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NASA Social

Supersonic and UAS research highlighted

By Jay Levine
X-Press editor

A NASA Social highlighted two projects, one with supersonic aircraft and the other featuring subsonic aircraft and a remotely piloted airplane, May 31 at NASA Armstrong.

About 45 social media representatives and a number of media organizations listened to updates on NASA's work to mitigate the sound made by aircraft traveling supersonically. The other topic was how aircraft are helping to validate technologies that could lead to Unmanned Aircraft Systems Integration (UAS) into the National Airspace System (NAS).

Dave Richwine, NASA Commercial Supersonic Technology (CST) subproject manager based at Langley Research Center in Virginia, said the U.S. needs to "make sure it is out front" in supersonic aircraft. Supersonic aircraft could reduce travel times by half and infuse the economy with good jobs and open new markets.

Tom Jones, NASA CST associate project manager based at Armstrong, said supersonic travel could one day "bring the world a little closer together."

AFRC2016-0154-071 **NASA/Lauren Hughes**

Attendees of a NASA Social at Armstrong heard a NASA F/A-18 demonstrate different volumes of sonic booms during a routine pilot proficiency flight.

A three-pronged strategy is progressing. The approach includes a sonic boom simulation lab at NASA Langley, shaped sonic boom research in restricted airspace at Armstrong and data collection with a proposed supersonic demonstrator called Quiet Supersonic Technology (QueSST).

The strategy could provide the information needed to make recommendations to the Federal Aviation Administration for amending a prohibition in place since the 1970s on over land supersonic travel. The idea is to reduce the strength of the sonic booms and break them up so the sound is hardly noticeable by people on the ground, Jones explained.

The QueSST is being designed through a NASA contract with Lockheed Martin. Michael Buonanno, Lockheed Martin chief engineer for the QueSST contract, said the design includes a 94.2-foot long, piloted aircraft with a single engine. The concept includes many commercially available systems to reduce cost of the potential future X-plane that would greatly reduce the sound of current breaches of the

NASA Social, page 7

DC-8 needs prep for each mission

By Kate Squires
NASA Armstrong Public Affairs

There are many layers to orchestrating a mission as complex as the Korean U.S. Air Quality (KORUS-AQ) study. Preparing the aircraft and science instruments to come together as one is just a single layer, but it's extremely important to ensure a safe and successful mission.

NASA's DC-8 flying laboratory looks like a normal aircraft, but it's far from it. The highly modified airplane has removable seats, ports and windows. The onboard electronics have also been modified to support a variety of instruments and racks. Despite the many "holes" in the aircraft filled with instruments, the structure is highly stable and well suited as an airborne laboratory.

Photo courtesy of NSERC/Jane Peterson

NASA's DC-8 is based at Armstrong's Hangar 703 in Palmdale.

Instrument integration work began three weeks prior when the science instruments were shipped to the science lab at Armstrong's Hangar 703 in Palmdale. Some of the instruments arrived in pieces and had to be built from the ground up before they were installed on the aircraft. Others arrived fully assembled and only needed to go through power and other system checks before being ready for installation on the plane.

Before loading instruments into the plane, DC-8 lead operation engineer Matt Berry inspected each for airworthiness in the science lab. He made sure that each instrument did not omit sparks, smoke or create other operational hazards that could potentially cause problems during flight.

"Basically, once the instrument is on the plane, it's not coming off. But we need to make sure it's safe before we even get to that point," he said.

While the scientists made sure their instruments were functional, aircraft mechanics removed windows on the aircraft and installed a wide variety of air intake probes. They also installed optical ports into the top and bottom of the plane for laser sensors. After port installation was done, the aircraft looked similar to a porcupine.

Each instrument was then rolled out of the science lab and placed on a large scale that weighed for weight and balance requirements. From there, each instrument was loaded onto a lift and carried up to the aft doors of the aircraft.

This part was tricky. Cabin space is limited and the payload of 26 instruments is large by comparison to most missions. So instruments had to be loaded in a specific order, starting with the instruments located at the front of the plane.

Mechanics, avionic techs, data system engineers and experimenters worked side-by-side to install each instrument without causing delays to the 10-20 sensors in the queue behind them. The experimenters were then free to make sure their instruments were functioning and communicating with the onboard data system.

After installation was completed, the aircraft was moved outside of the hangar to allow the experimenters to calibrate the sensors. The aircraft was then turned back over to the DC-8 crew who performed necessary aircraft maintenance checks on the engines and cabin pressure.

"Our primary job at NASA Armstrong is to make sure that all of the experimenters onboard are safe and can focus on collecting as much data as possible. The DC-8 crew works extremely hard to make that happen," DC-8 crew chief Corry Rung said.

The final checks happened throughout several short flights. The first, called a "shake flight," ensured that none of the instrument hardware was loose and functioned correctly. The second two flights were devoted to testing the science instruments themselves.

With aircraft preparations completed, the next stop was South Korea.

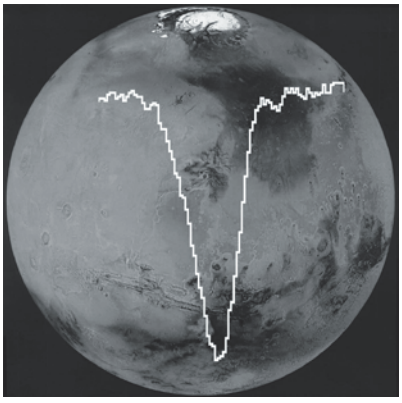
Meanwhile across the country at NASA's Langley Research Center, in Hampton, Virginia, the UC-12B King Air was going through a similar integration process. However, because the King Air has a smaller fuel tank and payload capacity, the aircraft could not make the transit flight to the U.S. Air Force's Osan Air Base in South Korea with all of the instruments onboard. After the science instruments were installed and checked, they were quickly uninstalled and packed into shipping boxes headed to Osan Air Base. Once the King Air aircraft arrived, the crew reintegrated the science instruments just short of the mission beginning.

Atomic oxygen detected in Martian atmosphere

Kassandra Bell
SOFIA Science Center, NASA Ames Research Center

An instrument onboard the Stratospheric Observatory for Infrared Astronomy (SOFIA) detected atomic oxygen in the atmosphere of Mars for the first time since the last observation 40 years ago. These atoms were found in the upper layers of the Martian atmosphere known as the

Mars page 3



SOFIA/GREAT spectrum of oxygen superimposed on a Viking 1 composite image of Mars by USGS University of Arizona. The amount of atomic oxygen computed from this SOFIA data is about half the amount expected.

SOFIA/GREAT spectrum: NASA/ DLR/USRA/DSI/MPIfR/GREAT Consortium/ MPIfS/Rezac et al. 2015. Mars image: NASA

AIRBOS cover is all-time top 5

The Aviation Week 100th Anniversary edition was recently published with a prominent award going to a project based at NASA Armstrong. There was a competition for selecting the best cover images from the magazine's 5,200 editions in multiple categories. The NASA Armstrong air-to-air background oriented schlieren, or AirBOS, image of shock waves from a United States Air Force Test Pilot School T-38 that appeared on the cover of the digital magazine from September 7, 2015, made the list of the five most memorable covers. Researchers used NASA-developed image processing software to remove the desert background, then combined and averaged multiple frames to produce a clear picture of the shock waves.

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Environmental plan reviewed

NASA Armstrong and Edwards Air Force Base personnel are conducting the second five-year review of groundwater below the center.

It was determined in 2006 that a combination of land use controls, groundwater monitoring and chemical oxidation treatment, would treat groundwater below the center that was in the past impacted primarily by chlorinated solvents.

The five-year review is conducted to verify that the solution continues to protect people and the environment. As part of the review, interviews will be conducted with members of the Armstrong community. The review is scheduled to be complete in September 2016.

Contact Jennifer Flavin, environmental manager at Jennifer.Flavin@nasa.gov, or (661) 276-2909 for additional information, or if you wish to participate in the interview process.

Mars... from page 2

mesosphere.

Atomic oxygen affects how other gases escape Mars and therefore has a significant impact on the planet's atmosphere. Scientists detected only about half the amount of oxygen expected, which may be due to variations in the Martian atmosphere. Scientists will continue to use SOFIA to study these variations to help better understand the atmosphere of the Red Planet.

"Atomic oxygen in the Martian atmosphere is notoriously difficult to measure," said Pamela Marcum, SOFIA project scientist. "To observe the far-infrared wavelengths needed to detect atomic oxygen, researchers must be above the majority of Earth's atmosphere and use highly sensitive instruments, in this case a spectrometer. SOFIA provides both capabilities."

The Viking and Mariner missions of the 1970s made the last measurements of atomic oxygen in the Martian atmosphere. These more recent observations were possible thanks to SOFIA's airborne location, flying between 37,000-45,000 feet, above most of the infrared-blocking moisture in Earth's atmosphere. The advanced detectors on one of the observatory's instruments, the German Receiver for Astronomy at Terahertz Frequencies (GREAT), enabled astronomers to distinguish the oxygen in the Martian atmosphere from oxygen in Earth's atmosphere. Researchers presented their findings in a paper published in the journal Astronomy and Astrophysics in 2015.

SOFIA is a Boeing 747SP jetliner modified to carry a 100-inch diameter telescope. It is a joint project of NASA and the German Aerospace Center. NASA's Ames Research Center manages the SOFIA program, science and mission operations in cooperation with the Universities Space Research Association headquartered in Columbia, Maryland, and the German SOFIA Institute (DSI) at the University of Stuttgart. The aircraft is based at NASA Armstrong's Hangar 703.

Rood, spectrum manager, passes

Rich L. Rood, Armstrong spectrum manager, died April 5. He was in his 60s.

He began his 27-year career at Armstrong (then Dryden) as an instrumentation engineer and worked on the F/A-18 High Alpha Research Vehicle program.

People who knew him said he was well liked and Range Operations branch coworkers said they will miss him.

News at NASA

Kavandi, Free accept new NASA posts

Former astronaut Janet Kavandi is director of the agency's Glenn Research Center in Cleveland. Kavandi served as Glenn's deputy director since February 2015 before she was selected as the new director.

Kavandi succeeds Jim Free, who was named deputy associate administrator for technical programs in the agency's Human Exploration and Operations Mission Directorate.

As director, Kavandi will lead a center with more than 3,200 civil service and contractor employees and an annual budget of approximately $580 million.

Kavandi was selected as an astronaut in December 1994. She is a veteran of three spaceflights, serving as a mission specialist on the STS-91 mission in 1998, STS-99 in 2000 and STS-104 in 2001. Kavandi has logged more than 33 days in space.

She has been recognized with a Presidential Rank Award, two NASA Outstanding Leadership Medals, two Exceptional Service Medals and three NASA Space Flight Medals.

Free joined NASA in 1990 as a propulsion engineer at NASA's Goddard Space Flight Center in Greenbelt, Maryland. His first assignment at Glenn was in 1999 as the International Space Station liaison for the center's Fluids and Combustion Facility. From 2008 to 2009, Free was the Orion Test and Verification Manager at NASA's Johnson Space Center in Houston. In 2010, he was appointed Glenn's deputy director and named director in January 2013.

Orion support

Armstrong honored for role, officials talk about the future

By Jay Levine
X-Press editor

NASA's Orion space program representatives came to Armstrong recently to honor employees' contributions and talk about the space program.

Charles Lundquist, NASA Orion deputy program manager, C.J. Johnson, Orion project manager for the Capsule Parachute Assembly System (CPAS), Ann Bufkin, Orion CPAS test engineer and Barbara Zelon, Orion program communications manager, also learned details of the center's support during their visit.

"We are thrilled to be here," said Lundquist. "We appreciate your contributions to manned space flight and the Orion, and we are excited about the progress we are making."

During the award ceremony, Lundquist presented Armstrong Deputy Director Patrick Stoliker with an American flag that was flown aboard the Orion capsule during the Exploration Flight Test-1 (EFT-1) mission on Dec. 5, 2014.

NASA's Ikhana remotely piloted aircraft, which is based at Armstrong, was used to capture live video during the Orion re-entry and landing. Planning is ongoing for the Ikhana to again be available for the re-entry at the conclusion of the Orion and Space Launch System Exploration Mission-1 (EM-1) certification mission expected in 2018.

"We learned about some of the challenges today of how the team here was able to get the Ikhana to the right place, at the right time to provide the impressive footage of Orion's re-entry," Johnson said. "We appreciate what you were able to acquire."

To support CPAS, Armstrong provides air-to-air aircraft imagery and chase plane support for the C-17 airlaunch of the system tested at the U.S. Army's Yuma Proving Ground. Photography and videography is used for test reconstruction and parachute performance photogrammetric analysis.

ED14-0341-25 **NASA/Carla Thomas**

NASA's Ikhana remotely piloted aircraft, based at Armstrong, was used to observe and transmit the Orion capsule's return from space and its landing.

ED14-0375-165 **NASA/Jim Ross**

Armstrong supports Orion parachute tests in Yuma, Arizona, with chase aircraft and photo and video documentation. Images like this one help engineers to see aspects of the flight that offer clues to resolving system challenges.

"CPAS provided a lot of data collection on the parachute's performance and photo and video documentation gives us unique views on key events that are used in helping in the evaluation of the system," Johnson added. "Certifying parachutes for human spaceflight is not easy."

In addition to work on EFT-1, Armstrong is supporting CPAS during the qualification testing for EM-1. A successful flight is a step toward a manned mission in the early 2020s.

EM-1 is a proving ground mission. The proving ground is the space near Earth and extending beyond the moon's orbit where we demonstrate human and technical capabilities for long-duration space exploration with the goal of achieving Earth independence and readiness to proceed on the long voyage to Mars.

"EM-1 will validate that the systems are safe and reliable because the next time it counts – when we have astronauts aboard," Lundquist said.

NASA Armstrong is supporting Orion launch abort system flight test development, including preparations for the Ascent Abort-2 (AA-2) in 2019. Armstrong will provide development flight instrumentation for AA-2. Armstrong also manages the NASA contract for the Abort Test Booster, which will be used for the AA-2 launch.

The Orion spacecraft and the Space Launch System (SLS) exploration rocket will enable humans to travel into deep space on NASA's journey to Mars. Teams across the country are making steady progress toward their first integrated flight, including building a revitalized launch complex at Kennedy Space Center in Florida.

Armstrong, Edwards Air Force Base and many suppliers in California contribute to making Orion and SLS missions successful and enabling NASA's journey to Mars. The Orion and SLS programs collectively have 762 suppliers and subcontractor companies in California.

Armstrong employees honored

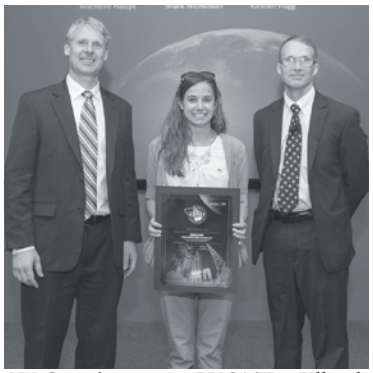
Charles Lundquist, NASA Orion deputy program manager, and C.J. Johnson, Orion project manager for the Capsule Parachute Assembly System (CPAS), recognized Armstrong teams' support at a recent ceremony at the center.

The teams supported NASA's Armstrong-based Ikhana aircraft that captured live video during the Dec. 5, 2014, Orion re-entry and landing and CPAS assistance. Armstrong provides air-to-air aircraft imagery and chase plane support for the C-17 airlaunch of the CPAS system.

The Ikhana Imagery Team was recognized for outstanding achievement in planning and executing real-time imagery of the first Orion Crew Module descent from space during the Exploration Flight Test 1 mission.

Members of that team include Stephanie Crutcher (formerly Allison), Terry Bishop, Greg Buoni, Daniel Burgdorf, Tim Burt, Maria Caballero, Larry Camacho, Gus Carreno, Jeremy Clay, Paul Clinton, John Del Frate, Maj. Nicholas Devereaux, Mike Drew, Ashley Edwards, Al Guajardo, Bob Guere, Andy Gutierrez and Scott Howe.

Honorees, page 6



AFRC2016-0133-05 NASA/Ken Ulbrich

C.J. Johnson, left, and Charles Lundquist, right, present Michelle Haupt of the Operations Engineering team with a certificate.

AFRC2016-0133-08 NASA/Ken Ulbrich

Armstrong members of the Ikhana Imagery Team were recognized for their roles with the vehicle's capture and transmission of the Orion capsule's re-entry and landing. C.J. Johnson, far left, and Charles Lundquist, far right, present team members with certificates. Team members, beginning from second to left, are Al Guajardo, Tom Rood (accepting for Rich Rood), Tim Burt, Stephanie Crutcher (formerly Allison), Andy Gutierrez, Tim Peters, Kevin Rohrer, Jesus Vazquez, John Del Frate, Jeremy Clay, Russ James, Joe Innis, Maricio Rivas, Greg Strombo, Robert Racicot, Scott Howe, Kathleen Howell and Hernan Posada.

AFRC2016-0133-05 NASA/Ken Ulbrich

Armstrong Deputy Center Director Pat Stoliker, left, accepts an American flag from Charles Lundquist, NASA Orion deputy program manager. The flag was flown aboard the Orion capsule during the Exploration Flight Test-1 mission on Dec. 5, 2014.

AFRC2016-0133-13 NASA/Ken Ulbrich

Armstrong members of the Support Fleet Maintenance team were recognized for their roles with the Orion EFT-1 Capsule Parachute Assembly testing. C.J. Johnson, far left, and Charles Lundquist, far right, present team members with certificates. Team members, beginning from second to left, are Dan Batcho, Dale Hogg, Chris Brooke, Richard Cordes, Jim McNally, Sam Habbal, Paul Sichenzia and Tim Logan.

AFRC2016-0133-11 NASA/Ken Ulbrich

C.J. Johnson, far left, and Charles Lundquist, far right, present Aircraft Maintenance and Engineering team members with certificates. From second to left are Angelo De La Rosa, April Bailey and Walter Kondracki.

AFRC2016-0133-10 NASA/Ken Ulbrich

C.J. Johnson, far left, and Charles Lundquist, far right, present Life Support team members with certificates. From second to left, are Pedro Villegas, Dave Sermon and Phil Wellner.

Honorees... from page 5

The team also included Kathleen Howell, Joseph Innis, Russ James, Gregory Kyle, Dane Lariosa, Lyndel Lohberger, Lori Losey, David McAllister, Staff Sgt. Maria Moresco, Melissa Newell, Joe Nixon, Guy Noffsinger, Steve Parcel, Tim Peters, Hernan Posada, Robert Racicot, Patrick Ray, Lt. Col. Walter Reiss, Mauricio Rivas, Hector Rodriguez, Kevin Rohrer, Rich Rood, Kelly Snapp, Greg Strombo, Rosalia Toberman, Master Sgt. Brian Toward, Jesus Vazquez and Ken Wilson.

Armstrong employees recognized for dedication and outstanding support of the Orion EFT-1 Capsule Parachute Assembly Team included:

- Pilot's Office team members Manny Antimisiaris, Troy Asher, Frank Batteas, Stu Broce, Richard Ewers, Nils Larson, James Less, Dean Neeley, Hernan Posada, Wayne Ringelberg, Jim Smolka, Denis Steele and Tim Williams
- Operations Desk team members Patricia Kinn, Denise Ryan and Brett Thomas
- Life Support team members Raymond Kinney, Wason Miles, Richard Nires, Dave Sermon, Pedro Villegas and Phil Wellner
- Aircraft and Maintenance and Engineering team members April Bailey, Angelo De La Rosa, Walter Kondracki, Brittany Martin and Keith Rossman
- Operation Engineering staff including Kirsten Fogg, Michelle Haupt and Mark Nicholson
- Support Fleet Maintenance team members Charlie Aguirre, Jerrod Anderson, Dan Batcho, Chris Brooke, Richard Cordes, Sharay Dylewsky, Delman Ellis, Nick Felix, Jessy Gray, Sam Habbal, Dale Hogg, Tim Logan, Genaro Martinez, Jim McNally, Bob Pimofsky, Norm Roberson, Manny Rodriguez, Paul Sichenzia, Mario Soto, Danielle Stewart, Paul Tremlin and Scott Zinn
- Photography/Videography team members Michael Agnew, Lori Losey, James Ross, Brian Soukup and Carla Thomas

AFRC2016-0133-14 NASA/Ken Ulbrich

C.J. Johnson, far left, and Charles Lundquist, far right, present Photo/Video team members with certificates. From second to left, are Michael Agnew, Brian Soukup, James Ross and Carla Thomas.

AFRC2016-0133-9 NASA/Ken Ulbrich

C.J. Johnson, far left, and Charles Lundquist, far right, present Pilot's Office team members with certificates. From second to left, are Tim Williams, Hernan Posada, Dean Neeley and Frank Batteas.

NASA Social... from page 1

sound barrier.

Attendees heard sonic booms from a NASA F/A-18 supersonic aircraft in level flight as well as witnessed demonstrations of a special flight technique that mimics the magnitude of the much quieter sonic booms that the QueSST aircraft is being designed to achieve in level flight.

Philip Belzeski, a Boise State University physics major who is popular on Twitter for his music, said he has worked with astronauts and wants to be one in the future. He heard his first sonic boom.

"The first sonic boom was shocking," he explained. "I was startled. The other demonstration flights sounded more like dropping a mattress (from an aircraft)."

A panel including Richwine, Jones, Peter Iosifidis, Lockheed Martin program manager for the QueSST contract, and NASA Armstrong aerospace engineer Ed Haering and NASA Armstrong pilot Jim Less, answered questions about supersonic aircraft and various schlieren processes, which capture images of the air density changes around aircraft as it travels supersonically.

Britt Dietz, who is popular on Facebook for his aviation photography, said he was fascinated by the use of filters and the sun to produce stunning images.

The second part of the social focused on UAS Integration in the NAS (UAS-NAS) with a presentation by Laurie Grindle, NASA UAS-NAS project manager, and Sam Kim, NASA UAS-NAS integrated test and evaluation project engineer for Armstrong.

To complete the work needed for UAS integration, all four aeronautics centers including Ames Research Center in California, Armstrong, Glenn Research Center in Ohio and NASA Langley are tackling aspects of the challenge to reduce technology barriers to UAS integration in the NAS. The goal is ultimately to have routine National Airspace System access for UAS.

ED15-0138-01 **NASA/Carla Thomas**

The aircraft based at Armstrong that are used in the Unmanned Aircraft Systems Integration in the National Airspace System project include, front from left, a TG-14, a T-34C and the Ikhana remotely piloted aircraft. The back row from left includes a B-200, a G-III and a C-90.

AFRC2016-0154-026 **NASA/Ken Ulbrich**

Tom Jones, NASA Commercial Supersonic Technology associate project manager based at Armstrong, explains components of NASA's supersonic research including the proposed Quiet Supersonic Technology demonstrator illustrated in the background, which is currently under design by Lockheed Martin.

Procedures and standards, and infrastructure tests to evaluate those standards, are part of that effort. For example, a Federal Aviation Administration regulation includes a provision that a UAS have the capability to see and avoid other aircraft. To meet that goal, UAS industry partners developed a sense-and-avoid technology to assist a remote pilot to maintain a safe separation from other air traffic.

NASA's remotely piloted Ikhana, based at Armstrong, is validating sensors that detect other aircraft from further distances. Other aircraft with similar systems are called cooperative aircraft in the simulations. Aircraft that do not have such systems, like general aviation aircraft, are considered non-cooperative aircraft and Ikhana uses radar to detect those aircraft. Command and control allows a pilot to fly with a radio and support infrastructure to facilitate a move from one tower to another.

Human factors allow for design of ground displays that serve as the interface of sense and avoid and command and control. These displays provide the pilot information such as traffic alerts that allow the aircraft to remain clear of congested areas.

Live distributed systems allow virtual aircraft to interact, so pilots can work with many "intruder" aircraft safely. The UAS Integration

Event, page 8

AFRC2016-0154-210 NASA/Kyria Luxon

A NASA Social attendee at NASA Armstrong takes a picture of herself with pilots Nils Larson, from left, Mark Pestana, Hernan Posada and Scott Howe.

AFRC2016-0154-149 NASA/Kyria Luxon

Britt Dietz, who is popular on Facebook for his aviation photography, asks a question at the NASA Social.

Event... from page 7

into the NAS project is expected to continue looking at solutions to remaining challenges, potentially through 2020, Grindle said.

"There still is a pilot in the loop on the ground and in communication with the aircraft," Kim explained. "Many systems are autonomous, but there are a lot of human factors."

Grindle, Kim and Debra Randall, NASA UAS-NAS chief systems engineer, and Hernan Posada, UAS-NAS pilot, sat on a panel to answer questions.

Participants asked about cyber security. Panel members said security is included in the standards and what kind of protection a data link requires. Researchers work closely with the Federal Aviation Administration on what the minimum standards should be.

Another question was what happens if the Ikhana loses communication with the ground control station. In that case, Posada said, Ikhana is programed to return home.

Attendees were able to see supersonic aircraft such as a NASA F/A-18 used in the flight earlier in the day, and the Ikhana remotely piloted aircraft that is a part of the UAS in the NAS work.

NASA Social attendees learned about aspects of supersonic flight and UAS systems. Regardless of how fast or slow an aircraft flies, NASA researchers are working on it.

AFRC2016-0154-170 NASA/Kyria Luxon

Laurie Grindle, NASA Unmanned Aircraft Systems Integration in the National Airspace System project manager, explains how the project is validating technologies.

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