HISTORICAL NARRATIVE
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

Lyndon B. Johnson Space Center

The Lyndon B. Johnson Space Center (JSC) officially opened in June 1964 as the Manned Spacecraft Center (MSC). This approximately 1,620-acre facility is located about 25 miles from downtown Houston, Texas, in Harris County. Many of the buildings are specialized facilities devoted to spacecraft systems, materials research and development, and astronaut training. JSC also includes the Sonny Carter Training Facility, located roughly 4.5 miles to the northwest of the center, close to Ellington Field. Opened in 1997, this facility is situated on land acquired through a lease/purchase agreement with the McDonnell Douglas Corporation. In addition, NASA JSC owns some of the facilities at Ellington Field, which are generally where the aircraft used for astronaut training are stored and maintained.

The origins of JSC can be traced to the summer of 1958 when three executives of the National Advisory Committee for Aeronautics (NACA), Dr. Hugh L. Dryden, Dr. Robert R. Gilruth, and Dr. Abe Silverstein, began to formulate a space program.[1] Almost immediately, Gilruth began to focus on manned spaceflight, and subsequently convened a group of his associates at Langley Aeronautical Laboratory, in Hampton, Virginia. This group compiled the basics of what would become Project Mercury, the first U.S. manned space program. Eight days following the activation of NASA (October 1, 1958), with the approval of NASA's first administrator, Dr. T. Keith Glennan, the Space Task Group (STG) was created to implement this program.[2] The group was formally established on November 3, 1958, with Gilruth named as Project Manager. The initial staff of the STG came from Langley, but was soon supplemented with engineers from Lewis Research Center, in Cleveland, Ohio (now John H. Glenn Research Center), and AVRO Aircraft, Ltd. of Canada.[3]

At first, the STG's offices were located at Langley. With the May 1959, establishment of the Goddard Space Flight Center in Greenbelt, Maryland, plans were made to move the STG to Goddard, thus creating a new "space projects center," but it was later decided to leave the STG at Langley until the completion of Project Mercury.[4] However, as Project Mercury continued and NASA began to consider sending men to the Moon, it was obvious that the STG, which at that moment was essentially a project office, would need to develop into an autonomous center, and

[1] Dryden was the Director of NACA; Gilruth was the head of the flight research section of NACA's Langley Aeronautical Laboratory in Hampton, Virginia; and Silverstein was the Director of NACA's Lewis Flight Propulsion Laboratory in Cleveland, Ohio. James M. Grimwood. *Project Mercury: A Chronology* (Washington, D.C.: NASA, Office of Scientific and Technical Information, 1963); Roger D. Launius. *NASA: A History of the U.S. Civil Space Program* (Malabar, Fla.: Krieger Publishing Company, 2001), 29.

[2] As part of NASA's establishment, NACA, was deactivated and all of its personnel and facilities were transferred to NASA. Also at this time, the names of the three NACA Laboratories were changed: Langley Aeronautical Laboratory became Langley Research Center; Lewis Flight Propulsion Laboratory became Lewis Research Center; and Ames Aeronautical Laboratory (at Moffitt Field, in California) became Ames Research Center. 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), 113.

[3] Grimwood; Swenson, et al., 153.

[4] Swenson, et al., 115.

on January 3, it was designated as such.[5] The May 25, 1961, announcement by President John F. Kennedy to send a man to the Moon by the end of the decade reinforced the idea that the STG needed its independence, and soon. Thus, in August 1961, John Parsons, Associate Director of the Ames Research Center (ARC), was charged with establishing a survey team to locate a site for the new center.[6]

On September 19, 1961, James Webb, NASA Administrator, announced that Houston, Texas, would be the site for NASA's new Center for Manned Spaceflight.[7] Numerous factors influenced the choice of Houston as the home of the MSC. First of all, Rice University was willing to donate 1000 acres of land for the Center. Additionally, Houston met all of the requirements set forth in the selection criteria. For example, air operations could be supported at nearby Ellington Air Force Base, and the proximity of Clear Lake and Galveston Bay facilitated barge traffic. Houston also has a year-round moderate climate, and both Rice University and the University of Houston were in close proximity to the new site.[8]

On November 1, 1961, the STG officially became the "Manned Spacecraft Center," with Gilruth as its first Director.[9] The first employees officially transferred to Houston from Langley were Ed Campagna of the Facilities Division, John Powers, from Public Affairs, and Martin Byrnes, Site Manager; their first offices were two vacant dress shops in the Gulfgate Shopping Center, which were donated by its site manager, Marvin Kaplan.[10] The trio was assigned the responsibilities of procuring temporary office space, hiring new personnel, and meeting with local organizations to help facilitate the needs of those co-workers who would soon be joining them.[11] From November 1961 until April 1962, nearly 400 additional employees were transferred from LaRC to Houston; the new Center officially became operational in Houston on March 1, 1962, when Gilruth moved the MSC's headquarters there.[12]

To supplement the 1000 acres of land promised by Rice University, NASA purchased an additional 620 acres, mainly to provide highway access for the estimated 4000 employees.[13] In

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[5] Swenson, et al., 251.
[6] Swenson, et al., 363-364.
[7] Glennan resigned effective January 22, 1961 when President Eisenhower left office. Webb was sworn into office on February 15, 1961. Grimwood.
[8] From a political viewpoint, Houston was located within the district of U.S. House Representative, Albert Thomas, chairman of the House Appropriations Committee, and Texas was the home state of Vice President Lyndon B. Johnson. Dr. Robert Gilruth Oral History Interview, February 27, 1987, 273-275, *The Glennan-Webb-Seamans Project*, National Air and Space Museum.
[9] "STG Renamed; Will Move." *Space News Roundup* (1, 1), November 1, 1961, 1.
[10] Martin A. Byrnes, Jr., interview by Robert Merrifield, December 12, 1967 (Houston, TX, Archives Department, Lyndon B. Johnson Space Center), 6.
[11] Temporary offices were located in buildings throughout the Houston area, including the Phil Rich Building, the Farnsworth-Chambers Building, the Lane-Wells Building, the Canada Dry Bottling Building, and a Veterans Administration Building; and at Ellington Field. "Houston Site Offices Move to Rich Building." *Space News Roundup* (1, 3), November 29, 1961, 1; "Move To Houston Area Is On Schedule." *Space News Roundup* (1, 6), January 10, 1962, 1; "Photo Captions." *Space News Roundup* (1, 18), June 27, 1962, 2.
[12] Henry C. Dethloff. *Suddenly, Tomorrow Came…A History of the Johnson Space Center* (Houston: Lyndon B. Johnson Space Center, 1993), 48.
[13] "Interview with I. Edward Campagna, Assistant Chief, Technical Services Division, Maintenance and Operations." August 24, 1967, Box MERR1, Oral History Series. Johnson Space Center History Collection, University of Houston-Clear Lake; Dethloff, 48.

September 1961, the Fort Worth Division of the U.S. Army Corps of Engineers (ACOE), under District Engineer, Colonel R. Paul West, was designated as the construction agency for the new Center. Their first task was to hire an architecture/engineering (A/E) team to complete the initial design work. Twenty teams were considered for the initial contract, and after three rounds of reviews and cuts, an A/E team headed by Brown & Root, Inc., of Houston, Texas, was selected. Partnered with them were master planners Charles Luckman Associates, Los Angeles, California; and the architectural firms of Brooks & Barr, Austin, Texas; Harvin C. Moore, Houston, Texas; MacKie & Kamrath, Houston, Texas; and Wirtz, Calhoun, Tungate, & Jackson, Houston, Texas.[14] The nearly $1.5 million contract was officially awarded in December 1961, and included general site development; master planning; design of the flight project facility, the engineering evaluation laboratory and the flight operations facility; and various site utilities.[15]

Charles Luckman Associates developed the master plan of the Center, and "did an outstanding job of meeting the functional requirements that had been set forth in developing a campus-like atmosphere for the facility."[16] The central "quad" area was bounded by 2nd Street on the west, Avenue D on the south, 5th Street on the east, and Avenue C on the north. Three "lagoons" surrounded by small, man-made hills, as well as various walkways, trees, and shrubs characterized the quad area.[17] Luckman Associates also advocated the use of a modular design system for the buildings with materials that could be manufactured off-site, which aided in meeting the tight schedule for completion. Most of the buildings incorporated a poured concrete foundation, and skeletal steel walls faced with precast exposed aggregate facing (PEAF) panels. This allowed for the fabrication of the steel components while the foundation was being poured, and subsequently the manufacture of the PEAF panels while the steel skeleton was being erected.[18]

Initial construction of the Center was completed in three main phases. The contract for the first phase, preliminary site development, was awarded on March 29, 1962, to a joint venture of Morrison-Knudsen Construction Company of Boise, Idaho, and Paul Hardeman of Stanton, California; it amounted to $3,673,000. They began the work in early April; it was completed on July 18, 1963.[19] The task included "overall site grading and drainage, utility installations including an electrical power system, a complete water supply and distribution system, sanitary and storm drainage systems, basic roads, security fence and street lighting."[20]

The invitations to bid for the Phase II contract of the construction, which was the first to include actual buildings, were distributed in early July 1962. At first, the task included an office building, a shop building and warehouse, a garage, a central heating and cooling plant, a fire station, and a sewage disposal plant, as well as all necessary paving and utilities for these

[14] "Photo Captions." *Space News Roundup* (1, 12), April 4, 1962, 2.
[15] "Design Work Contract Is Let For Clear Lake." *Space News Roundup* (1, 5), December 27, 1961, 8.
[16] "Interview with James L. Ballard, Jr." August 1, 1968, Box MERR1, Oral History Series. Johnson Space Center History Collection, University of Houston-Clear Lake.
[17] Campagna, August 24, 1967.
[18] Ballard, August 1, 1968; Campagna, August 24, 1967.
[19] "First Construction Contract Work Underway at Clear Lake." *Space News Roundup* (1, 13), April 18, 1962, 1; "Clear Lake Site Commitment Now Stands At $38,911,458." *Space News Roundup* (3, 4), December 11, 1963, 3.
[20] "Interview with Jack P. Shields." August 1, 1968, Box MERR4, Oral History Series. Johnson Space Center History Collection, University of Houston-Clear Lake; "First Construction Contract Work."

structures.[21] By the time bids were received and opened, the statement of work had been revised to exclude the office building, the shop building, and the warehouse, all of which were replaced by the Data Processing Center (Building 12). The task had changed a second time, prior to contract award in October 1962. In the end, the ACOE signed a contract with the joint venture of W.S. Bellows Construction Corporation and Peter Kiewit & Sons Corporation, both of Houston, in the amount of $4,145,044, for the construction of Building 12, the sewage disposal plant, the central heating and cooling plant, the fire station, and a water treatment plant and associated building.[22] Of these facilities, the fire station was the first to be completed in September 1963; the central heating and cooling plant was last, finished in December 1963.[23]

Phase III of the Center's construction incorporated the largest grouping of buildings under one contract. The invitations to bid on this phase were issued on September 25, 1962, and listed ten buildings with an approximate total area of 760,000 square feet.[24] Similar to Phase II, the statement of work was revised prior to the submittal of the bids to include eleven office and lab buildings, and the temperature and humidity control machinery for the entire site. Interested firms were also asked to submit alternate proposals that incorporated additional facilities, which NASA was hoping to add to the contract if funding became available.[25] On December 3, 1962, Colonel Francis P. Koish, the new ACOE District Engineer, signed the official contract, which amounted to roughly $19 million, with the joint venture of C.H. Leavell and Company of El Paso, Texas, Morrison-Knudsen Construction Company, and Paul Hardeman. Eleven major facilities were part of this contract, including the project management building, the cafeteria, the flight operations and astronaut training facility, the crew systems laboratory, the technical services office and shop buildings, the systems evaluation laboratory, a spacecraft research lab and office building, and a data acquisition building. Funding for other facilities had become available by this time, so additional support buildings, such as the shop building and warehouse, were also included. Per the contract, the buildings were to be ready for occupancy in 450 calendar days.[26]

In October 1963, the Logistics Division became the first to move into its complete facility, the Support Office (Building 419) and its shops and warehouse (Building 420). By the end of 1963, twelve additional buildings were certified as operational.[27] The major relocation to the new Center occurred between February and April 1964, and included the occupation of facilities such as the Auditorium and Public Affairs Facility (Building 1), the Flight Crew Operations Office (Building 4), the Flight Crew Operations Lab (Building 7), the Systems Evaluation Lab

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[21] "Second Major Clear Lake Building Contract Awarded." *Space News Roundup* (1, 17), June 13, 1962, 8.
[22] "Bids Open On Phase Two Of Clear Lake Work." *Space News Roundup* (1, 23), September 5, 1962, 1; "Phase II Contract Goes to Bellows, Peter Kiewet, Sons." *Space News Roundup* (1, 25), October 3, 1962, 8; Shields, August 1, 1968.
[23] "Photo Captions." *Space News Roundup* (2, 23), September 4, 1963, 3; "Central Heating and Cooling Plant Completed." *Space News Roundup* (3, 5), December 25, 1963, 8.
[24] "First Building Contract To Be Let In November." *Space News Roundup* (1, 20), July 25, 1962, 8.
[25] "Bids Open On Phase 3 Of Center Construction." *Space News Roundup* (2, 2), November 11, 1962, 1-2.
[26] "19 Million Dollar Construction Contract Signed." *Space News Roundup* (2, 4), December 12, 1962, 1; "MSC 'Site' Three-Fourths Complete, First Move Scheduled Next Month." *Space News Roundup* (2, 24), September 18, 1963, 1; Shields, August 1, 1968.
[27] "MSC 'Site' Three-Fourths Complete;" "Major Move To Clear Lake Begins February 20." *Space News Roundup* (3, 6), January 8, 1964, 1.

(Building 13), and the Spacecraft Technical Lab (Building 16). The Director's office officially moved on March 6, 1964, into what was then Building 2 (it was later designated Building 1, the Project Management Building; the original Building 1, the Auditorium and Public Affairs Facility, became Building 2 at that time). During May, the Instrument and Electronics Lab (Building 15) was occupied, followed by the Manned Spaceflight Control Center, Houston (Building 30) at the end of June, when all leases on the temporary facilities expired.[28]

Although the MSC officially moved to Houston prior to the completion of Project Mercury, Project Gemini and the Apollo Program were the first tasks to be organized and operated from the new Center.[29] The Apollo Program, initiated in 1960, was officially announced by President Kennedy on May 25, 1961. Project Gemini was officially announced in December 1961, less than two months after the STG was renamed the MSC, because NASA officials decided that an intermediate step between Project Mercury and the Apollo Program was essential, in order to develop procedures necessary for a lunar mission.[30] Gemini flew 12 missions between April 1964 and November 1966, all but the first two manned. The program met all of its goals, including the production of a two-man vessel, the first successful extravehicular activity, the first vehicle rendezvous and docking sequence, and the longest flight duration, 14 days, as of that date. Gemini IV, which flew in June 1965, was also the first mission controlled by Houston's MCC.[31] Apollo flew 11 manned and six unmanned missions between May 1964 and December 1972; all but the initial unmanned flights were controlled from Houston. Like Mercury and Gemini, it met all of its goals with the first lunar orbit (Apollo 8) and the first lunar landing (Apollo 11).

Following the death of former President Lyndon B. Johnson on January 22, 1973, U.S. Senator Lloyd Bentsen of Texas, introduced a resolution to rename the MSC in Johnson' memory. President Johnson had been a firm supporter of the U.S. Space Program when he was a Senator, when he helped draft and enact the legislation that became the National Aeronautics and Space Act of 1958; as Vice President, when he served as the chairman of the National Aeronautics and Space Council and hired the first NASA Administrator; and as President.[32] The Senate passed the resolution, and President Nixon signed it on February 17, 1973, saying "Few men in our time have better understood the value of space exploration than Lyndon Johnson." The formal dedication ceremonies were held at the newly-designated Lyndon B. Johnson Space Center (JSC) on August 27, 1973.[33]

During the dedication ceremonies, the second manned mission of the Skylab Program was underway. Skylab, an application of the Apollo Program, was the largest habitable structure ever placed in space at the time, and served as an early type of space station. Skylab's prime

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[28] "Majority of MSC Personnel Relocated At New Site." *Space News Roundup* (3, 11), March 18, 1964, 2; "Final Relocation Of Center Employees Begins Today." *Space News Roundup* (3, 18), June 24, 1964, 1.

[29] For continuity, the Project Mercury offices remained at Langley, until their official closure in November 1963, when all staff was transferred to the Apollo Program. All of the missions were controlled from the Cape Canaveral Air Force Station in Florida. ACI 2007, Section 4.3.2.

[30] Dethloff, 77.

[31] Dethloff, 92; "Future Gemini Flights To Be Controlled Here." *Space News Roundup* (4, 13), April 16, 1965, 1.

[32] Launius, 30-32; "MSC Is Renamed 'JSC'." *Roundup*. (12, 8), March 2, 1973, 1.

[33] "MSC Is Renamed 'JSC'," 1; "Capacity Crowd View Dedication Ceremonies." *Roundup* (12, 20), August 31, 1973, 1.

objectives were to experiment in earth and medical sciences, as well as study astronomy, at a much lower cost. As with the Apollo lunar flights, JSC was responsible for the scientific experiments, modifications to the spacecraft, flight operations, and astronaut training.[34] The Apollo-Soyuz Test Project of 1975, was the final application of the Apollo Program, and the country's first joint international space mission. The Center played a prominent role in working group meetings to evaluate the possibility of a test flight between the Soviets and Americans, and iron out other issues once an agreement was reached. The mission produced a common docking system, allowing the two spacecraft to rendezvous in orbit.[35]

With the initiation of the SSP, JSC was again given the responsibility of the development of the spacecraft, in this case, the orbiter, as well as the integration of all shuttle systems; MSFC handled the propulsion elements, i.e., the SSMEs, the SRBs, and the ET; KSC controlled the shuttle processing, launch and landing.[36] From 1969 to 1972, while private companies under contract to NASA performed initial studies for the spacecraft's design, JSC, under the direction of Max Faget, performed their own in-house study of the vehicle design. Ultimately, JSC's "MSC-040C" design became the base for the shuttle design, which was modified as wind tunnel tests provided more data on the design.[37] With President Nixon's instruction to proceed with the design and building of a partially reusable space shuttle (see page 3), NASA issued an RFP for development of a Space Shuttle. The contract, which was awarded to the Space Division of North American Rockwell Corporation of Downey, California, was managed by JSC.

As the Center in charge of the orbiter, it was JSC who conducted the ALT program from the MCC (see page 4), constructed numerous facilities for the continual research and testing of the vehicle's systems and any planned upgrades, and tested and developed the various materials used on the orbiter. Aside from the development and testing of the orbiter, JSC's role in the shuttle program has remained consistent with that of the previous programs. Johnson was to handle mission control and operations, astronaut selection and training, and overall engineering and systems integration.[38]

Principle Functions of JSC

Since its beginnings as the STG, JSC has had four main tasks with regard to manned spaceflight: spacecraft development; mission control; research and development; and astronaut selection and training.[39] The basic design guidelines for each space vehicle used during the Mercury, Gemini, Apollo, and Space Shuttle programs were developed by JSC engineers. JSC subsequently managed the contracts with private firms for spacecraft manufacture. It was also the responsibility of JSC engineers to develop the proper interfacing between the spacecraft and its respective launch vehicle, which was developed separately by NASA's MSFC (Mercury-

[34] "Skylab Mission Forges Ahead, Trouble Shooting Pays Dividends." *Roundup* (12, 15), June 8, 1973, 1 and 4.
[35] Dethloff, 219-221.
[36] T. A. Heppenheimer. *Development of the Space Shuttle, 1972-1981*. Volume Two of *History of the Space Shuttle* (Washington, D.C.: Smithsonian Institution Press, 2002), 37.
[37] Jenkins, 79, 142-149, 201.
[38] "Three NASA Centers to share in Space Shuttle Management Tasks." *Roundup* (10, 16), June 18 1971, 1; "Agency gets Go-ahead to Develop Shuttle." *Roundup* (11, 4), January 7, 1972, 1.
[39] "Gilruth Cites MSC Progress Despite Difficult Relocation." *Space News Roundup* (1, 19), July 11, 1962, 1.

Redstone, Apollo-Saturn, Shuttle SRBs, ET, and SSMEs) or the U.S. Air Force (Mercury-Atlas, Gemini-Titan).[40]

Mission control at JSC begins once the space vehicle has cleared the launch pad, and ends when the vehicle lands.[41] The key figure of mission control is the Flight Director, who makes all final decisions with regards to the proceedings. All communication between the ground and the spacecraft is coordinated through the Spacecraft Communicator. The mission control team also includes personnel who monitor all aspects of the space vehicle, such as flight dynamics, communications links, data processing, and instrumentation. Between missions, the controllers plan for the next flight, conduct various in-house training exercises, and aid with astronaut training.[42]

In conjunction with vehicle design, JSC has historically conducted related research and development, which generally falls into four categories: materials, electrical systems, life systems, and life sciences. The materials category includes development and testing of active thermal control systems as well as spacecraft structure testing. Electrical systems includes testing of the various interfaces with spacecraft hardware and software, ensuring there are no anomalies within the wiring and electronics systems, and confirming the ability of the spacecraft's communications systems to connect to relay satellites and ground stations. Life systems and life sciences are inherently connected to one another and include the astronauts' spacesuits and backpacks, as well as ensuring that their meals meet nutritional guidelines, taste good and store well.[43]

Probably the most well-known task of JSC, besides mission control, is astronaut selection and training. From the original "Mercury 7," JSC has determined the criteria for astronaut selection and handled all interviews and examinations during the selection procedure. Additionally, the Center has established all training curricula, which provide astronauts with the basic knowledge needed to fly a mission and survive in emergency circumstances, as well as more specific training for tasks associated with a particular mission. Since Project Gemini, program-specific spacecraft simulators and trainers have been located within various buildings at JSC for astronaut training.[44]

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[40] Archaeological Consultants, Inc. (ACI). *Survey and Evaluation of NASA-owned Historic Facilities and Properties in the Context of the U.S. Space Shuttle Program. Lyndon B. Johnson Space Center, Houston, Texas*, November 2007, Section 4.3.1.

[41] Likewise, those who designed the launch vehicle generally handled the actual launch process. It should be noted that the Kennedy Space Center, which has conducted all launches for Apollo and Space Shuttle, grew from MSFC's Launch Operations Directorate, which controlled the initial Mercury-Redstone launches.

[42] All Mercury missions and the first four Gemini missions were controlled from the old Mercury Control Center at Cape Canaveral, Florida. The Mission Control Center at Houston took over starting with Gemini IV. ACI, Section 4.3.3.

[43] ACI, Section 4.3.4.

[44] ACI, Section 4.3.2.