

A NEW ROAD AHEAD FOR NASA'S ICONIC LAUNCH INFRASTRUCTURE



A new dawn of spaceflight is nearing as NASA's Commercial Crew Program and its partners, Boeing and SpaceX, continue development on systems that will carry up to four astronauts at a time to the International Space Station.

(Photo credit: NASA)

Since the Apollo Mission landed on the moon in 1969, NASA has led the world in space exploration efforts, highlighted by its own Skylab Space Station, its collaboration on the International Space Station (ISS), and of course, its Space Shuttle program.

The first Space Shuttle launch blasted off on April 12, 1981, and the final flight landed on July 21, 2011. In between, NASA's Space Shuttle fleet—Columbia, Challenger, Discovery, Atlantis, and Endeavour—flew 135 missions, helped construct the ISS, and inspired generations.

Federal budget cuts that began with the Bush administration and continued with the Obama administration effectively ended the Space Shuttle program in 2011, and suspended American manned

space flight indefinitely. At the time, a shuttle mission to the moon and back cost \$1.5 billion.

And thus, August 31, 2011, marked the end of NASA's 30-year Space Shuttle launching program. The grand finale was the takeoff of NASA's 166th manned shuttle mission, the Atlantis STS-135. Atlantis lifted off from the historic launch pad 39A at the Kennedy Space Center (KSC) on July 8, 2011, and landed on July 21.

Launch pad 39A is joined by 39B at KSC, as well as Complex 41 at the Cape Canaveral Air Force Station (adjacent to one another)—all three of which have served as the initiation points for numerous notable NASA space vehicles. From these pads, astronauts left for the moon, Shuttles launched into orbit, rovers left for Mars, and probes took off for outer planets.

And with the suspension of the Shuttle program, it looked as if the pads would either drift into historical obscurity, fall prey to unforgiving weather conditions on Florida's eastern edge, or both. But now the pads have a new mission: to usher in a new era as the off-Earth ramps for commercial capsules and new NASA missions that send astronauts, technology, and cargo to the ISS and beyond.

Indeed, there will be manned American missions to space once again—launching from familiar pads in Cape Canaveral and KSC—albeit slightly different in form, function, and perhaps uniform logo.

In the spirit of “embrace the change,” or even “be the change,” Pad 39A at KSC and Complex 41 at Cape Canaveral are being readied to host NASA astronauts in the coming two to three years. The construction work includes lowering historic structures and raising the first new launch gantry to support crewed launches in more than three decades.

In an article last year for *Popular Mechanics*, Scott Colloredo, director of the Center for Planning and Development Directorate at KSC, said, “Right this minute, we have three different launch pads under construction for three different human spaceflight programs.”

He was referencing: Complex 41, with the Atlas V rocket and Boeing CST-100 Starliner commercial spacecraft; Pad 39A, which was leased for 20 years in 2014 by SpaceX (founded by Elon Musk) to launch its Falcon rockets and Crew Dragon capsules; and Pad 39B, which will host NASA's Space Launch System (SLS) and Orion spacecraft (with its sights set on a manned mission to Mars).

“It's just amazing that we could be at this point, with such a diversification,” Colloredo continued. “We control the master plan for Kennedy; it's essentially the equivalent of a city that has zoned out its property.”

The reconstruction work for the three launch pads actually began in 2011, and is expected to continue through 2019. With SpaceX and Boeing leading the way, the history of American space travel is transitioning from one strictly created and controlled by NASA to a more jointly shared endeavor operated by commercial crews. As the historic launch pads and related facilities undergo their necessary modifications, the excitement is difficult to contain for almost everyone involved.

(Photo Credit: SpaceX)

“THE NEW COMMERCIAL RELATIONSHIPS ALLOW NASA THE ADDED FLEXIBILITY REQUIRED TO OPERATE WITHIN CHANGING ECONOMIC TIMES.”

— Stephanie Martin, Kennedy Space Center Commercial Crew Program

A horizontal integration facility has been constructed near NASA's Launch Pad 39A at Kennedy Space Center, to ready the pad for SpaceX's Falcon 9 and Falcon Heavy rockets.





A crane lifts the sixth tier of the Crew Access Tower into place at Space Launch Complex 41. Once completed, the tower will stand 200 feet tall.

(Photo credit: NASA/Jim Grossmann)



Commercial Crew astronauts and United Launch Alliance employees watch as a crane lifts a 15-foot-long, 650-pound beam to the top of the Crew Access Tower in December 2015.

(Photo credit: NASA/Kim Shiflett)

Stephanie Martin, with the KSC Commercial Crew Program Office, sees this opportunity for NASA as a productive new chapter within an already inspiring story. “NASA’s commercial crew program was an initiative started in 2010 to help partner with the aerospace industry in order to develop commercially managed human space flight service,” she said. “The ultimate goal was to transport our astronauts to low-orbit destinations, as well as the ISS. Indeed, it’s an extremely exciting time at NASA—representing the evolution of over fifty years of human space flight, leading to our eventual journey to Mars.”

According to Martin, NASA worked with eight different commercial aerospace companies, and through a series of development programs and contracts, they were able to flesh out significant development and fully integrated systems that include a launch vehicle, ground systems, mission operations, and more.

“Currently, we’re working with Boeing and SpaceX, and we have four commercial crew astronauts who have been selected to start training,” she added. “They’re working side by side with NASA, Boeing, and SpaceX to learn all about these systems. So it’s a great opportunity for the astronauts to get an inside look early on in the development process of how these systems come together. And by NASA working with these

two commercial companies, we’re able to take these astronauts back to the ISS without full reliance on Russia, which enables NASA to focus on deep space exploration—with Orion and the SLS.”

The new commercial relationships allow NASA the added flexibility required to operate within changing economic times. Martin emphasized, “We’ll continue to use Pads 39A and 39B, in addition to others, like Complex 41, but for example, by leasing 39A to SpaceX, they’re able to capitalize on our infrastructure with necessary upgrades and accommodations, while we’re able to continue maintaining these national assets without spending taxpayer dollars when we’re not using them.”

She also noted that the flexibility equates to freedom for NASA—the freedom to focus on loftier goals. “The work being done at KSC to repurpose facilities and turn them over to the aerospace industry for future commercial opportunities really allows us to expand that low-earth orbit marketplace to a commercial market, and in turn, allows NASA to focus more on deep space exploration goals—without having to fund assets that aren’t being used at the time.”

The overall objective of the reconstruction of the launch pads was to make them as user-friendly as possible—to attract a range of commercial space



A 325-ton crane lifts the first half of the K-level work platforms up and out of High Bay 4 inside the Vehicle Assembly Building at NASA's Kennedy Space Center.

(Photo credit: NASA/Ben Smegelsky)



(Photo credit: NASA)

Since 1968, all astronauts launched from the United States have flown exclusively from Launch Pads 39A and B at Kennedy Space Center.



On Launch Pad 39B at Kennedy Space Center, a crane lowers the orbiter access arm, which ends in the "White Room," toward the ground.

businesses. Pad 39B was the first structure to be partly demolished and "cleaned" by the end of 2011. The rotating service structure (RSS) was completely removed and the construction pad was then left remaining for future construction use. Ultimately, 39B will accommodate some of the largest rockets in the world, which will blast beyond Earth's orbit to locations like Mars, and even asteroids.

SpaceX is utilizing a new approach with 39A in bringing the pad up to applicable codes and modifications. It will inevitably host the Falcon Heavy (the world's most powerful rocket, according to SpaceX) and the Crew Dragon capsules by the end of this year. As a result, SpaceX has constructed a horizontal integration facility located near 39A.

In the past, NASA rockets were moved by a crawler transporter to the launch pad. Then, standing vertical atop a mobile launch platform, the shuttle was positioned next to a fixed gantry tower. Finally, an RSS swung around to load cargo and further prepare the shuttle for launch.

The horizontal integration facility is a critical piece of the new launching strategy for SpaceX. The building is a long hangar situated at the entrance of the pad. Inside the hangar, Falcon rockets will be processed.

A transporter erector will then move the booster by rail to the top of the pad. The Falcon will then rise to a vertical position, with its Dragon spacecraft or payload already attached on top of it.

For crewed launches, a new crew access arm is currently being attached to the gantry. Then, construction crews will remove the top-mounted mast and replace it with a new set of lightning protection towers positioned in a Y-shape around the pad. Finally, NASA will also deconstruct the RSS.

"If you think about the early days, when we were preparing for the Apollo mission, we had key infrastructure that we'd built up," noted Martin. "The vehicle assembly building, the crawlers, the launch pad, and that allowed us to support the Saturn V rocket as it took Apollo to the moon. So that was an iconic moment for the U.S.—a proud moment for the American public.

"And now, it's inspiring to see how we're able to capitalize on everything we've learned—since our beginning days with Mercury and Gemini, all the way through Apollo and Shuttle. We've been able to build on we've learned, and use these same assets so they're ready to support us for the next fifty years of human space flight. It's a very exciting time for all of us." ■

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