach Abort-1), this used a Redstone to successfully test the off-the-pad escape system of the first production spacecraft. The final three Redstone qualification launches were Mercury-Redstone 1 (MR-1) on November 21, 1960, MR-1A on

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70 The LJ-1 flight was considered a failure due to a premature firing of the escape tower. This brought about the LJ-1A flight, which was considered only partially successful and therefore, LJ-1B was scheduled. Grimwood; Swenson, et al., 208-213; Williams, et. al., 5-6.
71 Grimwood; Swenson, et al., 209-211.
72 Grimwood; Swenson, et al., 200-208.
73 Grimwood; Swenson, et al., 328-332.

December 19, 1960, and MR-2 on January 31, 1961, all from Pad 5 at LC-5/6 at CCAFS. The objective of MR-1 and MR-1A was to qualify the Mercury capsule/Redstone rocket combination. The MR-2 flight was to confirm the combination, and to observe a primate (in this case, a chimpanzee named "Ham") in suborbital flight and auto abort as an indication of how a human would perform in space and the effects of spaceflight on humans.

The five Atlas qualification tests were interspersed among flights using other rockets, and all used LC-14 at CCAFS. Mercury-Atlas 1 (MA-1) launched on July 29, 1960, with the goal of qualifying the Mercury capsule/Atlas rocket combination. The test was a failure, and resulted in a second try, which was designated MA-2. This flight occurred on February 21, 1961, and was a success. Two months later, on April 25, MA-3 lifted-off with the objective of putting the spacecraft, complete with a "mechanical astronaut" in orbit. During launch, the booster failed to roll as planned and had to be destroyed 40 seconds into the flight. The last two Atlas qualification flights–MA-4 on September 13, 1961, and MA-5 on November 29, 1961–were partially successful. MA-4 launched with a goal of testing the spacecraft's environmental control. It was the first Mercury spacecraft to achieve orbit, although some abnormalities arose throughout the flight. MA-5 was essentially a repeat of MA-4, except that it carried a chimpanzee named "Enos" and orbited twice.

The three qualification flights using the Little Joe rocket all had the same objective: to test the abort and escape systems at maximum dynamic pressures. Designated LJ-5, LJ-5A, and LJ-5B, they occurred on November 8, 1960, March 18, 1961, and April 28, 1961, respectively. LJ-5 failed to meet the objectives specified for the mission, thus LJ-5A was launched. Since it was only partially successful, LJ-5B was added to the schedule. A mission entitled Mercury-Scout 1 (MS-1) launched on November 1, 1961, with the goal of testing a Mercury-Scout launch configuration and to qualify the WWTN. Forty-three seconds after launch, the booster was destroyed because it began to tear apart, and the mission was listed as a failure. Rather than attempt a second Scout launch, the STG used flight MA-5 (see above) to qualify the WWTN.

The Manned Flights

Of the six manned missions in Project Mercury, the first two were suborbital ballistic flights and the last four were orbital flights; all of the flights launched from CCAFS. For the most part, all of the missions followed the same generic flight phases: prelaunch preparation, launch, orbit, reentry, and recovery; the notable exception being the orbit phase. Prelaunch began with the start of the launch vehicle check-out and ended with the final preparation for lift-off. The launch phase covered the time from lift-off until orbital insertion; the orbit phase lasted from insertion to retrofire.[74] The reentry phase lasted from the time of retrorocket firing until the spacecraft landed, at which point the recovery phase began. This last phase ended with the collection of the astronaut and the capsule by the recovery forces.[75]

On May 5, 1961, Alan Shepard became the first American in space with the launch of mission MR-3. At 2:40 AM, the final countdown began; Shepard entered his capsule, called “Freedom 7” at 5:21 AM.[76] At 9:34 AM, MR-3 lifted-off from Pad 5 at LC-5/6 for its 15.5-minute flight, which lifted Shepard to an altitude of 116.5 statute miles and carried him 303 statute miles downrange at a velocity of 5,134 miles per hour (mph). The objectives of the mission were simple: to launch a man into space and determine his capabilities in a zero-G environment; it was a success.[77]

On July 21, 1961, Virgil “Gus” Grissom became the second American in space with his flight, MR-4, designated “Liberty Bell 7.” Originally scheduled to launch on 16 July, weather postponed the flight, and on July 19, NASA experienced its first scrubbed mission, i.e., the first time an astronaut was in his capsule poised for flight when it got cancelled. When it successfully launched, Grissom’s flight lasted just over 15.5 minutes and proved to be a successful repeat of Shepard’s. Unfortunately, as Grissom was awaiting the recovery forces, the capsule’s explosive hatch blew, and the capsule took on water and eventually sank; Grissom was successfully rescued by a second helicopter. This flight marked the end of the Mercury-Redstone phase.[78]

On February 20, 1962, John Glenn became the first American to orbit the Earth in his spacecraft, “Friendship 7.” He entered his spacecraft at 6:03 AM, and at 9:47 AM, his flight, designated MA-6, launched from LC-14 for its historic flight. Glenn traveled a distance of 75,679 statute miles, completing three orbits of the Earth over a period of nearly five hours; his average velocity was 17,544 mph. The objectives of Glenn’s mission were those of the Mercury program: to place a man in orbit, observe his actions in a zero-G environment, and bring him home safely. The mission was an unqualified success, despite a malfunction in the automatic control system, as well as a microswitch malfunction.[79]

On May 24, 1962, a second American successfully orbited the Earth, although a high consumption of fuel caused a great deal of concern. The flight, MA-7, was crewed by Scott Carpenter, who had dubbed his capsule, “Aurora 7.” Although essentially a repeat of Glenn’s flight, the mission plan called for additional scientific experimentations during the flight.

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[74] For the suborbital ballistic flights, the launch phase ended with the vehicle turn-around into what would be an orbital insertion period; the “orbit phase” would be considered the time from that turn-around until retrofire. Grimwood.
[75] Grimwood; IBM, *Final Report: Project Mercury*. March 1962, 2-3.
[76] In 1961, Gilruth and Webb decided that the astronaut for each flight had the right to name his spacecraft, keeping with past traditions. Each of them used a “7” in the title as a reference to the seven original astronauts. Grimwood.
[77] Grimwood; Swenson, et al., 347-365.
[78] Grimwood; Swenson, et al., 365-377.
[79] Grimwood; Swenson, et al., 422-434.

Altogether, Carpenter flew for a period of just under five hours, traveling a total distance of 76,021 statute miles.[80]

The next mission was MA-8, which flew on October 3, 1962, carrying Wally Schirra, who had named his capsule "Sigma 7." His flight served as an intermediate step between the initial three-orbit flights, and a planned long-duration flight. Shirra orbited the Earth six times, traveling for a total distance of 143,983 statute miles and a total duration of just over nine hours. Aside from a minor problem with his spacesuit, which the astronaut was easily able to adjust, the flight was a total success, even retaining a larger percentage of fuel than the previous flight. NASA was now ready to keep a man in space for a whole day.[81]

On May 15, 1963, the last mission of Project Mercury, MA-9, was launched from LC-14. Gordon Cooper, in his spacecraft designated "Faith 7," began his twenty-two orbit mission, becoming the first American to sleep in space. His flight lasted just over thirty-four hours, carrying Cooper for a distance of 546,167 statute miles. Although a series of electrical malfunctions occurred over the last two orbits, Cooper was able to navigate to a landing within four miles of the recovery ship using the capsule's manual controls. Again, the mission was a success, which prompted the end of the Mercury program, with all objectives achieved.[82]

Project Gemini

Project Gemini unofficially got its start during 1959, when NASA began to plan a follow-up program to Project Mercury. Ideas included a two-man capsule, extended duration flights (up to two weeks), a manned lunar expedition, and a manned orbiting laboratory. In early January 1961, a firm decision was made by NASA to "plan an Earth-orbital rendezvous program independent of, although contributing to, the manned lunar program," which became especially important after President Kennedy charged NASA with landing on the moon by the end of 1969.[83] Throughout the rest of the year, NASA conducted research into such topics as rendezvous techniques and launch vehicles, while hiring McDonnell to examine improvements to the existing Mercury capsule for such a mission. By the end of August 1961, the new program was being referred to as Mercury Mark II, and a preliminary Project Development Plan had been

[80] Grimwood; Swenson, et al., 446-460.
[81] Grimwood; Swenson, et al., 464-486.
[82] Grimwood; Swenson, et al., 494-503.
[83] James M. Grimwood and Barton C. Hacker (with Peter J. Vorzimmer), *Project Gemini Technology and Operations, A Chronology* (Washington, D.C.: NASA, Scientific and Technical Information Office, 1969).

submitted to NASA Headquarters.[84] On December 7, 1961, NASA approved the Mercury Mark II project, which was redesignated "Gemini" on January 3, 1962.[85]

As the intermediate step between Project Mercury and the Apollo Program, the primary objective of Project Gemini was to prepare for a lunar landing. As such, its goals were to keep a two-man crew in space for up to fourteen days; rendezvous and dock with orbiting vehicles, and maneuver the combination; and to perfect methods of entering the atmosphere and landing.[86] In addition, NASA desired to gain additional information on the effects of weightlessness on humans; and the Flight Operations Division planned on honing new skills in mission planning and control. Project Gemini would also be the first manned spacecraft program operated by the Manned Spacecraft Center (now Johnson Space Center) in Houston, Texas.

The Gemini spacecraft was essentially an enlarged Mercury capsule, designed for a two-man crew. It retained the same appearance as the Mercury capsule, and used the same proven thermal protection system. However, the Gemini spacecraft also built on the lessons learned during Mercury, and incorporated newer technologies that had been developed. For example, the Gemini spacecraft was distinguished from the Mercury capsule by an onboard computer that gave the astronauts navigational and maneuvering capabilities, as well as the use of ejection seats, as opposed to an escape tower, for emergency contingencies. Additionally, advancements to the engine and fuel systems allowed for longer duration missions.[87]

The launch vehicle selected for Project Gemini was the Air Force's Titan II ICBM, the largest missile ever deployed by the U.S.[88] Developed by the Martin Company, the Titan II was a two-stage rocket capable of lifting much heavier payloads than the Atlas rocket. The first Titan II was launched from CCAFS on March 16, 1962; it was declared operational in 1963. NASA would order twelve of the Titan II launch vehicles for the Gemini program.

With the new, expanded manned spaceflight program, additional astronauts were required. On September 17, 1962, the second group of nine astronauts, which included two civilians, was introduced. These men were Major Frank Borman, Captain James A. McDivitt, Captain Edward H. White II, and Captain Thomas P. Stafford of the Air Force; Lieutenant Commander James A. Lovell, Jr., Lieutenant Commander John W. Young, and Lieutenant Charles Conrad, Jr. of the Navy; and civilians Neil A. Armstrong and Elliot M. See, Jr. Thirteen months later, a third group

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[84] Grimwood, et al.
[85] The name "Gemini" was derived from the twin stars Castor and Pollux of the Gemini constellation because the new capsule would carry a crew of two. Grimwood, et al.
[86] National Aeronautics and Space Administration, Kennedy Space Center, "Gemini Goals." *Gemini website*. 2000; Kranz, 119.
[87] Barton C. Hacker and James M. Grimwood, *On the Shoulders of Titans: A History of Project Gemini* (Washington, D.C.: NASA, Scientific and Technical Information Office, 1977), 40-41.
[88] Cliff Lethbridge, "Titan II Fact Sheet." *Spaceline.org*. 1998.

of astronauts was selected, only five of whom would fly during Gemini.[89] During Project Gemini, the astronauts would have the same type of workload as during Project Mercury.

With the advent of the more complex missions of Project Gemini, it became clear that the capabilities of the original MCC, as well as the WWTN, were inadequate. A decision was made to construct a new mission control center at the new headquarters of the Manned Spaceflight Center in Houston, Texas. This new center would have the capacity to control the "rendezvous" missions of Project Gemini, and have the ability to be modified for future programs, such as the Apollo Program, which would take Americans to the moon. This new control center, however, would not be operational for the earliest flights of the new program; therefore, it was necessary to modify the existing MCC and WWTN for the "non-rendezvous" flights of Gemini.[90]

Of the original eighteen stations in Project Mercury, fifteen continued to serve the early part of Project Gemini, including the stations on Grand Bahama and Grand Turk Islands. The station in Zanzibar was closed down; and the two in Australia (Woomera and Muchea) were combined into one station, which was relocated to Carnarvon, Australia.[91] The other tracking stations also remained operational, the old station in Woomera, Australia was reactivated, and five additional stations were added in Antiqua; Ascension Island; Pretoria, Africa; Tananarive, Malagasy; and Wallops Island, Virginia.[92]

The MCC controlled the first three missions of Project Gemini. The first two, Gemini I and Gemini II, were to qualify the Gemini spacecraft/Titan II rocket combination and demonstrate the heat protection, structural integrity, subsystems performance, and the checkout and launch procedures, respectively. The third mission, Gemini III, was the first manned mission of the program. Flown by Gus Grissom and John Young on March 23, 1965, the astronauts successfully performed three orbital maneuvers, which changed the speed and orbit of the spacecraft.[93] The new mission control center in Houston was operational for Gemini IV (June 3, 1965), with the MCC serving as the back-up control center; this would be the last flight it supported.[94]

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[89] These five were Major Edwin E. "Buzz" Aldrin, Jr., Captain Michael Collins, and Captain David R. Scott of the Air Force, and Lieutenant Commander Richard F. Gordon, Jr. and Lieutenant Eugene A. Cernan of the Navy. Grimwood, et al.

[90] Henry E. Clements, Richard L. Holt, and Douglas W. Carmichael, "Mission Control Center and Network." On file, KSC Archives.

[91] NASA, *Welcome to the Mission Control Center*. No date.

[92] Clements, et al. 175.

[93] Hacker and Grimwood, 231-237.

[94] Kraft, *Flight*, 218-219.

Mission Control Center

Construction

The building that would eventually house the MCC was originally constructed between 1956 and 1958 as the "Receiver Building #3." The U.S. Army Corps of Engineers served as the architect; the general contractor was Carlson-Ewell. As designed, the facility included a large roof for telemetry equipment and a data processing area.[95]

With the advent of Project Mercury and the development of the WWTN (see pages 14-17), a central facility was needed to control all aspects of the mission. In 1959, Burns and Roe, Inc., as subcontractors to WEC, began the design of two small additions to the "Receiver Building #3." One addition, built along the original north elevation, became the flight control area (with a support room), and the viewing area; the second addition, along the west elevation, provided additional space for support equipment, such as data recorders.[96] By December 1959, a tentative layout of the facility was completed. At this time, it was decided that the control room "would have trend charts to indicate the astronaut's condition and world map displays to keep continuous track of the Mercury spacecraft."[97] The Burns and Roe, Inc. drawings referred to the facility as the Mercury Control Center.[98]

Between 1962 and 1963, the MCC was further modified to handle the additional complexities of the Gemini Program. Pan American World Airways, Inc. was contracted in 1962 to design an addition to the facility, which wrapped around the east, north, and most of the west and south sides of the MCC. This addition included areas for flight control briefing, data analysis, and a large space for a new Gemini spacecraft trainer.[99] On December 26, 1963, ownership of the MCC was officially transferred from the Air Force to NASA. Over the next decade, small repairs and modifications were made, which included such items as replacement motors, electrical system changes, and the relocation of equipment between different rooms.[100]

On June 1, 1967, the MCC became a stop on the tour of NASA facilities at KSC and CCAFS offered through the KSC Visitor's Center (now Visitor Complex). Tourists entered the viewing area, where they listened to a pre-recorded monologue, during which the various consoles and

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[95] U.S. Army Corps of Engineers, Jacksonville, "Group I-Project WS-107-A, Receiver Building #3." Date unknown, Sheet R-1.
[96] Burns and Roe, Inc, New York, "Project Mercury; Station No. 1A." December 1959.
[97] Grimwood.
[98] Burns and Roe, Inc. At this time, the building was still owned by the Air Force. NASA, *Real Property Record for Building 1385A*. December 26, 1963.
[99] Pan American World Airways, Inc., Cape Canaveral, "Mission Control Center." November 1962. These were the earliest documents discovered during this documentation that officially referred to the facility as the "Mission Control Center."
[100] NASA, *Building 1385A*.

displays were lit up as the tape described them. The set-up of the control area, as well as the orbital paths displayed on the world map, remained in the layout used for the third Gemini flight. Subsequently, in August 1973, a new raised floor and acoustical ceiling were installed in the Viewing Area.[101] In 1999, all of the original consoles, as well as the world map and time displays, were removed from the MCC and installed in the "Early Space Exploration" exhibit at the KSC Visitor Complex.

Function and Layout

On September 15, 1959, Walter C. Williams, who had been the chief of NASA's High Speed Flight Station (now the Hugh L. Dryden Flight Research Center) in Edwards, California, became the Associate Director for Project Mercury Operations.[102] Subsequently, Williams established the Operations Coordination Group at Cape Canaveral, with Christopher Kraft as the Flight Director, Stanley White as the Chief Flight Surgeon, Merritt Preston as the Launch Operations Manager, and Scott Simpkinson as the Capsule Operations Manager.[103] This group assumed the responsibility for all mission control operations, and on March 9, 1960, they issued titles for the major positions at the MCC, the blockhouse, and the launch pad. The complete MCC staff operated for the first time with the launch of MR-1 on November 21, 1960.[104]

The objective of mission control activities was to "increase the probability of mission success and crew safety" by handling the "detailed conduct of the mission from vehicle lift-off to landing."[105] During Project Mercury, the MCC was essentially used for the flight control portion of mission control, the purpose of which was "to aid the astronaut in monitoring the spacecraft systems, to evaluate systems performance, and to advise the astronaut on the proper action necessary in case of a spacecraft malfunction."[106] Additionally, flight control was responsible for recording the information necessary for the postflight analysis, and had the capability of commanding the reentry process (required for unmanned flights; if necessary for manned flights).

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[101] NASA, *Building 1385A.*
[102] Grimwood.
[103] Christopher Kraft had been a Langley engineer appointed to the STG; Preston and Simpkinson were employees of Glenn Research Center who eventually were transferred to the STG; and White was from the Air Force. Kraft, *Flight*, 71, 84.
[104] Grimwood; Swenson, et al., 253; Catchpole, 113.
[105] Christopher C. Kraft, Jr., John D. Rodge [sic] and Eugene F. Kranz, *Mission Control for Manned Space Flight* No date, 200.
[106] Lift-off was controlled from the blockhouse at the launch pad; recovery operations were essentially run from the specified recovery ship, although they did have their own support center within the MCC. John D. Hodge and Daniel T. Lockard, "Flight Control Operations." *Mercury Project Summary Including the Results of the Fourth Manned Orbital Flight, May 15 and 16, 1963 [SP-45]* (Washington, D.C.: NASA, Office of Scientific and Technical Information, 1963), 253; Kraft, *Flight* 102.

Flight control operations were divided into five separate tasks: preflight preparation, execution of mission control, supplementation of the vehicle systems analysis for the spacecraft crew, assistance to the crew in attaining the mission objectives, and participation in postmission analysis. The first task included the development of a flight plan, a countdown procedure, and mission rules, as well as the training of personnel in flight operations and vehicle systems. Also a part of this was the simultaneous training of the flight controllers at their consoles with an astronaut in the Mercury procedures trainer. These sessions allowed both parties the chance to get acquainted with one another, as well as practice any mission-specific events. Additionally, various malfunctions could be introduced to the simulation, which allowed the controllers and the astronaut to practice the procedures involved in emergency situations.

The second task incorporated the direct supervision and coordination of the ground support and the control of the launch vehicle and spacecraft crew during the flight. The third task comprised of the compilation, reduction, and evaluation of the telemetry and voice data acquired from the spacecraft and the astronaut. The fourth task included participating in the development of a flight program, providing and coordinating the real time ground support to achieve the flight program, modification of the flight plan as required during the mission, and assisting in the crew's preparation for subsequent mission phases. As part of the fifth task, a review of the mission operations and an analysis of the vehicle systems and crew performance were conducted, that ultimately led to recommendations for future flights.[107]

During Project Mercury, the layout of the MCC's Flight Control Area (FCA) was rather simple (see Figure A-5). On the front wall of the room in the center was a large world map display. On this display "[t]here was the path to be followed by the capsule, like a sine wave overprinted on the ocean and land masses. Each station in the worldwide network was clearly shown with a circle drawn around it…A Mercury capsule symbol moved along the sine wave, or ground track."[108] Above the world map were five clocks, which showed from left to right, Greenwich Mean Time; orbit number; count-down time; elapsed time; and time to retrofire. To each side of the world map display was a large trend chart that displayed telemetry data from all of the worldwide stations.[109]

Toward the center and rear of the FCA were three rows of consoles that faced the world map display. The first row sat on the main floor plane, and contained from left to right (facing the map), a station for the support control coordinator, a Sanborn recorder, the Flight Surgeon's console, the Capsule Environmental Monitor's console, a Sanborn recorder, the Capsule Communicator's console, the Capsule Systems Monitor's console, and another Sanborn recorder. The second row of consoles contained the Recovery Status Monitor's console, a station used by the Operations and Procedures Officer, the Flight Director's console, the Network Status

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[107] Hodge and Lockard, 253-254
[108] Kraft, *Flight*, 133.
[109] WEC, *Flight Controller*, 14-15.

Monitor's console, and the Missile Telemetry Monitor's console. The third row consisted of desks for the Recovery Task Force Commander, the Operations Director, and the Network Commander.

On the right side of the room were two consoles that faced the right wall. The one closest to the world map display was for the Retrofire Controller; the other was for the Flight Dynamics Officer. In front of them was a row of four plot boards, which displayed various computations, such as landing points and range versus altitude. Behind the FCA was a viewing area that consisted of two levels. The lower level contained a row of chairs; the upper level had a row of chairs to the front and standing room to the back, which were separated by stand-up railings.

For Project Gemini, a few changes were made to the FCA layout due to the enhanced complexity of the Gemini missions (see Figure A-14). The old trend charts to either side of the world map display were replaced by rear projection screens, although they were used to display the same types of information.[110] The world map display changed to reflect the new tracking stations, and the right-most clock above the map changed to estimated lift-off. The first row of consoles now contained only two Sanborn recorders; and the support control coordinator's station was removed and a Booster Systems Console was inserted. The second row of consoles changed to include, from left to right, the Operations and Procedures Officer's console, the Assistant Flight Director's console, the Flight Director's console, the Network Controller's console, and a spare console. Within the third row, a desk for the NASA Public Affairs Officer was inserted to the left of the Operations Director's station.

In addition, a pair of consoles was set up on the left side of the room, facing inward. These two stations were for the support control coordinator and the display coordinator. On the right side of the room, a console for the Guidance Officer was placed next to the console for the Flight Dynamics Officer, and a fifth plot board was added to the row of four from Project Mercury.

[110] These panels were actually in place prior to the MA-9 mission of Project Mercury, see Figure A-12.

Physical Description

The MCC was a one- and two-story structure with a poured concrete foundation, concrete block walls, and a flat, built-up roof.[111] It had approximate overall dimensions of 220' in length and 141' in width; the height varied based on the historic use of the interior spaces. As previously discussed, the pre-demolition MCC was constructed in three phases.[112] The initial structure, built during 1956-58, comprised most of the south half of the facility (11,307 square feet).[113] The MCC Flight Control and Raised Viewing Areas (approximately 4,770 square feet) were constructed along the north wall of the facility between 1959 and 1960. At the same time, a small support area (180 square feet) was added along the west elevation.[114] The final addition to the facility (roughly 14,580 square feet) was built during 1962-63. This section began on the west elevation, extended around the north and east elevations, and then ended on the south elevation.[115]

Exterior

The east elevation (1962-63) served as the principal façade of the MCC (Photo Nos. 1, 2 and 8). It was divisible into two distinct areas, the southern section at 15' in height and the northern section at 21' in height. In the southern portion, there were two entrances, each of which consisted of a pair of three-light, metal swing doors. Each set of doors had a small concrete stoop shaded by a canopy. In the northern section, there was a single pair of one-light, metal swing doors. To the north of this entrance there was a NASA "meatball" logo, composed of painted plywood, mounted to the wall. Additionally, there were five, wall-mounted floodlights and three pairs of speakers distributed across the elevation.

The north elevation of the MCC (1962-63) was divisible into three different sections (Photo Nos. 2-4). The eastern section of the façade stood 21' in height and contained a pair of metal swing doors at its western end. These doors were accessed via a metal staircase and opened into the second floor mechanical room. To the east of this entrance was a second NASA "meatball" logo (Photo No. 9), similar to that on the east elevation. The central portion of the north elevation had a height of 15', and retained two entrances. The eastern opening consisted of a pair of three-light metal swing doors with a concrete stoop and a metal canopy; that to the west was a pair of metal swing doors with a metal transom. The western section of the north façade projected roughly 10' from the rest of the elevation. This area had one pair of metal swing doors with a metal transom

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111 A small section of the north elevation contained a wood stud wall, see Photos 3 and 61. Pan American World Airways, Inc., Sheet A-2.
112 See pages 23-24.
113 U.S. Army Corps of Engineers, Sheet R-1.
114 Burns and Roe, Inc., Sheet 18.
115 NASA, Launch Operations Center, Cocoa Beach, "Mission Control Center." September 1964, Sheet A-1.

near its eastern end and one single metal swing door just to the east of its centerline; all of the doors had a louver at the bottom. In addition, there were three wall-mounted floodlights, one pair of speakers, and various electrical boxes, cable trays, and pipes positioned across the facade.

The west elevation of the MCC was also divisible into three segments: the northern section that dated to ca. 1962-63 and stood about 15' in height; the central area that also dated to ca. 1962-63 but measured roughly 11' in height; and the southern end, which was part of the original structure and stood approximately 15' in height (Photo Nos. 4-6). Within the northern section, there was a rolling door at its north end and a pair of metal swing doors with a metal canopy near its centerline. The central area contained a single metal swing door at its north end and one pair of metal swing doors at its south end. The southern section was recessed 20' from the remainder of the elevation, but had a small 21'-wide x 6'-deep projection at its southern end, which corresponded to the original mechanical room. The only door in this area was a single metal swing door on the north face of the mechanical room projection. Across the entire elevation, there were eight wall-mounted lights and various mechanical ducts and conduits.

Like the north and west elevations, the south elevation was divisible into three sections (Photo Nos. 6-8). The first of these was the western end, which stood 15' in height and dated to the original structure. Within this portion of the façade, there was a 13'-wide x 14'-high metal rolling door. The central section (at 13' in height) and the eastern segment (at 15' in height) both dated to the ca. 1962-63 addition. Within the central section was a pair of three-light metal swing doors. In the eastern portion, there was an 8' x 8' metal rolling door and a third NASA "meatball" logo, which matched those on the east and north elevations. This elevation also contained five wall-mounted light fixtures and three pairs of speakers.

Interior

At the time of documentation, the MCC encompassed an area of approximately 30,840 square feet. Although the boundary of the resource included the entire footprint of the facility, the exceptional significance of the MCC was derived from the 6,390 square feet at the northwest corner used in direct support of Project Mercury and the Gemini Program. As defined by the Cape Canaveral National Historic Landmark District nomination form, the historically significant area of the MCC was comprised of the Flight Control Area (Room No. 253); the Raised Viewing Area (Room No. 250); the Data Analysis Room (Room No. 223); the Network Support Team Room (Room No. 222); the Flight Control Briefing Room (Room No. 221); and the north corridor (Room No. 221A).[116] These six rooms were located within the northwestern quadrant of the facility. The Flight Control Area (FCA) and the Raised Viewing Area (VA) were

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[116] The historically significant areas are designated through a note and a floor plan within the nomination, as on file at the Florida Division of Historic Resources, see Appendix C. Butowsky, *Cape Canaveral Air Force Station*.

the oldest of these spaces, constructed as part of the 1959 addition for Project Mercury. The other four rooms were built during 1962-63, in preparation for the Gemini Program.

Flight Control Area

The FCA measured approximately 49’ in length and 45’ in width, and contained two distinct areas; the main control room to the east and its support area to the west. These two spaces were separated by a multi-faceted partition wall, which gave the control room a “D”-shaped plan and the support area, a “C”-shaped plan (Photo Nos. 10-11, 56). The central section of this wall (27’-wide) once contained a large world map and time displays, which served as the focal point of the control room. At the time of documentation, these displays had been removed; however, the steel framework and mobile components of the world map remained mostly intact.[117] The steel framework was composed of a perimeter of narrow pipes and four internal support posts, which were stabilized by diagonal bracing formed by narrow pipes. Approximately 8’ above the finished floor were two horizontal tracks that were mounted back-to-back and extended for the entire length of the framework (Photo No. 19). Attached to each track was a moveable arm, one of which held a model capsule (control room side), the other, a small dot to indicate the landing site (support area side). Each arm was composed of two pipes, 8’ in height, which were connected by four metal braces and had small projecting pieces that held a pulley system to move the capsule/dot vertically.[118] They were attached to the track through a motor box that controlled the movement of the arm horizontally along the track (Photo Nos. 20 and 21), and the capsule/dot vertically along the pulley system. The electrical panel for the motors was located within the south area of this partition segment near the floor (Photo No. 22).

To either side of this central section, and angled forty-five degrees toward the east, was a smaller wall segment that had a width of 12’. The segment to the north (Photo No. 10) contained a rear projection screen, approximately 8’ x 10’ in its upper half, which dated to the 1962-63 modifications; the remainder of the wall was faced with vinyl wall covering (see footnote 120). The south segment (Photo No. 11) was almost a mirror image of this section, except the screen was approximately 8’ x 8’, and there was a back-lit chart to the outer side.[119] The two outermost segments of the partition wall, which were parallel to the central section, each contained a doorway between the control room and the support area (Photo 24).

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[117] The world map is currently part of a display within the Early Space Exploration exhibit at the KSC Visitor Complex.

[118] The pulley lines were removed at an unknown date.

[119] Although a firm date of installation could not be established, historical photographs show that this backlit display was not present in the MCC during Project Mercury or the Gemini Program; it was added ca. 1967 as part of the exhibit for the tour. Luis Berrios. Interview with Joan Deming and Patricia Slovinac. KSC, Visitor Complex, March 4, 2009; Doug Fisher. Interview with Joan Deming and Patricia Slovinac. KSC, Visitor Complex, March 4, 2009; Daniel Gruenbaum. Interview with Joan Deming and Patricia Slovinac. KSC, Visitor Complex, March 4, 2009.

The north and south walls of the control room were faced with two shades and styles of vinyl wall covering, which were separated by a narrow band of aluminum mounted 6’-10” above the finished floor (Photo No. 12).[120] A 6”-wide strip of aluminum formed the baseboard. The north wall (Photo Nos. 10 and 13) featured a set of double doors in the center, which were constructed of pressed steel and faced with the same vinyl covering used on the lower half of the wall. These doors were original to the Project Mercury addition, and provided outdoor access. Equidistant from this doorway to the east and west was a single, painted hollow metal door, added during the Gemini Program renovations. The door to the west led into the Data Analysis Room; that to the east opened into the Flight Control Briefing Room. At the top of the north wall above each doorway was an 8” x 42” ventilation grille, also added during 1962-63. This wall also featured a Simplex fire bell (Photo No. 18), and an original fire alarm switch, manufactured by Sperti Faraday, Inc.

The south wall of the control room featured an 8’-6” x 3’ viewing window along its centerline, which was composed of two sheets of ¼”-thick polished glass (Photo No. 12). This provided visibility between the control room and the Recovery Operations Area.[121] To the east of this window was a hollow metal door for access between these two rooms. Immediately to its east was a second hollow metal door, which led through a security area and into the remainder of the MCC facility. To the west of the viewing window was a small alcove that originally held a water cooler.[122] Other features of the south wall included original Honeywell thermostats between the Recovering Operations Area window and door.

The lower finish on the north and south walls continued across the lower half of the east wall, which contained a ribbon of five slanted windows in its upper half (Photo Nos. 13-15). Each window measured 7’-6” in height and 10’ in width and was composed of two sheets of ¼” polished glass. These windows provided visual access of the control room from the VA. Other features of the lower east wall included an access door near the north end for the cabling tunnel and a large electrical panel near the south end (Photo No. 17), both original to the control room; and a modern data port near the center.

Throughout the control room, the floor was raised 1’-6” above the concrete foundation slab, and consisted of removable panels. These panels measured 3’-10” x 3’-1”, were faced with rubber tile, and had an aluminum edge.[123] Within the east half of the control room and centered on the east wall, there was a two-level raised platform area composed of similar removable panels

[120] These finishes were specified as ¼” Curon Covering in Smoke Gray (upper surface) and Vicrtex Stip-L-Tex V211 in Desert Tan (lower surface) on the architectural drawings. Burns and Roe, Inc., Sheet 24.
[121] The Recovery Operations Area was not considered a contributing element to the MCC, see footnote 115.
[122] Burns and Roe, Inc., Sheets 18, 22 and 23.
[123] The purpose of the raised floor was to provide space for all of the necessary cables between the consoles, data recorders, power sources, etc. The floor tile specified on the drawings was 1/8”-thick rubber tile by Armstrong Cork Company in Ash Taupe. Burns and Roe, Inc., Sheet 24.

(Photo Nos. 13 and 14). The lower level had overall dimensions of 28'-6" in length and 13'-6" in depth; the upper level was centered within the lower level, and measured 25' in length and 6' in depth. Access to the lower level was provided by four steps; one extending across the south side; one across the east half of the north side; and two small steps along the west side.[124] The steps to the upper level followed this same pattern. Across the west end of each platform and along the main floor was a row of openings within the removable panels, which denoted where the consoles once stood (Photo No. 16).[125]

The control room ceiling, which was suspended 13'-6" above the finished floor, was composed of 2' x 4' acoustical tile. Centered across the ceiling along the east-west axis was a pattern of fifty-eight recessed lighting fixtures, which were spaced 4' on center (Photo No. 59). These lights were joined by a sequence of eight heating, ventilating, and air conditioning diffusers also centered along the east-west axis, but had been removed for storage prior to documentation. Also located within the drop ceiling were various speakers for the intercom system, each of which had a cover plate consisting of concentric brushed aluminum rings. As with the heating diffusers, some of these speakers had been removed for storage.

The support area, to the west of the partition, had the same type of raised floor as the control area, with tile-faced removable panels. The walls, however, were painted concrete block; the ceiling was also painted concrete. Suspended from the ceiling were pendant light fixtures with large air diffusers, similar to those in the control room, interspersed among them. Along the west wall of the support area was a series of electrical panels, mounted at varying heights. At the base of the partition wall, near the south end of the central segment, was a group of rheostats and other electrical panels that supported the world map display (Photo No. 23). In the northwest corner of the support area was a two-level wood platform, constructed at an unknown date. A similar platform, built of metal and plywood, sat in the southwest corner; a set of metal steps provided access to its top (Photo No. 25). A large projector sat on the top level of this platform; its corresponding mirror was mounted on the south wall (Photo No. 26).[126]

Raised Viewing Area

The VA was located to the east of the FCA, and had overall dimensions of 49' in length, 15' in width, and a maximum ceiling height of 9' (Photo No. 28). The walls of the VA were painted

[124] The step along the north side of the lower platform originally extended for the entire width, but the northwest corner of this level was chamfered and had a railing added when the modifications for the Gemini Program were underway; NASA, Launch Operations Center, Sheet A-1. The railing is now within the ESE exhibit at the Visitor Complex.

[125] These holes allowed the sub-floor cabling to be connected to the various controls on the consoles. Like the world map display, the original consoles are currently part of an exhibit in the Visitor's Complex.

[126] The platform and projector that were in the southwest corner of the support area at the time of documentation are depicted in the architectural plans for the 1962-63 building addition. There is no reference in these plans, or on the 1964 floor plan, to a platform and projector in the northwest corner. Pan American; NASA LOC.

concrete, and the floor was composed of a concrete slab faced with tile.[127] The ceiling was a continuation of that within the FCA, and also contained the same type and pattern of light fixtures and air diffusers. At the time of documentation, the VA contained three stepped levels that rose to the east, the upper two of which had a metal rail along their western edge.[128]

There were two entrances into the VA, one along the north wall and one along the south wall; both of them opened onto the uppermost level. The north entrance consisted of a hollow metal door accessed by a set of tile-clad metal and wood steps (Photo No. 30). The door dated to the 1959-60 addition; the stairs dated to the 1962-63 addition. The south entrance was comprised of a wood folding door that was reached by a concrete staircase with tile-faced treads (Photo No. 29).[129] Other features of the VA included small step lights along the east wall, a small alcove on the south wall that originally contained a water cooler, and original thermostats on both the north and south walls.

Flight Control Briefing Room

The Flight Control Briefing Room (FCBR) was situated to the north of the FCA and VA; its east wall abutted the north stairwell to the VA. This room had approximate dimensions of 26' in length, 19' in width, and a 9'-3" ceiling height (Photo No. 31). The wall surfaces were painted concrete block with a vinyl baseboard; most of the floor was a tiled concrete slab. There was a T-shaped cable trench within the room that was covered with removable panels (Photo No. 32). The FCBR had a drop ceiling composed of 2' x 2' acoustical tile, which supported an array of pendant light fixtures and air diffusers. There were three entrances to this room; all of which were hollow metal doors. The door on the east elevation led to a corridor; a door on the south elevation led to the FCA; and the third door, on the west elevation, opened into Room No. 222. Other features in this room included an original intercom speaker on the north elevation, three non-historic white boards on the east elevation, and one non-historic white board on the west elevation.

Network Support Team Room

The Network Support Team Room (NSTR) was situated to the west of the FCBR and to the north of the FCA. This room had approximate dimensions of 26' in length, 13' in width, and 9'-

[127] Per the architectural drawings, the Viewing Area originally had the same finishes as the control room. Burns and Roe, Inc., Sheet 24.
[128] This room was highly modified while the MCC was a stop on the KSC Visitor Complex tour. As per the original architectural drawings, it contained only two levels. The lower level and the west half of the upper level were fitted with chairs for the observers; the east half of the upper level provided additional standing room. Burns and Roe, Sheets 18 and 23; NASA KSC, Building 1385A.
[129] The north entrance was originally enclosed by a curtain, see Burns and Roe, Inc., Sheet 18 and Pan American, Sheet A-3.

3” in height (Photo No. 33). The perimeter wall surfaces were painted concrete block with a vinyl baseboard; a non-historic fabric partition divided the room into north and south sections.[130] Like the FCBR, most of the floor was a tiled concrete slab; however, there was a cable trench topped with removable panels, which sat below the partition. The NSTR had a drop ceiling composed of 2’ x 2’ acoustical tile that supported its pendant light fixtures and air diffusers. There were three entrances to this room; all of which were composed of hollow metal doors. The first was the door along the east wall, within the south section, that led into the FCBR. The other two entrances, on the south and north walls, consisted of paired doors. The door on the south led to the FCA; the door on the north led to the corridor. In addition, there was a door in the partition from one section to the other. Other features in this room included two original speakers, each of which was removed from its original location and mounted on either side of the partition, and one original thermostat on the north wall.

Data Analysis Room

The Data Analysis Room (DAR) was situated to the west of the NSTR and to the north of the FCA. This room had approximate overall dimensions of 31’ in length and 21’ in width, and had a height of 9’-3”. Like the FCBR and NSTR, the perimeter wall surfaces were painted concrete block with a vinyl baseboard, and a non-historic fabric partition divided the room into south and north sections (Photo Nos. 34 and 35).[131] Also similar to the rooms adjacent to the east, most of the floor was a tiled concrete slab, with small sections of removable panels covering a cable trench. The DAR contained pendant lighting fixtures and air diffusers, which were supported by a drop ceiling composed of 2’ x 2’ acoustical tile. There were three entrances to this room, all of which were composed of hollow metal doors. One of the doors was on the south wall; it opened into the FCA. The other two doors were along the east wall and opened into the NSTR; there was one on either side of the DAR’s inner partition. Other features in this room included two original speakers, each of which was removed from its original location and mounted to either side of the partition, and one original thermostat on the east wall next to the north door.

North Corridor

The north corridor extended across the north walls of the FCBR, the NSTR, and the DAR. It had approximate overall dimensions of 30’ in length, 4’-8” in width, and 9’-3” in height (Photo No. 36). Like these three rooms, the wall surfaces of the corridor were painted concrete block with a vinyl baseboard. Also similar to its adjacent rooms, the floor was a tiled concrete slab, and the

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[130] The 1962-63 drawings and the 1964 plan show that this was originally one open space. Pan American, Sheets A-2 and E-7; NASA LOC, Sheet A-1.

[131] The 1962-63 drawings and the 1964 plan show that this was originally divided in half by a wood stud wall. At the time, the room was entered either from the FCA or the north corridor and a doorway in the stud wall provided access between the two areas. At the time of documentation, the fabric partition sat slightly north of the location of the original stud wall. Pan American, Sheets A-2 and E-7; NASA LOC, Sheet A-1.

drop ceiling was composed of 2’ x 2’ acoustical tile. Three pendant light fixtures were spaced along the central axis, and there was an air diffuser at the west end. Each wall of the corridor contained a doorway. On the north, there was a pair of doors leading to the exterior of the building; on the south wall, there was a pair of double doors into the NSTR. On the east and west walls, there was a single door that opened into the main building corridor and the DAR, respectively. All were hollow metal doors.

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Figure A-1. Astronaut John H. Glenn in front of the east elevation of the MCC, May 5, 1961.
(Note signage that says "Mercury Control Center")
Source: Taub Collection, Astronaut Hall of Fame, Kennedy Space Center.

Figure A-2. Aerial view showing modifications to the MCC for Project Gemini, May 31, 1963.
Source: John F. Kennedy Space Center, LOC-63-5634, on file KSC Archives.

Figure A-3. Aerial view of MCC, July 12, 1963.
Source: John F. Kennedy Space Center, LOC-63-6871, on file KSC Archives.

Figure A-4. View of the northeast corner of the MCC, 1964.
(Note signage that says "Mission Control Center")
Source: John F. Kennedy Space Center, KSC-64C-2699 P-26244, on file KSC Archives.

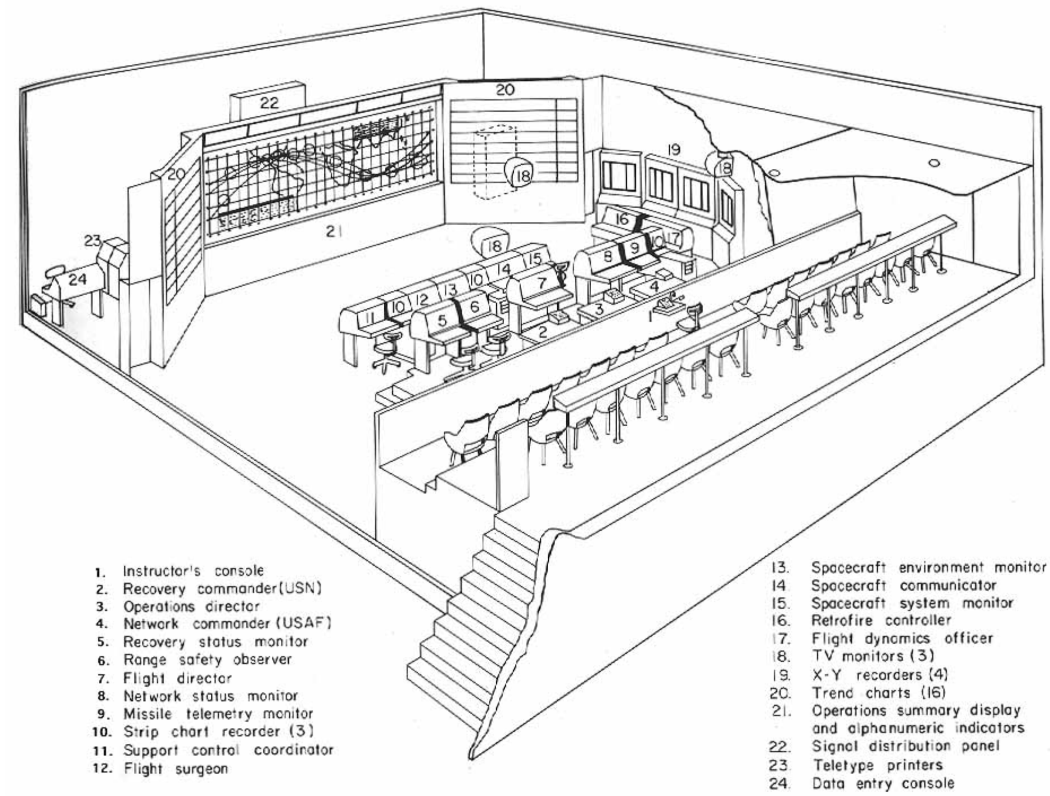

Figure A-5. Diagram of the Flight Control and Raised Viewing Areas of the MCC during Project Mercury, no date.
Source: John F. Kennedy Space Center, 'Consolelocationsp141a', on file KSC Archives.

Figure A-6. Flight Control Area of MCC from Raised Viewing Area during MR-3 mission, July 1, 1961.
Source: John F. Kennedy Space Center, 61-MR3-95, on file KSC Archives.

Figure A-7. Astronaut Alan B. Shepard (right) performing duties as CapCom during MR-4 flight, with Astronauts Schirra (left of Shepard) and Glenn (standing), July 21, 1961. Source: John F. Kennedy Space Center, 61-MR4-90, on file KSC Archives.

Figure A-8. Astronaut Alan B. Shepard monitoring the launch of MR-4 at the CapCom console, July 21, 1961.
Source: Taub Collection, Astronaut Hall of Fame, Kennedy Space Center.

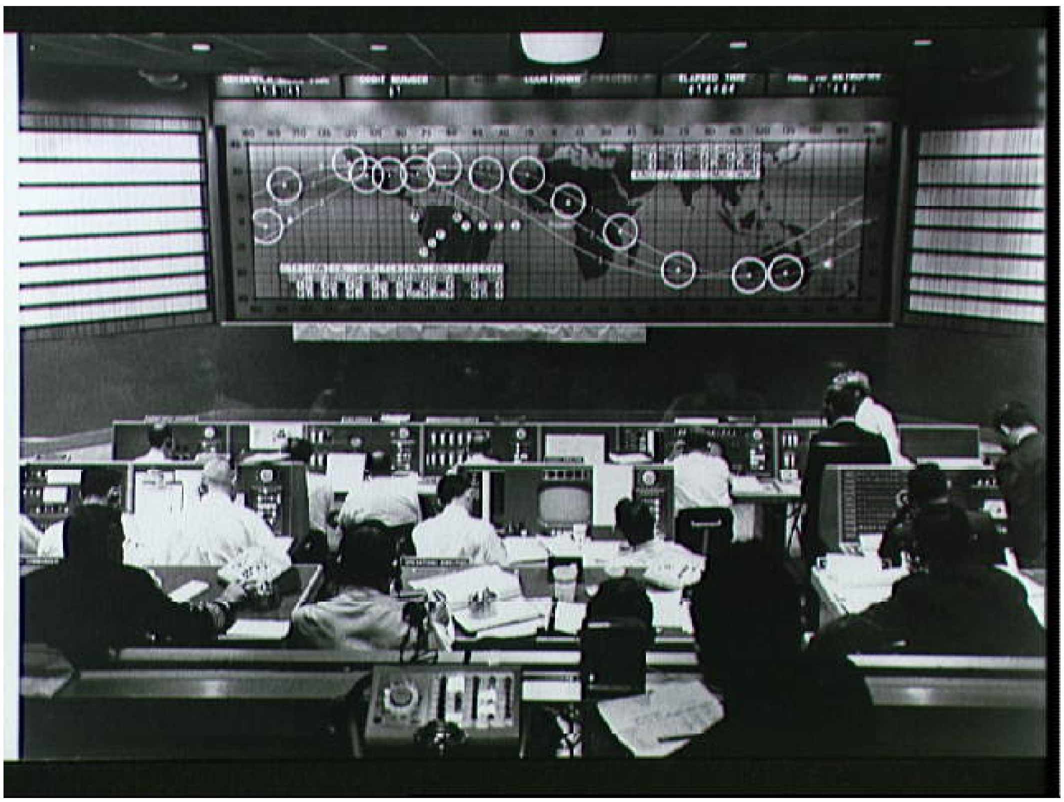

Figure A-9. Flight Control Area of MCC from Raised Viewing Area during MA-6 mission, February 20, 1962.
Source: John F. Kennedy Space Center, 62-MA6-161, accessed via the NASA Image Exchange (NIX) at http://nix.nasa.gov/.

Figure A-10. President John F. Kennedy in the Flight Control Area of the MCC a few days after the MA-6 mission, February 1962. Behind Kennedy is Astronaut John H. Glenn (left) and Flight Director Christopher Kraft (right); at the right of the photo is Astronaut Alan B. Shepard. Source: Lyndon B. Johnson Space Center, S74-33007, accessed via NIX at http://nix.nasa.gov/.

Figure A-11. Flight Control Area of MCC from Raised Viewing Area during a simulation of the MA-8 mission, September 10, 1962.
(Note the six orbital paths on the world map display.)
Source: John F. Kennedy Space Center, P-06426, on file KSC Archives.

Figure A-12. Flight Control Area of MCC from Raised Viewing Area during the MA-9 mission, May 15-16, 1963.
(Note the rear projection screen to the left of the world map display.)
Source: John F. Kennedy Space Center, 63-MA9-164, on file Kennedy Space Center Photo Lab.

Figure A-13. Mercury Operations Director Walter Williams (left) discusses the MA-9 mission with Flight Director Christopher Kraft (right), May 16, 1963.
Source: John F. Kennedy Space Center, 63-MA9-153, on file Kennedy Space Center Photo Lab.

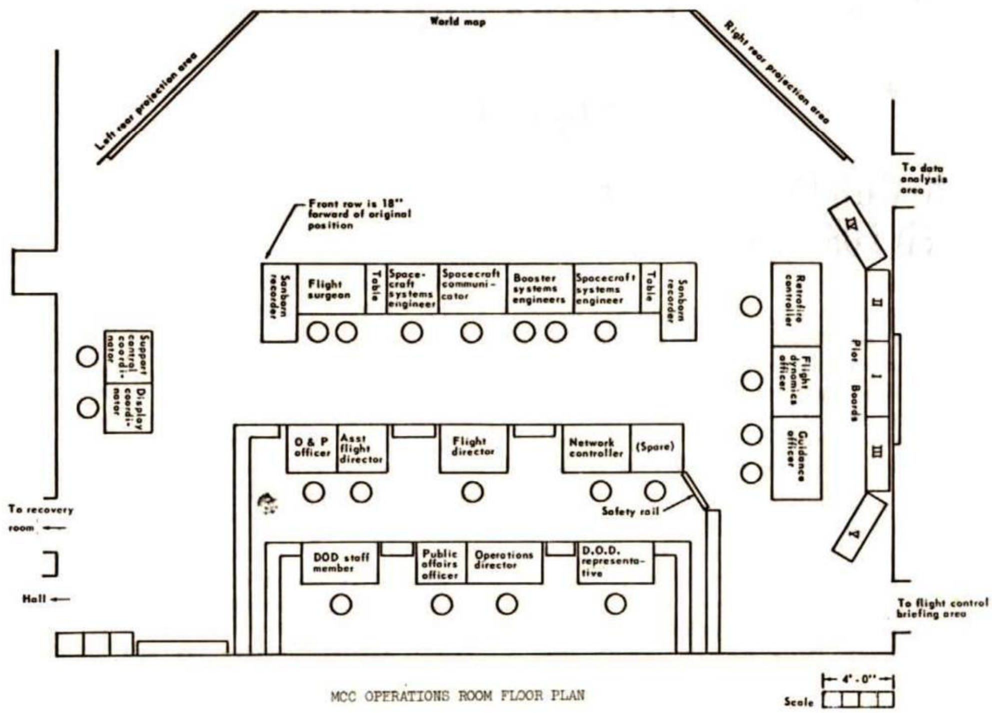

Figure A-14. Diagram of the Flight Control and Raised Viewing Areas of the MCC during Gemini Program, no date.
Source: Kennedy Space Center Visitor Complex.

Figure A-15. View of the Flight Control Area of the MCC during Project Gemini, March 9, 1964.
Source: John F. Kennedy Space Center, KSC-64C-1869, on file Kennedy Space Center Photo Lab.

Figure A-16. Flight Control Area of MCC from Raised Viewing Area during the Gemini I unmanned mission, April 6, 1964.
Source: John F. Kennedy Space Center, 64C-861, on file Kennedy Space Center Photo Lab.

Figure A-17. Astronauts Clifford C. Williams, Frank Borman, and Alan B. Shepard (left to right) observing the Gemini IV flight at the MCC, June 3, 1965.
Source: Lyndon B. Johnson Space Center, S65-30263, accessed via NIX at http://nix.nasa.gov/.

Figure A-18. Aerial view of the MCC, February 21, 1996.
Source: John F. Kennedy Space Center, KSC-396C-55.29, on file Kennedy Space Center Photo Lab.

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CAPE CANAVERAL AIR FORCE STATION HAER No. FL-8-AV
MISSION CONTROL CENTER
(Building No. 1385, Mercury Control Center)
Mission Control Road, east of Samuel C. Phillips Parkway
Cape Canaveral
Brevard County
Florida

Penny Rogo Bailes, Photographer; Teresa Norman, Assistant Photographer March 2009
(FL-8-AV-1 through FL-8-AV-54)

Penny Rogo Bailes, Photographer, May 2009 (FL-8-AV-55 through FL-8-AV-65)

FL-8-AV-1 VIEW OF EAST ELEVATION, FACING NORTHWEST.

FL-8-AV-2 VIEW OF EAST AND NORTH ELEVATIONS, FACING WEST.

FL-8-AV-3 VIEW OF NORTH ELEVATION, FACING SOUTHWEST.

FL-8-AV-4 VIEW OF NORTH AND WEST ELEVATIONS, FACING SOUTH.

FL-8-AV-5 VIEW OF WEST ELEVATION, FACING SOUTHEAST.

FL-8-AV-6 VIEW OF WEST AND SOUTH ELEVATIONS, FACING EAST.

FL-8-AV-7 VIEW OF SOUTH ELEVATION, FACING NORTHEAST.

FL-8-AV-8 VIEW OF SOUTH AND EAST ELEVATIONS, FACING NORTH.

FL-8-AV-9 DETAIL VIEW OF NASA “MEATBALL” LOGO ON NORTH ELEVATION, FACING SOUTHWEST.

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FL-8-AV-11 OVERALL VIEW OF THE FLIGHT CONTROL AREA, FACING SOUTHWEST.

FL-8-AV-12 VIEW OF SOUTH WALL OF THE FLIGHT CONTROL AREA, FACING SOUTH.

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FL-8-AV-14 OVERALL VIEW OF THE FLIGHT CONTROL AREA, FACING SOUTHEAST.

FL-8-AV-15 DETAIL VIEW OF WINDOW BETWEEN FLIGHT CONTROL AREA AND VIEWING AREA, FACING SOUTH.

FL-8-AV-16 DETAIL VIEW OF THE FLOOR OPENINGS FOR THE CONSOLE CABLES, FACING WEST.

FL-8-AV-17 DETAIL VIEW OF ELECTRICAL PANEL ALONG EAST WALL, FACING EAST.

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FL-8-AV-20 DETAIL VIEW OF THE MOTOR BOXES FOR THE TWO MOVEABLE ARMS FOR THE WORLD MAP DISPLAY, FACING NORTHWEST. NOTE THE CAPSULE AND CIRCLE DESIGNATIONS ON THE SIDE.

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FL-8-AV-22 DETAIL VIEW OF THE SMALL ELECTRICAL PANEL FOR THE MOVEABLE ARMS FOR THE WORLD MAP DISPLAY, FACING SOUTHWEST.

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FL-8-AV-25 DETAIL VIEW OF THE PLATFORM AND PROJECTOR IN THE SOUTHWEST CORNER OF THE SUPPORT AREA, FACING WEST.

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Photograph Nos. FL-8-AV-37 through FL-8-AV-54 are of original equipment that was removed from the MCC in 1999 to be used in the Early Space Exploration exhibit at the KSC Visitor Complex.

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FL-8-AV-44 DETAIL VIEW OF THE CAPSULE COMMUNICATOR CONSOLE, FACING EAST.

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Photograph Nos. FL-8-AV-55 through FL-8-AV-65 are photocopies of engineering drawings, and are 8” x 10” enlargements from 4” x 5” negatives. Original drawings are located at the Infrastructure Operations and Maintenance Service Engineering Documentation Center, CCAFS, Florida.

FL-8-AV-55 Photocopy of drawing
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CCAFS, Cape Canaveral, Florida
Drawing 01-01385, Burns and Roe, Inc., December, 1959
DRAWING LIST
Sheet 17A

FL-8-AV-56 Photocopy of drawing
PROJECT MERCURY, STATION NO. 1A
CCAFS, Cape Canaveral, Florida
Drawing 01-01385, Burns and Roe, Inc., December, 1959
FLOOR PLAN
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FL-8-AV-57 Photocopy of drawing
PROJECT MERCURY, STATION NO. 1A
CCAFS, Cape Canaveral, Florida
Drawing 01-01385, Burns and Roe, Inc., December, 1959
ELEVATIONS AND CROSS SECTIONS
Sheet 19

FL-8-AV-58 Photocopy of drawing
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FL-8-AV-59 Photocopy of drawing
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CCAFS, Cape Canaveral, Florida
Drawing 01-01385A, Pan American World Airways, Inc., November, 1962
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FL-8-AV-61 Photocopy of drawing
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