

Sustainability Bites  
at Schiphol Airport

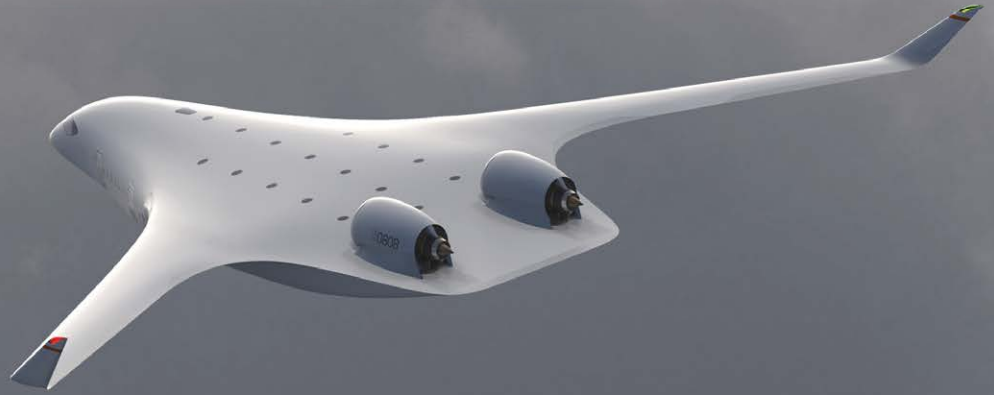
**737 MAX**  
More Delays

Embraer's Defense  
Future After the C-390

\$14.95 APRIL 24-MAY 7, 2023

# AVIATIONWEEK

## & SPACE TECHNOLOGY



## BLENDING WING UPSTART



## **Digital Edition Copyright Notice**

The content contained in this digital edition (“Digital Material”), as well as its selection and arrangement, is owned by Informa and its affiliated companies, licensors, and suppliers, and is protected by their respective copyright, trademark and other proprietary rights.

Upon payment of the subscription price, if applicable, you are hereby authorized to view, download, copy, and print Digital Material solely for your own personal, non-commercial use, provided that by doing any of the foregoing, you acknowledge that (i) you do not and will not acquire any ownership rights of any kind in the Digital Material or any portion thereof, (ii) you must preserve all copyright and other proprietary notices included in any downloaded Digital Material, and (iii) you must comply in all respects with the use restrictions set forth below and in the Informa Privacy Policy and the Informa Terms of Use (the “Use Restrictions”), each of which is hereby incorporated by reference. Any use not in accordance with, and any failure to comply fully with, the Use Restrictions is expressly prohibited by law, and may result in severe civil and criminal penalties. Violators will be prosecuted to the maximum possible extent.

You may not modify, publish, license, transmit (including by way of email, facsimile or other electronic means), transfer, sell, reproduce (including by copying or posting on any network computer), create derivative works from, display, store, or in any way exploit, broadcast, disseminate or distribute, in any format or media of any kind, any of the Digital Material, in whole or in part, without the express prior written consent of Informa. To request content for commercial use or Informa’s approval of any other restricted activity described above, please contact the Reprints Department at (877) 652-5295. Without in any way limiting the foregoing, you may not use spiders, robots, data mining techniques or other automated techniques to catalog, download or otherwise reproduce, store or distribute any Digital Material.

NEITHER Informa NOR ANY THIRD PARTY CONTENT PROVIDER OR THEIR AGENTS SHALL BE LIABLE FOR ANY ACT, DIRECT OR INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OF OR ACCESS TO ANY DIGITAL MATERIAL, AND/OR ANY INFORMATION CONTAINED THEREIN.

# Automatic ammunition handling for extreme military environments

Meggitt has developed and fielded state-of-the-art lethality solutions for the most challenging operational environments across the spectrum of conventional ammunition calibers as well as advanced ammunition in the form of case telescoped and electromagnetic railgun rounds. Meggitt delivers unprecedented reliability to the mission-critical weapon systems of today and tomorrow.



**Meggitt Defense Systems**

9801 Muirlands Blvd.

Irvine, CA 92618

Tel: +1 949 465 7700

E-mail: [kyle.pattermann@meggitt.com](mailto:kyle.pattermann@meggitt.com)

**[www.meggittdefense.com](http://www.meggittdefense.com)**





Access **AW&ST** Online  
Go to: [AviationWeek.com/AWST](http://AviationWeek.com/AWST)

# AVIATIONWEEK & SPACE TECHNOLOGY

April 24-May 7 • Volume 185 • Number 8

**JESSE H. NEAL AWARDS**  
Est. 1985  
2022 Winner

68

## FEATURES

- 16** | **‘Successful Failure’**  
 SpaceX Starship/Super Heavy experiences a “rapid unscheduled disassembly” in its first test flight
- 18** | **Reaching Limits**  
Dutch government and airlines take Amsterdam Schiphol Airport flight cap proposal to court
- 30** | **Slow Going**  
The GAO denies Sikorsky’s Future Long-Range Assault Aircraft protest, but new delays loom
- 54** | **Enter the Quiet Age**  
Whisper Aero targets defense first for ultraquiet electric propulsion, starting with military drones

## SUSTAINABILITY

- 20** | JetZero unveils midmarket airliner and air force tanker BWB plan


## TECHNOLOGY

- 24** | Aalyria aims to enable “network of networks” in space

## MILITARY SPACE

- 26** | U.S. Space Force urges companies to prioritize ground control systems
- 27** | Space Safari’s Victus Nox nears “hot standby” phase

## DEFENSE

- 32** | Russia is close to launching a new  high-speed air-launched missile
- 34** | What comes after the C-390 for Embraer’s defense unit?
- 36** | Japan prepares to engage in international weapons trade

## DEPARTMENTS

- 5** | Feedback
- 61-62** | Tech Take
- 6-7** | Who’s Where
- 65** | Contact Us
- 8-9** | First Take
- 65** | Aerospace Calendar
- 10** | Up Front
- 12** | Going Concerns
- 14** | The Launchpad

24

*Aalyria says its software could coordinate a network stretching into cislunar space.*

- 38** | New British trainer is central to the RAF’s green agenda
- 39** | Romanian officials speed up F-35 procurement plans
- FUEL**
- 40** | Synthetic fuel producer makes progress on technology
- COMMERCIAL AVIATION**
- 42** | Cathay Pacific targets short-term recovery and long-term growth 
- 44** | FAA seeks New York-area airline service cuts due to ATC shortfall
- 45** | U.S. airlines invest in providing no-cost onboard Wi-Fi
- 46** | Automation and autonomy are at center of flight deck research

- 49** | Vertical stabilizer issue slows Boeing 737 delivery surge
- 50** | New requirements bog down Boeing 737-7 approval
- PROPULSION**
- 56** | NASA nears all-electric experimental X-57 preflight milestone
- 58** | Flying Whale selects Honeywell-Pratt for airship power
- 59** | Universal Hydrogen bets on Toulouse for ATR 72-600 project
- TWO VIEWS**
- 66** | Will the aviation sector replicate big oil’s playbook?
- 66** | How aviation aids—responsibly—when disaster strikes



JOE ANSELMO/AW&ST

## BEHIND THE SCENES

Venturi Astrolab founder and CEO **Jaret Matthews** (right) showed off a prototype of the company’s lunar terrain rover to Aviation Week Senior Editor **Guy Norris** at the 38th Space Symposium in Colorado Springs. The California startup has a deal with SpaceX to launch its rover to the Moon in 2026 and is competing for NASA’s lunar rover vehicle service contract. Aviation Week’s team covering the four-day space event included Norris, Jen DiMascio, Brian Everstine, Garrett Reim, Wes Charnock and Joe Anselmo.

## ON THE COVER

*Startup JetZero has partnered with Northrop Grumman to bid for a U.S. Air Force program to build a full-scale demonstrator of a blended wing body commercial aircraft that could be converted to an advanced tanker/transport. Our report by Senior Editor Guy Norris and Technology Executive Editor Graham Warwick begins on page 20. JetZero concept image.*

*Aviation Week publishes a digital edition every week. Read it at [AviationWeek.com/AWST](http://AviationWeek.com/AWST)*

 **DIGITAL EXTRAS** Access exclusive online features from articles accompanied by this icon.



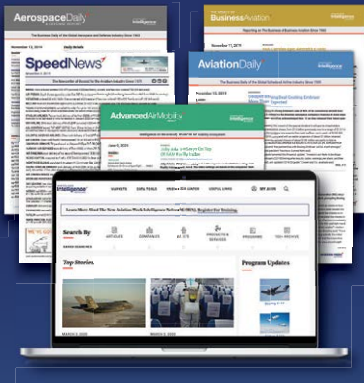
AviationDaily

AerospaceDaily  
& DEFENSE REPORT

SpeedNews

THE WEEKLY OF  
BusinessAviation

AdvancedAirMobility  
REPORT



Go beyond the news of the day with Aviation Week Intelligence Network's Market Briefings.

- Stay ahead of the market
- Identify new opportunities
- Drive revenue

Learn more:  
[aviationweek.com/marketbriefings](http://aviationweek.com/marketbriefings)

AVIATION  
WEEK  
NETWORK

AVIATIONWEEK  
& SPACE TECHNOLOGY

**Editor-in-Chief** Joseph C. Anselmo [joe.anselmo@aviationweek.com](mailto:joe.anselmo@aviationweek.com)

**Executive Editors**

Michael Bruno (Business) [michael.bruno@aviationweek.com](mailto:michael.bruno@aviationweek.com)  
Jen DiMascio (Defense and Space) [jen.dimascio@aviationweek.com](mailto:jen.dimascio@aviationweek.com)  
Jens Flottau (Commercial Aviation) [jens.flottau@aviationweek.co.uk](mailto:jens.flottau@aviationweek.co.uk)  
Lee Ann Shay (MRO and Business Aviation) [leeann.shay@aviationweek.com](mailto:leeann.shay@aviationweek.com)  
Graham Warwick (Technology) [warwick@aviationweek.com](mailto:warwick@aviationweek.com)

**Editors** Lindsay Bjerregaard, Christine Boynton, Sean Broderick, Bill Carey, Chen Chuanen, Thierry Dubois, Brian Everstine, Matt Fulco, Ben Goldstein, Jeremy Kariuki, Irene Klotz, Helen Massy-Beresford, Molly McMillin, Jefferson Morris, Mark Nensel, Guy Norris, Tony Osborne, James Pozzi, Lori Ranson, Garrett Reim, Adrian Schofield, Steve Trimble

**Director, Editorial and Online Production** Michael O. Lavitt

**Managing Editor** Andrea Hollowell

**Art Director** Lisa Caputo

**Artists** Thomas De Pierro, Vicki Hopewell, Rosa Pineda, Colin Throm

**Senior Content Producer** Audra Avizienis

**Copy Editors** Jack Freifelder, Peri Meyers, Arturo Mora, Natalia Pelayo, Andy Savoie

**Production Editors** Andrea Copley-Smith, Theresa Petruso

**Podcast Editor** Guy Ferneyhough

**Contributing Photographer** Joseph Pries

**Content Marketing Operations** Wes Charnock, Elena Baxendale, Sundus Ghani, Cheryl Heng, Leanne Jade Lawrence, Barbara Nichols

**Data & Analytics**

**Senior Director, Forecasts and Aerospace Insights** Brian Kough

**Director, Data Operations and Solutions** Terra Deskins

**Head, Defense Markets and Data** Craig Caffrey

**Editorial Offices**

2121 K Street, NW, Suite 210, Washington, D.C. 20037 (202) 517-1100

605 Third Avenue, New York, N.Y. 10158

**Bureau Chiefs**

**Atlanta**

Jeremy Kariuki [jeremy.kariuki@aviationweek.com](mailto:jeremy.kariuki@aviationweek.com)

**Auckland**

Adrian Schofield [adrian.schofield@aviationweek.com](mailto:adrian.schofield@aviationweek.com)

**Boston**

Christine Boynton [christine.boynton@aviationweek.com](mailto:christine.boynton@aviationweek.com)

**Cape Canaveral**

Irene Klotz [irene.klotz@aviationweek.com](mailto:irene.klotz@aviationweek.com)

**Chicago**

Lee Ann Shay [leeann.shay@aviationweek.com](mailto:leeann.shay@aviationweek.com)

**Colorado Springs**

Guy Norris [guy.norris@aviationweek.com](mailto:guy.norris@aviationweek.com)

**Frankfurt**

Jens Flottau [jens.flottau@aviationweek.co.uk](mailto:jens.flottau@aviationweek.co.uk)

**Houston**

Mark Carreau [mark.carreau@gmail.com](mailto:mark.carreau@gmail.com)

**London**

Tony Osborne [tony.osborne@aviationweek.co.uk](mailto:tony.osborne@aviationweek.co.uk)

**Los Angeles**

Garrett Reim [garrett.reim@aviationweek.com](mailto:garrett.reim@aviationweek.com)

**Lyon**

Thierry Dubois [thierry.dubois@aviationweek.com](mailto:thierry.dubois@aviationweek.com)

**Moscow**

Maxim Pyadushkin [mpyadushkin@gmail.com](mailto:mpyadushkin@gmail.com)

**Paris**

Helen Massy-Beresford [helen.massy-beresford@aviationweek.co.uk](mailto:helen.massy-beresford@aviationweek.co.uk)

**Washington**

Jen DiMascio [jen.dimascio@aviationweek.com](mailto:jen.dimascio@aviationweek.com)

**Wichita**

Molly McMillin [molly.mcmillin@aviationweek.com](mailto:molly.mcmillin@aviationweek.com)

**President, Aviation Week Network** Gregory Hamilton

**Senior Vice President, Data, Intelligence & Media** Anne McMahon

**Senior Vice President, Content** Joseph C. Anselmo

**Senior Vice President, Events** Lydia Janow

**Managing Director, Media & Marketing Services** Iain Blackhall

**Managing Director, Defense & Space** Andrea Rossi Prudente

AVIATIONWEEK  
NETWORK  
An Informa business

## IMPACT REVIEW

I enjoyed Guy Norris' article discussing the validation testing detailing the positive attributes of the shorter inlet configuration (*"Boeing-Rolls Short-Inlet Tests Show Potential To Cut Big Fan Drag," Feb. 27-March 12, p. 34*). What I found missing was the discussion of possible impact to certification blade-out event testing. Although the primary containment capability of a fan blade release event is dictated by the immediate structure surrounding the blade tip region, one might be concerned about the effects of a change in the inlet flow dynamics under various engine operational flight conditions and the impact on a blade release.

Recent blade release events have resulted in significant nacelle damage, including subsequent airframe penetration and loss of life.

Repeating a certification test subsequent to a significant design change is usually determined via a reassess-



## BEHIND THE SCENES

Delta Air Lines CEO **Ed Bastian** (right) was interviewed by Aviation Week Editorial Director **Joe Anselmo** onstage to kick off the Aviation Week Network's 2023 MRO Americas conference. This year's event drew more than 15,000 attendees and over 875 exhibitors to Atlanta April 18-20. It included sessions on the supply chain, mergers and acquisitions, NextGen airspace and infrastructure planning, and digital and cybersecurity.

PHOTO: LEE ANN SHAY/AW&ST

On June 15, 1993, I submitted testimony to Congress regarding "A Proposal for a Restructured, Independent Federal Aviation Administration." On Oct. 7, 1994, then-Rep. James Oberstar (D-Minn.), chairman of the House Transportation Committee at the time, introduced H.R. 5274 to improve the safety and convenience of air travel by establishing the FAA as an independent federal agency. The issues described by Grizzle were defined in that 1994 legislation. The legislation established a five-year fixed term of the administrator and the role of chief operating officer. Funding and other reforms were considered a bridge too far in 1993. Why in 2023 are the same critical issues being discussed?

Recently, I met with a number of air traffic first-line managers and was advised that their positions have been underfunded, resulting in a shortfall of approximately 500 positions. They also noted an increase of "controllers in charge" to manage the tactical operations of air traffic. The recent Notice to Air Missions crisis, near collisions and closed air traffic airspace sectors are indications of a fundamental crisis within the national air traffic control system. What are the underlying causes? Congress, industry, travelers and the FAA need to understand the systemic issues and finally construct a modern FAA and air traffic system. Will the FAA be repeating the same issues in 2050 as noted in 1993 and 2023?

*Maurice F. Connor, Port St. Lucie, Florida*

## COLLABORATIVE EFFORT

Prior to retiring from the corporate world, I was very active in many industry-wide events related to advanced manufacturing concepts. As a member of the Aerospace Industry Association, I had the benefit of listening to Richard Aboulafia, who was a frequent guest speaker. Reading his column in the Feb. 27-March 12 issue (*"Aviation Angst," p. 10*), it dawned on me when he emphasized parts shortfalls that our collaborative network needs to expand.

Having come from several industries and having the ability to work across the entire supply chain, I view today's situation as an apocalypse. Parts shortages have now surpassed microchip shortages.

We need a more collaborative effort to overcome the tremendous headwinds facing our parts supply chains. I am now chair of the Investment Casting Institute's additive manufacturing subcommittee, leading an effort to bring the metals community together so that we can learn how to apply these new technologies to improve our businesses and close on our parts commitments. In March, as a first step, representatives from academia, government and industry attended the Investment Casting Institute's second annual Additive Manufacturing for Investment Casting symposium, held in collaboration with the Steel Founders Society of America and the American Foundry Society.

*Donald Deptowicz, Berthoud, Colorado*

ROLLS-ROYCE



ment of the failure modes and effects analysis and substantiation thereof. One would hope the completion of the final development tests and analysis would include the review of impact to the original blade-out certification test.

*Robert Gleason, Pleasant Unity, Pennsylvania*

## A FUNDAMENTAL CRISIS

After reading the comments of David Grizzle in "The FAA's Funding Conundrum" (*Feb. 13-26, p. 44*), I am concerned that the FAA continues to manage the National Airspace System with little change. Grizzle cites the salient issues in detail. Clearly, the FAA has not moved forward with modernization of the National Airspace System to ensure critical staffing and adequate funding. My point is: Have Congress, the FAA and industry recognized the history of the FAA's present situation?

Address letters to the Editor-in-Chief, *Aviation Week & Space Technology*, 2121 K Street, NW, Suite 210, Washington, DC, 20037 or send via email to: [awstletters@aviationweek.com](mailto:awstletters@aviationweek.com) Letters may be edited for length and clarity; a verifiable address and daytime telephone number are required.



**Patricio Northland** has been promoted to CEO from executive president at *Beetle-Sat*. Northland brings executive leadership experience, including at Eutelsat Americas,

Satmex and AT&T Latin America.

**Amy Spowart** has been appointed president and CEO of the *National Aeronautic Association*. She held the same roles at the National Aviation Hall of Fame for seven years.

**Paddy Kelleher** has been brought on as capture management director at *Raytheon Intelligence & Space*. He has worked at L3Harris Technologies, Lockheed Martin and Northrop Grumman, among others.

**Makenzie Lystrup**

has been named director of *NASA Goddard Space Flight Center* in Maryland. She succeeds Dave Mitchell, who was Goddard's acting center director since January and has resumed his duties as chief program management officer at NASA Headquarters in Washington. Lystrup was vice president and general manager of civil space at Ball Aerospace.

ATL Partners has launched *Light-Ridge Solutions*, a space and airborne developer to be led by **Bill Gattle**. He was president of L3Harris Technologies' space sector.

**Ted Di Giorgio** has joined aerospace and landing gear manufacturer *HerouxDevtek* as director of the corporation and member of the audit committee. He was an audit partner at Ernst & Young.

**Richard Kube** has been hired as chief production officer at *Sidus Space*. He was vice president of engineering at Cape Design Engineering.

**Tim Martin** has been appointed chief revenue officer and executive team member at cargo drone airline *Dronamics*. He was chief operating officer at travel agency Kuoni Tumlare and previously senior vice president for global sales and marketing for Asia Pacific at DHL Global Forwarding.

*The International Society of Transport Aircraft Trading (ISTAT)* has announced

new leadership. **Mary Prettyman** will serve as president and **Sigthor Einarsson** as chair of the ISTAT Foundation. Prettyman is head of marketing for commercial engines at Pratt & Whitney, while Einarsson is chairman and senior partner at Icelease.

**Ken Aso** has been appointed chief operating officer at *FDH Aero*, a supply chain solutions provider for aerospace and defense OEMs and aftermarket segments. Aso was a partner and senior advisor at Oliver Wyman. Before that he held various roles at Boeing Global Services including managing director of Global Services Engineering, Maintenance and Mods Product Management.

**Germaine Hunter** will become chief diversity officer at *GE Aerospace*, effective May 1. She was chief diversity executive and talent acquisition leader at Marathon Petroleum and the first chief diversity officer at The Clorox Co.

*Sierra Space* has hired **Tim Keating** as chief strategy officer and senior vice president for global government operations. He was the longtime executive vice president of government operations at Boeing until his 2021 departure.

**Paul Petersen** on May 1 will become the first executive director of the *United Aerial Firefighters Association*, which launched in February. Petersen brings more than 30 years of industry experience and is now a state fire management officer for the U.S. Bureau of Land Management.

**Tiffany Taylor** has joined the association as senior policy director. She was director for the office of contracting and procurement at the U.S. Department of Agriculture and has served in the U.S. Forest Service.

*Ball Aerospace* has promoted **Jake Sauer** to vice president and chief technologist from vice president and general manager of its Tactical Solutions special business unit. Vice President of Operations **Paula Burns** takes his former position. **John Martin** has been



named vice president of the Operations Strategic Capabilities unit.

**Ron van Manen** has been hired as project director and managing director of the project office at Dutch research program *Aviation in Transition*.

Hybrid electric vertical-takeoff-and-landing aircraft developer *PLANA* has hired **Taekyu Reu** as senior vice president of aircraft configuration engineering. He was vice president of the Advanced Defense Technology Research Institute at South Korea's Agency for Defense Development.

Private equity firm *Clayton, Dubilier & Rice* has appointed **John Hayes** as operating advisor for funds. He was chairman and CEO of Ball Corp.

**John W. Dietrich** has been elected to the board of directors for *AAR*. He is president and CEO of Atlas Air Worldwide Holdings, as well as chair-

man of the National Defense Transportation Association.

**Stefanie Sedam** has been promoted to manager of regional managers from senior Bombardier airframe service sales representative at *Duncan Aviation*. She brings years of sales and customer service experience, including on interior, maintenance and modification projects.

**Linda O'Brien** has joined the board of directors at *Astronics Corp*. She is vice president and chief engineer at Lockheed Martin Aeronautics.

*VulcanForms* has hired **David Kalinske** as vice president and general manager for aerospace and defense. He was president of TDX Government Services Group.

*Spaceport America* has named **Francisco Pallares** as director of business development. He was professor of economics at Sul Ross State University and deputy director of the economic development department for the city of Las Cruces, New Mexico.

The board of directors at *Boeing* has nominated **Sabrina Soussan** as a new director. She is currently chair and CEO of Suez, a French water and waste management utility company.

*Northrop Grumman* has added **Kimberly A. Ross** and **Mary A. Winston** to its board of directors. Ross was chief financial officer at WeWork, as well as at Baker Hughes. Winston is



president and founder of WinsCo Enterprises, and was interim CEO at Bed Bath & Beyond.

**Mehmet T. Nane** has been appointed chairperson of the board of directors at *Pegasus Airlines*. He was vice chairperson of the board, and continues to serve as managing director at the company.

*ISTAT* has elected five new board members: **Marine Benoit**, vice president of aircraft leasing and marketing at Aviation Capital Group; **Sarah Conway**, senior vice president at Deucalion Aviation Ltd.; **Michael Littleton**, head of aircraft trading at SMBC Aviation Capital; **Paul O'Dwyer**, chief commercial officer at ORIX Aviation; and **Paraic Quinn**, head of capital markets and trading at Avolon.

### HONORS & ELECTIONS

The Space Foundation has awarded U.S. Army 1st Lt. **Tanner Bush** its *Adm. James O. Ellis, Jr., New Generation National Security Scholarship*. His performance in the U.S. Space Force's 2nd Space Operations Sqdn. won him

selection for commission within two years. He also was responsible for the first-ever satellite control authority transfer of the newest Block III GPS satellites to the squadron. Bush holds a master's degree in space studies and is pursuing a second master's in project management.



**Ed Libassi**, owner and president of A&P Aircraft Maintenance, has been presented the FAA's

*Charles Taylor Master Mechanic Award*, which celebrates those with over 50 years of service in aviation. At age 19, Libassi opened A&P Aircraft Maintenance in Bayport, New York, and eventually moved it to MacArthur Airport in Ronkonkoma, New York. Libassi

started his career as an aircraft mechanic at Eastern Airlines' John F. Kennedy International Airport base of operations, at which he worked until Eastern went out of business in 1991. He is a licensed FAA aircraft and powerplant mechanic with inspection authority; a certified designated airworthiness designee, maintenance; and a director of maintenance for both Part 135 and Part 141 operators.

**William "Bill" Shea** has received the *Wesley L. McDonald Distinguished Statesman of Aviation Award* from the National Aeronautic Association for his contributions to aeronautics. He is founding director of the University of Nebraska Omaha Aviation Institute, was chair of the aviation department at the University of North Dakota and continues to write and lecture. 🌐

To submit information for the Who's Where column, send Word or attached text files (no PDFs) and photos to: [whoswhere@aviationweek.com](mailto:whoswhere@aviationweek.com) For additional information on companies and individuals listed in this column, please refer to the Aviation Week Intelligence Network at [AviationWeek.com/awin](http://AviationWeek.com/awin) For information on ordering, telephone U.S.: +1 (866) 857-0148 or +1 (515) 237-3682 outside the U.S.



# Avionics & Mission Video Architecture

Seamlessly integrate old and new cameras, sensors, processors, and displays.

## ARINC 818

AVIONICS DIGITAL VIDEO BUS

[GREATRIVERTECH.com](http://GREATRIVERTECH.com)

FRAME GRABBERS \ VIDEO GENERATORS \ SWITCHES \ PROTOCOL ANALYZERS \ VIDEO CONVERTERS \ IP CORES

GET THE NEW

**PRODUCT GUIDE!**



# FIRST TAKE

For the latest, go to  
[AVIATIONWEEK.COM](http://AVIATIONWEEK.COM)

EMBRAER



## DEFENSE

**Embraer has launched** a NATO-compliant version of the A-29 Super Tucano light attack turboprop as Portugal starts shopping for a close air support aircraft.

**Lockheed Martin will not** pursue further legal action to overturn the U.S. Army's selection of Bell's V-280 Valor after its protest was rejected by the Government Accountability Office (page 30).

**The U.S. Defense Department** is giving Aerojet Rocketdyne \$215.6 million to increase manufacturing capacity amid a chronic shortage of solid rocket motors that power key munitions.

**North Korea tested a new** solid-fuel intercontinental ballistic missile on April 13, the Hwasong-18. It traveled 620 mi. before impact in the Sea of Japan.

**The UK Defense Ministry** has released the latest tranche of \$829 million in funding to support development of technologies for the Global Combat Air Program.

**Argentina's state-owned** aircraft manufacturer plans to roll out the IA-100 Malvina basic trainer next year, targeting domestic and foreign customers.

**The Japan Defense Ministry** has awarded Mitsubishi Heavy Industries \$2.8 billion to develop and manufacture a range of standoff missiles (see page 36).

**Finland has selected** the Rafael David's Sling ground-based air defense system, becoming the first foreign customer for the Israeli system.

## COMMERCIAL AVIATION

**A French court has** cleared Air France and Airbus of involuntary manslaughter

charges relating to the crash of Flight AF447 in 2009 en route from Rio de Janeiro to Paris.

**A production problem** with vertical stabilizer fittings will force Boeing to repair some undelivered 737 MAXs and delay a number of deliveries (page 49).

**A New York court has** ordered Russia's AirBridgeCargo to pay BOC Aviation \$406.2 million for defaulting on three leases for Boeing 747-8 freighters and failing to return aircraft and engines in 2022.

**Russia's largest airline**, Aeroflot, has sent one of its Airbus A330-300 wide-body aircraft to Iran for technical maintenance for the first time.

**Southwest Airlines moved** quickly to recover from a brief groundstop on April 18 as work continues to ensure operational integrity following its meltdown in late 2022.

**The drifting ash cloud** from a volcanic eruption on Russia's Kamchatka Pen-

insula on April 11 disrupted air service in Alaska in the latter half of the week.

**JetBlue Ventures has** invested in Shift5, a data and cybersecurity company expanding its defense focus to include capabilities for commercial aircraft.

**Air passenger duty** on UK domestic routes has been cut by half in a government bid to incentivize airlines to expand their networks.

**Etihad Airways has been** reprimanded by the UK Advertising Standards Authority for misleading eco-advertising, despite efforts to advance sustainable aviation technologies.

**Israel Aerospace Industries** will open a Boeing 777 passenger-to-freighter conversion line in South Korea in collaboration with local maintenance, repair and overhaul firm Sharp Technics K.

**Cathay Pacific is** to support plans by energy company State Power Investment Corp. to build four sustainable aviation fuel plants in mainland China in 2024-26.

## VIEW FROM WASHINGTON

### Pentagon Bids To Free Up New Starts

The U.S. Air Force is losing precious time to move ahead with new programs because of red tape in Washington. To help change that trend, Air Force Secretary Frank Kendall has an unlikely message to Congress: Give up some of your authority.

A legislative proposal the White House Office of Management and Budget has sent to Capitol Hill calls for the Defense Department to initiate less expensive work on new programs ahead of congressional approval. Research and planning for the Air Force's seven top investment priorities finished a year ago, but the service has to wait for congressional action on authorization and appropriations to start work on these areas.

Under the proposal, the Pentagon would be able to start the initial phases of an acquisition program, up through a preliminary design review, without congressional approval.

"Time is going by," Kendall says, "and for all of those things that we worked hard to understand and formulate good solutions to, we're not able to act on them yet. One of the reasons this hasn't happened in the past is because of Congress' reluctance to give up even this much authority. I think it's a minimal amount of authority to give up for a very high return in terms of [time]."



REGENT



**TECHNOLOGY**

**U.S. startup Regent has** unveiled the full-scale mockup of its Viceroy electric seaglider, selecting EP Systems to supply batteries and Macigall for motors.

**The largest manufacturer** of batteries for electric vehicles, China's CATL, has launched a high-energy-density "condensed battery" technology, targeting electric aircraft.

ISSEI KOBAYASHI



**Boom Supersonic has** moved its XB-1 one-third-scale demonstrator to Mojave, California, for the start of flight tests.

**Chinese lessor GDAT has** agreed to buy 50 Airbus H160s, the largest single order for the helicopter since the type was unveiled in 2015.

**U.S. startup Merlin is to** demonstrate automated flight control of a Cessna Caravan flying cargo routes in Alaska under a contract from the FAA.

**SPACE**

**The first launch of** the SpaceX Starship/Super Heavy on April 20 failed to reach orbit when the vehicle exploded as its upper stage prepared to separate about 3 min. after liftoff (page 16).

**The penultimate Ariane 5** lifted off from Europe's spaceport in Kourou, French Guiana, on April 14, launching the European Space Agency's JUICE probe to Jupiter's icy moons (page 14).

**New Zealand space** transport startup Dawn Aerospace has begun rocket-

powered test flights of its suborbital Mk. 2 Aurora spaceplane.

**Russia is to replace** U.S. equipment on the Venera-D spacecraft and launch the exploration mission to Venus in 2029 without NASA participation, with less ambitious scientific goals.

**OBITUARIES**

**Larry Flynn**, former president of Gulfstream Aerospace, died April 12 after a battle with cancer. He was 71. Flynn retired from Gulfstream in 2015 after 20 years with the company and was previously with fixed-based operator Stevens Aviation. Flynn was an influential voice and "a tireless industry champion," says National Business Aviation Association President Ed Bolen.

**Republican congressman** Elmer Greinert "Bud" Shuster, former chairman of the House Transportation and Infrastructure Committee, died April 19. He was 91. Shuster was committee chairman for six years from 1995 to 2001. "Shuster passed several major aviation and other transportation infrastructure bills with overwhelming bipartisan support—a rarity in today's highly partisan environment," says National Air Carrier Association President and CEO George Novak. 🗳️

**QUOTED**

"FROM A SUSTAINABILITY PERSPECTIVE WE NEED A CLEAN-SHEET DESIGN . . . BUT THE REALITY IS, **BOEING'S GOT BIGGER CHALLENGES THAN A CLEAN-SHEET DESIGN.**"



STEVE MARCUS/REUTERS/ALAMY STOCK PHOTO

—ED BASTIAN,

Delta Air Lines CEO, addressing Aviation Week's MRO Americas conference in Atlanta on April 18

**40 YEARS AGO IN AVIATION WEEK**

**The first spacewalk of the space shuttle** era was featured on our cover from April 25, 1983. Astronauts Story Musgrave and Don Peterson were pictured working in the payload bay of the space shuttle Challenger during the orbiter's first flight. The 4-hr. 17-min. spacewalk was the first by U.S. astronauts in more than nine years. The highlight of Challenger's five-day mission was the deployment of NASA's first Tracking and Data Relay Satellite (TDRS-1), which ended up in the wrong orbit after its Inertial Upper Stage booster malfunctioned. It took several months, but NASA was able to maneuver TDRS-1 into its proper orbit using extra propellant on the satellite. Musgrave went on to fly on five additional shuttle missions, the last in 1996.



Subscribers can access every issue of Aviation Week back to 1916 at: [archive.aviationweek.com](http://archive.aviationweek.com)





## UP FRONT

## RICHARD ABOULAFIA

**U.S. MILITARY AIRFRAMERS AND**

their contractors are entering a golden age. A plethora of new aircraft are in development or about to begin develop-

ment. The U.S. Air Force's Northrop Grumman B-21, Next-Generation Air Dominance (NGAD), Collaborative Combat Aircraft (CCA) and Boeing T-7 are to be joined soon by a new tanker, the KC-Z, and new strategic transport, the C-X. The U.S. Navy is working on its F/A-XX and MQ-25. The U.S. Army is developing its Bell Helicopter V-280 tiltrotor and Future Attack Reconnaissance Aircraft vertical scout/attack competition.

## Contingency Planning

### Four lessons from military aviation's lost generation

But the last golden age was in the 1980s, and it did not go well. The end of the Cold War and the demise of the Soviet Union led to a steep drop in defense budgets and radically changed defense priorities. We can learn four key lessons from this almost-lost generation.

First, programs should have a diverse customer base. Joint programs might not be in vogue, and sometimes exports are not feasible, but both create program resilience. The Air Force's Northrop Grumman B-2 and Lockheed Martin F-22 both suffered from single-customer status. B-2 exports were not conceivable, and F-22 exports were illegal under the Obey Amendment.

Program managers should keep this in mind. For example, the U.S. Marine Corps should be encouraged to buy into the V-280, and the Air Force and Navy should try to make NGAD and F/A-XX technologies as common as possible. Exports should be a high priority for everything—even the B-21. Australia is buying nuclear submarines, so why aren't stealth bombers a possibility?

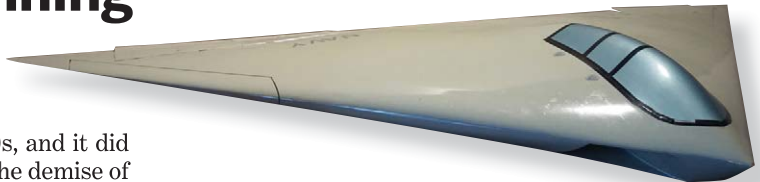
Second, the services need backup plans. The end of the McDonnell Douglas-General Dynamics A-12 and Naval Advanced Tactical Fighter programs and the cancellation of the Grumman F-14D and A-6F left the Navy with no choice but to fill carrier decks with Boeing F/A-18E/F Super Hornets. That may or may not have been the best alternative. Similarly, the end of the Boeing-Sikorsky RAH-66 Comanche program left the Army with plenty of Boeing AH-64s but no real plans for reconnaissance and scout helicopters.

The services need to plan for worst-case scenarios in the event that their top-priority programs are not approved. At the least they should be prepared to fill capability gaps, such as using business jets for intelligence, surveillance and reconnaissance duties; civil cargo aircraft for lift shortfalls; or refurbishing F-22s if the NGAD program slips or dies.

Third, program managers and the services should

keep requirements rationales ecumenical. Not all 1980s programs perished due to strategic change. The V-22 arguably benefited from the shift in focus away from Central Europe, with total production close to the original program of record. Similarly, the Northrop Grumman E-8 J-Stars rationale pivoted quickly from Europe to the Middle East, thanks in part to its service entrance in the Gulf War. But programs with a heavy focus on the Soviet threat, such as the Comanche or F-22, were hit hardest.

The lesson here is clear: Do not focus too much on China as a threat. For example, the NGAD, CCA, F/A-XX and others should be presented as necessary tools to



MICHAEL BARBERA/VIKIMEDIA

### McDonnell Douglas-General Dynamics A-12

combat any next-generation air-to-air adversary, not just the Chinese Air Force.

Finally, do not be a target. The A-12 was an easy kill in part due to its multibillion-dollar overruns. The Boeing C-17 survived only because bad program management was remedied. If China had not emerged as a potential peer adversary in the 2010s, the overrun-plagued Lockheed Martin F-35 might not have survived. In bad times, good execution is crucial.

If the current strategic drivers stay in place, most if not all of the new programs will have a clear path, regardless of their execution. In the middle of the Cold War, even deeply troubled programs such as the General Dynamics F-111, Lockheed C-5 and Rockwell B-1 did just fine. As long as China remains a menace—and perhaps Russia, too—many new high-value aircraft programs will emerge in the coming decades, with a relatively high tolerance for delays and cost overruns.

The odds are that the geopolitical drivers behind today's record defense budgets and weapons requirements will stay in place. China's government is unlikely to turn nice. But a renewed level of cooperation between China and the world, a detente of sorts, cannot be ruled out, leading to a weaker budget outlook. A conflict in the next few years between China and the U.S. and its allies, resulting in a cooling-off period, cannot be ruled out either.

In these circumstances, defense budgets could fall and programs will be scrutinized. The companies, services and people dependent on today's promising new generation of aircraft would do well to heed the lessons of the past. 🗨️

.....  
Contributing columnist Richard Aboulafia is managing director at AeroDynamic Advisory.



**Luigi Scatteia**  
Global Space Practice Leader,  
France, PwC



**Dan Osrin**  
Space Practice Leader,  
UK, PwC



**Tim Ford**  
Space Practice Leader,  
US, PwC

## Future of the Industry: Predictions for the Global Space Sector

The space industry is at a critical inflection point. Affordability improvements, advances in technology, increased public/private interest, and increasing satellite data exploitation have created an urgency for industry players to reshape traditional approaches to the market. Successful companies are aggressively shifting focus, investments, and capabilities to stay competitive, relevant, and responsive to market requirements. This webinar will analyze emerging trends and discuss predictions within the public and private space markets.

This webinar discusses:

- Emerging trends and challenges impacting the global space market
- How nations are developing space strategies for emerging space economies
- How investments are being made by an increasingly diverse group of investors
- Why commercial and military space capabilities are converging
- How organizations can enable a successful space strategy



To view this webinar, register at <https://bit.ly/3FEOZ1M>



# GOING CONCERNS MICHAEL BRUNO

## THE COLLAPSE OF SILICON VALLEY

Bank and fire sale of Credit Suisse have reminded the world what it was like in 2008 when the “great financial crisis” emerged. Logical or not, cable news business channels are full of pundits wondering whether we are in the middle of another bank run.

For commercial aerospace, the memories are almost visceral, as there remains collective post-traumatic stress disorder from the 2008 crisis, when the aircraft financing environment took a nosedive. Naturally, the latest bank stress is leading some observers to wonder about the outlook. The answer is that everything is going to be fine—probably. We’ll get to that in a moment.

## Fair Skies

### Aerospace glides through the banking storm

According to Boeing’s just-released update to its annual Commercial Aircraft Finance Market Outlook (CAFMO), this year’s aircraft financing environment is shaping up as the best overall since 2019 and far better than in the years after the 2008 crisis.

Boeing’s widely followed “stoplight chart” shows that financial institutions across the board should at worst be considered “cautionary,” but only in comparison to each other. For instance, financing provided by aircraft and engine OEMs is colored yellow (cautionary), but industry executives say that is because private-sector financing has exploded to record levels, rendering the need for OEM financing almost nil. Moreover, lessors—despite the rising cost of capital over the last year—continue to expect to be responsible for about half or more of their deals in the future.

The fact is, a great deal of money still is swimming around, and aviation deals attract some of it because of well-founded expectations for long-duration returns on investment. At the same time, the actual demand forecast for airliners is the strongest it has been in years. Aircraft financing needs are expected to near pre-pandemic levels this year.

“We doubt there are too many end markets where investors are more optimistic about the demand environment right now than commercial aerospace,” JP Morgan analysts told their clients after the latest CAFMO was published. “This reflects both the ongoing pandemic recovery as well as the durability of travel demand in the face of higher ticket prices. The conventional wisdom is that the recent upheaval in the banking system need not cause a meaningful decline in travel demand, and that seems fair enough for now.”

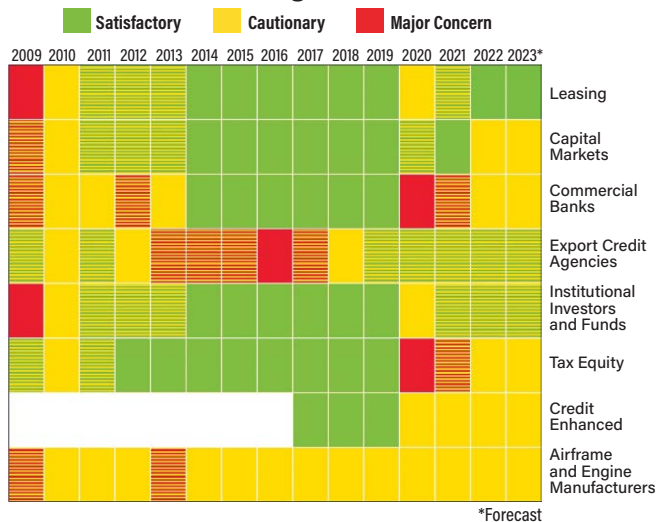
At the same time, any bank pullback is an opportunity for private funders to take on more financing in aerospace and defense, said Francis Tran, managing director at investment bank Lincoln International. In a March webinar, he noted record-high amounts of

“dry powder” or money remain available for investment. Private equity investors continue to voice strong interest in aerospace and defense even as interest rates rise, and fundraising rounds are oversubscribed amid persistent long-term market optimism. “The private markets remain quite open,” Tran said.

To be sure, there are reasons for industry to stay vigilant. Silicon Valley Bank was a favorite for venture-capital-backed startups, and the aerospace and defense world increasingly is embracing startups for the advanced technology they provide—without legacy companies risking a lot of their own money. While any chilling effect on startup banking would be unwelcome, advantages remain.

“The failure of Silicon Valley Bank rippled through the [venture capital] community and may yet impact credit to national-security-focused or dual-use startups,” Capital Alpha Partners Managing Director Byron Callan wrote in March. “Defense Department contractors with venture arms could see this as an opportunity to invest more in order to access new technology and products.”

### Aircraft Financing Environment



Sources: Boeing Analysis as of February 2023

\*Forecast

For its part, Boeing expects capital markets, bank debt and government export credit agencies to expand commercial aviation financing this year. Indeed, lessors could face more competition from other sources of financing, as ample funds remain for aviation deals.

“I think we’ve had a very comfortable transition,” says Vasgen Edwards, managing director of capital markets and outreach at Boeing Capital Corp. He tells Aviation Week that, compared with 2008, the financing environment is better itself and better reflects the inherent confidence in commercial aviation, which is growing again after the coronavirus pandemic and despite geopolitical tensions. “It feels like more of a bounce-back than we saw a decade ago,” he says. 🗣️





On April 13, 2023

Vaughn College honored

**Nicholas E. Calio**

President and Chief Executive Officer



# THANK YOU

Vaughn College would like to thank the sponsors for their generous contributions that made this our most successful Gala ever! Your support ensures our engineering, technology, management and aviation students will reach new heights on their journey to become futureproof.

**PLATINUM SPONSOR:**



**GOLD SPONSORS:**



**SILVER SPONSORS:**



**BRONZE SPONSORS:**



**BENEFACTOR SPONSORS:**



Mary and Bruce Thompson



## THE LAUNCHPAD

# IRENE KLOTZ

**NINE ROBOTIC PROBES HAVE** visited Jupiter, beginning with the Pioneer 10 flyby 50 years ago. All the spacecraft were owned and operated by NASA, and only two—the flagship Galileo mission and the current Juno campaign—ended up in orbit for long-term studies of the gas giant and its entourage of moons.

With the launch of the Jupiter Icy Moons Explorer (JUICE), the European Space Agency (ESA) takes the driver's seat with a mission designed not only to chip away at figuring out how the behemoth planet formed, but also to focus on three of the most intriguing places in the Solar System that may be suited for life.

No fewer than 35 flybys of the icy moons are planned between July 2031 and November 2034, after which JUICE is scheduled to orbit Ganymede until September 2035. In the process, JUICE would become the first spacecraft to change orbit from another planet to one of its moons—in this case, from Jupiter to Ganymede—and then the first to orbit a moon other than Earth's.

The focus on Ganymede stems from its physical features. The biggest moon in the Solar System, Ganymede hosts a large, subsurface ocean sandwiched between two layers of ice. The total quantity of water is estimated to be greater than what exists on Earth.

## Journey to Jupiter

Europe's JUICE spacecraft is heading to **outer moons with inner oceans**



NASA/JPL-CALTECH/SWRI/MSSS

**NASA's Juno spacecraft took this 2017 image of Jupiter.**

Scientists already have strong evidence that the moons—Callisto, Ganymede and Europa—hold large liquid oceans beneath their thick icy surfaces. The \$1.8-billion JUICE mission aims to verify the oceans' existence, investigate their properties and assess if there are environments where life may exist.

"The main goal is to understand whether there are habitable environments among those icy moons," says JUICE Project Scientist Olivier Witasse. "The questions are: 'Where are those oceans located and at what distance underneath the surface[s] of the moons? What is the depth of [those] ocean[s]? How much water do [they] have? What is the composition of this water?' To understand this question of habitability, we need to explore the Jupiter system globally."

The journey to Jupiter began with a launch from Kourou, French Guiana, on April 14 aboard an Ariane 5 rocket, the penultimate mission for the workhorse Arianespace heavy-lift booster that entered commercial service in 1999.

Two hours after launch, JUICE deployed its massive, 915-ft.<sup>2</sup> solar arrays—the largest ever built for an interplanetary spacecraft. That set the stage for an eight-year, 373-million-mi. voyage that will require several gravity slingshots from Venus and Earth to propel JUICE toward Jupiter. The spacecraft is expected to arrive in July 2031.

Scientists say the probability that conditions for life are being met in Ganymede's ocean is high. In addition to liquid water and a source of energy, those conditions include a stable environment and the presence of nitrogen, carbon, oxygen, sulfur and other elements.

Ganymede also is the only moon in the Solar System with an internal magnetic field, possibly from a liquid iron core like Earth's. Scientists will study if Ganymede's magnetic field interacts with Jupiter's, which could be a model for better understanding magnetic field interactions between the Sun and Earth.

The 6.6-ton JUICE spacecraft is outfitted with 10 instruments, including cameras, spectrometers, a radar system (which can penetrate 5.6 mi. beneath an icy surface), an altimeter, a radio-science experiment, a particle package and various magnetic and electric field sensors.

Airbus is ESA's prime contractor for JUICE, which includes 80 partners across 23 countries. NASA, the Japan Aerospace Exploration Agency and the Israel Space Agency contributed hardware for instruments. NASA also provided JUICE's ultraviolet imaging spectrograph.

NASA's Europa Clipper, slated to be launched in 2024, is due to arrive at Europa a year ahead of JUICE. The agencies are planning a series of collaborative studies to maximize the scientific harvest of both missions. ☪

—With Thierry Dubois in Lyon



# Bringing the MRO community back to Brisbane

Hear from expert speakers:



**Brett Daley**  
Group General Manager  
E&M, Operations,  
Air New Zealand



**Chris Monahan**  
Executive Manager,  
National Operations  
and Standards,  
Civil Aviation Safety  
Authority (CASA) Australia



**Chris Snook**  
General Manager,  
Technical Operations,  
Virgin Australia



**Asta Zirlyte**  
CEO,  
Heston MRO

For the latest agenda and full list of speakers visit  
[mroaustralasia.aviationweek.com](http://mroaustralasia.aviationweek.com)

Premium Sponsors



Sponsors



Official Publication



Purposeful Partners





# 'SUCCESSFUL FAILURE'

- > SUPER HEAVY IS THE MOST POWERFUL ROCKET EVER FLOWN
- > MASSIVE BOOSTER'S MISSION IS TO SHRINK COSTS
- > SPACE X IS FOCUSED ON RAPID UPGRADES

**Irene Klotz** South Padre Island, Texas

**E**lon Musk's fervent wish before the Starship's orbital debut was that if the launch was not successful—a highly likely scenario, given that the 33-engine Super Heavy first-stage booster had never flown before—at least the launchpad be spared.

"It's a very risky flight," Musk, the founder, CEO and chief engineer at SpaceX, said during a question-and-answer session on Twitter ahead of the first launch attempt. "It would take us probably several months to rebuild the launchpad if we melt it."

At 9:33 a.m. EDT on April 20, Musk got his wish. On its second launch attempt, the 394-ft.-tall, 30-ft.-dia. vehicle cleared the launchpad at SpaceX's privately owned spaceport in Boca Chica Beach, located just south of here on the Texas coast.

Climbing through partly cloudy skies, the vehicle headed east over the Gulf of Mexico with a ground-shaking roar from the Super Heavy's methane-fueled Raptor engines. Combined, the 33 engines can generate more than 16.7 million lb. of force at liftoff—twice the power of NASA's Space Launch System Moon rocket, which debuted in November for the Artemis I mission. However, not all the Super Heavy's engines were firing as the booster began its ascent.

The Starship and Super Heavy passed through the region of maximum aerodynamic pressure but ran into an issue as the booster was flipping itself to prepare to separate from the upper stage about 3 min. after liftoff.

The vehicle, which reached an altitude of about 24 mi., appeared to be in a slow tumble before exploding. SpaceX did not immediately confirm if the vehicle was destroyed by its automated flight-termination system. "That's what we call a rapid unscheduled disassembly," SpaceX launch commentator John Insprucker said.

Musk was quick to compliment the SpaceX team on its effort. "Congrats on an exciting test launch of Starship," Musk wrote on Twitter. "Learned a lot for next test launch in a few months."

SpaceX's first Super Heavy rocket lifted off from Boca Chica Beach, Texas, on April 20, aiming to put a Starship spacecraft on a test run around the planet. The 400-ft.-tall integrated vehicle was destroyed about 4 min. after liftoff after the stages failed to separate.

## Starship Specifications

HEIGHT .....	120 m (394 ft.)
DIAMETER .....	9 m (29.5 ft.)
PAYLOAD CAPACITY .....	100-150 tons (fully reusable)

**Gallery** See more images of the Starship/Super Heavy flight test:

[AviationWeek.com/Starship-Flight-Test](https://www.aviationweek.com/Starship-Flight-Test)



The first launch campaign on April 17 ended when engineers discovered a problem with a valve used to help pressurize a Super Heavy propellant tank.

Three days later, the booster and the Starship upper stage were refilled with more than 10 million lb. of liquid methane and liquid oxygen, and at 8:33 a.m. local time, the most powerful rocket ever developed lifted off.

SpaceX had hoped the Super Heavy's 33 methane-fueled Raptor engines would burn for 2 min. 49 sec. and separate, leaving the Starship upper stage, outfitted with six Raptor engines, on track to reach near-orbital velocity and an altitude up to 146 mi. above Earth.

For its debut launch, SpaceX did not plan to attempt to recover the Super Heavy booster, but future versions are to be designed to return for reuse, similar to SpaceX's current fleet of Falcon 9 boosters. For the flight test, after separating from the Starship, the booster was to flip around, reignite engines and make a soft landing in the Gulf of Mexico about 20 mi. off the coast of Boca Chica.

Meanwhile, the Starship was to coast around the planet, then splash down into the Pacific Ocean about 140 mi. off the coast of Oahu, Hawaii, 90 min. after launch.

The Starship/Super Heavy is intended to become a fully reusable, multipurpose transportation system capable of putting 100-150 tons into orbit. "When you have a high flight rate and full and rapid reusability, even a rocket the size of the Starship might be \$1 million or a few million dollars per flight," Musk said.

Among the Starship's customers is NASA, which in 2021 awarded SpaceX a multibillion-dollar contract to use a Starship variant to shuttle astronauts to and from lunar orbit and the surface of the Moon.

The U.S. Space Force also is keeping a close eye on the Starship and other superheavy lifters. "We track Starship very closely," Maj. Gen. Stephen Purdy, program executive officer for Assured Access to Space, said at the Space Symposium in Colorado Springs on April 18.

These systems are designed to provide "massive throw weight to [low Earth orbit (LEO)]—not to any other domain," Purdy said. "Potentially, long-term, we move to kind of a massive freight train model of



**The first integrated Starship/Super Heavy flight test ran into problems about 4 min. after liftoff on April 20 when the first and second stages failed to separate. The vehicle was destroyed about 24 mi. over the Gulf of Mexico.**

pushing all the customers into LEO."

SpaceX launched a series of Starship second-stage prototypes for a total of nine suborbital, high-altitude and landing tests between July 2019 and May 2021, but it has never put the vehicle into space.

A reusable, Mars-class rocket—a personal and professional goal of Musk's for decades—is the key to bringing down the cost of space transportation to the point where human civilization can migrate beyond Earth. "What actually matters here is the fact that we are building rockets at a rapid pace," Musk said before launch.

"We have Booster 9 and Ship 26 almost ready to go and a steady cadence of rocket production afterward with significant improvements between each iteration," he added. "The payload for this mission is information—information that allows us to improve the design of future Starship builds. That is our only goal."

The FAA, which oversees commercial spaceflight by U.S. companies, granted SpaceX a license to launch on April 14, culminating a multi-agency process that took more than 500 days. "We're hoping for a safe launch, but you never know where things might break or when things might go wrong," an FAA official said before launch. "I think we have really good mitigations in place [to cover] all the potential hazards that could occur during launch."

A safety zone extending about 4 mi. from SpaceX's Starbase spaceport was established to keep nonessential personnel and launch viewers from the potential blast danger zone. Under its FAA license, SpaceX was required to obtain an insurance policy covering at least \$500 million for possible third-party property damage caused by a launch accident and \$48 million for any third-party damage during prelaunch preparations. 🚀

—With Garrett Reim in  
Colorado Springs



# REACHING LIMITS

- > AMSTERDAM SCHIPHOL FLIGHT CAP PROPOSAL SETS OFF COURT BATTLE
- > AIRLINES WANT EU "BALANCED APPROACH" TALKS ON NOISE TO CONTINUE
- > AIRPORT PLAN WOULD BAN PRIVATE JETS AND LIMIT NIGHT FLIGHTS

**Helen Massy-Beresford** Paris



**UNCERTAINTY OVER FUTURE LEVELS OF flight activity at Amsterdam Airport Schiphol is highlighting how tighter environmental scrutiny will affect aviation.**

Airlines and business aviation operators at Schiphol, one of Europe's biggest and busiest airports, have concerns about how environmental measures—whether imposed by the government or the airport itself—will affect their operations.

The Netherlands first announced plans to limit flight movements to reduce noise at Schiphol last June, proposing that starting in late 2023 the airport would no longer be allowed to exceed the established noise nuisance limits, effectively limiting flight movements to a maximum of 440,000 a year. The current limit is 500,000; an interim limit of 460,000 was put forward in February.

While environmentalists were pleased, airlines were less impressed. KLM Royal Dutch Airlines, which has its hub at Schiphol, says limiting capacity would harm its network and thereby limit connectivity for the Netherlands. The airline contends that noise and emissions can be reduced in other ways.

In February, when the Air France-KLM group presented its annual results, KLM CEO Marjan Rintel warned that the capacity limit could cut off about 30 KLM destinations. KLM Royal Dutch Airlines, Delta Air Lines, Corendon, EasyJet and TUI have teamed up to take the government to court over the plan.

In early April, airlines welcomed a Dutch court ruling that the government plans did not abide by European Union rules. But they noted it was only a temporary reprieve, albeit one that provides clarity for winter schedules.

"We would rather cooperate with the other parties than face them in court," KLM said April 5 in response to the court decision. "We were unfortunately forced to file these preliminary relief proceedings to get clarity;

the capacity for the coming winter will be determined at the beginning of May. With this verdict, we have clarity."

"The judge has understood that the Dutch government violated its obligations in shortcutting processes that would bring scrutiny to its desire to cut flight numbers at Schiphol," International Air Transport Association (IATA) Director General Willie Walsh says. "This decision gives vital stability for this year to the airlines using

**KLM will be affected by changes at its Schiphol Airport base, whether the government caps capacity or the airport itself makes operational changes.**





Schiphol Airport and maintains the choice and connectivity passengers value. The threat of flight cuts at Schiphol remains very real and is still the stated policy of the government.”

Sure enough, just a few days later, the Netherlands said it would appeal the ruling. “Because of the ruling, we are unable to restore the legal position of residents in the area surrounding Schiphol,” Infrastructure Minister Mark Harbers told the Dutch members of parliament. “Therefore, the ruling is not in the interest of the residents. That’s why I have decided to appeal the verdict.”

Whatever the outcome of that legal process, airlines and business jet operators at Schiphol are facing another threat, in the form of green measures planned by Royal Schiphol Group, which runs the airport.

The airport wants to become “quieter and cleaner,” abandoning plans to build an extra runway, banning private jets and tightening limits on night flying to reduce noise, the group said April 4.



ARTHUR VAN DER KOOLJ/ANP/AFP/GETTY IMAGES

Schiphol said it wanted to ban aircraft takeoffs between midnight and 6 a.m. and landings between midnight and 5 a.m., abandon plans to build an additional Kaagbaan runway and that “private jets and the noisiest aircraft will no longer be welcome.”

“Schiphol connects the Netherlands with the rest of the world,” Ruud Sondag, CEO of Royal Schiphol Group, said in the April 4 statement. “We want to keep doing that, but we must do it better. The only way forward is to become quieter and cleaner more rapidly.”

Schiphol wants to take a stricter approach to noisier aircraft, gradually tightening existing standards for those that are allowed to take off and land. It aims to ban private jets and small business aviation aircraft because they cause a disproportionate amount of noise nuisance and CO<sub>2</sub> emissions per passenger, but the airport plans to continue to allow police and ambulance flights.

These moves could have a major impact: General aviation accounted for about 6% of the airport’s 422,000 total aircraft takeoffs and landings in 2022, the airport’s official statistics show.

The airport said 30-50% of private jet flights were to leisure destinations such as the Spanish island of Ibiza; Cannes, France; and Innsbruck, Austria—all of which it noted have “sufficient scheduled flights” available.

Those three measures are proposed to go into effect no later than 2025-26, the airport says. “According to current models, the number of people around Schiphol experiencing severe nuisance will fall by approximately 17,500 (16%), and the number of local residents experiencing severe sleep disturbance will fall by approximately 13,000 (54%),” it stated.

Schiphol said it would reserve 2.5% of available takeoff and landing slots for cargo but that cargo flights also will have to adhere to new, tighter rules for noisier aircraft and the new night hours.

Schiphol’s plans took airlines by surprise and could have considerable implications for KLM as well as low-cost carrier (LCC) Transavia, which is part of the Air France-KLM group.

“Schiphol’s plans, in particular for night curfews, could be a big issue for Transavia, as an LCC needs as many rotations per day as possible,” JLS

Consulting Director John Strickland says. “And these night closures would significantly damage their business model by reducing productivity and increasing unit costs.”

KLM would also be affected by the changes proposed by Royal Schiphol Group. “Small changes to operations, such as having to move back arrivals from Asia by an hour, could make flights less competitive and create aircraft scheduling challenges, particularly for a based airline,” Strickland adds.

KLM says it can use its own measures to cut noise and will demonstrate this through the EU’s balanced approach procedure, which is underway. The procedure must be carried out when an EU member state wishes to implement noise-related operating restrictions on an airport with more than 50,000 aircraft movements per year. It starts with setting a goal for noise abatement. Measures that can contribute to achieving the noise abatement objective then need to be identified.

“The balanced approach is about the best way to reduce the number of people affected by aircraft noise. To this end, we would like to continue cooperating with the government, Schiphol and any other relevant parties,” KLM said.

“Airlines understand the importance of resolving issues such as noise,” Walsh adds. “The balanced approach is the correct, EU and global legally enshrined process for managing noise impacts. It has helped airports around the world successfully address this issue.”

“The risk for airlines is political interference rather than political collaboration,” Strickland says.

Europe’s major airlines argue that Single European Sky (SES) progress could lead to a 10% reduction in emissions. They also say that they are seeking to buy and use more sustainable aviation fuel (SAF), going beyond the blending mandates set to be imposed, but that governments need to incentivize greater production.

“Airlines are calling for progress on SES, coordinated investment in new-generation engine technology and support for SAF development, but for politicians it may appear easier to take the line of least resistance and simply limit airport capacity,” Strickland says. 🗳



# JETZERO'S MIDMARKET MULTIMISSION BWB

- > STARTUP EMERGES TO CHALLENGE BOEING AND AIRBUS
- > SCALED Z-5 DEMONSTRATOR IS SET FOR FLIGHT TESTS
- > PIVOT GEAR CONCEPT IS KEY TO NEW BLENDED WING BODY

**Guy Norris** Colorado Springs

**H**as the time for the blended wing body finally arrived? JetZero thinks so, and the California startup has emerged from stealth mode to unveil a multimission design targeting the midsize commercial and military tanker-transport markets.

First appearing as a concept in the late 1980s and studied on and off ever since, the blended wing body (BWB) has failed to gain traction despite promising performance projections. Now, JetZero says, a yawning market gap for a sustainable midsize airliner

and the U.S. Air Force's simultaneous quest for a similarly sized advanced tanker-transport means the stars are aligned for a BWB as never before.

The BWB concept blends the airframe structure and aerodynamics to reduce weight and drag while enabling

the fuselage to contribute to lift. Also known as a hybrid wing body, the configuration is usually tailless and more efficient than a conventional tube-and-wing design because of its reduced wetted area, friction drag and lower form drag. BWBs are also inherently quieter than current airliners because the airframe shields most of the noise from engines mounted on the upper surface.

JetZero's Z-5 design, the first in a proposed family of Z-series aircraft, is optimized for a range of at least 5,000 nm and up to 250 passengers.





JETZERO

**Partnering with Northrop Grumman, JetZero has proposed the Z-5 for the U.S. Air Force's program to build a large-scale advanced tanker-transport demonstrator.**

enable the Z-5 to use derivatives of existing single-aisle engines such as the CFM Leap 1 or Pratt & Whitney PW1100G. The aircraft is equipped with mostly conventional systems, simplifying development and reducing cost and risk, the company adds.

The Z-5 is aimed at the heart of the market for the new midmarket airplane (NMA) that was studied by Boeing until the project was shelved in 2020. Although Boeing has since revived low-level studies of a conventionally configured NMA-class aircraft for possible service entry in the mid-2030s, the manufacturer is, by its own admission, still years away from any new product launch.

Airbus also is years away from developing an all-new aircraft in the NMA category, although a 200-seat BWB is one of three mid-2030s hydrogen-fueled concepts being studied under its ZEROe initiative. The European manufacturer is focusing instead on developing the A321XLR, a long-range variant of the A321neo designed to carry as many as 220 passengers on routes up to 4,700 nm. The aircraft is due to enter service in 2024.

But the program that could provide a near-term springboard for development of the Z-5 is the U.S. Defense Department's plan for a BWB demonstrator that is to be evaluated as a future tanker and airlifter. The initial goal is to develop the digital design of a prototype, as well as perform initial airworthiness and test planning for a demonstrator, culminating in the "manufacture of a prototype large-scale aircraft for certification and testing," the Air Force says.

JetZero submitted its proposal for the \$245 million cost-sharing program at the end of March, and with flight tests of a NASA-supported subscale demonstrator planned for this year, the company decided the time was right to go public with its concept.

"The milestone is that, having completed the conceptual design, we have to move out of the incubation phase and into the demonstration phase," says JetZero co-founder Tom O'Leary. "That conceptual design has

led to the development of a blended wing body that would fill the middle-of-the-market gap with existing single-aisle engines and a 50% reduction in fuel burn and emissions—and be a viable tanker.

"The goal of the Air Force is to demonstrate the capability of a commercial BWB that can be converted [into a tanker]," O'Leary continues. "We have letters of support from across all the supply base that we submitted with our Air Force proposal—including fabrication and mission systems."

Because of its fuel efficiency, the Z-5 can carry up to twice the fuel of the Boeing KC-46 tanker on a maximum-range mission, JetZero says. The aircraft also is designed to use current airport infrastructure. The Air Force is due to select a winning proposal by midyear and plans to begin demonstrator flights in 2027.

The Air Force released its initial solicitation last year, stating that the BWB "is one of the single most impactful technology opportunities for future U.S. Air Force aircraft, both in terms of capability improvement and greenhouse gas emissions reduction." Converting the cargo, tanker and bomber fleets to a BWB design would reduce annual fuel costs by \$1 billion compared with kerosene at current prices, it added.

The Z-5 emerges at a serendipitous time for the industry, says Barry Eccleston, former Airbus Americas and International Aero Engines CEO and a member of JetZero's advisory board. "You have all these tailwinds from the environment, the Air Force and NASA, plus you have the technology tailwind, which makes it viable when it wasn't before," he says. "Then you set that against the fact that Boeing and Airbus are doing nothing new in this space and you say, 'We can't sit here and do nothing.' The industry deserves it, and the industry needs it. If you've got something you know will be 30-50% better than today's products, why would you not do it?"

JetZero, meanwhile, is preparing to flight-test its subscale BWB demonstrator, a 23-ft.-wingspan, 12.5%-scale vehicle funded under a 2021 contract awarded during an earlier round of NASA's Sustainable Flight Demonstrator (SFD) program. The aircraft will be used to evaluate the Z-series configuration, a key feature of which is a novel landing gear design that maximizes

The all-composite aircraft has a wide single deck and high-aspect-ratio wing. Although this extends the wingspan to close to 200 ft., similar to an Airbus A330, the body length is shorter than a Boeing 767. Despite the overall size, JetZero says the midmarket aircraft "will be about half the weight and require half the power of aircraft it replaces, such as the 767."

Importantly for JetZero's business plan, which targets entry into service in the 2030s, the reduced weight and power requirements are designed to





In addition to the high-aspect-ratio wing and embedded top-mounted engines, the midmarket Z-5 features side exits and skylight windows.

JETZERO IMAGES

internal volume and assists the aircraft in rotation. The main SFD contract went to Boeing in January for development of a 737-size demonstrator of the Transonic Truss-Braced Wing concept.

Developed by Mark Page, a BWB veteran from the McDonnell Douglas days and the co-founder and chief technology officer of JetZero, the “pivot gear” concept improves low-speed pitch control and lift capability—two key challenges faced by BWB designs. First designed for the Ascent 1000 BWB airliner proposed by California-based Dzyne Technologies, a forerunner of JetZero, the design moves the nose landing gear forward and the main gear rearward into unused internal volume aft of the cabin.

For takeoff, the nose gear extends by several feet to increase angle of attack by about 6 deg., allowing the BWB’s body to produce lift to “amplify the effect of the aircraft’s elevons,” JetZero says. The design, which is passively controlled without needing pumps or actuators, enables the Z-5 to reach pitch attitude faster. This allows liftoff speed to be slower and reduces demand for high takeoff thrust. It also eliminates the requirement for leading-edge high-lift slats and re-

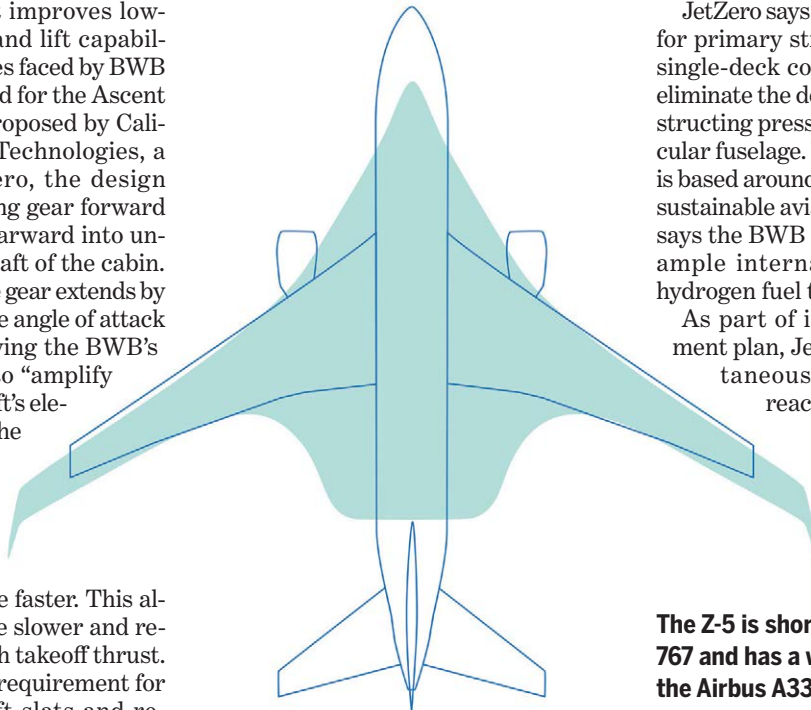
duces the size of the trailing-edge flaps.

To counter concerns about passenger egress, ride quality and the lack of windows in sections of the cabin—all criticisms of earlier BWB concepts—the Z-5 has side windows in the forward section and skylight windows in the main and aft cabin. Although no

internal dimensions have been released, the aircraft is expected to have a cabin width and ride quality similar to the Airbus A380. For emergency egress, the Z-5 is expected to follow principles outlined for the Ascent 1000, which offered quicker access to exits forward and aft than a comparable conventional cabin layout.

JetZero says advances in composites for primary structures, added to the single-deck configuration of the Z-5, eliminate the design challenges of constructing pressure vessels in a noncircular fuselage. While the initial design is based around conventional tanks for sustainable aviation fuel, the company says the BWB configuration provides ample internal volume for liquid-hydrogen fuel tanks in the future.

As part of its industrial development plan, JetZero says it is “simultaneously launching an outreach to private sources of funding and engaging with potential program partners.” For the tanker demonstrator pro-



**The Z-5 is shorter than a Boeing 767 and has a wingspan close to the Airbus A330’s.**

posal, this includes Northrop Grumman, the only major airframe-maker with design and manufacturing experience of flying-wing aircraft similar to the BWB configuration. Prototyping subsidiary Scaled Composites “will contribute substantially to the BWB demonstrator,” Northrop says.

“We think we’re in a real good spot with the Air Force to win this BWB demonstrator program award,” says O’Leary, who was formerly chief operating officer of electric vertical-takeoff-and-landing aircraft startup Beta Technologies. “To build it, we’ve got a host of industry partners. In order to come up with a conceptual design, we had to work with the entire supply base. So you name it, we’ve talked to them. There’s nobody who said, ‘Oh, that’s crazy—we won’t work with you.’ And that’s everybody, from top to bottom of the supply base.”

“One of the biggest battles is, of course, that Boeing and Airbus are going to work really hard to make sure it doesn’t happen,” Eccleston points



**The wide single-deck main and aft cabin has three aisles, skylight windows and digital outside view display screens. The forward cabin has side windows.**

out about the competitive aspect. “I’m not saying we’re smart enough to out-smart Boeing and Airbus, but we’re getting a bunch of partners that are going to give us real credibility,” he

adds. “So when the first question you get in the marketplace is, ‘How are you going to do all that?’—we have a plan, and we have the strength of partners to do it.”

# MROProspector

## Aftermarket Opportunities at Your Fingertips

The only solution dedicated to commercial aftermarket professionals, MRO Prospector contains accurate and reliable MRO data and intelligence so you can find new opportunities.



Details on thousands of contracts covering 37,000 aircraft and 80,000 engines.



Discover maintenance opportunities, including component repairs by ATA Chapter.



Research operator’s fleets by tail number, including age, hours, cycles and lease status.

Visit [aviationweek.com/MROP](https://aviationweek.com/MROP) to schedule your demo.

Or call:

Anne McMahon at +1 646 469 1564  
or Melissa Crum at +1 913 284 2951

**AVIATION  
WEEK**  
NETWORK



# Aalyria Aims To Enable 'Network of Networks' in Space

- > DEFENSE INNOVATION UNIT CONTRACTED THE COMPANY TO DEMONSTRATE "HYBRID SPACE ARCHITECTURE"
- > STARTUP IS PARTNERING ON RIVADA SPACE CONSTELLATION

Garrett Reim Los Angeles



**CONNECTING EVERYTHING,** everywhere, all at once seems like a network engineer's dream (or nightmare), but that is

close to what Aalyria says it can do in outer space.

The Livermore, California-based startup launched in 2022 on the back of Project Loon networking and laser communications technologies purchased from Alphabet. Running from 2011 to 2021, that project sought to broadcast the internet from high-altitude balloons.

In March, Aalyria announced a partnership with Rivada Space Networks to use Aalyria's Spacetime software to coordinate laser communications within a planned constellation of 600 low-Earth-orbit (LEO) communications satellites. With a first satellite launch set for 2025 and global service starting in 2026, the partnership is the first step in a larger plan to facilitate

a shared laser and radio communications network in space, within the atmosphere and back on Earth.

Aalyria aims to set up a marketplace for space-based communications capacity, allowing users to send data through third-party satellites with spare, unsold capacity. The company says its software ought to enable a "network of networks." Such an overarching system would mesh different types of steerable directional antennas and laser communications terminals across satellites, aircraft, high-altitude platforms, ground stations and maritime vessels, among other hardware.

Unlike the internet back on Earth, communications networks in space tend to be private and disconnected from one another. Compatibility issues between different types of laser and radio communications systems make connecting users difficult, as does the fact that some satellites are constantly moving and line of sight between nodes is often distorted by clouds or heat.

Aalyria says its software creates a digital twin of potential network nodes, such as satellites and ground users. Its software accounts for motion propagation, weather interference and atmosphere characteristics, among other things that might interfere with a signal. The Spacetime software takes all those variables and analyzes millions of possible paths to find the most efficient route to transmit data across the network, says Chris Taylor, Aalyria CEO and founder.

"I can connect a lunar base to an L1 Lagrange relay satellite, back to a constellation on Earth—in [geostationary Earth orbit], [medium Earth orbit] or LEO—to a [high-altitude platform] constellation, to perhaps a string of commercial airliners going across the Atlantic or Pacific, and down to any number of users on the ground who may be interested in whatever's happening at that lunar station," he says.

Satellite network operators would run the Spacetime software on Earth, using it to coordinate signals between spacecraft, ground stations and user terminals, he says.

"If an asset's communications payload is communicating with Spacetime, they need only to exchange the bytes required to communicate revisions to the schedule and to enable Spacetime to monitor the state transitions," Taylor says.

Spacetime should support all radio



Aalyria says its software could coordinate a network stretching into cislunar space.



frequency bands from 1 MHz to 100 GHz, as well as optical wavelengths, and the software is designed to be interoperable with legacy, hybrid space, 5G nonterrestrial network architectures and other future networks, he adds.

Communications satellites use different radio frequencies and laser communications systems operate on an entirely different part of the electromagnetic spectrum. Aalyria is not directly connecting those heterogeneous nodes, but the company would route signals through compatible systems and look for bridges between networks, perhaps via intersatellite laser links or terrestrial fiber-optic cables between ground stations.

The idea has captured interest from the Defense Innovation Unit, which in September granted Aalyria a contract to help develop and demonstrate a sort of internet in space made of government and commercial communication satellites. The company says the deal is worth \$8 million. Anduril, Atlas and Enveil also received contracts as part of the "Hybrid Space Architecture" program.

The Defense Department is interested in establishing mesh satellite networks in space to enable military personnel to pass information on the battlefield, as well as to nearly anywhere on Earth.

In tandem with the U.S. Space Force, the commercial satellite industry aims to facilitate satellite-based networks using laser communications systems that can transfer larger amounts of data at a faster rate than conventional radio-based systems. Intersatellite laser links allow communications satellites to relay data to one another around the Earth. However, weather and atmospheric interference make it difficult for satellites to use lasers to pass data to the Earth's surface.

Aalyria says its Spacetime program can reroute laser downlinks around weather interference. And the company's Tightbeam product can "algorithmically" correct for distortions, much like during an eye exam when an optometrist uses a phoropter and a series of lenses to correct a person's vision, Taylor says.

"Before we acquired the technology, [Alphabet's] Google spent a lot of money solving the science problem of light going through the atmosphere and being coherent at the end so that it can be recoupled at the fiber and all of the data would make it through," Taylor says.

The company has been testing Tightbeam via a laser communications system mounted atop its building in Livermore, beaming signals about 19 mi. to a terminal atop Mount Diablo and then passing them back down another 19 mi. to their origin. The laser goes over hot tar roofs; heating, ventilation and air conditioning blowers; highways; arid land; and through clouds near the top of the mountain. It transmits 100 Gbps, has almost no latency and can sustain 4K video, Taylor says. "We are pushing that from our roof with a near-zero packet error rate," he notes.

By year-end, Aalyria plans to test its technology on an on-orbit spacecraft, as well as on a ground station, Taylor says. 🌐

## Advanced Air Mobility REPORT

### INTELLIGENCE AND ANALYSIS OF KEY DEVELOPMENTS HAPPENING IN **ADVANCED AIR MOBILITY**

Delivered right to your inbox, **Advanced Air Mobility Report** will provide you the data and intelligence you need to stay informed of this emerging market.

Download your complimentary edition at  
[aviationweek.com/AAMReport](https://aviationweek.com/AAMReport)

Call Melissa Crum at +1 913 284 2951 | [melissa.crum@aviationweek.com](mailto:melissa.crum@aviationweek.com)

**AVIATION  
WEEK**  
NETWORK 

# U.S. Space Force Urges Companies To Prioritize Ground Control Systems

> ACQUISITION HEAD: THIS YEAR IS THE TIME FOR FIXES

> BUDGET INCREASES SPENDING ON PROBLEMATIC PROGRAMS

**Brian Everstine** Washington

**T**he U.S. Space Force is spending heavily and looking to launch large numbers of satellites rapidly to meet critical missions, particularly proliferated missile warning and tracking and protected data transport.

But these will be largely worthless after launch if they cannot be controlled quickly and effectively from the ground. And so far, the track record for this has not been great.

“It is the worst thing in the world to launch a spacecraft and not be able to use it rapidly because you’ve provided basically nothing at that point in time

Enterprise Ground Services Program.

Air Force Secretary Frank Kendall notes that these are software-intensive programs, an area in which the Pentagon always struggles. Additionally, companies have focused primarily on the satellites themselves, and the service needs to pressure contractors to “put their A teams on those programs,” he says.

“We tend to have a problem with software programs in general in the Department of Defense,” Kendall says.

Some of these programs have been long-standing problems for the

military. For example, MGUE has been in development for about three decades. OCX has been plagued by development problems, including a cost overrun in 2016 that prompted a Nunn-McCurdy Provision breach, meaning the program’s cost per unit was 25% over the baseline estimate. The department will focus specifically this year on making substantial progress on trouble-

some programs, Calvelli asserts.

“This is our year. It is time to get these programs complete,” he said in January at the National Security Space Association’s Defense and Intelligence Space Conference. “There are key programs that we need. These albatrosses [have been] dragging the department down for decades.”

Late last year, Calvelli emphasized ground control in a memo outlining his key tenets for space acquisition. These include having ground control stations delivered and operational before launch. The entire national security space community, including the National Reconnaissance Office that Calvelli used to lead, has been bitten by large ground programs. These should be broken up to avoid

“monolithic” programs that are delivered slowly and cannot be updated incrementally, he says.

Gen. Chance Saltzman, Space Force chief of space operations, said during the subcommittee hearing that the service wants to change how it acquires and develops software-based systems for new acquisition programs, so it “stands [to] reason that some programs are lagging.”

The Space Force outlined a new approach in a March request for information (RFI), which followed the February stand-up of the Rapid Resilient Command and Control (R2C2) Combined Program Office. The office is tasked with delivering tactical command-and-control services. It is staffed and funded by both the Space Rapid Capabilities Office and Space Systems Command. The RFI seeks input from industry on how to “acquire software systems in bite-sized pieces—delivering timely C2 capability to on-orbit mission partners.”

The service’s fiscal 2024 request includes extensive funding for those worst-performing acquisition programs. This includes:

■ **Space Command and Control** \$122.3 million in fiscal 2024 and \$634 million total expected over the next five years. This is planned to deliver 13 applications to U.S. Space Command and Space Force units and decommission the legacy Space Defense Operations Center by the end of 2023.

■ **Enterprise Ground Services Program** \$155.8 million in fiscal 2024 and \$715 million expected over the next five years. This is an increase of \$22 million from fiscal 2023, to expand service development, scale enterprise capabilities and provide services to more mission partners, according to budget plans.

■ **MGUE** \$355 million in fiscal 2024 and \$793.2 million planned over the next five years.

■ **OCX** \$317.3 million in fiscal 2024 and \$436 million planned over the next five years, falling sharply to less than \$7 million per year in fiscal 2027 and 2028.

■ **FAB-T** \$282.8 million in fiscal 2024 and \$983.2 million over the next five years. Fiscal 2024 funding includes \$122 million to buy the first 23 FAB-T Force Element Terminals low-rate initial production units for Boeing B-52 integration, along with fielding them on Boeing E-4Bs and E-6s for initial operational capability. 🌐

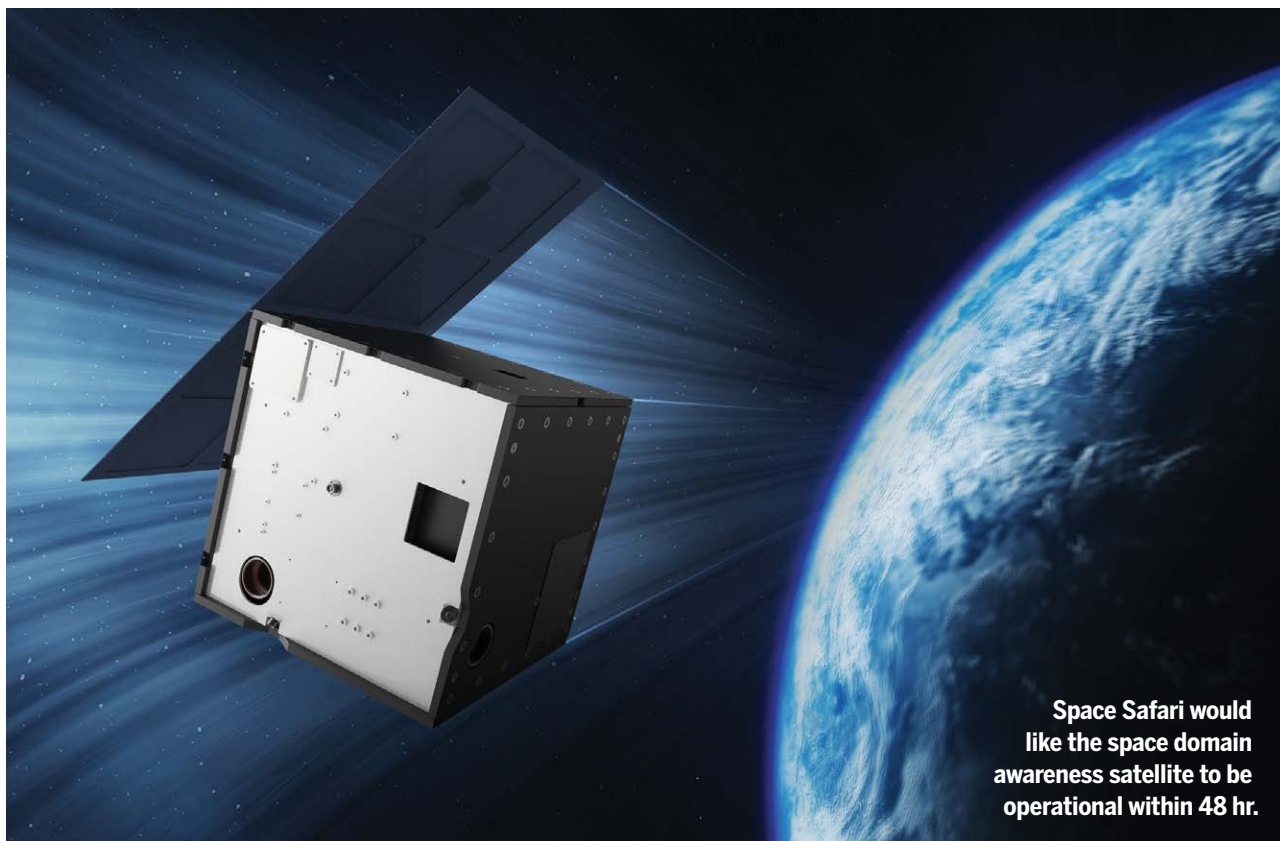
KATHRYN DAMON/U.S. SPACE FORCE



**The National Space Defense Center at Schriever SFB, Colorado, is tasked with controlling many of the Space Force’s assets for military operations.**

for the warfighter,” says Frank Calvelli, assistant secretary of the Air Force for space acquisition and integration. “And we really have to get on our game and make sure the ground is in place.”

Top officials in the Department of the Air Force were pressed on this on Capitol Hill recently. Rep. Ken Calvert (R-Calif.), House Appropriations defense subcommittee chairman, said during a late-March hearing that a recent Space Force report outlined its top five worst-performing acquisition programs—and all were ground control systems. These are: the Next-Generation Operational Control System (OCX), Space Command and Control, Family of Advanced Beyond-Line-of-Sight Terminals (FAB-T), Military GPS User Equipment (MGUE) and the



**Space Safari would like the space domain awareness satellite to be operational within 48 hr.**

## Space Safari's Victus Nox Approaches 'Hot Standby' Phase

- > THE PENTAGON WANTS MORE TACTICALLY RESPONSIVE SPACE CAPABILITIES
- > ON-ORBIT SPARE SATELLITES ARE A POSSIBLE RESILIENCY STRATEGY

**Garrett Reim** El Segundo, California

**W**hen it enters a new phase soon, U.S. Space Systems Command's Space Safari Program Office—as well as satellite builder Millennium Space Systems and launch provider Firefly Aerospace—could get a call at any moment from the U.S. Space Force and be told to launch the Victus Nox satellite into low Earth orbit.

"We don't know—I don't even know [and] my leadership doesn't even know at this time when we are going to be asked to launch," says Lt. Col. MacKenzie Birchenough, Space Safari's materiel leader. "They need to be ready anytime over the next six months."

Millennium Space is wrapping up the build phase of the Victus Nox spacecraft, moving the program toward a six-month hot standby phase. During this period, once given the "go" command, the Space Safari Program

Office—set up in 2021 as a "high-speed integrator for specialized space missions"—would have 60 hr. to fuel, load up and then transport Victus Nox, a space domain awareness satellite, from Millennium Space's El Segundo, California, factory to Vandenberg SFB, a journey of about 140 mi. by aircraft. After arriving at the base, the team would be put on a 24-hr. standby for launch.

The "tactically responsive space" mission is designed to demonstrate a credible response to new, threatening spacecraft from an adversary. It typically takes years to develop a satellite and months to prepare for a launch, but the timeline for Victus Nox has been cut to a little over a year.

"We are definitely shrinking things very drastically," Birchenough says. The short schedule is an attempt to be "absolutely as realistic as possible,"

she says. "We don't know what threats we might be facing in the coming years. We need to have the ability to respond quickly."

Space Safari declines to name specific threats, but some Chinese and Russian spacecraft seem to be capable of maneuvering close to U.S. military satellites for spying or even to cause damage using a grapple arm. In recent years, space domain awareness has become a priority for the Space Force as it seeks to understand what adversaries are doing with their spacecraft in regions of space ranging from low Earth orbit all the way to lunar orbits.

Victus Nox, Latin for "conquer the night," will be for demonstration purposes only, and the spacecraft will not be used to examine any specific threat, Birchenough says. Space Safari declines to talk about the capability of the small satellite.

For the demonstration, Millennium—a Boeing subsidiary—pulled a satellite bus from its production line, modified it and delivered it about eight months after it was awarded the program. The company declines to say which satellite bus was used. The Victus Nox satellite, which recently completed environmental testing, was about the size of a minifridge when



viewed by Aviation Week during a tour of the company's facilities.

Millennium Space is "80% vertically integrated"—it manufactures 22 in-house products—and that helps it rapidly assemble novel satellites, says Andrew Chau, Millennium Space's advanced projects program manager for the Victus Nox spacecraft.

"Of course, one of our big challenges here is being able to support these rapid timelines," he says. "We have the advantage at Millennium of having an active production line. By doing so, we were able to leapfrog a lot of those long procurement timelines."

Birchenough says. "Los Angeles traffic can also pose issues with that."

Once at Vandenberg, the team would be put back on standby. "We [will] wait for notification to launch," Birchenough says. "Once that notification to launch comes, the team has 24 hr. to be ready to launch."

The satellite is slated to be lofted by a Firefly Aerospace launch vehicle. In October, that company's Alpha small-satellite booster reached orbit for the first time after launching from Vandenberg. The two-stage Alpha launch system has a lift capacity of 2,580 lb. to low Earth orbit.

In addition to having a shared interest in tactically responsive space launches, Northrop Grumman and Firefly Aerospace in August announced a partnership to develop a first-stage upgrade for the Antares rocket and a new medium-launch vehicle.

Birchenough says a variety of lessons were learned from Tactically Responsive Launch-2. "One of the big takeaways was that it is much more than just about launch," she says, noting a need to focus on rapid space vehicle development as well as quickly obtaining launch range and regulatory approval. "Trying to make sure we get all those approvals in a short timeline can be challenging," she says.

Space Safari sees three ways to fulfill the Space Force's tactical responsive space needs. In addition to launching rapidly from the ground, the program office is considering ways to keep spare satellites on orbit.

"If the asset was already on orbit, we could move it at the time of need—or effectively turn it on at the time of need—without having to go through the launch phase," Birchenough says. Space tugs could be used to reposition spare spacecraft rapidly, she adds.

The Space Force also might purchase data from commercial spacecraft operators, Birchenough says. "The ultimate goal here is to get to an enduring, tactically responsive capability in the [2025-26] timeframe," she says.

While much emphasis has been placed on small launch vehicles and the type's ability to insert small spacecraft into specific orbits quickly, Space Safari also is considering ways for spacecraft to squeeze at the last minute onto rideshare launches, such as SpaceX's Responder missions, Birchenough says.

For its part, Millennium Space is aiming to be able to launch its satellites on any rocket available, CEO Jason Kim says. "We try to have really good relationships with all the launch providers because we want to be launch-vehicle-agnostic," he says.

Prior to attempting those additional tactically responsive space missions, Space Safari wants to wring out the Victus Nox demonstration to see what can be learned. Birchenough says the hardest part so far has been trying to figure out how to squeeze in so much into such a short schedule. "We are really stressing the system," she says. 🌐

MILLENNIUM SPACE SYSTEMS



**Millennium delivered Victus Nox about eight months after contract award.**

Keeping all personnel vigilant during the six-month hot standby phase is not realistic, so Space Safari, Millennium Space and launcher Firefly Aerospace have created fallbacks.

"We all have to make sure that we have redundancy in our team, because we don't know when that call is going to come in," Birchenough says. "There will be vacations, family events, illnesses and things that happen over the next six months that we have to be prepared for."

The Victus Nox team is attempting to work out some of the kinks soon with a dry run using a mockup of the space domain awareness satellite. When the real call to launch comes, the team will ferry the satellite to Vandenberg in a Boeing C-17 transport.

"We are also reserving the option to make sure that we can drive it safely to Vandenberg on a short timeline,"

Birchenough notes that the satellite may not take off exactly within 24 hr.—as it may be delayed due to weather or orbital mechanics—"but the team will absolutely be ready to go."

Once Victus Nox is on orbit, the team will be tasked with making it mission-capable within 48 hr. "It doesn't do us much good to get something on orbit quickly if we can't use it very fast as well," Birchenough notes.

Victus Nox is a follow-on demonstration to the Space Force's Tactically Responsive Launch-2, a 2021 mission that put a technology demonstration satellite on orbit within 21 days of being requested. The demonstration used a Northrop Grumman Pegasus XL rocket, carried aloft to 40,000 ft. under the centerline of the company's "Stargazer" L-1011 aircraft, a modified Lockheed L-1011 TriStar airliner, dropped and then launched into space.

AVIATION WEEK

**Intelligence**  
NETWORK

# Intelligence & Data Solutions Covering the World's Military Fleets & MRO

Only Aviation Week Intelligence Network's (AWIN) comprehensive portfolio provides the news, fleet data, analyses and forecasting models needed to:

- Gain a competitive edge
- Enhance research and decision making
- Monitor today's top global military programs



To learn more, go to:

[aviationweek.com/GlobalDef](https://aviationweek.com/GlobalDef)

Or call Melissa Crum at +1 913-284-2951

AVIATION  
WEEK  
NETWORK



# SLOW GOING



- > U.S. ARMY SEES NEW FUTURE VERTICAL LIFT DELAYS
- > GAO SAYS SIKORSKY'S PROPOSAL WAS UNACCEPTABLE
- > SIKORSKY WILL NOT APPEAL THE RULING

BELL PHOTOS

**Brian Everstine** Washington

**T**he U.S. Army and Bell are free to move forward on the V-280 tiltrotor digital prototypes for the service's Future Long-Range Assault Aircraft program after the Government Accountability Office denied Sikorsky's push to protest the deal.

That GAO ruling lays out a complicated decision by the Army to prioritize Bell's engineering details and use of Modular Open Systems Architecture (MOSA) over the far lower cost of the Sikorsky-Boeing Defiant X. According to the report, Bell's evaluated price for V-280 development is \$8.087 billion, substantially more than Sikorsky's estimate of \$4.445 billion.

The GAO on April 13 published a 38-page report on its denial of Sikorsky's protest, ruling that the Sikorsky-Boeing bid did not meet architecture requirements under the service's request for proposals (RFP) and therefore was not eligible.

A single, arcane sentence in the RFP lies at the heart of the disputed contract award to Bell: "[The responses] shall include allocation of system functions to functional areas of the system." The Sikorsky-Boeing team expected that a detailed allocation of subsystem functions could be submitted after the contract was awarded, the GAO said. The Army's view was that only bids with such details complied with the solicitation.

However, the Army's RFP said engineering design and development and product supportability outweigh cost concerns. The RFP said the bidders could not receive any less than "accept-

able" when evaluated for these factors.

The Army's evaluation criteria divided engineering design and development into four subfactors: weapon system performance design, architecture, test and evaluation, and engineering processes. The report states that Bell received an "acceptable" rating overall, with subfactor ratings of good, acceptable, marginal and acceptable, respectively.

However, Sikorsky's rating overall was "unacceptable," with only the architecture subfactor not receiving an acceptable rating.

The RFP states that the rating means the "proposal does not meet requirements of the solicitation, and thus, contains one or more deficiencies, and/or risk of unsuccessful performance is unacceptable. Proposal is unawardable."

Sikorsky's architecture category included four significant weaknesses and 11 regular weaknesses. This was based on multiple factors, the GAO writes.

"Sikorsky did not provide allocation of functions below the system level of the logical architecture representing an incomplete functional decomposition, allocation and use of system functions," the GAO states. "It is unclear to the evaluators how the subsystems and components and

**Bell's V-280 is a new evolution of the company's tiltrotor approach to vertical lift, improving upon the V-22 Osprey.**

their boundaries were determined."

A key issue seems to be the requirement for using MOSA, which would mean that upgrades could be installed easily regardless of the manufacturer. Evaluators stated that "weaknesses resulted from insufficient evidence and inadequately defined scope to determine how [Sikorsky's] proposed architecture would meet the government's MOSA and architecture requirements and presents a cost and schedule impact resulting in an unacceptable risk."

This risk rendered Sikorsky's much lower price not as realistic as Bell's, the Army argues.

"[Sikorsky's] cost realism could not be fully assessed due to their unacceptable approach, which is therefore indicative of cost and performance risk," the Source Selection Authority concluded, according to the GAO. "In contrast, [Bell's] proposed price, in comparison to the design's [independent government estimate], is reasonable and provides the best value to the government."

Lockheed Martin, Sikorsky's parent company, issued a statement April 18 saying the company would not pursue further legal action.

"We value our long-standing partnership with the U.S. Army, and serving their missions remains our top priority," the statement said. "We are focused on driving innovation

and delivering the transformational Raider X for the Future Attack Reconnaissance Aircraft, modernized Black Hawks and future technology critical to mission readiness.”

Sikorsky's home team of congressional representatives quickly blasted the GAO's decision and called on the Army to explain itself. Connecticut's seven Democrats—Sens. Richard Blumenthal and Chris Murphy along with Reps. Rosa DeLauro, John Larson, Joe Courtney, Jim Himes and Jahana Hayes—wrote in a joint statement that they would uncover the Army's decision-making process with the goal of keeping jobs in their state.

In a separate statement, Murphy accused the Army of blocking every request for a briefing on the contract.

“I'm going to make sure Congress fulfills its constitutional obligation to be a responsible steward of taxpayer dollars,” Murphy said. “That duty includes finally getting answers about why this contract leaves Americans on the hook for an overpriced and inferior tiltrotor that could put our men and women in uniform at risk.”

As of mid-April, Army officials had not provided a public explanation of why the Bell tiltrotor was selected, largely citing the GAO's open investigation. Army Secretary Christine Wormuth told Blumenthal about one week before the decision that the service's acquisition boss Doug Bush would be ready to provide a briefing once the GAO decision was complete.

The most extensive Army explanation came in a short news conference when the decision was announced. Maj. Gen. Robert Barrie, the service's program executive officer for aviation, said the service sought the “best-value approach” using an evaluation of “a set of factors.”

That award initially provided Bell \$232 million of a \$1.3 billion ceiling for 19 months of work to design digital prototypes of the V-280 meeting the Future Long-Range Assault Aircraft (FLRAA) specifications. The full program, including potential foreign military sales, could be worth up to \$70 billion.

In the service's fiscal 2024 budget request, the Army requested \$1.5 billion

for both FLRAA and the other Future Vertical Lift effort, the Future Attack Reconnaissance Aircraft (FARA). The service would spend \$1.044 billion on commencing production of six engineering and manufacturing development (EMD) FLRAA aircraft while also continuing an analysis of how many aircraft would be fielded beginning in 2030.

However, more in-depth justification documents released weeks later show changes to FLRAA's overall expected schedule. The service would like the virtual prototypes now under contract to be delivered in the fourth quarter of 2024. Building of physical prototypes is slated to begin in the third quarter of 2025, a year's delay



**The V-280 will replace much of the Sikorsky UH-60 Black Hawk fleet as the backbone of Army aviation.**

from the prior budget's plans. Plans call for their delivery and flight tests to start in the second quarter of 2026, diverging from the previous schedule of the third quarter of 2025. Flight tests are now scheduled to end in the first quarter of 2030, about the same time the first operational aircraft would be fielded.

For FARA, the Army is requesting \$458 million for research, development, test and evaluation, with spending expected to increase to \$1.39 billion in fiscal 2028. Funding is about steady from last year, but it is a sizable drop from fiscal 2022's allocated \$607 million.

The Army expects a request for proposals in the second quarter of 2024. Justification documents show more delays for the program, with an EMD award not scheduled until the second quarter of 2026, a delay from last year's expectation of the third quarter of 2025. This means the timing for the award is now two years later than the original plan. Preliminary design

review is scheduled for 2025, with critical design review two years later.

Despite the new delay, the Army still expects the phase to run until 2032—a date set in the prior year's spending plan.

“It's fully funded in the [Future Years Defense Plan],” Army Under Secretary Gabe Camarillo says. “It's got more development, more testing that goes through that, and then it would obviously go into . . . the next phase of the program. So it's fully funded, both FLRAA and FARA, in this particular [Future Years Defense Plan].”

The Army had been planning for a fly-off in 2023, but that has been delayed by ongoing issues with the GE Aerospace T901 engine required for the aircraft. The competitors—Bell with its 360 Invictus and Sikorsky with its Raider X—are awaiting delivery of the powerplant, which manufacturing challenges have pushed out until early 2024, Bush said in March. The engines had been expected to be delivered this spring.

“This is complicated stuff,” Bush says. “Some of these parts are very difficult to manufacture. . . . But you know, GE has to perform. I need those engines on time.”

In a statement, GE attributed the delay to a small number of components hit by industrywide supply chain problems. The company plans to flight-test the engines and deliver them to the Army in the fall. They will then be disassembled and inspected, reassembled and retested before delivery to Bell and Sikorsky.

“We are laser-focused on execution and working closely with the Army to deliver flight-test engines this fall to support the FARA competitive prototypes,” GE says.

The competitor aircraft are largely completed, except for the engines, and the Army needs them delivered to set FARA requirements.

“It's an ambitious program,” Bush says. “A helicopter that size that can do what we want to do is a technical challenge, so we're going to see. And it's really good to see for real whether the two companies can do it, and that'll let us make adjustments if we need to based on the facts and not just PowerPoint.”



# Russia Is Close to Launching New High-Speed Air-Launched Missile

- > THE KH-41 IS LIKELY TO FLY FASTER AND FARTHER THAN THE KH-31
- > THE WEAPON IS DESIGNED TO TARGET SURFACE SHIPS AND GROUND AND AERIAL TARGETS

**Piotr Butowski** Gdansk, Poland

**A**n increasing number of signs indicate that work on a new Russian high-performance air-launched missile is nearing completion and that the nation is accelerating missile production.

During a March 14 visit to the headquarters of Tactical Missiles Corp. (KTRV) in Korolyov near Moscow, Russian Defense Minister Sergei Shoigu gave a short speech calling for a sharp increase in the production of air-launched weapons to meet demand for military operations in Ukraine.

“We need to double the production,” Shoigu said in brief video footage from the event. “You have already recruited staff, quite qualified staff whose work is on the rise, [who are] in good spirits. The component issues have been resolved. Now the task is to increase productivity . . . and through this, I will repeat again, double the production of the items that you make and that are so needed.”

The KTRV facility has absorbed almost all Russian aviation and naval armament manufacturers. Kh-31, Kh-35, Kh-38M and Grom tactical air-to-surface missiles all are in series production in Korolyov. The plant also serially produces the long-range R-37M air-to-air missile developed by Vypel in Moscow.

Only brief footage from Shoigu’s trip with Alexey Krivoruchko, the deputy defense minister responsible for procurement, has been published. Virtually nothing can be seen except for the officials, who included KTRV CEO Boris Obsonov and the factory walls.

But the words of Shoigu’s speech were compelling down to the last sentence. “We hope that the commitments you have made . . . for 2023, 2024 and for the entire program will be fulfilled,” he stated. “And in addition to what we already have, there will be a new product that . . . the armed forces of other countries do not have.”

What revolutionary product might Shoigu have had in mind?

It is worth recalling what Boris Obsonov told the Tass news agency in June 2021. Obsonov said the corporation is conducting “research and development work to create a new-generation high-speed anti-ship missile with increased range and speed, with improved jamming resistance.”

Obsonov was responding to a question about further development of the Kh-31 missile, which flies at a maximum speed of Mach 3.5 at a distance of up to 155 mi. (250 km). He added that “this advanced model will complement the existing range of air-launched weapons created by KTRV,” which means that the new missile is not a Kh-31 replacement but a complement to it, similar in purpose but with much higher performance characteristics.

All of this indicates that the new missile Shoigu and Obsonov were discussing is the Kh-MTs (“MTs” stands for “multiple targets”). Its operational designation is expected to be Kh-41. This missile has never been presented to the public, although the project started at OKB Zvezda more than 30 years ago, around 1990.

The new-generation Kh-MTs tactical and theater-level air-to-surface missile is designed to be compatible with any Russian platform. Russia plans to use it on multirole fighters, bombers, surface ships, submarines and coastal launchers. The Kh-MTs is intended to fight surface ships as well as some ground

**KTRV is producing numerous missiles, including (from left) the Kh-31PM, Kh-35U and Kh-38M missiles, pictured with a Sukhoi Su-35S multirole fighter.**



and air targets, such as early warning aircraft. The effectiveness of the missile is to be ensured by a combined guidance system consisting of an active radar channel, broadband passive radar channel and final guidance, probably in the form of an infrared sensor.

This would allow the missile to operate with incomplete initial target indication and in a heavy jamming environment. The missile is intended to fly along various trajectories—for example, with a jump to an altitude of 30-35 km (98,000-115,000 ft.) and a dive at an angle of 70-80 deg. to reach the target at an altitude of 3-5 m (9.8-16.4 ft.) in the terminal phase.

In the early 1990s, work on the Kh-MTs remained at the conceptual design stage but stopped for many years due to lack of money. The project was resumed after almost 20 years. The previous designations, Kh-MTs and “Izdeliye 75,” were retained. The Russian Defense Ministry commissioned research and development work in 2012 under the codename Gremlin. According to the contract, the missile was to complete its qualification tests in 2017. Undoubtedly, the reordered missile differed from the first project in technology but remained the same in concept.

Unknown difficulties left the Gremlin program unfinished, soon to be replaced by another program called Lichinka. The engine was known to have problems. The defense ministry awarded the Lichinka research and development contract to KTRV on Nov. 29, 2018. The flight-test missiles were supposed to be ready in October 2020, but they were delayed. The contract stipulates that qualification tests of the missile will be completed in 2023.

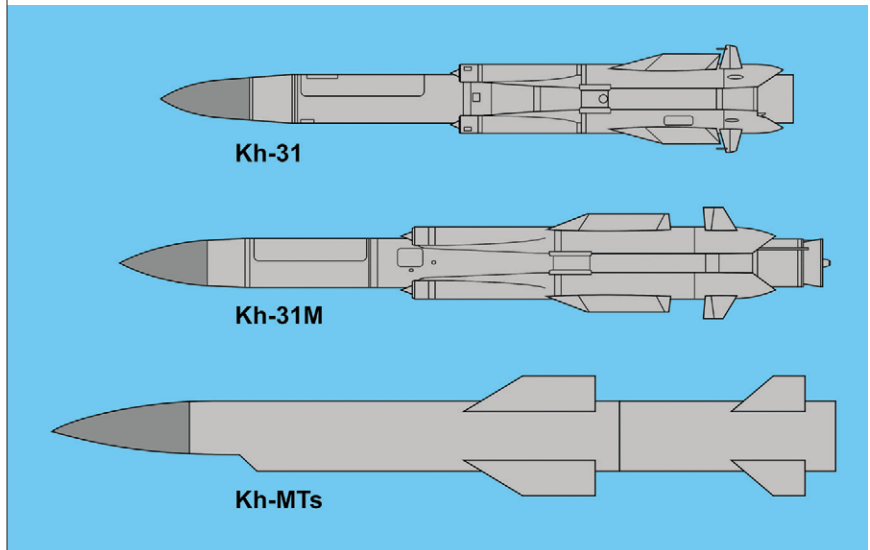
The same contractors are participating in the current project. The scramjet engine for the missile “Izdeliye 75” is made by TMKB Soyuz in Lytkarino, about 4 mi. southeast of Moscow. The same company also produces the “Izdeliye 52” ramjet for the Kh-31 missile.

The Temp-Avia company in Arzamas, about 60 mi. south of Nizhny Novgorod, is making the SNAU-75 navigation and control system. The active-passive radar seeker, known as the Gran-75, is being developed by the Ural Design Bureau Detal in Kamensk-Uralsky, about 50 mi. north of Chelyabinsk, and the broadband Gran-75PK passive channel for the seeker is being produced by TsKBA in Omsk, about

400 mi. east of Chelyabinsk. To increase survivability in a complex air defense environment, the missile has a self-defense system made by NII Ekran in Samara.

The same multirole fighters that carry the Kh-31—the Sukhoi Su-30, Su-34, Su-35 and Su-57 as well as

about the Kh-MTs, and considering that one of the carriers of this missile is the Tu-95MS bomber, the length of the missile with the launch booster probably would be no longer than 6 m (the maximum size to fit inside the Tu-95MS weapon bay) and the launch weight 1,300-1,500 kg (2,800-3,300 lb).



**The Kh-MTs, depicted here in a concept drawing, is likely to be carried by multirole fighters and modernized bombers that carry Kh-31 missiles.**

modernized Tupolev Tu-95MSM and Tu-22M3M bombers—are likely to carry the Kh-MTs.

In 2015, the defense ministry planned to produce 50 missiles per year in 2020. It did not meet that deadline, but the war in Ukraine undoubtedly increased production-volume plans.

It is not clear whether the Kh-MTs missile is related to Russia's hypersonic missile programs. Obsonov described the missile as flying faster and farther than the Kh-31 but did not use the term “hypersonic.” Nevertheless, it is very likely that the “Izdeliye 75” is a hypersonic missile.

In 2013, Alexander Zelin, who had been commander in chief of the Russian Air Force from 2007 to 2012, told aviation manufacturers that by 2020, “a small theater-level missile with a range of 1,500 km and a flight speed of around Mach 6” was to be developed.

He used the abbreviation GZUR, a Russian acronym for hypersonic guided missile. He probably meant “Izdeliye 75,” because in 2013, the only other such program being implemented was the Kinzhal for the Mikoyan MiG-31K, but this missile can hardly be called small. Assuming Zelin was talking

In 2016, the Russians launched yet another hypersonic air-launched missile program—the Ostrota R&D work ordered by the Russian Defense Ministry at MKB Raduga in Dubna, about 50 mi. north of Moscow. According to the contract, the missile was to complete trials in 2022. Multiple documents show that the Ostrota missile, probably designated “Izdeliye 21,” is powered by an “Izdeliye 71” scramjet developed by the same TMKB Soyuz in Lytkarino. The Russian press says the Raduga Ostrota is smaller than the KTRV Lichinka missile and fits in the Su-57's internal bay, which limits the length to 4.2 m, but this is unconfirmed.

The fact that Obsonov and Shoigu openly discussed the new missile means this program is at such an advanced stage that its public presentation can be expected soon. Perhaps “Izdeliye 75” will appear at one of this year's exhibitions in Russia—MAKS 2023 in July or Armiya 2023 in August. 🗣️

**Check 6** Aviation Week editors discuss the recent leak of U.S. military and intelligence documents regarding Ukraine: [AviationWeek.com/Check6](https://www.aviationweek.com/Check6)



## What Comes After the C-390 for Embraer's Defense Unit?

- > NEW BRAZILIAN GOVERNMENT IS OPEN TO BOOSTING DEFENSE
- > SECOND BATCH OF F-39 GRIPENS IS UNDER REVIEW

**Steve Trimble** Rio de Janeiro

The 14-year-long, 5.79 billion reais (\$1.18 billion) development phase for the Embraer C-390 Millennium came to an end on April 3. The Brazilian Air Force declared that the jet-powered transport-tanker and aerial firefighter had achieved full operational capability, even as a recently truncated production run continues, with the sixth aircraft nearing delivery.

The declaration moves the development phase of Embraer's most technologically ambitious aircraft into the history books. Its Brazilian engineering team conquered the challenges of integrating on one aircraft for the first time: fly-by-wire, active control sticks and autothrottles into the cockpit; a cargo delivery system in the payload bay; a refueling system on the wings; and a defensive aids suite positioned around the fuselage.

Now the newly elected Brazilian government appears poised to ramp up military spending for the first time in more than a decade. With a focus on developing indigenous technology, the timing seems to coincide with Embraer's seasoned engineering team looking for a new aircraft project. Glimpses of new possibilities appeared during the four-day LAAD Defense and Security event here, including a new collaboration with Saab on projects such as future fighter studies and a new light transport aircraft.

Much depends on how President Luiz Inacio Lula da Silva responds to statements made at LAAD by his defense minister. Although a co-founder of the left-wing Workers' Party and the leader of a country facing no immediate state-level threats, Lula appears open to making a his-

toric investment in the armed forces.

In remarks to reporters at the opening of LAAD, Defense Minister Jose Mucio Monteiro Filho justified gradually raising spending on the armed forces to 2% of gross domestic product (GDP) despite forecasts of a declining economy this year in Brazil. "It is an industry that generates a lot of jobs, which pay a lot of taxes," Mucio said.

No Brazilian government has spent 2% or more of GDP on the military since 1994, the year Embraer was privatized, according to Stockholm International Peace Research Institute data. During the past 15 years, Brazilian defense spending ranged between 1.1% and 1.5% of GDP. That figure is expected to be about 1.3% this year. A gradual 70-basis-point increase could fund large new projects, which Embraer executives would welcome.

"We are excited the new government is looking forward," Joao Bosco da Costa, Jr., president and CEO of Embraer Defense & Security, said in an interview at LAAD. "The defense industry could help them to increase even more the economy of the country. So we are so excited."

In the near term, a significant expansion of the Brazilian Air Force's



Saab delivered the first four F-39Es to then-commander of the Brazilian Air Force, Lt. Brig. Carlos de Almeida Baptista, Jr., in Sweden in 2021. If Brazil orders a second batch, Embraer wants more content to transfer to Brazil.

largest project offers the quickest path to increasing spending in aviation. In 2014, the Brazilian government signed a contract now worth an estimated 26.88 billion reais to buy 28 Saab F-39E and eight two-seat F-39F Gripens. In return, Saab transferred some technology to Brazil, including rights for Embraer to assemble 15 of the F-39Es. Embraer and Akaer engineers also are helping to develop the two-seat version. Finally, Saab opened an aerostructures plant for the Gripen in Brazil and selected the AEL Siste-mas wide-area display as a standard Gripen cockpit feature. AEL is the Brazilian subsidiary of Israel-based Elbit Systems.

During an April 11 press conference at LAAD, Saab and Embraer agreed to deepen their partnership. As part of the pact, Saab will promote the KC-390 to the Swedish government, while Embraer will participate in ongoing studies on the next Swedish fighter and upgrades to the Gripen. The agreement comes as Brazil's defense ministry studies the air force's proposal to buy another 30 F-39s.

"Just this week we spoke with the Swedish ambassador about it, and it is a conversation that is [just] beginning," Mucio said in an interview with Reuters at LAAD.

For Embraer, negotiations on a second batch of fighters open the door to expanding the company's scope of work on fighters in Brazil. In the 1990s, for example, Embraer teamed up with Aeritalia and Aermacchi to develop the AMX-1 attack fighter and received nearly one-third of the manufacturing work. Embraer now assembles nearly half of the first batch of Gripens in Brazil but plays no role in component or subassembly manufacturing.

Bosco said Embraer could help Saab by evaluating the costs of the Gripen production system and suggesting "some cost-effective solutions." The Brazilian manufacturer also wants more production work if a second batch of fighters is approved in Brazil and more of the production content on international sales of the Gripen, Bosco said.

The new agreement between Saab and Embraer also includes future Swedish fighter technology. Last June, the Swedish military procurement agency awarded Saab a contract to study future combat air capabilities. Embraer engineers will have a

role in those studies as Saab considers fighter technologies beyond the Gripen E/F configuration, which was defined more than a decade ago.

"For the new fighter that they are looking for," Bosco said, "I think our engineering . . . could play an important role, bringing some capabilities, some knowledge and some ways to develop things in a short cycle and in a cost-effective cycle as well."

Another near-term need for the Brazilian Air Force is a replacement for aging C-95 Bandeirante and C-97 Brasilia transports, two of the first aircraft developed by Embraer. At the moment, no Brazilian-made aircraft meets the air force's requirements. During a meeting with Lula in January,

zilian Air Force has made a decision about SkyCourier. And it's too early to say that the Brazilian Air Force will join anyone in a new development. I think both of us are studying that."

As future development work continues to be weighed, Embraer's immediate focus is on selling more C-390s. So far, three countries have ordered a total of 26 aircraft—Brazil (19), Portugal (five) and Hungary (two). The Netherlands also has committed to purchasing five more C-390s.

Potential new sales could come from several interested countries. Air force representatives from Austria and the Czech Republic, for example, attended a C-390 international users group meeting in Portugal in March.



**Embraer Defense & Security CEO Joao Bosco da Costa, Jr. (second from left) and Saab CEO Micael Johansson (with microphone) agreed at the LAAD event to deepen their decades-old partnership.**

Lt. Brig. Marcelo Kanitz Damasceno, the new air force commander, named the Cessna C-408 SkyCourier—a high-wing, twin-engine utility transport—as a "priority project."

But Embraer executives say that air force officials continue to consider indigenous alternatives. Three years ago, the air force received proposals for different versions of a hybrid-electric-powered utility transport from three Brazilian companies: Akaer, Embraer and Des aer. However, the air force later shelved the project.

A military transport aircraft featuring a hybrid-electric propulsion system may be too ambitious, but Embraer has other options for the air force.

"We do believe that we have found new things and new possibilities around this size of airplane. You are going to see a more cost-effective airplane," Bosco said. "So we are exploring this with the Brazilian Air Force. I think it's too early to say that the Bra-

Embraer also displayed the transport aircraft at Aero India in February, then flew it to Kazakhstan and Uzbekistan, countries that have historically operated Russian transports.

Other near-term opportunities are being pursued through industrial partnerships. Saab has agreed to market the C-390 to the Swedish Air Force, which in March canceled plans to acquire used Lockheed Martin C-130Js from Italy. Embraer also has teamed up with L3Harris Technologies to offer the KC-390 Agile Tanker concept to the U.S. Air Force, which is analyzing options for a next-generation aerial refueling fleet. Embraer is betting the U.S. Air Force will need a tanker in the 2030s that can operate from small and austere airfields in the Asia-Pacific region as development of a future stealthy refueler continues.

"L3 is trying to convince [them] that this [concept] could be a good case for the U.S. Air Force," Bosco said. ☛



# Japan Prepares To Engage in International Weapons Trade

- > TOKYO MAKES AN EFFORT TO BOOST ITS MILITARY SUPPLY CHAIN
- > SEEKING NEW COLLABORATIONS, THE COUNTRY HOPES TO DEVELOP NEW ARMS TECHNOLOGIES

**Chen Chuanren** Tokyo

Japan plans to double its military spending by 2027 and has established ambitious procurement plans to respond to threats in the region. But Tokyo also must export its military equipment overseas to remain relevant on the global stage and to establish a robust domestic defense supply chain.

In a poetic nod to the return of Japan to the international arms trade, the theme of the Acquisition, Technology & Logistics Agency (ATLA) booth at the recent DSEI Japan exhibition was “Dawn Breaks.” Much has changed since the show was last held

commercial market because of their ability to produce high-end platforms, they have failed to repeat such successes in the defense sector.

The panel agreed that Japanese industry should work closely with the government and international companies to penetrate the global market and instill an arms-trading culture within Japanese companies.

Tokyo also has imposed regulations to allow the government to take over production lines from private companies that withdraw from defense programs, ensuring a steady and reliable defense production capability.



JAPANESE DEFENSE MINISTRY

in 2019. Tokyo has emerged from the pandemic in a world where its Chinese and North Korean neighbors have rapidly strengthened their military power and full-fledged war between sovereign states remains a reality.

Japan has relaxed its export policies in various stages since 2014, marketing arms products, ranging from radars to submarines, internationally. Yet its major success has been the sale of three J/FPS-3 air surveillance radars to the Philippines in 2020.

In a DSEI panel, ATLA, the Japanese economy, trade and industry ministry, as well as the Japan Maritime Self-Defense Force all agreed that while Japanese companies have made names for themselves in the

At the company level, Kawasaki Heavy Industries (KHI) is looking at methods to lower the production cost of its C-2 strategic airlifter. KHI told Aviation Week at the event that it is moving toward “sophisticated and leaner” production and assembly methods to increase the production rate. KHI will translate all technical and training manuals into English and implement international standards.

Separately, Japanese companies are stepping up to meet the defense ministry’s vision of developing and acquiring technologies laid out in its national defense strategy in the areas of standoff weapons, hypersonic technology, autonomous systems and integrated air defense.

Japan aims to acquire uncrewed aircraft systems (UAS) technology, such as the loyal wingman, within 10 years. Kazuhiro Horie, director general of ATLA’s department of technology strategy, told Aviation Week at the event that Japan will conduct UAS joint research “with some countries,” revealing that it has already done so with Australia in the area of autonomous ground vehicles.

Israel’s Elbit Systems signed a memorandum of understanding with Nippon Aircraft Supply and Itochu Aviation to provide “main components, technology and knowledge” to Japanese companies. The trio will identify the specific opportunities with Japan’s military that might lead to codevelopment and assembly of UAS in Japan. Should its system be selected, this would be a first for Elbit.

Despite Japan’s ambitious targets on hypersonic and railgun systems, Horie said ATLA and Mitsubishi Heavy Industries (MHI) have made progress on scramjet engines for a hypersonic missile. The system achieved “positive results” in a hypersonic wind tunnel test conducted in 2022; the truncated engine was calculated to have achieved

## Kawasaki Heavy Industries aims to reduce the cost of making the C-2 strategic airlifter.

speeds exceeding Mach 5. The missile program will move into system level research in April.

MHI and KHI also have introduced prototype high-energy laser weapons mainly for counter-UAS purposes. However, since the most powerful system in Japan, made by MHI, currently operates at only 20 kW, it is still a far cry from the Rafael Iron Beam’s 100-kW output.

Japan is looking toward a new era of defense policies and international partnerships. The Global Combat Air Program initiative with Europe also indicates that Tokyo is shifting away from self-development as well as away from the usual collaboration with the U.S.

Continuing to depart from its conservative postwar stance, Japan is increasing participation in global security, too. On March 21, Prime Minister Fumio Kishida traveled to Ukraine. Time will tell if Tokyo will follow other military powers and send weapons to the war-torn country. 🌐



# 20 TWENTIES 2024

## Unparalleled Recruitment Opportunity

Hire the most qualified industry professionals — the best of the best talent across the aviation, aerospace & defense industry with a 20 Twenties sponsorship.

### Sponsorship benefits include:

- A diverse & inclusive pool of candidates – direct access to 80+ top students/young professionals, including contact information, resumes, letters of recommendation, and more!
- Sponsor recognition on all 20 Twenties marketing promotion and at the 20 Twenties Luncheon & Laureate Awards & Dinner
- A digital subscription to *Aviation Week & Space Technology*

### 20 Twenties winners go places! Here's where some of our winners have landed:

- Boeing, Systems Engineer
- Blue Origin, Guidance, Navigation & Control Engineer
- Lockheed Martin, Life Support Integration Engineer
- NASA, Engineer, Space Suit Technology
- Pratt & Whitney, Software Engineer
- Sierra Space, VP, Dream Chaser
- SpaceX, Mission Integration Engineer
- The Sky Guys, President
- Northrop Grumman, Program, Satellite Servicing
- Raytheon Missiles & Defense, Operations Engineering Project Lead



**Sponsor the 20 Twenties  
Class of 2024 Today!**

[aviationweek.com/20twenties](https://aviationweek.com/20twenties)

**AVIATION WEEK**  
NETWORK

# New British Trainer Is Central to the RAF's Green Agenda

> STARTUP HOPES TO FLY SWIFT TRAINER THIS YEAR

> RAF AIMS FOR NET-ZERO EMISSIONS BY 2040

**Tony Osborne** London

The first British civil aircraft to be wholly designed, manufactured and certified in the UK in more than two decades has found an unexpected role as a testbed for the Royal Air Force's future technologies.

Startup Swift Technology Group's (STG) eponymous Swift light aircraft, due to make its first flight later this year, is set to be at the center of the service's push to achieve net-zero carbon emissions in 2040, ahead of the UK's legislated target of 2050.

RAF Coltishall, England, the Swift is an all-composite, two-seat, low-wing, aerobatic-capable aircraft that the company hopes will appeal to the pilot-training and general aviation market. Interest in the aircraft from the general aviation industry has been encouraging, STG officials say. Concept design for the development of the aircraft has been taking place over the last decade and is now "mature," the company tells Aviation Week.

After the planned first flight this

That fleet is used for preservice flying training, grading and assessment, as well as support of the RAF's University Air Sqdns. and Air Experience Flights. That broader program, called Project Telum, aims to deliver such an aircraft by around 2027; work on Project Monet could put the Swift in a good position for Telum. The company also received an innovation loan from the UK Defense Ministry's Defense and Security Accelerator (DASA) (AW&ST July 26-Aug. 8, 2021, p. 52).

Company officials say the Defense Ministry assessments for securing the DASA loan and now the Monet work "validate" its approach to development.

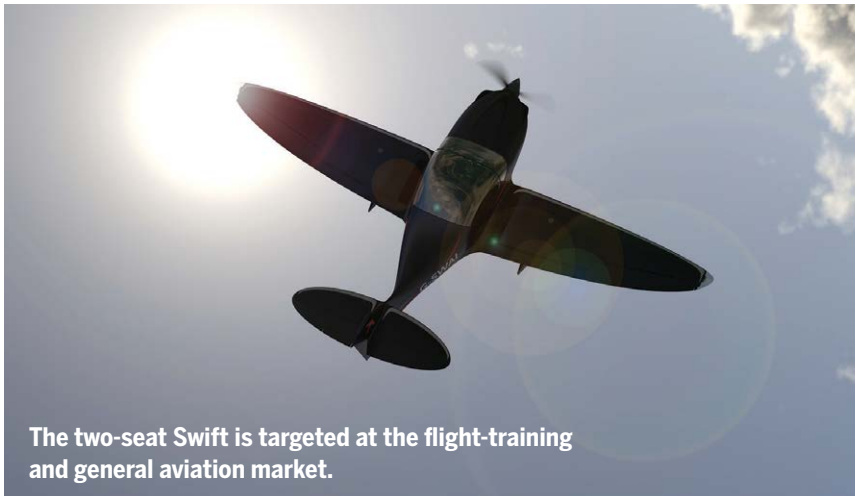
STG says the "timing is right" for a new light training aircraft, noting that pilot-training requirements are expanding and calling for more training to be done on fewer platforms. The Swift, the company says, will feature a large cockpit for a broader demographic of pilots to fit comfortably, while its aerobatic capability "will broaden the scope of training that operators can provide to customers," including upset prevention and recovery training.

The RCO will have access to two Swift aircraft as part of the trials, as well as access to the company's technology development. Flight assessment will be performed by test pilots from both Swift and the Defense Ministry. Other partners in Project Monet include: Babcock, the current provider of the Grob Tutor fleet as well as an MRO provider; CFS Aero; Zero Petroleum; electric powertrain specialist Delta Cosworth; and Uplift360, a recycling technology company.

"Monet will be an exciting journey into the future of sustainable flight for the RAF," said RAF Group Capt. Peter Hackett, the military head of flight test for Team Tempest. "We will develop and understand the technologies to enable future military aircrew and air cadets to begin their journey into aviation, and yet not adversely impact the world we all share."

In addition to Project Monet, the RAF is continuing to explore the use of sustainable aviation fuel (SAF) and synthetic alternatives. In early April, Eurofighter Typhoons were refueled in midair with a 43% blend of SAF provided by an RAF Airbus A330 Voyager tanker. As well as reducing the service's carbon emissions, the synthetic fuel efforts are aimed at lessening reliance on supply chains. ☉

SWIFT TECHNOLOGY GROUP



The two-seat Swift is targeted at the flight-training and general aviation market.

The Swift has been selected for Monet, a UK Royal Air Force (RAF) Rapid Capabilities Office (RCO) project exploring greener propulsion alternatives and considering the environmental effects of operating with those powerplants. Among the technologies being considered are all-electric battery power, hydrogen fuel-cell propulsion, hybrid-electric configurations, as well as synthetic fuel use in combustion engines.

Swift was selected in part because several of those propulsion technologies are part of the Swift's development road map. The company has defined an architecture for the aircraft to support alternative power systems and has selected two as-yet-undisclosed UK-based partners to support the work.

Under development at the former

year, certification—meeting the European Union Aviation Safety Agency's CS-23 requirements for Normal, Utility, Aerobatic and Commuter aircraft—is expected in 2025-26, with the different propulsion options to be offered later.

If successful, it will be the first British aircraft to be certified since the Avro RJ series of regional airliners.

The Monet project is "complementary to our goals," says David Stanbridge, founder and managing director of STG, adding that the Monet efforts are seen as a way to refine the aircraft further. Crucially, STG has an eye on proposing Swift to meet the RAF's ambition to deliver an electric-powered, fully aerobatic training aircraft that would replace the Grob G 115 Tutor aircraft that are currently in service.



# Romanian Declarations Speed Up F-35 Procurement Plans

> BUCHAREST PLANS TO RETIRE ITS MiG-21 FLEET IN MAY

> CONCERNS ABOUT UKRAINE WAR INFLUENCED THE DECISION

**Tony Osborne** London

**R**omania looks set to join Eastern Europe's growing community of F-35 customers.

After nearly a decade of its ministers and air force officials declaring interest in the aircraft, Bucharest appears to be signaling an acceleration of its Joint Strike Fighter procurement plans.

At an April 11 meeting of the country's Supreme National Defense Council led by Romanian President Klaus Iohannis, ministers and senior defense officials gave the green light to modernize the Romanian Air Force with the Lockheed Martin-built fighter.

The council approved "the concept of achieving the operational capability of air defense with fifth-generation multirole aircraft," adding that "the process of modernization of the air force will continue with the purchase of the latest-generation F-35 aircraft," the office of the Romanian president said in a statement.

These F-35 aircraft are equipped with a wide range of advanced sensors, the ability to exchange encrypted information in real time—with both air platforms and ground-based defense systems—and the ability to manage the operational picture of the battlefield with high-precision, intelligent munitions, the statement said. The aircraft type also allows Romania to achieve and maintain air superiority, "a mandatory condition for ensuring sovereignty in the national airspace and, if necessary, for its defense."

Bucharest has not indicated when it might want the aircraft, or indeed how many it would order, but the approvals suggest acquisition will begin much earlier than the 2030s time frame previously discussed by Romanian officials and Lockheed Martin. Iohannis himself name-checked the F-35 during a speech at Campia Turzii air base in February 2022, days before the Russian invasion of Ukraine, stating that Romania should move toward a purchase.

The Russia-Ukraine war has undoubtedly played a part in the Roma-

nian government's thinking, and it stands to reason that an F-35 acquisition could be more of a deterrent than its current combat aircraft fleets.

Romania has a small border with Ukraine and deep concerns about Russian destabilization of neighboring Moldova. The Romanian Air Force is in the process of adding more secondhand Lockheed Martin F-16s to its fleet—with aircraft acquired from



Romania would be the third Eastern European country after Poland and the Czech Republic to adopt the F-35.

Norway expected to replace the long-serving MiG-21 Lancers due for retirement in the coming weeks. Bucharest has long considered acquisition of the F-16 to be a gateway capability toward the F-35.

Thirty-two ex-Norwegian F-16s, all A/B models that have received an extensive midlife update, are set to join a squadron of ex-Portuguese aircraft. While this will give Romania a sizable F-16 fleet, neighboring countries are modernizing their combat aircraft with more advanced equipment.

In a series of parallel developments around fighter aircraft, Bulgaria and Slovakia will receive Block 70-model F-16s, and Greece is upgrading its F-16s to the Block 70 standard, acquiring the Dassault Rafale and planning

a purchase of F-35s. Meanwhile, Poland's first of 32 F-35s is on the production line in Fort Worth, and the Czech Republic is planning to advance its own F-35 procurement this fall after selecting the platform last summer.

"With the regional security situation, it is no surprise that Romania would move toward the F-35," says Douglas Barrie, senior fellow for military aerospace at the London-based International Institute for Strategic Studies.

While the aircraft's price has been reduced through economies of scale, a question remains as to whether Bucharest can afford the platform's life-cycle and operations costs. "Moving from the MiG-21 to the F-16 is a significant leap in complexity," Barrie notes. "Arguably, that leap is even greater when it comes to the F-35."

Another factor in the F-35 choice is establishing a stronger relationship with the U.S., although Romania already has robust ties with Washington.

Since Russia's annexation of Crimea in 2014, Bucharest has invested heavily in U.S. defense equipment, including Raytheon's Patriot ground-based air defense system and the Lockheed Martin High-Mobility Artillery Rocket System. Romania has requested Abrams main battle tanks, too.

The country also hosts one of the two Aegis Ashore ballistic missile defense facilities in Europe, the other being in Poland. And its other recent defense acquisitions include the purchase of Turkish Bayraktar TB2 uncrewed air systems and land-based Naval Strike Missile batteries. ☛

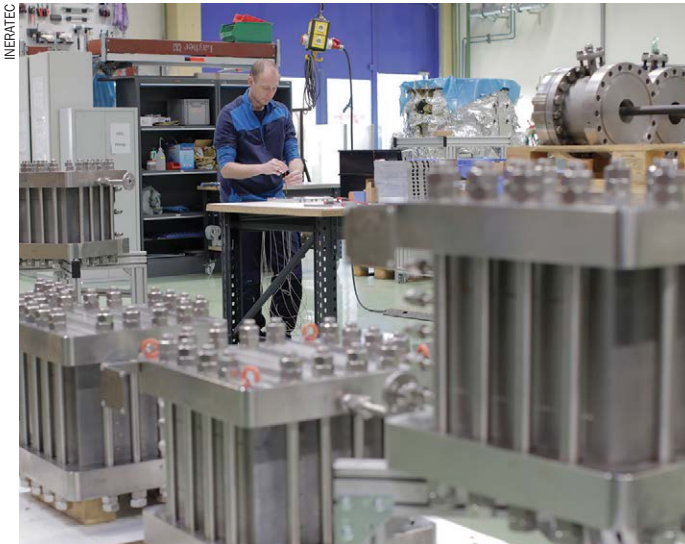
# Synthetic Fuel Producer Makes Technology Progress

- > INERATEC OFFERS COMPACT AND EFFICIENT FISCHER-TROPSCH REACTORS
- > SAFRAN SEES PREDICTABILITY IN E-FUEL FEEDSTOCK

**Thierry Dubois** Karlsruhe, Germany

Compared with biomass-based sustainable aviation fuel, the feedstocks on which synthetic fuel relies are less readily available. The process requires capturing carbon dioxide and producing hydrogen—so why spend time and energy developing synthetic fuels?

One reason is synthetic fuel's climate neutrality. As long as the carbon dioxide (CO<sub>2</sub>) does not come from a fossil fuel source and the electrolysis process forms hydrogen using renewable electricity, it meets that goal. Synthetic fuels, also known as e-fuels, can be seen as the indirect electrification of vehicles that cannot be electrified.



**Thanks to an innovative cooling system, Ineratec has reduced reactor size by a factor of 100.**

Meanwhile, the promoters of biomass-based sustainable aviation fuels (SAF) reckon they can reduce aviation's carbon footprint by up to 80%. The other main reason for the uptake of SAF is the availability of the biomass feedstock, but not all the biomass in the environment is usable—for instance, it would be impractical to collect all dead leaves.

Moreover, political decisions determine which feedstock is allowed for biomass-based SAF, which makes the available quantity uncertain, according to Nicolas Jeuland, Safran's senior group expert for future fuels. This underlies the push to study e-fuels, despite discouraging assessments by energy giants such as TotalEnergies.

Safran early in 2022 became a minority shareholder in Karlsruhe, Germany-based Ineratec, a startup company specializing in synthetic fuels. "We wanted to learn the technology, and whether it is realistic, from the inside," Jeuland explains.

One year on, Safran's interest has solidified, signaling that the fledgling industry has reasonable hope to be able to contribute to aviation's—and other sectors'—carbon footprint reduction endeavor.

All that said, the synthetic fuels industry has a long way to go. It would take an entire year of annual production for Ineratec to fill the tanks of just 250 long-haul commercial aircraft. That is assuming the development and 2025 service entry of a 100-megawatt factory goes to plan. Another assumption is that all the fuel created would go to aviation, which is technically and economically unlikely.

Of course, Ineratec intends to sell or operate a number of increasingly powerful production plants, and other players will add their output. Nevertheless, those numbers hint at the daunting task ahead.

Ineratec is in the business of selling e-fuel production plants and producing e-fuel itself. It has sold or operates a dozen plants at relatively small power levels. One more pilot plant being commissioned, a joint project with Lufthansa Cargo, targets an output of 350 metric tons (1 megawatt) per year.

The technology has yet to mature to a level at which continuous production is possible. "We operate in campaigns," says Ineratec CEO Tim Boeltken. The machinery is not stable enough to run the desired 8,000 hr. per year, he adds.

Ineratec is still one of the most promising companies in the sector, according to Jeuland. The compactness of Ineratec's reactors is a strong point. The Fischer-Tropsch conversion that leads to synthetic fuel conventionally requires a large facility for acceptable efficiency. Researchers and engineers have managed to reduce reactor size, for a given efficiency, by a factor of 100. In particular, the cooling system uses multiple metal plates with microstructures for water and steam flows.


As a result, an e-fuel production plant can be installed where an often limited quantity of feedstock is available. Typically, hydrogen is difficult to transport, so building a plant next to a hydrogen factory makes sense. And Ineratec's production units can adapt to the amount of hydrogen and CO<sub>2</sub> that can be procured locally.

Direct air capture of CO<sub>2</sub> is being considered for the long term but is still too expensive, Boeltken says. Instead, capturing biogenic CO<sub>2</sub>—from a biomass plant, brewery, sewage plant or fossil fuel user that participates in the EU Emissions Trading Scheme—is the short-term solution. Additionally, Ineratec's modular approach makes it easier to ramp up production as feedstock availability improves.

Among Ineratec's strengths is its command of the reverse water-gas shift (RWGS) reaction, Jeuland adds. RWGS produces carbon monoxide (CO) and hydrogen, a mix known as syngas, from CO<sub>2</sub> and hydrogen. Then, using CO and hydrogen, the well-known Fischer-Tropsch process creates the e-fuel.

Ineratec says the overall efficiency of e-fuel production stands at 55%. That evaluation factors in the energy consumption of CO<sub>2</sub> capture and hydrogen production, two processes Ineratec does not perform, Boeltken says. Some 80% of losses can be found in electrolysis, he adds.

The waste heat in Ineratec's process can be used easily in the form of 200C (392F) steam, Jeuland notes.

Ineratec, now with a 130-strong workforce, formed in 2016 as a spinoff of the Karlsruhe Institute of Technology. It has received €36 million (\$39 million) of investments and grants since its inception. 



AVIATION WEEK   
**MRO**  
BEER

June 14-15, 2023  
Warsaw, Poland



# The region's largest MRO event returns to Poland.

Airline led discussions on changes and challenges:  
LOT, Ryanair, TUI Airways and Wizz Air.

Deep dive into strategies & techniques to boost your efficiency, address labour shortages, supply chain bottlenecks & rising inflation.

## FEATURING



**Julia Brix**  
HEAD OF TECHNICAL SERVICES  
WIZZ AIR



**Lee Carey**  
VP Asset Management  
EirTrade



**Arpad Demeny**  
CEO  
Aeroplex



**Alistair Dibisceglia**  
Sales Manager EMEA  
Delta Tech Ops



**Joost Groenenboom**  
Director  
ICF



**Adam Hale**  
HEAD OF HEAVY MAINTENANCE  
RYANAIR



**Krzysztof Krolak**  
VP TECHNICAL OPERATIONS  
LOT POLISH AIRLINES



**Zilvinas Lapinskas**  
CEO  
FL Technics



**Anca Mihalache**  
VP Engine Trading & Leasing  
APOC Aviation



**Frederic Pralus**  
VP Technical  
Avion Express



**Geert Somers**  
DIRECTOR ENGINEERING &  
MAINTENANCE  
TUI AIRLINE



**Maria Jesus Ymbernon Salva**  
Head of Vendor Management  
Maintenance  
Vueling

REGISTER BY MAY 12 FOR BEST RATES. [MROBEER.AVIATIONWEEK.COM](https://mrobeer.aviationweek.com)

# Cathay Pacific Targets Short-Term Recovery and Long-Term Growth

- > CHINA'S REOPENING MOVES WERE A WELCOME SURPRISE
- > AIRLINE EYES NEW AIRCRAFT ORDERS FOR INTRA-ASIA NETWORK

**Adrian Schofield** Hong Kong

**W**hile it had a later start than most airlines in the Asia-Pacific region, Cathay Pacific's post-pandemic capacity recovery continues to gain strength as demand surges in its key markets.

Cathay has been one of the region's most-watched airlines during the COVID-19 pandemic. Some industry observers speculated that its Hong Kong hub may have suffered long-term competitive damage, as Hong Kong trailed most other markets in easing onerous operational and travel restrictions.

However, this year Cathay has been achieving its capacity growth targets, which is increasing confidence in its timetable for a full recovery.

The carrier also is looking ahead to new fleet growth opportunities presented by the expansion of Hong Kong International Airport. The airport development, which would allow its capacity to increase beyond 2019 levels, is one of the major factors being considered as Cathay plans its next wave of aircraft orders.

The Cathay Group met its goal of lifting capacity to 50% of pre-pandemic levels by the end of March, says Lavinia Lau, the airline's chief customer and commercial officer. This represents a relatively rapid rise from capacity levels of 16% in September 2022 and 27% in November.

Cathay is likely to hit 60% of pre-pandemic capacity within a few months, during the summer peak season, Lau tells Aviation Week. This growth reinforces Cathay's optimism that it will reach its target of at least 70% of 2019 capacity by year-end, with a full recovery forecast by the end of 2024.

Cathay expected a surge in demand after Hong Kong's quarantine requirements eased in September, Lau says. However, what the carrier did not ex-

pect was how quickly the key Chinese mainland market would reopen.

When Cathay formulated its business plan and budget last year, the airline anticipated that it would be quite fortunate if the mainland market reopened by the middle of 2023, Lau says. But then the mainland government announced that many travel

The majority of the group's mainland China frequencies before the pandemic were flown by its Cathay Dragon subsidiary, which ceased operations in October 2020. Cathay has picked up many of Dragon's former routes, and Cathay's low-cost carrier subsidiary HK Express operates some, too.

Most of Cathay's markets began recovering earlier than the mainland China routes. Overall outbound demand from Hong Kong began ramping up in the fourth quarter of last year, particularly within the Asia-Pacific region to destinations such as Japan and Thailand, Lau says.

Like other airlines, Cathay has seen outbound demand from Japan recover slowly. However, that outbound traffic



BAYNE STANLEY/ZUMA PRESS INC./ALAMY STOCK PHOTO

**Cathay Pacific has two more Airbus A350-900s due for delivery this year.**

restrictions would be dropped in early January.

Initially, demand for inbound travel to mainland China was greater than for outbound, as it took time for Chinese travelers to obtain passports and visas. But these processes started to accelerate after the Lunar New Year holiday period in late January, Lau says. Since then, Cathay Pacific has seen strong pent-up demand for outbound travel from mainland China.

Data from Aviation Week Network's CAPA - Centre for Aviation and OAG shows that for the week of April 10, the Cathay Group's frequencies between Hong Kong and mainland China were at 36.5% of the levels at the same point in 2019. This is up dramatically from 16.5% at the start of January.

recently has been picking up slightly, Lau says. In contrast, flights inbound to Japan have been full.

Travel demand from Southeast Asian countries also has been strong, both within the Asia-Pacific region and connecting to longer-haul destinations in Europe and the U.S.

Cathay's connecting traffic generally has not rebounded as quickly as point-to-point traffic. Last year, after Hong Kong reopened, the limited capacity available was dominated by origin-and-destination traffic. The share of connecting traffic "is still not at pre-pandemic levels, but it is growing every week," Lau says.

There have been some bottlenecks to recovery, though. The main one so far has been in pilot training. Cathay



has had to retrain many pilots who lost their recency during the pandemic years, and it has a lot of new pilots to train as well. Another training need is moving pilots up to higher grades. Pilot training is the major factor determining how quickly Cathay can rebuild capacity, Lau says.

Other constraints also have become evident. These include bottlenecks in areas such as airport ground handling, catering and aircraft engineering. In most cases, they involve partners outside the airline. Such problems are not unique to Cathay and are industrywide.

The full-service Cathay Pacific airline for the most part has been able to gain access to the overseas airports it wants to resume serving, Lau says, though HK Express has run into some issues. For example, HK Express has faced constraints in accessing smaller secondary airports in Japan that have not fully rebuilt their resources.

The low-cost carrier has recovered its capacity more quickly than the Cathay Pacific parent carrier, however. While the group overall is at about 50% of pre-pandemic capacity, HK Express' flight frequencies have already reached 2019 levels, Lau says.

HK Express primarily targets origin-and-destination traffic in Hong Kong, and this sector was the fastest to return after border measures eased last September. The carrier "captured that first wave of pent-up demand out of Hong Kong very well," Lau says.

However, a significant caveat is that HK Express had a far smaller base level of flights than the full-service airline and operates mainly short-haul routes within the region.

Even before the pandemic, Cathay had "expected HK Express to play an increasingly important role within the group," Lau says.

Although Cathay Pacific's immediate focus is on rebuilding capacity to pre-pandemic levels, the carrier also is looking ahead to new fleet growth opportunities.

Cathay Pacific has been hinting for some time that it is in discussions regarding new orders. The airline aims to order aircraft to bolster its network within the Asia-Pacific region, Lau says. These will likely include both narrowbody and widebody aircraft. Cathay is considering ordering new freighter aircraft as well.

The orders Cathay is planning

would be partly intended to replace older passenger aircraft. The oldest types in the regional passenger fleet are Boeing 777s and Airbus A330s. However, there still will be a greater focus on fleet growth than replacement, Lau says.

As of the start of this year, the Cathay Group—including HK Express—had 48 outstanding aircraft orders due for delivery through 2028. A few of these have been delivered this year. The CAPA fleet database shows Cathay has 44 aircraft remaining on order.

The existing orders include Airbus A321neos for both Cathay and HK Express, two more A350s and 21 Boeing 777-9s. The A350s are due this year and would boost Cathay's A350 fleet to 48, comprising -900s and -1000s.

The widebodies already on order mean the carrier's long-haul fleet needs are well covered, Lau says, so the upcoming orders are aimed at the intraregional fleet.

Cathay Pacific expects to restore its capacity to pre-pandemic levels by the end of 2024. Around that time, Hong Kong Airport is due to complete work on its third runway system, which would allow expansion beyond pre-pandemic levels.

"That will be a very good growth opportunity, so we are looking ahead at what aircraft and what fleet size we would need to grab that opportunity," Lau says. "We [were] thinking about our [fleet] growth plans even before the pandemic, and the major trigger is the third runway system."

Lau notes that in the years before COVID-19 hit, Cathay was constrained in its growth plans by the scarcity of

slots at Hong Kong Airport. The expansion project will ease these constraints.

The new development also is likely to lead to greater competition, as many rival airlines had been waiting to grow at the airport before the pandemic.

In the shorter term, Cathay Pacific will be rebuilding its fleet by returning parked aircraft to service. Lau says the carrier intends to complete the reactivation of its parked aircraft by early next year.

The carrier had about 40 aircraft in long-term storage in Australia at the end of 2022, Lau says. Cathay's plan is to return all the stored aircraft gradually to active service, except for those that are at the end of their leases and will be returned to lessors.

Cathay—excluding other group airlines—has a total of 130 aircraft in service, with 51 categorized as inactive, according to the CAPA fleet database. The predominant in-service type is the A350.

Two-thirds of the inactive fleet are 777s. Over half of Cathay's 41 777-300ERs are in service, but just three of its 17 777-300s are active.

The fact that Cathay is making long-term growth plans indicates its confidence in achieving a full recovery and setting its expansion goals back on track. It is also a positive sign that Cathay has moved back into investment mode after nearly three years of severe financial pressure caused by the pandemic. 🗣️

**Check 6** Analysts Sash Tusa and Richard Aboulafia join *Aviation Week* editors to discuss whether Boeing can come back in China:

[AviationWeek.com/Check6](https://www.aviationweek.com/Check6)

**AEROMART**  
NAGOYA - JAPAN

5TH EDITION

INTERNATIONAL B2B MATCHMAKING  
EVENT FOR THE AEROSPACE  
SUPPLY CHAIN

SEPTEMBER 26 - 28, 2023  
[aeromartnagoya.com](https://aeromartnagoya.com)

Organized by: **abe** Advanced Business Events **BCI AEROSPACE**

# FAA Seeks New York-Area Airline Service Cuts

- > AIR TRAFFIC CONTROL STAFFING SHORTAGE PROMPTS FAA REQUEST AND SUMMIT
- > THE AGENCY WARNS DELAYS THIS SUMMER COULD EXTEND BEYOND THE REGION

**Christine Boynton** Boston

**F**acing a busy summer season and staffing levels in New York's air traffic control zone below targets, the FAA has asked airlines to reduce summer services in the region voluntarily. The complex airspace is at about 54% of its Certified Professional Controller goal, according to FAA data.

To address the issue further, the FAA's Air Traffic Organization (ATO) hosted a summit March 29 convening airlines, general aviation representatives and the National Air Traffic Controllers Association (NATCA) to discuss improving traffic flow management strategies, system resiliency, facility staffing and the air traffic controller training backlog.

"Operators requested collaboration and communication with the FAA early and often to plan for circumstances that could result in delays," the FAA said. "They discussed how closer collaboration and frequent air traffic updates would help them more effectively schedule crews. They also requested increased coordination between facilities to take advantage of alternate routes, such as deep-water routes."

On March 27, the FAA requested that airlines reduce summer service in the region voluntarily by 10% amid low staffing levels at New York Terminal Radar Approach Control (N90). NATCA has blamed recently adjusted low hiring goals from the FAA as part of what it calls an almost 30-year low in the number of fully certified controllers across the National Airspace System. Nodding to funding instability as one of the FAA's biggest challenges in maintaining capacity, NATCA said in March 23 testimony that the agency also has not kept up with ATC attrition.

"By the end of fiscal year 2022, there were 1,200 fewer Certified Professional Controllers employed by the FAA than a decade earlier, and 6% of those who remain are eligible to retire," NATCA President Rich Santa said before the House subcommittee on aviation. Calling the FAA's recently increased hiring goal for fiscal 2024-26 a positive development, he added: "Hiring more trainees in the short term will not immediately solve this staffing crisis because it takes 1-3 years of on-the-job training for controllers to become fully certified after graduating from the FAA's training academy in Oklahoma City. Moreover, only about 60% of all controller trainees reach full certification within three years."

NATCA and the ATO's Collaborative Resource Work-

group partnership in February presented a report with updated Certified Professional Controller operational staffing targets to FAA Acting Administrator Billy Nolen. NATCA says the targets should guide not only hiring goals, but also improved distribution of the operational workforce.

In a March 22 Notice of Limited Waiver, the FAA said it was progressing toward moving responsibility for the Newark, New Jersey, radar sector from N90 to the Philadelphia Traccon, with related training slated to begin in September.

The FAA projects a 45% year-over-year increase in overall delays during summer operations at New York-area airports. During the May-September period in 2022, 41,498 delays occurred from Newark (EWR) and New York's John F. Kennedy (JFK) and LaGuardia (LGA) airports. The three facilities had 252,099 scheduled departures during that five-month period, according to FAA data.

Warning that delays caused by N90 air traffic control staffing shortfalls could extend beyond the area "due to the amount of connecting flights in the New York region as well as the interdependency and complexity of the airspace surrounding EWR, JFK and LGA," the FAA issued a rule on March 27 granting a limited waiver of slot-usage requirements

"due to post-pandemic effects" on N90 air traffic control staffing. It covers high-density slot-controlled Level 3 airports JFK, LGA and Ronald Reagan Washington National (DCA) as well as EWR, a Level 2 slot-facilitated airport. The limited waiver will remain valid from May 15 through Sept. 15 for carriers that identify the slots and timings before April 30.

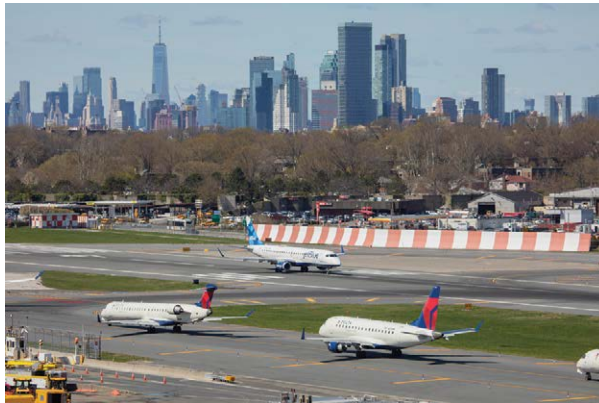
"This relief is being provided to give carriers the ability to reduce operations during the peak summer travel period, which are likely to be exacerbated by the effects of Air Traf-

fic Controller staffing shortfalls," the FAA writes in its rule. The agency also expects airlines to minimize passenger impacts in other ways, including through the operation of larger aircraft and communications about potential disruptions.

The agency said it "will not reallocate the returned slots or approved operating timings at JFK, LGA or EWR," as it aims to reduce operational volumes.

Delta Air Lines and United Airlines submitted requests for the return of up to 10% of slots at JFK, LGA and DCA and approved operating times at EWR. United plans to use larger aircraft to minimize disruptions, stating that even with the reductions it "will fly 5% more seats out of these airports than we did in Summer 2019." American Airlines says it also will reduce frequencies on selected routes from LGA and EWR this summer, and JetBlue Airways is reviewing options for reducing its flight schedule at JFK and LGA.

"We are advocating for Congress to provide the FAA with the funding and resources it needs to fully staff air traffic control now and for the long term and . . . to invest in new modern technology that will make air traffic control more efficient," JetBlue said in a statement to Aviation Week. "There's no region that will benefit more from that than New York." 🗎



PORT AUTHORITY OF NEW YORK AND NEW JERSEY

**The FAA expects a 45% year-over-year increase in overall delays at New York-area airports this summer.**



# U.S. Airlines Invest in Providing No-Cost Onboard Wi-Fi

> DELTA PLANS TO JOIN JETBLUE IN OFFERING FREE VIASAT SERVICE BY YEAR-END

> HAWAIIAN WILL PROVIDE CONNECTIVITY WITH STARLINK

Christine Boynton Atlanta

**T**he problem with Wi-Fi, Delta Air Lines' CEO says, is that it does not work as an ancillary revenue stream.

"People want to figure out a way to make money on it as a product in and of itself, and you can never invest enough to have it with the reliability that you need, the quality that you need, at a price point that people are willing to pay," CEO Ed Bastian said April 18 at the Aviation Week Network's MRO Americas conference here.

In January, the airline announced it would make in-flight connectivity (IFC) complimentary for all members of its free loyalty program, SkyMiles. Only one U.S. airline provides IFC for free on this scale—JetBlue Airways offers "Fly-Fi" through Viasat "at every seat, on every plane."

Delta sees the product as a differentiator in building loyalty. "The core premise of Wi-Fi is to provide it as an additional reason for flying Delta," Bastian said. "This is not easy to do. This is not about finding a new satellite contract and flipping the switch. . . . The challenges as an innovator are difficult and expensive."

The carrier's investments are part of a larger trend—as IFC technologies improve, U.S. airlines are upgrading service. Some are doing so with trials of free access.

On an existing fleet equipped with its legacy provider Anuvu, Southwest Airlines is installing latest-generation routers and modems. So far it has equipped more than 350 aircraft, with installations on the full fleet expected to be completed by the third quarter. The carrier's new aircraft are equipped with Viasat; it received the first of these in early March. Southwest charges \$8 per device for

internet access from takeoff to landing.

Wi-Fi on United Airlines and American Airlines comes through several providers and is offered onboard starting at \$8-10. T-Mobile subscribers on eligible plans can connect for free on domestic and international United flights as well as on American's Intelsat-equipped aircraft—expanding this quarter to include the airline's Viasat-equipped aircraft under a 12-month agreement.



SPRINT IMAGES LIMITED/ALAMY STOCK PHOTO

**Hawaiian said last spring that it plans to equip its Airbus A330s like this one as well as A321neos and Boeing 787-9s with free IFC via Starlink.**

American also grants Boingo customers free Wi-Fi access on its Viasat-equipped aircraft and for iPass customers on those with Panasonic equipment. It began a trial in April 2022 for 20 min. of free Wi-Fi onboard 25% of its domestic flights operated on narrowbodies with Viasat. "[The trial] is helping American understand which experiences are most meaningful for customers," a spokesperson tells Aviation Week.

Hawaiian Airlines will join Delta and JetBlue soon in offering free connectivity. It will provide complimentary access via SpaceX's Starlink on all its transpacific aircraft. The carrier plans to equip its A321neos first, followed by its A330s and an incoming fleet of Boeing 787-9s. Hawai-

ian expects to begin offering the service this year on select aircraft.

"We waited until technology caught up with our high standards for guest experience, but it will be worth the wait," Hawaiian Airlines President and CEO Peter Ingram said in the airline's April 2022 announcement.

Bastian described Delta's offering as part of the core onboard customer experience. The airline has seen results since it began rolling out the service for free in December.

"If you're thinking about the customer for the long term, you're thinking about your next generations of customers, it's key," he told MRO Americas attendees. "The only thing to be able to get onto our Wi-Fi portal that we ask our customers is to be a member of our SkyMiles program. And interestingly, about half of the [people signing up]—the raw numbers

in terms of unique customers—are not [already] members of our program. Just since this soft launch in the first part of the winter, we've gained 500,000 new younger customers . . . [with an] average age of 32, which is almost 10 years younger than the average age of our current SkyMiles profiles."

Delta expects free Wi-Fi to be available on all its domestic flights by year-end and on all international and regional flights by the end of 2024. Bastian noted that the company has invested more than \$1 billion in the last three years on its system.

"We're thinking long-term, we're thinking about what customers need for the future," he said. "And being connected in the sky is just as important as the destination you're going to for some people."

While other U.S. airlines have not announced plans for free IFC, industry entrepreneur David Neeleman may be leaning in that direction. The Breeze Airways CEO and management team are not yet in agreement on whether Wi-Fi should be free on their Airbus A220 fleet being outfitted with Viasat, but Neeleman told reporters at ISTAT Americas in March: "There is a reason why Delta did away with the \$5 charge." ❧

—With Jens Flottau in San Diego



# DIGITAL

- INDUSTRY ADVANCES FLIGHT DECK AUTOMATION
- FOCUS IS ON AIDING PILOTS IN EMERGENCIES
- RESEARCH UNDERWAY TO UNDERSTAND CURRENT TRAINING AND GAPS

**Thierry Dubois** Lyon and **Sean Broderick** Washington

**T**he debate over the future of flight decks is intensifying while a separate effort to develop global guidance for today's pilots on using automated systems and maintaining manual flying skills is making progress.

Looking ahead, the gap is widening between the promoters of more autonomous flight—which would use artificial intelligence (AI) and machine learning in particular to enable potential single-pilot operations—and pilots. The latter insist a crew of two is primary redundancy and therefore a safety requirement.

The polarized debate, as opposed to a consensus, means the flying public may remain doubtful of the benefits of single-pilot operations. That caution may effectively thwart any significant evolution toward autonomy beyond pilot assistance.

Airbus has been expanding its research into autonomous flight systems. The DragonFly program was unveiled last January as a follow-on to the two-year Autonomous Taxi, Take-off and Landing project. DragonFly adds the capability to select an emergency diversion airport automatically—taking into account external factors such as flight zones, terrain

and weather—and plan a trajectory to the alternate, where the camera system will be used to identify the runway and guide the aircraft to a landing.

The system's features include automated communication with air traffic control (ATC) and the airline operational control center. The focus of the project is technology maturation, after which Airbus will look at certifiability.

"No commercial pilot was involved," says Vincent Gilles, vice president of French pilots union SNPL. "We would have loved to be asked to participate. Even when you do not agree with the principle of a project, you can help make it better."

DragonFly is focusing on very simple use cases, such as a diversion during an intra-European flight, he points out. "The problem is that it would have to be used worldwide, such as in China when it takes a crew 10 min. to negotiate with ATC and avoid a thunderstorm amid military areas," Gilles says.

"Airbus' proposed system was devised outside a realistic operational context," he adds. "Test pilots do not know an airline pilot's job, which involves years of flying on a variety of routes with accompanying fatigue and multiple unexpected situations."

Gilles has reviewed the use cases that Airbus suggested. If a pilot is incapacitated, the well-known procedure for the other pilot is to divert and land, he says. DragonFly is designed to handle that. But if a pilot is suicidal, the program is not designed for ATC to take control remotely.

If the crew has to manage a crisis with the passengers, would a pilot tell them: "Do not worry, our automated system is taking us to our gate in Beijing?" he wonders. "In case of poor weather [at] an airport without an [instrument landing system,] what would be the added value? Pilots can see, too."

Another use case involves engine failure, which pilots are trained to manage. Failure of both engines on a twinjet aircraft is very unusual and so "you do not want to develop a complex system for [such] rare instances," Gilles says. "And in those cases, the two pilots in the cockpit managed to find solutions that design engineers would not have been able to anticipate."

Gilles describes Airbus' approach as





SOUTHWEST AIRLINES

overconfident. “AI is sophisticated statistics with an associated learning process,” he says. “It is not intelligence.”

And the airframer is seen as proceeding with a hidden agenda for alleged cost-cutting. “The demonstration project, in fact, aims to advance the concept of single-pilot operations,” Gilles says. “Going ahead with one pilot instead of two is eliminating a fundamental redundancy. That is a step the industry should not take. It has yet to be demonstrated that single-pilot operations are safer.”

Pilots have consistently emphasized that they are not against technology improvements, such as the Airbus A350’s automated emergency descent in case of cabin depressurization. “We are happy with automating simple tasks,” Gilles says. “The cockpit has to be designed to enable the pilot to do what they are best at, where they have added value. That works, providing the pilots are trained, and a broken-down system can be cut off.”

Gilles’ position reflects a broader concern among pilots. Shortly after he spoke to Aviation Week, representatives from the International Federation of Air Line Pilots’ Associations, the European Cockpit Association and Air Line Pilots Association International issued a joint statement warn-

ing against reduced-crew operations. They characterized the idea as a new threat to safety.

The three unions intend to “prevent airlines and manufacturers from pushing ahead with plans to remove pilots from the flight deck, a profit-driven scheme that poses a significant safety risk,” the statement reads. They are worried about “an aggressive corporate-led lobbying campaign targeting regulators around the world, including the International Civil Aviation Organization.” Airline and airframer lobbyists are putting profit first and introducing an unacceptable level of risk, the unions add.

Despite developments in automation and improved technologies on the flight deck, two pilots at the controls remains among the most important safety features of an aircraft, the unions say. “Pilots eliminate system failure scenarios and act as a critical onboard backup for failed systems, bridge technology gaps and adapt in real-time and in the real environment to unanticipated situations and emergencies.”

Meanwhile, in Europe, the European Aviation Safety Agency (EASA) has issued a concept paper on machine-learning applications. The concept paper, which is aimed at anticipating

## The push to advance flight deck automation is clashing with pilots’ concerns about maintaining two-person cockpits.

future requirements, defines AI as “any technology that appears to emulate the performance of a human.” It distinguishes between assistance to humans and human-machine collaboration.

However, despite Europe’s long-established leadership in aircraft automation, the U.S. agency is one step ahead in the use of AI. In its study, EASA uses the analysis the FAA conducted of Daedalean’s visual landing system (VLS) as an example.

Daedalean, a Swiss startup focusing on autonomous flight, has its first AI-based avionics system moving toward FAA certification. The first certified product based on the technology will be PilotEye, developed by U.S. avionics company Avidyne. PilotEye is designed to improve pilot situational awareness in general aviation and special mission aircraft.

Avidyne and Daedalean are working on supplemental type certification of the PilotEye system with the FAA and parallel validation by EASA. The VLS includes an AI vision processor and a forward-looking camera as the sole external sensor. The system recognizes and tracks hard-surface runways present in the field of view and allows the pilot to select the one intended for landing—or the system selects it according to the flight plan.

Once a runway has been selected and the aircraft begins its final descent, the VLS provides its position in the runway coordinate frame as well as horizontal and vertical deviations from the intended glideslope—similar to an instrument landing system. It is designed for use in daytime visual meteorological conditions. A neural network performs image analysis. Post-processing includes tracking and filtering.

Daedalean uses complex deep neural networks that have low theoretical bias, meaning they make proper relations between input and target outputs. However, their higher variance might cause small fluctuations in the training set to introduce errors, EASA says. That oversensitivity is mitigated through the use of sufficient data.

EASA categorizes the VLS as assistance to human operation, as it only provides the pilot with additional and

advisory information without suggesting actions. In a precertification joint research project, the FAA and Daedalean discussed coupling the system to an onboard autopilot.

Meanwhile, an International Civil Aviation Organization (ICAO) working group is studying how airlines train pilots to manage automated systems and maintain manual flying skills. Prompted by observations from fatal Boeing 737 MAX accidents in 2018 and 2019, the working group was formed as part of a larger effort to help improve baseline pilot training provided by manufacturers (*AW&ST* Jan. 25-Feb. 7, 2021, p. 45).

norm for future certification programs, the FAA has said.

Other weaknesses persist, however, particularly in how effectively pilots are taught to handle current-generation aircraft.

“Although increased use of automation has enhanced safety, this trend is also likely contributing to a lack of practice and therefore potentially a degradation of pilot skills in flightpath management using manual flight control,” representatives from the U.S., Canada, Peru and Trinidad and Tobago write in a joint paper presented to ICAO calling for formal action. “These skills are essential for pilot confidence

and pilot monitoring. First up for the automation group is drafting a report on four areas: automation dependency, airline policies, regulatory material and how manufacturers convey certain concepts.

The automation dependency piece will lean heavily on an analysis of accidents and incidents in recent years.

About 40 airlines from around the world have provided examples of their policies, one source familiar with the group’s work tells *Aviation Week*. They are being reviewed to find consistencies and, more important, discrepancies. In some cases, operators are using similar terms to mean different things. In others, basic definitions are lacking.

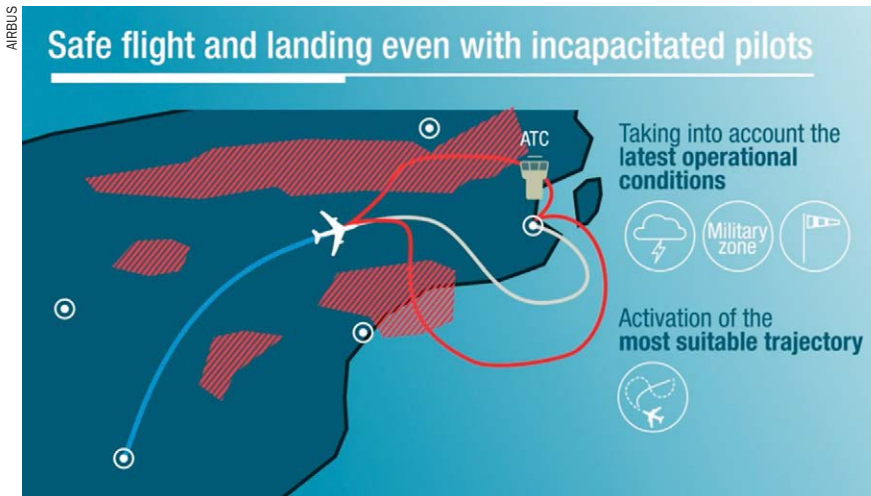
“One airline’s concept of manual flying may not be similar to another’s,” says the source. “Does manual flying mean all automation is off, just that the autopilot is off or something else? The more consistency operators have, the better it is for pilots.”

The regulatory review is straightforward, but important. Pilot qualification standards and guidance around the world differ, as do the specific training topics they must go through. Understanding the variances will help manufacturers ensure that training curriculum they develop is both sufficient and flexible enough to serve a global customer base.

Some of the group’s work may follow regulators’ leads. A recent FAA advisory circular tackles flightpath management (*AW&ST* Feb. 21-March 6, 2022, p. 26), providing recommended content for air carrier training policies and programs, for instance.

Examining general philosophies and attitudes about pilot behavior and training held by different manufacturers also is expected to spotlight areas for improvement. For instance, the 737 MAX accidents underscored that long-held assumptions about pilot reactions in non-normal scenarios are not reliable. The FAA is developing better pilot performance guidance based on recent human factors research. While this is likely to have the largest ramifications on aircraft design and certification, developing a common understanding of how pilots perform will result in more effective training programs.

The working group’s report is in its final stages, the sources tell *Aviation Week*. Completion is expected by the middle of the year. 🗞



**Among the use cases for its DragonFly system demonstrator, Airbus suggests an autonomous landing capability in case the crew is incapacitated.**

Among the many issues spotlighted by the accidents is the fact that when certifying aircraft, manufacturers and their regulators do not take into account the myriad ways pilots are trained around the world. In the U.S., for example, the FAA and Boeing would routinely use U.S.-based pilots to evaluate training programs for new aircraft. An FAA stamp of approval often was enough for other regulators to adopt the training programs as written, even if their minimum pilot standards differ from the FAA’s.

Industry has taken several steps to close these gaps. The 737 MAX’s return-to-service process included simulator sessions for line pilots to test new flight control software and training, for instance. Participants came from several airlines around the world, not just U.S. carriers, and they were not all captains with years of experience. This process will be the

and competence, and they are necessary to take control of the aircraft when automated systems do not function as intended. This issue may be further complicated by the variation in pilot training, skills and experience entering air carrier service worldwide.”

The paper helped convince ICAO to place a working group under its Personnel Training and Licensing Panel. The group is divided into four subgroups: automation, training, simulation and workforce. The last group is examining why certain populations, notably women, are underrepresented in the global pilot workforce; meetings began in 2021.

The automation group’s work is considered the top priority, sources with knowledge of the ICAO project tell *Aviation Week*. Its goal is to recommend updates for the organization’s guidance material on manual flight, managing automated systems



# Vertical Stabilizer Issue Slows Boeing 737 Delivery Surge

> MANY MAXs WILL HAVE TO BE INSPECTED AND REPAIRED

> RAMIFICATIONS FOR FULL-YEAR DELIVERY TOTALS ARE NOT CLEAR

Sean Broderick Washington and Guy Norris Colorado Springs

**A** new production-quality problem will force Boeing and supplier Spirit AeroSystems to repair a large number of 737s in Boeing's inventory, halting the program's momentum just as 737 MAX deliveries were ramping up.

The issue, disclosed April 13, affects vertical stabilizer fittings made by Spirit. The supplier discovered that two of eight fittings at Station (STA) 1016 did not meet Boeing's specifications, says a Boeing source familiar with the issue.

Boeing is working to identify the precise number of affected aircraft in both its stored inventory and the in-service fleet. The source confirmed the issue affects airframes built from 2019 to this month. Affected variants include the 737-7, -8, -8200 and P-8 maritime patrol aircraft. While not all airframes in those variants are affected, Boeing said the identified population is large. It also must flag non-conforming parts in its possession and on the roughly 30 aircraft on the production line. The Boeing source said some, but not all, aircraft in production are affected.

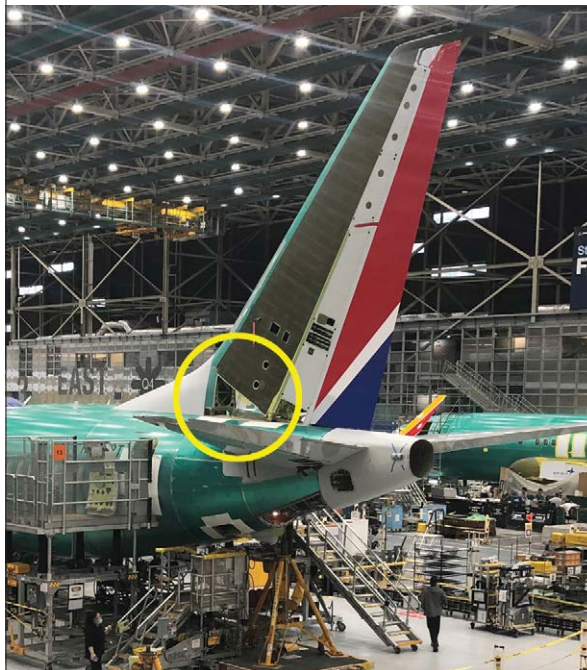
"This is not an immediate safety-of-flight issue, and the in-service fleet can continue operating safely," Boeing said in a statement. "However, the issue will likely affect a significant number of undelivered 737 MAX airplanes, both in production and in storage."

Unaffected aircraft, including all 737-9s, are still rolling off assembly lines and being delivered, Boeing says. "We expect lower near-term 737 MAX deliveries while this required work is completed," the company adds.

Boeing CEO David Calhoun, speaking at the company's annual general meeting April 18, suggested the issue could lead to delivery delays on as many as 50 aircraft in the next several months.

Affected aircraft in Boeing's inventory must undergo repairs before the FAA can approve them as conforming with the company's design. "This

is an airplane-by-airplane evaluation," Calhoun said. It is unclear how long the repairs will take, but Boeing describes the issue as not nearly as significant as the set of repairs that undelivered 787s are undergoing to



GUY NORRIS/AW&ST

**The nonconforming fittings are where the aft body fuselage section meets the tail cone.**

correct a series of production-quality problems (*AW&ST* Sept. 14-27, 2020, p. 22). The affected area on the 737 includes access panels designed to ease routine inspections and maintenance.

Boeing said all rear fuselage sections coming from Spirit after April 13 would conform to design standards.

In-service aircraft will have to be repaired as well, but because the issue is not deemed an immediate safety risk, repairs will be conducted via a routine service bulletin and likely an airworthiness directive.

Boeing's statement described the problem as "a nonstandard manufacturing process . . . used during the installation of two fittings."

The Boeing source said the issue is

related to "the mechanical attachment procedures" and how the fittings were attached to the supporting structure.

The aircraft-maker is working with both Spirit and the FAA to finalize inspection processes for the production system, aircraft in inventory and the in-service fleet.

"Spirit has notified our customer, Boeing, that we have identified a quality issue on the aft fuselage section of certain models of the 737 fuselage that Spirit builds," the supplier said in a statement. "Spirit is working to develop an inspection and repair for the affected fuselages. We continue to coordinate closely with our customer to resolve this matter and minimize impacts while maintaining our focus on safety."

On the 737, STA 1016 is the location of the fuselage structural join between the Section 46 aft body and Section 48 tail cone sections (see photo). STA 1016 marks where the aft pressure bulkhead sits in the fuselage.

The vertical stabilizer attaches to the fuselage at the forward and aft spars with main connection points indicated at or close to STA 1016 (forward) and STA 1085.56 (aft). According to structural repair documents available for the 737-800, the principal parts of the

structure associated with the issue most likely are ATA 55-30-90 part numbers related to the vertical stabilizer front spar terminal fittings and intermediate fittings forward of the rear spar terminal fittings.

Before this latest problem was discovered, Boeing's 737 program delivery figures were trending upward. Boeing 737 MAX deliveries surged in March to 52, nearly doubling the number delivered in the first two months of the year and keeping the manufacturer's full-year delivery goals well within range. It is unclear if Boeing's target of 400-450 737 program deliveries in 2023 is in jeopardy or if deliveries will ramp up quickly as affected airframes are repaired. 🛩

# MOVING TARGET



- > BOEING 737-7 APPROVAL IS BOGGED DOWN AMID NEW REQUIREMENTS
- > SYSTEM SAFETY ASSESSMENT WORK REMAINS
- > NEW LAW REQUIRES ADDITIONAL WORK BY THE FAA

**Sean Broderick** Washington and **Guy Norris** Colorado Springs

**T**he primary outstanding task on Boeing's 737-7 to-do list—validating presumed pilot reactions and other human factors assumptions in safety risk assessments—is also one of the newest items on the FAA's list of key aircraft certification issues not covered in rules or guidance. The issue's appearance on the Transport Airplane Issues List, where items often stay for years while new rules or policies are developed, goes a long way toward explaining why securing FAA approval of the smallest 737 MAX variant is proving such a challenge.

Boeing is working on "a few issues" with the remaining 737-7 certification data submittals before handing them over to the FAA, Boeing Commercial Airplanes President Stan Deal said March 30. "We've got less than a handful left to go into the FAA," he told reporters following a Wings Club event in New York. "We're working through a few issues around those submittals."

Deal did not provide details on the submittals, but sources with knowledge of the situation tell Aviation Week that validating underlying human factors assumptions in system safety assessments (SSA) continue to be the pacing item. That validation now includes a mandatory FAA review, courtesy of a section in a December 2020 law targeting the FAA's

certification process for revamping.

The new requirement prohibits the FAA from giving company-appointed representatives the final word on SSAs for "critical" design features that include "underlying assumptions related to human factors," according to the bill. Instead, agency human factors experts must review the applicant's logic for assuming a pilot or other front-line worker would react in a certain way when something goes wrong.

The new law resulted from investigations into two fatal 737 MAX accidents in which pilots reacted in ways Boeing did not expect, in part because the failures triggered a series of warnings and alerts—some of them spurious—that the pilots could not prioritize. The 737 MAX's lack of a modern flight crew alerting system to help pilots analyze failures that prompt immediate responses contributed to the pilots' confusion.





man factors experts” to help agency experts validate pilot-recognition assumptions. Once the new tools and methods have been determined, the NTSB recommended that the FAA then develop new guidance and design standards for manufacturers to use during certification.

The FAA responded with a December 2022 draft rule to update the SSA process. It also formed an internal Human Factors and Flight Crew Coordinating Group (HFFCG) committee to help create new SSA evaluation methods, related industry guidance and design recommendations.

the issue paper was not ready for application to the existing Model 737-7 and 737-10 certification programs, the related background, guidance and FAA regulatory position are effectively being applied.”

In the meantime, Boeing and the FAA are working through specific scenarios applicable to the 737-7. The airframer had completed much of the anticipated certification work for the 737-7, which first flew in 2018 and was once slated to enter service in 2019, before the 737 MAX was grounded in March 2019. But the 2020 law’s language means that any human-factors-related SSA work approved by Boeing’s FAA-appointed Organization Designation Authorization team had to be reexamined by agency experts, effectively sending Boeing back to the beginning on dozens of key deliverables required for FAA approval.

“A system safety assessment can be extremely broad,” says one engineer with extensive type certification project experience. “You start with an aircraft-level [hazard assessment]. You look at every intended function on the aircraft. They literally have to take three steps back and look at every assumption, starting at the highest level of aircraft functions, and drill down into systems functions.”

The FAA’s Transport Airplane Issues List entry underscores the reach of the human factors assessment. “This issue paper defines the information expected within an applicant’s system safety documentation to facilitate FAA review of flight crew human factors assumptions,” it says. While the primary focus is FAA Part 25.1309, which covers equipment, systems and installations and codifies the SSA process, the issue extends to SSAs conducted to support several other certification regulations, including those covering flight control systems, engines and engine reverser systems “where these assessments include flight crew human factors assumptions,” the agency explains. The human factors analysis goes beyond the flight deck and into maintenance tasks.

SSAs started in the 1960s, when aircraft manufacturers began incorporating more complex systems into their designs. British regulators introduced the process, assigning statistical probabilities to system failures as part of certifying the Concorde.

At the time, the probability of a

### 737 MAX Firm Order Backlog\*

Variant	Firm Orders	Percentage of Backlog
737-7	293	6.9%
737-8	2,578	60.4
737-8200	289	6.8
737-9	153	3.6
737-10	948	22.2
Boeing Business Jet**	8	0.2
<b>TOTALS</b>	<b>4,269</b>	

\*As of April 6, 2023. \*\*Includes multiple MAX Boeing Business Jet variants

Source: Aviation Week Fleet Discovery

### More than a year after FAA-required flight tests wrapped up, the 737-7 still is not certified.

JOE WALKER

The National Transportation Safety Board (NTSB) in 2019 recommended that the FAA reexamine the 737 MAX-family SSAs and validate Boeing’s assumptions that link to “immediate and appropriate” pilot response.

Specifically, the board flagged the need to ensure that pilot response analysis factors in “the effect of all possible flight deck alerts and indications.” Where gaps are evident, Boeing should modify designs, pilot procedures or training to reduce risk.

The 737 MAX’s simplistic flight crew alerting functions exacerbated the problems Lion Air and Ethiopian Airlines pilots faced in the 2018 and 2019 fatal accidents, respectively. But the issue goes beyond legacy Boeing design.

The NTSB also urged the FAA to apply the new, expanded SSA standards to all manufacturers and “develop robust tools and methods, with the input of industry and hu-

Work on these initiatives is not likely to finish before 2024. Meanwhile, 737-7 certification is happening now.

To help ensure that some of the new SSA methodology can be used on the 737-7, Boeing and the FAA developed new processes for documenting the reasoning behind pilot human factors assumptions (HFA) (*AW&ST* Nov. 7-20, 2022, p. 22). The FAA is incorporating the processes into a formal “issue paper”—a means for showing compliance with a new or novel issue not covered in current rules—that would help guide applicants. But this takes time; the paper is expected to be ready for use on the 777-9 program, which has not begun formal FAA certification flight testing.

“In support of the evaluation and validation of the underlying HFA of [the] SSA supporting the 737 MAX [return to service], the FAA drafted a project-specific issue paper, which will be applied to the Boeing Model 777-9 and future certification programs,” FAA Acting Administrator Billy Nolen told the NTSB in an August 2022 letter updating the agency’s progress on several recommendations. “Although

catastrophic accident was about one per million flight hours. Approximately 10% of accidents were linked to system failures. Regulators assumed that a transport-category airplane design had about 100 system-related catastrophic failure conditions. Spreading the probability of a system-related catastrophic failure among 100 theoretical conditions, regulators settled on a system-linked failure probability of one per billion flight hours—more commonly referred to as  $10^{-9}$ —a benchmark still used today.

The FAA adopted the British approach in 1982. In 1988, the FAA and Europe's Joint Aviation Authorities, the predecessor to the European Union Aviation Safety Agency (EASA), harmonized their SSA rules and guid-

Meanwhile, Boeing continues to seek approval of its last two 737 MAX variants. The two models account for nearly 30% of the aircraft-maker's 4,269-aircraft 737 MAX backlog. While the 737-7 is set to beat the 737-10 into service, the latter is by far the more important variant, with more orders and a broader customer base. It also should be even more difficult to certify, even after the 737-7 work helps smooth the way through some of the new SSA process.

The 737-10's design incorporates several notable changes from the rest of the family. It features a taller main landing gear design that raises the body by 9 in. and moves the aircraft takeoff rotation point aft. The 737-10 also is to be the first 737 MAX-family

stabilizer fittings on the 737-7, -8, -8200 and P-8 maritime patrol versions, Boeing's Deal still hopes twinjet production rate will rise beyond the current 31 per month "very soon" (see page 49).

Amid a gradual easing of the most critical supply chain issues that have handicapped production line ramp-up plans, Boeing is reactivating the long-dormant "east" 737 assembly line in Building 4-82 at its plant in Renton, Washington. The line is set to join the existing "west" and "center" lines this year as part of the company's gradual push toward a production target of 42 per month by January 2024.

Boeing is adopting a slower buildup plan for the long term, which is intended to foster improved production stability and balance market demand with the supply chain's ability to keep up. Under the revised schedule, the OEM is aiming to build 52 aircraft per month by January 2025. This should be enabled in part by the addition of a fourth 737 MAX line, announced in January of this year. Preparations are underway

**The framework of guidance being developed for 777-9 certification will be applied to the 737-7 and 737-10.**

for the new line, which will occupy Boeing's Building 40-26 in Everett, Washington, as part of plans to commence production in the second half of 2024.

The new line at Everett marks the first time Boeing has built a single-aisle model in the formerly exclusively twin-aisle facility and comes as part of a major reshuffling following the end of 747 production late last year. The 737s will be assembled in Building 40-26, which was developed originally for the 787 and later used for rework on the widebody after Boeing consolidated new-build 787 assembly in Charleston, South Carolina (*AW&ST* Dec. 6-19, 2021, p. 14).

The adjacent Building 40-25 remains the site of 777 freighter production, while the 40-24 777X line is expected to be reactivated as well for low-rate production this year. Building 40-24 was originally the site of 767 production before becoming a surge line for 787s in the late 2000s. The area recently occupied by 747 production in Buildings 40-21 and -22, in addition to 40-23, is being cleared for the transfer of 787 rework and KC-46A completions. Building 40-23, one of the three original bays



LINSEY WASSON/REUTERS/ALAMY STOCK PHOTO

ance, embedding them within each agency's Part 25.1309 regulation.

Along the way, SSA-related guidance evolved to support applicants' efforts to meet regulations, with the notable exception of one area: human factors. A 2002 joint FAA-industry study on aircraft certification flagged human performance as the most common factor in air transport accidents. In a 2019 analysis supporting related recommendations, the NTSB noted the 2002 study statement that "there were no methods available to evaluate the probability of human error in the operation of a particular system design and that existing qualitative methods for assessing human error were not 'very satisfactory.'" The FAA HFFCG is examining the lack of reliable human performance guidance as part of its tasks.

variant to have a third angle-of-attack (AOA) data source—a synthetic system that derives data from existing sensors—and switches that would allow crews to stop nuisance stick-shaker alerts without having to pull a circuit breaker.

The AOA and nuisance alert inhibitor were added at EASA's behest as part of return-to-service conditions following the 737 MAX grounding (*AW&ST* Jan. 25-Feb. 7, 2021, p. 49). Under the agreement, both functions are to be retrofitted to the entire 737 MAX fleet, at Boeing's expense.

Obtaining approval for both variants is a key part of Boeing's plan to ramp up 737 production to 52 aircraft per month in two years. Despite the continual threat of assembly line disruptions, including the most recent revelations of a production problem with vertical



Boeing is testing its production process as part of expanding 737 work to Everett, Washington.



built on the Everett site for the 747 in the 1960s, was later used as a surge line for the 777. Building 40-32, on the north side of the main building complex, continues to be the site of 767 and KC-46A production.

Boeing meanwhile says two 737-8 fuselages remain in temporary stor-

age at Everett. The fuselages were delivered in mid-March by BNSF Railway using the 2-mi.-long Boeing Plant Spur that was built in 1966 for the 747 program and provided “an early learning opportunity” for checking clearances and other aspects of the transport infrastructure ahead

of the Everett site expansion, Boeing says. The Everett 737 site is expected to focus mainly on production of the longer-body 737-10 and -9 as well as special configuration models such as the high-capacity 737-8-200. 🌐

—With Andrea Hollowell in New York

# Together, we're converting opportunities into results in **Defense & Space.**

Staying on top of programs, budgets, contracts, new business models, and technological developments is key to driving growth, and you can't afford to lose track. Our comprehensive set of tools and resources is designed to bring help to your fingertips in seconds.

- 1 READY**  
We deliver the knowledge and insights to inform how you do business.
- 2 SET**  
Our predictive intelligence and customized data solutions ensure you're always ahead of the curve.
- 3 GROW**  
We connect you to your customers with an unmatched network of events and best-in-class marketing solutions.



Are you ready to grow your business?  
Visit [AviationWeek.com/ReadySetGrow](https://AviationWeek.com/ReadySetGrow)



# Enter the Quiet Age

- > WHISPER AERO TARGETS DEFENSE AS AN EARLY APPLICATION FOR ULTRAQUIET ELECTRIC PROPULSION
- > ELECTRIC DUCTED FANS COMBINE LOW NOISE WITH HIGH EFFICIENCY
- > CLASS 2 SURVEILLANCE DRONE IS INAUDIBLE FLYING OVER AT 200 FT.



**Graham Warwick** Washington

**E**lectric aviation is in its infancy, equivalent to the piston era of a century ago. But propulsion startup Whisper Aero is already working to enable the transition from the propeller age to the jet age by developing ultraquiet, ultraefficient electric ducted fans.

Based in Crossville, Tennessee, Whisper Aero has raised \$32 million in Series A funding to grow its team and launch production, initially targeting U.S. Defense Department applications such as intelligence, surveillance and reconnaissance (ISR) uncrewed aircraft that are inaudible from the ground.

The startup has validated its technology with flights of a custom-designed 55-lb. ISR drone powered by a single 10-lb.-thrust demonstrator propulsor. Flying over at about 200 ft., the Whisper drone could not be acoustically detected by a ground observer but the 2-lb. multicopter chase drone could clearly be heard at the same altitude, the company says.

But Whisper's ambitions go far beyond powering small drones, to encompass air taxis and transonic aircraft and even consumer and industrial applications from leaf blowers to compressors. "This is going to touch everything that wants to move air quietly and efficiently," says co-founder and CEO Mark Moore.

"We've flown a drone that weighed 55 lb., but for another customer we're looking at vehicles in the tens of thousands of pounds, with propulsion systems in the thousands of pounds and able to exceed the current capability of other solutions like propellers and even turbfans," Chief Engineer Devon Jedamski says. "We've already

**Whisper's ultraquiet 55-lb. ISR drone has a single top-mounted, 10-lb.-thrust electric ducted fan.**

been paid by the government to see how this scales up and show that this can achieve up to transonic speeds for newer applications."

Electric aviation is getting started with propellers and rotors because the speeds are modest and noise, efficiency and time to market are priorities. "Electric aircraft developers are in a race to get things flying and certified as quickly as possible. That's great, but they are in the Model T era of electric flight," says Moore, a former NASA engineer and co-founder of the Uber Elevate aerial ride-sharing initiative. "What Whisper Aero is all about is leapfrogging into the next generation, where there is much more performance opportunity for products with compelling economics."

The Series A funding gives Whisper a solid footing for the next three-plus years, says co-founder, Chief Operating Officer and Chief Product Officer Ian Villa. "Our mission is building a cleaner, quieter, more efficient thrust for aviation and more," he notes. "Over the last two years, we've been improving on the fundamentals. Now we're moving to a point where the first principles are proven, validated and verified. These next two years are focused on spooling up the first production lines, selling our first defense-focused propulsors and then continuing prototyping newer products that will make their way into commercial aviation as well as consumer and industrial applications."

Founded in 2020, the startup began by fundamentally questioning how electricity should be converted to

thrust. The traditional way to reduce propulsor noise is by reducing disk loading and tip speed. Whisper examined all sources of noise and then tailored each source's acoustical content to minimize the amplitude and tune the frequencies to reduce the effect on humans and blend into background noise. Some of the tones are moved into the ultrasonic range, beyond human hearing.

"When we started two years ago, we had some analysis, but what we really had was just a cool idea," Moore says. "In these past two years, over nine generations of design-build-test, we have validated this propulsion technology, and it works better than we initially anticipated. And not only did we prove out the tech in the first year, but we did it fast enough that in the second year we built the custom Whisper drone and validated the technology in flight."

Whisper is providing no details yet on its eQ (electric quiet) propulsion systems, which are targeted at all types of electric aircraft, whether they take off and land conventionally or vertically (eCTOL or eVTOL). "We are an electric propulsion provider to everyone who wants to implement our propulsor stack on their concept, whether it's eCTOL or eVTOL," Moore says. "It is an electric ducted fan. We haven't wanted to say that before because a ducted fan is a known entity, but our version of it is very different from what anyone has ever done before."

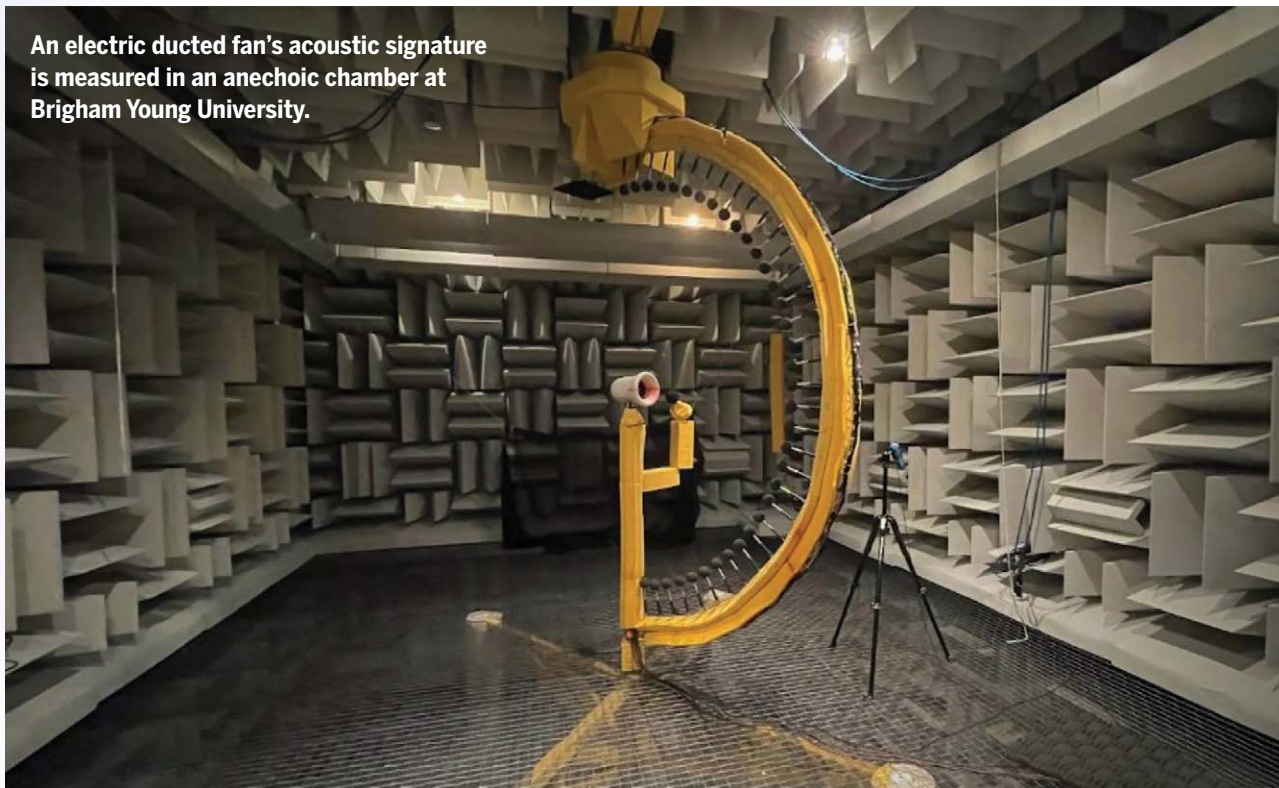
"Our initial mindset was to create this optimum propulsion solution akin to an actuator disk, which is a theoretical construct in propulsion that provides the minimum pressure pulse over the entire disk in a uniform manner," he continues. "It achieves the lowest possible noise and highest possible efficiency."

In rethinking how a propulsor works, Whisper developed a specialized computational framework that enables it to design with acoustics as an objective function in a multidisciplinary optimization. This was validated with flights of the 55-lb. drone and allows the company to develop new electric ducted fans quickly and accurately.

"There are two diametrically opposing parameters when you want to do both low noise and high efficiency," Moore says. "It's about compromises between low tip speed, which is what



An electric ducted fan's acoustic signature is measured in an anechoic chamber at Brigham Young University.



noise wants, and higher tip speed, which is what performance and efficiency want. And what we've accomplished is the first ultrasonic propulsor ever developed." The design combines a low magnitude of noise with pushing the tonal content from the blade passage frequency (BPF) into the ultrasonic while having low tip speed.

"These are two diametrically opposed requirements," Moore says. "Ultrasonic BPF means you really want to spin it fast, but for other noise characteristics you want to spin it slow, and we've managed to accomplish both."

Developing the electric ducted fan required innovations over five different technology areas, including manufacturing. "When you need to build something relating to these diametrically opposing requirements, you get into challenging structures," he notes. "So a lot of our breakthroughs are not just in acoustics, but in being able to build things that in the past you could not."

"Getting to these innovations requires design and process innovation throughout," Villa says. "What underlies all of our hardware intellectual property is this ability to design really fast." Essentially, the computational tools take established propulsion design disciplines that engineers would

normally step through sequentially and couples them into an optimization framework that can produce relevant results more quickly.

Whisper has just completed acoustic testing of its latest propulsor in an anechoic chamber at Brigham Young University. "Often propulsion manufacturers can optimize for efficiency and thrust . . . but acoustics isn't even considered early on; it's typically addressed in preliminary design. But we're able to design to acoustics as an objective function, and we've been able to validate it with this testing," Jedamski says.

Because of the technology's potential in markets outside aerospace, manufacturability was considered from the outset, such as avoiding exotic materials and using low-cost processes. "While our next two years are about taking this technology to the Defense Department as a first customer, we are excited about civil aerospace, about prosumer and industrial applications. And we've already prototyped applications in other areas," Moore says.

"This technology needs to go into not just million-dollar drones, but into a \$500 leaf blower," he asserts. "Because as we prove that out for prosumer and industrial applications, the

aerospace products get much cheaper. We think there's an opportunity for thrust by the pound on the order of 1/10th the cost of traditional aerospace. We still have to prove that, but we're working toward that goal."

The propulsion technology also requires unique integration into the airframe. Some electric aircraft use a gearbox to drive the propeller, which adds weight, or run the electric motor at a lower speed to enable direct drive. "Electric motors want to turn fast. Our motor spins very fast and gets great specific power," Moore says. Thermal management adds weight and drag. "We don't add drag to cool the motor and controller units. Instead, we get a thrust benefit with a simple system," he adds.

"We see this as the equivalent of the transition from the propeller age to the jet age, and electric motors really want to be in the jet age," Moore says. "Everybody else's is stuck at these lower speeds and in the propeller age. We're interested in a technology that opens up the high productivity, the high speeds that expensive aerospace products demand. A loitering ISR drone was an obvious first step to showcase this technology. But now we're moving on to much higher-speed implementations." 🚀

# ELECTRIC EDUCATION

- > NASA NEARS X-57 PREFLIGHT MILESTONE
- > 12 TEST FLIGHTS ARE PLANNED FOR THE MOD 2 STANDARD



The X-57's motors were run using onboard battery power for the first time late last year.

NASA PHOTOS

**Guy Norris** Colorado Springs

**N**ASA's long-running X-57 Maxwell program, the agency's first all-electric experimental aircraft, is entering the final validation and verification phase to clear the way for first flight this year at the Armstrong Flight Research Center in California.

Although delayed several times by airworthiness, design and qualification challenges, the program has provided valuable lessons that are already informing the path forward for electric aviation, both for industry and regulators, the agency says. As NASA is a public entity, its X-57 development experience is transferable to aircraft and engine manufacturers as well as to the FAA for the formulation of certification standards and regulations.

First unveiled in 2016, the original program included multiple phases that first involved modifying the aircraft with electric motors in a stage dubbed Mod 2. This was to be followed by a Mod 3 configuration with the motors moved to the wingtips to increase propulsive efficiency. A Mod 4 configuration would have had a high-aspect-ratio wing with 12 smaller propellers along its leading edge to augment

takeoff-and-landing aerodynamic lift.

NASA originally aimed for an initial flight using electrical power as early as 2018. However, development challenges with the battery system, electric control system and electromagnetic interference, together with the impact of the COVID-19 pandemic, significantly slowed down the schedule.

As a result, NASA is focusing on tests of the Mod 2 configuration with an electric propulsion system and, amid budget constraints, has shelved plans for follow-on flight tests with a new wing and distributed propulsion system. The program is now due to conclude at the end of fiscal 2023 following flight tests of Mod 2 and ground tests of the Mod 3 and 4 components.

Based on the Tecnam P2006T light twin, the X-57 incorporates Joby Aviation-developed JM-X57 electric cruise motors in place of the original Rotax 912 S3 piston engines. Power is supplied by 16 battery modules arranged in two 400-lb. lithium-ion battery packs. These were fully installed and used to power the motors for the first time late last year.

Validation and verification testing, which started in March, is due to finish in April. NASA plans to begin its

flight-readiness review process after that. "We'll be going to our air worthiness and flight safety review board, and then our final approval for flight will come at what we call our tech briefing," Heather Maliska, X-57 project manager at NASA's Armstrong Flight Research Center, said at the American Institute of Aeronautics and Astronautics SciTech Forum in January.

"That's where they actually sign our flight release, and then we will go flying—that'll be the end of the summer," Maliska said. The current plan is to conduct around 12 flights of the Mod 2 standard. "These are basic airworthiness and system functionality flights and then we'll collect data. Then we will shift gears and start really documenting things and prioritize knowledge transfer and getting all our lessons learned out to the community," she added.

"The flight-test program that we're looking forward to flying this summer is really a pathfinder for the experimental propulsion system performance and reliability, and it really reduces the risk as we start to look at more complex configurations of the X-57," Maliska said.

Although NASA does not plan to



flight-test the Mod 3 and 4 configurations, research and analysis continues to take place on those structural and propulsion system components. “We are working with ESAero [San Luis Obispo, California-based Empirical Systems Aerospace] on developing those subsystems while we get into the Mod 2 flights so that we’re able to share those lessons learned as well,” Maliska said.

The high-aspect-ratio wing, which would increase wing loading to 45 lb. per ft.<sup>2</sup> from 17 lb. per ft.<sup>2</sup>, is due to be delivered by the end of April, NASA says. In the meantime, testing is accelerating on the smaller high-lift motors, motor controllers and propellers that are to be fitted along the Mod 3 wing leading edge under the Mod 4 phase. Developing 10.5 kW of power, these motors and 1.9-ft.-dia. propellers are designed to generate lift for take-off and then fold to reduce cruise drag.

NASA initially focused on functional tests of the high-lift motor controller hardware in late March before moving on to verification and validation of the control software. That work is due for completion by the end of April. The high-lift propellers have also completed wind tunnel testing, and testing of the fully integrated motor and propeller is expected to start this summer.

Discussing the key challenges involved in the design, Sean Clarke, principal investigator with NASA’s Armstrong Flight Research Center, said at the SciTech Forum that a key breakthrough was the development of highly efficient inverters that would operate with a passive cooling system. The inverters convert DC power from the aircraft’s lithium-ion batteries to AC power for its electric motors. “We needed to get these up to 98% efficiency for the critical parts of our flight envelope in order to be able to put them in a nacelle that doesn’t have active cooling. I don’t know that anyone else is doing this,” he said.

To ensure the system will operate with ram-air cooling, the main inverter system and motors “have to produce as little heat as possible to reject into the air stream,” Clarke said. “Our team was able to get these inverters operating at takeoff power at 98% efficiency, so we’ve had less than [1 kW] of heat coming out of each one of these boxes when they’re producing 40 kW of electrical power into the

motor. That was a huge step, but we had to do a lot of redesign work and a lot of qualification and testing.”

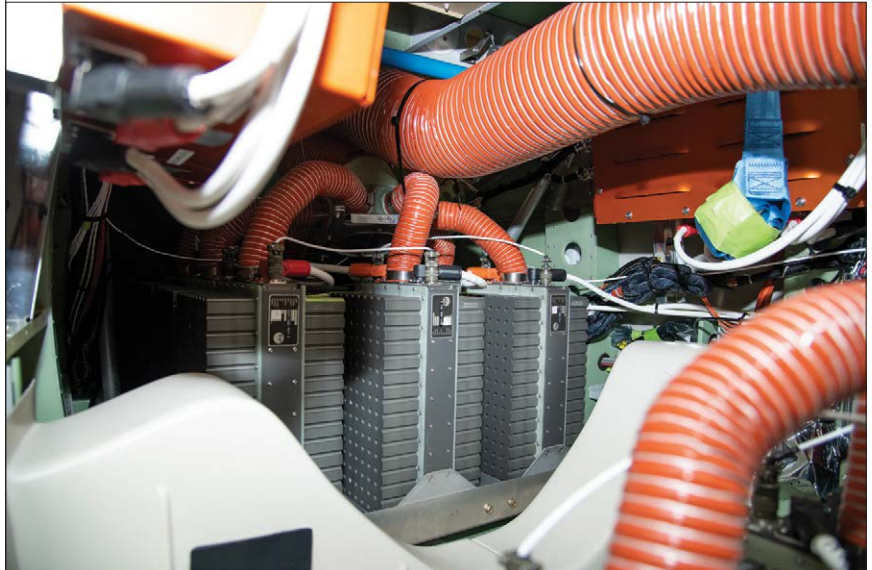
Another focus area has been development of a practical energy-state display for the crew. “There are 700 parameters coming out of our battery system,” Clarke said. “The pilot can’t look at all that data, so we’ve got to condense it down into something that he can manage while he’s also aviating. Our cockpit display system does that job for us. It collects temperature data from the cruise nacelles and then combines and synthesizes the parameters from the battery and motor controllers to put on our multi-function display.

“We had a lot of incompatibility between our motor controllers and our battery system,” Clarke said in providing new details about the electromag-

search Center to prevent the noise from propagating back into the battery system.

Thermal management has been another challenging area, with the compact design that places the DC-to-AC power inverter close to the computer processors that control the switching. “There’s a relatively delicate computer sitting nearby that’s got to control turning those Mosfets on and off,” Clarke said, referring to the silicon carbide metal-oxide-semiconductor field-effect transistors, or Mosfets, at the heart of the system. To handle the temperature difference, the X-57 researchers developed a dual heat sink design and added dedicated cooling ducts.

Although no Mod 3 or 4 flights are planned, NASA has conducted a new computational fluid dynamics (CFD)



**The aircraft’s power is provided by 16 lithium-ion batteries arranged in two 400-lb. battery packs located at the X-57’s center of gravity.**

netic interference challenges. “Those two things need to work together if you’re going to have an electric airplane work well.”

The team discovered that the motor controller “swamped the battery bus with lots of extra switching noise,” Clarke said. “As soon as we would turn on our inverter system, the serial data from the battery would just disappear, so we were running motors off battery power, but we could not see what was going on inside the battery pack anymore.” To fix the issue, a compact and lightweight filter was custom-designed at NASA Glenn Re-

search Center to prevent the noise from propagating back into the battery system. study on the “as-built” configuration to obtain a more detailed analysis of the expected aerodynamic benefits of a wingtip-mounted motor and lighter-weight leading-edge motors. The higher-resolution CFD mesh evaluation with more advanced design tools produced positive results, Clarke said.

“Not surprisingly, it turns out that putting propellers out on the wingtip reduces the drag of the wing itself, and putting high-lift propellers along the wing increases lift, so it’s encouraging that those assumptions we made early on are panning out with this higher-performance CFD model,” he said. ☺

## Flying Whale Selects Honeywell-Pratt for Airship Power

> HONEYWELL 1-MEGAWATT GENERATOR IS PAIRED WITH PRATT & WHITNEY PT6C

> FLIGHT TESTS ARE PLANNED FOR 2025

**Guy Norris** Colorado Springs

**A**s engine-makers and power companies prepare for a more hybrid-electric future, some are finding surprising applications of their new technology—not in advanced and urban air mobility but in the revitalized airship sector.

Two entrants into the lighter-than-air market have been among the first to take advantage of the latest advances in electric power systems from Honeywell Aerospace and Collins Aerospace, both of which predict bright futures in hybrid propulsion.

Honeywell has received a breakthrough order for its 1-megawatt generator from French and Canadian airship developer Flying Whales, while Collins Aerospace continues development work on a 500-kW electric motor to power Hybrid Air Vehicles' planned hybrid-electric Airlander 10 heavy-lift airship. The Honeywell system has been selected to power Flying Whales' LCA60T large-capacity hybrid-electric cargo airship.

In a twist, Honeywell says the generator will be integrated with a gearbox and a Pratt & Whitney-provided PT6C turbine capable of using both regular jet fuel and sustainable aviation fuel. Honeywell previously demonstrated the generator with its indigenously developed HGT1700 auxiliary power unit, while Pratt is also pursuing a powertrain for a Canadian-backed hybrid-electric De Havilland Dash 8 demonstrator based on a 1-megawatt Collins electric motor and an unspecified turbine.

Pratt and Collins also are working on development of a new Scalable Turboelectric Powertrain Technology (STEP-Tech) sustainable propulsion demonstrator at the Raytheon Technologies Research Center in East Hartford, Connecticut. STEP-Tech focuses on high-voltage distributed turboelectric hybrid-electric propulsion concepts in the 100-500-kW class.

Flying Whales' 200-m-long (656-ft.) LCA60T rigid airship is designed to carry payloads of up to 60 metric tons and cruise at around 100 kph (54 kt.). The vehicle is to be configured with a cargo bay measuring 314 ft. long, 26 ft. wide and 23 ft. high and is supported by 10 nonpressurized helium cells.

The generator is to be integrated into a 4-megawatt hybrid-electric propulsion system powering the vehicle's 32 sets of propellers. Of these, eight are to be arranged in two aft-mounted sets of four, 12 in two midship-mounted sets of six, eight in two forward-mounted sets of four and four mounted fore-and-aft on the forward upper hull.

The LCA60T's vectoring thrust propulsion system is designed for vertical takeoff and landing and to maintain stationary hover for loading and unloading over remote locations with no ground transportation infrastructure.



The LCA60T's propulsion and flight control system is designed to enable precise maneuvering even with payloads of 60 metric tons and outsize loads, such as wind turbine blades.



Honeywell plans to provide the first generator to Flying Whales for integration and ground tests in 2024, with initial flight tests planned for 2025.

Flying Whales intends to assemble the first LCA60Ts in Laruscade in southwest France and produce 150 aircraft over the next 10 years. Commercial operations are due to begin in 2027, with production to scale up following the addition of a second assembly line in Quebec, Canada. The company hopes to establish a third production site in Asia.

The airship developer also recently selected Thales' FlytX certifiable avionics suite and fly-by-wire flight control computer for the LCA60T. The airship would use a next-generation, high-integrity, ultrasmall form-factor flight control computer, which Thales plans to develop in Quebec.

Flying Whales' selection of Honeywell's energy-dense generator is a key move for the power company as it seeks new hybrid-electric applications in the emerging advanced air mobility, autonomous cargo and regional markets. The 1-megawatt unit is 2.5 times more powerful than the company's first HTS900 turboshaft-based turbogenerator system announced in 2019 and builds on experience gained during development of a high-power generator for DARPA's XV-24A LightningStrike vertical-takeoff-and-landing hybrid-electric X-plane.

Although the Aurora-developed XV-24A project was canceled in 2018, Honeywell continued work on the generator, forming the design basis of the integrated 200-kW units unveiled with the HTS900 the following year. Designed to achieve an efficiency of 98% compared with 92% for traditional aircraft generators, the XV-24A unit was packaged with five times the power density of existing megawatt-class

generators to enable the high levels of power required for electric propulsion.

The 1-megawatt unit, which completed initial tests in May 2022, has run continuously at 1,000 kW and demonstrated a power density of 8 kW/kg at an efficiency level of about 97%. "Our generator is four times as powerful as any other generator flying today and at unmatched power density," says Dave Marinick, Honeywell Aerospace's president for engines and power systems.

Collins, meanwhile, is continuing development work on the 500-kW electric motor for the Airlander 10. In England, it is pursuing the hybrid-electric airship with Hybrid Air Vehicles and the University of Nottingham, supported by more than £1 million (\$1.2 million) in UK government funding via the Aerospace Technology Institute under the E-HAV1 project, which seeks to build a full-scale prototype of the electric propulsor for ground testing.

The motor is planned to produce 500 kW of continuous power at a low 2,000 rpm, enabling direct drive of the vectoring propulsor. The machine would operate at 1,000 volts DC, nearly twice the latest 540-volt standard used in aircraft. ☛

---

## Universal Hydrogen Bets on Toulouse

---

- ENGINEERS DELVE INTO DETAILS OF ATR 72 HYDROGEN CONVERSION
  - AIRBUS AND ATR HAVE YET TO ENDORSE THE COMPANY'S APPROACH
- 

**Thierry Dubois** Toulouse

**W**hen you exit the Pierre Nadot tramway station near Toulouse-Blagnac Airport, the headquarters of Airbus, ATR and Universal Hydrogen's European development facility are all within walking distance. The proximity is expected to be beneficial to Universal Hydrogen as it seeks to form links with one or both airframers.

Hawthorne, California-based Universal Hydrogen (UH), which aims to obtain a supplemental type certificate (STC) to retrofit ATR 72-600s with liquid-hydrogen tanks, fuel cells and electric motors, is looking to make the most of the aerospace design skills available in Toulouse. Its effort there is in full swing. The ambitious schedule still raises eyebrows but has gained credibility since the first flight of a modified De Havilland Canada Dash 8-300 in March (*AW&ST* March 13-26, p. 14).

In the U.S., UH is focusing on the Dash 8-300 powertrain and flight-testing the aircraft as a proof of concept. In Toulouse, the company's engineers have been assigned to work on the cryogenic storage system and the ATR 72-600 STC, Pierre Farjounel, Universal Hydrogen Europe's general manager, tells *Aviation Week*.

They find themselves at a crossroads of aviation history. Their workplace—Hangar B16—previously accommodated programs such as the 1950s-era Sud Aviation SE 210 Caravelle 70-seat twinjet, for which Pierre Nadot was a test pilot. Universal Hydrogen Europe's payroll has been



growing fast—it employs 45 people, up from 10 in March 2022.

Creating a logistics network for liquid hydrogen is UH's overarching goal. The ATR 72 STC is intended to help create a market for the fuel, and so development of a tank module is at the heart of the engineers' work. UH plans to swap empty tank modules with full ones on the apron. The company intends to be the STC holder and seek a partnership with a maintenance, repair and overhaul service provider for the installation of the conversion kit.

The liquid-hydrogen tank, also known as a capsule, required relatively little research and technology work, Farjounel says. It is made of aluminum but is similar to steel capsules other industries use, such as those on Daimler trucks, he says. UH plans to bill customers for consumed hydrogen and thus has a vested interest in meeting its goal of a four-day capsule capacity, from fill-up to consumption.

The module uses the LD3 container base plate standard to accommodate a tank. It is designed to be easy to transfer between aircraft and ground vehicles, as well as to transport on trucks, trains and ships. It includes a vaporization system—gaseous hydrogen is easier to distribute, Farjounel explains.

asserts, thanks to the 500-nm range (including reserves).

The company aims to refuel the ATR 72 rapidly by swapping out modules using a quick connect-disconnect system, Chris Gilmore, Universal Hydrogen's head of advanced concepts, said at the Vertical Flight Society's H2-Aero Symposium in late March in Long Beach, California.

"We want to be able to use existing ground support," he noted. "We don't want to have to add any more cost. [The modules are] forklift-compatible. That's also part of the reason why we have this outer shell to protect against potential damage from the normal day operations."

The capacity of the luggage compartment located behind the modules will not change as measured per passenger, Farjounel says.

UH's unorthodox methods can be seen in its preparations for the ATR 72 flight evaluations. The first of three flight-test aircraft is scheduled to fly during 2024, Farjounel says, and service entry is planned to follow in 2025.

"We still have time to buy a used aircraft for flight testing," Farjounel says. "And we have development work ahead of us for a 2-megawatt powertrain." The fuel cell used in flight on the Dash 8 is in the 1-megawatt power class.

Whether ATR 72 flight tests will begin in Europe or the U.S. has yet to be confirmed. The latter most likely will be chosen because the FAA will be the primary certification authority and the launch customer is proposed U.S.-based Connect Airlines. It is more straightforward to obtain an experimental certificate from the FAA than from its European counterpart.

Despite the certification issue, branching out to Toulouse was an obvious choice for UH. "If you want to work on the ATR 72, you should take advantage of Toulouse's ecosystem," says Farjounel, a former Airbus employee. "Moreover, the Occitanie region has taken French leadership in hydrogen within the Corridor H2 project at the European level."

European Union Aviation Safety Agency (EASA) certification would have to follow soon after the U.S. STC, as European launch customer Amelia is

expecting its first aircraft in 2026. As part of the EASA certification campaign, ATR 72 test flights in European skies are likely in 2025, Farjounel says.

When UH announced plans to establish a facility in Toulouse in 2021, ATR officials expressed a high level of interest. But they have since refocused their efforts on a yet-to-be-confirmed contribution to Airbus' ZEROe hydrogen propulsion program. Airbus jointly owns ATR with Leonardo.

"We are independent," Farjounel says. "But a cooperation scheme would make things easier. We would benefit from ATR's experience, such as with new door designs."

As for Airbus, UH is trying to convince Glenn Llewellyn, vice president for zero-emission aircraft, that a modular tank is the only way to go. Refueling with liquid hydrogen would take several hours, Farjounel asserts. "We talk to Airbus; we have plenty of topics in common, particularly in the hydrogen ecosystem," he says. "We are proposing a solution that would derisk and accelerate their road map." 🌐



**Led by General Manager Pierre Farjounel (pictured), Universal Hydrogen Europe engineers are using this ATR 72 as a mockup for integration of a hydrogen module (far right).**

In Hangar B16, engineers are using a decommissioned ATR 72 to check their digital concept against the reality of the airframe. "We use it as a physical mockup, along with a digital mockup, to obtain design data and validate choices," Farjounel says.

For instance, the ATR 72's cargo door is located on the forward fuselage, while UH needs one on the aft fuselage. Structural reinforcement and cable installation can be readily examined, Farjounel says. An ATR 42 fuselage next to the complete ATR 72 airframe is used for parts inventory. In addition, this ATR 42 fuselage's forward passenger door (not every ATR 42 has one) can be studied in detail before UH designs one for the ATR 72.

UH's concept for the ATR 72 is to rely on two modules for a combined 340 kg (750 lb.) of hydrogen, with the full modules weighing 1,200 kg. Creating a module bay in the fuselage would reduce capacity by 14 seats, to 56. But 98% of the aircraft's missions still would be covered, Farjounel



# TECH TAKE

By **Graham Warwick**

For the latest, go to [AVIATIONWEEK.COM](http://AVIATIONWEEK.COM)

## Evolito Motor Powers Hydrogen-Electric Islander

Cranfield Aerospace Solutions has selected Evolito to supply electric motors and inverters for its Project Fresson hydrogen-electric aircraft demonstrator, a nine-passenger Britten-Norman Islander being modified for fuel-cell propulsion.



**Evolito's D1500 2 X 3 axial-flux motors will power the hydrogen-electric Islander conversion.**

Based near Oxford, England, Evolito is the aerospace spinout from UK automotive electric drive developer Yasa. When Mercedes-Benz acquired Yasa in July 2021, Evolito was formed to apply the company's high-performance, low-weight axial-flux motor technology to aviation.

Cranfield Aerospace Solutions (CAeS) has selected Evolito's D1500 motor, which has a peak power of 280 kW and 2,000 rpm. "The Fresson project is the first application showcasing our 2 X 3-phase direct-drive electric motor," says Mukesh Patel, Evolito chief engineer, referring to the motor's double three-phase winding layout.

The motor and inverter will form part of the 240-kW hydrogen fuel-cell propulsion system being developed by CAeS for the Islander. Ricardo UK is supplying the fuel-cell system and Innovatus Technologies is developing the dual-chamber composite, high-pressure underwing tanks to store the gaseous hydrogen.

The Project Fresson demonstrator is planned to fly in early 2024, and CAeS and Britten-Norman plan to have

a certified hydrogen-powered Islander on the market by 2026.

The yokeless and segmented axial-flux motor architecture originally developed by Yasa is about one-third the weight of competing radial-flux electric machines, Evolito says, requiring up to 75% less iron and copper as well as fewer permanent magnets.

In addition to being lighter and more efficient, the Evolito motor and inverter "[is] also an extremely compact solution that has allowed CAeS to integrate and package [the fuel-cell propulsion system] . . . within the Islander engine nacelle," says Robert Marsh, CAeS director of engineering.

## MIT To Fly Silent-Propulsion Demonstrator

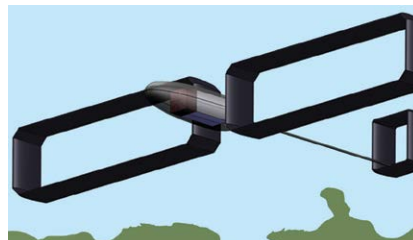
NASA is funding further work by researchers at the Massachusetts Institute of Technology on a near-silent propulsion system for urban drones—and potentially air taxis. The two-year, \$600,000 Phase 2 grant has been awarded under the NASA Innovative Advanced Concepts program.

The award will continue work on electroaerodynamic (EAD) propulsion. With no moving parts, EAD works by accelerating ions between two electrodes, an emitter and a collector. As they flow from emitter to collector, the ions collide with neutral air molecules, transferring energy to the airflow and generating an ionic wind that produces thrust to propel the aircraft.

In November 2018, researchers led by Steven Barrett, a professor at the Massachusetts Institute of Technology (MIT), flew an aircraft on EAD propulsion. The aircraft weighed barely 5 lb., produced less than 1 lb. of thrust and flew just 160 ft. across a gym, but it was the first flight of an aircraft with solid-state propulsion.

Under a Phase 1 grant from the NASA Innovative Advanced Concepts program, the MIT team showed that an uncrewed vertical-takeoff-and-landing (VTOL) aircraft using tilting EAD thrusters was theoretically capable of performing useful urban air mobility missions—with the near-silent propulsion system eliminating the noise nuisance that could lead to community opposition.

Phase 1 focused on conceptual aircraft design and thruster modeling. In



**The demonstrator will use multistage ducted electroaerodynamic thrusters for propulsion and control.**

Phase 2, MIT plans to fly an aircraft powered by multistage ducted EAD thrusters that has a useful payload of about 1 lb. and a flight endurance in the tens of minutes. The demonstrator will have the same configuration as MIT's proposed VTOL aircraft but will perform a conventional-takeoff-and-landing mission.

The aircraft will be used to validate MIT's design models, in particular for thruster performance and noise; advance the power electronics and thruster capabilities with the goal of reaching the performance required for VTOL; and provide an understanding of pressure losses in a multistage ducted EAD propulsion system.

## Structural Color Promises Ultralight Aircraft Paint

Researchers at the University of Central Florida have developed an ultralightweight paint that mimics how the iridescent colors of butterflies are created through the scattering of light by nanostructures in their wings. The mechanism is known as structural color and differs from how the pigments used in conventional paint produce color by absorbing specific frequencies of light energy.

Instead of controlling the absorption of light to produce different colors, structural colorants control the way the light is reflected or scattered. The color is the result of optical phenomena produced by nanoscale structures and does not use toxic pigments that fade with exposure to heat or light, say the researchers.

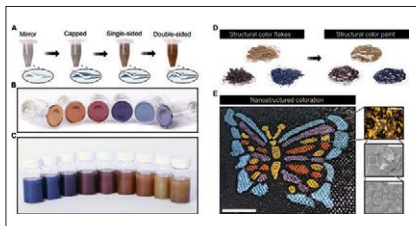
The paint on a Boeing 747 weighs about 500 kg<sup>2</sup> (1,100 lb.) based on a paintable surface area of about 3,200 m<sup>2</sup> (34,500 ft.<sup>2</sup>) and a current paint density of 156 grams per m<sup>2</sup> (0.03 lb./ft.<sup>2</sup>), the researchers write in a paper published

STEVEN BARRETT/MIT

in *Science Advances*. “The structural paint would only add 1.3 kg of extra weight, saving weight equivalent to 4-8 adult passengers,” the paper states.

The process starts with a thin sheet of double-sided aluminum mirror. Islands of aluminum nanoparticles are then grown on both sides of the sheet in an electron beam evaporator. This results in micrometer-size colored flakes that can be stored dry in powder form. The researchers formulated a simple paint by mixing the flakes with an oil binder.

UNIVERSITY OF CENTRAL FLORIDA



**Nanoislands are deposited on an aluminum mirror, then broken into flakes to produce the colorant.**

“In contrast to the several micrometers required for commercial paints, our ultrathin paint can impart full coloration with a thickness of only 150 nanometers. Consequently, this huge lateral area-to-thickness ratio makes it the lightest paint in the world with a surface density of only 0.4 grams per m<sup>3</sup>,” the researchers write.

“Our approach presents the first environmentally friendly, large-scale, multicolor and self-standing platform for imparting nanostructured coloration to any surface, thus bridging the gap from proof of concept to industrial production,” the paper states.

## Merlin To Trial Autonomy on Alaska Cargo Flights

U.S. startup Merlin Labs aims to demonstrate its automated flight control system in a Cessna Caravan flying cargo routes in Alaska under a \$1 million contract from the FAA. The Merlin Pilot flight control system will act as the pilot in command from takeoff to landing, with a safety pilot on board to monitor operations.

Boston-based Merlin has flown its

autonomous flight hardware and software in five different aircraft types and is working on supplemental type certification of the system on the Caravan, its first commercial application. A first for the FAA, the Alaska project “will allow Merlin Pilot to fly in the national airspace system for the first time,” says Merlin co-founder and CEO Matthew George.

The flights will be conducted in partnership with the FAA-designated University of Alaska-Fairbanks uncrewed aircraft system (UAS) test site and Alaska airline Everts Air Cargo. The flight trials will involve three test routes serving five rural destinations that rely on air freight for supplies. Flights are planned to begin in the second quarter, and all test routes will originate from the UAS test site.

“Merlin Pilot is going to be in the aircraft, essentially as the pilot in command,” George says. “There’s a human pilot in the cockpit who’s ultimately legally responsible for the safety of the airplane, but the Merlin Pilot is going to do auto-takeoff [and] navigation, talk to air traffic control and land. So it will be in charge of the flight from soup to nuts in national airspace, which is a first.”

Unlike some of its rivals, Merlin is not taking the route of remotely piloting the Caravan from the ground. “Fundamentally, we believe we have to close the safety case for autonomy aboard the aircraft,” he says. “Unlike some of the others, where they are using a remotely piloted model or some combination of limited autonomy onboard but primarily remotely piloted for safety-critical phases of the flight, we believe those true autonomy functions need to be aboard the aircraft.”

“This aligns with the state of the art of every other part of the autonomy industry. Google is not driving around remote-controlled cars; they’re driving around autonomous cars,” George says. “And we fundamentally believe that is the safest and most effective way. Especially when that autonomy is paired with a human pilot aboard the aircraft.”

Merlin Pilot will fly the Alaskan routes like any human-piloted instrument flight, he says. The system will pull in the assigned route from air traffic control (ATC), then use artificial intelligence (AI)—machine learning and natural language processing—to interact with ATC while in flight. “We’re flying real routes in the real airspace. And an air traffic controller can modify the

route, based on weather or other constraints, and interact with the aircraft in natural voice just like they’d interact with a human pilot.” The machine learning model has been trained on thousands of hours of data from ATC centers, he says.

Deconflicting the route for terrain and weather will be performed as normal during flight planning, but as with a piloted aircraft, ATC will be able to vector the Merlin Pilot-controlled aircraft off its planned flightpath to avoid traffic. “It’s still an active discussion about how much vectoring the FAA is going to allow us to do up in Alaska versus the human pilot taking over,” George says. “But in our certification system, air traffic controllers are able to talk to the aircraft and say: ‘I need you to turn 30 deg. to deconflict with traffic.’”

The Alaskan flight trials will involve a single modified Caravan and are planned to begin in late May and continue through most of the summer. Merlin, meanwhile, is working to certify its system on the Caravan through the New Zealand Civil Aviation Authority in close collaboration with the FAA. The company submitted its project-specific certification plan two years ago, he says, and “we’re confident we will likely be the first to fly certified takeoff-to-landing autonomy.”



MERLIN

**The Merlin Pilot system will command the Caravan from takeoff to landing on cargo flights in Alaska.**

In the early stages, Merlin Pilot-equipped aircraft will continue to have human pilots. “The pilot for us is really critical. For our contract with the U.S. Air Force, where we were selected to bring crew augmentation to the [Lockheed Martin] C-130J, we are putting the Merlin Pilot onboard the aircraft as the second required crewmember, still leaving a human pilot,” George says. “We don’t think the technology is at the point where an AI pilot like we are developing is able to get to the level where you don’t need a human pilot.”



Continued from page 66

human progress. Overstating the uncertainties about aviation's non-CO<sub>2</sub> effects amounts to cherry-picking arguments to justify inaction.

But let's get three things straight:

❶ The science is clear enough about the importance of the problem. In spite of the uncertainties, we know that non-CO<sub>2</sub> effects of aviation have a climate impact at least as big as (and probably worse than) CO<sub>2</sub>. Is the aviation industry doing at least as much to tackle non-CO<sub>2</sub> as it is doing to decarbonize? The answer: It is doing nowhere near enough.

❷ Solutions do exist, and we do not need to eliminate all uncertainties before acting.

Take contrail formation—the main driver of non-CO<sub>2</sub> effects. We already know that less than 5% of flights create 80% of contrails' warming effect. Minor changes to the flightpaths of those “worst offender” flights would minimize contrail formation without disrupting air navigation significantly and with almost no fuel-burn penalty.

Another solution is using SAF, which emits fewer particles when burnt. This reduces warming from contrail cirrus and improves air quality around airports. However, SAF will take time to scale up. In the meantime, we can achieve similar benefits by hydrotreating jet fuels, a technology used for decades by refineries to lower the amount of particle emissions from road and shipping fuels. Climate and health benefit from the application of mature technology. Why wait?

❸ We need a solid policy framework to tackle the problem. It is unlikely that the aviation industry will mitigate non-CO<sub>2</sub> effects proactively without binding regulation in place, considering that it has failed to meet most of its own climate targets to date.

## “CARBON EMISSIONS ARE JUST THE TIP OF THE ICEBERG.”

The EU is taking steps in the right direction. Its Emissions Trading System (EU ETS) for aviation will introduce a system to monitor, verify and report non-CO<sub>2</sub> effects from European flights. However, we cannot stop there. If we want to make a dent in the impact of non-CO<sub>2</sub> effects, we need them to be priced as part of the ETS in the second half of the decade. The price signal would incentivize the adoption of non-CO<sub>2</sub> mitigation strategies.

We also need legislation to optimize jet fuel quality by 2025 if we want to be serious about tackling aviation's climate and health effects.

I am pretty sure that aviation can do better than big oil. Instead of downplaying the problem or opposing policies and regulations, the industry should show climate leadership in tackling non-CO<sub>2</sub> effects with an innovative, can-do attitude. After all, it is arguably the quickest, most cost-effective way to curb aviation's climate impact. Who would oppose that? 🌱

*Carlos Lopez de la Osa is an aviation technical manager at the European Federation for Transport & Environment.*

and respond to more disasters by leveraging their limited transportation budgets, which often are nonexistent or overspent because of the increasing number of disasters.

Airlink was putting an environmentally responsible lens on use of aviation assets for humanitarian purposes well before “ESG” concerns. Airlink's approach is working with credible relief organizations, using aviation assets where they are the best option for aid delivery, using existing capacity first, utilizing sea freight or trucking where timing and routes allow, and limiting charter flights to essential large shipments from NGOs when it is the only or best option. By guaranteeing NGOs space on scheduled flights, “air bridges” lead to sustainable delivery options more efficient for all parties. Full aircraft make for environmentally responsible flights.

## “AVIATION IS ADDRESSING THE HUMANITARIAN CONSEQUENCES OF CLIMATE CHANGE RESPONSIBLY.”

Airlines are investing resources in helping to address the damage climate change is causing by participating in Airlink's growing network of 50+ international and regional commercial passenger and cargo airline partners, including United Airlines, American Airlines, Qatar Airways, Virgin Atlantic, Air Canada, Atlas Air, UPS, Amerijet and Turkish Airlines. Through their donations of airlift and accessible capacity during peak periods, these airlines are solving problems caused by the rise in climate change disasters. Environmental efficiency in humanitarian aid transportation and logistics means sending the right aid, at the right time, to the right place—a driving principle for Airlink.

Sixty percent of unsolicited in-kind donations and other inappropriate humanitarian goods are wasted by many estimates, including from the U.N. Office for the Coordination of Humanitarian Affairs, with an unnecessary environmental impact resulting from burn piles, landfills and wasted transportation. These often come from well-intentioned public collection drives for donated items that are not what is needed, do not have distribution recipients and plans, or are available in more local economies. It is why cash donations to NGOs like Airlink and its partners ensure funding for transportation and logistics costs—expenses that regularly exceed donated airlift and are overlooked or underfunded—and distribution plans to beneficiaries.

Airlink's slogan is: “Step One. Get There.” A 2019 report by the International Civil Aviation Organization stated: “Aviation is by far the world's safest and most efficient mode of long-range transportation. . . . Air transport functions as an essential service to provide lifeline connections that otherwise would not be available.” I absolutely agree and know that the aviation sector is addressing today's humanitarian consequences of climate change in the most responsible way that goes beyond its own footprint. 🌱

*Sandra Walter, director of development for Airlink in Washington, has 35 years of experience developing philanthropic partnerships.*

AVIATION WEEK   
**ENGINE LEASING  
TRADING & FINANCE**  
EUROPE

7-8 JUNE, 2023  
PARK PLAZA VICTORIA  
LONDON, UK

# The Leading Conference Solely Focused on Engine Leasing Management

REGISTER BEFORE 26 APRIL AND SAVE £200

FREE PLACES FOR QUALIFYING AIRLINES

Hear from engine leasing experts including:



**Kata Cserep**

Global MD,  
Aviation, Travel &  
Tourism  
**ICF**



**Andri Geir  
Eyjólfsson**

Director,  
Technical  
Operations  
**PLAY Airlines**



**Aoife  
Fennell**

EVP & CTO  
**Engine Lease  
Finance  
Corporation**



**Dave  
Goodger**

Managing  
Director EMEA,  
Tourism  
Economics  
**Oxford  
Economics**



**Ronan  
Murphy**

Director  
**Alton Aviation  
Consultancy**



**Sam Raby**

Associate  
Director  
Aftermarket  
Strategy & Sales  
Support  
**Pratt & Whitney**



**Olga  
Razzhivina**

Director  
**Oriel**



**David  
Rushe**

SVP, Mature  
Aircraft &  
Engines  
**Aergo Capital**

HOST SPONSOR



PREMIUM SPONSOR



SPONSOR



PURPOSEFUL PARTNERSHIP





# Contact Us

**President/Publisher:** Gregory D. Hamilton  
hamilton@aviationweek.com

**Managing Director, Media & Marketing Services:**  
Iain Blackhall (UK)  
iain.blackhall@aviationweek.co.uk

## U.S. Sales Offices

**Senior Director, North American Media:** Rob Howlett  
rob.howlett@aviationweek.com

## International Regional Sales Offices

**Managing Director, Defense & Space:**  
Andrea Rossi Prudente (UK)  
andrea.rossiprudente@aviationweek.co.uk

## Marketing Services

**Director, Digital Customer Solutions:** Jason Washburn  
jason.washburn@informa.com

**Sales Team Listings:** @AviationWeek.com/sales-contacts

## Business/Production

**Ad Operations Manager:** Bonnie Streit  
yvonne.streit@informa.com

## Advertising/Marketing Services

**Media Kits, Promotions or Custom Media:**  
www.aviationweek.com/mediakits or Elizabeth Sisk  
elizabeth.sisk@aviationweek.com

**Business and Finance Manager:** Gabriel Balmes  
gabriel.balmes@informa.com

## Subscriber Service

**U.S.:** (877) 369-3767

**Outside the U.S.:** +1 (913) 850-6931

**Manage Your Subscription (and Claim Digital Edition) at:**  
aviationweek.com/awstcustomers

## Conferences/Exhibitions

[www.aviationweek.com/events](http://www.aviationweek.com/events):

**To Sponsor/Exhibit:** Beth Eddy;  
(561) 279-4646; betheddy@aviationexhibits.com

**To Register:** Virginia Gongora  
virginia.gongora@aviationweek.com

## AW&ST Mailing List Rental and Sales

**Anthony Treglia** [Anthony.treglia@informa.com](mailto:Anthony.treglia@informa.com)

## Reprints, Photocopies and Permissions

**Custom Reprints:** [informa@wrightsmedia.com](mailto:informa@wrightsmedia.com)

**Wright's Media**, 2407 Timberloch Place, Suite B  
The Woodlands, Texas 77380  
Office: (281) 419-5725  
Toll Free: (877) 652-5295  
Cell: (713) 724-6987  
Fax: (281) 419-5712  
[wrightsmedia.com/sites/aviation-week/contact.cfm](http://wrightsmedia.com/sites/aviation-week/contact.cfm)

## Social Media

**Join the conversation. Follow us at:**

[linkedin.com/company/aviation-week](https://www.linkedin.com/company/aviation-week)  
[Twitter.com/AviationWeek](https://twitter.com/AviationWeek)  
[Facebook.com/AvWeek](https://www.facebook.com/AvWeek)  
[YouTube.com/AviationWeek](https://www.youtube.com/AviationWeek)

Aviation Week & Space Technology is published biweekly, with one issue in August by Informa Markets, a trading division of Informa PLC, 22701 W. 68th Terrace, Ste. 100, Shawnee, KS 66226-3583. Member of Audit Bureau of Circulations and Magazine Publishers of America. Periodicals postage paid at Kansas City, MO and additional mailing offices. Canadian GST #R126431964. Title reg.® in U.S. Patent Office. Copyright © 2023 by Informa Markets, a trading division of Informa PLC. All rights reserved. All rights to these names are reserved by Informa Markets.  
**Postmaster:** Send address changes to *Aviation Week & Space Technology*, Attention: Subscription Services, 22701 W. 68th Terrace, Ste. 100, Shawnee, KS 66226-3583.

**Aviation Week & Space Technology**  
**April 24-May 7, 2023**

**VOL. 185, NO. 8 (ISSN 0005-2175)**

[AviationWeek.com/AWST](http://AviationWeek.com/AWST)

# Aerospace Calendar

To submit Aerospace Calendar Listings  
email: [aero.calendar@aviationweek.com](mailto:aero.calendar@aviationweek.com)

**May 8-11**—Special Operations Forces Week 2023. Tampa Convention Center. Tampa, Florida. See [sofweek.org](http://sofweek.org)

**May 9-10**—Business Aviation Safety Summit (BASS2023). Sheraton New Orleans. New Orleans. See [flightsafety.org/bass-2023-new-orleans](http://flightsafety.org/bass-2023-new-orleans)

**May 9-11**—The Airport Show. Dubai World Trade Center. Dubai. See [theairportshow.com/en-gb.html](http://theairportshow.com/en-gb.html)

**May 10-11**—Aerospace & Defense Meetings—Central Europe. Centrum Wystawienniczo Kongresowe. Opole, Poland. See [poland.bciaerospace.com](http://poland.bciaerospace.com)

**May 11-26**—RTCA Plenary Sessions/Committee Meetings. Virtual or various locations. See [rtca.org/content/upcoming-committee-meetings](http://rtca.org/content/upcoming-committee-meetings)

**May 16-18**—Vertical Flight Society's Forum 79. Palm Beach County Convention Center. West Palm Beach, Florida. See [vtol.org/forum](http://vtol.org/forum)

**May 16-18**—2023 Humans to Mars Summit. National Academy of Sciences Building. Washington. See [exploremars.org](http://exploremars.org)

**May 16-18**—International Air Transport Association Aviation Energy Forum. Hyatt Regency Bellevue. Seattle. See [iata.org/en/events/all/iata-aviation-energy-forum](http://iata.org/en/events/all/iata-aviation-energy-forum)

**May 17-18**—GEO Business 2023. ExCeL London. London. See [geobusinessshow.com](http://geobusinessshow.com)

**May 18**—American Institute of Aeronautics and Astronautics Awards Gala. John F. Kennedy Center for the Performing Arts. Washington. See [aiaa.org/events-learning/event/2023/05/18/default-calendar/2023-aiaa-awards-gala](http://aiaa.org/events-learning/event/2023/05/18/default-calendar/2023-aiaa-awards-gala)

**May 23-24**—Air Dominance Summit. The Mirage. Las Vegas. See [idga.org/events-air-dominance-summit](http://idga.org/events-air-dominance-summit)

**May 23-25**—European Business Aviation Convention & Exhibition (EBACE2023). Palexpo. Geneva. See [ebace.aero/2023](http://ebace.aero/2023)

**May 23-25**—International Astronautical Federation Global Space Conference on Climate Change (GLOC 2023). Radisson Blu Scandinavia Hotel. Oslo. See [gloc2023.org](http://gloc2023.org)

**May 23-25**—Future Travel Experience EMEA and Ancillary & Retailing Conference (co-located). The Royal Dublin Society. Dublin. See [futuretravelexperience.com/fte-emea](http://futuretravelexperience.com/fte-emea)

## Aviation Week Network Events

+1 (800) 722-6344 or [Events.AviationWeek.com](http://Events.AviationWeek.com)

**May 9-11**—Routes Europe 2023. Lodz, Poland.

**May 17-18**—MRO Australasia. Brisbane, Australia.

**May 23**—CTC Hong Kong Corporate Travel Summit 2023. Hong Kong.

**June 1-2**—GAD Americas. Miami.

**June 2**—ATW's Airline Industry Achievement Awards. Istanbul.

**June 7-8**—Engine Leasing, Trading and Finance Europe. London.

**June 14-15**—MRO BEER (Baltics & Eastern European Region). Warsaw, Poland.

**June 19-25**—Paris Air Mobility at the Paris Air Show. Le Bourget, France.

**June 27**—CTC Singapore Corporate Travel Summit 2023. Singapore.

## ADVERTISERS IN THIS ISSUE

Aeromart Nagoya - Japan	43
Aviation Week Events	
Engine Leasing Trading & Finance	64
MRO Australia	15
MRO Beer	41
Aviation Week Network	
20 Twenties 2024	37
Advanced Air Mobility Report	25
Aviation Week Intelligence Network	29

Fleet Discovery Military	3rd Cover
Market Briefings	4
MRO Prospector	23
ReadySetGrow	53
Great River Technology	7
Lockheed Martin	4th Cover
Meggitt Defense Systems	2nd Cover
PwC	11
Vaughn College Gala Spring 2023	13

## Will Aviation Replicate Big Oil's Playbook?

By **Carlos Lopez de la Osa**

**W**hen the use of fossil fuels was on the rise, a group of scientists sounded the alarm: The resulting carbon emissions could have disastrous consequences for our Earth's climate.

We know what came afterward. Oil companies captured the narrative, denied the problem, deflected attention and delayed action. They managed to silence the alarm bell and kept pumping oil, gas and coal, racking up trillions of dollars while breaking down the climate.

Fast forward to 2023. We clearly are feeling the heat of climate change, as scientists predicted. Most people do not deny it anymore, and action to address it is speeding up. One even might think that if scientists sounded a new alarm about a climate issue, we would try our best to avoid the same mistake. We would take bold, decisive action to solve the problem and avoid further worsening global warming. Unfortunately, when it comes to the non-CO<sub>2</sub> climate effects of flying, the aviation industry seems to think otherwise.

Carbon emissions are just the tip of the iceberg of aviation's climate impact. Other emissions from aircraft engines (soot, water vapor, sulfur and nitrous oxides) create changes in the upper atmosphere, such as persistent contrails or increased greenhouse gases. These non-CO<sub>2</sub> effects cause additional warming that is at least as bad as—and up to three times worse than—aviation's carbon emissions.

Instead of facing the issue and solving it, the aviation industry appears to be following big oil's playbook from the 1970s in several ways.

First, the industry is failing to acknowledge the problem exists. Non-CO<sub>2</sub> effects have been researched for decades, and their impact has been well known for more than 20 years. However, while the aviation industry has created much hype around decarbonization, sustainable aviation fuel (SAF) and zero-emission technologies, it is quite rare to find any mention of non-CO<sub>2</sub> effects in sustainability reports, conferences or press releases.

Second, the industry is deflecting attention from the issue. Even when non-CO<sub>2</sub> effects are recognized, many industry stakeholders say it is essential to focus on decarbonization first, although there is no reason why we cannot tackle both problems in parallel.

Third, the industry is delaying action. Scientific knowledge may have limitations, but it is the main driver of

## How Aviation Aids When Disaster Strikes

By **Sandra M. Walter**

**I**t is interesting to me that when CO<sub>2</sub> emissions are reported, aviation seems to receive an unfair amount of disapprobation, considering its impact is 4.9% of global emissions (CO<sub>2</sub> and non-CO<sub>2</sub>), according to the Climate Action Network and International Coalition for Sustainable Aviation. That is not insignificant, but it is a small part of a bigger story. No conversation about aviation should be complete without consideration of the positive impact it has on humanitarian outcomes caused by both climate change emergencies and complex humanitarian crises. Of-

ten the scale of disaster, critical needs and geography makes air the most responsible transportation option—for both material supplies and expert responders.

The science and the industry concur that aviation emissions play a role in global climate change. The industry itself is taking concrete measures to reduce its carbon footprint through investment in alternative fuels, increasingly efficient engines, aircraft and more. These measures will take

years to decades to come online, scale and have a net effect on emissions and climate change.

Meanwhile, climate change emergencies continue to impact millions of people. Powerful weather events once confined to defined seasons are now predictably unpredictable. When they occur in countries experiencing war, conflict and poverty, resilience is low, and infrastructures are compromised. Already strained basic services such as healthcare, water, sanitation, shelter and food are stretched beyond limits, exacerbating the need for immediate and increased material aid and expertise from across the region or around the world.

Given all that, and the time lag in implementing new technologies, how can—and does—the industry mitigate near-term impacts of climate change? Studies, including one from Kuehne Logistics University and HELP Logistics, show as much as 73% of humanitarian funding is spent in the supply chain, with transportation representing often the most essential, volatile and costly component. Since 2010, with the founding of Airlink by the International Society of Transport Aircraft Trading, the aviation sector has been collaborating on humanitarian response operations in an innovative way. By removing the barriers that nongovernmental organizations (NGO) face due to logistics challenges and the high, volatile costs of transportation after a disaster, Airlink's 150+ relief partners are able to reach more people

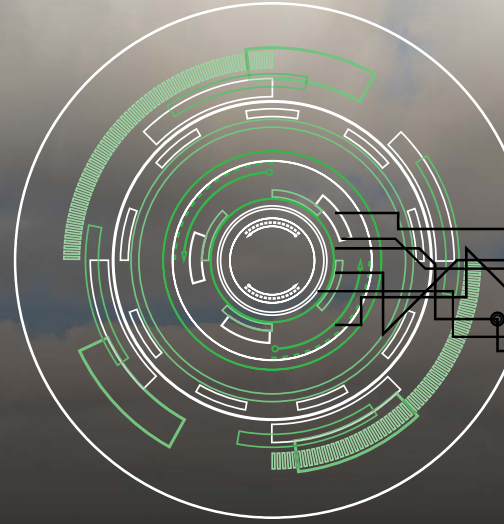


REBECCA COLE/ALAMY STOCK PHOTO

*Continued on page 63*



# FleetDiscovery



## Fleet Discovery **Military**

Aviation Week Intelligence Network's **Fleet Discovery Military** simplifies tracking global military aircraft and engines — piloted and unpiloted, fixed wing and rotary — so you can discover new opportunities to grow your business.



70,000+  
aircraft



110,000  
engines



400+ military  
operators



Searchable and  
filterable data

Learn more at  
[aviationweek.com/FDMil](https://aviationweek.com/FDMil)

Or call:  
**Melissa Crum** +1 (913) 284-2951  
[melissa.crum@aviationweek.com](mailto:melissa.crum@aviationweek.com)

**AVIATION  
WEEK**  
NETWORK

FROM HARDWARE  
TO SOFTWARE  
TO EVERYWHERE

ENSURING THOSE WE SERVE ALWAYS STAY

**AHEAD OF READY**

