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When man first walked on the moon, Long Island was there

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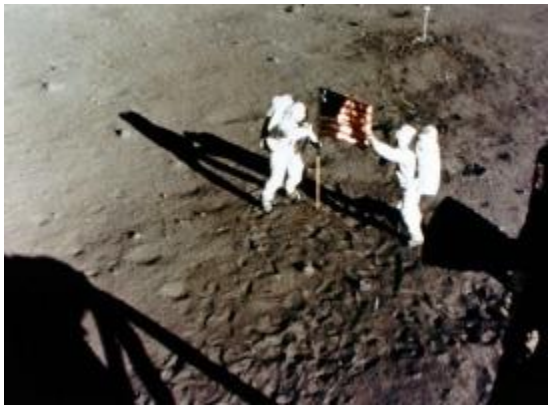

Thomas J. Kelly, the propulsion expert known as the father of the moon lander, heaved a sigh of relief as a cargo plane carrying the LM-1 left the Grumman airfield in Bethpage for the Kennedy Space Center in Florida.

It was June 1967, just months after the deadly Apollo 1 launch pad fire had further delayed the nation's quest to land Americans on the moon by the end of the decade. Behind schedule and over budget, Grumman's Lunar Module 1 - the little vehicle that would detach from the Apollo spacecraft and take astronauts down to the moon - had finally been approved for shipment to Cape Canaveral.

But Kelly's relief didn't last long.

The LM-1 failed its first inspection.

"What kind of two-bit garage are you running up in Bethpage?" raged NASA's Lt. Col. Rocco Petrone, according to "Moon Lander," Kelly's 2001 account of the lunar program, published the year before his death.

"That LM you sent us yesterday is supposed to fly in space, but I wouldn't even allow it on the launch pad," said Petrone, director of the Space Center's launch operations. "Its propulsion tanks and plumbing leaked like a sieve - it's a piece of junk, garbage!"

So much was at stake - not just Grumman's corporate prestige, but the international standing of a nation bent on beating the Soviet Union to the moon.

If the lander failed, its occupants would be doomed. If everything worked, thousands of Grumman engineers, assembly workers and subcontractors led by the Bethpage headquarters - and spread across 46 states - would pull off one of the great engineering feats of the age.

The lander was designed to ferry two astronauts to the moon and back while the main sections, the command and service modules, stayed in lunar orbit. It was a delicate craft - nothing like the sturdy fighter planes Grumman had built in World War II - with a bulging cabin atop an octagonal base perched on four spindly legs sheathed in gleaming Mylar insulation.

"It looked so fragile, like a spider with aluminum foil covering it," said Larry Lutz, a former Grumman test engineer who then lived in Seaford.

The leaking fuel lines cited by Petrone were pulled out and flown back to Bethpage. The redesigned system eventually passed muster and went back to Florida in time for the Apollo 5 test launch into Earth's orbit in January 1968.

It performed well enough that NASA put astronauts in the next lunar module sent into space. Each lander after that flew as designed, including the Eagle (the fifth lander, or LM-5) that took Neil Armstrong and Buzz Aldrin to the lunar surface 40 years ago this summer.

Joe Gavin, director of the LM program and a former Grumman president, remembers walking down the hall at Mission Control in Houston after the Eagle docked back with the command module in lunar orbit on July 21, 1969. A congressman who had supported the project put his arm around Gavin's shoulder.

"In my heart," he said to Gavin,

"I didn't believe you could do it."

The decision to go to the moon came as Cold War tensions between the United States and the Soviet Union grew over the Berlin Wall, Soviet nuclear testing and the failed Bay of Pigs attempt to overthrow Fidel Castro.

Both nations had benefitted from rocket technology developed by Nazi Germany in World War II. The USSR had taken over the V-2 rocket test facilities there. The United States recruited 500 German researchers and lead scientist Wernher von Braun, but the late 1950s found the Americans behind in the Space Race.

The Russians launched Sputnik, the first man-made satellite, into orbit in 1957, and soon after sent up a live passenger - a dog named Laika. Four years later they blasted the first man, Yuri Gagarin, into space for a two-hour orbit of the Earth.

"I think a number of us in the U.S. and the world were rather shocked," Aldrin said recently. "A somewhat backward nation . . . was able to take the technology not just to threaten the world here and there with their bombers, but they were able to put their satellites up there . . . We put our monkeys up, but they beat us to the orbital flight."

A month after Gagarin's 1961 voyage, President John F. Kennedy challenged lawmakers in a May 25 speech before a joint session of Congress: "I believe that this nation should commit itself

to achieving the goal, before this decade is out, of landing a man on the moon and returning him safely to Earth."

The president's words set off a burst of activity among military contractors. Lucrative and prestigious, the Apollo program captured the imagination of young engineers such as Kelly, then 32 years old.

"Look up there, kids," Kelly told his children on a moonlit night during a 1961 vacation on Nantucket. "Your daddy's going to build a spaceship to go there someday."

The top brass at Bethpage had decided that bidding for the main Apollo contract was too big a risk. Instead, they signed up as a subcontractor on General Electric's bid. But when North American Aviation won that contract, the space team at Grumman set its sights on the moon lander, the last available piece.

"In the beginning we really didn't know a lot about what we were getting into," Gavin said.

The lander would never operate within the atmosphere or Earth's gravity, so there was no way to flight-test it. And designers had to be sure it could handle the lunar terrain, then largely a mystery.

"We did not know if we were going to land on green cheese, rock or talcum powder," said Bob Watkins, Grumman's chief of support for the LM project.

Grumman proposed a two-part spacecraft. The lunar module's crew would be housed in the top portion, the ascent stage that the astronauts would fly back from the moon. The descent stage - underneath the cabin - housed a rocket engine that would take the LM to the moon's surface, as well as landing gear, scientific instruments and oxygen and water to sustain the astronauts while on the moon.

The LM would use the descent stage as a launch pad to blast off from the lunar surface, then return to orbit and redock with the main spacecraft.

The call from NASA came through on Nov. 7, 1962. Grumman began negotiations on a $387-million contract to build the lunar modules. Those costs ultimately grew to $2 billion as the mission swelled the company's ranks - and gave thousands of Long Islanders a role in putting astronauts on the moon.

Design constraints and the looming deadline set by John F. Kennedy's very public commitment to the moon landing ratcheted up the pressure on the Grumman team.

The LM had to fit snugly inside the Apollo stack, beneath the two other components, whose size and weight had already been fixed. To save fuel, it also had to be light - no more than 30,000 pounds or so (with fuel and crew aboard).

"They gave them the dimensions of a shoe box, and told them to fly to the moon and back," said Dick Dunne, the LM project's public affairs director.

Yet, the moon lander also had to be engineered for redundancy, with as many backup systems as possible.

"There were two guys in that craft, no rescue mission - it absolutely had to work right," said Tom Gwynne, a Grumman consulting pilot who tested guidance and navigation systems as an astronaut stand-in.

So engineers at Plant 25, the three-story LM engineering building in Bethpage, whittled out weight any way they could. They swapped out fuel cells for batteries and milled the metal skin of the crew compartment down to the thickness of three sheets of aluminum foil. The eggshell-thin titanium fuel tanks literally stretched when filled.

The push to meet NASA's strict deadlines meant triple shifts and six- and seven-day workweeks. Grumman also was hustling to catch up with the other Apollo contractors, who had a 12-month head start.

"The schedule was just murderous," said Lynn E. Radcliffe, sent by Grumman to New Mexico to run the rocket propulsion test facility.

Designers, production staff, technicians and test engineers were called in on nights and weekends to resolve problems. Kelly, whose fifth and sixth children were born during this time, lived in Huntington but sometimes bunked on a cot in his office.

"It was a lot of hard work for a lot of people," said his widow, Joan Kelly of Cutchogue. "Hard work for the men and women who worked on it, and hard work for those of us at home."

Gavin and others stayed in constant contact with the many subcontractors as Grumman's engineers labored to complete the big picture using slide rules and drawing boards. Computations were done on big IBM mainframe computers. Per NASA requirements, everything was documented, producing more than 10.5 million pages of material that filled hundreds of filing cabinets.

Engineers sat five and six abreast in vast bullpens on open floor of Plant 25. "Between the mechanical calculators and all the acoustics, the noise was incredible," said systems engineer John Devaney. "If you had to get up to go to the water fountain, you'd have to step over the desks."

Over on the manufacturing side, at Plant 5, former grease-monkeys - many of whom spent their careers riveting aircraft wings - donned smocks and booties to work in the "clean room" where the LMs were assembled. Some were made for testing only, while others would fly on future Apollo missions.

Every piece of equipment went through five levels of testing, from circuit boards to the LM itself. Engineers dropped finished versions from various heights and dunked them in 37,000-gallon vats of liquid to test structural integrity.

"The commitment was unbelievable," said Tom Haller, who worked in production control. "When you were sick you would crawl into work because you didn't want to miss anything."

NASA oversaw it all. Astronauts flew in regularly to test the LMs at Bethpage, buzzing the Grumman complex's airfield south of the railroad tracks in their T-38 jets. Agency managers ran tough performance and product reviews at Bethpage and Grumman's outposts in New Mexico, Houston and Florida.

NASA's button-down approach initially clashed with Grumman's more relaxed workplace culture. "We were looked on frankly as a bunch of wise-ass New Yorkers," said Watkins, who worked at Kennedy Space Center during the final years of LM development. "But as time went on, the relationships got to be very close."The Apollo 11 moon mission blasted off from Kennedy Space Center at 9:32 a.m. on Wednesday, July 16, 1969. The Grumman team monitored the mission from special support rooms in Houston, Florida and Plant 25 in Bethpage that were linked by phone to Mission Control.

Four days later, Armstrong and Aldrin left the command module and crawled into the moon lander. At 1:46 p.m. they headed for the moon's surface as command pilot Collins continued in lunar orbit.

Shortly before landing, Armstrong began manually steering the craft because the computer-guided descent path had them headed for a field of boulders. His heartbeat rising from 77 to 156, he flew to a smoother spot, extending the flight about 30 seconds as the ground crew watched anxiously, concerned the Eagle would run out of fuel.

"Houston, Tranquillity Base here. The Eagle has landed," Armstrong said.

"Roger . . ., " replied Charles Duke, the voice of Mission Control. "We copy you on the ground. You got a bunch of guys about to turn blue. We're breathing again. Thanks a lot."

Plant 5 manufacturing workers watching the broadcast on closed circuit television in the main hanger were ecstatic. "Everybody was shaking each other's hands," said Bill Stevens, an electronic technician.

But Kelly and the Grumman support team remained wary, monitoring a blockage of fuel frozen in one of the lines. It had the potential to explode as residual heat from the engine moved up the fuel line. After some tense moments, the problem resolved itself.

Over the next few hours the astronauts rested, then set up a TV camera so millions back on Earth could watch them explore the lunar surface. Armstrong, then Aldrin exited the craft, erected the American flag, took pictures and collected soil samples for the scientists back home.

For those who worked on the lunar module, the most nail-biting moment was still to come: liftoff.

The ascent rocket that Radcliffe's team tested over and over in New Mexico provided the only means of return for the two astronauts on the moon surface. Explosive bolts had to break the connection between the ascent and descent stages, then a sort of guillotine would slice the wires and cables before the engine propelled the ascent stage into lunar orbit.

"If that thing didn't work, they didn't have a tool kit," Dunne said. "There was always that gnawing doubt that it wouldn't work."

It worked.

The Eagle redocked with the command and service modules at 5:35 p.m. on Monday, July 21, while passing over the dark side of the moon. The LM was jettisoned into space two hours later.

For Gavin and the other leaders at Mission Control, full relief would not come until the command module splashed down into the Pacific off Hawaii on Thursday, July 24.

But some Grummanites who supported the mission let loose in exuberant celebration. Even before the command module had splashed down, Devaney and other engineers repaired to their Houston hotel. "After the moon landing we had garbage cans full of beer," he said.

Radcliffe, who watched the moon landing and liftoff from Bethpage 40 years ago, remembers it "as though it happened a minute ago," he said. "That was the culmination of all our years of concern and worry. It had to be perfect - any part of it that isn't, you lose your astronauts. There is no such thing as getting it partly right."