



THE ARMSTRONG

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X-59

New experimental jet cleared for final assembly, page 2





Courtesy of Lockheed Martin

This illustration shows the completed X-59 QueSST landing. The cover image shows the X-59 main assembly coming together.

Coming together

X-59 QueSST final assembly approved

By Jim Banke

NASA Aeronautics Research Mission Directorate

NASA's first large scale, piloted X-plane in more than three decades is cleared for final assembly and integration of its systems following a major project review by senior managers in December.

The management review, known as Key Decision Point-D (KDP-D), was the last programmatic hurdle for the X-59 Quiet SuperSonic Technology (QueSST) aircraft to clear before officials meet again in late 2020 to approve the airplane's first flight in 2021.

"With the completion of KDP-D we've shown the project is on schedule, it's well planned and on track. We have everything in place to continue this historic research mission for the nation's air-traveling public," said Bob Pearce, NASA's associate administrator for Aeronautics.

The X-59 is shaped to reduce the loudness of a sonic boom

reaching the ground to that of a gentle thump, if it is heard at all. It will be flown above select U.S. communities to generate data from sensors and people on the ground in order to gauge public perception. That data will help regulators establish new rules to enable commercial supersonic air travel over land.

Construction of the X-59, under a \$247.5 million cost-plus-incentive-fee contract, is continuing at Lockheed Martin Aeronautics Company's Skunk Works factory in Palmdale.

Three major work areas are actively set up for building the airplane's main fuselage, wing and empennage. Final assembly and integration of the airplane's systems – including an innovative cockpit eXternal Visibility System – is targeted for late 2020.

Management of the X-59 QueSST development and construction falls under the Low Boom Flight Demonstrator project, which is part of NASA's Integrated Aviation Systems Program.

Best places to work

By Jay Levine

X-Press editor

NASA is the best place to work in the U.S. Government for the eighth consecutive year. The announcement on 2019 results comes from the Partnership for Public Service, which completes an employee viewpoint survey of all U.S. government workers annually.

NASA Armstrong employees recorded a historic high in satisfaction and ranked 26 out of 420 government agency subcomponents.

“Your individual drive and collective enthusiasm have always impressed me,” said NASA Administrator Jim Bridenstine. “This past year we have marked incredible progress in our research and exploration objectives. This is only possible because of your daily dedication. Together, we are launching the next era of human space exploration, increasing our understanding about the Earth and laying a foundation for the next generation to make even greater discoveries.

“I am proud to lead such a dedicated workforce that is determined to deliver on our promise to push the limits of humanity’s scientific knowledge further than ever before. On behalf of our nation, I wish to extend my heartfelt gratitude to each of you.”

Armstrong employee enthusiasm is reflected in the survey responses. Center staff are working on technology that will contribute to missions to the moon, Mars and beyond and to improve life on Earth. In addition, staff support flying experimental aircraft and Earth and space science missions. From a ranking of 69.7% in 2007 the direction of employee satisfaction has continued to rise almost every year, culminating in the 2019 ranking of 81.3%.

“The EVS participation numbers indicate that you believe that you



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NASA/Lauren Hughes

Arrival of the X-57 aircraft was a contributor to job satisfaction for many Armstrong staff members.

have a voice in change at the center,” said Armstrong Center Director David McBride. “The improvements in the results show that we take your input and make changes where we can to improve your working environment here at Armstrong. Thank you all.”

Staff gave the center the highest marks for the employee skills and mission match (86.4), effective leadership of supervisors (83.6), teamwork (82.2) and innovation (81.2).

Employees awarded the biggest single-year increases for teamwork, effective leadership of senior leaders, overall effective leadership and strategic management. Other areas that saw at least a 2% increase from the previous survey included effective leadership of supervisors and performance-based rewards

and advancement.

Also recognized for improvement in the current survey were innovation, effective management empowering employees, effective leadership fairness, employee skills and mission match, pay, training and development and support of diversity.

One area that was down slightly from the previous survey was the work-life balance, which decreased 0.4% to 68.2% satisfaction. The area of satisfaction still ranked in the top percentages of organizations in the subcomponents category.

Armstrong’s ranking the past three years are the best marks for the center since the inception of the EVS. In fact, scores have increased almost every year since 2012 and are significantly better than the first tally of 60.7% in 2005.

News at NASA

Koch set to return

NASA astronaut Christina Koch is set to return to Earth Feb. 6 after 328 days living and working aboard the International Space Station. Her mission is the longest single spaceflight by any woman.

Koch has been a crew member for three expeditions – 59, 60 and 61 – during her first spaceflight. She now holds the record for the second-longest single spaceflight by a U.S. astronaut, which places her seventh on the list of U.S. space travelers for overall time in space. Former NASA astronaut Scott Kelly holds the longest single spaceflight for U.S. astronauts at 340 days, set during his mission in 2015-16.

Koch’s record-setting mission included participation in more than 210 investigations, helping advance NASA’s goals to return humans to the Moon under the Artemis program and prepare for human exploration of Mars. Those studies included research such as how the human body adjusts to weightlessness, isolation, radiation and the stress of long-duration spaceflight.

During her spaceflight, Koch completed 5,248 orbits of Earth and a journey of 139 million miles, roughly the equivalent of 291 trips to the Moon and back. She also supported more than a dozen Soyuz and cargo resupply spacecraft. Koch completed six spacewalks during her mission, spending 42 hours and 15 minutes outside the station. Among those was the first all-woman spacewalk, which she conducted alongside NASA astronaut Jessica Meir.



Earth Venture

Amstrong hosted science campaign kickoff and will support the missions with aircraft and staff

National Oceanic Atmospheric Administration

Above, the image of an East Coast snowstorm is where the NASA P-3 and ER-2 research planes began studying Jan. 17 and will complete the mission March 1.

At right, NASA's ER-2 aircraft flies over a storm system in North Carolina during a previous investigation called the Integrated Precipitation and Hydrology Experiment.



NASA/Stu Broce



AFRC2020-0005-03

NASA/Lauren Hughes

At left, Lynn McMurdie and Samson Reiny provide details about the Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms mission.

Below, preparations begin to broadcast a demonstration of a high altitude suit, such as pilots of the ER-2 wear. Steve Parcel and Lori Losey are behind the cameras and Joey Barr and Dean Neeley (in the suit) are in front of the cameras.

By Samson Reiny
NASA Earth Science News Team

NASA is sending five airborne campaigns across the United States in 2020 to investigate fundamental processes that ultimately impact human lives and the environment, from snowstorms along the East Coast to ocean eddies off the coast of San Francisco.

A Jan. 7 event at Armstrong featured the Earth Venture 2020 Field Campaign and a NASA Social highlighted the missions and provided attendees with a sense of the science involved. The ER-2, B-200 and C-20A aircraft, which are based at Armstrong, will participate in all five missions.

Science teams will embark by land, sea and air as part of multi-year campaigns funded by NASA's Earth Venture program. This is NASA's third series of competitively selected Earth Venture suborbital investigations.

NASA uses the vantage point of space to increase our understanding of our home planet, improve lives and safeguard our future. To gain a more complete picture of how

and why our planet is changing, the agency also sponsors intensive field campaigns targeting critical science issues that can benefit from a deeper look by taking advantage of NASA's capabilities in airborne science.

Campaigns will conduct science on a variety of platforms. High-altitude aircraft will observe chemistry in the stratosphere, far beyond the reach of commercial planes, to study the impact of intense storms that breach the troposphere, where most weather occurs. A flotilla of autonomous gliders and floats will take to the Pacific Ocean to measure temperature and salinity at and below the water's surface to better understand the exchange of heat between ocean and atmosphere. Researchers will descend on wetlands by foot and boat to study how sea level rise is affecting delta ecosystems.

The five new Earth Venture integrated airborne and surface field campaigns began their first year of field work in 2020, running from January through October.



AFRC2020-005-09

NASA/Lauren Hughes

Intense Snowfall Events

On the densely populated U.S. East Coast, winter snowstorms are both frequent and disruptive. Snowstorms can shut down roads and close businesses and are hazardous for anyone caught in them. The storm and cloud processes responsible for snowstorms are often inaccurately reproduced by forecast models and are difficult to measure from

space, resulting in poor snowfall predictions.

The Investigation of Microphysics and Precipitation for Atlantic Coast-Threatening Snowstorms, or IMPACTS, airborne study of these snowstorms, which began in January, aims to get a better handle on how snow is distributed

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in the clouds.

“People see pictures of these big swaths of clouds and think they’re snowing everywhere, but they’re not,” said IMPACTS principal investigator Lynn McMurdie at the University of Washington in Seattle. “Inside the clouds are these long narrow regions of more intense snow bands. We’re trying to understand why they form and how they evolve with the developing storm. If we can understand the processes in the clouds, we can better predict how they distribute snowfall to us on the ground.”

IMPACTS is the first major field campaign to study East Coast snowstorms in 30 years. The instrumentation that will fly on NASA’s ER-2 high-altitude aircraft and P-3 cloud-sampling aircraft is a significant advancement since then, making now an opportune time to close the knowledge gap on snowstorms and help scientists improve how they interpret satellite data and incorporate them into weather forecasting models. The ER-2 based out of NASA Armstrong will fly out of Hunter Army Airfield in Savannah, Georgia, and the P-3 will fly out of NASA’s Wallops Flight Facility in Virginia.

Ocean-Atmosphere Heating

Circular currents of water called eddies play an important role in climate and ocean ecology, as they facilitate the exchange of heat between the ocean and the atmosphere and the vertical transport of nutrients, oxygen, and dissolved gases in the upper ocean. Some eddies are hundreds of kilometers in diameter, while others, called sub-mesoscale eddies, range in size from 1 to 10 kilometers, too small for current ocean-monitoring satellites to observe in detail.

In April, researchers with the Sub-Mesoscale Ocean Dynamics Experiment, or S-MODE, will venture 200 miles off the coast of San Francisco to make those



AFRC2020-005-40

NASA/Lauren Hughes

Chuck Irving gives a tour of the DC-8 science platform during the Jan. 7 event. The aircraft is about to undergo major maintenance. Instead of science stations and aircraft seats there are empty spaces and open panels.

critical observations. Three science aircraft—NASA’s King Air and Gulfstream V, in addition to a leased Twin Otter—the ocean research vessel Oceanus and an array of autonomous platforms will be fitted with instrumentation for measuring temperature, salinity, and ocean velocity across various time and spatial scales. Flights will originate from Moffett Federal Airfield at NASA’s Ames Research Center in California.

Computer simulations indicate that these eddies have important

long-term effects on the upper ocean, but their predictions are sensitive to relatively small details in how the simulations are implemented. The resolution and detail of these simulations have surpassed our ability to observe them with spaceborne or in situ sensors.

“These seemingly small factors matter when we simulate the climate system on long timescales,” said principal investigator Thomas Farrar, a physical oceanographer at Woods Hole Oceanographic

Institution. “Measurements from S-MODE can help us understand how well these processes are represented in models and how to improve their representation.”

River Deltas and Sea Level Rise

Millions of people rely on services provided by coastal deltas like the Mississippi River Delta. Those services include acting as nurseries for fish, crustaceans and other animals, in addition to protecting our infrastructure against hurricanes and tsunamis. However, most major deltas around the world are sinking under sea level rise and disappearing, taking the livelihoods and ecological services they provide with them.

The Delta-X mission will study the Mississippi River Delta to understand which parts of the region are likely to disappear and which will survive. The deltas may be able to keep up with sea level rise if enough sediment is deposited and if plants are healthy enough to grow roots. Delta-X scientists will use airborne remote sensing instruments aboard NASA’s King Air and Gulfstream aircraft, with flights originating from Lakefront Airport in New Orleans and NASA’s Johnson Space Center, and field measurements of water flow to determine where sediment transported by that water will get deposited. The scientists will also quantify how much organic soil is created from the decomposition of plants.

“These new data will help us to understand and mitigate the impact of sea level rise on the very important coastal resources found in deltas,” said Delta-X principal investigator Marc Simard from the Jet Propulsion Laboratory in Pasadena.

Aerosols Changing Clouds

The Aerosol Cloud Meteorology Interactions Over

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AFRC2020-005-23

NASA/Lauren Hughes

Armstrong pilot Dean Neeley talks about the C-20A science platform aircraft that will assist with upcoming missions.



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NASA

Howard C. "Tick" Lilly was the first NACA engineering pilot assigned to the Muroc Flight Test Unit, now known as NASA Armstrong. He also was the first pilot who died on a research mission. Lilly is posing beside a P-63A.

Joseph A. "Joe" Walker piloted such aircraft as the X-15. He died during a mission piloting the F-104.

Remember the heroes

By Christian Gelzer

NASA Armstrong Historian

NASA's Day of Remembrance Jan. 30 recognized astronauts who have perished in the efforts to advance the nation's reach into space. It was also a day to reflect on how to keep future astronauts safe and the need to remain vigilant on safety.

On the same solemn day, NASA Armstrong officials remembered three pilots in its history who died at the stick of a NASA or National Advisory Committee for Aeronautics (NACA) aircraft.

Howard C. "Tick" Lilly was the first NACA engineering pilot assigned to the Muroc Flight Test Unit, now known as NASA Armstrong. Lilly trained as a Naval aviator and joined the NACA's Langley Memorial Aeronautical Laboratory in Virginia, now known as Langley Research Center in 1942. In 1943 he transferred to the NACA's Lewis Flight Propulsion Laboratory in Cleveland, Ohio, (today's Glenn Research Center) and then to Muroc in 1947.

At Muroc, he flew the Douglas D-558-1 transonic research



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NASA

Richard E. "Dick" Gray, seen above with the AD-1 oblique wing experimental aircraft, lost his life during a pilot proficiency flight.

aircraft and the Bell X-1. Lilly was the fourth person to exceed the speed of sound. He died May 3, 1948, when components of the D-558-1's engine compressor failed, severing control cables and the airplane crashed. He was the first NACA pilot to die in the line of duty.

It was 18 years later when the center lost another pilot. Joseph A. "Joe" Walker was a chief research pilot at the NASA Flight Research

Center during the mid-1960s.

During World War II Walker flew P-38 aircraft for the Army Air Force in North Africa. He joined the NACA's Lewis Flight Propulsion Laboratory in Ohio in 1945 and transferred to the High-Speed Flight Research Station in 1951.

Walker made the first NASA-piloted X-15 flight March 25, 1960, and flew the aircraft 24 times, achieving its highest altitude

(354,200 ft.) Aug. 22, 1963. He made the first flight in the Lunar Landing Research Vehicle in 1964 that led to the Lunar Landing Training Vehicle used in Houston to train astronauts to land on the moon. Walker perished June 8, 1966, when his F-104 was caught in the wingtip vortex of the North American XB-70.

In the 1980s, a pilot proficiency flight claimed the life of Richard E. "Dick" Gray.

Gray was an aerospace research pilot at NASA's Johnson Space Center in Houston, from 1978 until he transferred to Ames-Dryden Flight Research Center, now NASA Armstrong.

At JSC he was chief project pilot on the WB-57F high-altitude research aircraft and served as the prime chase pilot in the T-38 aircraft for video documentation of the landing portion of space shuttle orbital flight tests. A Naval aviator, he flew 48 combat missions in F-4s over Vietnam while assigned to squadron VF-111 aboard the USS Coral Sea in 1972.

Gray was fatally injured Nov. 8, 1982, in the crash of a Cessna T-37 aircraft while on a flight to hone his skills flying the airplane.

New bird takes flight



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Lauren Hughes

NASA 868 in December had its first operational flight since it underwent check flight evaluations at NASA Armstrong after its arrival on Nov. 6, 2018. The F/A-18B aircraft is new to the center, but came from U.S. Naval Air Station Patuxent River in Maryland. It is set to support the Pilot Breathing Assessment Phase II and the Airborne Location Integrating Geospatial Navigation Systems project.

Jerry Malcolm dies at 80

Jerry Malcolm, a former associate director at Armstrong (then Dryden), died Oct. 20. He was 80.

In 2001 he was assigned associate director of Aerospace Projects for Access to Space at the center. The position included responsibility for the center's participation in X-plane flight projects such as the hypersonic X-43, Hyper-X, the X-37 Space Transportation Vehicle, the X-38 Crew Return Vehicle and the Space Launch Initiative second generation projects.

He had more than 40 years of direct technical participation in research and development programs requiring a wide variety of disciplines. Malcolm had varied positions with Armstrong, NASA's Ames Research Center and industry during his career.

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the Western Atlantic Experiment, or ACTIVATE, will look at the critical role marine boundary layer clouds play in Earth's energy balance and water cycle. This type of cloud covers large stretches of the planet's oceans. How cloud systems change continues to be one of the biggest remaining uncertainties in models that look at global warming.

The campaign, which begins in February, will focus on the western North Atlantic Ocean, where researchers will measure a broad range of aerosol, cloud and meteorological conditions. Researchers will conduct science flights on two aircraft – a NASA Falcon and King Air – that will fly in a coordinated fashion while outfitted with a host of remote sensing and in-situ instruments. Flights will originate from NASA's Langley Research Center in Virginia.

“We don't have comprehensive measurements under a variety of conditions to draw definite conclusions about the effects of these interactions between aerosols, clouds and meteorology on climate,” said Armin Sorooshian, ACTIVATE principal investigator from the University of Arizona.

When Strong Storms Punch into the Stratosphere

In June, Dynamics and

Chemistry of the Summer Stratosphere, or DCOTSS, will investigate intense storms that form over the central United States during the summer months. When these storms grow tall enough, they overshoot the troposphere, the lowest layer of Earth's atmosphere, and can inject water vapor and pollutants into the stratosphere above, significantly altering its chemical composition. They may even negatively affect stratospheric ozone, which absorbs harmful ultraviolet light from the sun.

The scientists will target these overshooting storms using data from weather satellites and ground-based radar and will collect measurements with NASA's ER-2, which will fly up to 70,000 feet, significantly higher than most research aircraft. Flights will originate from Salina, Kansas.

“DCOTSS is the first science mission specifically designed to observe material lifted into the stratosphere by intense thunderstorms,” said Ken Bowman, DCOTSS principal investigator from Texas A&M University. “By directly measuring storm outflow with the ER-2 aircraft, we can learn how these storms affect today's stratosphere, and how their impacts might change as the atmosphere changes in coming decades.”

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