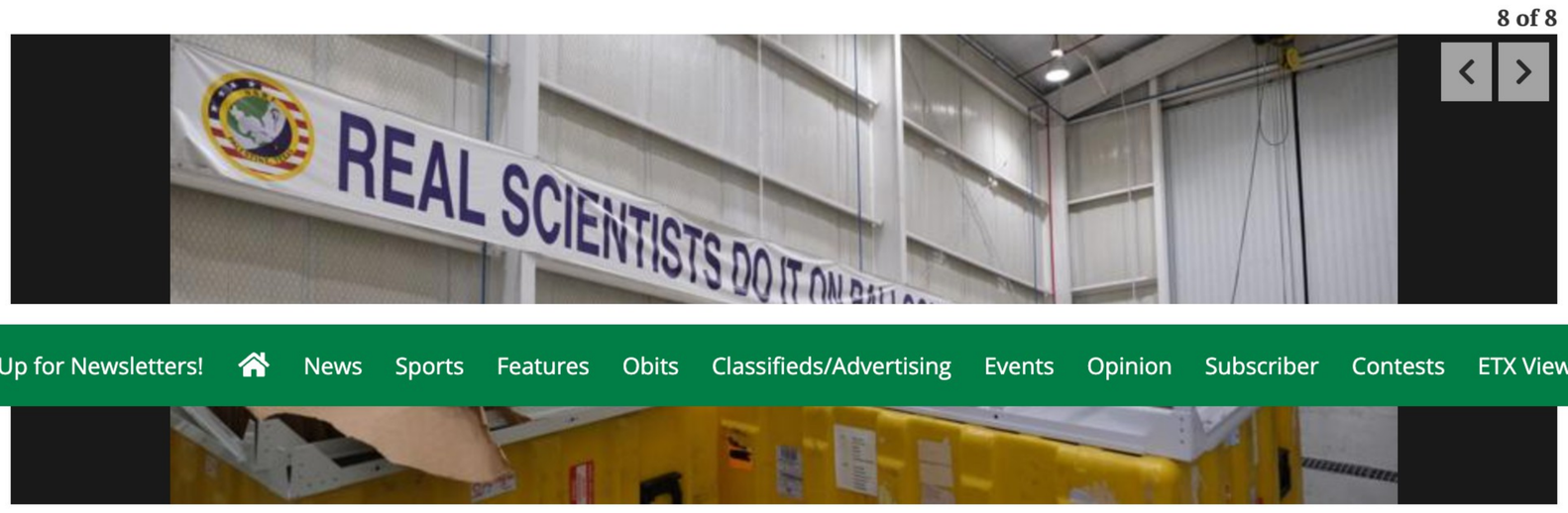
CENTERPIECE

How a small NASA facility in East Texas builds the largest balloons in the country

Samuel Shaw 2 hrs ago 6 min to read



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An informal motto at the Columbia Scientific Balloon Facility: "Real scientists do it on balloons." (Samuel Shaw/Longview News-Journal Photo)

Longview's brand is synonymous with hot air balloons. The city hosts the Great Texas Balloon Race, and for one week in the summer, the skies of Gregg County are filled with wicker baskets bobbing under hot air balloons of almost every size, shape, and color. But Longview is not where you'll find the largest or highest flying (hot) aircraft in East Texas.

Seventy miles southwest in Palestine, mammoth siblings to Longview's hobby and race balloons are assembled at a NASA complex nestled off a two-lane country road. These balloons can inflate to the size of a football stadium and rise to altitudes where the sky turns black — the Earth 130,000 feet below as well as 98% of the planet's atmosphere.

Dangling from each one is a scientific payload that can be as large as a truck; think telescopes, cosmic ray detectors or instruments measuring stratospheric winds.

The super pressure balloon is at the cutting edge of NASA's stratospheric balloon program. They can hoist payloads of nearly 5000 pounds to heights above 120,000 feet. Unlike their older "zero-pressure" siblings, super pressure balloons are sealed, enabling them to remain aloft for over a month at a relatively stable altitude. Development began roughly a decade ago on the super pressure balloons, which expand to the size of a football stadium. (Courtesy Photo)

The Columbia Scientific Balloon Facility in Palestine was constructed in the early 1960s to help experiments studying the atmosphere take flight. Its mission is much the same today, said Robert Renko, the site's program manager and an employee of Peraton, the national security contractor that runs day-to-day operations at the facility.

You can think of the facility like a kitchen and every launch as a dish. In Palestine, technicians receive specialized envelopes — the part of the balloon that inflates — from a company called Aerostar in Sulfur Springs. Visiting scientists housed at the CSBF dormitory ready their experimental payload while on-site engineers integrate electronics and rig the craft together for flight.

A launch is scheduled once all the ingredients come together, and the CSBF turns to its next job: controlling and communicating with the balloon as it conducts its mission.

But only the smallest missions start their journey in Palestine these days. Facility staff are more likely to join scientists at remote locations in New Zealand, Sweden and Antarctica for the most important missions.

“That’s why a lot of people, even local residents, aren't aware that NASA has this facility out here,” Renko said. “Residents used to set up lawn chairs on the perimeter when we launched large balloons in Palestine.”

As the region’s population has grown, NASA thought twice about multi-ton experiments gliding over homes, Renko said.

Robert Renko, the CSBF program manager, is also an employee of Peraton, the national security contractor which runs day-to-day operations at the complex. (Samuel Shaw/Longview News-Journal Photo)

Hitching a ride

By contrast to satellites and rockets, balloons are a relative bargain for research teams hoping to send their instruments aloft.

“Our motto is low-cost access to near space,” Renko said.

The stratospheric taxis come in two varieties: zero-pressure and super pressure.

Zero-pressure balloons have been the backbone of NASA’s balloon program since the 1960s, when they featured in a series of manned space suit tests in preparation for the Mercury Program.

At ground level, zero-pressure balloons look like a crinkly rope of cellophane trailing a bulb of helium at the envelope’s tip. As the balloon gains altitude, the helium expands to fill the envelope into a teardrop shape.

Vents keep the balloon from expanding to the point of rupture, yet it's that venting action that limits the effectiveness of the zero-pressure approach, Renko said.

They lose altitude with each day-night cycle as less and less helium remains inside the envelope.

“Every day it's a little bit lower, a little bit lower, a little bit lower,” Renko said. “So they have a more finite flying time.”

NASA began developing an alternative vehicle for balloon-based experiments roughly a decade ago. Super pressure balloons are sealed and able to remain aloft for more than a month at a relatively stable altitude. What super pressure balloons gain in flight time, they lose in raw simplicity, however.

“We haven't worked all the bugs out of it yet, but they’re very, very promising,” Renko said. “Right now, we're only flying those out of New Zealand, so it's still in the development stage.”

Their paper-thin envelope has to be ruggedized not only to withstand

A team from the National Center for Atmospheric Research in Colorado made the trip out to Palestine in November to integrate their HIWIND instrument for a super pressure mission set for next Spring in New Zealand. (Elizabeth Bernhardt/Courtesy Photo)

ruggedized not only to withstand solar radiation and the intense temperature swings of the stratosphere, but also pressurized gas straining to escape from within.

Inside a testing and integration area at the balloon facility, an engineer subjected a sample envelope to near-space vacuum using a sealed chamber. Nitrogen replaced the oxygen, dropping the temperature to about -4 degrees. Pipes leading into the chamber were swollen with frost.

The fate of multi-million dollar experiments depends on detecting failures before a launch, not after.

Super pressure and space weather

The Columbia Scientific Balloon Facility began life as an appendage of the federally funded National Center for Atmospheric Research in Boulder, Colorado. The relationship continues to thrive, thanks in no small part to the opportunities opened up by NASA's super pressure technology.

In late November, an NCAR team departed for Palestine as snow pelted Colorado. Some team members had visited the facility before ahead of previous balloon missions, but not Elizabeth Bernhardt, an instrumentation engineer with NCAR.

"It's much more humid here, but no matter where we've gone to eat, it's all been pretty good," she said.

Bernhardt and her colleagues were readying the third flight of NCAR's HIWIND instrument, which examines high-altitude thermospheric winds that impact GPS and satellite communications.

At NASA's Columbia Scientific Balloon Facility in Palestine, a technician works on wiring for an upcoming mission. (Samuel Shaw/Longview News-Journal Photo)

"It's flown two other flights on a zero-pressure before," Bernhardt said. "This is the first time HIWIND will be on a super pressure balloon, though."

The team was performing integration and compatibility testing with the balloon side of the operation before the mission was set for launch in New Zealand around spring 2025.

Pat Zmarzly, an NCAR optical engineer on the HIWIND project, described balloons as an important "stepping stone to space" for scientific instruments. "You might go from a ground-based instrument, to a balloon, to a satellite," Zmarzly said. "The cost of a space mission is huge. The cost of a stratospheric balloon is a lot less."

And compared to what scientists call a "sounding rocket," which gathers samples

during a short flight through the atmosphere, stratospheric balloons — the super pressure variety in particular — can hoover up days or weeks worth of data, he said.

“I've also done tethered balloon work from the ground where you have a tether that goes up to two kilometers maximum. This is just a totally different animal.”

Houston, we have a problem

NASA’s Johnson Space Center in Houston is the command center for all U.S. missions on the International Space Station. If the command center ever experienced a direct hit from a hurricane, for example — which are expected to strike Houston with greater intensity in the coming decades — the backup command center is in Palestine at the Columbia Scientific Balloon Facility.

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Desks shaped like chevrons with inset monitors and official-looking telephones pointed toward the front of the room where a digital clock posted the current time at McMurdo Station in Antarctica as well as in Wanaka, New Zealand and Sweden.

Aside from being the designated contingency site for NASA command, the CSBF control room allows agency personnel to track balloon missions around the globe from East Texas.

“When we’re doing international missions, this room is staffed by folks monitoring telemetry parameters, latitude, longitude, altitude, air speed, wind speed,” Renko said.

Careful tracking allows NASA to recover payloads as parachutes manage their descent back to Earth. Presumably, tracking also comes in handy if a balloon drifts off course.

GAPS (the General Antiparticle Spectrometer) gets rigged and integrated in Palestine at the Columbia Scientific Balloon Facility. (NASA/Courtesy Photo)

For a brief moment in 2023, one ostensibly off-course balloon over the United States originating from China sparked a diplomatic crisis, highlighting the stakes of drifting through the wrong airspace.

China's top diplomats said the balloon was no different than those operated out of Palestine for civilian research purposes. In fact, it appeared the Chinese design was based off of NASA’s super pressure technology. The U.S. military, however, determined the balloon to be a surveillance platform and shot it out of the sky with a jet above North

Carolina.

Renko declined to comment on whether the facility contributed its expertise during the 2023 Chinese surveillance balloon incident, but he did offer details about the mysterious craft that suggested its mission was not scientific.

“I can’t say a lot about it, but that balloon operated at around 55,000 to 75,000 feet, a much lower altitude than our balloons do,” Renko said. “The reason is that it was designed to be maneuverable, and they have the ability of changing altitude like a submarine does with ballast.”

He explained how — like the hot air balloon racers in Gregg County — the Chinese balloon could ride low-altitude wind currents to change course.

CSBF staff test materials in a chilled vacuum chamber that replicates near-space environments. (Samuel Shaw/Longview News-Journal Photo)

“Our balloons don’t do that. Our balloons operate in the 120,000 to 130,000 foot range,” Renko said.

While these details interested Renko, who previously served in the Air Force, his enthusiasm for NASA’s civilian achievements seemed to eclipse any lingering fascination with national security: “We’re supporting science, and I think it’s so cool.”

“The GUSTO mission last year out of Antarctica was a record breaking flight for us, 57 days,” he said, walking beneath the NASA logo painted on a water storage tower. “And its payload was this huge telescope looking up. It gave images better than Hubble. But I thought GAPS (the General Antiparticle Spectrometer) was the coolest mission, personally.”

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Reporter

Hi! I'm Sam Shaw, a Report for America corps member covering rural-to-urban transformation in East Texas for the Longview News-Journal. I grew up in Colorado and have reported from London, Washington, DC and across my home state. Reach out or send tips to sshaw@news-journal.com.