KSC

KENNEDY SPACE CENTER, FLORIDA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

LAUNCH COMPLEX 37 FACILITIES

SATURN HISTORY DOCUMENT
University of Alabama Research Institute
History of Science & Technology Group

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SATURN PROGRAM HISTORY AND OBJECTIVES

Saturn I, Saturn IB and Saturn V are the launch vehicles of the Apollo program which has as its major goal the landing of astronauts on the moon and returning them safely to earth.

Under the direction of the Office of Manned Space Flight, NASA, the Apollo program is a joint responsibility of the Manned Spacecraft Center, Houston, Texas; Marshall Space Flight Center, Huntsville, Alabama; and Kennedy Space Center, Florida.

Development of Saturn launch vehicles is directed by the Marshall Space Flight Center. The Manned Spacecraft Center oversees development of the Apollo spacecraft systems and manages astronauts selection and training.

Kennedy Space Center conducts NASA launch operations. KSC provides the launch facilities and is responsible for receiving, inspecting, assembling, preflight testing and launching Apollo/Saturn space vehicles.

The first flight of the fully configured Saturn I space vehicle from Complex 37 occurred January 29, 1964, establishing a number of milestones in the national space program. It was the first time the booster engines were used at full-rated thrust; the first flight of the live hydrogen-filled second stage; and the first flight of the instrument unit. The vehicle placed 38,700 pounds in earth orbit.

The Saturn I series was completed with the successful launches of five more vehicles from Complex 37, three of which placed Pegasus micrometeoroid detection satellites in orbit.

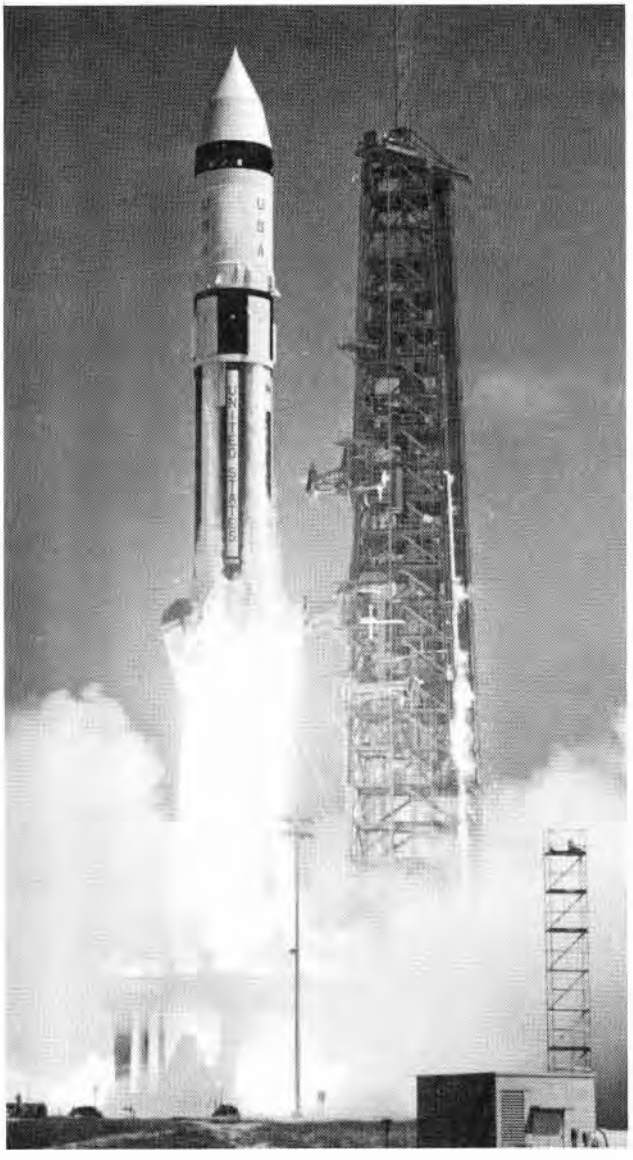
Aerial view of Launch Complex 37 shows the rail-mounted service structure positioned at launch Pad B to the right. Pad A is to the left. Igloo-shaped building in the foreground is launch control center.

SATURN IB PROGRAM

After completion of the Saturn I program, facilities at LC-37 were modified for the assembly, checkout and launch of the larger and more powerful Saturn IB vehicles. These vehicles are designed to boost Apollo spacecraft into earth orbit for vehicle and spacecraft qualification. The Saturn IB launches represent the second phase of the program leading to the manned Apollo/Saturn V lunar missions.

The first Saturn IB launch from Complex 37 took place July 5, 1966. It successfully demonstrated second stage restart capability which is essential to successful lunar flights, and transmitted TV photos of liquid hydrogen fuel behavior to ground stations. The second stage, weighing 58,500 pounds made four orbits of the earth.

Launch of AS-203, the first Saturn IB space vehicle launched from Complex 37.



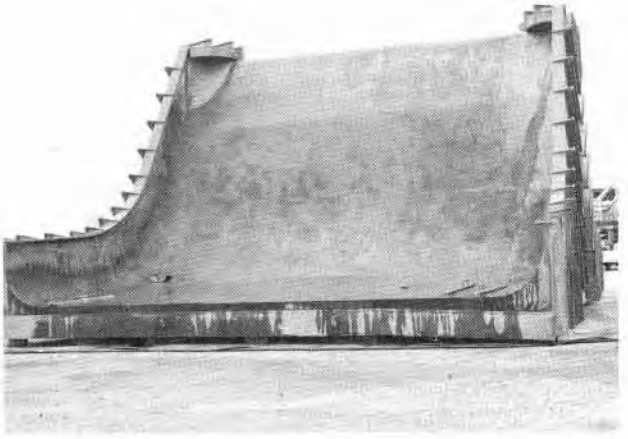
LC 37 FACILITIES

Complex 37 includes two launch pads connected by a 1,200 foot-long railway. Each launch pad has a launch pedestal, umbilical tower, and automatic ground control station. Both pads are served by a single service structure and launch control center.

LAUNCH PADS

The launch pads at LC-37 are 300 feet square and have maximum height of 16 feet above sea level. The pad areas are covered with fire brick to minimize erosion caused by first stage engine ignition. Located at each pad is a steel launch pedestal which provides a platform to support the launch vehicle and certain ground support equipment. Each pedestal is 35 feet high and 55 feet square. An opening, 32 feet in diameter in the center of the pedestal, allows access to the first stage of the vehicle and permits passage of exhaust to the flame deflector below. Eight holddown arm assemblies are bolted around the opening in the top of the launch pedestal to support the vehicle. These holddown arms hold the vehicle on the pad until all first stage engines are operating at full thrust and then release the vehicle for flight.

Flame deflector.



There are three inverted V-shaped flame deflectors, one at each pad and one held in reserve. Each is 21 feet high. They are constructed with a series of steel trusses covered with 1-inch thick steel skin, and coated with 4 inches of a special heat-resistant refractory material.

The two umbilical towers are approximately 900 feet apart. Each is a 268-foot-high steel-trussed structure. Four swing arms are attached to each tower by hinged joints. Each swing arm carries lines between the space vehicle and um-

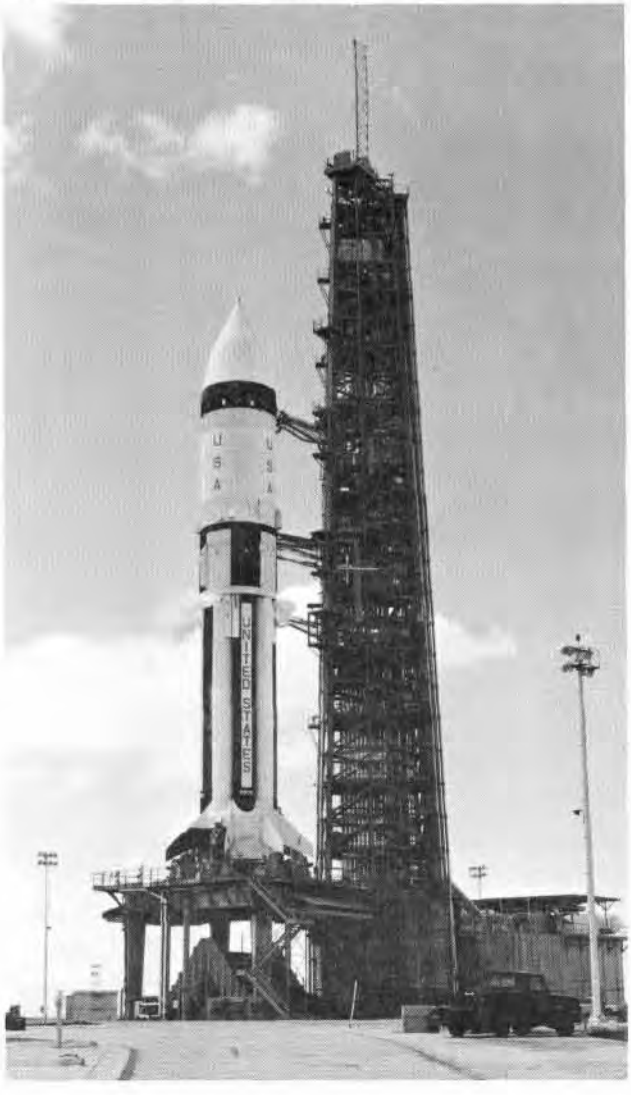
bilical tower which lead to ground-based power, air conditioning, hydraulic, pneumatic, fuel, measuring and command systems.

At the 228-foot level of the umbilical tower is the Apollo spacecraft access arm which is attached to the environmental chamber, or "white room." The umbilical tower elevator provides a fast means of egress, designed to operate in either a normal or emergency mode. It is capable of carrying 3,000 pounds at 450 feet per minute.

Mounted on the umbilical tower is a boom hoist capable of lifting 2-1/2 tons, equipped with a trolley that extends the hook 27 feet from the boom pivot.

Located at the base of the umbilical tower is an automatic ground control station that contains digital computers and checkout equipment. It also serves as a distribution point for cables, provides space for vehicle test power equipment and serves as a distribution point for all high-pressure gases. The station occupies 16,884 square feet of space at four levels.

AS-203 during countdown demonstration shows the swing arms leading from the umbilical tower to the vehicle. Flame deflector is visible under the launch pedestal.



The RP-1 facility stores and transfers fuel to the launch vehicle's first stage. The remotely trol center. The storage tank is 67 feet long and 12 feet in diameter. It has a 43,500-gallon capacity; a fast-fill transfer rate of 2,000 gallons per controlled, automatic/semiautomatic system consists of equipment located at the storage facility, automatic ground control station and launch conminute and a slow-fill rate of 200 gallons per minute.

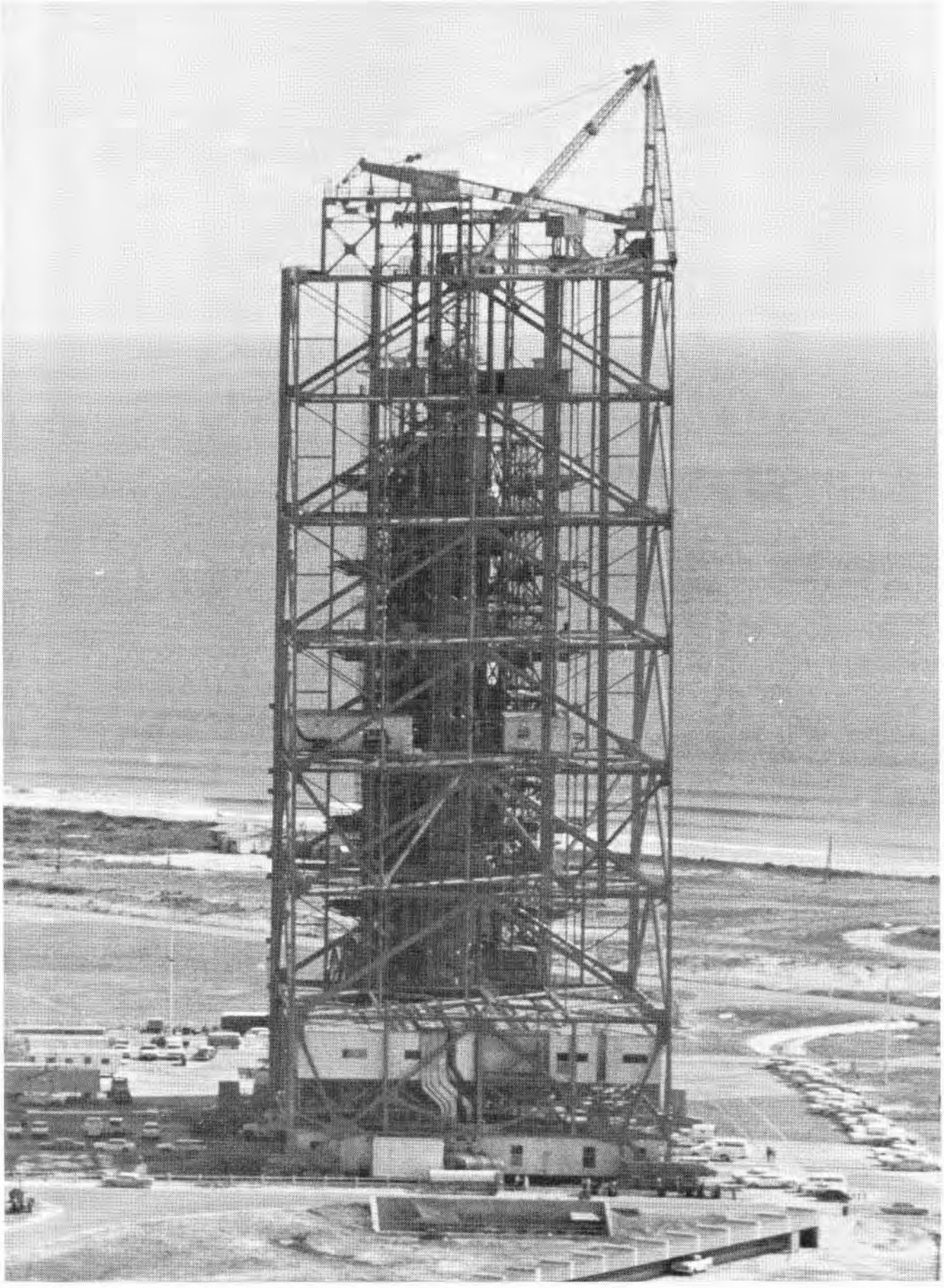
Liquid oxygen is stored and transferred at -297° F. The liquid oxygen facilities store and transfer LOX to the vehicle's first and second stages during fill and replenish operations. A main tank and a storage tank are provided.

Liquid oxygen service facility

The main tank is a double-walled sphere insulated with perlite and pressurized with gaseous nitrogen. It measures 42 feet in diameter and has a 125,000-gallon capacity.

The replenish tank is a vacuum-and perlite insulated double-walled cylinder that is 62 feet long and 11 feet in diameter, with a 28,000-gallon capacity.

Liquid oxygen is transferred to the first stage at the rate of 2,500 gallons per minute; second stage transfer rate is 1,000 gallons per minute.



Service Structure

Liquid hydrogen is stored and transferred at −423°F. The fuel is supplied to the second stage of the Saturn IB vehicle by the remotely controlled, automatic/semiautomatic liquid hydrogen system, which consists of the storage facility, transfer line and control equipment. The 125,000-gallon storage tank is a double-walled, vacuum-and-perlite insulated sphere 39 feet in diameter.

The converter-compressor facility serves both Launch Complex 34 and 37 as the source of all gaseous nitrogen and helium required to check out, service and launch uprated Saturn I vehicles.

Storage for liquid nitrogen is provided by a 125,000-gallon, double-walled spherical tank, and a 35,000-gallon tank. Liquid nitrogen is converted to gaseous nitrogen by means of four high-pressure vaporizers and two low-pressure vaporizers. The nitrogen from the high-pressure vaporizers is transferred to gaseous nitrogen storage cylinders (batteries). Four 200-cubic foot vessels and six clusters of nine vessels each (200 cubic feet per cluster) are manifolded together to form the nitrogen battery.

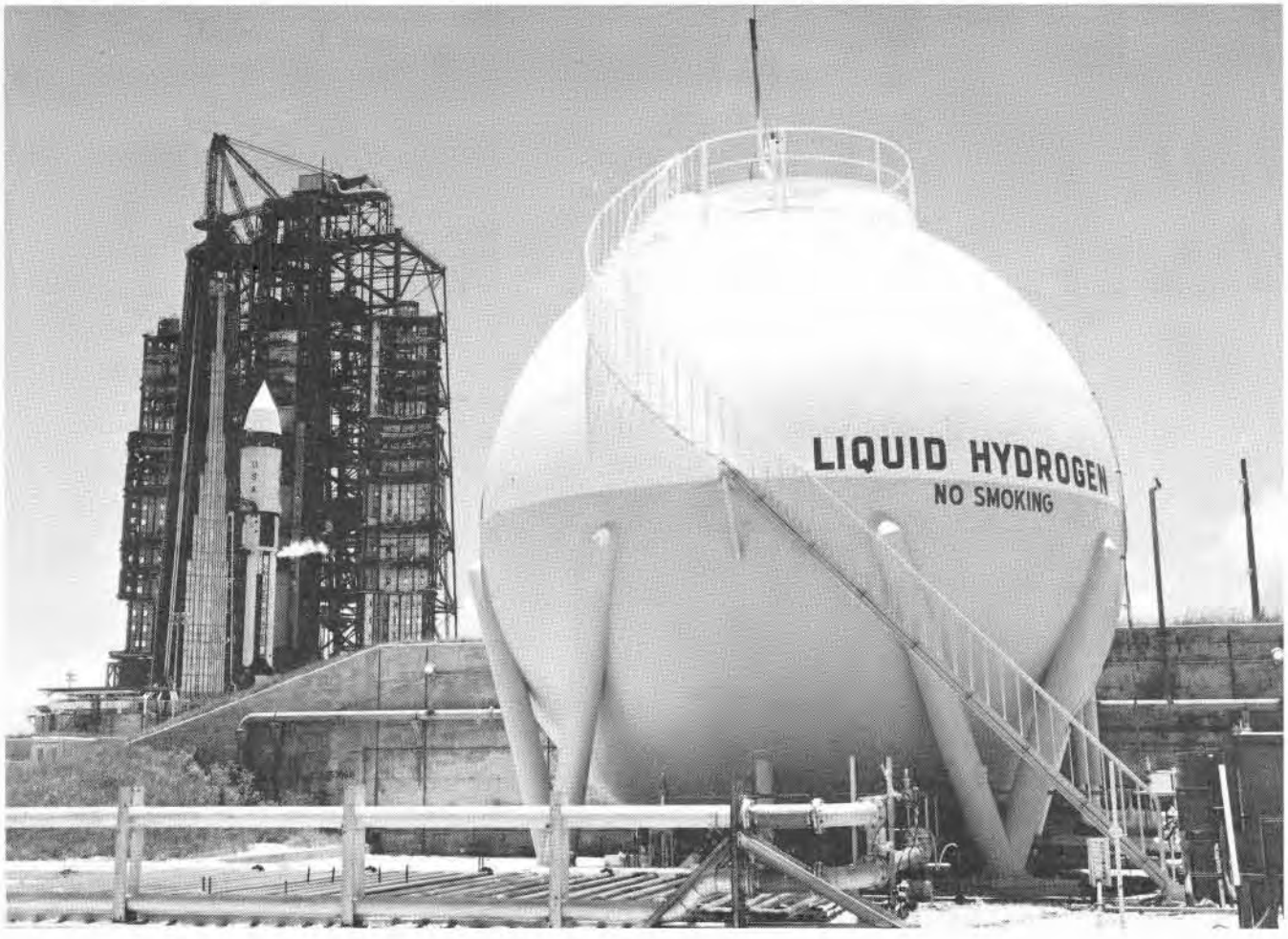
Helium is compressed by means of three separate four-stage compressors, and is stored in the helium battery which consists of six clusters of vessels (200 cubic feet per cluster) each manifolded together. Both the nitrogen and helium batteries supply gas at a pressure of 6,000 pounds per square inch and contain filters, dryers, relief valves and shutoff valves.

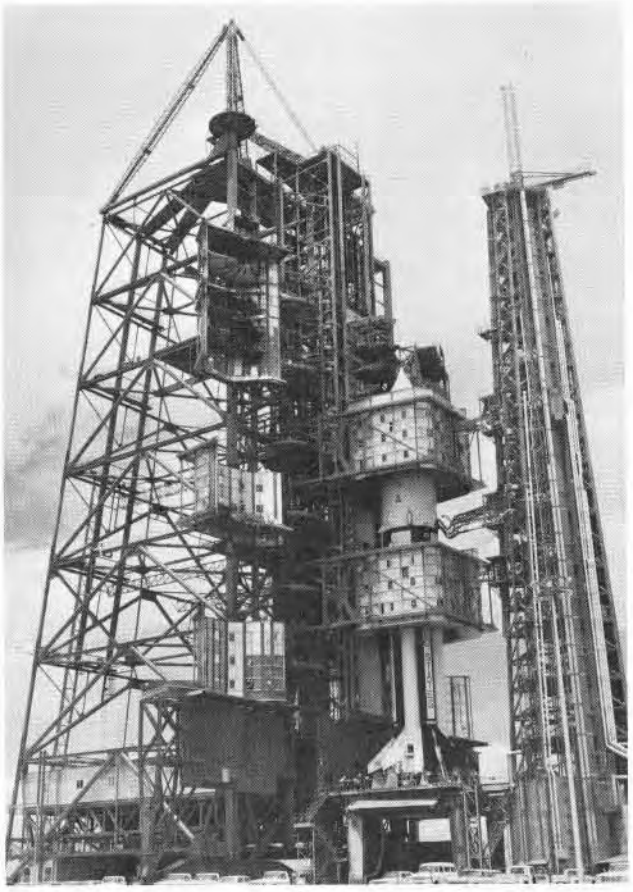
A high-pressure hydrogen battery supplies hydrogen gas for the second stage of the launch vehicle. The battery consists of two cylindrical gaseous hydrogen vessels capable of delivering a maximum pressure of 6,000 pounds per square inch.

SERVICE STRUCTURE

The 5,200–ton service structure at LC-37 provides for vertical erection, assembly and checkout of Saturn IB vehicles. It contains work platforms for personnel, cranes for lifting rocket stages and spacecraft into place on the launch pedestal, and provides protection from the weather for both the space vehicle and personnel.

Liquid hydrogen service facilities.





Service structure silos enclose portion of space vehicle at launch pad during test and checkout operations. Umbilical tower is to the right.

The self-propelled service structure is mounted on four trucks that ride on rails, and is driven by four 100-horsepower electric motors. The trapezoidal structure is of rigid-truss construction and extends to a height of 300 feet. The base of the service structures measures 120 feet square.

There are four elevators in the service structure and a minimum of 10 work platforms at various levels. Each elevator has a 3,000-pound capacity. Access to the service platforms is from individually adjusted platform landings. Weather protection is provided by a hurricane curtain around the launch pedestal which extends from the 35-foot level to the 65-foot level, and split "silo" enclosures that reach to the 248-foot level.

At the launch pad, support points lift the service structure from the trucks and anchor it to the ground. Before the Saturn IB is launched, the service structure moves to its parking position at the opposite pad.

LAUNCH CONTROL CENTER

Personnel, instrumentation and control equipment connected with checkout and launch activities are housed in the launch control center, which also provides blast protection in the event of a launch vehicle explosion.

The launch control center is a two-story,

Exterior view Launch Control Center

dome-shaped building located approximately 1,200 feet from the launch pad. The dome, constructed of reinforced concrete, varies in thickness from 7 feet at the top to 41 feet at the base. The interior is sprayed with a 2-inch coat of acoustical material. The building contains 20,968 square feet of space and is designed to withstand blast pressures of 2,188 pounds per square inch.

The first floor is used by personnel involved in tracking, telemetry, and closed-circuit television communications. Launch control and various monitoring recording consoles are located on the second floor.

SUPPORT BUILDINGS

The 102-foot by 40-foot operations support

Engineers and technicians at consoles of launch control center conduct prelaunch countdown procedures prior to launch of ***Saturn IB.***

building, located adjacent to the launch control center, provides 5,600 square feet of space at two levels for critical spare parts storage, mechanical equipment and personnel work areas.

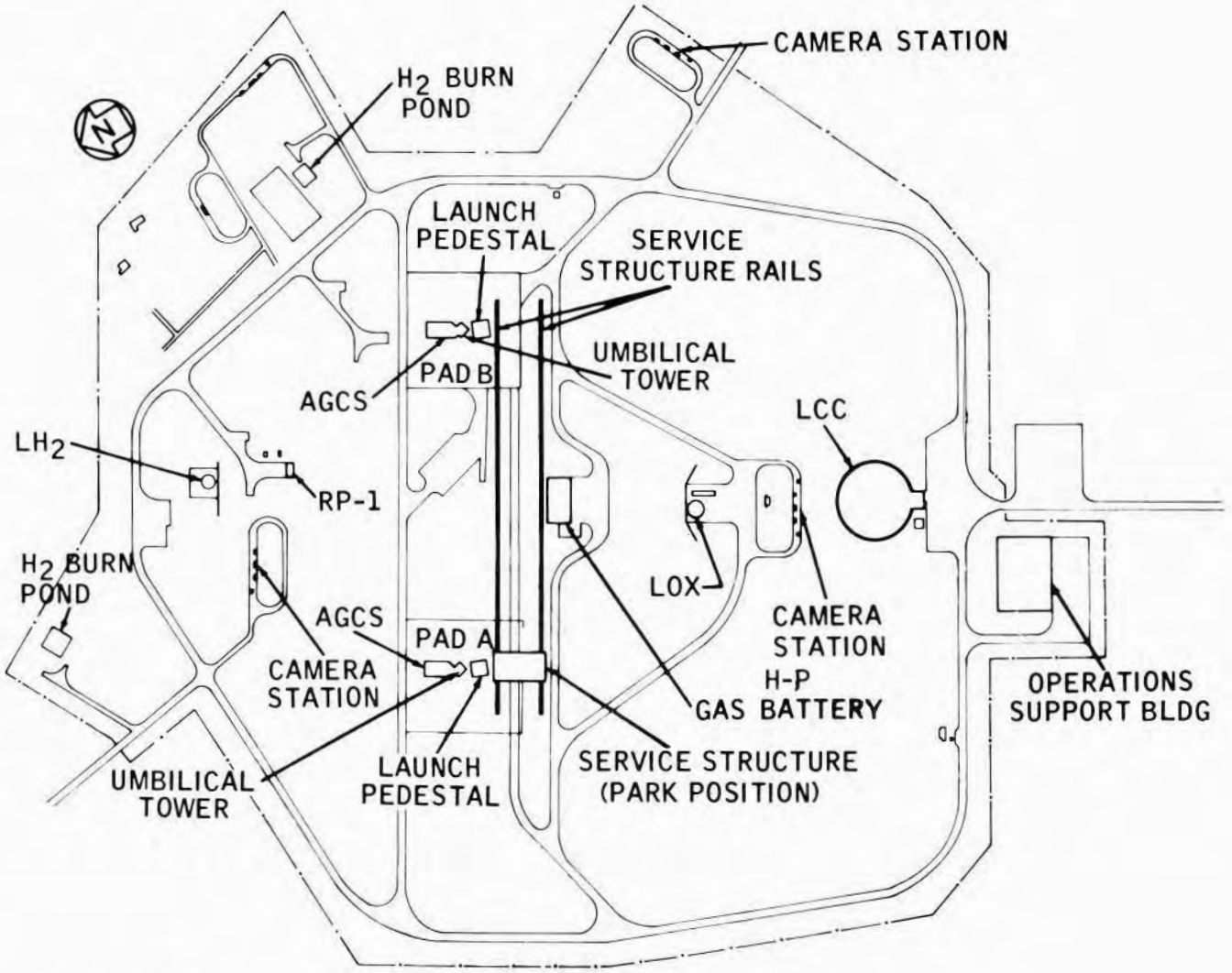
The spare parts storage building at Complex 37 provides 6,000 square feet of enclosed storage space and 2,000 square feet of outside storage for equipment associated with launch operations. The building is 162 feet long and 42 feet wide.

COMMUNICATIONS SYSTEM

Completely flexible intercommunications, closed-circuit television, timing distribution and paging systems exist between all operational areas.

The intercom system is a two-wire system compatible with other on-site systems. Various control station panels are tied in with the Eastern Test Range; external tie-ins are also provided with launch-associated agencies including the Mission Control Center, Houston, Texas; worldwide tracking network, Goddard Space Flight Center, Greenbelt Maryland; and NASA Headquarters, Washington, D. C.

The closed-circuit television system contains monitors and cameras which have a complete mass switching capability from the launch control center. Numerous views of prelaunch activities in the vicinity of the complex can be selected. Distribution of launch countdown information is accomplished from the launch control center after generation by range support operations.



Site Plan, Complex 37.