THE NATION'S FIRST SPACE PORT

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The Nation's first space port is now under construction at the John F. Kennedy Space Center, NASA. Our chairman, Mr. Holmes, had much to do with this undertaking during his tour in NASA, and we are happy to acknowledge his truly fine support. This paper covers some of the unusual developments in the facilities and equipment areas as well as our management plans and some future considerations for which provision has been made in our planning and designs.

To establish a frame of reference, it is necessary to go back to 1961, when NASA and the Department of Defense undertook a study to select a suitable location for the space port. Major General Leighton Davis represented the Department of Defense, and I represented NASA. We surveyed eight possible sites, including Hawaii, Christmas Island, locations in Texas and Georgia (including offshore islands), and the Cape Kennedy area.

An island base would offer distinct advantages but would also create serious problems in construction and logistics. Cape Kennedy offered the completely instrumented Atlantic Missile Range, plus communities to house our people, and good transportation networks. Further, there was available an undeveloped tract of lowland and swamp on northern Merritt Island, contiguous to the Cape, which would provide adequate room for building as well as the necessary buffer zones between the operational areas and the populated Florida mainland.

General Davis and I, therefore, recommended acquisition of the Merritt Island site of approximately 88,000 acres. NASA and the Department of Defense accepted the recommendation. In 1962 the Congress authorized NASA to acquire the property and has thus far authorized $74 million, of which we have committed $63 million to date.

The Merritt Island location lies between the Cape

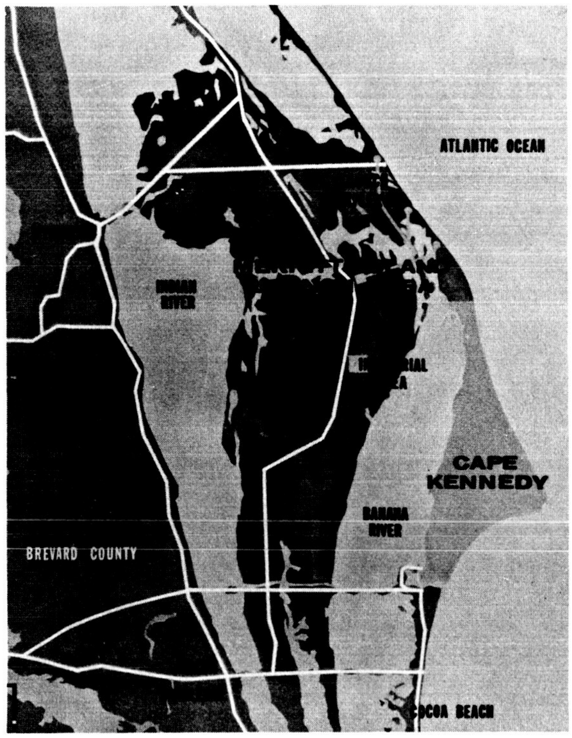

FIGURE 1.—Merritt Island location.

and the mainland (fig. 1). We are building causeways to provide direct access from U.S. Highway 1 to the NASA complex and the Cape. These arteries will be open to official traffic September 1 this year. We anticipate that they will become the principal means of access both to the Kennedy Space Center and to the Atlantic Missile Range.

About 42 percent of the total area west of Highway A-1-A, which bisects Merritt Island, has been placed under control of the U.S. Bureau of Sports Fisheries and Wildlife for land management. This is subject to recall by NASA in the event of future need. Sportsmen will be interested in the fact that the Bureau has posted much of the tract as a wildlife refuge for the seasonal concentrations of waterfowl. We have also outleased some producing citrus groves, which will continue to play a part in the local economy.

Having received authorization to acquire the land, and more than 92 miles of shoreline on the Banana and Indian Rivers and the Atlantic Ocean, we set to work on the master plan for site development. From this we derived the funding requirements reflected in the Space Authorization Acts of fiscal years 1963, 1964, and 1965. As the following tabulation indicates, we have reached the investment peak; and the demands on construction funds will taper off quickly in the next and subsequent years until we are required to accommodate vehicles much larger than Saturn V.

Fiscal year	Land acquisition	Construction
1962	$57,750,000	
1963	$27,750,000	$261,466,000
1964		$274,491,000
1965		$89,520,000 (requested)

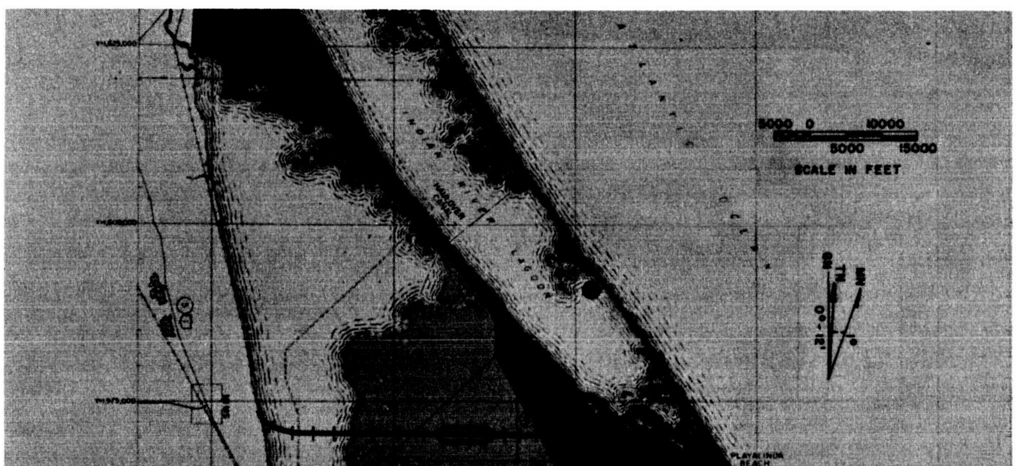

FIGURE 2.—Merritt Island industrial and launch areas.

Our planning focused on two major areas. One, in the southern portion of the site, is an industrial area directly west of Cape Kennedy across the Banana River (fig. 2). More than 50 structures are under construction. All the utilities and services expected of a municipality will be provided, such as a post office, fire and police stations, rail yard, heliport, and roads, and a communications center and dispensary which are already open and in business.

The foundation of the Kennedy Space Center Headquarters is being prepared (fig. 3). This will serve as the administrative center for the entire Merritt Island launch area. We expect to vacate our cramped quarters on Cape Kennedy next Spring and transfer into the new structure.

Another large structure site in the industrial area will house the field office of the Manned Spacecraft Center (fig. 4). This is the Operations and Checkout Building, in which Gemini and Apollo spacecraft will be assembled and inspected prior to mating with their launch vehicles. Here, too, quarters will be provided for the astronauts who will live at the launch site for several weeks prior to flight.

The first of the mission facilities will be ready for occupancy in June. This will be comprised of a group of buildings identified as the Fluid Test Complex (fig. 5), where MSC will first check out Gemini capsules. These structures are located along the eastern edge of the industrial area and will be used for preflight tests

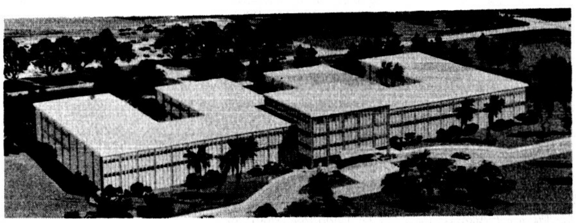

FIGURE 3.—Kennedy Space Center Headquarters.

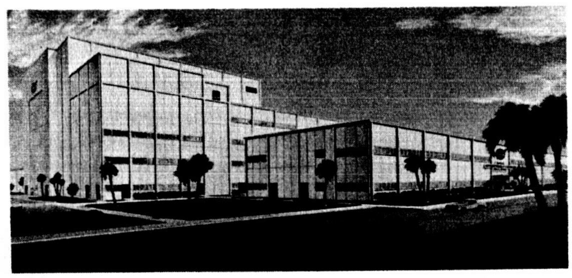

FIGURE 4.—Operations and Checkout Building.

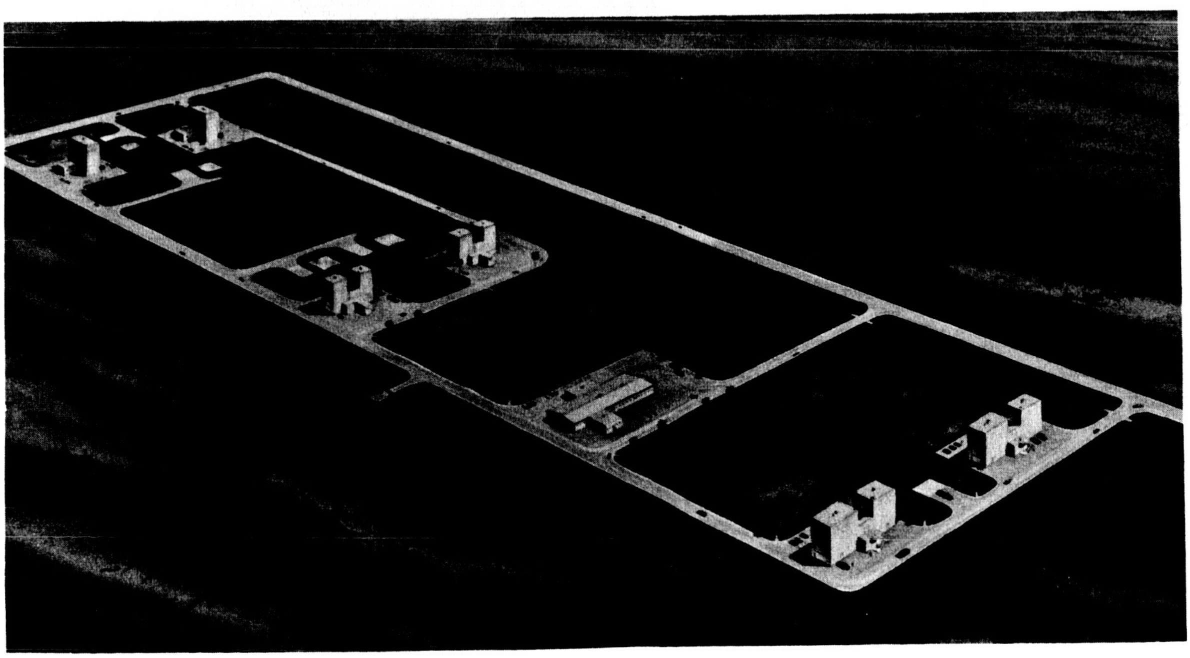

FIGURE 5.—Fluid Test Complex

of life-support equipment and propulsion systems of Gemini and, later, the Apollo spacecraft.

The Central Instrumentation Facility will be located next to the Kennedy Space Center Headquarters. It will function as the primary distribution point for data received from NASA and Atlantic Missile Range instrumentation during checkout and launch of heavy space vehicles from Complex 39.

Mechanical engineering buildings, laboratories, and warehouses round out the industrial area complex.

Seven miles north of the industrial area, construction is in progress on Launch Complex 39 (fig. 6). It involves an investment of nearly $450 million, which is without precedent in the category of U.S. launch facilities. But, then, so is the complex itself. The real distinction of Complex 39 is the operational concept which shaped its design.

Conventionally, the stages of large space vehicles have been separately transported to the launch pads and assembled, using heavy service structures for this purpose. This means that the vehicle is fully exposed to weather and the corrosive effects of the beach atmosphere. This is true of the present Saturn I facilities, such as Complex 37, pictured in figure 7. In effect, this constrains the launch preparations to a fixed facility and has the major disadvantage of concentrating prelaunch assembly and checkout operations right on the pad. This not only denies any flexibility but ties up the entire launch complex for months in the case of man-rated vehicles. It also rules out any possibility of rapid and successive launches which should be anticipated in lunar missions or the resupply of orbiting space platforms.

Complex 39 was designed, therefore, to eliminate these imposed conditions. For the first time, we will have a mobile facility. With the advent of Saturn V, we can assemble and prepare the entire machine for flight in a controlled environment, then transport it to the pad, fuel, and launch it in minimum time.

FIGURE 6.—Launch Complex 39.

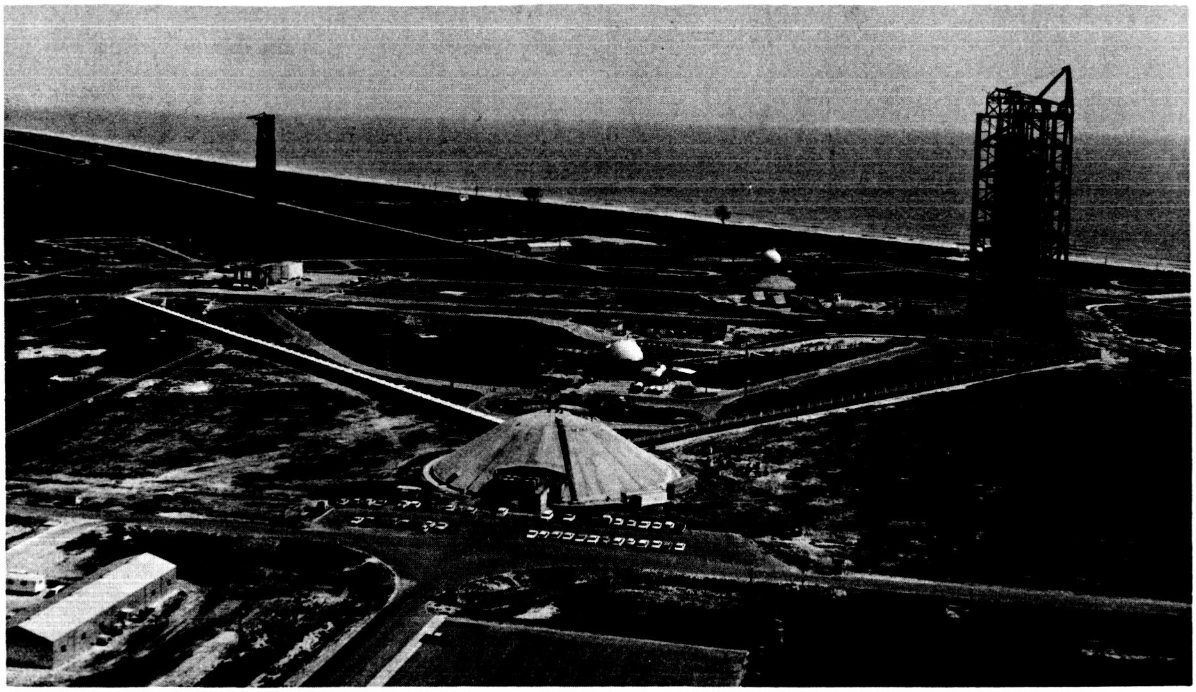

FIGURE 7.—Complex 37.

The assembly and checkout functions will be accomplished in a hangar, instead of on an exposed service structure. It will be possible to move the entire vehicle, not just pieces of one, out of the way of such hazards as storms. Since the pad is not tied up, except for a relatively short period during the actual launch, we can schedule successive launches from the same facility. We will carry the service tower with the launch vehicle and transfer them as a package from hangar to pad, or vice versa if necessary.

As is true in other facets of the Saturn program—such as manufacturing, testing, human engineering, and launch operations—the construction phase is also a first. It involves the construction of some very large structures and the fabrication and assembly, on site, of a crawler-transporter capable of moving the complete Saturn/Apollo configuration between assembly building and launch pad.

The Vertical Assembly Building (VAB), in which the Saturn V/Apollo will be assembled and checked out, will be a smooth steel box of rather large proportions—710 feet long, 518 feet wide, and 552 feet high, which is a little higher than Florida's palm trees. Much of the structural steel is already in place (fig. 8 and 9). The challenge which this structure posed to the architects and engineers of the design team has been very well stated by Max Urbahn, who headed this group:

> The VAB is not so much a building to house a moon vehicle as a machine to build a moon craft. The Launch Control Center that monitors and tests every component that goes into an Apollo vehicle is not so much a building as an almost living brain.

In the high bay area of the VAB (fig. 10), beneath a ceiling 50 stories high, there will be multilevel

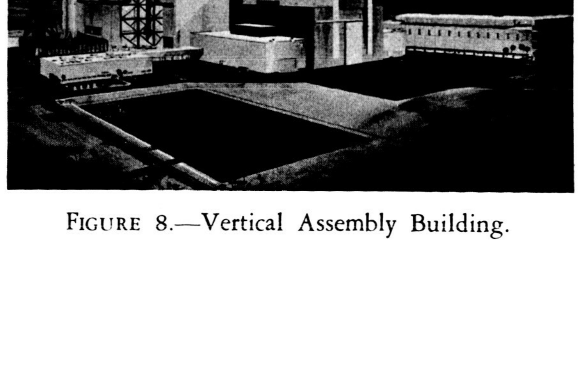

FIGURE 8.—Vertical Assembly Building.

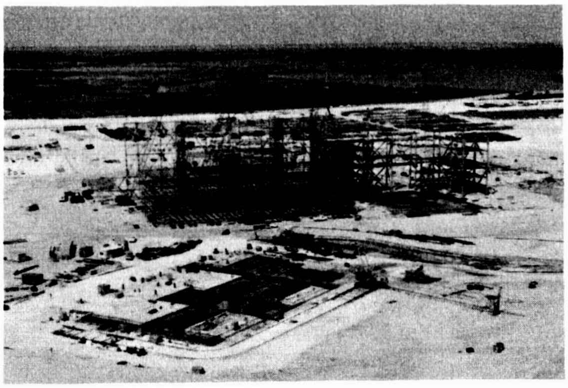

FIGURE 9.—Construction of Vertical Assembly Building showing structural steel in place.

platforms, each as large as a three-story house, suspended from the walls. These structures will enclose the Saturn V/Apollo and provide access to the entire vehicle at any height. The VAB will accommodate four complete vehicles simultaneously and thus facilitate a high-launch rate. Only two of the four bays will be equipped initially.

The low bay area, although less imposing, is by any other measure a very large structure (fig. 11). Here the upper stages of the Saturn V/Apollo will be received and inspected before the 175-ton transfer aisle crane picks them up and moves them into the high bay for sequential assembly atop the booster. The entire building will be ready by early 1966.

The Launch Control Center (fig. 12) is a semidetached wing of the VAB that will house all systems required in checkout and launch operations. We plan to employ digital data transmission techniques of data and quality. This Center will be located 3 miles from the launch pads; thus, there is no need for the conventional, bomb shelter-type construction. Instead, the launch team will enjoy a picture window view of pad work and the actual launching.

The Launch Control Center will be connected with the vehicle through the launch umbilical tower (fig. 13) on which it will be assembled within the VAB. The mobile LUT, as we call it, resembles a conventional launch pad; but it is much larger and, more significantly, it is movable. Its mobility is the key to the operation of Complex 39. The LUT has a supporting platform one-half acre in size and 25 feet thick. Inside are 30 compartments on two levels, where much of the electrical and pneumatic equipment normally housed under the launch pad can be

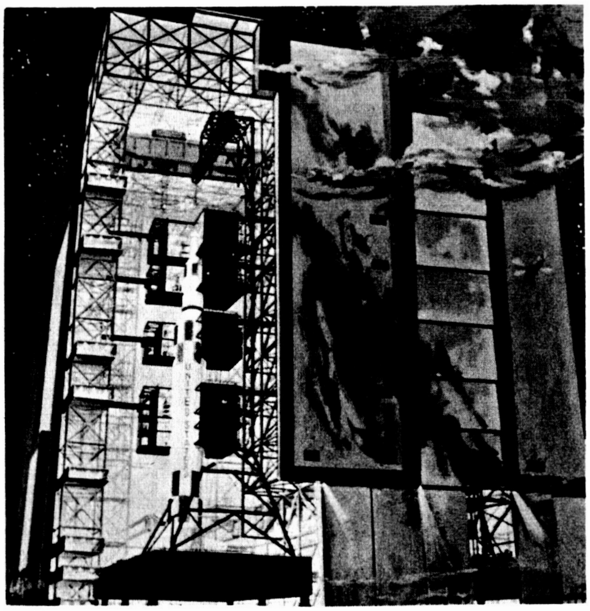

FIGURE 10.—High bay area of Vertical Assembly Building.

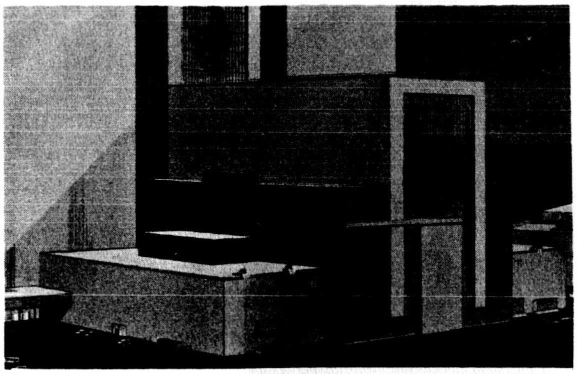

FIGURE 11.—Low bay area of Vertical Assembly Building.

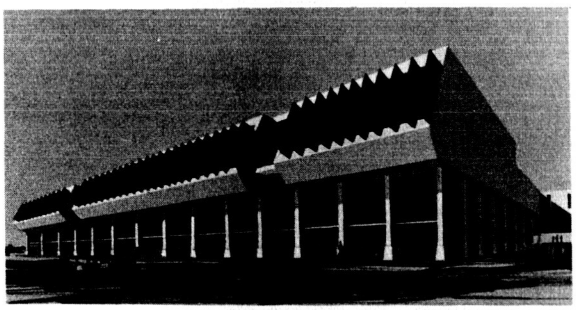

FIGURE 12.—The Launch Control Center, a wing of Vertical Assembly Building.

placed. Through the LUT's systems, the launch crew can supply pneumatic, electrical, and propellant feeds to the vehicle at various levels.

When the vehicle is ready for transfer to the pad, the crawler-transporter (fig. 14) will come into use. This machine is really an oversized version of the heavy crawlers developed by the earth-moving industry and often employed in strip mining. Its proportions are such that it could not be transported from point of manufacture to Merritt Island, so it is being brought to us in manageable pieces and assembled on site. It will weigh 5.5 million pounds when completed and can transport up to 12 million pounds.

Several days before launch the crawler will pick up the LUT and the space vehicle (fig. 15) and move them to the pad. It will then reverse its course toward the VAB, traversing a specially prepared roadway some 8 feet thick, and transport the arming

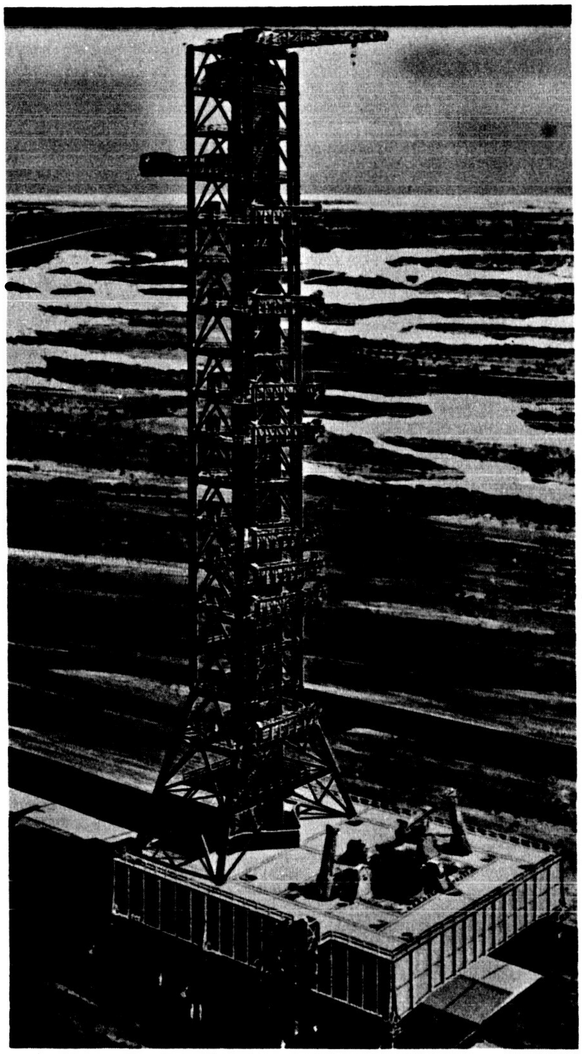

FIGURE 13.—Launch umbilical tower (LUT).

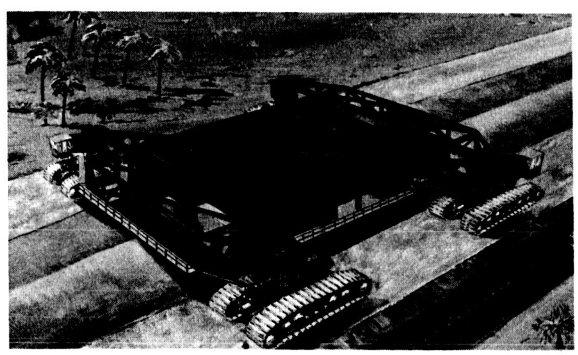

FIGURE 14.—The crawler-transporter.

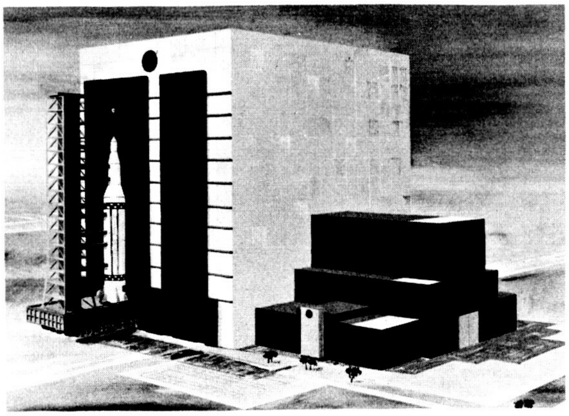

FIGURE 15.—Transfer of launch umbilical tower and vehicle by the crawler from the Vertical Assembly Building to the launch pad.

tower (fig. 16) to the pad. This tower will be 340 feet tall; it will provide 360-degree access during the installation of sensitive or residual ordnance at stage junctions, and during fueling of the spacecraft. The arming tower will be withdrawn 7 hours prior to launch.

As mentioned in connection with the crawler-transporter, much of the ground support equipment is being assembled at the space port. We have reached the phase in manned spaceflight where the facilities and equipment necessary for launch operations are so large as to make it impractical to assemble them elsewhere. Thus, the first of the LUT's is also arriving in piecemeal fashion and is now in process of erection where the crawler is under assembly.

The crawlerway is being graded in preparation for paving from the VAB area to the pads near the ocean beach. Good progress is being made in the entire construction project. The Army Engineers are supervising the facilities construction for NASA.

Similarly, in the less technical aspects of the Kennedy Space Center activities, we have placed increasing reliance on industry. In the past, the Air Force provided this kind of support through a base contractor at Cape Kennedy. The Merritt Island launch area is, however, an exclusive NASA responsibility. So we decided to divide the support functions into four areas: administration and maintenance, instrumentation, base operations, and launch support operations.

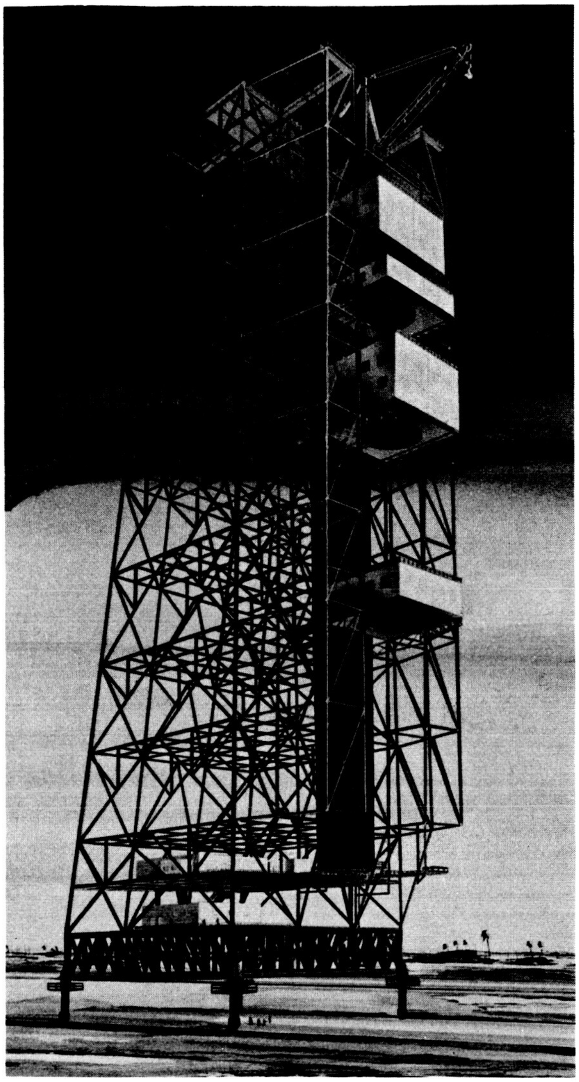

FIGURE 16.—Arming tower.

We then selected firms specialized in the first three of these fields of activity and negotiated contracts with them with a basic value of from $1 million to $7 million for fiscal year 1965. The launch support operations contract has not yet been concluded. Each of the support contracts contains an incentive award provision, plus an option to extend it for 2 additional years, or a total of 3 years; in this way we hope to retain and preserve the experience gained by the contractor.

To put it briefly, the Merritt Island launch area can accommodate the next class of space boosters beyond

Saturn V, perhaps of 25 to 40 million pounds thrust. We have conducted studies of noise levels, explosive safety distance requirements, and other factors; the results indicate quite clearly that is is feasible to launch such vehicles from the space port. We have reserved a fairly large area north of Complex 39 for more advanced facilities whenever the space program may require them.

Looking farther down the road, and applying my personal judgment as to the logical trends, the sequentially staged vehicles may, with Saturn V, reach their limits of height and slenderness ratio. Anything beyond the Saturn V would present enormous problems of structural integrity. So I consider it likely that the 25 to 40-million-pound-thrust boosters may be much shorter and stubbier, much larger in diameter, but designed for launching from the new space port. When the future space program demands even more powerful boosters than those of the 40-million-pound class, I believe we may have to go to sea to assemble and launch them from pads similar to the Texas tower-type oil rigs.

NASA is investigating methods of transportation, or resupply, between points on Earth and very large spacecraft or space platforms. One concept would employ sled-boosted, two-stage vehicles. The *first stage* would be reusable, and its function would be to carry the upper stage and payload beyond the atmosphere. Then its astronaut pilot would fly that first stage back to a jet airfield. The *second stage,* also reusable, would transport passengers or freight to the space station and be capable of reentry and operation within the atmosphere to land at its operational base. This concept seems to be the most promising area for investigation. The big boosters, in my judgment, would be useful only for launching very heavy mass into space.

In any event, the learning curve is rising rapidly. I firmly believe that this nation can and will do anything which the people determine as the national policy for the future exploration of the universe.