

HISTORIC AMERICAN ENGINEERING RECORD

NASA JOHNSON SPACE CENTER, BUILDING 37, LUNAR RECEIVING LABORATORY (Life Sciences Laboratory) HAER TX-109-F

LOCATION:

The Lunar Receiving Laboratory (Building 37) is located between 4th and 5th Streets, on the south side of E. Linkage Road, in Area 1 of Lyndon B. Johnson Space Center (JSC) located at 2101 NASA Parkway, Houston, Harris County, Texas 77058.

The building is located at latitude: 29.560505, longitude: -95.082977. This point was obtained on July 29, 2024 using Google Maps (WGS 1984). There is no restriction on its release to the public.

PRESENT OWNER:

National Aeronautics and Space Administration

PRESENT USE:

Now known as the Life Sciences Laboratory, Building 37 is currently being prepped for demolition and all re-usable equipment and architectural features have either been relocated to the new life sciences building (Building 21), are being repurposed in other buildings, or have been placed in storage at JSC.

The complex design of Building 37 originates in the diverse components required for the building's original purpose as the Lunar Receiving Laboratory (LRL). Building 37 was originally constructed to support the Apollo Program's lunar landing missions and was designed to achieve several functions, which include: a quarantine facility for returning Apollo crewmembers, spacecraft, equipment, and lunar samples; an isolation facility where specific biomedical evaluations of the lunar samples could be performed to determine whether the samples contained any hazardous replicating microorganisms; an isolation facility where time-critical physical science investigations could be performed; and a facility for lunar sample preparation and distribution to outside principal investigators for detailed scientific analyses.¹

SIGNIFICANCE:

The Lunar Receiving Laboratory (Building 37) is significant as the home of the Apollo Lunar Quarantine Program and the Medical Operations clinical laboratories, both of which were critical to the success for all of the manned missions after 1967 including Apollo (1961 to 1972), Skylab (1965 to 1979), Apollo-Soyuz Test Project (1971 to 1975), Shuttle-Mir (1993 to 1998), Space

¹ Johnston, et al., "The Lunar Quarantine Program," SP-368 Biomedical Results Of Apollo (Washington, D.C.: U.S. Printing Office, 1975).

Shuttle (1981 to 2011), and ISS (1993 to current).

Building 37 is also associated with numerous astronauts important to the U.S. Space Program including Neil Armstrong, John Glenn, Deke Slayton, Kathryn Sullivan, and Sally Ride, all of whose work and training at Building 37 were vital to the success of their mission and whose roles in the success of the U.S. Space Program have been heavily documented.

Finally, Building 37 is an example of excellence in design and engineering, and retains its original PEAFF panel walls that reflect the Modern design concept used by Federal contractors in the 1960s and 1970s, designed in the style resembling Brutalism, which is a thick masonry variation of Modernist architecture. The PEAFF panel walls were an outstanding engineering achievement and pioneering design concept in the early 1960s and well illustrate the implementation of President Kennedy's Federal Program Guiding Principles for Federal Architecture and the GSA's philosophies of engineering functionality and economical materials selection. Regarding engineering, Building 37 houses unique architectural features such as the Radiation Counting Laboratory (RCL) underground chamber, 50' below surface, lined with 3/8" steel, enclosed with 36" of crushed dunite, surrounded by 5' thick concrete walls, then topped with earthen overburden.

The Lunar Receiving Laboratory also contributes to a visual sense of the overall historic environment at JSC. The building is united historically with numerous other buildings and events within the geography of the JSC campus.²

HISTORIAN:

Adam Graves, Forty-One G Services, LLC. (41G)

March 2018

PROJECT INFORMATION:

The Lunar Receiving Laboratory recording project was completed with guidance and assistance by Sandra J. Tetley, Real Property Officer, Historic Preservation Officer, NASA JSC. The project was managed by Adam Graves 41G, HAER Project Leader. The measured drawings are copies produced by Marilyn Blevins, Facilities and Real Estate Division, NASA JSC. The large-format photographs were produced by the Imaging Lab at JSC. The written historical and descriptive data were adapted in 2018 from a technical report written by Adam Graves. The National Park Service accepted the documentation in 2024 after some editing overseen by Jan Vedanth at NASA, but descriptions reflect 2018 conditions.

Designed within the original JSC Master Plan, architects and engineers for Building 37 followed the U.S. federal government design objectives of that time, which were focused on economy, future flexibility, and simplicity.³ Federal government complex buildings were constructed to provide maximum flexibility of space utilization, while providing maximum economy and

² Letter, Justin Kockritz to Sandra J. Tetley, "Project Review under Section 110 of the National Historic Preservation Act, Final Historic and Architectural Survey and Evaluation of Facilities at the NASA's Lyndon B. Johnson Space Center, Houston, Harris County (NASA/110, THC #201701384)," December 19, 2016.

³ GRAVitate, LLC. "NASA Johnson Space Center, Historic and Architectural Survey and Evaluation of Facilities, report prepared for NASA JSC (September 2016), 79.

efficiency in the operation of its buildings.⁴ Priorities have since changed to focus on reduction of costs, square footage and energy consumption, consolidation of space, and divestment of surplus and inefficient properties.

The Repair by Replacement Infrastructure Plan helps JSC meet these goals by consolidating all of the Center's life science research into one building, the Human Health and Performance Laboratory.⁵ Thus, Building 37 closed in October of 2017 and was designated for demolition.⁶

⁴ GRAVitate, "JSC Survey," 79.

⁵ Sandra J. Tetley, JSC Historic Preservation Officer, JP-18-003 Letter to Mark Wolfe, Executive Director, State Historic Preservation Office, Texas Historical Commission (February 2, 2018).

⁶ Tetley, JP-18-003 Letter to Wolfe.

Part I. Historical Information

A. Physical History:

1. Date of construction: Conducted in two phases, Phase I commenced on August 10, 1966, with the contract filed by NASA as complete on March 15, 1967 and the Phase II contract was filed by NASA as complete on June 26, 1967.
2. Architect/Engineer: Smith, Hinchman and Grylls Associates, Inc. (SH&G) of Detroit, Michigan. The firm was instrumental in implementing Eero Saarinen's ideas for innovative technology used in the General Motors Technical Center (1955) which was one of the most significant modern corporate campuses in the United States. It is still a symbol of United States Modernism. In 1955 SH&G used much of the same advanced technology developed for the technical center in the construction of the Michigan Bell Telephone Northwest Staff Center in Southfield, Michigan. From 1956 to 1966 they developed the Cultural Center for the city of Flint, Michigan, including Whiting Auditorium, Longway Planetarium, and the Sloan Museum. Other significant modern buildings designed by the firm include the Detroit Wayne County Airport (1964), First Federal Savings & Loan Association Bank Building in Detroit (1965), the Detroit Hospital Medical Research Building (1965), and Hart Plaza (1975).⁷
3. Builder: Phase I contract belonged to Warrior Construction Company, of Houston, Texas; Phase II contract belonged to Warrior-Natkin-National, of Houston, Texas.
4. Original plans and construction: The three-story facility complex originally consisted of a south wing, north wing, and west wing, all of which were seamlessly connected via a network of interior corridors. The complex design of Building 37 originated in the diverse components required for the building's original purpose as the Lunar Receiving Laboratory (LRL). The south wing measured approximately 217' in length and 81' wide. The north wing measured approximately 143' in length and 176' wide, while the west wing measured approximately 136' in length and 143' wide. Original construction features included a concrete foundation, concrete and vinyl tile floors, PEA panel walls, and a built-up roof over light-weight concrete and a metal deck. The original building had a total floor area of 82,581 square feet.
5. Alterations and additions: The interior has been modernized and modified several times since 1967, as needed, to accommodate the U.S. Space Program within the federal building design mandate. A spiral stairway (2SE) was installed in March 1970. Most of Building 37's quarantine equipment and labs were dismantled and relocated to the University of California's Los Alamos Scientific Laboratory in 1973. A film vault freezer was placed in renovated Room 206 in December 1989. A mezzanine level was constructed above Rooms 201A and 204C in April 1997.⁸ The roof was replaced in 2011.⁹ Most of the rooms were redesigned and modified many times over the years to accommodate specific programs. Routine upgrades to laboratory, administrative, and support spaces have occurred throughout the life of the building in response to changing programmatic requirements and necessary

⁷ Michigan Modern: Design that Shaped America, <https://www.michiganmodern.org/modern-designers/smith-hinchman-grylls/>

⁸ Real Property Record, NASA/1047/137 (n.d.) ⁹ Real Property Record, NASA/1047/137 (n.d.) ¹⁰ Real Property

⁹ Real Property Record, NASA/1047/137 (n.d.)

maintenance.¹⁰ Improvements to the building, such as installing floodlights and safety rails, upgrading fire suppression systems, and modernizing electrical wiring and plumbing, have occurred since the building was originally constructed.

B. Historical Context:

Originally designed as the Lunar Receiving Laboratory (LRL), Building 37 was constructed in support of the Apollo Program's lunar landing missions (1969 to 1972). In early 1964, NASA identified the need for a simple stand-alone facility to process lunar samples.¹¹ According to Mangus and Larsen, Aleck Bond, then Manager of Systems Tests and Evaluation, presented a memo to the Chief of the Office of Technical Information and Engineering Services defining MSC's vision for the LRL by April 14, 1964.¹² Initially referred to as the Sample Transfer Facility, Bond's memo argued that "MSC should build a facility that...initially receives the samples collected by the astronauts on the Apollo missions; opens the containers under precisely controlled, uncontaminated, sterile conditions; checks the samples for presence of viable organisms; performs some control testing of the samples; carefully divides the samples into appropriate amounts for distribution to the various investigators; prepares and repackages the portion of each sample in accordance with the analytical technique to be used by each investigator; and delivers the portion of the sample to the individual investigator."¹³

The Lunar Receiving Laboratory (Building 37) is located between 4th and 5th Streets, south of Avenue B in the JSC southeast sector (Area 1) that comprises the Main Facility Complex. The Lunar Receiving Laboratory comprises the main building (Building 37), Tank Farm (Building 37A), Sterilizer Equipment Building (Building 37AA), and Chemical Storage Building (Building 37J). Buildings 37A, 37AA, and 37J are all support structures to the Lunar Receiving Laboratory.

Initial design of a proposed LRL for the MSC consisted of a modest clean room. MSC administrators began planning the sample processing facility, although the basic design still lacked any consideration of quarantine.¹⁴ Growing concerns of NASA officials and specialists, including those at the United States Geological Survey, quickly identified the complex nature of back contamination issues associated with handling lunar materials. By the summer of 1964, an interagency Conference on Potential Hazards of Back Contamination from the Planets formulated these issues and sparked discussions between the MSC and NASA Headquarters about the role of the LRL, and in September funded an LRL feasibility study.¹⁵ In November 1964, the Office of Space Sciences created the Ad Hoc Committee on the Lunar Sample Receiving Laboratory to establish firm criteria for the laboratory's functions, which included "initial handling and subsequent distribution of all lunar samples throughout the scientific community for detailed analyses," preliminary analytical investigations of lunar materials, and, according to later Ad Hoc Committee suggestions in February 1965, sterilization and quarantine procedures.¹⁶ In May 1966, MSC Director Gilruth implemented a "crash program" and policy board to complete construction of the LRL by the scheduled first lunar landing mission of

¹⁰ Real Property Record, NASA/1047/137 (n.d.)

¹¹ Susan Mangus and William Larsen, *Lunar Receiving Laboratory Project History*, NASA/CR- 2004-208938. NASA STI Report Series (Washington, D.C.: U.S. Printing Office, 2004), 1.

¹² Mangus and Larsen, "LRL Project History," 4-5.

¹³ Mangus and Larsen, "LRL Project History," 5.

¹⁴ Mangus and Larsen, "LRL Project History," 5.

¹⁵ Mangus and Larsen, "LRL Project History," 7-8.

¹⁶ Mangus and Larsen, "LRL Project History," 8-9, 12.

1969.¹⁷ Justification for the LRL's funding and location in Houston was given by NASA before the Subcommittee on Manned Space Flight of the House Committee on Science and Aeronautics in February and March 1966.¹⁸ The budget hearings of 1966 resulted in the allocation of \$8.1 million—a \$1 million reduction from the amount originally requested—for LRL construction at the MSC by Congress.¹⁹

During the construction and implementation phase of LRL development, MSC management created an organizational structure for the new facility which had to deal with continuously changing facility standards and requirements as NASA moved toward Apollo's lunar landing missions. The LRL Program Office under Joseph V. Piland managed the construction phase throughout 1967.²⁰ Three groups facilitated construction and implementation for the complex new facility: the Biological Advisory Committee advised MSC's Director of Medical Research and Operations Dr. Charles Berry, who had responsibility for biological containment, quarantine, and lunar materials testing, as well as the development of protocol for all three; the LRL Working Group processed proposals for lunar sample analysis and advised the LRL about design issues related to experiments; and the Lunar Sample Analysis Planning Team determined which samples the principal investigators would receive for their experiments. The Lunar Sample Analysis Planning Team also advised the Science and Applications Directorate concerning LRL processes, equipment, and operations.²¹ As well, they advised sample allocations, methods of sample handling, experiment priorities and sequencing, and sample return during the quarantine period.²² Additionally, NASA organized the Lunar Sample Preliminary Examination Team to oversee scientific testing during the quarantine period.²³ In a January 1967 meeting, NASA and Public Health Service officials determined that the LRL's primary function was to implement quarantine procedures for returned lunar missions.

Back contamination was a main issue associated with the LRL, as then-NASA Associate Administrator for Manned Space Flight, Dr. George Mueller, explained during a NASA authorized hearing on March 31, 1966. He described the quarantine procedure purpose: "To protect the public's health, agriculture and other living resources. To provide lunar sample distribution to approved scientific investigators. To preserve the scientific integrity of the samples at all times."²⁴ Under the supervision of the Science and Applications Directorate at MSC, led by Director Dr. Wilmot Hess, the LRL was to be a unique research facility, the focal point where Apollo crews would unfold the story of their lunar flight and the national and international scientific community would begin their investigation of the moon.²⁵

The LRL was a multi-level research structure designed for three principal purposes that included: quarantine and testing for possible harmful organisms in the lunar samples, spacecraft, and crews; performance of scientific sample investigations that are time-critical and must be accomplished within the quarantine period; and repackaging and distributing lunar samples to scientists throughout the world for detailed investigation after the quarantine period (Appendix

¹⁷ Mangus and Larsen, "LRL Project History," 16.

¹⁸ Mangus and Larsen, "LRL Project History," 18.

¹⁹ Mangus and Larsen, "LRL Project History," 20.

²⁰ Mangus and Larsen, "LRL Project History," 24.

²¹ Mangus and Larsen, "LRL Project History," 24-25.

²² Mangus and Larsen, "LRL Project History," 25.

²³ Mangus and Larsen, "LRL Project History," 25.

²⁴ Mangus and Larsen, "LRL Project History," 19.

²⁵ Gordon, Bob, "Where the Moon Meets the Earth," *Space News Roundup* Volume 6 (18) (1967), 4.

B, Figure 1).²⁶ In 1967, this laboratory was considered the only one of its kind in the country. The lunar-returned pilots were transferred to the LRL following their recovery from the Pacific Ocean in Mobile Quarantine Facility Units that resembled a travel trailer. The lunar samples, film, tapes, and other flight equipment were flown by hi-performance aircraft directly to the LRL for quarantine and analyses.

In June of 1967, Meplar Inc, of Falls Church, Virginia, was awarded the contract to furnish Apollo recovery quarantine equipment, which included four mobile quarantine facility units for crew; air-tight plastic transfer tunnels for crew linking the spacecraft and mobile quarantine facility, an air-tight plastic transfer tunnel linking the mobile unit and the LRL; as well as containers for flight film, tapes, hardware, and lunar samples.²⁷ The mobile quarantine facility units were fabricated from heat-treated aluminum with sleeping quarters, work area, food preparation area, and medical area, for both flight crews and support technicians.²⁸ These totally self-sufficient units were equipped with bunks, chairs, tables, lavatory, sink, kitchen, and any other items necessary for debriefing and preliminary medical examinations during the transfer period from the recovery vessel to the LRL at the MSC.²⁹ The 35' long mobile units were equipped with a hoisting sling for placement aboard the recovery vessel and flatbed trailer.³⁰

Apollo crewmen entered the Mobile Quarantine Facility Unit from the CM through a plastic transfer tunnel attached to the spacecraft and the mobile unit. The crew, together with an MSC physician and a recovery technician, remained in the Mobile Quarantine Facility Unit during the trip to Houston.³¹ From the recovery vessel to port, the Mobile Quarantine Facility Unit was transferred to an aircraft and flown to Houston.³² After the crew exited the Apollo CM, it was sealed and transported to Houston where the CM was placed in a separate quarantine area than the crew.³³

Management of the LRL was turned over to Lunar and Life Sciences Division Chief, Dr. Persa R. Bell, in the fall of 1967.³⁴ During the fall of 1968, the MSC's Director of Medical Research and Operations, Dr. Charles Berry, was given "total responsibility for biological containment, quarantine, and testing of lunar material in the LRL."³⁵ The test system equipment was developed and installed during the period from mid-1966 until approximately September 1968.³⁶ After a lengthy certification process involving the creation of protocols for quarantine testing and other back contamination issues and operational readiness testing, the LRL was scheduled to open for operations on July 14, 1969, in preparation for Apollo 11, the first lunar landing mission.³⁷

The biological barriers were a unique system to both protect lunar samples from Earth contamination as well as protect the outside world from lunar material contamination. The Crew Reception Area had quarters for crew and attendant technicians for the quarantine period.

²⁶ Gordon, "Where The Moon Meets The Earth," 4.

²⁷ Melpar Picked to Build Lunar Quarantine Units" *Space News Roundup* (June 23, 1967), 3.

²⁸ "Melpar Picked," 3.

²⁹ "Melpar Picked," 3.

³⁰ "Melpar Picked," 3.

³¹ Gordon, "Where The Moon Meets The Earth," 4.

³² Gordon, "Where The Moon Meets The Earth," 4.

³³ Gordon, "Where The Moon Meets The Earth," 4.

³⁴ Mangus and Larsen, "LRL Project History," 24.

³⁵ Mangus and Larsen, "LRL Project History," 31.

³⁶ Johnston, et al., "The Lunar Quarantine Program."

³⁷ Mangus and Larsen, "LRL Project History," 51.

Analyses of lunar material was to be performed in the Sample Operations Area. The Administration and Laboratory Support area was designed to support the labs.

The results of the Apollo Lunar Quarantine Program were ultimately successful.³⁸ Following negative results from life-detection experiments on Apollo 11, 12, and 14's return samples and no evidence of hazards being detected from samples, craft, or crew, NASA revisited whether quarantine procedures were needed on future lunar landing missions.³⁹ Quarantining operations were not only expensive but inconvenient to technical staff as they impeded post-flight briefings and delayed the release of eagerly sought lunar samples to investigative teams. Meltzer described, "Considerable evidence suggested that quarantines simply were not required for the protection of Earth and that life had either never existed on the Moon, or at least appeared to have left no trace at the sites examined." Acting NASA Administrator, George M. Low, announced on April 26, 1971, that analysis had proved that lunar material caused no hazards to man, animal, or plants, and quarantine procedures would be discontinued.⁴⁰ Biomedical analyses of returned lunar samples did continue, as protecting lunar samples from Earth contamination on the return journey from the moon as well as during transport to the LRL did not significantly change and contamination procedures for handling lunar material were maintained for Apollo 15, 16, and 17 to protect sample integrity.⁴¹ The bulk of each lunar sample brought back to Earth was retained in the LRL in the high vacuum system, under ultraclean conditions, in specially prepared containers, specifically designed for long term storage and curation.⁴²

³⁸ Donald Bogard and Gary W. McCullom, presentation to NASA Alumni League "Apollo Lunar Quarantine Program." (Houston, Texas, June 18, 2012.)

³⁹ Michael Meltzer, *When Biospheres Collide: A History of NASA's Planetary Protection Programs*. History Program Office, NASA SP-2011-4234 (Washington, D.C.: U.S. Printing Office, 2011), 245.

⁴⁰ Meltzer, *When Biospheres Collide*, 245.

⁴¹ Meltzer, *When Biospheres Collide*.

⁴² King, *Moon Trip*, 66.

Part II. Structural Design Information

A. General Statement

1. Character

Building 37 was originally named Lunar Receiving Laboratory and was changed to Life Sciences Laboratory in 1974. Originally designed to house a geology laboratory, biological laboratory, and astronaut quarantine facility, it became a critical mission support building used as a multipurpose laboratory for ground-based and in-flight medical operations support and biomedical research activities relative to health, safety, and performance of flight crews during all phases of manned space flight. Designed by Smith, Hinchman and Grylls Associates, Inc. of Detroit, Michigan, the complex design of Building 37 originates in the diverse components required for the building's extremely unique original purpose as the LRL.⁴³

Construction of Building 37, Building 37A, and Building 37AA was conducted in two phases, the first by Warrior Construction Company and the second by Warrior-Natkin-National. Phase I commenced on August 10, 1966 and concluded by March 15, 1967 with Phase II concluded by June 26, 1967. Major test equipment was provided by the Research Foundation of the State University of New York, Albany. Gas Analysis Equipment, the vacuum system, and RCL were provided by the U.S. Atomic Energy Commission, Oak Ridge, Tennessee.⁴⁴

The north wing of the first floor is an irregular rectangle housing numbered rooms of various sizes, connected internally, with loading docks on the west and north sides. A cement walkway, at the northwest corner of the north wing, connects a side entrance (10SNW) to the Tank Farm and PEAFF Panel Enclosure (Building 37A). The south wing of the first floor is an irregular-shaped rectangle housing numbered rooms of various sizes, connected internally, with two loading docks along the west side, and tunnel access at the northwest corner of the south wing. The square-shaped second floor was constructed above the northwest corner of the first floor. The second floor is primarily open space, with small various shaped rooms only in the northwest corner. Access to the second floor is from the north side via stairs. There are three floor hatches, one in the center, one in the southeast corner, and one along the eastern wall. The second floor has roof access from the south wall. The small square-shaped third floor was constructed above the northwest corner of the second floor. The third floor is open space, with access to the third floor via stairs at the northeast corner. The south half of the third floor supports an open area of reinforced crane rails. The small rectangular shaped basement, 50' below the surface, can be accessed from approximately the center of the north wing of the first floor via a concrete shaft that contained an elevator and stairwell linking the underground lab with ground level support facilities. A process tunnel also connects the basement with the Tank Farm and PEAFF Panel Enclosure (Building 37A) from the northwest corner of the first floor.

A spiral stairway (2SE) was installed in March 1970. In 1973, much of Building 37's quarantine equipment and labs were dismantled by technicians from the University of California's Los Alamos Scientific Laboratory and relocated to their labs for the Atomic Energy Commission for their pioneering research using laser light in nuclear fusion experiments.⁴⁵ Materials to install a

⁴³ Gordon, "Where The Moon Meets The Earth," 5.

⁴⁴ Gordon, "Where The Moon Meets The Earth," 5.

⁴⁵ "Lunar Receiving Lab Now in N.M." *Space News Roundup* (October 26, 1973), 1.

film vault freezer, to be placed in Room 206, were obtained in late December 1989. A mezzanine level was constructed above Rooms 201A and 204C in April 1997. Several rooms were redesigned and modified to accommodate specific programs. Routine upgrades to laboratory, administrative, and support spaces have occurred throughout the life of the building in response to changing programmatic requirements and necessary maintenance. In 2011, the building's roof was replaced.⁴⁶ Improvements to the building, such as installing floodlights and safety rails, upgrading fire suppression systems, and modernizing electrical wiring and plumbing, has occurred since the building was originally constructed.

The Tank Farm (Building 37A) is immediately to the northwest of Building 37. The Tank Farm is a separate freestanding facility behind Building 37 that housed large chemical settling tanks. All the liquid effluents from the Lunar Receiving Laboratory went into these chemical tanks, where they were treated with chemicals and then dumped into the sewer lines.⁴⁷

The Sterilizer Equipment Building (Building 37AA) is also located northwest of Building 37. Glenn Holt described in conversation that the facility originally consisted of a control room and an auxiliary laboratory area for medical sterilization.⁴⁸ When documented in 2016, the facility was mostly abandoned and provided minimal laboratory equipment storage support for compressed gas tanks in the upstairs area and flammable chemical storage lockers and deionized water filtration and control in the former control room.⁴⁹ The building was used to store chemicals as well as other supplies to support the Lunar Receiving Laboratory.

The Chemical Storage Building (Building 37J) consists of a small, rectangular, one-story ancillary structure that Construction by Centennial Contractors commenced on September 14, 1995 and concluded March 28, 1996. This later addition to the Building 37 complex is located immediately southwest of Building 37.

2. Condition of Fabric

Building 37 is mothballed and is being prepped for demolition. All re-usable equipment has been relocated and is being repurposed in other buildings or been placed in storage.

Since originally constructed, the Tank Farm (Building 37A), Sterilizer Equipment Building (Building 37AA), and Chemical Storage Building (Building 37J) have undergone minor improvements, such as installing floodlights and safety rails, upgrading fire suppression systems, replacing equipment as needed, and modernizing electrical wiring and plumbing. These facilities are currently not in use but maintain good condition and are structurally sound.

B. Description

Overall Dimensions

The Lunar Receiving Laboratory (Building 37), a three-story building, has a gross square footage of approximately 82,915 square feet and consists of a south wing (i.e., main building), north wing, and west wing, all of which are seamlessly connected via a network of interior

⁴⁶ Real Property Record, NASA/1047/137 (n.d.)

⁴⁷ Bogard and McCullom, Presentation, 7.

⁴⁸ Glenn Holt, 2014 oral communication.

⁴⁹ GRAVitate, "JSC Survey," 266.

corridors. The first floor is generally square and measures 279'-0" x 257'-0" x 15'-6" and includes the 217'-0" x 81'-0" south wing, the 143'-0" x 176'-0" north wing and the 136'-0" x 143'-0" west wing. The square-shaped second floor was constructed above the northwest corner of the first floor above the north wing and measures 140'-0" x 140'-0" x 33'-6". The third floor was constructed above the northwest corner of the second floor above the north wing and measures 56'-0" x 65'-0" x 68'-6".

Approximately 50' below grade is the Radiation Counting Laboratory which is a rectangular-shaped bisected room measuring 30'-0" x 52'-8" accessible via a concrete shaft that contained an elevator and stairwell linking the underground lab with ground level support facilities.⁵⁰ To shield the counting laboratory from terrestrial background radiation sources that could obscure faint signals from the lunar samples, the chamber is held in place with a 3/8" steel liner, enclosed with 36" of crushed dunite (a material found in Earth's mantle consisting mainly of olivine), surrounded by 5' thick concrete walls, and topped with earthen overburden, eliminating most cosmic ray background from the laboratory.⁵¹

The Tank Farm (Building 37A) comprises a gross area of 1,872 square feet and measures 40'-0" x 25'-0" x 18'-6". The Sterilizer Equipment Building (Building 37AA) comprises an area of 1,806 square feet and measures 14'-0" x 34'-0" x 18'-6" at ground level, and the basement level measures 34'-0" x 40'-0" x 14'-3". The Chemical Storage Building (Building 37J) is 198 square feet and measures 10'-0" x 19'-0" x 10'-0".

Foundations

The Lunar Receiving Laboratory (Building 37), Tank Farm (Building 37A), Sterilizer Equipment Building (Building 37AA), and Chemical Storage Building (Building 37J) were each constructed on steel reinforced poured concrete structural slabs on compacted sand.

Walls

The Lunar Receiving Laboratory (Building 37), Tank Farm (Building 37A), Sterilizer Equipment Building (Building 37AA), and Chemical Storage Building (Building 37J) were each constructed using pre-cast exposed aggregate facing (PEAF) panel exterior walls. Nine removable metal panels were built into the west elevation of Building 37 painted to match the PEAFF panel walls.

Structural System

Buildings 37, 37A, 37AA, and 37J, like many other permanent structures at JSC, were built using reinforced steel beam construction. The structural framework was constructed to support the large panel exterior walls as well as lightweight (2,000 psi) concrete floor decks for the second and third floors of the building and support structures. The RCL was built below ground and inside a ring of 3'-0" diameter caissons.

Walkways

Exterior walkways leading to and wrapping around Building 37 are exposed aggregate finish

⁵⁰ Gordon, "Where The Moon Meets The Earth," 5.

⁵¹ Meltzer, *When Biospheres Collide*, 234.

concrete, which originally were a reoccurring feature across JSC.

Openings

Overall, there are twelve access points into Building 37, all of which are in their original locations and of their original materials. On the east elevation there are two aluminum-framed glass doors for access into the administrative portions of the building. The north elevation of the building has two aluminum-framed glass doors and a third-floor hollow metal door for fire escape down the connecting external metal staircase. Additionally, the north elevation loading dock has one metal roll-up door and standard hollow metal external door. The south elevation is the main entrance to Building 37 and has one aluminum-framed glass double-door and one hollow metal door fire escape on the second floor which steps out onto the roof of the first floor. The west elevation has hollow metal double doors at the location of the removable metal panels, two metal loading dock roll-up doors, and a large ground-level steel double-door.

The east, south, and half of the north elevations of Building 37 at ground level are comprised of glass window panels recessed under an overhang faced with PEAFF panel fascia and supported by PEAFF panel covered square columns. The windows are aluminum framed and are of solar glass. Immediately below each window panel is a porcelain panel, which create a floor-to-ceiling glass look while also creating a functional barrier from outside environmental factors. The lower panels that make up the western-most face of the south elevation are insulated metal as an additional safety measure at the location of the astronaut quarantine area.

Roof

Building 37 original construction features also include a truss steel-framed flat roof, topped with lightweight concrete fill on a metal deck. The stacked and offset rooflines that comprise the first, second, and third floors are commonly described as being analogous to an offset wedding cake. The roof is drained by concrete roof drains.

Interior

Unlike many of the permanent buildings at JSC, the interior spaces of the Lunar Receiving Laboratory (Building 37) were not designed to be re-useable, flexible space that could be redesigned based on Program needs to reconfigure administrative and high-bay spaces. Rather, the general layout of Building 37 may be organized into through functional areas: the administration and support area (south wing), the Sample and Operations Area (including the underground Radiation Counting Laboratory), and the Crew Reception area. The latter two areas are bound by a biological barrier.

Stairs inside Building 37 are a concrete fill on sheet metal pan construction. The original construction features of the interior flooring included concrete and vinyl tile floors. Walls that comprise the biological barrier are Concrete Masonry Unit (CMU) walls, while the remaining walls through the building are gypsum board. Ceilings are drop ceiling panels that were originally asbestos containing.

Of note are the glass viewing windows that were originally designed for the returned astronauts to interact with the administrative NASA personnel, media, and their respective families. These windows were carefully built into the biological barrier.

C. Operation

The Lunar Receiving Laboratory was used as a multipurpose laboratory for ground-based and in-flight medical operations support and biomedical research activities relative to health, safety, and performance of flight crews during all phases of manned space flight. The facility personnel housed in Building 37 worked to define life sciences and life-support requirements for advance space exploration initiatives. Many at JSC still use the name LRL when referencing this building. Building 37 was designed for diverse functions and can be divided into four functional areas: The Sample Operations Area and Radiation Counting Laboratory (RCL) in the west wing; the Crew Reception Area (CRA) in the north wing; and the Administration and Support Area in the south wing.

Biological containment was achieved in Building 37 through the use of a primary and secondary barrier system. The primary biological barrier consisted of the Vacuum Laboratory, Class III Biological Cabinets, and a low-level radiation counting facility, while the secondary barrier was maintained in the CRA and Sample Laboratories. The Administration and Support Area was located outside of both biological barriers. The Apollo Back-Contamination Program was divided into three phases. The first concerned in-flight procedures by crewmen to eliminate lunar-surface contaminants from the Apollo CM; the second, spacecraft and crew recovery and provisions for isolation and transport to the MSC; the third, quarantine of crew members over a minimum twenty-one-day period and lunar samples over a minimum fifty-day period in Building 37. Transportation from the aircraft carrier in the spacecraft recovery zone to Building 37 in Houston was a complex process. Astronauts, lunar samples, bio-specimens, mission data film and tapes, and the Apollo CM were ultimately brought to Building 37 following isolation procedures and via a combination of direct air transport, surface transport, and the use of the Mobile Quarantine Facility—an Airstream trailer designed for astronaut isolation.⁵²

Analyses of materials at Building 37 were performed that included vacuum, magnetics, gas analysis, biological testing, and radiation counting laboratories.⁵³ Scientists have used Building 37 facilities for non-lunar materials such as meteorite fragments. MSC geologist Dr. Elbert King tested fifteen pounds of meteorite fragments that entered Earth's atmosphere and landed in Pueblito de Allende, Chihuahua, Mexico, in February of 1969.⁵⁴ King ran several tests and analyses on the fragments that included using gamma radioactivity analysis in the RCL.⁵⁵

Sample Operations Area

The Sample Operations Area provided immediate reception, processing, experimentation, and biological testing of lunar samples directly from the Mobile Quarantine Facility. Both the biological and geological areas of the Sample Operations Area used contractor technicians. Upon arrival at Building 37, lunar sample return containers were transferred through an airlock and three decontamination chambers before being opened in a vacuum chamber designed to ensure sterility and sample integrity during preliminary examinations by simulating lunar pressure. Special containers were also designed for the return of medical samples, films, and data tapes from the recovery area to Building 37. Lunar sample containers entered Building 37

⁵² Bogard and McCullom, Presentation.

⁵³ Gordon, "Where The Moon Meets The Earth," 5.

⁵⁴ "MSC Lab Analyzes Meteorite Fragments," *Space News Roundup* (February 21, 1969), 1.

⁵⁵ "MSC Lab Analyzes Meteorite Fragments," 1.

through an overhead door located on the west wall at the intersection of the west and north wings. From there, they immediately entered the primary biological barrier area, the Vacuum Laboratory Complex, where sample containers were opened and initial sample processing began. During the quarantine period, lunar samples were stored in vacuum-tight containers or handled in sealed plastic bags in the Sample Laboratories where quarantine studies of lunar material were conducted that included botanical, virological, and zoological investigations.⁵⁶

The secondary biological barrier which surrounded the Sample Operations Area included facility systems and operational procedures. As originally designed, tight building construction was used and all penetrations were sealed. The Sample Operations Area had a single-pass air conditioning supply and exhaust system that maintained the area at a pressure negative with respect to the outside air. All inlet air was filtered and all air exited through absolute biological filters. All liquid waste produced in the Sample Operations Area was sterilized with steam before being transported to the JSC sewage treatment plant. All solid materials including waste, clothing, and trash were sterilized. During quarantine operations, the Sample Operations Area only received supplies through ultraviolet-lighted airlocks.⁵⁷

Vacuum Complex

Items entering and exiting the Vacuum Complex were sterilized to prevent contamination.⁵⁸ All items leaving the complex during the quarantine period were either placed in vacuum-tight containers, the exteriors of which were sterilized with peracetic acid, or were directly sterilized with the acid, then effluent gases from the Vacuum Chamber pumps were passed through absolute biological filters, incinerated, and filtered again prior to venting to the outside environment.⁵⁹ The Vacuum Complex had its own absolute biological filters, which conducted primary filtration, incineration, and secondary filtration before venting.⁶⁰

Biological Cabinets

Biological and physical/chemical testing of the lunar samples was performed within biological cabinets. The Biological Cabinets were gastight enclosures through which all manipulations were performed using neoprene gloves. Then air or nitrogen entered the cabinets through absolute biological filters, was incinerated, and was filtered again before being vented to the outside. All material entering the Biological Cabinets was sterilized. The Biological Cabinets were operated at a pressure negative with respect to the laboratory to ensure that any leak that developed would be directed into the cabinets rather than into the laboratory.⁶¹ The rooms in which the cabinets were housed were also maintained at a pressure negative with respect to the adjacent corridors, which guaranteed that escaping lunar material would be contained.

Radiation Counting Laboratory (RCL)

After intensive analyses, debates, and volumes of research were produced on every procedure to occur in Building 37, followed by several NASA advisory committee presentations, the general

⁵⁶ Bogard and McCullom, Presentation.

⁵⁷ Johnston, et al., "The Lunar Quarantine Program."

⁵⁸ Bogard and McCullom, Presentation.

⁵⁹ Johnston, et al., "The Lunar Quarantine Program."

⁶⁰ Bogard and McCullom, Presentation.

⁶¹ Johnston, et al., "The Lunar Quarantine Program."

plan of lunar sample intake at Building 37 was developed. The first step was introducing the rock boxes containing the lunar samples into the main vacuum system, then opening the rock boxes to visually inspect the samples, taking two small chips of each sample. One sample was sent down a metal pipe to the physical-chemical test area to undergo preliminary scientific examination and characterization, while the second sample was sent down a similar metal pipe to the quarantine test area for pathogen testing.⁶² Meanwhile, specially packaged samples were removed from the vacuum system, sealed in three biological barriers, and transported to the RCL.⁶³ The RCL was a 'state-of-the-art gamma ray spectrometry laboratory fabricated for low radiation background materials, that housed the latest large-volume detectors and electronics.⁶⁴ The RCL was important for measuring the natural radioactivity of lunar samples, some of which was caused by cosmic rays. Additionally, because the radioactivity of some nuclides has very short half-lives, they needed to be measured during the initial quarantine period, when they were first collected and brought back to Earth, or the data would be lost.⁶⁵

The RCL consisted of a first-floor work area of offices and support facilities and an underground counting room or chamber, located 50' below surface for radiation shielding purposes.⁶⁶ The counting laboratory contained a special ventilation system using chilled charcoal beds and other filters providing a radon-free atmosphere.⁶⁷ The air/radon filter is still extant, but not operational. Except for preamplifiers, all ancillary electronic instrumentation was located in an adjacent control room on the same underground level.⁶⁸ It has been rumored that the underground chamber of the RCL, designed specifically for Building 37, is a former missile silo structure. The RCL remains intact but has not been used since 2008.

The detector system used for the Apollo 11 mission samples was comprised of two large scintillation detectors at 180° with the sample placed between them. The two detectors consisted of a crystal of NaI 23 centimeters in diameter and 13 centimeters long, coupled optically to a pure NaI(Tl) (Sodium iodide activated with thallium) light guide 23 centimeters in diameter and 10 centimeters long. Gamma ray absorption in the light guide attenuated the gamma radiation from the four RCA type 4521 photomultiplier tubes used to collect the light. The principal detectors were surrounded by a mantle of NE-102 plastic scintillator 30 cm thick, viewed by twenty-two RCA type 4521 photomultiplier tubes.⁶⁹ The mantle was connected in anticoincidence with the NaI(Tl) detectors both to suppress background events and to improve the peak-to-total ratio for gamma spectra by rejecting those events by which a gamma ray transfers only a portion of its energy to the NaI(Tl) accompanied by the escape of a degraded photon. The background is further reduced by enclosing the detectors and anticoincidence mantle inside a lead shield with walls 20 centimeters thick. The shield weighs about 24 metric tons and was constructed by casting lead "concrete" inside a reinforced steel liner. The concrete consisted of 83 percent lead shot, 16 percent Chemtree-82 (product of Chemtree Corporation,

⁶² King, *Moon Trip*, 66.

⁶³ King, *Moon Trip*, 66.

⁶⁴ King, *Moon Trip*, 64.

⁶⁵ King, *Moon Trip*, 64.

⁶⁶ Gordon, "Where The Moon Meets The Earth," 5.

⁶⁷ Meltzer, *When Biospheres Collide*, 234.

⁶⁸ G. Davis O'Kelley, James S. Eldridge, Ernest Schonfeld, and P.R. Bell, "Primordial radionuclide abundances, solar proton and cosmic-ray effects and ages of Apollo 11 lunar samples by non-destructive gamma ray spectrometry," in *Proceedings of the Apollo 11 Lunar Science Conference*, Vol 2 (Washington, DC: U.S. Printing Office, 1970), 1408.

⁶⁹ O'Kelley et al, *Primordial*, 1408.

Central Valley, NY), and 1 percent LiF (lithium fluoride).⁷⁰ These materials used in the construction of the shield were carefully selected for their low levels of radioactive contamination.

Room 0SE in the RCL was used for equipment storage with the original equipment cabinets still located along the walls. Room 001 housed the RCL proper and a lead sample vault. Room 001 has its own air handling system, which is separate from that of the CRA, and consisted of an air/radon filter located in the second-floor machine room. Glenn Holt described in conversation that the RCL facilities were last used circa 2008.⁷¹

Crew Reception Area (CRA)

The CRA provided a quarantine space for the returned crew, Mobile Quarantine Facility, and Apollo CM. Quarantine objectives consisted of the biological containment of astronaut crews, lunar samples, and other lunar-exposed material until quarantine release, as well as biological assessment of lunar materials prior to their safe release.⁷² Quarantine procedures included daily biomedical evaluations of astronaut health, as well as Building 37 personnel interacting with lunar materials.⁷³

The CRA was divided into office and living space, medical facilities, and support and storage facilities. Astronauts entered the CRA from a double entrance door adjacent to an overhead door located on the west wall through which the lunar samples were received. Four astronaut quarantine sleeping quarters were located in Rooms 1163, 1165, 1167, and 1169, which were converted into offices when astronaut quarantine at Building 37 was concluded. Flight surgeon sleeping quarters adjoined each of the astronaut quarters in Rooms 1116, 1118, 1120, and 1122, respectively.⁷⁴ Intercoms connected flight surgeon and astronaut quarters in case of emergency and are still extant, though not operational. At the time of this documentation, hallway 11CS retains the gurney-width doors leading into and out of the sleeping quarters. Quarantine and some on-flight food was prepped in Room 1082.⁷⁵ Crew and personnel dining occurred in the northern portion of the CRA. Quarantine operating rooms were located in Rooms 1253, 1257, and 1263, which were later converted to the Biochemistry Laboratories. The Medical Operations Support Laboratory was operational as a clinic throughout the Apollo mission quarantine period, remaining operational for several decades following Apollo. The official Apollo quarantine clinic was located in Room 1005, also later converted to office space. Room 1264 was the Family Room used during Building 37's quarantine period where Astronauts behind the glass wall biological barrier in Room 1264 could visit with their families via an intercom system and a pass-through door adjoining the family side in Room 1016.⁷⁶ The Family Room was later converted to offices but the intercoms are still extant, just not operational.

The CRA also housed the Spacecraft Room where the CM was decontaminated as necessary. Like with every other aspect of space mission planning, NASA made provisions for spacecraft decontamination, when it was required. When CM decontamination occurred, before biological

⁷⁰ O'Kelley et al, *Primordial*, 1409.

⁷¹ Glenn Holt, 2013 oral communication.

⁷² Bogard and McCullom, *Presentation*.

⁷³ Mangus and Larsen, "LRL Project History," 35.

⁷⁴ GRAVitate, "JSC Survey," 256.

⁷⁵ GRAVitate, "JSC Survey," 256.

⁷⁶ GRAVitate, "JSC Survey," 256.

barriers (door panels) were installed, the exterior was photographed and preparations were made to connect the decontamination equipment. This first step was completed by non-quarantined personnel who did not deal with "contaminated" systems and who left the room in which the spacecraft was located when the biological barriers were installed. The Spacecraft Room contained all equipment required for decontaminating the CM, which was closely monitored using closed circuit television for quality assurance, decontamination activities, and cleanup.⁷⁷

Formaldehyde decontamination of the CM cabin and the Suit Circuit was accomplished without reopening the hatch. The Suit Circuit provided circulation of atmospheric gases through the CM environmental control unit, spacesuits, and cabin, through one of two centrifugal compressors. The environmental control unit provided air cooling, water, and breathable oxygen for the astronauts, and was connected to their spacesuits and spacecraft cabin. Following a minimum twenty-four-hour kill period, the hatch was opened and the cabin exhausted through the room air conditioning system. The water and waste management systems were also decontaminated with aqueous formaldehyde (formalin) for twenty-four hours. Spore strips were placed at random locations in the CM to verify decontamination was effective. Personnel from the CRA were trained to open the CM hatch and remove the double-bag stowed equipment, which included lithium hydroxide canisters, fecal bags, food bags, and space suits. The individual working inside the CM doffed shoe covers upon egress and all persons showered upon reentering the CRA.⁷⁸ These procedures kept the risks of contaminating the CRA and space suit room minimal.

The former CRA currently retains many of its original unique features, including soldered copper vent piping and a vent stack leading to both the bio-filter on the second floor and autoclaves in the walls. As originally designed, quarantine air supply was filtered independently from all other areas of Building 37 through the second-floor machine room (Room 206). Filtering for biological containment during the Apollo Program remains extant in Room 206. The second floor of the north wing was a human test subject facility during the Apollo Program and has since been converted to office space. Room 203C retains its original clinical sink, as well as marks on the wall from the former x-ray light box and floor imprints from the patient table.⁷⁹ The second floor also contains a freezer space for the contemporary clinic and ISS sample curation, which was originally a transformer room for Building 37.⁸⁰

Flight equipment that had been exposed to the lunar surface also underwent quarantine, including flight films and data tapes. In the oral history transcript of Terry Slezak, assigned to the CRA in the JSC Photographic Division, he described the Apollo mission film downloading and sterilizing process. Slezak's duties included still and motion photography of engineering, medical, and Public Affairs Office operations, as well as film sterilization. Slezak said, "When the spacecraft came into the spacecraft bay in the Lunar Receiving Lab, I was on the team to decontaminate the spacecraft...The procedure was to use ethylene oxide gas in an autoclave, which was pumped down to -20 inches of mercury. The initial problem was to find something that we could interleave the film with so that this gas could pass around through the film. We tried a bunch of different things, including some kind of nylon material, and it left fuzz on the film. That didn't work. Finally we ended up using—we should have thought of this earlier—the same paper that Kodak used for packaging their 120 film. It worked really well, and it would allow

⁷⁷ Johnston, et al., "The Lunar Quarantine Program."

⁷⁸ Johnston, et al., "The Lunar Quarantine Program."

⁷⁹ GRAVitate, "JSC Survey," 257.

⁸⁰ GRAVitate, "JSC Survey," 257.

the gas to pass around through the film all right."⁸¹ In addition, Slezak had special light-baffled canisters made with only a small opening in the top (about the size of a silver dollar) that allowed gas to go in, but no light could reach the film.⁸² Slezak and Fred Southard (who, according to Slezak, primarily designed the interleaving device) used to interleave the film, both 16-millimeter and 70-millimeter, then following the sixteen-hour soak in the ethylene oxide gas, the light-baffled canisters were placed into the autoclave where spore strips of *Bacillus globigii* (bacteria) were interleaved with the film so that people could open the autoclave from the outside, take the film out, and prepare the film for bonded storage at Building 37. Slezak then completed the microbiology analyses of the film, in the Sample Operations area of the Building 37, by placing the spore strips in petri dishes with algae in an incubator to try to get them to grow something. After twenty-four hours in the incubator without algae growth, "we figured we had a good kill." Following microbiology analyses, Slezak said, they called armed guards who escorted the flight film to the Photographic Technology Laboratory to finally be processed.⁸³ In the mid-1960s NASA photographic techniques shifted to the use of 16- and 70-mm (e.g., long roll) thin based film supplied by Kodak, which required a humidity-controlled cold storage vault to preserve the film.⁸⁴ Temporary bonded cold film storage was provided in a freezer in the second-floor machine room (Room 206) in Building 37.⁸⁵

Support and Administrative Area

The Support and Administrative Area, located on the first floor, was designed to operate outside of the biological barrier, providing offices and conference facilities for visiting researchers during missions, a visitor viewing area, a data storage and retrieving system, and support laboratories for pre-flight sample preparation for biological testing. The Apollo pressroom was located in the contemporary first floor conference room (Rooms 1002 and 1006). Room 1002 was the astronaut side of the pressroom located behind the biological barrier. A glass viewing wall separated Rooms 1002 and 1006.

Current Facility Functions

During the *NASA Johnson Space Center, Historic and Architectural Survey and Evaluation of Facilities* survey completed for NASA JSC in 2016, Building 37 supported the Medical Operations Branch of the Space Life Sciences Directorate and the Crew and Thermal Systems Division of the Engineering Directorate.⁸⁶ The first floor supported Space Toxicology offices and Medical Operations clinical laboratories, including the Biochemistry Laboratories, Toxicology Laboratory, DNA Laboratory, and Medical Ops Clinical Support Laboratory. The second floor, which was restricted to the west wing, was dominated by a large machine room (2M1) with subdivided office spaces located in the northwestern portion of the second floor. The third floor was further restricted to the northwestern portion of the west wing and consisted of Microbiology office space (Room 302) and the Microbiology Laboratory (Room 302A). Building 37 resembled, in structural form, what facility manager Glenn Holt described in

⁸¹ Slezak, Terry. Oral History Transcript, NASA Johnson Space Center Oral History Project. Interview by Rebecca Wright, Boerne, Texas (July 29, 2009), 22.

⁸² Slezak, "Oral History," 22-23.

⁸³ Slezak, "Oral History," 22-23.

⁸⁴ Slezak, "Oral History," 11, 18.

⁸⁵ Slezak, "Oral History," figure TS_11.

⁸⁶ GRAVitate, "JSC Survey," 258.

conversation as an “off-center wedding cake” composed of three floors.⁸⁷ Through 2016, Building 37 laboratories were integral to operations in JSC’s Buildings 8, 228, 241, 261, 266, and 272.

Currently, Building 37 is being prepped for demolition. All re-usable equipment and architectural features have been relocated and are being repurposed in other buildings or have been placed in storage until JSC’s new life sciences building is operational.

D. Site Information

Building 37 was sited at the Manned Spacecraft Center (MSC), now JSC, for proximity to the engineering and medical teams that would perform post-flight assessments, to avoid delays in schedule, and because the MSC bore responsibility for the Apollo program operations, including sample reception and distribution. Situated to the south of Avenue B, between Fourth Street and Fifth Street, Building 37 is immediately adjacent to Building 59, the Mockup Warehouse, to the west and Building 31, the Planetary and Earth Sciences Laboratory, to the south. The building is surrounded by cultivated landscaping, including ornamental grasses, shrubs, and hedges with scattered trees.

Auxiliary structures include Building 37A, a Tank Farm located approximately 8' immediately northwest of Building 37, Building 37AA, a Sterilizer Equipment Building located approximately 8' immediately north of Building 37, and Building 37J, a Chemical Storage Building located approximately 24' immediately southwest of Building 37. Buildings 37A, 37AA, and 37J are all support structures to the Life Sciences Laboratory.

⁸⁷ Glenn Holt, 2013 oral communication.

Part III. Sources of information

A. Primary Sources

Brown & Root, Inc, Charles Luckman Associates, Brooks & Barr, Harvin C. Moore, Mac Kie & Kamrath, and Wirtz, Calhoun, Tungate & Jackson. "Master Plan and Architectural Concept: Manned Spacecraft Center, National Aeronautics and Space Administration, Clear Lake, Harris County, Texas." *Corps of Engineers Contract No. DA-41-443-CIVENG-62-702*, prepared for U.S. Army Engineering District, Fort Worth, Texas, 1962.

Holt, Glenn. Oral communication. 2013.

Kennedy, John F. "John F. Kennedy's Special Message to Congress on Urgent National Needs," May 25, 1961, from <https://archive.org/details/jfks19611025>.

Kennedy, John F. "John F. Kennedy's Address at Rice University on the Nation's Space Effort," September 12, 1962, from <http://er.jsc.nasa.gov/ricetalk.htm>.

Kockritz, Justin, Letter to Sandra J. Tetley, "Project Review under Section 110 of the National Historic Preservation Act, Final Historic and Architectural Survey and Evaluation of Facilities at the NASA's Lyndon B. Johnson Space Center, Houston, Harris County (NASA/ 110, THC #201701384)," December 19, 2016.

Tetley, Sandra J. JP-12-008 Letter to Mark Wolfe, Executive Director, State Historic Preservation Office, Texas Historical Commission, n.d.

B. Secondary Sources

Angel, William D. "The Politics of Space: NASA's Decision to Locate the Manned Spacecraft Center in Houston," *The Houston Review Volume VI (2)*, 1984.

Archaeological Consultants Inc (ACI). "Mission Control Center (Building 30): Historical Documentation." Report prepared for NASA JSC, Houston, Texas, March 2011.

Belew, Leland F. *Skylab, Our First Space Station*. Washington, DC: U.S. Printing Office, 1977.

Bogard, Donald and Gary W. McCullom, "Apollo Lunar Quarantine Program Presentation" presented to the NASA Alumni League, Houston, Texas, June 18, 2012.

Brooks, Courtney G., James M. Grimwood, and Loyd S. Swenson. "Chariots for Apollo: A History of Manned Lunar Spacecraft," *NASA History Series, NASA Special Publications-4205*. Washington, DC: U.S. Printing Office, 1979.

Brown, Sylvia K. *Biography. Guide to the George M. Low Papers, 1930-1984*. Troy, N.Y.: Institute Archives and Special Collections, Folsom Library, Rensselaer Polytechnic Institute, 1988.

Chapman, Burton. "The First Days in Houston," *Houston History Magazine Volume VI (1)*, 2008.

- Day, Dwayne A. "Invitation to Struggle: The History of Civilian-Military Relations in Space" in *Exploring the Unknown: Selected Documents in the History of the U.S. Civil Space Program, Vol II, External Relationships*, ed. John M. Logsdon. Washington, DC: U.S. Printing Office, 1995.
- Dethloff, Henry C. *Suddenly, Tomorrow Came...A History of the Johnson Space Center, The NASA History Series, NASA SP-4307*. Washington, DC: U.S. Printing Office, 1993.
- European Space Agency. "Tribute to the Space Shuttle," from http://www.esa.int/Our_Activities/Human_Spaceflight/Space_Shuttle/Spacelab, n.d.
- Ezell, Edward Clinton, and Linda Neuman Ezell. "Testing Hardware" in *The Partnership: A History of the Apollo-Soyuz Test Project. NASA History Series, NASA Special Publications-4209*. Washington, DC: U.S. Printing Office, 1978.
- Gordon, Bob, "Where the Moon Meets the Earth," *Space News Roundup Volume 6* (18), 1967.
- GRAVitate, LLC. "NASA Johnson Space Center, Historic and Architectural Survey and Evaluation of Facilities," report prepared for NASA JSC, September 2016.
- Grimwood, James M., "PART III (A) Operational Phase of Project Mercury: May 5, 1961 through May 1962," *Project Mercury A Chronology NASA SP-4001*. Washington, DC: U.S. Printing Office, 1963.
- Hacker, Barton C. and James M. Grimwood, "On the Shoulders of Titans: A History of Project Gemini," *NASA Special Publication-4203, NASA History Series*. Washington, DC: U.S. Printing Office, 1977.
- Johnston, Richard S. John A. Mason, Bennie C. Wooley, Gary W. McCollum, and Bernard J. Mieszkuc, "The Lunar Quarantine Program," *SP-368 Biomedical Results of Apollo*. Washington, DC: U.S. Printing Office, 1975.
- King, Bert, *Moon Trip: A Personal Account of the Apollo Program and its Science*. University of Texas, Houston, 1989.
- Logsdon, John M. "Return to Flight: Richard H. Truly and the Recovery from the Challenger Accident," *From Engineering Science to Big Science: The NACA and NASA Collier Trophy Research Project Winners, NASA History Series*, ed. Pamela E. Mack. Washington, DC: U.S. Printing Office, 1998.
- Malik, Tariq. "NASA's Space Shuttle by the Numbers: 30 Years of a Spaceflight Icon," *Space.com* from <http://www.space.com/12376-nasa-space-shuttle-program-facts-statistics.html>, 2011.
- Mangus, Susan and William Larsen, "Lunar Receiving Laboratory Project History," *NASA/CR-2004-208938*. Washington, DC: U.S. Printing Office, 2004.
- Meltzer, Michael, *When Biospheres Collide: A History of NASA's Planetary Protection Programs, NASA SP-2011-4234*, History Program Office. Washington, DC: U.S. Printing Office, 2011.

Morse, Mary Louise, and Jean Kernahan Bays. "The Apollo Spacecraft – A Chronology, Volume II," in *NASA History Series, NASA Special Publication-4009*. Washington, DC: U.S. Printing Office, 1973.

National Aeronautics and Space Administration (NASA). "The Magellan Venus Explorer's Guide," *JPL Publication No. 90-24* from <http://www2.jpl.nasa.gov/magellan/guide.html>. Pasadena: Jet Propulsion Laboratory, 1990.

NASA, available online:

"About Orion," from <https://www.nasa.gov/exploration/systems/orion/index.html>, 2016.

"Apollo 7," from <https://nssdc.gsfc.nasa.gov/nmc/masterCatalog.do?sc=1968-089A>, 2017.

"Apollo 17: Mission Objective," from http://www.nasa.gov/mission_pages/apollo/missions/apollo17.html, 2011.

"Bibliographic Data, Edward G. Gibson," from <http://www.jsc.nasa.gov/Bios/htmlbios/gibson-eg.html>, 1993.

"40th Anniversary of Skylab," from <http://www.nasa.gov/topics/history/features/skylab.html>, 2013.

"Galileo," from <http://science.nasa.gov/missions/galileo/>, 2016.

"Johnson Space Center," from https://crgis.ndc.nasa.gov/historic/Johnson_Space_Center, 2014.

"July 20, 1969: One Giant Leap For Mankind," from https://www.nasa.gov/mission_pages/apollo/apollo11.html, 2014.

"The Mercury Astronauts," from <https://www.nasa.gov/content/the-mercury-astronauts>, 2015.

"Mission Information," from http://www.nasa.gov/mission_pages/shuttle/shuttlemissions/index.html, 2011.

NASA, "The History of Skylab," from www.nasa.gov/missions/shuttle/f_skylab1.html, 2003.

"NASA-ST5-51L Mission Profile," from http://www.nasa.gov/mission_pages/shuttle/shuttlemissions/archives/sts-51L.html, 2005.

"Space Shuttle Era," from https://www.nasa.gov/mission_pages/shuttle/flyout/index.html, 2015.

"Spacelab Payloads on Shuttle Flights," from http://www.nasa.gov/mission_pages/shuttle/main/index.html, 2007.

"STS-60," from <http://www.nasa.gov/mission/sts-60.html>, 2010.

“STS-91,” from http://www.nasa.gov/mission_pages/shuttle/shuttlemissions/archives/sts-91.html, 2007.

“STS-107,” from http://www.nasa.gov/mission_pages/shuttle/main/index.html, 2007.

“30th Anniversary of Apollo 11: 1969-1999” from <http://history.nasa.gov/ap11ann.html>, 2002.

NASA JSC. Real Property Record, NASA/1047/137.

NASA. “Together in Orbit: The Origins of International Participation in the Space Station,” *Monographs in Aerospace History No. 11*, from <http://history.nasa.gov/monograph11.pdf>, Washington, DC: U.S. Printing Office, 1988.

National Park Service (NPS). “NASA Johnson Space Center, Building No. 32, Space Environment Simulation Laboratory, Chambers A & B (HAER No. TX-109-B).” Washington D.C, n.d.

Nield, George C., and Pavel Mikhailovich, Ed. “Phase 1 Program Joint Report,” *NASA History Series, NASA Special Publication SP-1999-6108*. Washington, DC: U.S. Printing Office, 1999.

O’Kelley, G. Davis, James S. Eldridge, Ernest Schonfeld, and P.R. Bell, “Primordial radionuclide abundances, solar proton and cosmic-ray effects and ages of Apollo 11 lunar samples by non- destructive gamma ray spectrometry,” *Proceedings of the Apollo 11 Lunar Science Conference, Vol 2*. Washington, DC: U.S. Printing Office, 1970.

Portree, David S.F. “NASA’s Origins and the Dawn of the Space Age” in *Monographs in Aerospace History, Number 10*. Washington, DC: U.S. Printing Office, 1998.

Redmond, Charles. “The Flight of Apollo-Soyuz,” from <http://history.nasa.gov/apollo/apsoyhst.html>, 2004.

Ross-Nazzal, Jennifer. “The Right Place—Houston Makes History,” *Houston History Magazine Vol 6*, Number 1, 2008, from <https://houstonhistorymagazine.org/wp-content/uploads/2014/03/right-place-Houston-makes-history.pdf>.

Slezak, Terry. “Oral History Transcript,” NASA Johnson Space Center Oral History Project. Interview by Rebecca Wright, Boerne, Texas, July 29, 2009.

Space KSC. “Why Bush Cancelled the Space Shuttle,” from <http://spaceksc.blogspot.com/2010/03/why-bush-cancelled-space-shuttle.html>, 2010.

Space News Roundup, Editor(s).

“Astronaut Henize to fly May 16 on Airborne Spacelab simulation,” *Space News Roundup*, April 29, 1977.
<https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/77-04-29.pdf>

- “Astronauts Move to New Offices at Ellington AFB,” *Space News Roundup*, November 13, 1963. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/63-11-13.pdf>
- “Bids Open on Phase 3 of Center Construction,” *Space News Roundup*, November 14, 1962. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/62-11-14.pdf>
- “Corps of Engineers Supervise Construction at Clear Lake Site,” *Space News Roundup*, March 4, 1964. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/64-03-04.pdf>
- “Current Plans Call for Building Bids during September,” *Space News Roundup*, April 18, 1962. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/62-04-18.pdf>
- “Design Work Contract is Let for Clear Lake,” *Space News Roundup*, December 27, 1961. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/61-12-27.pdf>
- “Gemini Teamwork on Action,” *Space News Roundup*, December 23, 1966. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/66-12-23.pdf>
- “Logistics Personnel Move into New Clear Lake Offices,” *Space News Roundup*, October 16, 1963. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/63-10-16.pdf>
- “Lunar Receiving Lab Now in N.M.,” *Space News Roundup*, October 26, 1973. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/73-10-26.pdf>
- “Major Move to Clear Lake Begins February 20,” *Space News Roundup*, January 8, 1964. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/64-01-08.pdf>
- “MSC Lab Analyzes Meteorite Fragments,” *Space News Roundup*, February 21, 1969. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/69-02-21.pdf>
- “Melpar Picked to Build Lunar Quarantine Units,” *Space News Roundup*, June 23, 1967. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/67-06-23.pdf>
- “Mercury Personnel to be Shifted to Other Two Projects,” *Space News Roundup*, June 26, 1963. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/63-06-26.pdf>
- “MSC Structural Reorganization to Strengthen Space Programs,” *Space News Roundup*, November 13, 1963. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/63-11-13.pdf>

“19 Million Dollar Construction Contract Signed,” *Space News Roundup*, December 12, 1962. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/62-11-14.pdf>

“Phase II Contract Goes to Bellows, Peter Kiewit, Sons,” *Space News Roundup*, October 3, 1962. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/62-10-03.pdf>

“Philco IMCC Pact Signed for Total of \$33.8 Million,” *Space News Roundup*, April 3, 1963. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/63-04-03.pdf>

“Reagan, Bush visits mark firsts at JSC,” *Space News Roundup*, November 20, 1981. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/81-11-20.pdf>

“Real-time Computers Moved into MCC,” *Space News Roundup*, April 29, 1964. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/64-04-29.pdf>

“Skylab Crews Conduct 11 Days of Simulation,” *Space News Roundup*, September 15, 1972. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/72-09-15.pdf>

“Spacelab simulation ends at JSC, another continues in California” *Space News Roundup*, May 27, 1977. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/77-05-27.pdf>

“This Is Mission Control,” *Space News Roundup*, September 20, 1993. <https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/roundups/issues/93-09-20.pdf>

Swenson, Loyd S., James M. Grimwood, and Charles C. Alexander. “This New Ocean: A History of Project Mercury,” *NASA Special Publications-4201 in the NASA History Series*. Washington, DC: U.S. Printing Office, 1989.

Wells, Helen T., Susan H. Whiteley, and Carrie E. Karegeannes. “Origins of NASA Names,” *NASA Special Publications-4402 in the NASA History Series*. Washington, DC: U.S. Printing Office, 1976.