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Brightly painted Mitsubishi F-15Js of Japan's aggressor squadron simulate hostile aircraft.



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ON THE COVER

General Atomics has unveiled the YFQ-42, a Collaborative Combat Aircraft prototype, as it seeks to write a new chapter in its history of pioneering uncrewed aircraft systems. Senior Defense Editor Steve Trimble's report begins on page 24. General Atomics Aeronautical Systems Inc. photo.

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ROTARY REVISIT

Reading about the U.S. Navy's Sikorsky MH-60 replacement plans (*"U.S. Navy Progresses on Future Vertical Lift, Interim MH-60 Upgrade," May 5-18, p. 36*), I recalled that when the MH-60R reached initial operating capability in 2005, we expected a 10,000-hr. airframe life would take about 20 years to reach, suggesting that a major upgrade/replacement should start development in about 10 years. The thought was that this would keep the production team of the U.S. Navy and Lockheed Martin sharp and the technology fresh. But schedules slipped to the right, and the team that built the world's premier anti-submarine warfare helicopter has largely retired. Meanwhile, the replacement isn't even on the drawing boards yet—apparently, it is still waiting for the requirements?

Fortunately, the current MH-60 modernization program could draw on the efforts of a small group that worked on the Program Objective Memorandum 2019 MH-60R Block 1 proposal. With extensive support from



CRISTIAN SCHRIK/ROYAL NETHERLANDS AIR FORCE

the fleet (on both coasts) and Air Test and Evaluation Sqdn. 21, the team proposed a radar, electronic support measures, acoustics refresh, optimized internal networking architecture, complete operator system interface redesign to incorporate artificial intelligence/machine learning (AI/ML) and Minotaur for automated search/detection/classification support. The intent was to provide the crew additional bandwidth to manage external resources (including uncrewed air vehicles), oriented around Tactical Targeting Network Technology (TTNT) and no longer tethered by Hawklink and Link 16.

The core missions of the SH-60B and MH-60R share broad overlap. Building on Hawklink, Link 16 allowed tremendous growth in sharing of information, which would be magnified multiple times by TTNT and possibly greater still by incorporating Starlink. Even current-generation AI/ML presents an



opportunity for dramatic reductions in the MH-60R task load, allowing equally dramatic gains in tactical battle management and direction of external platforms, such as air-launched effects. The MH-60 25-tube launcher has been used to deploy an AeroVironment Switchblade-size air vehicle, which in turn could be dispatched to investigate autonomously an anomalous automatic identification system response while maintaining a very low probability of detection, for example.

Perhaps it is finally time to give the hardworking maintainers and fearless MH-60R aircrew a much-needed boost in reliability and capability.

*Nat Jennings,
SH-60B pilot/MH-60R systems engineer
Sykesville, Maryland*

SMALL COMPANIES, BIG STEPS

I commend Aviation Week for its insightful coverage of advancements in aerospace technology. Brian Everstine's article "U.S. Military VIP Transports See Major Changes, Starting at the Top" (*May 19-June 1, p. 39*) stated that Marine One is "the first helicopter in the world with Starshield, according to Naval Air Systems Command." Our team of small companies used Starlink with helicopters and created a ground-to-air-to-air-to-ground communications system during the

BEHIND THE SCENES

Aviation Week editors visited NASA's Electric Aircraft Testbed in Ohio earlier this year as Wright Electric prepared to begin testing its 2.5-megawatt WM2500 electric motor. Discussing the WM2500 are (clockwise from left): Senior Defense Editor **Steve Trimble**, Executive Editor for Technology **Graham Warwick**, NASA Glenn Public Affairs Officer **Brian Newbacher**, Senior Propulsion Editor **Guy Norris** and Wright Electric CEO **Jeff Engler**. Our report begins on page 56.

Hurricane Helene disaster relief effort in North Carolina, where we also integrated rescue dogs with satellite tags.

Our effort shows how quickly small companies can innovate and use new technology like Starlink for important work, even before larger government projects.

*Malcolm K. Beyer, Jr.,
CEO of Advanced Ground Information
Systems
Jupiter, Florida*

NOT THE WORK OF A PILOT

I enjoyed the latest AW&ST issue, but there was a glaring mistake in the appreciation of FedEx founder Fred Smith (*June 30-July 13, p. 66*). He was not a Marine Corps pilot. Smith served two tours in Vietnam with the U.S. Marine Corps, first as a platoon commander (infantry) and then as a forward air controller. In the latter role, he flew in the back of a North American Rockwell OV-10, where he radioed in target coordinates. Hairly business, but not the work of a pilot.

Bill Donohue, Chicago

Editor's note: The reader is correct. The appreciation has been updated with the correct information in the AW&ST archive and on AviationWeek.com.

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 Letters may be edited for length and clarity; a verifiable address and daytime telephone number are required.

Denise Mangan-Fahy

has been named CEO of *Shannon Engine Support*, a joint venture between AerCap and Safran, succeeding Julie Dickerson. She was head of portfolio and rental operations for AerCap Engines and prior to that was GE Capital Aviation Services' senior vice president of portfolio and rental operations.



Boeing has appointed **Jay Malave** chief financial officer (CFO), effective Aug. 15, and **Steve Parker** CEO of Defense, Space and Security, effective immediately. Current CFO **Brian West** will become senior advisor to the CEO. Malave was CFO at Lockheed Martin and L3Harris Technologies. Parker had been interim Defense, Space and Security CEO since September and before that was chief operating officer of the division.

Nico Neumann has become the sole CEO of *Deutsche Aircraft*. He had shared the co-CEO title with longtime CEO **Dave Jackson** since December, before which he was chief operating officer. Jackson became CEO in March 2007, having led *Deutsche Aircraft* predecessor 328 Support Services, and he has been named CEO of *Deutsche Aircraft Group*.



Tommy Hughes has joined *Satair* as chief commercial officer. He was CEO of VAS Aero Services and

will remain interim managing executive there while the company searches for a successor. Before VAS Aero Services, he worked at Volvo Aero and Delta TechOps.

Lockheed Martin has hired **Craig Martell** as chief technology officer and promoted **Brian Petro** to vice president of program finance for missiles and fire control from vice president and controller for the segment. Martell was chief artificial intelligence officer at Cohesity and before that was chief digital and artificial intelligence officer at the U.S. Defense Department. Petro has worked at the defense prime since 2002, including as CFO of Lockheed Martin Commercial Flight Training.

Wheels Up has shaken up its executive suite and consolidated functions.

Mark Briffa has been appointed chief sales officer and **Meaghan Wells** chief growth officer, while Chief Commercial Officer **David Harvey** becomes senior advisor before his departure in August. Briffa was executive vice president for charter as well as CEO of Air Partner, which Wheels Up acquired in 2022. Wells was executive vice president of enterprise planning and strategy and previously worked at TF Holding and Vista Global.

Chris Pogue has joined *Calian* as president of defense and space. He was president and CEO of Thales Canada and prior to that held senior positions at the U.S. Missile Defense Agency, General Dynamics Mission Systems Canada and CAE Professional Services.



Christian Sandén has been hired by *Avtech Sweden* as chief commercial officer, effective Aug. 18. He takes the reins from Lars Wernblom, who held the role in an interim capacity. Sandén was chief commercial officer at Braathens Regional Airlines and worked previously at Telia and Sekoia.

Charter operator *Northern Jet* has named **Matt Taylor** chief pilot. He is a pilot of Cessna Citation CJ3 and XLS+ aircraft with more than 25 years of service in the U.S. Air Force, including as a pilot and an instructor.



Paula Castellano has been appointed senior vice president of operations at *CPI Aerostructures*. She was site director for

GKN Aerospace in Amityville, New York, and before that was Air Industries Machining Group's vice president of operations.

Suffolk Construction has hired **Peter Cormier** as senior vice president of field operations and national transportation. He was a project executive at Cranshaw Construction, where he oversaw Boston Logan International Airport's Terminal B Optimization.



Roberto Farnese

has joined *Omni Helicopters International* as executive vice president for fleet. He was vice president and regional manager for Europe

and the Americas at Milestone Aviation, where he was previously vice president for commercial. His past employers include Bell Helicopter and Leonardo.

Oneworld Alliance has tapped **Stephan Nagel** as vice president of global partnerships, **Chris Kelly Singley** as vice president of communications and marketing, and **Guido van Til** as vice president of digital. Nagel is a longtime member of Oneworld's management board and vice president of airline partnerships at Qatar Airways. Singley was head of public relations at JetZero and worked in media relations at Boeing, American Airlines and Delta Air Lines. Van Til was a global unified commerce evangelist at New Black and before that was vice president of digital strategy at Air France-KLM.

William Hurd has joined the board of trustees at *The Aerospace Corp.* He is also chief strategy officer at tech startup CHAOS Industries and previously served in the U.S. House of Representatives for Texas' 23rd district and worked for the CIA.

XTI Aerospace has appointed **Alex Williams** senior advisor. He was an automated systems architect and process lab manager at Apple and previously worked at Pratt & Whitney.

James Bennett has joined the board of directors for the *Aircraft Fleet Recycling Association*. He is chief commercial officer of aftermarket services provider AerFin, and he has held senior commercial aviation and sales and marketing positions at Chromalloy, HEICO Aerospace and TES Aviation Group. ☺



To submit information for the Who's Where column, send Word or attached text files (no PDFs) and photos to: 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 For information on ordering, telephone U.S.:

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AURORA FLIGHT SCIENCES CONCEPT

DEFENSE

DARPA has ended its Liberty Lifter effort to have Boeing-owned Aurora Flight Sciences build a full-scale seaplane demonstrator, deciding it was not cost-effective or feasible.

Spain plans to acquire 28-30 Turkish Aerospace Industries Hurjet advanced trainers to replace its air force's Northrop F-5s. Six are due for delivery by 2028 (page 30).



BELL TEXTRON

DARPA has picked Bell Textron's stop-fold-tiltrotor concept for Phase 2 of the high-speed vertical-takeoff-and-landing Speed and Runway Independent Technologies program.

Embraer delivered the first four of six A-29 Super Tucano light fighters to the Paraguayan Air Force on June 30.

Israel says its operations against Iran included more than 500 strikes and interdictions by uncrewed aircraft and that Israel intercepted 99% of drones and 86% of ballistic missiles launched by Iran.

Japan's Board of Audit has raised con-

cerns about the low operational reliability of the Maritime Self-Defense Force's Kawasaki P-1 maritime patrol aircraft, citing persistent engine problems and poor supply chain management.

SPACE

U.S. Transportation Secretary Sean Duffy has replaced Janet Petro as acting NASA administrator. The agency has been without a permanent administrator since January.

The MethaneSat mission has failed after little more than a year on orbit. The American-New Zealand project said it lost contact with the spacecraft on June 20.

A third interstellar comet, designated 3I/ATLAS and measuring up to 20 km (12 mi.) wide, was detected July 1 by the Asteroid Terrestrial-Impact Last Alert System telescope in Rio Hurtado, Chile.

BUSINESS AVIATION

Bombardier announced a \$1.7 billion order from an unnamed customer for 50 Challenger and Global business jets, plus options for 70 additional aircraft. Deliveries are scheduled to begin in 2027.

BUSINESS

TransDigm has acquired precision components manufacturer Simmonds from RTX for \$765 million in cash. It is the Cleveland-based supplier's second acquisition this year.

ADVANCED AIR MOBILITY

Beta Technologies has received a committed purchase order for up to five Alia electric vertical-takeoff-and-landing aircraft from FlyNyon, a New Jersey-based aerial phototourism company.

COMMERCIAL AVIATION

Bryan Bedford, former CEO of Republic Airways, has been confirmed as FAA administrator by the U.S. Senate.

Malaysia Airlines has ordered 20 more Airbus A330neos, exercising purchase rights secured with the original 20-aircraft commitment in 2022. Deliveries of the latest tranche are due in 2029-31.

Air France-KLM plans to increase its stake in SAS Scandinavian Airlines to 60.5% from 19.9% in the latest European airline consolidation effort.

VIEW FROM THE UAE

Flying in the Desert

Joby and Archer Aviation have kicked off electric-vertical-takeoff-and-landing flight-test campaigns in the United Arab Emirates. Joby is

conducting trials of its S4 in its chosen

overseas launch market, Dubai, while Archer is using Abu Dhabi for its uncrewed Midnight.

Joby said its first flight on June 20 was part of "market-readiness flights," in which the company

evaluates performance of the piloted aircraft and its

various subsystems. These are conducted mostly away from people and not in a mission-representative environment.

Archer followed on July 2 to assess its vehicle's performance in desert conditions, including high temperature, humidity and dust exposure. The test flights are expected to culminate in market survey flights, nonrevenue trials of the types of routes and missions Archer intends to perform in commercial service.

Joby's first aircraft is a preproduction model, so this flight testing will not count toward type certification. The company plans to send additional aircraft to Dubai this year to join the test fleet there.

Joby Chairman Paul Sciarra says the company is on track to launch some type of commercial service in Dubai as soon as later this year or early 2026. Archer has previously given a similar time frame for the start of commercial services, depending on FAA type certification.



KEVIN DIETSCH/GETTY IMAGES



Oman Air has joined the Oneworld alliance, raising the group's membership to 10 carriers.

Another attempt to partially reprivatize TAP Air Portugal is underway. Lisbon initiated a process that could see up to 49.9% of the national carrier sold.

Airbus handed over 306 airliners through June 30 against a full-year target of 820. Boeing, which has not given a firm full-year delivery goal, handed over 280, roughly on par with its recovery trajectory (page 37). 

Follow the news and our analysis of Indian investigators' probe into the June 12 Air India Flight 171 accident, the first involving a Boeing 787, at:

AviationWeek.com



The civil aviation industry needs to hire 400 professionals a day for the next 10 years to keep up with soaring global demand for air travel, according to the 2025 Aviation Talent Forecast by Montreal-based simulation and training company CAE. The new study estimates that nearly 1.5 million pilots, aircraft maintenance technicians, cabin crew and air traffic controllers will be sought by 2034 to keep up with growth and to replace retiring workers. But demands vary by region. North America has an acute need for technicians, while the Asia-Pacific region—where air travel is growing fastest—needs pilots the most. Europe will lead demand for air traffic controllers due to its fragmented aviation market and aging population. The forecast, which uses Aviation Week Network fleet data, projects the number of commercial aircraft in service will rise to 44,000 in 2034 from 33,000 today and the number of business aircraft to 27,000 from 23,000. To keep up, industry will need to attract 300,000 new pilots, 416,000 technicians, 678,000 cabin crew and 71,000 air traffic controllers.

The chart displays two data series: Procurement (blue line) and Research, Development, Testing and Evaluation (red line). The Y-axis represents U.S. \$ Billions (Nominal) from 0 to 250. The X-axis represents years from 2000 to 2028. Procurement starts at approximately \$55 billion in 2000, peaks at about \$165 billion in 2008, and ends at approximately \$205 billion in 2028. Research, Development, Testing and Evaluation starts at approximately \$35 billion in 2000 and shows a steady increase, ending at approximately \$185 billion in 2028.

Year	Procurement (U.S. \$ Billions)	Research, Development, Testing and Evaluation (U.S. \$ Billions)
2000	55	35
2001	60	35
2002	60	40
2003	75	55
2004	80	60
2005	100	65
2006	105	70
2007	135	75
2008	165	78
2009	135	78
2010	135	78
2011	130	75
2012	115	75
2013	95	65
2014	95	65
2015	100	65
2016	115	68
2017	120	75
2018	145	90
2019	145	95
2020	140	105
2021	140	105
2022	155	115
2023	175	135
2024	205	150
2025	175	145
2026	195	165
2027	205	185

Source: Aviation Week Network Defense Market Analyzer

The 2025 spending reconciliation act saves the U.S. Defense Department from the May discretionary budget request's procurement spending drop to \$153.3 billion in fiscal 2026 from about \$174.4 billion in fiscal 2025. The reconciliation funding adds \$51.9 billion for procurement, lifting it to \$205.2 billion, or roughly the same as in fiscal 2024, when military aid for Ukraine pushed the procurement budget to \$204.6 billion. Research and development accounts are poised to hit an all-time high of \$180.3 billion.

 Find out more about the Defense Market Analyzer and other Aviation Week defense data products at [AviationWeek.com/awin-defense-data](https://www.AviationWeek.com/awin-defense-data)

Fighting with Japan still raged in July 1945, but the U.S. Army allowed Lockheed to show off one of the best-kept secrets of World War II. A year and a half earlier, a small team of engineers and mechanics, working in secrecy, delivered the prototype of the first operational U.S. jet fighter in less than 180 days. C.L. Johnson, popularly known as “Kelly,” penned a three-page, first-person account of the creation of his famous Skunk Works in our July 1 issue that year. The technical challenges were daunting. Johnson’s team designed a wing based on an airfoil that had never been used before and an aircraft around a jet engine they had never seen before. And time was not on their side. The Messerschmitt Me-262 was already in testing for the Luftwaffe, and the U.S. Army Air Corps had no response. By physically separating a small team of hand-picked experts from the rest of the company, Johnson delivered the first jet fighter in less than five months. His account contained sev-



Time-saving monomorphism, which made possible design and construction of P-80 in just 142 days, was handled by MG mobile built and

WHEN LOCKHEED AIRCRAFT Corp. undertook in 1943 to engineer and construct a radically new jet-propelled fighter airplane for the Army Air Forces in the

[illegible]

eral insights, but also one fallacy. "We do not feel that a large airplane would respond to a similar development program," Johnson wrote. The Skunk Works would disprove that less than 20 years later, when a member of the Mach-3 Blackbird family made its first flight 2.5 years after contract signing.

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UP FRONT

KEVIN MICHAELS

**THE AEROSPACE “SUPER-CYCLE”**

was a popular discussion topic at the Paris Air Show last month, as all major end-user segments—commercial, defense, business aviation and space—are poised for concurrent production growth. But below the optimistic veneer lies a weak and fragile supply chain that continues to struggle after years of cost pressure and cash extraction by OEMs.

A fundamental reset of OEM-supplier relationships and commercial terms will be required to reach higher production rates. A “Supplier New Deal” is needed, built on fairness, collaboration and mutual investment. What are the elements of a new social contract between OEMs and suppliers?

First, reduce supplier payment terms. As I argued in my Up Front column titled “Suppliers Aren’t Banks” about two years ago (*AW&ST* April 10-23, 2023, p. 10), standard U.S. commercial aerospace payment terms have increased to 120 days from 30 days over the past 15 years, leading to a disastrous increase in the cash-to-cash cycle and diminished working capital. OEMs have treated suppliers like banks to boost free cash flow and equity prices. Payment terms are better in Europe, but many subtler suppliers are struggling to repay government loans issued during the COVID-19 crisis while they grapple with funding production rate increases.

Second, guarantee schedule stability. Suppliers have been whipsawed by the late-2010s ramp-up, the Boeing 737 MAX production shutdown, the COVID-19 crisis and now erratic OEM production rates and 737/777 certification delays. As a result, most suppliers distrust OEM forecasts and are loath to order long-lead items or invest capital. Many rely on their own assumptions about realistic build rates, which undermines a well-functioning ecosystem. Forward-thinking OEMs can “walk the talk” by implementing take-or-pay contracts to guarantee supplier revenue.

Third, widen supplier delivery windows. OEMs have considerably tightened on-time delivery windows while increasing penalties and cost assertions. A decade ago, for example, Boeing’s window was 15 days (+10 early, -5 late), which it reduced to five days (+3 early, -2 late) in 2017 and then three days (+3 early, 0 late) in 2020. This places an unfair burden on suppliers that are contending with their own bottlenecks and labor shortages. In some cases, OEMs lack systems to manage reorder lead times, avoid short-flow orders and accurately track delivery performance.

Fourth, adjust pricing models and share cost risks.

Suppliers face unrelenting price increases, especially in engineered components, special processes, forgings, castings and extrusions. Another rising cost is U.S. tariffs—aluminum and steel tariffs are already in place, and country-specific measures seem to shift daily. Someone will have to “eat” the tariffs, and smaller companies with fewer political connections often bear the burden. OEMs should revisit unfavorable long-term

contracts and consider revising termination clauses.

“I used to see new competitors enter the market every month, but when margins got forced so low, it’s no wonder nobody invested in this industry,” one aerostructures executive says. “Why spend tons of money on expensive equipment and process controls when the market yields 6-7% operating profit? Pricing must increase if the ecosystem is going to get healthy.”

Finally, OEMs should embrace humility. They should admit past mistakes and rebuild rela-

tions and trust with their supply base. It is time to turn the page on such damaging policies as Boeing’s Partnering for Success and Airbus’ SCOPe+. This shift would require cultural and organizational changes that promote critical thinking and encourage solution-oriented approaches beyond existing policy constraints. Adapting to this new paradigm would mean upskilling supply chain and procurement teams across all levels and restoring technical support capabilities that have been depleted in recent years. In the words of former Airbus Americas CEO Barry Eccleston: “We need to get real about the supply chain.”

There are signs of hope that major OEMs are changing. Suppliers indicate that Boeing is becoming more collaborative under CEO Kelly Ortberg, who was once on the receiving end of Boeing’s tactics as the leader of Collins Aerospace. And GE Aerospace is conducting intensive supplier listening sessions as it reconsiders its supplier strategy in the Larry Culp era.

Without a Supplier New Deal, the promise of an aerospace super-cycle is at risk. The current game of supply chain whack-a-mole will persist, and supplier attrition—or defection to other industries—will continue.

Will OEMs rise to the challenge and lead the reform? 🗳️

Reform Required

Aerospace needs a **Supplier New Deal**



SKYNESHER/ISTOCK



QUANTUM LEAP GARRETT REIM

BY AUG. 29, 1940, FRANCE HAD fallen to Nazi rule. German bombs were falling on London. And Edward George Bowen was on a mission to get out of the city.

Bowen was headed to Euston Station and then Liverpool. From there, he would deliver across the Atlantic Ocean a locked metal deedbox containing a top-secret cavity magnetron. The device was a critical component for a critical new instrument of war: microwave radar.

En route to the train station, the driver he hailed refused to carry the box inside the cab, so the delicate device was strapped to the taxi roof. At the station, an overeager porter ran off with the precious hardware; Bowen later found the black box sitting on the train luggage rack, waiting for him.

But the greatest act of trust was yet to come. Bowen and the other members of the Tizard Mission would present and leave behind the cavity magnetron, as well as blueprints for the UK's most important technological secrets, to their American and Canadian cousins with a no-strings-attached plea: Develop and mass-produce these advanced British military inventions.

The U.S. and Canada would accept the partnership and UK designs for early turbojets, proximity fuses, sonar systems and self-sealing fuel tanks, as well as research on nuclear fission. Microwave radar was particularly potent. Compact enough to fit on submarines, ships and aircraft, the technology was useful for hunting U-boats from the air and helped win the Battle of the Atlantic. Shortly after the war, historian James Phinney Baxter III hailed the cavity magnetron as "the most valuable cargo ever brought to our shores."

The Tizard Mission—named for its leader, Henry Tizard, chairman of the UK's Aeronautical Research Committee—laid the technological foundation for the Allied victory. It should serve as a reminder of the power of alliances.

Today, the U.S. is moving away from its friends, even as it faces the technological, economic and military behemoth that is China. Future historians will likely not view the Trump administration's trade war against the entire world, all at once—including against decades-old allies—as a grand strategy by a "very stable genius."

Liberal democracies should be linking arms against China. They should recognize that supply chains—not trade deficits—matter. And allied nations should say the quiet part aloud: We should shrink trade with countries that are pointing nuclear weapons at us.

Defense treaty partners should upgrade their relationships to an economic security pact that lowers trade barriers for friends and places uniform tariffs and security restrictions on strategic components produced by adversaries. To reforge the arsenals of democracy, tariff-generated funds should be spent building up an allied supply chain via loans for industry, scholarships for university students and salaries for scientists.

A trade security alliance among NATO nations, Australia, Japan, New Zealand and South Korea would create a new supersize military industrial base that could overmatch the scale of Chinese production. There are inklings of such a pact in the AUKUS agreement, but that partnership is too focused on difficult-to-produce nuclear submarines and hypersonic missiles.

Scale—matching industrial capacity with good ideas, as was done in World War II—is the chief benefit of a multinational trade security alliance. As such, members should look widely to "ally-shore" mass-produced civilian components with dual uses, such as semiconductors, batteries, electric motors, sensors and radios, that are lethal when used to make a loitering munition, for instance.

To keep an edge, cross-border collaboration among researchers and engineers developing emerging technologies should be encouraged, such as in space, quantum computing, nuclear fusion, advanced manufacturing, high-energy lasers and artificial intelligence.

This would be, of course, an act of trust. Such an accord would be a bet that a common security requires a common economy. It would require the current U.S. leadership to see trade among friends as a force multiplier, not a zero-sum transaction.

Washington needs to set aside its trade war with allies and go the extra mile to make amends. If it stubbornly refuses, the U.S. will relearn the hard way the Churchillian maxim: "There is only one thing worse than fighting with allies, and that is fighting without them." 🇺🇸

'Ally-Shoring'

A trade security alliance
would strengthen the U.S.



Microwave radar enabled the Royal Air Force Bristol Beaufighter Mk. VIF to intercept inbound German bombers at night.

PEMAGS/ARCHIVE/MILITARY/ALAMY STOCK PHOTO



LEADING EDGE

GRAHAM WARWICK

THE END OF THE STEALTH ERA IS

coming, and its demise will be at the hands of quantum sensing, predicts a top official at the Pentagon advanced research agency that was instrumental in developing the first practical stealth aircraft.

DARPA Deputy Director Rob McHenry predicted the demise of stealth in a sensor-dominated future during a June 25 webinar organized by the Washington-based Mitchell Institute for Aerospace Studies.

"The U.S. has been living through the stealth era, delivered by DARPA back in the 1970s with Have Blue, and that's formed a mindset where we're trying not to be seen," McHenry said. "We're trying not to be engaged. And I don't think that is a future that's going to hold much longer."

He was referring to the DARPA-funded Have Blue demonstrator developed by Lockheed Martin's Skunk Works, with its faceted shape designed to divert radar waves (AW&ST Aug. 14-Sept. 3, 2017, p. 50). First flown in 1977, Have Blue was the precursor to the F-117, which began a trend of stealthy design since copied by China and Russia.

McHenry predicts a future where there is no hiding place. "With the types of capability that quantum sensing is going to deliver, the cross-domain sensing opportunities from space to air, the sophistication of sensor fusion and tracking using [artificial intelligence] and other techniques, I don't think we're going to be able to hide in any operational sense in a realistic way," he said.

Stealth changed the way aircraft are designed, using shaping, materials and other techniques to minimize radar cross-section, infrared signature and electromagnetic emissions to avoid detection and engagement. The end of stealth could fundamentally change how aircraft operate.

"It makes me question the offensive-defensive balance, especially in the air domain," McHenry said. "If you look at naval combatants: They're designed to be shot at; they're designed to defend themselves; and they're designed to take a hit and keep fighting. If you look at our aircraft, much of that isn't true."

He questioned why tactical aircraft are not armed with anti-missile missiles, the way warships have close-in weapons systems to defeat anti-ship missiles.

"We've been maybe too heavily weighted on the offensive side, and we really need to look at what that defensive side may look like," he said.

The end of stealth is coming because technologies like quantum sensing are moving out of academia and into production. "We're transitioning from the era of quantum sensing as a science to quantum sensing as an engineering discipline that we can deploy in real-world situations and platforms," McHenry said. "I think we are about to see this wave of massive changes."

He used the example of the U.S. Air Force's highly specialized and expensive RC-135 Rivet Joint radio-frequency (RF) intelligence-gathering platform. "A Rivet Joint is designed around the apertures to go do its mission," he said. "And we have quantum cells that are literally a few cubic centimeters that have higher sensitivity across the whole spectrum of everything on that aircraft."

McHenry was likely referring to DARPA's Quantum Apertures project. This is developing receivers (see

concept image) that detect changes in the intensity of a laser beam passing through a cloud of atoms in highly excited Rydberg quantum states that are highly sensitive to electric fields, acting like tiny antennas.

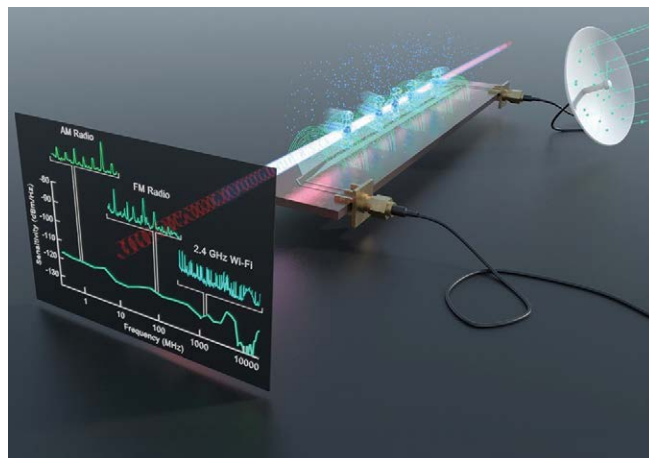
This phenomenon decouples the size of the antenna from the wavelength of the incoming signal. Rydberg-atom-based sensors can receive extremely low-intensity, modulated RF signals across a wide spectral range—a single sensor less than 1 cm³ (0.06 in.³) in size detecting signals from 10 MHz to 40 GHz, potentially reducing the size and number of antennas on platforms.

"When you start thinking about that higher sensitivity, if you emit a milliwatt of energy, you're going to be seen, and you're going to be engaged," he said. "The ability to do that in small, lightweight form factors is going to be fundamentally different from anything we've had before."

And it cuts both ways. Quantum sensing may be a threat to U.S. reliance on stealth, but it is also a capability the U.S. can use against its adversaries. "While we're worried about the implications for the stealth era and what's beyond that, we're also obviously leveraging that fully to go after adversaries and be able to see and track things virtually anywhere, anytime," McHenry said. ☛

Quantum vs. Stealth

There will be no hiding place, DARPA says



U.S. ARMY

AIRLINE INTEL

JENS FLOTTAU



OVER THE PAST FEW WEEKS,

Embraer's E2-series sales campaigns have seen mixed results. The Brazilian manufacturer lost one of its most im-

portant customers, LOT Polish Airlines, to Airbus' A220 after a hard-fought battle that spanned two years. On the other hand, it persuaded SAS Scandinavian Airlines to buy up to 55 E2s to replace older regional jets and small narrowbodies such as the Airbus A319.

While the SAS deal was certainly welcome and reason for celebration, the loss of LOT was the latest in a series of painful defeats in the past few years as several major carriers operating E2s have opted for an alternative, which has almost always turned out to be the A220.

That trend has been particularly prevalent in Europe, once a large market for Embraer's previous-generation E1 jets. ITA Airways chose the A220 for its regional fleet long before it joined the Lufthansa Group. Then Lufthansa placed another large A220 order for its new affiliate, City Airlines, to feed the hubs in Munich and Frankfurt. Subsidiary Austrian plans to phase out the E1s it inherited from Lufthansa CityLine. A larger E1 fleet will be consolidated at Air Dolomiti, which operates secondary routes from Italy.

KLM CityHopper flies a large fleet of E1s and E2s.

In North America, Air Canada and JetBlue have switched to the A220, and while startup Breeze launched with an interim fleet of E1s to begin operations quickly, it plans to focus on the A220 in the future. On the other hand, Porter Airlines—with an order for 75 E195-E2s, 44 of which have been delivered—is Embraer's biggest success story, as well as the largest operator of E2s in the world.

U.S. regionals are off-limits for the E2 because of scope clauses, but they remain a large customer base for the Embraer 175, as demonstrated by the SkyWest Airlines order for 60 aircraft revealed at the Paris Air Show.

The fact that so many large E2 customers have defected raises questions about the type's market potential. Neither legacy nor low-cost carriers have bought into the program to the extent Embraer had hoped. Also, airlines are doing the opposite of what the company had pitched, replacing aircraft with larger—in some cases, much larger—types. Most continue to neglect the “rightsizing” argument.

At the same time, Embraer has delayed a decision to launch a larger narrowbody, which would place it into a much bigger part of the commercial market but also

in more direct competition with Boeing and Airbus.

The E2 backlog is strongly focused on the E195-E2, with 196 aircraft, including the SAS deal. Embraer has 40 orders for the E190-E2, among them 15 from All Nippon Airways that were confirmed at the Paris Air Show.

Three airlines dominate the current E195-E2 backlog: Porter, Azul and now SAS. Embraer is highly exposed to Brazilian airline Azul—51 aircraft have yet to be delivered. Adding to the uncertainty, Azul filed for bankruptcy protection in May. However, the carrier's business model is largely defined by serving secondary markets for which the E2 appears to be best suited.

Where could Embraer place more E2s? Given how important incumbency is in the industry, the current E1 operator base is the most promising market. Embraer will have to manage shifting dynamics: The company sold 568 E190-E1s over the life of that program, but only 172 E195-E1s. Among the second-generation E-Jets, customers prefer the larger variant by far—if they have not switched to the A220. The E190-E1 in-service fleet is spread across many smaller operators, most of which fly fleets of fewer than 10 aircraft.

With a lot of decisions already made in Europe and scope clauses not changing

in the U.S., Asia is going to be Embraer's biggest hope. AirAsia plans to place an order for up to 100 smaller aircraft in the coming weeks. Again, the A220 and the E2 are in the running. Winning the campaign would be huge for Embraer, but it is a very long shot, given that Airbus is the incumbent supplier at the low-cost carrier; customer financing or other concessions could play a big role in the decision. For example, CEO Tony Fernandes indicated that sister carrier AirAsia X may stop flying widebodies even though it has 15 more Airbus A330-900s on firm order. It is not uncommon to tie changes of existing contracts to new orders.

China could become a major opportunity over time, as Tianjin Airlines has one of the world's largest fleets of E190-E1s—38 aircraft, according to the Aviation Week Network's Fleet Discovery database.

One of the growth engines in commercial aviation, India, is still in its infancy as far as Embraer is concerned: Star Air operates five 170s. Should IndiGo or Air India pursue large regional jets, the opportunity would be tremendous. IndiGo is no stranger to regional flying. The carrier operates 48 ATR 72-600s and could find good reasons for an aircraft that is larger than the turboprop but smaller than the Airbus A320neo. 



STARTUPS STRIKE

Steve Trimble Washington

A question has hovered over the U.S. Defense Department's decade-long courtship of Silicon Valley-based or -inspired technology startups: Even if those non-traditional suppliers produce a new class of low-cost, mass-producible alternatives to proven, if high-priced, weapon systems, would the Pentagon cough up the money to buy them?

Thanks to a combination of the Trump administration's first annual budget proposal and Congress' newly approved defense reconciliation package, the military can answer "yes"—if only for one year, perhaps.

The prospect of a combined \$961 billion defense budget in fiscal 2026—adding an \$848 billion base budget proposal and \$113 billion from a potentially one-off budget reconciliation law—could allow the Pentagon's spenders to keep most traditional weapons programs on track while opening a funded, parallel path of development and procurement dollars for defense industry newcomers.

The package, if enacted by a base budget approval from Congress, could allow the Pentagon to sidestep several difficult choices.

The U.S. Air Force, for example, could ramp up Boeing F-47 fighter development, extend Boeing F-15EX production and accelerate Northrop Grumman B-21 bomber deliveries in the reconciliation package while reviving the hypersonic Lockheed Martin AGM-183 Air-Launched Rapid Response Weapon in the base budget request. Meanwhile, Congress also added \$750 million in the reconciliation law for the F/A-XX program, ignoring objections from Navy leaders who had gutted the program's funding in the base budget proposal because of concerns about the defense industry's ability to deliver the future carrier-based fighter.

On top of those favorable moves for traditional defense contractors, the

Pentagon opened new funding channels that could attract an expanding pool of nontraditional suppliers, including:

- Procuring the Air Force's Family of Affordable Mass Missiles and the Navy's Multimission Affordable Capacity Effectors, with a targeted price tag at about 15% of the stealthy Lockheed AGM-158D Joint Air-to-Surface Standoff Missile.

- Launching development of a new class of low-cost, air-to-air missiles to arm future Collaborative Combat Aircraft with a weapon that is a fraction of the cost of a Raytheon AIM-120 Amraam.

- Completing development of the Blackbeard, a rocket-boosted hypersonic glide vehicle designed by startup Castelion that features a proposed unit cost about 1/10th that of a Lockheed Dark Eagle missile from the Army's Long-Range Hypersonic Weapon program.

The reconciliation fund, which President Donald Trump christened the One Big Beautiful Bill, stands as a unique opportunity for the defense industry. Of the \$148 billion approved for the Pentagon and the National Nuclear Security Administration, more than \$120 billion would be spent on

The B-21 Raider emerged as a big winner in the reconciliation process, receiving an extra \$4.5 billion budget boost to accelerate the production ramp-up.



NORTHROP GRUMMAN

GOLD

procurement or research, development test and evaluation (RDT&E). The effect is a one-year, 40% jump in spending for both categories over the fiscal 2026 base budget request.

Moreover, funding approved through the reconciliation process does not expire for five years, giving the Pentagon's spenders until fiscal 2029 to obligate all of the money. In the base budget, RDT&E funding expires after two years, and procurement money expires after three.

The extra cash and flexibility give the Pentagon a unique opportunity to address several chronic shortages in the U.S. defense industrial base. The spending will include a \$7 billion investment in the industrial base for critical minerals, seeking to break China's mining and processing dominance over those ubiquitous raw materials. Billions more are set aside for expanding U.S. manufacturing capacity for drones, munitions and rocket motors.

For example, a newly created \$1.4 billion fund to expand the industrial base for small uncrewed aircraft systems helped persuade Israeli drone-maker Xtend to acquire a European electronics supplier and move production to the U.S. By tapping into the fund, Xtend expects to reduce the financial risk of the move and dramatically lower the cost of building up inventories.

"It's [for] the machinery; it's the workforce," says Roy Levy, Xtend's U.S. general manager.

But the reconciliation package could not spare the Pentagon from every hard decision. The Army Transformation Initiative, which seeks to retire half of the Boeing AH-64E Apache fleet in the fiscal 2026 proposal, was left untouched by lawmakers. Nor does reconciliation funding contain any measure to reverse the Defense Department's proposal to cancel procurement of the Boeing E-7A Wedgetail after the first two prototypes, leaving the strategy in place to migrate airborne command and control to space-based sensors in the long term and a joint unit operating land-based Northrop Grumman E-2D Advanced Hawkeyes in the short term.

- > **PENTAGON PLUS-UP PUSHES DEFENSE INNOVATORS TO THE FOREFRONT**
- > **ONE-YEAR RECONCILIATION PLUS-UP RAISES QUESTIONS ABOUT FUTURE SPENDING LEVELS**
- > **SOME LAWMAKERS ARE CONCERNED ABOUT FISCAL 2026 APPROPRIATIONS**

Lawmakers also made no attempt through the reconciliation process to offset the Defense Department's proposal to buy only 47 Lockheed Martin F-35 Lightning IIs in the fiscal 2026 base budget, which roughly halves the military's traditional annual request. The Pentagon instead plans to divert some of the savings to help Lockheed

pass the fiscal 2026 defense appropriations bill could meet the same fate.

"What I'm trying to tell you is, back here on planet Earth, you're going to have to make do with the money we get you on reconciliation," Louisiana Republican Sen. John Kennedy said during a June 24 appropriations committee hearing on the Navy budget request. "We're headed toward a series of [continuing resolutions]. I hope I'm wrong, but again, I live on planet Earth." Kennedy also predicted that Congress would

propose a new round of reconciliation spending next year.

Those concerns underlie another risk in relying on the reconciliation process to fund defense spending growth. The Trump administration invoked the rare legislative maneuver to cover spending shortfalls created by the full-year continuing resolution in fiscal 2025. Instead of proposing an extra \$150 billion in the Pentagon's base budget request for fiscal 2026, the White House chose to fund the military's spending gaps and new requirements by adding those items to the so-called One Big Beautiful Bill.

Several programs, including F/A-XX and line items associated with the Golden Dome concept for homeland air and missile defense (page 16), now rely on the reconciliation process for continued funding, unless the administration inserts future spending requirements into the base budget request. The reconciliation process was intended to be a one-off solution this year, but that approach could change.

"We can do more than one reconciliation bill," Kennedy said to Navy Secretary John Phelan during the June 24 hearing. "You and your colleagues need to start planning for that eventuality. Maybe it'll change. Maybe someday donkeys will fly backward, too. But for the foreseeable future, I don't see it." 🐘



A glut of funding for low-cost munitions creates a new path to development for startups, such as Virginia-based CoAspire, which produces the Rapidly Adaptable Affordable Cruise Missile.

recover from delays with the F-35 Technology Refresh-3 and Block 4 modernization efforts. Despite the proposed cuts, Lockheed is not backing off from a target to deliver 170-190 F-35s this year. CEO James Taiclet reassured analysts that international demand can cover any reductions in U.S. orders for the stealthy jet.

To be sure, reconciliation is not the only option for offsetting reductions or omissions in the base budget request. The appropriations process also gives Congress the option to amend the fiscal 2026 spending proposal, but that comes with a caveat. Despite Republican control on Capitol Hill and in the White House, lawmakers failed to pass an appropriations bill in fiscal 2025, settling for a full-year continuing resolution slightly higher than the enacted level in fiscal 2024. Some lawmakers are warning that efforts to

U.S. Golden Dome Details and Aggressive Schedule Come Together

➤ TRUMP WANTS THE SYSTEM IN PLACE WITHIN THREE YEARS

➤ INITIAL FOCUS IS ON SCALING UP EXISTING TECHNOLOGY

Brian Everstine Bacchus, Utah, and Washington

In 1991, TRW Space & Technology Group took on a \$340.5 million contract to build “Brilliant Pebbles,” the most technologically complex part of the Reagan-era Strategic Defense Initiative.

The ill-fated program, famously known as “Star Wars,” sought to build space-based interceptors that would orbit the Earth and take down missiles launched by the Soviet Union. The plan quickly fizzled, however, because of rising costs and immature technology. Decades after acquiring TRW, Northrop Grumman has, in a way, dusted off that plan—bolstered by massive technological gains and a more affordable era of space launch—as part of its offering for the Golden Dome for America.

“We were the prime contractor way back when,” says Rob Fleming, corporate vice president and president of Space Systems at Northrop Grumman. “At the time, the technology was not ready for the type of capability that was needed. The capabilities today I am much more optimistic about.”

The Golden Dome has quickly gone from a January executive order that took much of the defense and space world by surprise to a program with a nominated executive and, as of early July, about \$25 billion set to be authorized to start. White House plans, the Pentagon’s budget request and a Republican-led bill have all outlined specific steps to ramp up production of existing systems and develop new ones to make the Golden Dome somewhat real by the end of President Donald Trump’s term in 2029; the spending plan includes \$175 billion over three years to try to achieve that.

“There’s meaningful capability that can be scaled,” Fleming says. “Is it going to solve every single threat in Year 3? I think that’s optimistic, but we can get a meaningful distance down the track. Absolutely.”

Trump outlined his anticipated architecture for the Golden Dome in the Oval Office on May 20. Standing a few

feet to his right was Space Force Gen. Michael Guetlein, vice chief of space operations, who as of early July was still awaiting Senate confirmation to take the lead on the Golden Dome. Guetlein previously worked at critical organizations, including the service’s Space Systems Command, where he oversaw acquisition, as well as the Missile Defense Agency (MDA) and National Reconnaissance Office.



Lawmakers and Northrop Grumman are looking at increasing Ground-Based Interceptor production as part of the Golden Dome.

EVAN KETH/MISSILE DEFENSE AGENCY

Realizing the Golden Dome will require a “whole-of-government” approach that will bring together the Pentagon and intelligence committees and will require a change of behavior among companies, Guetlein told an audience of intelligence-focused industry representatives on July 2.

“American technology and capabilities exist today to build the Golden Dome,” Guetlein said. “The technology exists today. However, the capabilities are spread across multiple [Defense Department] services, agencies and stovepipes. Golden Dome is not [as much] a technological challenge as it is an organization behavior challenge.”

Guetlein provided an extensive overview of the current vision of a Golden Dome architecture, broken down into four layers. A space layer would be supported by new space-

based interceptors, the Space Development Agency’s (SDA) Proliferated Warfighter Space Architecture (PWSA), the MDA’s Hypersonic and Ballistic Tracking Space Sensor (HBTSS) and Discriminating Space Sensor, ground and air moving-target-indication capabilities, and new counter-command-and-control systems both on the ground and in space.

An upper-tier layer would rely on Ground-Based Interceptors, Next-Generation Interceptors (NGI), Glide-Phase Interceptors, Standard Missile-3s and space-based interceptors, all connected to Ground-Based Mid-course Defense and over-the-horizon radars to defend against ballistic missiles.

The middle tier would comprise Lockheed Martin Patriot PAC-3 Mis-

sile Segment Enhancement and Standard Missile-6 interceptors. A lower tier would combine PAC-3s with newly developed interceptors—including network-enabled, container-launched systems—plus Terminal High-Altitude Area Defense interceptors and a new Joint Laser Weapon System, using AN/TPY-2 radars for hypersonic, cruise and ballistic missile defense. Lastly, new and existing sensors would monitor and target weapons before they are launched.

One company cannot produce or integrate architecture of this scale alone, nor can one part of the government, Guetlein said. “Golden Dome will require the defense industrial base to expand and to change behaviors,” he noted.

Northrop Grumman is pitching ways to bring together existing sys-

tems at a new scale to address this problem. For example, Fleming says Northrop is connecting its Ground-Based Midcourse Defense work with the air defense-focused Integrated Battle Command System that it is building for the U.S. Army.

Much of the sensing and space-based interceptor work is classified, although Fleming says Northrop has fielded the most space-based sensing capabilities in the past 40 years, including interceptors “of all different flavors” for different threats. Space-based interceptors dating back to the TRW days are needed to counter weapons in the boost, midcourse and glide phases. Additionally, he says space-based interceptors are needed to target weapons that are put into space to await launch orders.

“When you put all that together, as a company, we’ve got a ton of investment, a ton of technology,” Fleming says. “We have significant capacity to build hundreds of satellites. It’s an extension. . . . It’s more capacity of existing systems that are fielded today,

some of which we build in large quantities, and then it’s integration of systems that perhaps historically have been fairly stand-alone.”

A group of Republican lawmakers in late June put forward a new bill further specifying the existing technology they want to see. The Golden Dome Act, which aims to authorize programmatic spending included in the One Big Beautiful Bill reconciliation package, would create a new Southern Hemisphere-facing early warning radar system to help detect and track such threats as China’s Fractional Orbital Bombardment System. The bill also calls for a new Aegis Ashore tracking system in Hawaii, for the SDA to accelerate three more tranches of the PWSA, and for the MDA to speed up its HBTSS by outfitting at least 40 space vehicles with payloads for the system.

The lawmakers want to increase NGI numbers to as many as 80 interceptors, speed up the GPI development and accelerate fielding of ground-mobile interceptors and radars. The

bill also calls on the Pentagon to study space-based interceptors. Space Systems Command’s Program Executive Office for Space Combat Power on June 27 released a solicitation for the capability, including the interceptor itself and fire-control capabilities. The request for information calls for a host satellite, inflight target update capability and terminal guidance system to hit targets outside the Earth’s atmosphere or within, below 120 km (75 mi.).

Fleming says technological change, coupled with an unprecedented sense of urgency in the past several months, could make the Golden Dome a reality, if everything lines up right—a “Manhattan Project-type effort” that could create the right acquisition responsibilities as well as significant funding, the right talent and correct contracting responsibilities.

“Pulling all of that together in a structure that is driving toward an outcome is what is needed to be done,” he says. “And the government, I think, is making great starts to get there in general.” ☐

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The Pentagon Embraces Space-Based Airborne Warning and Control Systems

➤ PROPOSED BUDGET CANCELS E-7 WEDGETAIL TO FOCUS ON SPACE

➤ SPACE FORCE DIRECTS BILLIONS OF DOLLARS TOWARD THE LONG-RANGE KILL CHAIN PROGRAM WITH THE NRO

Vivienne Machi Los Angeles

The U.S. Defense Department is becoming more serious about moving into space missions that have long been associated with flagship airborne platforms, a shift that would upend more than 70 years of operations.

siles and other military advances could pose considerable risk to high-value airborne platforms.

Air Force leaders had resisted plans to cancel the E-7A, which also would have taken over the battle manage-

Guillot, commander of U.S. Northern Command and North American Aerospace Defense Command, said recently (*AW&ST* June 2-15, p. 17).

To help drive the mission shift, the Space Force's \$29 billion R&D spending request includes \$6.4 billion to develop and demonstrate Long-Range Kill Chains. The effort is part of the service's venture with the National Reconnaissance Office (NRO) to develop GMTI-capable satellites to replace a portion of the Joint Stars fleet by 2030. Gen. Michael Guetlein, vice chief of Space Operations, said on July 2 that the capability will be fielded in 2027-28. Officials have described space-based GMTI as a mission evolution that will be more survivable in a contested environment.

The NRO aims to review system requirements this fiscal year for the first block of planned space vehicles, budget documents show. The service is seeking \$1 billion in "operational systems development" costs to continue fielding a space-based GMTI capability that could soon enter production.

The Pentagon says it plans to award firm fixed-price contracts built on "mature commercial technologies" to field satellites more quickly. It intends to continue other technology maturation efforts and select a vendor to provide the second block of space vehicles.

The Space Force also designated about \$14 million for ongoing R&D of space-based moving-target-indicator sensors and for related artificial intelligence and machine-learning models for autonomous classification and identification of moving targets among other technology development efforts.

The Space Development Agency also would contribute to the moving-target tracking mission under the proposed budget request, using about \$88 million in R&D funds to develop and demonstrate a slew of space sensing technologies, including surface moving-target custody capabilities.

The endeavor received congressional sign-off when the Senate and the House passed the One Big Beautiful Bill Act on July 2 and 3, respectively. President Donald Trump signed the reconciliation bill into law on July 4. Now Air Force supporters are lobbying Congress to restore funding for the E-7A in full under the fiscal 2026 defense appropriations bill. ☐

—With Brian Everstine and Steve Trimble in Washington

ALONES CREATIVE/GETTY IMAGES



The U.S. military wants to field space-based moving-target-indicator capabilities by the 2030s.

The Pentagon, in its latest budget request, has earmarked sizable funds to transfer the targeting mission from airborne platforms to space-based systems. To underline its intent, the Defense Department coupled the space investment plan with a proposal to cancel the U.S. Air Force's procurement of 26 Boeing E-7A Wedgetail airborne early warning and control aircraft.

The decision to move to on-orbit assets stems from "significant delays" to the E-7A program, a senior military official told reporters on June 26. The unit cost of the program has jumped more than 23%, to \$724 million per aircraft, the official said.

But cost was only one factor. The official also cited "survivability concerns in a contested environment" with the Boeing 737-based platform, echoing the argument that the Pentagon made when it canceled the business-jet-class replacement for the Northrop Grumman E-8C Joint Stars used for ground moving-target tracking. U.S. officials have become increasingly concerned that Chinese long-range air-to-air mis-

sion command-and-control mission from the Boeing E-3A aircraft that it was due to replace. The service only last year finalized a \$2.56 billion contract with Boeing to convert two 737-700 aircraft into E-7A prototypes; the first flight of one should occur soon.

The Pentagon does not expect the space-based options to be ready until the 2030s, and perhaps even later, to migrate the associated battle management and command-and-control capabilities into space. As a gap-filler, the Defense Department plans to procure four of the Navy's Northrop Grumman E-2D Hawkeyes from carriers for land-based operations, the official noted.

Shifting the air moving-target-indicator (AMTI) and ground moving-target-indicator (GMTI) missions to space also presents formidable physics challenges inherent in tracking such targets from great distances. But military officials believe they are making progress. Satellites equipped with synthetic aperture radar have been performing AMTI tasks in orbital demonstrations, Gen. Gregory

WHATEVER THE AIRCRAFT WE HAVE THE MISSILES.



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\$10 Billion Gives NASA a Reprieve—But No Clarity

- > CONGRESS, WHITE HOUSE SEND MIXED MESSAGES
- > THE LUNAR-ORBITING GATEWAY IS IN PLAY

Irene Klotz Cape Canaveral

In passing the Trump administration's flagship domestic policy and spending bill, Congress bought NASA's Artemis program some time. But with little chance of a new budget in place before the fiscal year starts on Oct. 1, the reprieve may be short-lived.

President Donald Trump's One Big Beautiful Bill Act includes a \$10 billion boost for NASA, with funds to be available through September 2032. The bill, which Congress passed on July 3 and Trump signed a day later, directs the agency to spend an extra \$4.3 billion on Space Launch System (SLS) rockets and Orion capsules for missions that are canceled in the White House's proposed fiscal 2026 budget.

determined, and prospects of Congress passing a budget before the new fiscal year begins Oct. 1 are highly doubtful.

Continuing resolutions typically bridge the gap until Congress passes a new appropriation, with budget levels and established programs maintained in the interim. But Trump's Office of Management and Budget is expected to attempt to bypass that process and impose its planned 24% NASA budget cut regardless. If enacted, that would reduce the space agency's \$25 billion budget to about \$19 billion—its lowest level in inflation-adjusted dollars since 1961, according to a database maintained by The Planetary Society advocacy organization. Efforts to trim NASA's civilian workforce are already underway.

On July 9, Trump replaced acting NASA Administrator Janet Petro with Transportation Secretary Sean Duffy, temporarily bypassing congressional authority to approve a new agency leader. Trump has not announced a new nominee to head NASA after rescinding support for entrepreneur and private astronaut Jared Isaacman days before his expected confirmation.

Meanwhile, tests and demonstrations continue for Artemis missions that the Trump administration seeks to end. Artemis, which was created during

Trump's first term, is intended to extend human presence and commercial development into cislunar space.

L3Harris Technologies-owned Aerojet Rocketdyne conducted a 500-sec. static hot fire of a next-generation RS-25 engine on June 20. Four RS-25s power the core stage of the SLS, which debuted on the Nov. 16, 2022, Artemis I flight test. A second launch is targeted for April.

NASA has enough original RS-25s from the space shuttle program for three more flights and then plans—or had planned—to transition to the new version. The Trump administration wants to end the program there, but the

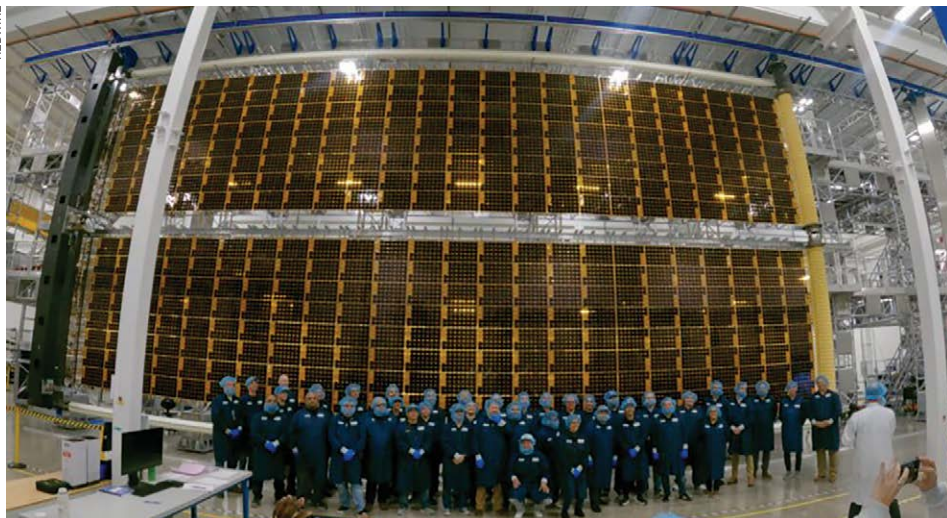
new legislation authorizes missions through Artemis V. Missions beyond Artemis III would require a new upper stage for the SLS and a new mobile launcher platform.

The RS-25 test was followed on June 26 with a static fire of a new SLS solid rocket booster made by Northrop Grumman. It was the first hot fire of the Booster Obsolescence and Life Extension (BOLE) program, which was created to replace shuttle-era steel casings with a carbon-fiber composite design and other upgrades to boost SLS lift capacity 10%.

That test did not go entirely as planned. Part of the nozzle broke off the booster about halfway into the 2-min. 20-sec. hot fire. NASA had planned to use BOLE boosters on Artemis IX.

Rounding out recent demonstrations of Artemis hardware that may never fly was a June 30 gathering at Redwire's facility in Goleta, California, to showcase the massive rollout solar array (ROSA) for NASA's Gateway station. The Gateway is intended to serve as a staging platform for

REDWIRE



With conflicting directions to launch the Gateway and also to terminate the program, NASA is proceeding with testing, including a demonstration of one of its rollout solar arrays.

The new legislation also includes \$2.6 billion for a small lunar-orbiting base, known as the Gateway, another element of NASA's Artemis Moon exploration program that the Trump administration seeks to terminate.

The bill adds \$1.25 billion—\$250 million per year in fiscal 2025-29—for International Space Station (ISS) operations and to fund work on follow-on commercial platforms. NASA wants to pay one or more commercial providers to host research experiments and astronauts in low Earth orbit after the station is retired.

The bill allocates another \$325 million to fund the remainder of SpaceX's \$843 million contract with NASA to supply a spacecraft to deorbit the station, which is targeted for 2030.

In contrast, the White House's fiscal 2026 budget unveiled in May proposes to scale back ISS operations by reducing the crew size and number of resupply flights.

How the administration and Congress reconcile their differences in funding and priorities for NASA has yet to be

crewed missions to and from the lunar surface. International partners are contributing about 60% of its development costs.

Regardless of the SLS and Orion, Gateway proponents say a station in lunar orbit is key for U.S. national and economic interests, especially in light of China's planned lunar development initiatives.

"The [Gateway's] Power Propulsion Element, which the ROSAs are attached to, will represent the pinnacle of solar electric propulsion," says Michael Gold, Redwire's president of civil and international space. "This is yet another example of a critical technology [in which] we cannot afford to fall behind the Chinese—not only for civil space and exploration but for national security purposes."

Although some Gateway components are slated to fly on SLS missions, Gold notes that the program is architecture-agnostic. "No matter what you're doing or how you're getting to the Moon, having an orbital platform to support and bolster your capabilities is always going to be critical," he says. "It is a key piece of infrastructure that will dramatically increase the amount of time, and therefore the nature of activities, that we can conduct on the Moon." The Gateway program is

planned for termination in the White House's 2026 budget.

"Our posture is to continue to execute the program on behalf of our customer and on behalf of the American people until we are told otherwise by Congress, which ultimately makes those decisions," Gold says.

The Big Beautiful Bill includes three new initiatives for the space agency:

- \$700 million for a Mars telecommunications orbiter.
- \$1 billion for long-delayed infrastructure improvements at NASA's Johnson, Kennedy, Stennis, Marshall and Michoud facilities.
- \$85 million to relocate a retired space shuttle to Texas.

Nearly 15 years ago, a Houston-based organization was among 29 contenders vying to build public displays for NASA's three surviving orbiters. Texas lost, and the shuttles were delivered to the Smithsonian Institute, the California Science Center in Los Angeles and the Kennedy Space Center Visitor Complex.

Absent from the Big Beautiful Bill was any mention of NASA's science, technology and aeronautics programs. The Trump administration plans to cut those portfolios 50% or more. ☹

Smithsonian Fights Texas Grab for Space Shuttle Discovery

— Joe Anselmo Washington and Irene Klotz Cape Canaveral —

TEXAS LAWMAKERS ARE A STEP CLOSER TO SNATCHING the National Air and Space Museum's prized space shuttle and moving it from Northern Virginia to Houston.

A provision tucked into the massive tax and spending bill Trump signed into law on July 4 provides \$85 million to relocate the space shuttle Discovery from the Smithsonian's Steven F. Udvar-Hazy Center in Northern Virginia, where it has been on display since 2012. The money ostensibly would pay for the move and construction of a new building to display the shuttle at NASA's Johnson Space Center, although cost estimates to do so are several times higher.

"Houston has long been the cornerstone of our nation's human space exploration program, and it's long overdue for Space City to receive the recognition it deserves by bringing the space shuttle Discovery home," said Sen. John Cornyn, who wrote the measure with the support of fellow Texas Republican Sen. Ted Cruz.

Not so fast, counters the Smithsonian Institution, which is fighting to keep its prized shuttle near the nation's capital, where it is viewed by more than 1 million visitors every year.

Transporting Discovery would be enormously complicated, since the two modified Boeing 747s that carried space shuttles mounted on their roofs are themselves museum pieces. Smithsonian officials say that moving the shuttle by land and barge would cost more than \$300 million—and risk damaging the orbiter.

"It would be unprecedented for Congress to remove

an object from a Smithsonian collection and send it somewhere else," the Smithsonian, which receives about 60% of its funding from the federal government, stated in a memo to lawmakers on Capitol Hill.

The memo also noted that NASA had transferred ownership of Discovery to the Air and Space Museum. "The Smithsonian does not manage our collections as government property subject to federal property disposal rules; our records, policies and procedures treat them as 'trust' objects subject to Smithsonian control."

And the center's namesake also has weighed in. Hazy told Aviation Week in an email on July 7 that the Smithsonian owns the shuttle and that Texas and NASA "do not have a legal right to transplant Discovery to Houston."

Johnson Space Center, home to human mission operations and the NASA Astronaut Corps, played a major role in the 1981-2011 shuttle program. Texas lawmakers have long chafed that they were not given an orbiter for public display after the vehicles were retired due to safety concerns.

In addition to Discovery, Atlantis is displayed at the Kennedy Space Center Visitor Complex on Merritt Island, Florida; Endeavour is at the California Science Center in Los Angeles; and the prototype Enterprise, which never flew in space, is at the Intrepid Museum in New York. Two other shuttles, Challenger and Columbia, were destroyed during fatal accidents in 1986 and 2003, respectively.

Atlantis is the only orbiter still owned by NASA. ☹

ATC Revamp Receives Funding Boost

> SUPPLEMENTAL MONEY FOCUSES ON TECHNOLOGY UPGRADES

> TOTAL COST IS EXPECTED TO EXCEED \$30 BILLION

Sean Broderick Washington

A \$12.5 billion down payment on the U.S. Transportation Department's plan to upgrade key air traffic control infrastructure—courtesy of a massive spending bill signed into law July 4—provides insight on the effort's priorities and costs.

the FAA's four-year budget authorization that runs through fiscal 2028 but must be appropriated annually. One exception is the ARTCC provision, which stipulates that the new center replace "at least" three of the 22 existing facilities as part of a broader

The FAA's air traffic control infrastructure revamp would touch airspace and major airports throughout the U.S.



JOE PRESERVATION.NET

Eighty-five percent of the air traffic control funding in the Trump administration's One Big Beautiful Bill is divided among four buckets: \$4.75 billion for telecommunications infrastructure modernization and systems upgrades, \$3 billion for replacing radar systems, \$1.9 billion for construction of a new air route traffic control center (ARTCC) and \$1 billion for terminal radar approach control (tracon) improvements and consolidation.

The rest is spread out across various FAA initiatives, including airport surface safety systems, expanding implementation of certain Next-Generation Air Transportation System (NextGen) technologies, remote air traffic control (ATC) towers and the new Center for Advanced Aviation Technologies in Texas.

The funding comes in addition to whatever the Transportation Department can squeeze out of its annual FAA budget, which has yet to be approved for fiscal 2026.

However, the law offers few details about how the ATC money must be spent beyond funding levels and references to other legislation, such as

streamlining that the Trump administration asserts will save money without reducing service levels.

While technologically feasible, consolidation is likely to face considerable pushback from affected controllers and their communities. But Congress, whose members are usually the first to speak up when high-paying jobs leave their voting blocs, appears to be committed to the push. Another \$100 million in the law is dedicated to "an ARTCC realignment and consolidation effort" targeting closure or consolidation of "at least" 10 centers.

Even with substantial savings from streamlining, the Transportation Department's proposed ATC modernization cost will far exceed current funding. While the plan unveiled in May does not include cost estimates (AW&ST May 19-June 1, p. 16), law firm Holland & Knight estimates a price of \$31 billion in fiscal 2025-28, citing Transportation Department sources.

Last year's FAA budget request proposed \$8 billion over five years to replace more than 20 ATC tower and tracon facilities and upgrade more than half of the agency's 618 radar sys-

tems with remaining money. The proposal came too late to be folded into the current FAA budget bill, but the agency has not given up.

The fiscal 2026 budget request includes \$445 million in dedicated funding for new radars, which were designed to last for 20 years but average 36 years of age, the FAA says. The agency plans to ask for another \$1.6 billion through 2030 as part of the radar upgrade plan.

The NextGen technology advancement language provides \$300 million and gives the FAA and Transportation Department 180 days to "evaluate and expedite the implementation of" several NextGen programs and capabilities. Among them is performance-based navigation (PBN), which shifts aircraft guidance to onboard systems from sensors and ground stations.

Under the legislation, the FAA has three years to "fully implement" PBN procedures "for all terminal and en route routes, including approach and departure procedures for covered airports," a category that includes about 40 large and medium hubs. The PBN effort must prioritize specific procedures, including trajectory-based operations, optimized profile descents, multiple airport route separation and converging runway display aids.

The FAA also must work with industry on equipage requirements, as well as with stakeholders and the NextGen Advisory Committee to establish PBN procedures "as a primary means of navigation to further reduce the dependency on legacy systems within the national airspace system." That plan should include a "two-year implementation plan" to "further incentivize" accelerated equipage rates among air carriers, the law says.

Those NextGen initiatives were laid out in the 2024 FAA reauthorization act, which the law references directly.

Industry welcomed the supplemental funding as part of a larger effort it considers crucial.

"It's really important to underscore that the entire industry is united in this proposal," National Business Aviation Association President and CEO Ed Bolen said about the ATC revamp during a June 4 congressional hearing. "I think this is probably as united as our community has been for an investment in our air transportation system since the creation of the Airport and Airways Trust Fund in 1970." 🗳️

**Zoran Savic**

Director of Product Management
for the Flight Management Solutions
portfolio at Flightscape -
Powered by CAE

Discover How Flightscape – Powered by CAE is Helping Airlines Navigate the Evolution from Reactive to Predictive Flight Planning

With airline profit margins measured in just a few dollars per passenger, every operational decision counts. Aviation Week Network spoke with Zoran Savic of Flightscape – Powered by CAE to learn how intelligent automation is revolutionizing flight planning while preserving the critical human expertise needed during irregular operations.

Q Aviation Week: How has flight planning evolved over the years, and what does the future hold?

A Zoran Savic: The level of integration and automation has increased dramatically. In the past, dispatchers had to manually check weather impacts throughout all flight phases to maintain situational awareness. Today, weather monitoring runs automatically in the background, triggering alerts only when conditions deteriorate—and those alerts are automatically sorted and prioritized by severity.

The future goes beyond alerts. We're now using machine learning and artificial intelligence to analyze both real-time and historical data, recommending multiple solution options for dispatchers to choose from. The workflow is evolving from manual checks to managed-by-exception to intelligent insights that drive decisions.

Q Aviation Week: Why is flight planning automation so critical to airline operations today?

A ZS: Airline margins are razor thin—a recent study shows the average profit per passenger is just \$6. A single delay requiring a voucher or cappuccino as compensation can completely eliminate that profit.

The two major cost drivers are fuel and labor. For fuel optimization, we focus on continuous route improvements that operate cost-effectively while reducing CO2 emissions. For labor costs, automation increases productivity through streamlined processes and intuitive user experiences.

Airlines measure success through specific KPIs—flights planned per dispatcher per shift and clicks required to dispatch a flight. Automation eliminates manual, repetitive tasks so dispatchers can focus on higher-value activities that require human expertise.

Q Aviation Week: How has automation transformed flight planning workflows, and what still requires human expertise?

A ZS: Automation isn't about removing humans—it's about enhancing their capabilities. We've moved from manual, repetitive tasks to collaborative human-machine interaction where dispatchers focus on higher-value decision-making.

Transparency is crucial. Users need to understand how and why the system recommends something—we don't want black boxes. The system enhances oversight by flagging key issues and recommending solutions, but the dispatcher stays in control.

To read the full interview, go to aviationweek.com/cae-flightscape

The YFQ-42 (left) follows GA-ASI's 18-year quest to field a jet-powered uncrewed aircraft, starting with the MQ-20 (middle) and continuing with the XQ-67 (right).

GENERAL ATOMICS AERONAUTICAL SYSTEMS INC.

ROLE REVERSAL

> ORIGINAL DISRUPTER
GA-ASI FACES
A NEW THREAT

> FIRST FLIGHTS OF
YFQ-42 AND YFQ-44
ARE COMING SOON

> THE COMPANY
MAINTAINS AN
AGGRESSIVE POSTURE

Steve Trimble Paris and Washington

Linden and Neal Blue founded General Atomics Aeronautical Systems Inc. on Sept. 28, 1992, starting with a small team and a disruptive idea.

At the time, remotely piloted aircraft remained stubbornly out of the mainstream of military aviation fleets outside of Israel. By linking such aircraft to newly available space-based navigation and communications systems, the brothers believed the new company could usher in a breakthrough capability.

"Those were two of the big factors that enabled the original innovation to not just build an airplane that you could fly and demonstrate, but to end up building a fleet of aircraft that the military or other organizations—including

law enforcement—could use . . . and allow you to fly 70 [combat air patrols] per day, which we're still doing now," Linden P. Blue, Neal Blue's son, said during a Paris Air Show industry forum on June 16.

Although affiliated with prime contractor General Atomics—a then-37-year-old leader in the nuclear industry—the fledgling Poway, California-based subsidiary operated with a startup culture in 1992.

It was a technology David competing against defense industry Goliaths.

"It started out very much as a small business," said Blue, now CEO of General Atomics Aeronautical Systems Inc. (GA-ASI). "The small business culture back then also focused very much on solving the problem of the warfighter, as opposed to worrying about contracting."

Thirty-three years later, the remotely piloted aircraft

industry is poised for another new breakthrough, and GA-ASI finds itself in a different position.

This summer, the U.S. Air Force plans to start flight-testing two new operational prototypes for Increment 1 of the nascent Collaborative Combat Aircraft (CCA) family: the GA-ASI YFQ-42 and the Anduril YFQ-44.

Both CCA models represent potential new breakthroughs in aircraft design and manufacturing to lower production costs, along with autonomy software to reduce the burden on human controllers. In combination, these armed and autonomous aircraft offer a path to recreating affordable mass in air warfare, in collaboration with more expensive and survivable fighters and bombers operated by human pilots. The Air Force's concept for CCA continues to evolve, but leaders previously outlined plans to acquire about 1,000 CCA that will be selected next year, including at least 100 copies of the winning Increment 1 design.

In Poway, however, GA-ASI finds itself in a new competitive position. A year ago, three defense industry giants—Boeing, Lockheed Martin and Northrop Grumman—lost bids to deliver the CCA Increment 1 prototypes. As the Air Force evaluates bids for Increment 1 production contracts, GA-ASI now plays the role of the established defense industry heavyweight, competing against Anduril, a well-financed and relative newcomer that aims to disrupt the defense industry.

David Alexander, president of GA-ASI and a 30-year veteran of the company, pushed back on labeling the maker of the MQ-1 Predator, MQ-1C Gray Eagle and MQ-9 Reaper as the established defense contractor in the CCA competition.

"I do feel like we're still the disruptor, and we are still the nontraditional aerospace company," Alexander told Aviation Week in a July 8 interview. "There are things we do that bridge, I would say, more toward a commercial company."

An example is GA-ASI's approach to taking significant financial risks during the production phase of an aircraft program, a period when publicly traded, larger defense companies traditionally play it safe. When other defense companies may put production on hiatus in the absence of confirmed orders, GA-ASI still self-funds continued manufacturing that is at risk, which avoids restart costs that are ultimately passed on to customers.

"We lean [into] risk and keep the production line smooth and the deliveries going," Alexander said. "It allows us to do things like deliver [MQ-9A] airplanes to the French in three months. Why? Because we forecasted production [demand]."

Without naming names, GA-ASI's practice contrasts with the approach taken by other defense contractors, Alexander said. "We're still doing things aggressively, leaning forward and not playing games with [saying], 'Oh, you come in here and want to buy two airplanes, so I'm going to give you a cold-start price and a cold-start delivery date,'" Alexander said. "No, we don't do that. We don't play that game."

Although GA-ASI enters the CCA competition with decades of experience in the defense industry, the company also has learned several painful lessons. After scoring breakthroughs more than 20 years ago with the piston-powered MQ-1A/B and turboshaft-driven MQ-9, the YFQ-42 design represents the latest attempt in an 18-year-old quest for the company to sell a turboprop-class, armed aircraft to the military.

The first attempt came with the company's self-funded, turboprop-powered MQ-20, also known as the Predator C

Avenger, which achieved first flight in 2009. As the project got off the drawing board, GA-ASI's leaders quickly discovered they had designed the wrong aircraft.

"We originally designed MQ-20 to fly fast," Alexander said. "And then it turned out the customer that was interested in it really wanted high altitude and long endurance, so . . . we redesigned the wings and tails and got right back into flight again to satisfy that."

In the end, GA-ASI produced only a handful of MQ-20s, some of which still serve as airborne testbeds for payloads and autonomy software. In some ways, the company was lucky that Predator A/B-size demand eluded the Avenger model. The largely hand-built design was ill-suited for automated manufacturing. "I can tell you right now, I would not want to go into mass production on MQ-20," Alexander said.

But the experience helped the company understand how to design a turboprop-powered aircraft with stealthy features, such as S-shaped ducts that hide the face of the engine from detection by radar.

GA-ASI's next opportunity to field a jet-powered, uncrewed aircraft came with the U.S. Navy's 30,000-lb.-class MQ-25 Stingray, a carrier-based air refueler about 50% heavier than the MQ-20. Boeing's 2018 victory in that decade-long competition remains a bitter subject inside GA-ASI circles, due to a late change in the evaluation criteria that favored the lowest-cost bid.

"We actually went through two airplane designs in nine years" during the competition, Alexander said, recalling the company's costly investment in bidding for the contract. "And then, as history shows, two months before the final [request for proposals] came out for the final design, it was turned into a buy-in program. Our lesson learned from that is buy-in programs for us are a loser's game. Because that's just not something that we can do."

By then, GA-ASI had become deeply involved in a secretive Air Force Research Laboratory (AFRL) initiative. The Low-Cost Attributable Aircraft Platform Sharing program proposed a step-change reduction in manufacturing cost, adapting the automotive-style common chassis approach to producing several different types of aircraft models around a common keel.

This time, GA-ASI's approach proved more successful. The AFRL selected GA-ASI and Kratos over Boeing, Lockheed and Northrop to compete as finalists to build a flight demonstrator. In the end, GA-ASI won the contract and flew the XQ-67 for the first time in February 2024.

Alexander views the XQ-67 program now as a design and manufacturing proof of concept for what became the YFQ-42. The designs show an obvious common heritage. The latter features lower-aspect-ratio wings and a higher angle of sweep, two hallmarks of a design point that calls for greater speed and reduced endurance.

The YFQ-42 reuses several major subsystems from the XQ-67, including avionics, software and landing gear, Alexander noted.

However, the CCA Increment 1 program also focuses on ramping up to a high rate of production and delivery as quickly as possible.

"The big difference going from one to the other was that the YFQ-42 had to go into high-rate production," Alexander explained. "All that reuse from one to the other has allowed us to not reinvent the wheel there but now go focus on high-rate production." 🗨️

Ukraine War Drives Multiprong Missile Defense Response

➤ U.S. NAVY DEPLOYS COYOTE DRONE INTERCEPTOR AT SEA

➤ DIEHL DEVELOPS LONG-RANGE IRIS-T SLX SYSTEM

Robert Wall London and Le Bourget

The clamor for air defense capabilities has become an “everything, everywhere, all at once” problem.

In the early days of Russia’s full-scale invasion of Ukraine, one of the highest priorities for Kyiv’s backers was procuring RTX Stinger man-portable air defense systems to hold Russian attack helicopters and fight-

high-power microwave counterdrone system to the U.S. Marine Corps.

The current interest in that segment brings challenges, too, particularly as companies look to make a business case. “It’s a crowded market,” one industry executive notes.

Russia’s inability to gain air superiority in Ukraine has underscored the stra-

The Pentagon might also buy an initial batch of the Army’s Lockheed Martin Patriot PAC-3 Missile Segment Enhancement interceptors for the Navy. And the German Defense Ministry late last year funded Diehl and Thyssenkrupp to develop a submarine-launched anti-air system.

To handle swarms in that domain, Israel has deployed a maritime version of the Rafael Iron Dome.

Something similar is playing out in the air domain, where services are looking for ways to intercept threats at a lower cost. The U.S. Air Force, for instance, has equipped Boeing F-15Es with BAE Systems Advanced Precision Kill Weapon System rockets. The Israeli Air Force has used attack helicopters to intercept drones fired by Iran as a more efficient way to counter those threats than with other engagements. In at least one case, a Boeing AH-64 Apache used its gun to intercept an Iranian UAV.

The fighting in Ukraine has set off an unprecedented buying spree among countries in the region to bolster their ability to counter threats from the air. Kongsberg’s Nasams air defense system, for instance, has downed more than 1,000 Russian targets, industry officials say. At least a dozen countries are either buying the system or have disclosed procurement plans.

Kongsberg said in June that it would work with a Ukrainian partner to produce a new air defense missile for use from Nasams that typically employ RTX Amraam or AIM-9X missiles. The goal is to fire lower-cost interceptors to take out cheap drones.

Other systems are also on European countries’ shopping lists. Sweden said in June it would buy Diehl’s IRIS-T SLM medium-range surface-to-air system. And Romania announced its purchase of advanced short-range air defense equipment only days after Denmark said it would spend close to \$1 billion on urgent fielding of ground-based air defense systems to protect cities and critical infrastructure as it considers long-term plans.

The Pentagon, long the largest buyer of air and missile defense equipment, is stepping up its purchases after expending a large number of systems in the Middle East. The Defense Department plans to increase the number of PAC-3s it is buying beyond the Navy purchase, and the fiscal 2026 budget request also calls for ac-

Ukraine has relied on Diehl IRIS-T SLM systems as part of its missile defense shield.



UKRAINE DEFENSE MINISTRY

ers at bay. More than three years into the fighting, demand for just about every other air and missile defense system has exploded, reflecting the multiplicity of threats looming over Ukraine—from drone swarms to hypersonic missiles.

Dealing with swarms of uncrewed aircraft systems (UAS) has become a particular concern for air defense operators, in part because their numbers can overwhelm defenses. That has spurred a search for kinetic and nonkinetic ways to defeat such systems.

Israel, for instance, says it has started using its Iron Beam laser-based counterdrone and counter-rocket system. Raytheon recently used a single Coyote drone interceptor with an electronic payload to down a double-digit number of small UAS, says Tom Laliberty, president of RTX’s Land & Air Defense Systems. The interceptor was recovered, recharged and ready to go again, he says. U.S. defense startup Epirus said in April that it delivered a

tegic importance of defensive systems beyond just intercepting a few drones or cruise missiles. It has forced Moscow to pursue a brutal ground campaign that some Western intelligence officials believe has resulted in more than 1 million Russian troop casualties.

The fighting in Europe and in the Middle East has expanded the rush for air and missile defense systems into the naval domain as well, since that has increasingly become part of the fighting. Ukraine’s Defense Intelligence Directorate said Kyiv shot down Russian fighters with anti-air missiles launched from drone boats. The U.S. Navy, meanwhile, is equipping vessels deploying to the Red Sea with the Coyote drone interceptor, originally used by the U.S. Army, to combat drones launched from Yemen. The ship-based batteries will come with Lockheed Martin Hellfire missiles as part of an effort to use lower-cost interceptors than the more capable Raytheon Standard Missile.

quisition of a greater number of Lockheed Martin Terminal High-Altitude Area Defense interceptors.

To keep up, such manufacturers as MBDA and Diehl are scaling up and trying to balance higher output with the development of new systems.

Diehl has increased some missile production tenfold and is expanding in all production sites, says Helmut Rauch, CEO of privately held Diehl Defense. The company has doubled the production floorspace where it integrates the firing units for the medium-range IRIS-T SLM system. In some places, Diehl has increased operations to two or three shifts to keep pace. A naval version of the system is due for ship-based testing in the fall, Rauch adds.

The company also is working on the IRIS-T SLX, a longer-range version capable of striking targets at 80 km (50 mi.). It is expected to be ready in 2028-29.

RTX, meanwhile, says it is in talks with a European partner to restart production there. "There was a long period where Stinger really wasn't ordered,"

The U.S. Air Force now operates F-15Es with low-cost interceptors to take down drones.



Laliberty says. "So we're bringing all of our suppliers back online and ramping up production." The effort unfolds as RTX's Raytheon strives to win the U.S. Army's Stinger replacement program, known as the Next-Generation Short-Range Interceptor. A source selection for that is expected in 2028.

Raytheon is also collaborating with MBDA in Germany to boost output of the Patriot PAC-2 GEM-T interceptor

to fulfill orders from several European NATO members.

For its part, Lockheed Martin is in talks about increasing its Patriot PAC-3 output. The company and the Army agreed in 2024 to boost output to 650 rounds a year, and there has been "an intense amount of discussion" about going higher, says Tim Cahill, president of the company's Missiles and Fire Control unit. ☞

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Japan Prepares Air Force for Elevated Threats

> TOKYO DEVISES A COLLABORATIVE COMBAT AIRCRAFT PLAN

> MITSUBISHI BEGINS UPGRADING F-15s

Chen Chuanren Tokyo and Komatsu Air Base, Japan

Japan has shifted its defense modernization efforts from cruise control into overdrive in recent years, reflecting a sense of urgency as threats mount. But more might be necessary to keep pace with regional developments.

The Japan Air Self-Defense Force's (JASDF) modernization has progressed at a measured pace since World War II. But Chinese military buildup, North Korean missile expansion and Russia's full-scale invasion of Ukraine have triggered a strategic reassessment in Japan. Tokyo outlined the operational functions and capabilities deemed essential to national defense in 2023 in the Seven Pillars framework. This plan has driven the country's pursuit of such capabilities as standoff weapons, integrated air and missile defenses, uncrewed systems and enhanced command and control.

Yet China's relentless modernization push and active air operations close to Japanese airspace have left military officials wondering whether the Seven Pillars are sufficient.

"We are watching the development of a long-range stealth bomber by China," Maj. Gen. Takahiro Kubota, JASDF director general of defense planning and policy, tells Aviation Week. China flew two new potentially stealthy combat aircraft late last year. "We are aware of the improvements and are curiously monitoring the developments," Kubota says. "We are watching to see if there is a requirement to amend the Seven Pillars projects in response to this development."

Other threats that have the JASDF on alert include the emergence of maneuverable ballistic missile warheads, multiple independently targetable reentry vehicles, long-range and high-speed cruise missiles, crewed and uncrewed stealth-capable multirole aircraft, anti-ship ballistic missiles and hypersonic glide weapons.

Japan's highest-profile effort to deal with these threats is the Global Combat Air Program (GCAP), which it is pursuing with Italy and the UK to develop a long-range, twin-engine fighter by around 2035. In Japan, that aircraft is to replace the Mitsubishi F-2. The new platform is expected to incorporate advanced networking capabilities, an internal weapons bay and high-end sensing technologies, including high-power radar and sensitive infrared sensors. Several JASDF personnel are assigned to the effort's joint project office, the GCAP International Government Organization, working alongside European counterparts.

Japan, like other air forces, is looking to augment its next-generation combat aircraft with an uncrewed element, often referred to as collaborative combat aircraft (CCA). "We are now drafting a CCA operational concept paper to prepare for the delivery of CCA in 2035," Kubota says.

Tokyo has yet to decide whether to field the CCA mainly with the Lockheed Martin F-35s that the JASDF has started to operate. Kubota says the service is open to CCA developed domestically or through international partnerships. Japanese defense companies, such as Mitsubishi and Kawasaki, have proactively unveiled concepts and technologies for future crewed-uncrewed teaming.

Japan is also modernizing the backbone of its air force, the Mitsubishi F-15J, to keep pace with threats. The fighter is in use with eight squadrons stationed at four major bases, including the 303rd Sqdn. at Komatsu Air Base, which is tasked with dealing with incursions over the Sea of Japan. From April 1, 2024, to March 31, 2025, the JASDF reported 704 scrambles; two-thirds involved Chinese aircraft, up about 5% from the year prior. The number of scrambles has been high for more than a decade, the Japanese Joint Staff Office said, which puts a strain on the service.

Crucial to Japan's medium-term defense modernization strategy is upgrading the F-15J into what the JASDF refers to as the F-15UG. The package spans 68 aircraft and includes an RTX APG-82 active, electronically scanned array radar, Honeywell Advanced Display Core Processor II, BAE Systems' Eagle Passive Active Warning Survivability System (Epawss) and Lockheed Martin's AGM-158B/B-2 Joint Air-to-Surface Standoff Missile-Extended Range (JASSM-ER).

Lt. Col. Yuki Kuraoka, commanding officer of the 303rd

The brightly painted Mitsubishi F-15Js of Japan's aggressor squadron simulate hostile aircraft.



CHEN CHUANREN/AM&ST PHOTOS

Sqdn., says the integration of the JASSM-ER and sensors—as well as the ability to carry more air-to-air missiles—is a significant increase in capabilities, akin to the U.S. Air Force's Boeing F-15EX. Mitsubishi Heavy Industries has commenced the F-15UG upgrade work, whereas JASSM-ER certification will take place in the U.S. using an upgraded F-15E testbed.

Kuraoka adds that training between F-15UGs and F-35s will begin soon to ensure effective integration between the systems. That will be the cornerstone of the JASDF's air-power until the GCAP fighter is fielded.

Japan is also investing in tying its systems together more closely to bolster information-sharing. “We are formulating the posture for effective surveillance and control activities over Japan and its surrounding airspace, including the vast area on the Pacific,” Kubota says.

The JASDF is upgrading the Boeing E-767 airborne early warning aircraft's central processing units and integrating electronic warfare support measures to improve situational awareness, even as the service reviews long-term plans to replace the system. These enhancements will operate alongside a Northrop Grumman E-2D Hawkeye fleet that is set to grow to 18 aircraft by 2028. The JASDF is also enhancing its networked radar-to-shooter system to improve detection, tracking and interception performance across multiple threat vectors.

In addition, the service is updating training to prepare for the new systems and to ready personnel for the higher threat environment. In December 2024, the Japanese Defense Ministry selected the Beechcraft T-6 Texan II to replace the aging Fuji T-7 as the JASDF's basic trainer, a notable departure from past procurement practices. Textron will deliver all 36 aircraft directly, bypassing the licensed production or local assembly approach that previous acquisitions typically favored.

Japan is also considering replacing the Kawasaki T-4 intermediate jet trainer. Boeing has pitched the T-7A Red Hawk and Leonardo is offering the M-346 Master. Mitsubishi recently revealed its T-X concept in a bid to fulfill the JASDF's future trainer requirements. Local suppliers anticipate that Japan might pursue a light attack capability with the new trainer platform to expand operational flexibility.



Training processes are being overhauled, too. “As we work toward more networking with the rest of the Self-Defense Forces, the training scope of individual operators has expanded to meet these threats,” Kuraoka says.

The service also plans to upgrade the F-15Js used by its aggressor Tactical Fighter Training Group (TFTG) at Komatsu to the F-15UG standard to emulate near-peer adversary fighters. TFTG Commander Col. Yoshimitsu Junichi says his unit continues to refine adversary tactics through equipment analysis and international engagement. The unit traditionally relied on U.S. cooperation but has recently partnered with European and Australian operators, reflecting the need to prepare for the GCAP fighter's arrival and strengthen defense ties between Tokyo and Canberra.

Junichi aims to send JASDF aggressor pilots to such exercises as Pitch Black in Australia to learn from international air forces. They have trained with Indian Sukhoi Su-30s, which visited Hyakuri Air Base for an exercise in 2023, to study tactics and capabilities associated with the Russian-made system that is similar to some of China's aircraft.

The aggressors already operate ALQ-131 jammers, and introducing the Epawss-equipped F-15UG should enhance the service's ability to train realistically in electronic warfare scenarios. 🌐

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GOING GLOBAL

ASFAT wants to offer A400M aftermarket services to other operators of the airlifter and provide options for the platform's new customers.



Tony Osborne Ankara, Eskisehir and Kayseri, Turkey

Across Turkey, about 30,000 people work in military factories that churn out spare parts and components, perform maintenance, repair and overhaul on vehicles and aircraft and even build warships.

These factories—owned by the Turkish National Defense Ministry and operated on behalf of the army, navy and air force—may appear to be a throwback to the Cold War era. Today, they give Turkey a level of defense self-sufficiency that many other NATO members have lost through cost-cutting and creeping contractorization. Now Ankara is seeking to broaden the potential of these 27 factories by selling their spare capacity in production and maintenance, repair and overhaul (MRO) to neighbors and allies.

In 2018, the government formed ASFAT, a Turkish acronym for Military Factory and Shipyard Management, a private enterprise that has become the

public face and shop front for doing business with these facilities. Since then, ASFAT has secured contracts with Pakistan to build warships. Beyond that, it also constructs mine-sweeping vehicles, aircraft tow trucks, munition carriers and even dumb bomb guidance kits for other countries.

The company is looking into offering its range of air capabilities, particularly for MRO services, ASFAT CEO Mustafa Ilbas told journalists during media tours arranged by the company in May.

“Our mission is to use the capabilities of these facilities,” Ilbas said. “We not only have the capabilities but also a geopolitical and geographical advantage. We are a part of Europe, but we

are also part of the Middle East and part of the Turkic world, too.”

Ilbas said that Turkey is increasingly seen as a trustworthy defense partner, particularly in Europe, pointing to the LBA Systems joint venture between Leonardo and Baykar as well as Spain's selection of the Turkish Aerospace Industries (TAI) Hurjet advanced jet trainer (AW&ST March 24-April 6, p. 22).

The company's immediate push is to open the Turkish Air Force's Airbus A400M MRO facilities at Kayseri to other operators of the airlifter. Operated by the Turkish Air Force's 2nd Air Maintenance Factory Directorate (AMFD), the facility is one of just two Airbus has certified to perform heavy maintenance and retrofits on the type, the other being in Spain. As the global A400M fleet grows, ASFAT sees a bottleneck in the capacity of available MRO facilities.

- > **ASFAT IS THE SHOP FRONT FOR TURKEY'S MILITARY FACTORIES**
- > **KAYSERI IS HOME TO ONE OF TWO ACCREDITED AIRBUS A400M MRO FACILITIES**
- > **SURPLUS CAPACITY IS BEING OFFERED TO INTERNATIONAL CUSTOMERS**



TONY OSBORNE/AW&ST

"We are telling Airbus just how important this facility is, particularly now [that] they are selling aircraft to countries such as Kazakhstan," Ilbas said.

Opening options for MRO and building competition for fleet sustainment could lead to new sales of the aircraft, he suggested. "This is good for Airbus, and it is good for the existing customers of the A400M now," he said.

The Turkish Air Force's Air Maintenance Factory Directorates are producing parts to support upgrades and life extensions of the country's F-16 fighters.

In early June, shortly after Aviation Week's visit, the A400M maintenance teams completed retrofit work on the eighth of the 10 operated by the Turkish Air Force. Turkey's A400Ms are among the busiest of the type in the

world, used extensively on international transport missions as part of the country's growing global soft power projection.

Following Russia's full-scale invasion of Ukraine in February 2022, two A400Ms were stuck at Kyiv's Boryspil Airport for 10 months, depriving Turkey of one-fifth of the fleet. Unable to leave, technicians looked after the aircraft and routinely performed engine runs, and the A400Ms were safely repatriated in December 2022.

Kayseri's facilities also support Turkey's Lockheed C-130 fleet and have been upgrading the aircraft with TAI's Erciyes avionics package.

ASFAT aims next to secure the ability to service and support the C-130J model as part of a wider plan for the Turkish Air Force to receive 12 surplus aircraft from the UK Royal Air Force. Those deliveries could begin this year.

"We are going to build new hangars because we want to increase the capacity and capability to look after the C-130s and the C-130J in particular," Ilbas said, adding that these facilities would be built to accommodate maintenance of C-130Js operated by other countries in Europe and the Middle East.

ASFAT is seeking to sell aftermarket services to African C-130 operators in particular, including Nigeria and Niger. Ilbas also suggested that the company could become an MRO house for the Eurofighter combat aircraft, should the Turkish Air Force adopt the platform.

ASFAT has access to three AMFDs—two operated by the air force, located

at Kayseri and Eskisehir, and a third in Ankara, run by the army to support the military helicopters of the army, navy, air force, coast guard and the Jandarma military police. The factories date back to the earliest days of the Turkish Republic, and some hangars at Kayseri originally were used by the first Turkish aircraft manufacturer, Tomtas, to license-build German Junkers aircraft during the mid-1920s.

One of ASFAT's goals is to modernize and rebuild these facilities with the income generated from the spare capacity.

The facilities in Kayseri can manufacture more than 18,000 different aircraft components. Most are not safety-critical but would be flight-critical; their malfunction or unavailability could ground an aircraft. Using the factories to produce these components considerably reduces the Turkish military's reliance on suppliers outside the country, reducing costs—something that is especially important now that the Turkish lira is weak in comparison with the dollar and euro.

While ASFAT and air force officials emphasize machining and avionics repair capabilities, the facilities also produce seals for fuel systems, parachutes, harnesses and helmets. Some parts required for older, less supported platforms are being reverse-engineered. In Ankara, teams have been established to examine the metallurgy and chemical composition of the materials used in the parts.



ASFAT

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Once that has been sourced, the facilities can produce the parts, often at a fraction of the cost of purchasing from existing supply chains. Display boards in each factory directly compare components' cover prices with the cost of local production in the AMFDs.

The difference is often staggering. An A400M propeller spinner costs €4,000 (\$4,500) from the manufacturer, but the teams in Kayseri say they can make it for 3,000 lira, the equivalent of around \$70. In Eskisehir, home of the 1st AMFD, teams can produce a midfuselage bulkhead for the Lockheed Martin F-16 as part of a structural modification to extend the aircraft's service life. The 1st AMFD says it can produce the component for around \$8,100, compared with the cover price of \$15,500. In another example, the AMFD recreated its own system for testing engine warning systems on the F-16. Buying from the manufacturer would have cost \$57,600, but the AMFD produced 12 sets for the equivalent of \$6,000.

ASFAT is now considering selling these components through NATO's Support and Procurement Agency (NSPA). Ilbas has established a NATO department within ASFAT to study meeting the alliance's standards and selling components to other members. Furthermore, the company is actively bidding on NATO contracts through the NSPA.

In addition, ASFAT sees opportunities for fighters and associated engine MRO. Eskisehir's AMFD has facilities for F-16 work as well as program depot maintenance of types such as the McDonnell Douglas F-4 Phantom and Northrop T-38 Talon, both of which remain in Turkish Air Force service. The AMFD is planning the construction of new, modern hangarage that would increase the capacity of fighter MRO facilities, potentially paving the way for maintaining foreign F-16s.

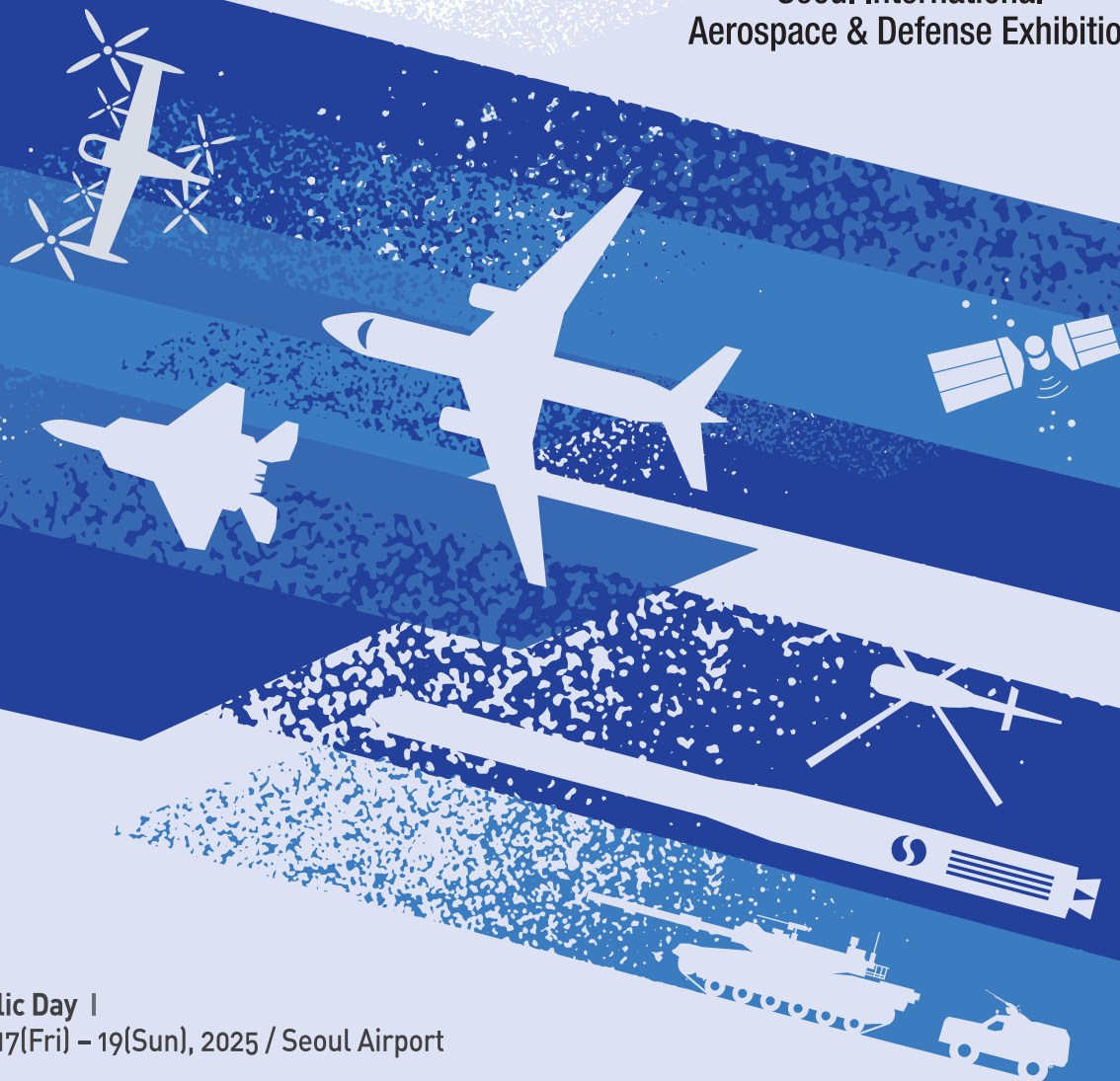
Eskisehir's AMFD is also looking at repurposing facilities that were built for engine MRO on the Lockheed Martin F-35 Joint Strike Fighter but never used because Turkey was banished from that program. Also located at Eskisehir are engine MRO facilities and test cells for the GE Aerospace F110 engine for the F-16, GE J79 and J85 powerplants for the F-4 and T-38 as well as GE T700 engines that power Sikorsky S-70 Black Hawk helicopters. 🇹🇷



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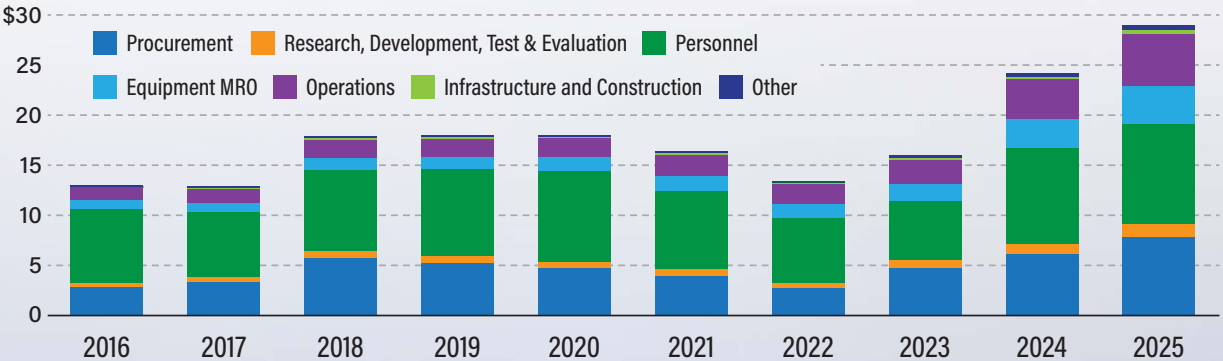
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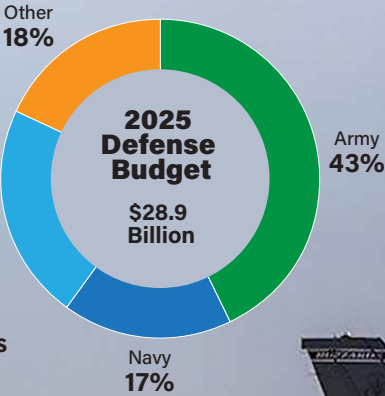
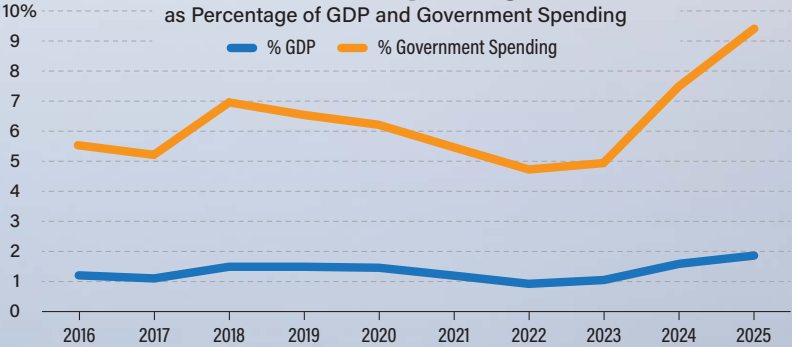
Source for charts: Aviation Week Network Defense Market Analyzer except where otherwise indicated

Aircraft in Service

Primary Mission	Number of Aircraft
Fighter	253
Trainer	245
Rotary Wing (Transport)	207
ISR-Strike	124
Transport	89
Rotary Wing (Attack)	67
Rotary Wing (Maritime)	32
Maritime	30
C4ISR	23
Light Combat Aircraft	13
Tanker	7
Collaborative Combat Aircraft	4

Source: Aviation Week Network Military Fleet Discovery

Defense Spending



Turkey has been buying aircraft, such as the Boeing E-7A (left), to help build up domestic defense industrial capacities.

U.S. Space Force Is Preparing for New Era of Protected Satcom

- BOEING WINS CONTRACT FOR NUCLEAR-HARDENED SPACECRAFT
- THE SERVICE CANCELS PROTECTED TACTICAL SATCOM PROGRAM TO INVEST IN EXISTING PROTOTYPES

Vivienne Machi Los Angeles

The U.S. military has taken key steps to overhaul its high-end satellite communications architecture to provide connectivity for tactical operators in the field and national leaders in doomsday situations.

For the past half-decade, the Pentagon has tasked Boeing and Northrop Grumman with building competing prototype spacecraft to modernize and eventually replace the aging Advanced Extremely High-Frequency (AEHF) satellites. The AEHF spacecraft currently provide tactical satellite communications (satcom) to operators on the ground as well as strategic connectivity for the president, combatant commanders and joint warfighters during nuclear and other extreme crises.

Boeing was selected to build up to four spacecraft to support the latter mission under a \$2.8 billion contract for the Evolved Strategic Satcom (ESS) program, the U.S. Space Force announced July 3. The cost-reimbursable contract is “the first step in a phased approach” to building a proliferated satellite constellation for the ESS and covers two initial satellites, with options for two more, the service’s Space Systems Command (SSC) said in a release. Boeing stated the same day that it plans to deliver the first spacecraft by 2031.

The Space Force envisions the ESS as a network of undisclosed assets positioned in diverse orbits. That system will take over the legacy AEHF mission of providing secure, survivable communications for strategic missions, including over the Arctic. The sixth and final AEHF satellite was launched in March 2020 to geostationary Earth orbit, and the constellation provides protected satcom to allies including Australia, Canada, the Netherlands and the UK. Lockheed Martin was the prime AEHF contractor and systems integrator, and Northrop Grumman supplied the payload.

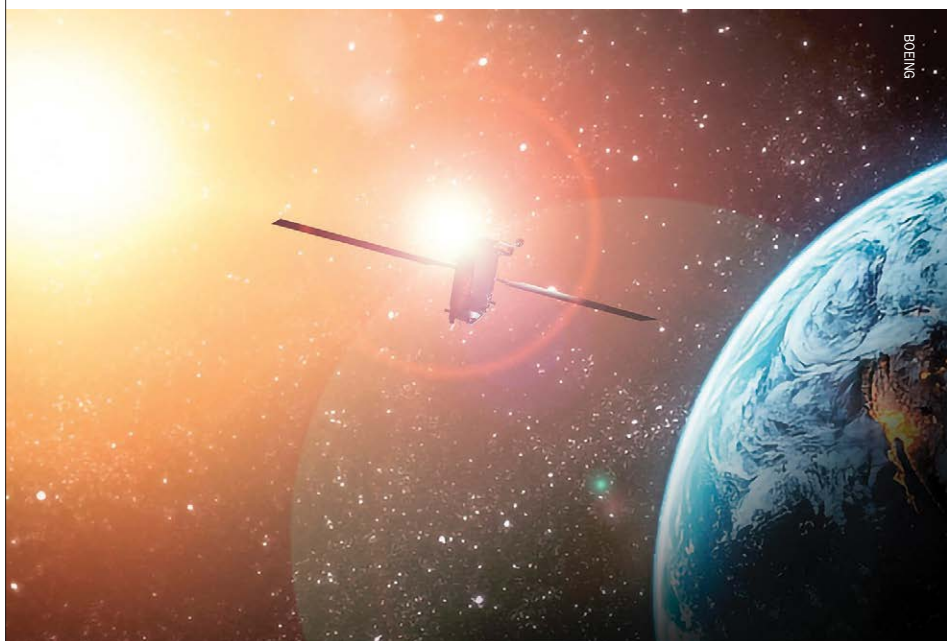
The most significant element of the

ESS will be its ability to service “an increased number of strategic users” that the current systems do not support, ESS Program Manager Col. A.J. Ashby told reporters during the annual Space Symposium in Colorado Springs in April. Ashby would not

Boeing said its ESS proposal harnessed technology developed for the Space Force’s 11th and 12th Wideband Global Satcom (WGS) spacecraft and for the SES O3b mPOWER constellation that uses the company’s multi-orbit BSS-702X satellite bus.

“We scaled our production capacity, invested in our team, hired cleared talent and assembled hot production lines to make sure that we can hit the ground running from Day 1,” Michelle Parker, vice president of Space Mission Systems, said in a release.

Boeing has invested heavily to automate and modernize production practices, shifting away from bespoke, mission-tailored spacecraft to satel-



Boeing expects to deliver the first Evolved Strategic Satcom spacecraft by 2031.

share how many spacecraft might eventually build out the constellation.

The contract award follows five years of technology maturation and risk reduction work from initial competitors Boeing, Lockheed and Northrop Grumman. All three companies were awarded rapid prototyping contracts in 2020. The Space Force then downselected two end-to-end prototypes from Boeing and Northrop Grumman in 2023.

This award is a critical win for Boeing and its newly permanent head of Defense, Space and Security, Steve Parker, who is focusing his team’s space strategy on national security programs. Northrop Grumman declined to provide a statement on the outcome of the ESS contract.

lites that are “fully digital, fully software-defined and can be much more flexible for the customer,” Parker told Aviation Week last summer at Boeing’s satellite facilities in El Segundo, California.

With ESS development up and running, the Space Force has also restructured its acquisition approach to field new capabilities known as Protected Tactical Satcom (PTS) to bring global, anti-jam wideband communications to warfighters quickly. The service was due to select either Boeing or Northrop Grumman to develop two new space vehicles under the PTS-Resilient contract this year but opted to cancel that contract, it announced July 3.

The Space Force previously described those prospective spacecraft as purpose-built “hub-in-space” satellites that would support a modernized, encrypted signal called the Protected Tactical Waveform (PTW), with full signal processing and switching capability that allows direct connectivity between users. Rather than build satellites, the service now plans to make “incremental improvements” to its two existing prototypes under its new PTS acquisition approach.

Boeing plans to host its prototype aboard the WGS-11 satellite, which is slated to launch in the second half of fiscal 2026 on a United Launch Alliance Vulcan rocket, says Col. Doug Pentecost, deputy program executive officer for Assured Access to Space at SSC.

Meanwhile, Northrop Grumman is using its ESPASat-HP bus to support its PTS demonstration. The company delivered the completed payload in January to its facilities in Gilbert, Arizona, where it will be integrated with the satellite bus and digital pro-

cessing system, a spokesperson says. That spacecraft is scheduled to be launched by another Vulcan rocket on Space Force mission USSF-43, planned for the summer of 2026, according to Pentecost.

“Fiscal 2026 budget documents reveal that the Space Force plans to use the O3b mPOWER constellation as the commercial option.”

The Space Force is also continuing plans to field two new types of satellites to provide military K_a- and X-band communications under the PTS-Global contract, and a new-start contract award is expected in the second half of fiscal 2026, budget documents show. The Global variant would employ “multiple satellites” as gap fillers between the more focused capa-

bilities developed under the PTS program and those supplied by commercial services or emerging military satcom efforts.

The service is also focused on fielding new ground infrastructure from Boeing to broadcast the PTW over the WGS constellation beginning in 2027. The SSC anticipates beginning initial broadcasting of the PTW over commercial spacecraft in 2029, Erin Carper, senior materiel leader for the command’s Tactical Satcom Acquisition Delta, said at the MilSatCom Conference in Arlington, Virginia, in June.

Fiscal 2026 budget justification documents reveal that the Space Force plans to use the O3b mPOWER constellation as the commercial option. SES has launched eight spacecraft out of a planned 13-satellite constellation to medium Earth orbit to date. Boeing recently delivered the next two satellites ahead of a scheduled launch this summer on a SpaceX Falcon 9 rocket from Kennedy Space Center in Florida. 🌐

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Boeing Deliveries Surge as 737-10 Tests Accelerate

> SIX-MONTH DELIVERIES RISE TO 280 AIRCRAFT

> 737-10 CERTIFICATION TARGETED FOR EARLY 2026

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

Bolstered by stronger delivery rates and long-anticipated signs of production stability, Boeing is accelerating certification tests on the 737-10, as the OEM hopes the aircraft's regulatory approval will underpin a broad-ranging financial recovery plan for 2026 and beyond.

While certification of the 737-7 and -10—the final two MAX variants—is key to the company's recovery road map, progress toward this goal is dominated by the test and verification of a long-running redesign of the engine anti-ice (EAI) system and associated nacelle inlet structure.

Problems with the EAI were unearthed by Boeing in mid-2023, leading to an FAA airworthiness directive that warned flight crews not to run the system when not in “actual or anticipated icing conditions.” Using the system—which redirects engine bleed air to the inlet cowl—when it is not needed “may result in severe engine inlet damage or failure,” the FAA said at the time.

The discovery of the issue, which centered on the vulnerability of the inlet's composite structure to thermal damage, led to the redesign of the inlet structure and elements of the EAI itself. The redesign included the introduction of a tita-

nium strap in the inlet between the acoustic inner barrel and the nacelle lip skin, and it stopped certification of the 737-7 in its tracks, which heaped additional delays on the 737-10 program that was already behind schedule. In the meantime, with 737-8s and -9s already in service, Boeing developed in-service limitations to the use of the EAI until the new inlet is available for retrofit across all fleets.

In an effort to put the 737-7 into service, Boeing originally sought an FAA exemption to permit the shorter-body model to be delivered with the inlets and in-service limitations. But the company withdrew its request after it faced increased FAA scrutiny following the Jan. 5, 2024, inflight loss of an exit door plug on an Alaska Airlines 737-9.

Fast-forward to now: There are signs that the redesigned inlet cowl and EAI, or a version of it, are progressing well through a series of increasingly intensive flight tests on the 737-10. The accelerating tempo is most apparent on the second test aircraft, 1G002, which saw a sudden spike in activity with 14 flights conducted in June, including a 5.5-hr. sortie on June 12.

The high test rate appears to be continuing. Five flights were completed within the first eight days of July, all of which targeted systems and performance testing. The rate of flights, staged from Clinton-Sherman Airport in Oklahoma, contrasts sharply with the recent past. In the first five months of 2025, 1G002 flew just eight times, and one of those sorties was a ferry flight to Seattle from Moses Lake, Washington, where the aircraft had been stored for more than two years.

Sister ship 1G001—the first 737-10, which has amassed almost 1,070 flight-test hours since it first flew in June 2021—also resumed test work on July 8, when it undertook a new round of system ground tests at Boeing Field in Seattle.

Engine anti-ice testing is pacing type certification for both the 737-7 and the stretched -10, the first example of which (pictured) is based out of Boeing Field in Seattle.



JOE WALKER

The third 737-10 (1G003), which is configured with an interior, has amassed more than 250 hr. on 78 flights, 12 of which occurred in 2025.

Boeing declines to comment on the status of the testing but says it remains hopeful tests can be completed late this year in time to earn 737-10 certification in the first quarter of 2026. Meanwhile, the FAA has finished its review of 737-7 tests, with flight testing 100% complete. Although approval of the shorter-fuselage variant is also paced by clearance of the EAI redesign, 737-7 type certification could edge into the fourth quarter of 2025 or first quarter of 2026.

“We’re hoping to get the two variants of the 737 MAX wrapped up this year so we can start deliveries of the -7 and the -10, two airplanes that are very, very important to our customers and our backlog,” Boeing President and CEO Kelly Ortberg told Aviation Week (AW&ST June 2-15, p. 36).

Redesigned inlet cowls for CFM International Leap-1Bs and engine anti-ice systems developed for the 737-7 and -10 also will be retrofitted to the 737-8 and -9 models.



GUY NORRIS/AM&ST

With more than 1,500 orders between the 737-7 and -10, there is no denying the accuracy of Ortberg’s statement. Certification may be one factor, but deliveries and service entry remain another. Alaska Airlines says it does not expect

Airbus Begins To Pick Technologies for A320 Successor

- > AIRFRAMER CONSIDERS COCKPIT AUTOMATION, MORPHING WING
- > MANUFACTURABILITY TO DRIVE DESIGN TO ACHIEVE PRODUCTION RATES OF MORE THAN 100 AIRCRAFT PER MONTH

Thierry Dubois Le Bourget

Airbus has entered a technology selection process for an A320 narrowbody replacement. The Toulouse-based airframer is considering technologies it started researching in recent years, such as a morphing wing and increased automation in the cockpit, while factoring in their compatibility with high production rates.

Airbus faces limited competitive pressure. Boeing issued a request for information to engine-makers in June while undertaking low-profile product development studies of a 737 replacement for the 2030s and beyond. But the company has backed away from a potential new product launch in the near-to-medium-term as it works to restore its financial health and stabilize production.

Airbus, meanwhile, intends to launch an aircraft program in the coming years for service entry in 2037-38. As Airbus gradually progresses

toward the launch of a next-generation single-aisle (NGSA), as the airframer calls it internally, suppliers are intensifying their own research and technology efforts to be ready in time.

Airbus sees the NGSA project as pivotal because demand is strongest in the narrowbody segment. “We want to make a difference on the market in fuel, maintenance and product efficiency,” says Bruno Fichfeux, head of future programs. The aircraft is planned to seat 200 passengers or more, responding to customer demand. This may mean Airbus would offer a stretched A220 with fewer than 200 seats.

Drastic fuel efficiency improvement is a key design driver, and reducing drag at wing level may contribute. Airbus is conducting the eXtra Performance Wing (X-Wing) research and technology program to develop a higher-aspect-ratio wing. Engineers

expect the increased wingspan and decreased wing area to cut induced drag.

Airbus UpNext, the company’s innovation arm, is modifying a Citation VII business jet to demonstrate that technology. The converted aircraft will feature a hinged wingtip extension, an adaptive trailing edge and pop-up spoilers. The goal is to improve aerodynamic performance without weighing down the wing structure.

“X-Wing is compatible, time-wise, with the NGSA,” Fichfeux says. “We want to harvest the result of the flight tests. . . . I am keen on seeing this in the air; there are many aerodynamic aspects we want to test. There are some tests of the system architecture we want to validate. Those will be very important on the road to NGSA.”

To accommodate CFM International’s open fan—currently the leading engine option—the NGSA might retain a low wing with increased inboard dihedral. Airbus is working on the so-called gull wing with CFM International for engine-airframe integration (AW&ST June 30-July 13, p. 17).

Cockpit automation demonstration projects may bolster safety—and, if certification authorities approve, reduce the number of flight crew. Airbus’ two-year Autonomous Taxi, Takeoff and Landing project demonstrated those phases in fully autonomous, vision-

to receive the variant until at least mid-2026, while United Airlines Chief Commercial Officer Andrew Nocella said in May that the airline does not anticipate putting the aircraft into service until 2027 at the earliest.

Aside from the final MAX models, the broader delivery picture for Boeing continues to improve, with surging deliveries and strong output in June. Both trends are healthy indicators of further stability needed within its Commercial division to meet stated production rate targets.

The company handed over 60 aircraft in June, pushing its first-half 2025 total to 280. The figure is the highest first-half total since 2018—the last full year in which Boeing was not facing delivery or production-constraining headwinds from internal issues or the 2020 global downturn during the COVID-19 pandemic. Boeing delivered 378 aircraft in the first six months of 2018 and a total of 806 for the year. Its annual delivery peak since 2018 was 528 aircraft in 2023.

While Boeing will not top its 2018 total this year, all signs point to steady momentum gains in what has been a halting recovery. The company's flagship 737 MAX program recorded 42 deliveries last month, Boeing said. More importantly, it rolled out 38 aircraft for the second month in a row, consultancy Aero Analysis Partners (AAP) reports.

The company is limited to 38 737 rollouts per month under an agreement with the FAA linked to production quality problems that came to a head with January 2024's 737-9 door plug blowout. Ortberg has said the company plans to seek permission to increase its monthly rate this year, but only after demonstrating stability at the 38-per-month limit. The company's notional goal is to build more than 50 aircraft per month by the end of 2026.

Activity on the 787 program is also rising steadily. Boeing recorded nine 787 deliveries in June, its highest monthly total in 2025. After handing over 13 in the first quarter, Boeing delivered 24 787s in the second quarter—a sign that nagging supply chain issues are easing.

Production also is ticking up. Boeing rolled out 10 787s in May and June, AAP reports. While that is short of Boeing's next stated target of seven per month, it indicates that output is beginning to steady amid supply chain challenges and production quality improvement efforts that must take hold before the company can boost its rate.

June's activity included 72 orders from unidentified customers—42 737 MAXs and 30 787s. Boeing did not announce any orders at the Paris Air Show as the company scaled back its presence following the fatal crash of an Air India 787 on June 12, just ahead of the show's opening. 🌐

OLI SCARFF/POOL/AP/GETTY IMAGES



Radically new wings on a future narrowbody will have to be compatible with high manufacturing rates, Airbus says.

based flight tests through onboard image recognition. More recently, the company flight-tested automated emergency diversion after pilot incapacitation in cruise under the Dragon-Fly project.

"Today, the focus we put on automation is how to support best the pilot from a safety perspective and to reduce the stress load," Fichfeux says. Some phases of operations are intense—especially taxiing, takeoff and landing—and Airbus intends to sup-

port them with higher levels of automation. This would rely on various sensors and perhaps artificial intelligence, Fichfeux adds.

Airbus is counting on solid growth in narrowbody demand as the air travel market is forecast to expand. To curb the sector's climate footprint, a more sustainable generation of aircraft has to replace 75% of the global in-service fleet by 2050, the Clean Aviation Joint Undertaking states.

To achieve that, Airbus is targeting

output of more than 100 aircraft per month. This means manufacturability will be as critical a design driver as performance. The NGSA is envisioned as starting at a manufacturing rate of 70-80 per month—the target rate for the A320, Fichfeux explains.

Even before launching a program, Airbus is using a "co-development" approach, studying product performance and industrialization in parallel. Could thermoplastic composites, promoted for their lightness and ease of manufacturing, find a greater use? "A whole bandwidth of technologies will be mixed—thermosets, thermoplastics," Fichfeux says. "The way we will combine them in structural parts and fittings is still an open question."

Airbus has involved its experts in industrialization, manufacturing engineering, procurement, programs and strategy, alongside suppliers and research institutes. "When a conclusion is reached on the readiness of the supply chain and our industrial systems, we will make a decision," Fichfeux says.

Airbus experts in Filton, England, are working on development of future wings like the X-wing via the Wings of Tomorrow research and technology program. "The demonstrator we are building in Cazaux [in southwest France] and Wings of Tomorrow go hand in hand," Fichfeux says. 🌐

Aeroflot Switches to More MC-21s Despite Longer Delays

- ▶ THE ALL-RUSSIAN VERSION OF THE NARROWBODY HAS YET TO FLY
- ▶ THE ORDER CHANGE CASTS FURTHER DOUBT ON VIABILITY OF THE TU-214 AND SUPERJET 100 PROJECTS

Jens Flottau Frankfurt and **Aviation Week Network Staff**

Western sanctions have hit Russia's air transport sector hard, leading to grounded fleets, a spare parts shortage and, above all, a cutoff from new aircraft deliveries. The alternative approach—returning to Russian-produced aircraft with all locally developed components—is facing more delays, and some plans are falling through completely.

Launch customer Aeroflot revealed in May that the Yakovlev MC-21 narrowbody is not expected to enter commercial service until the end of 2026. "What we are currently planning, and what the manufacturer is confirming to us, is the fourth quarter of 2026 [for] the start of operations," Aeroflot CEO Sergei Alexandrovsky said.

The new date represents another delay for the MC-21, which was set to enter service with Aeroflot subsidiary Rossiya Airlines in September 2022. Foreign suppliers quit the program after Moscow's full-scale invasion of Ukraine earlier that year and the subsequent sanctions, forcing a serious redesign to substitute domestic products for Western parts.

In May of this year, Yakovlev Deputy General Director Anatoly Gaidansky promised certification of the import-free MC-21-310 variant by the end of next summer and deliveries soon after. An MC-21 prototype with Russian components—except for the actuators, brakes and generators—has been conducting flight trials since April, but the all-Russian version has yet to fly.

The MC-21 is supposed to play a key role in Aeroflot's fleet modernization. The group expects to receive 108 of the aircraft by 2030 and 231 more throughout the following decade. This corresponds to Yakovlev's production capacity, which is expected to enable an initial rollout of 36 per year, according to Vadim Badekha, CEO of parent United Aircraft Corp.

Yakovlev assembled 14 fuselages prior to certification and has nine

more aircraft in earlier stages of production at its facility in Irkutsk.

The projected 108 aircraft are a sharp cut from earlier plans, under which the airline would have taken 339 in the same period. In 2022, Aeroflot placed a preliminary order for 210 MC-21s, 89 Sukhoi Superjet 100 regional jets and 40 Tupolev Tu-214 narrowbodies. All were expected to arrive before 2030 to replace aging Western jets.

Aeroflot expects to introduce the MC-21 at the end of 2026.



In 2023, Aeroflot firmed up a first batch from this order, including 18 MC-21s and 34 SJ-100s. The import-free versions of the aircraft had been expected to be available in 2023-24.

The latest delay prompted the group to change priorities. Aeroflot now plans to convert all 339 orders into MC-21s, casting further doubt on the viability of the Tu-214 and Superjet 100 revival and reconfiguration projects. The second batch—92 MC-21s—is expected to arrive in 2031-33, and deliveries of the last 139 will be scheduled for a later period, Alexandrovsky said.

The new narrowbodies will be distributed between Aeroflot and its subsidiary Rossiya. Another subsidiary, Pobeda, plans to continue operating its fleet of Boeing 737-800s. Pobeda is likely to receive more narrowbodies of the type from its sister airlines as they take new Russian jets.

Alexandrovsky said that fleet retire-

ments in 2022-25 are well below initial forecasts. According to Russian federal air transport agency Rosaviatsia, Aeroflot Group withdrew 17 aircraft—5% of its total fleet—from its air operator's certificate starting in 2022.

For now, Aeroflot and Pobeda rely exclusively on Western-made fleets. The parent carrier's narrowbody fleet comprises 92 Airbus A320/A321neos and A320/A321neos and 37 737-800s; its widebodies consist of 21 Boeing 777-300ERs, 12 A330s and seven A350s. Pobeda operates 42 737s. Rossiya is the only carrier in the group that flies Russian-made aircraft—72 SJ-100s along with 24 Airbus A319/A320s, 15 737 NGs, seven 777-300s and two 747s.

Meanwhile, Aeroflot plans to construct an engine repair shop at its Moscow Sheremetyevo International Airport base. The facility is to repair

CFM-56 engines plus Russia's new Aviadvigatel PD-8 and PD-14 powerplants. Because of sanctions, Aeroflot cannot rely on any support from CFM International or even communicate with the company.

Operations at the 28,000-ft.² shop are scheduled to start in 2027 and reach full capacity in 2028. "At full production capacity, the facility is expected to perform up to 70 overhauls per year," Alexandrovsky said.

Aeroflot Group set up a new company, AeroTrustTechnik, to run the project. It will be independent from subsidiary Aeroflot Technics, which provides line and base maintenance for the group's fleet.

The total Russian-operated commercial fleet using CFM engines counts almost 400 aircraft, including 196 Airbus and 194 Boeing jets. Many of those are with Aeroflot Group carriers. S7 Technics has had a local monopoly on CFM-56 repairs since 2022. 🌐

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Europe's Airlines Say Cabin Baggage Changes Threaten Consumer Choice

➤ EU LAWMAKERS DISCUSS PASSENGER LEGISLATION REVISIONS

➤ AIRLINES WELCOME SPANISH COURT'S DECISION TO SUSPEND A FINE IMPOSED FOR CARRY-ON BAG FEES

Helen Massy-Beresford Paris

Potential changes to the rules about airline carry-on bags are at the center of a debate in Europe as lawmakers in the region seek reforms to air passenger legislation and airlines highlight concerns about reducing consumer choice—not to mention a possible hit to ancillary revenue.

In short, European lawmakers have legislation on passenger rights firmly in their sights.

Plans to update the EU261 legislation, which includes passengers' right to help and compensation in the event of delays or cancellation, have been under discussion for more than 12 years, but the European Council finally managed to agree on a formal proposal for changes on June 5. At the time, airlines said the compromise agreement, which includes changes to the delay threshold for compensation, did not deliver the transparent and workable passenger rights they had been hoping to see.

An amendment put forward during the European Parliament's subsequent examination of the proposal—one that seeks to allow passengers to bring a wheeled cabin bag onboard at no extra charge beyond the standard ticket price, voted through June 24—is now causing further headaches for airlines.

While talks are still taking place, airlines have been vociferous in their objections. "Europe's airline market is built on choice," Airlines for Europe (A4E) Managing Director Ourania Georgoutsakou said June 20 just before the vote.

"Forcing a mandatory trolley bag strips passengers of that choice and obliges passengers to pay for services they may not want or need," she added. "What's next? Mandatory popcorn and drinks as part of your cinema ticket? The European Parliament should let travelers decide what services they want, what services they pay for and, importantly, what services they don't."

Forcing airlines to include a cabin

bag in the standard ticket price would be a "ludicrous" step, aviation consultant John Strickland said.

"We're not in the aviation system of the 1960s or 1970s," he added. "And the proposed legislation does not reflect to me a real analysis of what the traveling public wants."

"Over the past more than two decades, as [low-cost carriers] have grown, we have seen a drop in ticket prices and a democratization of air

Cabin baggage fees are an important part of ancillary revenue.

travel, to the benefit of customers, tourism and economies," Strickland said. "But airlines have only been able to set the headline fare at a low price because they can break out other elements, such as faster boarding, inflight food or drink or a cabin bag. They are commercial entities, and they have to make money, otherwise fares will go up, and that will exclude some people from travel."

Airlines can also use pricing mechanisms as a deterrent to bringing onboard large cabin bags, which create operational complications if too many passengers try to fit them in overhead bins and can slow down turnaround times. "Achieving high aircraft productivity, offering low fares and making a profit means a lot of moving parts working together," Strickland said.

As debate continues in Brussels, European airlines welcomed a Spanish High Court decision to suspend a fine imposed on Ryanair and Norwegian over cabin baggage charges and allow them to continue with their current carry-on bag policies until a final legal decision is made.

The case highlighted the importance of the cabin baggage issue for carriers.

"This ruling upholds Ryanair's right, under EU law, to offer customers the freedom to choose—and pay for—any bags they choose to bring onboard, in addition to the free under-seat bag all Ryanair passengers bring onboard free of charge," said Ryanair, which received a €107 million (\$126 million) fine in 2024.

Spain's consumer affairs minister, Pablo Bustinduy, had wanted to require all cabin baggage to be free of charge. Ryanair CEO Michael O'Leary said: "The Spanish High Court has rightly upheld EU law, which protects the freedom of all EU airlines to set our own prices, a fundamental right guaranteed under EU Reg 1008/2008."



JEFFREY ISAAC GREENBERG/ALAMY STOCK PHOTO

The court also upheld the right of all Spanish passengers to choose how much cabin baggage they wish to carry and pay for, in addition to Ryanair's 'maleta gratis,' which is bigger than the EU's prescribed sizes."

Ancillary revenue are important to all airlines, in particular low-cost carriers. In its latest set of annual results released in May, Ryanair pointed out a 10% increase in ancillary revenues, to €4.72 billion, out of total revenues of €13.95 billion, which were 4% higher year over year.

The airline called on the minister to scrap the bag fines altogether.

"The suspension of the Spanish consumer authority's measures, which would have stripped travelers of the freedom to choose what they pay for and [how they] carry their luggage, confirms how disproportionate the original decision was," A4E said. 🍿

Asian Airlines Increase Their Lead in the Widebody LCC Sector

➤ LOW-COST CARRIER WIDEBODY OPS AND ORDERS ARE SURGING IN ASIA

➤ INDIGO, VIETJET AND ZIPAIR ARE AMONG THOSE WITH GROWTH ASPIRATIONS

Adrian Schofield Auckland, **Helen Massy-Beresford** Paris and **Lori Ranson** Washington

The trend of low-cost carriers adding widebody aircraft to their fleet mixes is continuing to strengthen in the Asia-Pacific region, although the concept has lost ground in other regions, such as Europe and North America.

Several Asian low-cost carriers (LCC) are expanding their widebody fleets and have signaled their long-term confidence in this business model by placing major orders. The market

(see chart). Asian LCCs are also dominant in terms of widebody orders, with commitments for 79 aircraft versus 45 from Middle Eastern LCCs and seven from those in Latin America. European and North American LCCs have no widebodies on firm order.

Asian LCCs are now operating almost 30 more widebodies than in 2019, showing that this business model has gained in popularity in the post-pandemic environment. In Europe

widebody plans is IndiGo. The carrier in April 2024 ordered 30 Airbus A350-900s, which are due to begin arriving in 2027. IndiGo announced orders for another 30 A350s on June 1. Deliveries of those will start after the initial A350-900s ordered have been handed over.

However, the airline is not waiting until 2027 to debut widebody operations, and it is already expanding the reach of its network with leased wide-body jets.

IndiGo's first foray into widebodies was an agreement to damp-lease two Boeing 777-300ERs from Turkish Airlines to operate routes between India and Istanbul. This arrangement began in 2023, but the Indian government has ordered the leases to be terminated by the end of August due to worsening relations between the two countries.

IndiGo's next step was to damp-lease Boeing 787s from Norse Atlantic Airways. IndiGo reached an agreement to lease six of the Norse 787s, and the first arrived in March. All are set to join by early 2026.

The main aim of the damp-lease 787 operations is to enter the India-Western Europe market. IndiGo launched flights to Manchester, England, on July 1 and to Amsterdam on July 2.

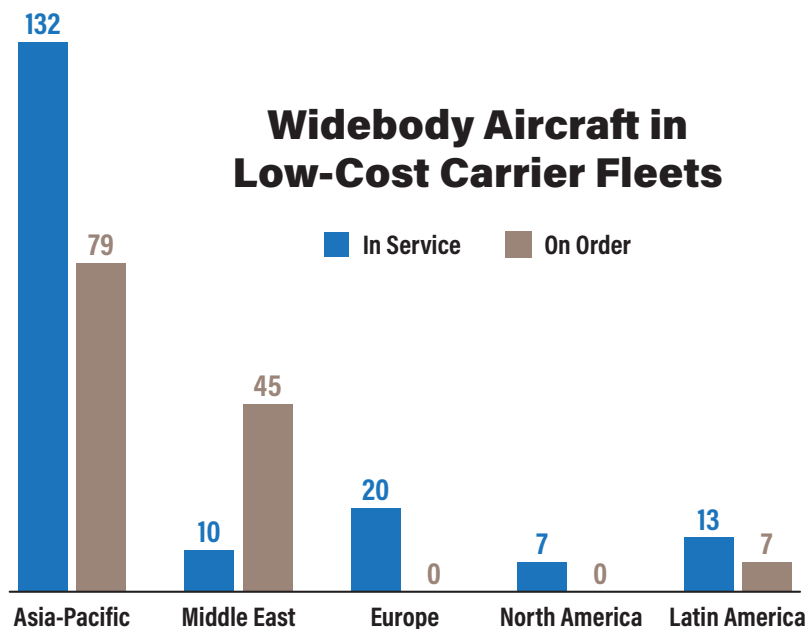
The carrier has plenty more destinations in mind. CEO Pieter Elbers noted during a recent earnings briefing that the "opportunity is massive" for IndiGo to expand into Europe.

VietJet is another Asia-Pacific airline with large growth ambitions in the widebody sphere. It operates seven Airbus A330s, and on May 26, signed an order for 20 A330neos. Combined with a previous order in 2024, this doubles its commitment to 40 A330neos.

The LCC operates its widebodies to Australia, India and Kazakhstan. The orders will allow VietJet to boost capacity on high-volume routes and expand its Asia-Pacific network. The carrier eventually aims to use the A330neos to launch long-haul flights to Europe.

Korean LCC T'Way has dramatically increased its widebody fleet and has more aircraft coming. The airline now operates nine A330s and two 777-300ERs, and it has five A330neos on order from lessor Avolon.

The increase is a side effect of Korean Air's takeover of Asiana Airlines. To gain regulatory approval in



dynamics and geography of the Asia-Pacific region are proving well-suited to widebody LCC operations.

In contrast, it has been much harder to make the model work in Europe and North America. The few LCCs in these regions that still operate widebodies are not increasing this fleet type significantly—and in some cases, they have retreated.

Data from CAPA – Centre for Aviation and OAG shows that Asia-Pacific LCCs operate 132 widebodies, versus 20 or fewer in each of the other regions

and North America, the trend has been in the other direction—LCCs in those regions are operating far fewer widebodies than in 2019.

Widebodies offer multiple benefits for LCCs. They can target more distant markets and can increase capacity on high-demand routes to congested airports. Larger aircraft also give carriers more flexibility to introduce premium cabins—thus blurring the lines of the traditional low-cost business model.

The LCC with the most ambitious

some jurisdictions, Korean Air agreed to support T'Way's entry to certain European markets, including leasing widebody aircraft to the LCC.

T'Way launched long-haul flights to Rome; Barcelona, Spain; Frankfurt; and Paris in the second half of 2024, and it also uses the widebodies on Asia-Pacific routes.

Japan Airlines (JAL) has big plans for its widebody LCC Zipair, which it launched in 2020. Zipair now has eight 787-8s and is due to take delivery of another two -8s in 2026. JAL announced in March that it plans to transfer 10 787-9s to Zipair. The first are set to arrive in 2027, and the remainder by the early 2030s.

Zipair has some Asian routes, but most of its capacity is allocated to its six U.S. and Canadian destinations, primarily targeting strong inbound demand to Japan. The carrier flies to Houston; Los Angeles; San Francisco; San Jose, California; Vancouver and Honolulu. The U.S. routes account for 44% of its seat capacity, representing its largest country market by far.

As with many LCC subsidiaries, Zipair's capacity has grown faster than that of its full-service sibling: Weekly seats are up 14% year over year for the week of June 30, data from CAPA and OAG shows.

All Nippon Airways is also pursuing the widebody LCC concept, having launched AirJapan in early 2024. The carrier so far has two 787-8s deployed on short- and medium-haul routes in Asia.

Malaysia-based AirAsia X was among the pioneers of widebody LCC operations. It now operates 18 A330s after adding a leased aircraft in March, and it has another parked aircraft that is due to return to service soon. It has orders for 14 A330neos. Affiliate Thai AirAsia X has a fleet of 10 A330s.

AirAsia X operates flights to several Asia-Pacific markets. It has one route outside the region, to Nairobi, Kenya, but plans to cancel this service in September.

Scoot, a subsidiary of Singapore Airlines, has the largest widebody fleet of any LCC in the region. The carrier operates 22 787s, and two more are slated for delivery during the fiscal year that began April 1.

Scoot uses its 787s on routes to Australia, North Asia and on some shorter Asia-Pacific routes. Scoot is also one of the few Asian LCCs with

long-haul routes to Europe. It operates to Athens, Greece, and started service to Vienna on June 3. However, it suspended its Athens-Berlin leg in March.

Cebu Pacific has completed the replacement of all of its A330s with 11 A330neos, and the carrier has five more remaining on order. It operates the widebodies on both international and domestic routes.

Other Asia-Pacific LCCs with widebodies in their fleets include Lion Air with five A330s and eight A330neos, Jetstar with 11 787-8s and Jin Air with four 777-200ERs.

Norwegian, taking on its former fleet and launching services in 2022.

Norse has 12 787s, but six of these will be allocated to IndiGo under their damp-lease agreement, which will significantly reduce Norse's own scheduled services. "We believe this represents a good balance between securing year-round fixed revenue from [damp leases] and maximizing the possibilities in our scheduled network," Norse said in a recent update.

Level is the only LCC widebody operator in Europe that is part of a major group—its parent is International Air-

JAL subsidiary Zipair operates transpacific routes using Boeing 787-8s.



PIEMAS/AVIATION/PAUL FEARLY/ALAMY STOCK PHOTO

There is also potential for widebody LCC operations to grow in the Middle East. Saudi Arabia's Flynas has eight A330s in its fleet, and it has orders for 15 A330neos. Additionally, Flydubai has 30 787-9s on order.

In Europe, widebody operations occupy a much smaller niche in the low-cost market than in Asia.

French Bee operates a fleet of four A350-900s and two A350-1000s. The sister airline of Air Caraïbes, French Bee destinations include New York, Miami, San Francisco and Los Angeles in the U.S.; Punta Cana in the Dominican Republic; the French overseas department Réunion Island; and Papeete in French Polynesia. Its latest destination, added last year, is Montreal.

Before the COVID-19 pandemic, Norwegian Air Shuttle was a major low-cost transatlantic operator of 787s. But the airline was forced to reconsider its strategy after a brush with bankruptcy, and in January 2021, it announced a shift to focus on short-haul routes in Europe, operating an all-narrowbody fleet.

New startup Norse Atlantic moved into the transatlantic space vacated by

lines Group (IAG). Level could benefit from a group order for 21 A330neos that IAG placed in May. These aircraft are set for delivery between 2028 and 2033 and will be deployed with Aer Lingus, Iberia or Level. In Level's case, they would replace short-term leases, IAG said.

The LCC currently operates seven A330s, and it expects to have eight by the end of 2026. Level serves routes between its Barcelona base and destinations in the U.S. and Latin America.

In North America, the main widebody LCC operator is Canada's WestJet, which has seven 787-9s in its fleet. Westjet made the decision in late 2022 to base all of its widebodies in Calgary, Alberta, as part of its strategy to deemphasize eastern Canada and reduce costs. The carrier currently operates 787 routes to Barcelona; Dublin; London; Paris; Reykjavik, Iceland; Rome; Seoul; and Tokyo.

Last year, Westjet told Aviation Week it was evaluating the 787 operation to determine if an increase in fleet size was warranted. However, the carrier has not added any more widebodies since then. 🌐

Canada's Competition Watchdog Seeks Fairer Skies

➤ THE BUREAU SUGGESTS OPENING THE MARKET TO GREATER FOREIGN OWNERSHIP

➤ RECENT BUDGET CARRIER FAILURES HIGHLIGHT SOME CHALLENGES FACING NEW ENTRANTS

Christine Boynton Boston

In its 1978 annual report, Air Canada described “intensified competition” in the marketplace as the North American airline industry moved toward less regulation.

“There is every indication that this trend will continue,” wrote then-CEO Claude Taylor. That year had been full of change: Airline deregulation in the U.S. was signed into law, and the Air Canada Act came into effect, paving the way for the flag carrier’s privatization. Roughly two decades later, Air Canada acquired its main competitor, Canadian Airlines, gaining a majority domestic share that was eventually tempered by WestJet’s growth.

Now more change could be ahead for a market still largely dominated by two carriers. Air Canada and WestJet account for 50-75% of domestic passenger traffic at Canada’s major airports, notes the country’s Competition Bureau in a report released on June 19. Describing certain factors as limiting competition, the agency proposes bold steps, including opening Canadian skies to wider foreign involvement.

Calgary-based Lynx Air suspended flights in early 2024, blaming “rising operating costs,” among other factors.



In “Cleared for Take-off: Elevating Airline Competition,” the independent law enforcement agency advises raising the foreign ownership limit for any one investor to 49% from 25% and creating a new domestic-only airline class that would allow up to 100% foreign ownership. The bureau also suggests permitting cabotage, which would enable foreign airlines to operate routes between domestic points.

“We found that restricting foreign investment and foreign carriers reduces competition in Canada’s domestic airline market,” Brad Callaghan, associate deputy commissioner of the Competition Bureau, explained at a press briefing. Allowing more carriers to enter the market “could lead to more routes, innovative services and improved efficiency,” he added. “Despite calls to the contrary, sheltering companies from competition does not create national champions.”

The agency names three areas of focus: prioritizing competition in aviation policy, leveraging international capital and experience, and supporting northern and remote market access. Although it found “encouraging signs of increas-

ing competition” from new entrants, such as ultra-low-cost carrier Flair Airlines, progress remains fragile, the report said. “Fragile” means that successful, sustained entry into the industry remains challenging,” Anthony Durocher, deputy commissioner of the bureau’s Competition Promotion Branch, explained during the briefing. “We found that the increased competition seen in recent years has mainly been limited to Canada’s busiest routes.”

Historically, Canada has had few major carriers, as its airlines serve distinct needs where geography and population patterns present unique challenges. Recent budget airline failures underscore the challenges that smaller carriers face. Calgary-based Lynx Air suspended flights in early 2024, blaming “rising operating costs, high fuel prices, increasing airport charges and a difficult economic and regulatory environment.” Ontario-based Canada Jetlines ceased operations in the summer of 2024, after failing to secure a fresh injection of capital. With the right policy changes, the bureau expects that governments can create the conditions for new airlines to grow and compete.

“With this report, we have identified concrete actions that governments can take to achieve these goals,” Commissioner of Competition Matthew Boswell said.

The findings are intended to provide decision-makers with “flexible, principles-based guidance on how to encourage more competition,” the bureau told Aviation Week. Recognizing that governments would need to consider other public policy goals in deciding whether and how to implement changes, a spokesperson noted, “We have seen positive impacts on competition in the past when the bureau has made such recommendations,” a reference to federal and provincial actions based on its Retail Grocery Market Study.

Canada’s Chamber of Commerce has cautioned that

opening domestic aviation to foreign involvement could have long-term consequences for regional connectivity. The chamber pointed to other domestic airline markets, such as the U.S., EU and Australia, as comparable, if not more concentrated. Similarly, Air Canada called competition in Canada “as robust, if not more” than other jurisdictions, publishing a list of “Myths and Facts on the Canadian Domestic Competitive Landscape.” Canadians have more choice than ever on a vast majority of routes, the carrier said.

WestJet, meanwhile, said the market study acknowledged “clear issues” affecting affordability and competition, particularly high third-party fees, charges and taxes—costs that have long been areas of contention for the carrier. “The Competition Bureau found that Canadians pay airfares that are more than 40% higher because of government-imposed fees and taxes and third-party fees and charges,” WestJet wrote. Lowering those fees and charges would help expand the market and create room for new entrants and more competition, the airline said.

Changes proposed in the study would represent sizable shifts, and industry observers are taking note. William Swelbar, chief analyst of the Swelbar-Zhong Consultancy, has praised Canada's willingness to take a serious look at competition, even considering such controversial strategies as foreign ownership and cabotage, "because of the limited opportunities to increase competition inside a mature marketplace." The bureau "has the guts to recognize that a concentrating/maturing market dampens new/smaller airlines' ability to effectively compete," he said.

the airline industry needs to understand that airlines with 5% or less of the domestic market are not the only tool to enhance competition without changes in the regulatory construct," Swelbar writes. "Canada does."

Ontario-based Canada Jetlines ceased operations last summer after failing to secure a fresh injection of capital.



Drawing a parallel to the U.S., which is similarly mature and concentrated, Swelbar suggests that many of the recommendations could be applied to a market in which four carriers collectively account for more than two-thirds of the domestic airline business. The six next largest each accounts for about 2-6%.

"To truly compete, the U.S. government that oversees

Although Canada's geography, population and traffic concentration differ from those in the U.S., certain pressures are familiar. The bureau identified airport access as one factor to examine closely, particularly the allocation of slots—something the newly formed Association of Value Airlines has highlighted as a key issue for its U.S. member carriers.

"Something similar is needed in the U.S.—and not shaped by special interests," Swelbar said of the report. "There is an elephant in the U.S. living room, too." 🐘

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The NH90 Rebounds With Upgrade and Export Hopes

> AIRBUS AND LEONARDO HAVE BEEN TAPPED TO BEGIN BLOCK 2 ARCHITECTURE STUDIES

> NHI SEES SALES PROSPECTS FOR AT LEAST 100 MORE NH90s

Tony Osborne Le Bourget

The NH90 helicopter may have emerged originally from a NATO project to meet European rotorcraft needs for the 1990s, but the program's industrial partners believe it could be part of the answer for the alliance for the 2040s.

NATO's Next-Generation Rotorcraft Capability is intended to replace hundreds of medium helicopters serving militaries across Europe in the 2040s. With questions emerging about the niche purpose and associated cost of high-speed rotorcraft in the region, industry believes new generations of NH90s could fulfill the continuing need for conventional rotorcraft.

Spain is set to emerge as a major NH90 operator with a plan to contract 31 of the rotorcraft by year-end.

At the Paris Air Show, two of the partners in the NHIndustries (NHI) joint venture—the helicopter businesses of Airbus and Leonardo—announced they had been contracted to begin architecture studies for the NH90 of the future. These studies will shape Block 2, a midlife upgrade that could keep the helicopter on the front lines until the 2080s, NHI CEO Axel Alocchio said.

"We are convinced that this is the best alternative for the nations," Alocchio told Aviation Week at the Paris Air Show. "If they are looking at introducing a new 10-11-[metric]-ton conventional helicopter, they already have it—it is called NH90. Let's improve it. Let's give it even more capabilities, rather than invest in a new greenfield project where we start all over again."

Planned for the back end of the 2030s, Block 2 is intended to address obsolescence, enhance the range of the aircraft, simplify maintenance and support, insert modular avionics and add more capabilities, such as new weapons or crewed-uncrewed teaming technologies. Alocchio said the program also could benefit from the European

Defense Fund-supported European Next-Generation Rotorcraft Technology (ENGRT) project, which is "developing techno-bricks," a term increasingly used in European industry to describe the underlying technologies that pave the way for new capabilities.



FRANCESCO FRANCESCHI TORRONTERA/AIRBUS HELICOPTERS

Options for extending the NH90's range could include new, more efficient and more powerful engines, or simply an upgrade to extract greater power. More complex would be transitioning the aircraft's avionics to an open architecture approach like that proposed for the NGRC and the U.S. Army's Future Vertical Lift program. The current system, while working well, is "complex to upgrade," Alocchio said. Each time NHI wants to add new functionality, the software must be reopened, "and it takes a lot of time," he explained.

An earlier upgrade, Block 1, is already contracted and mainly focuses on a new software release. It also features hardware upgrades, including a new electro-optical camera, identification-friend-or-foe transponder, new antennas to deal with satellite navigation system spoofing and jamming,

and the integration of anti-ship and anti-submarine weapons. Four countries, including Germany and Italy, will retrofit their fleets—around 200 helicopters in total—with Block 1 starting in 2027-28.

Plans for Block 2 are emerging as the program matures out of its challenging adolescence. The NH90 has faced difficult headlines in recent years. First, Australia ditched the type in 2021 in favor of Sikorsky UH-60 Black Hawks. Then in 2022, Norway, frustrated by availability issues, canceled its contract and stored the rotorcraft away. Sweden is looking to give up its land battlefield Tactical Transport Helicopter (TTH) NH90s

but plans to retain its land-based anti-submarine warfare versions for now.

Belgium will follow a similar path, its defense minister, Theo Francken, announced on July 10. Brussels' four TTH-model NH90s will be removed from service in September, but the remaining naval NFH aircraft will soldier on. Francken said the four TTHs have proved to be "extremely expensive to maintain" since they entered service in 2013.

Alocchio said the outlook is positive, however. NHI has another 80 rotorcraft to produce for existing customers, plus sales prospects for as many as 100 more from a mix of planned top-up orders by existing operators and new export campaigns, largely in the Middle East and Asia.

"The NH90 is a great platform," he said. "We are not saying everything is perfect. . . . We have had to fix our sup-

port performance, but we have really worked a lot on this.”

Looking back, Aloccio said that some countries left the program for political or organizational rather than technical reasons. He stated that Norway’s rotorcraft are 95% similar to the French Navy’s NATO Frigate Helicopter (NFH) variant and that service’s NH90 units routinely win awards for their interoperability with the U.S. Navy.

“How can it be that France is among the best in the world for anti-submarine warfare, and Norway, with almost the same configuration, is not able to do the same?” Aloccio asked.

Nonetheless, NH90 availability has been a bugbear for other countries, too. In response, NHI has invested heavily in a multiphase initiative to improve the availability of spares. The joint venture has spent €230 million (\$270 million) on the supply chain for additional spare parts and on boosting its own inventory. Australia’s decision to end operations helped bolster these initiatives, as NHI acquired

and harvested the country’s NH90 fleet. Those components are now back in Europe and are being revalidated for use in an exchange pool or sale to customers, Aloccio said. NHI also is continuing to work on expanding the capacity of its repair, overhaul and retrofit ecosystem.

Meanwhile, there is more to come as countries gear up for the prospect of high-intensity warfare, Aloccio said. Operators are now asking about “war readiness” and “what it takes for them to fly more,” should conflict break out, Aloccio said. NHI has submitted to the NATO Helicopter Management Agency (Nahema), which oversees the NH90 program, a list of 18 ideas on better preparing operators for wartime, including adapting and simplifying the maintenance program so that work can be done in the field.

“This is about how can we be more and more pragmatic, more efficient, even if this means taking a few more risks,” Aloccio said.

Ongoing production, export opportunities and upgrades to the Block 1 stan-

dard will help keep the NH90 supply chain system busy until Block 2 takes shape and is contracted by countries.

Aloccio reported a positive outlook for more orders. Spain plans to order as many as 31 TTH models as part of its National Helicopter Plan and could sign a contract by year-end. Similarly, the Netherlands is planning a top-up order of three more NFH-model rotorcraft, with options for a further two. NHI has also launched a feasibility study that would support Spanish acquisition of an NFH-model NH90, albeit with more local industry involvement in the mission system. The venture’s biggest export campaign aims to meet a need for naval helicopters in Saudi Arabia.

However, Spain is also interested in the Standard 2 capability being developed for French special forces. That configuration would include a new electro-optical camera as well as mechanical and electrical provisions for the future installation of a Distributed Aperture System that is in development. ☐

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The FAA Eyes Unleaded Avgas Options as Milestone Looms



➤ ALTERNATIVE UNLEADED FUELS UNDERGO TESTING

➤ FAA BEGINS DRAFTING AN AVGAS TRANSITION PLAN

Bill Carey Boston

The FAA has tied airport grant obligations to keeping leaded aviation gasoline available through 2030, giving the general aviation industry latitude to develop a consensus unleaded avgas alternative for piston-engine aircraft.

In April, the FAA served notice that it has modified grant assurances under the Airport Improvement Program (AIP) and added a new Grant Assurance 40. The latter binding obligation requires airports that accept federal development grant funding to allow the sale of 100 low lead (100LL) avgas through December 2030 unless an FAA-authorized, industry-recognized unleaded alternative fuel becomes available earlier.

Grant Assurance 40 responds to a directive that Congress inserted in the FAA Reauthorization Act of 2024. It applies to airport owners or operators that made 100LL available for sale or self-fueling at any time during 2022 and imposes a \$5,000-per-day penalty for violations. A separate provision of the reauthorization legislation prevents any restriction of 100LL in Alaska through 2032.

The new AIP grant requirement complements recent regulatory and legal rulings that prevent airports from summarily banning the sale of 100LL, which contains the fuel additive tetraethyl-lead (TEL) to boost its octane rating and is burned by roughly 170,000 piston aircraft in the U.S. While there are lower-octane unleaded avgas alternatives, aircraft with high-performance, high-compression piston engines require 100-octane fuel to operate safely.

One factor driving the transition to high-octane unleaded avgas is the sup-

ply chain. Innospec, the only Western supplier of TEL, reportedly is winding down production of the fuel additive at a facility in the UK. The company tells Aviation Week that it supports the FAA and industry goal of eliminating leaded aviation fuel by 2030 but as of May had set “no firm timelines on the cessation of TEL-B production” for 100LL avgas.

Piston-engine airplanes and helicopters are the largest remaining source of lead emissions into the air, says the U.S. Environmental Protection Agency (EPA), which issued a final determination in October 2023 that such emissions contribute to air pollution and endanger public health. Estimated annual consumption of 100LL is around 180 million gal.—a minuscule amount relative to the volume of lead-free jet and automobile fuel sold each year but of concern to communities clustered around small general aviation airports.

In March, the FAA ruled that Santa Clara County, California, violated federal grant assurances when it stopped offering 100LL at two county-owned airports in 2022 and ordered it to reverse restrictions preventing use of the fuel. The decision favored the Aircraft Owners and Pilots Association, which filed a formal complaint with the agency after county supervisors voted in 2021 to stop sales of 100LL in 2022.

Santa Clara County says it acted to phase out the supply of 100LL and solely offer lower-octane Swift UL94 unleaded avgas after a study revealed a “clear causal link” between piston aircraft burning leaded fuel and elevated blood-lead levels in children living near Reid-Hillview Airport in San Jose.

A California judge in May denied an environmental group’s attempt to

compel fuel suppliers in that state to replace 100LL with G100UL unleaded avgas, finding that the group had not demonstrated that the unleaded formulation is “approved for aviation use” and “commercially available,” as specified by a 2014 consent judgment.

Piston aircraft are the largest remaining source of lead emissions into the air.

Developed by General Aviation Modifications Inc., G100UL received FAA supplemental type certification (STC) approval in September 2022 for use across a broad range of piston-engine airplanes. But it has not gained wider industry acceptance because it lacks a production specification from standards organization ASTM, which subjects the formulation to peer review of its properties and performance.

Two other high-octane unleaded avgas formulations are being tested toward the goal of FAA fleetwide authorization across a diverse array of piston airplanes and helicopters. Swift Fuels 100R has STC approval for use in Cessna 172R/S models—authorization the company plans to expand to other types. UL100E, developed by LyondellBasell and VP Racing, is being tested at the FAA Technical Center and in the field through the Piston Engine Aviation Fuels Initiative.

Both 100R and UL100E are being vetted through the ASTM balloting process.

As a result of the EPA’s 2023 finding that lead emissions from piston aircraft endanger public health, the FAA is required to do more than test new fuel—it must develop standards for the composition and properties of aviation gasoline to eliminate lead emissions through a rulemaking process.

“The end of 2030 is a milestone; it’s not a deadline,” says National Air Transportation Association CEO Curt Castagna, who co-chairs the industry-government Eliminate Aviation Gasoline Lead Emissions (EAGLE) initiative. “The FAA is in the process of developing a national transition plan... that is basically a road map to establish the rules to phase out 100 low lead.

“Many factors could cause that coordinated transition to go beyond 2030,” Castagna adds. “On behalf of the industry and EAGLE, our biggest focus has been on the safe transition to an unleaded fuel.”

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> INSTALLATION TAKES MUCH LESS TIME THAN A HUD

AerAware uses ClearVision thermal and low-light imaging cameras.

Fred George Phoenix

It was zero-zero ceiling and visibility the night I flew AerSale's Boeing 737-700—or so it appeared from the left seat on my Runway 34 approach into Arizona's Laughlin-Bullhead International Airport. My view ahead of the aircraft was totally obscured by a large black sunshade, flattened inside my windshield to create virtual instrument meteorological conditions.

That made for ideal conditions to evaluate AerAware, aftermarket service provider AerSale's FAA-certified enhanced flight vision system (EFVS). AerAware is the first commercially available EFVS to earn a 50% visual advantage credit, the difference between what the pilot can see using enhanced vision versus unaided vision. In essence, the system cuts most charted visibility minimums in half.

Most competitive EFVS provide only a 33% visual advantage credit. A 50% credit allows operators to earn authorization to fly instrument approaches with reported visibility as low as 1,000-ft. runway visual range. While that is higher than the 600-ft. minimums associated with Category III autoland systems, AerAware can be used for operational credit on almost any instrument approach to

any airport—not just those with pricey Category III instrument landing systems.

The package includes left- and right-seat Elbit Systems SkyLens head-wearable displays, the first FAA-approved augmented reality headsets. The SkyLens is a virtual head-up display (VHUD) that takes the place of an aircraft-mounted HUD. It provides HUD-like guidance imagery, but only when the pilot is looking straight ahead through the windshield. The AerAware system is the first dual-pilot EFVS using head-wearable displays to be certified for transport-category aircraft.

Universal Avionics' six-sensor EVS-5000 ClearVision enhanced vision system (EVS), well proven onboard several other aircraft, is the other key component of AerAware. The sensors range from visible light to long-wave infrared, which can distinguish between runway pavement, paint stripes and the heat signatures of incandescent lights. Its night vision system amplifies visible light from LED, metal-vapor and ionized-gas lights, such as neon signs. Unlike first-generation FAA-approved infrared EVS sensors, the EVS-5000 does not require cryogenic cooling, so it is considerably more trouble free and has a much broader detection and amplification spectrum.

As with the VHUD symbology, EVS imagery is available only on the SkyLens display when the pilot looks straight

ahead. AerAware also includes a 360-deg. synthetic vision system (SVS), which, with the EVS, makes it a combined vision system. Only the EVS is used for operational credit.

In December 2023, AerSale earned FAA Part 91.176(b) EFVS-100 approval to use dual-side AerAware gear to fly down to a 100-ft. ceiling on straight-in instrument approaches and Part 91.176(a) EFVS-TD approval to continue all the way to touchdown and rollout. Boeing supported the supplemental type certification, which applies to all versions of its 737NG. Other aircraft approvals are in the works.

Reduced visibility was not a factor during the evening when we used SkyLens to fly four approaches to different airports near the Colorado River. Capt. Steve Fulton, my right-seat instructor wearing the second SkyLens VHUD, could see clear through his windshield, as there was nothing to block his view.

Notably, both the pilot flying and pilot monitoring must wear the SkyLens displays when using AerAware to fly to touchdown and rollout. When using the EFVS to descend to 100 ft. above the touchdown zone, only the pilot flying needs to use the device. Even when not flying instrument approaches, having both pilots use SkyLens devices full-time provides situational awareness virtually on par with using dual HUDs. Fulton used his right-side SkyLens VHUD functions to monitor my flying performance the entire time I flew with the left-side SkyLens.

Capt. Hal Andersen rode along as safety pilot while also helping me don, adjust and align the SkyLens device after I strapped in to the left seat. SkyLens weighs less than 1 lb., making it easy to remove and stow should one need to put on smoke goggles and an oxygen mask—and so lightweight that an aviation-grade audio headset helped stabilize the device on my head.

Prior to the demo flight, Andersen explained SkyLens' three functions during a daylong classroom session. The top level of information displayed is the 30-deg.-vertical X 40-deg.-horizontal field-of-view VHUD. As with conventional aircraft-mounted HUDs, the VHUD includes aircraft attitude, flightpath vector and flight director, speed error tape and acceleration caret, air data, lateral and vertical guidance, and flight mode annunciations.

The SkyLens VHUD also has an unusual-attitude recovery mode with decluttered symbology and a stall margin indicator. However, the VHUD does not have the tail strike avoidance and touchdown flare guidance functions common among most modern permanently mounted HUDs.

The VHUD imagery is monocular, shown only in front of the pilot's right eye. Based on my experience in the left seat, it takes little time to adapt. The visuals conform one-to-one with the outside world and are in monochrome green, like conventional HUDs, making it as easy to fly smoothly and precisely in instrument conditions as looking outside in visual conditions.

The second imagery level is synthetic vision, derived from the system's onboard digital database and displayed in the background of the VHUD. Imagery includes terrain, obstacles, airport and runways, plus extended runway centerlines for situational awareness if the runway waypoints are coded into the approaches. This helps pilots orient themselves to the runway centerline well before crossing the final approach fix.

SVS imagery is 360 deg. and available full-time. This differs from conventional aircraft-mounted HUDs with combined vision systems, which display SVS imagery only when the pilot is looking forward through the combiner glass.

Flying the 737 in total darkness, I could see SVS images of terrain, the Colorado River and even nearby landing facilities, shown by virtual signposts labeled with their identifiers. Panoramic SVS is a powerful situational awareness complement to the aircraft's terrain awareness warning system.

The third level of information is enhanced vision, real-time imagery gathered by the EVS-5000 sensors in the nose. As with other EFVS cameras, the EVS-5000's ability to see through obscuration depends upon a number of factors, including droplet size and distribution density,



Pilots must don the SkyLens' head-wearable device to use AerAware.

Andersen said. Temperature differences between pavement, paint and structures enable the cameras to “see” and display those features on the SkyLens. Like with all infrared sensors, the contrasting heat signatures of trees, terrain, pavement and runway stripes diminish near sunrise and sunset, causing “thermal crossover” during the transitions between warm days and cool nights.

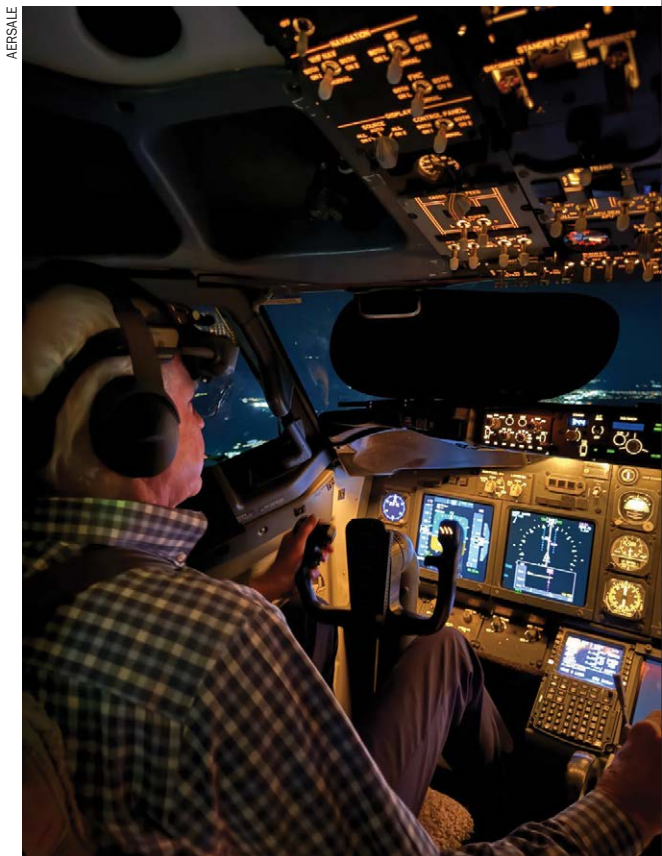
Thermal crossover does not affect the performance of the EVS-5000's visible light sensors. When looking straight ahead, I could see lights from buildings, highways and other sources at impressive distances. Similar to other EFVS equipment, AerAware's thermal and optical sensors perform better in dry air than in moist air. The 50% visual advantage credit was earned by recording system performance while testing in a variety of environmental conditions, including fog, rain and snow.

The camera detects infrared radiation from incandescent lights at longer ranges than pure visible light from LEDs and ionized-gas lights. As the display is monochrome, it cannot show the difference between red and white glidepath guidance lights.

Pilots who use SkyLens devices are able to move their heads to check instruments, flick switches, push keys, turn knobs, reach for checklists and conduct myriad other tasks

that require hand-eye coordination. The system incorporates a digital masking function that cuts off all video as soon as the wearer looks away from the flight deck windows, such as when turning to the overhead panel or flight instruments. Motion sensors on the SkyLens devices and position sensors on the flight deck activate the masking function.

In everyday operations, several pilots can share SkyLens devices. The head-wearable displays have adjustable vertical and horizontal bends, plus interchangeable padding, to accommodate different head shapes, sizes and hairstyles. Responding to concerns about cleaning and sanitation, AerSale says each pilot will have their own headpads.



FLYING IMPRESSIONS

Four guest pilots shared left-seat time flying with the AerAware system during our demo flight. Fulton is an FAA flight-test pilot designated engineering representative who has participated in numerous HUD certifications on jet and turboprop aircraft. Both he and Andersen have decades of Part 121 line operations experience flying HUDs, plus several hundred hours of flight time on the AerAware-equipped 737-700 and -800.

We departed AerSale's Phoenix-Goodyear Airport facility close to sunset and headed north toward Sedona. For those of us in the cabin awaiting our opportunity to test the system, a large flat-screen display on the forward cabin bulkhead showed what the pilot in the left seat was seeing through the SkyLens device.

Andersen explained that for full system functionality, each destination airport runway must be in both the aircraft's flight management computer approach waypoint database

and the AerAware SVS database. Sedona Airport's Runway 03 is not part of the area navigation (RNAV (GPS)) approach coding, so the SVS did not display either an extended runway lead-in line or expanding runway box imagery.

En route to Sedona, Andersen demonstrated that the boundary between the SVS and EVS imagery windows—called a synthetic vision reference line (SVRL)—can be dialed up or down like a virtual window shade. The SVRL also automatically rolls up to the zero-pitch reference line at 1,000 ft. above ground level (AGL) on approach to ensure it does not block the pilot's ability to spot the runway using the EVS or unaided sight.

At Sedona, for instance, the guest pilot used the SVS for most of the initial approach segment, enabling him to be aware of terrain hazards. The SVS displayed a prominent virtual "KSEZ" signpost, so there was no mistaking the correct destination from 40 mi. As we neared the airport, the pilot dialed up the SVRL curtain well before 1,000 ft. AGL to watch for the runway environment coming into view using the EVS.

The SkyLens VHUD also has an adjustable fixed pitch reference line, similar to aircraft-mounted HUDs, that can be dialed up or down from a 3-deg. default angle to coincide with the RNAV glidepath or instrument landing system glideslope. At Sedona, the RNAV (GPS) Runway 03 glidepath is 3 deg., so the guest pilot already had the 3-deg. fixed-pitch reference line. That appeared in the VHUD as the aircraft descended through 2,500 ft. radio altitude,

providing visual guidance for a stabilized approach.

If the pitch reference line looks like it will guide the aircraft short of the touchdown zone, the pilot can shallow out the glidepath to push out the reference line to the intended landing spot. If the aircraft risks landing too long, the pilot can increase the descent rate to pull in the reference line to the touchdown zone.

Soon we headed west toward the Colorado River and to Lake Havasu City, Needles and Laughlin-Bullhead airports, which were chosen to provide an interesting variety of approach geometries. It was time for me to belt into the Boeing's left seat and strap on the SkyLens. Adjusting the device to fit properly took a few minutes, as all four guest pilots were sharing the same device, and each of us had a different head shape and size.

Once I had the SkyLens properly strapped on, I took a few additional moments to position it for the best viewing and to assure I had all the VHUD symbology in view when looking straight out through the windshield. A SkyLens control panel in the left-forward section of the control stand enables turning on and off as well as adjusting the SVS and EVS, plus calibration, test and declutter functions. The knobs and buttons lack clear tactile feel differences, so I found myself frequently looking down and away from the windshield to verify that I was reaching for the correct control.

The AerAware system also includes on and off buttons for the EVS and SVS on the left and right control yokes, next to the pitch-trim rocker switches. This enables the pilot to clear the VHUD of SVS and EVS background imagery instantly to provide the best natural vision view of the runway.

The author flew AerSale's Boeing 737-700 on short final to Laughlin-Bullhead International Airport. The blackout screen in his windshield prevents him from having the runway in sight with natural vision.

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Once I was comfortably settled in, with VHUD symbology in sight, it was time to turn off autopilot, disconnect the autothrottles and hand-fly the aircraft. Immediately, I remembered why HUDs, either aircraft-mounted or head-worn, are one of the most significant safety advances since the advent of turbine engines.

The one-to-one conformity of aircraft attitude and heading symbology, the flightpath vector, the speed error tape and acceleration caret symbol all combine to simplify the task of flying the aircraft smoothly and precisely. The single-cue flight director appears as a small, moving circle that the pilot keeps centered in the middle of the flightpath vector symbol.

This is what the author could see "in view" using ClearVision.

Upon switching on the SVS and dialing down the SVRL curtain to the bottom of the display, it was as though I had an omnidirectional, monochrome 3D sectional chart in view whenever I looked through any flight-deck side window or windshields—not just forward through the VHUD. Turning my head away from the boresight of the aircraft caused the VHUD to disappear. Airspeed and altitude readouts remained in view, along with an arrow that indicated which way to turn my head to regain sight of the VHUD.

On approach, the EVS-5000 exhibited excellent night vision amplification and image fidelity. I was similarly impressed flying with the same sensor as part of Dassault's FalconEye system on the Falcon 8X.

The demonstration plan saw less than favorable winds on the RNAV (GPS) Runway 14 approach into Lake Havasu. On final approach, I encountered a tailwind of up to 31 kt., resulting in a ground speed exceeding 160 kt. and a descent rate of up to 960 ft./min. on the 3.4-deg. vertical navigation glidepath. But the VHUD's flight director, flightpath vector and other intuitive symbology made stabilizing easy.

During the approach, I frequently dialed the SVRL curtain up and down to compare SVS and EVS background imagery. The EVS provided comparatively high-resolution video of the Colorado River, road traffic, towns and other thermal and visible light sources. The SVS was better at displaying terrain, especially above the aircraft flight vector.

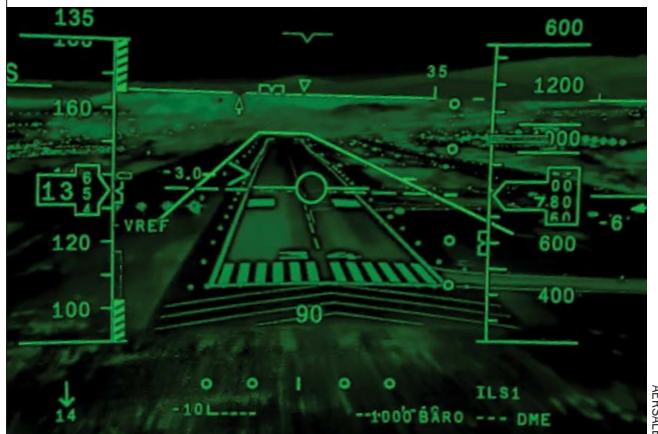
With no sight of the red-and-white optical glidepath, it is critical to align the flightpath vector, fixed pitch reference line and touchdown zone stripes in the VHUD to complete a stabilized approach. I failed to correct for the tailwind soon enough, so I overshot and would have landed too far down the runway. That was not a problem, though, as we planned to fly a low approach and go around without touching down.

Flying toward Needles' RNAV (GPS) Runway 29 gave the strongest impression of the system's certified visual advantage when flying challenging procedures. Lateral navigation straight-in minimums for Category C aircraft are not authorized at night, but we flew the entire procedure on visual flight rules, so that was not a limitation.

The flight management computer's vertical navigation function stabilizes the aircraft on the desired 3.2-deg. glidepath to the visual descent point. The final approach course to Runway 29 is 270 deg., but the runway centerline is 285 deg. That 15-deg. offset requires a crisp turn over the visual descent point for the 1-mi. final descent to the runway.

If the crew just gets the runway in sight with unaided vision at 1 mi. when arriving over the visual descent point,

making the turn to final approach is not much of a challenge—at least with a 3,600-lb. Beechcraft Bonanza. It can be a lot more stressful when flying a 130,000-lb. Boeing. If you can get the runway in view with the EVS at 2 mi., that extra mile provides a comfortable margin to plan for the 15-deg. turn to final.



We also dialed in the 3.2-deg. fixed pitch reference line in the VHUD, so when I turned to final at the visual descent point, I just visually positioned the flightpath vector atop the 3.2-deg. fixed pitch line and flew a stabilized approach to the runway. At 50 ft., I executed a go-around.

The highlight of the evening was flying the RNAV (GPS) Runway 34 approach into Bullhead. Andersen positioned the blackout sunshade inside my windshield. I flew most of the approach using the full SVS, with a small EVS cutout window around the expanding runway box. The SVS provided a long, dotted, lead-in line runway centerline, plus left and right course deviation indicators that funnel in toward the threshold.

Passing through 1,000-ft. radio altitude, the SVS curtain automatically rolled up, giving me EVS visuals of the runway environment. The EVS also showed a prominent, low cloud bank north of the airport but no vertical cloud buildups. A quick off-on click of the SVS/EVS button on the yoke confirmed that I was indeed flying blind. All I was seeing was through the EVS; I could not see anything with unaided vision.

Once I had the touchdown zone stripes in view using the EVS, I steepened the approach path slightly to pull back the VHUD's fixed pitch reference line to the big stripes.

Just short of the threshold and just after the flare cue popped into view at 55 ft. AGL, the radio altimeter announced "50." There was no flare guidance from the flight director. At "40," I started slowly raising the nose attitude, shallowing the glidepath to 1 deg. while gradually closing the throttles as the radio altimeter advised "30, 20, 10" ft. above the runway.

And then we touched down, just short of the big stripes. I had just hand-flown my first simulated Part 91.176(a) approach to touchdown using only the EFVS gear in lieu of unaided eye vision.

On the go-around, Fulton reset the flaps and trim for takeoff, I advanced the throttles, and we took to the air, still with no unaided sight of the runway environment. All too soon, it was time for me to relinquish the left seat and SkyLens device. However, my short experience flying the three approaches opened my eyes to the benefits of the system.

COST BENEFITS

AerSale has yet to sign a major airline launch customer for AerAware since earning certification in December 2023. The company emphasizes the system's potential for enabling operators to reach more destinations more predictably in very-low-visibility conditions. Based on my experience, I conclude that AerAware is a valuable tool for reducing weather-related delays and diversions. It is exceptionally effective at boosting situational awareness in low visibility when operating out of airports with terrain and obstacle risks. Even when skies are cloud-free, the basic SkyLens VHUD is virtually on par with a permanently mounted HUD as a safety enhancement.

AerSale says the system can be installed in three days, considerably less time than for an aircraft-mounted HUD. The time saving is even greater for 737NG freight-passenger combi operators, because there is no need to remove the midcabin freight barrier during installation to laser-align the system.

The current supplemental type certificate requires use of left and right SkyLens VHUDs, installation of the EVS-5000 system, dual VHUD computers, control panels and other equipment. Retail list price is just under \$1.5 million for the complete AerAware package, not including the three-day installation.

AerSale faces two significant barriers to widespread acceptance of AerAware equipment. First, many U.S. 737NG operators already have permanently mounted left-side

HUDs on their flight decks. They are unlikely to pull out their HUDs and put in SkyLens VHUDs. But the right-seat pilot could benefit greatly from installation of a second HUD or availability of a head-wearable display such as a SkyLens.

For greater commercial appeal, AerSale needs to expedite its plan to unbundle the SkyLens, EVS-5000, SVS and other components to allow use of permanently mounted HUDs with the EVS-5000 for the EFVS rule's lower visibility minimums. Also, some operators without aircraft-mounted HUDs might want to start with a basic SkyLens VHUD upgrade, adding the SVS and/or EFVS at a later date.

Crew qualification is the second challenge. AerSale has developed FAA-approved ground and flight training programs, assuring that 737 flight crews making the transition to AerAware equipment will be properly qualified and evaluated.

But no FAA-approved Level 6 flight training devices or Level D full flight simulators are currently equipped with AerAware gear. Fitting each operator or training center's devices with the equipment could be costly and time-consuming. Most training facilities cannot afford the out-of-service time for upgrades, and few operators can afford to take aircraft out of revenue service for training flights.

The bottom line? Clear the unbundling and training barriers. Then full AerAware packages, plus unbundled components, have considerable promise for wider acceptance, with higher mission completion rates, enhanced safety margins and improved situational awareness. ☺

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HIDDEN ASSET

- > BUDGET CUTS CONSTRAIN NASA'S STORIED ARMSTRONG TEST FACILITY
- > ELECTRIC PROPULSION TESTBED AT THE FACILITY IS BEING RELOCATED
- > THE AGENCY IS REWORKING ITS STRATEGY FOR AERONAUTICS

Graham Warwick Sandusky, Ohio

Tucked away in the woods south of Lake Erie near Sandusky, Ohio, is a complex of unique test facilities that together tell a story of NASA's adaptation to changing budgets and priorities. By testing rocket engines, space vehicles and electric powertrains in simulated extreme conditions, the little-known site has found a valued niche supporting government and private industry.

The Armstrong Test Facility (ATF) is an outpost of NASA Glenn Research Center, 50 mi. to the east in Cleveland and the agency's lead center for space and aircraft propulsion. Aviation Week visited Glenn and the ATF earlier this year for briefings on NASA's advanced propulsion research. The visit came before the Trump administration unveiled its fiscal 2026 budget and a surprise 24% cut in funding for NASA.

While President Donald Trump's budget reserves its biggest dollar cuts for NASA's Earth and space science portfolio, it slashes funding for aeronautics research 37% to just under \$589 million. NASA has been here before, and its aeronautics directorate with it, but the scale and speed of the cuts are brutal this time around—if the president's budget request is upheld by Congress.

The planned cuts come as the U.S.' commercial aviation rivals double down on government backing for civil aeronautics research. At the Paris Air Show in June, the EU's Clean Aviation and Sesar Joint Undertakings presented an aviation research and innovation strategy to the European Commission that calls for an investment of €66 billion (\$78 billion) in 2028-34, €22.5 billion of it to be provided

The altitude chamber in the relocated NEAT facility is shaped to create a larger working area for testing.



NASA PHOTOS

by the EU. The UK, meanwhile, has committed £2.3 billion (\$3.2 billion) to 2035 in government and industry funding for aerospace R&D.

The Trump administration wants to cut funding for climate-focused “green aviation” projects at a time when the EU and UK are supporting the development of technologies for the next generation of ultraefficient airliners and engines, including emissions-reducing hybrid- and hydrogen-electric propulsion.

Instead, NASA’s fiscal 2026 budget ends funding this year for the Electrified Powertrain Flight Demonstration (EPFD) program, rescopes or delays the Hybrid Thermally Efficient Core (HyTEC) engine project, eliminates contrails research and reduces work on aircraft emissions and electric air taxis.

The cuts have exposed differing opinions on NASA’s research. “In terms of the difference between NASA’s in-house expertise and what commercial industry is able to provide, I believe NASA should be working on . . . the near impossible, what no one else is capable of doing,” Jared Isaacman told a congressional hearing on his nomination for NASA administrator, later withdrawn by Trump. “And when they figure it out, commercial industry takes over and brings the rest of the world to follow.”

In a subsequent interview with *Aviation Week*, Isaacman said NASA’s aeronautics portfolio needs to be rebuilt. “Even before this budget, aeronautics is just \$1 billion of NASA’s \$25 billion budget, so they already feel somewhat like an afterthought,” he said. Isaacman directed his harshest criticism at the X-66 Sustainable Flight Demonstrator—shelved by Boeing before it was canceled by Trump—saying it was a bad design that NASA was willing to fund rather than lose a big program with no replacement in sight (*AW&ST* June 30-July 13, p. 40).

The U.S. industry’s trade organization, the Aerospace Industries Association (AIA), was quick to criticize the Trump administration’s deep cuts to NASA’s science funding, saying they “could jeopardize our space leadership,” but AIA has remained quiet on the planned reductions in aeronautics research.

Having cautioned against Trump’s tariffs, AIA’s silence on NASA’s deep aeronautics cuts seems surprising, given that the civil aircraft industry has the highest trade balance of any U.S. manufacturing sector. But it may be motivated by member companies’ desire to avoid challenging the administration directly and to work instead through Congress in a bid to restore funding.

Other associations representing the industry have weighed in. “Reductions to mission-critical programs could have a long-term impact on U.S. leadership in aero-

nautics, our nation’s No. 1 exporting industry,” says Clay Mowry, CEO of the American Institute of Aeronautics and Astronautics. “We are working with stakeholders to ensure that America continues to progress in advanced aviation technology.”

The Trump cuts would shut down NASA’s Revolution-

ary Vertical Lift Technology Project, which is supporting the emerging advanced air mobility market. “Proposed budget cuts at NASA would eliminate or drastically reduce vertical lift science and technology, including areas such as handling qualities, crashworthiness and planetary rotorcraft—fields in which NASA uniquely contributes,” says Angelo Collins, executive director of the Vertical Flight Society (VFS).

“Without dedicated rotorcraft programs, NASA will lose in-house capability, diminishing support for defense and civil applications,” he says. “This situation mirrors NASA’s 2002 cancellation of its Rotary Wing Project and shutdown of the [National Full-Scale

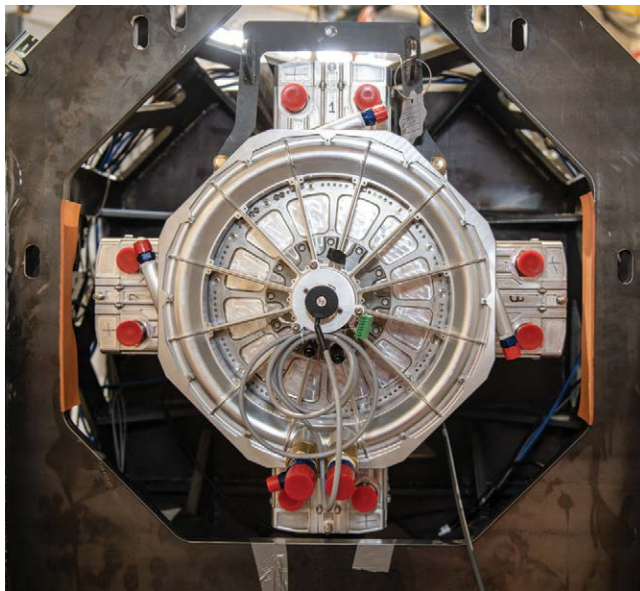
Aerodynamics Complex] in 2003—both of which were reversed, thanks in part to advocacy from VFS.”

NASA mothballed the National Full-Scale Aerodynamics Complex, home to the world’s two largest wind tunnels, because of budget issues. But concerned by the loss of rotorcraft testing capability, the Defense Department stepped in, and the U.S. Air Force took over management of the facility. A similar crisis looms as the 2026 budget calls for five of NASA’s 12 wind tunnels to be put into standby mode.

Aviation Week’s tour of the Armstrong Test Facility illustrated how past NASA budget pivots have had unexpected outcomes, leaving in place an array of unique test facilities that are available to private industry and that have proved invaluable to startups in space as well as aviation.

NASA’s predecessor, the National Advisory Committee for Aeronautics (NACA), first leased land at the Plum Brook Ordnance Works near Sandusky in 1955 for construction of a reactor to test how materials used in a nuclear rocket engine would behave after irradiation. The site had been acquired by the War Department in 1941 and produced explosives until the end of World War II. Bunkers where TNT was concocted still line the roads that crisscross the site but are either abandoned or used for storage.

NACA became NASA in 1958, and in 1959 NASA took over from the U.S. Air Force on what became the Nuclear Engine for Rocket Vehicle Applications (NERVA) program to develop a nuclear thermal rocket engine as an upper stage for the Saturn V launch vehicle and an engine for missions to Mars. NASA also took over the Centaur cryogenic upper stage. After a failure on its first launch in 1962,



Wright Electric’s 2.5-megawatt-class WM2500 is the most powerful electric motor tested in NEAT so far.



SpaceX tested the Crew Dragon in the In-Space Propulsion facility at NASA's Armstrong Test Facility.

the Centaur program was transferred to Lewis Research Center in Cleveland (now Glenn) for an intensive review.

Lewis led NASA's liquid hydrogen and nuclear propulsion activities. Liquid hydrogen was used in the Centaur and Saturn upper stages and was the working fluid in the NERVA engine. Most of Lewis' hydrogen and nuclear-related testing was conducted at Plum Brook, including more than 100 hot-firings of RL10 engines for the Centaur.

In 1963, NASA acquired the entire site and renamed it Plum Brook Station. The Plum Brook Reactor Facility reached its full 60-megawatt power level in 1963, and several large test facilities came online in the late 1960s, including the Spacecraft Propulsion Research Facility (B-2) with its ability to test rocket engines in space conditions and the Space Power Facility (SPF) with its towering vacuum chamber.

NASA's budget peaked at almost 4.5% of federal spending in 1965 at the height of the Apollo program. But by the early 1970s, funding had been halved, and the agency was cutting projects to pay for the space shuttle program. This included nuclear propulsion, and Plum Brook was moth-balled for 15 years.

In the early 1980s, the White House Office of Management and Budget recommended NASA dismantle the facil-

ities at Plum Brook and divest the site. Instead, an inter-agency team concluded that four of the largest facilities should be brought back online for use by both NASA and external customers.

By the early 1990s, NASA had brought the B-2, the SPF and the Hypersonic Tunnel Facility (HTF) back online. K Site also was reactivated to support the National Aerospace Plane program with slush hydrogen studies but was demolished—along with the decommissioned Plum Brook Reactor—in 2012.

Among the first paying customers in the 1990s, Boeing used B-2 (since renamed the In-Space Propulsion Facility) to perform engine testing of the cryogenic second stage for its ill-fated Delta III, while the SPF was used for shroud jettison tests for the European Space Agency's Ariane V. NASA itself used the SPF to test the Mars Pathfinder air-bag landing system and a large solar radiator for the International Space Station. Today these massive facilities seem as pristine as when they were first built.

The SPF underwent major modifications in the 2010s to support NASA's Constellation program. Renamed the Space Environments Complex (SEC), the cavernous facility simulates the vibrations, sounds, temperatures and pressures encountered during space missions. When Plum Brook was renamed the Armstrong Test Facility in 2020 to honor astronaut and Ohio native Neil Armstrong, NASA used the SEC to test the Orion crew capsule for the first Artemis mission around the Moon.

External customers have included SpaceX, which in 2018 tested its Crew Dragon capsule in the In-Space Propulsion Facility. Blue Origin conducted the first jettison test for the New Glenn's 23-ft. payload fairing in the SEC in 2022, and Sierra Space tested its Dream Chaser reusable spaceplane and cargo module there in 2023. In April, startup Vast signed up to perform the final environmental test campaign of its Haven-1 flight-ready space station in the facility in early 2026.

The purpose of Aviation Week's visit to the Armstrong Test Facility was to tour another of the site's unique facilities, NASA's Electric Aircraft Testbed (NEAT). Like the larger test sites still active at the former Plum Brook Station, the history of NEAT is indicative of the agency's ability to adjust to different political and technical climates.

"The ATF has an array of federally funded and unique space and aeronautic test capabilities with uses developed far beyond their original purposes," Director David Stringer says. "Commercial space and aeronautic companies can affordably test their ideas at Armstrong Test Facility without the risk of failure in early use.

"One example of these is NEAT. As it moves to its new location on Armstrong Test Facility, we know that the techniques we've developed are applicable to both space and aeronautic users," he says. "Armstrong Test Facility capabilities ensure safety and mission success while saving both time and money."

NEAT originally occupied the former HTF, which was designed to test nuclear thermal rocket nozzles for NERVA. Later it was reconfigured as a hypersonic facility capable of testing air-breathing propulsion systems. The HTF was brought back online in the early 1990s, but testing of scramjet inlets ended in 1996 after a catastrophic failure that required rebuilding and upgrading. By the time modifications were complete, interest in hypersonics had

Sierra Space tested the Dream Chaser reusable spaceplane in the Space Environments Complex at Armstrong.



faded, and the facility was placed on standby status in 2007.

First funded in 2014, NEAT was developed as a reconfigurable testbed for electrical propulsion systems for aircraft up to single-aisle airliner size with as much as 20 megawatts of power. The facility included a vacuum chamber that could simulate altitudes up to 60,000 ft. to test high-voltage electronics, motors and controls in extreme conditions. NEAT's first test in 2016 involved a small 600-volt power system.

GE Aerospace was the first to test a megawatt-class, multikilovolt hybrid-electric system at simulated altitudes up to 45,000 ft. in the facility in 2022, and startup MagniX tested its 700-kW Magni650 electric engine in NEAT in 2023-24 at altitudes up to 24,000 ft. Both test campaigns were conducted in support of NASA's EPFD project, now slated for termination before flight under Trump's budget.

During Aviation Week's tour, startup Wright Electric was preparing to begin simulated altitude testing of its 2.5-megawatt WM2500 motor, the largest and most power-dense to be tested in NEAT. Developing the WM2500 with support from the Energy Department's Advanced Research Projects Agency - Energy (ARPA-E), Wright was the last to use NEAT before it was closed to be relocated elsewhere on the ATF site.

NASA's facilities at Glenn and the ATF are "the beating heart of American aerospace innovation," Wright CEO Jeff Engler says. "First, they let engineers close the design-build-test loop faster, accelerating the pace of technological advancement. Second, no single company could realistically build something like this alone.

"It makes sense for the government to create and maintain shared infrastructure so that many innovators can

benefit," Engler continues. "That same logic applies to the NEAT facility. As the aerospace world moves toward hybrid and electric propulsion, we need a national-scale testbed for high-voltage, high-power systems. NEAT fills that gap. It's an invaluable resource—technically advanced, future-facing and cost-effective through shared use."

While NEAT was spooling up at the ATF, Congress in 2019 added funding to the Defense Department's budget to reactivate the HTF. Hypersonic weapons were back in vogue, and the HTF provided the capability for long test durations, up to 5 min., at Mach 5, 6 and 7 flight conditions using high-temperature, clean, nonvitiated air, rather than hot air created through combustion.

Reactivation of the HTF necessitated relocation of NEAT, and conversion of another building on the ATF site was well advanced at the time of Aviation Week's visit. The original NEAT was packed with power banks and festooned with cable runs and had a cramped altitude chamber. The new NEAT will have the same 20-megawatt power supply and testing capabilities as the original but with a modern control room, dedicated space for external customers and an altitude chamber with a more usable shape providing greater working space.

The new NEAT is scheduled to open in January, when RTX plans to test its ARPA-E-backed Ultra-Compact electric powertrain in the facility. "We moved the equipment that comprised NEAT from the old building to the new one, so it's essentially the same testbed," NASA says. "The equipment in the old facility always had the capability to test for space and aeronautics applications."

The 2026 budget directs NASA to develop a new strategy



Formerly Plum Brook Station, the Armstrong Test Facility site was originally a World War II explosives plant.

to maintain U.S. leadership in aviation, including developing tools for the FAA to increase airspace capacity and providing technologies and concepts that will “revolutionize aviation.” But the budget documentation is thin on detail.

Once the EPFD and HyTEC projects are wrapped up, NASA is directed to focus its Advanced Air Vehicles Program on research into “truly revolutionary propulsion capabilities that will drive future generations of airliner performance, further enhancing U.S. technological competitiveness and travel affordability.” But no clue is provided as to what those capabilities might be.

The task of developing the new strategy and identifying revolutionary technologies is being orchestrated by Robert Pearce, associate administrator for the Aeronautics Research Mission Directorate, then-NASA Acting Administrator Janet Petro told Aviation Week at the Paris Air Show in June.

“[Pearce] was coming to the Paris Air Show, but we had a discussion at the last minute in which he said, ‘I feel it would be better if I stay back here and work with the teams at NASA so we can figure out the answers to that question: What are the research and the focus areas in terms of technology development that they need to focus on to enable revolutionary propulsion?’”

NASA is working closely with its main industry partners on reshaping programs to meet the research agenda, Petro added. “We are looking to maintain American leadership in all domains, including aeronautics. [Pearce] will make those choices,” she said.

“Obviously, hypersonics [is a priority], and we are working with the Department of Defense and others, as that is high on the administration priority list,” Petro noted. “And of course the X-59 [Low-Boom Flight Demonstrator]. But for the smaller ones in there, they will have to make some tough choices.

They have a lot of industry and academic partners, so they’ll work with them, and maybe they can fill some gaps also.”

Petro acknowledged that Congress has the final say on NASA’s budget and that some of the deep cuts proposed by Trump could be blocked by appropriators on Capitol Hill. “We’re going to follow the president’s and administration’s priorities, and Congress will appropriate the budget that we will execute to,” she said.

From the vantage point of the Armstrong Test Facility, it is to be hoped that legislators and strategists alike recognize the enduring value to U.S. aerospace of the unique expertise and testing capability represented by facilities such as NEAT and the other iconic structures scattered across this slice of Ohio countryside. 🌐

—With Joe Anselmo and Guy Norris in Paris and Irene Klotz in Cape Canaveral

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By **Graham Warwick**

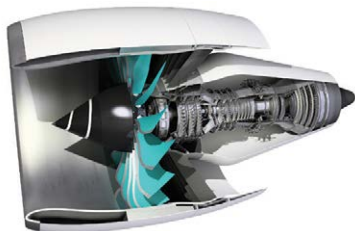
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UK Extends Backing for Aerospace R&D

The UK government is to extend its multi-year funding support for commercial aerospace research and development under a new industrial strategy launched June 23, providing £2.3 billion (\$3.2 billion) to 2035 through the Aerospace Technology Institute (ATI) program.

Release of the industrial strategy follows the award of more than £250 million in government and industry funding for aerospace projects, the first tranche of funding from the £975 million in support allocated to the ATI program by the government for 2025-30.

CLEAN AVIATION



The UK's industrial strategy backs Rolls-Royce's bid to reenter the narrowbody engine market with the UltraFan.

Under the UK's new industrial strategy, the ATI will focus on technologies for the next generation of more efficient and zero-emission aircraft, including Rolls-Royce's UltraFan engines, Airbus' new narrowbody aircraft and their supporting supply chains.

"The single biggest opportunity in aerospace over the next 50 years is to secure a UK engine position on next-generation single-aisle programs," the strategy document states.

For commercial aerospace, the strategy's goals include securing at least £35 billion to 2050 of additional private investment to industrialize technologies and increasing the UK's share of the global market by value to 15% from 10% by 2050 through targeting greater UK content on next-generation narrowbody aircraft.

"A 10-year commitment to ensure UK aerospace keeps investing in world-leading technology gives international com-

panies the confidence to invest, as well as playing a crucial role in developing the ultra-efficient and zero-carbon-emission aircraft we need to achieve our sustainability goals," ATI CEO Gary Elliott says.

The latest round of ATI funding supports two projects led by Airbus UK: £35 million for the second phase of the ZEROe Development Center to develop infrastructure for testing liquid hydrogen fuel systems and structural components, and £38 million for a project to scale up laser powder bed fusion 3D printing.

The funding supports three projects led by Rolls-Royce: £34.3 million for a project to develop advanced cooling technologies for engine hot sections; £20.7 million for the Aztec project to improve engine efficiency through an enhanced low-speed fan, novel compressor and ultra-highly loaded turbine; and £33.1 million for the Replenish project to create advanced aftermarket services.

Other funded projects include £15.8 million to the National Composites Center for a project to support high-rate manufacture of large composite structures like wing covers, £10.5 million for a GKN Aerospace-led project to advance large-scale additive manufacturing using laser metal deposition by wire and £6.3 million to Datum Tool Design and Queen's University Belfast for a project that focuses on computer numerical control machined tooling for large composite structures.

EASA To Assist Elfly With Seaplane Prototype

The European Union Aviation Safety Agency has signed a contract with Norway's Elfly Group to provide the startup with assistance in obtaining a permit to fly a conceptual prototype of its planned Noemi electric seaplane. The full-scale prototype is expected to fly by the end of 2027.

Elfly founder and CEO Eric Lithun signed the pre-application contract (PAC) with David Solar, head of sustainability, research and innovation at the European Union Aviation Safety Agency (EASA), on June 19.

Launched in 2023, the pre-application services program was EASA's response to industry feedback that it was easier for startups with novel technologies to work

with the FAA than with the European regulator. Signing a PAC allows a startup to begin working with EASA experts in specific areas before submitting a formal application for type certification.



ELFLY GROUP

Elfly's Noemi prototype reflects design changes, including a chined hull to deflect spray from the propellers.

German startup Vaeridion was the first to sign a PAC with EASA, in November 2023. A PAC is limited in scope and time, and in Vaeridion's case it focused on the multi-engine, single-propeller electric propulsion architecture of the startup's planned Microliner nine-seat electric regional airliner.

For Elfly, the PAC is focused on obtaining a permit to fly the full-scale Noemi conceptual prototype, which is being designed to validate the aerodynamics, hydrodynamics and propulsion architecture of the nine-passenger electric seaplane. Elfly recently competed the concept freeze review for the prototype.

The prototype will have the outer shape of the production aircraft but just a skeleton internal structure, Chief Technology Officer Tomas Brødreskift says. Elfly's goal is to comply with 70-80% of the requirements for EASA CS-23 airworthiness standards so the program is on a direct path to eventual type certification.

Elfly completed the first flight of a one-fifth-scale, radio-controlled model of the latest Noemi configuration on June 13. This features the seventh version of hull geometry, shaped to minimize hydrodynamic drag. The hull is close to the final design, Brødreskift says, with some more detail work required to ensure spray does not hit the propellers.

The latest model reflects many significant changes from the initial Noemi design. The original concept was to house the batteries below the cabin floor, in the hull, to provide a low center of gravity for stability in the water. "But by mid-2024, we were not able to nail down the form factor of the batteries," Brødreskift says, citing the choice of cylindrical or pouch cells of different sizes.

Elfly decided to move the battery

compartment into the fuselage, aft of the cabin, where it can accommodate different form factors and even energy sources, such as hydrogen fuel cells. “Now we are not dependent on one supplier to move forward,” he says.

“We have a fuselage and wing that outperforms the venerable de Havilland Twin Otter floatplane by a great margin,” Lithun says. The Noemi platform is designed to be propulsion-agnostic, supporting conventional Pratt & Whitney Canada PT6A turboprops, “if someone can present a valid business case,” he adds.

Electric Regional Startups Join Forces

Two European startups with ambitions to develop electrified regional airliners have joined forces to collaborate on topics ranging from setting standards for charging infrastructure at regional airports to exploring joint laboratory and flight testing.

The partnership brings together France’s Aura Aero and Germany’s Vaeridion. Aura is developing the Integral E electric, two-seat trainer and ERA hybrid-electric, 19-seat airliner. Vaeridion is developing the Microliner all-electric, nine-passenger aircraft.

Both startups face an uphill struggle to raise funding within Europe to develop their regional aircraft, even though the pressure to decarbonize aviation is more intense there than in most other parts of the world.

“Together with Vaeridion, we are bringing Europe to the forefront of electrical aircraft, with a joint approach towards certification and entry to service



Aura Aero says it has a backlog of more than 650 preorders for its ERA hybrid-electric 19-seater.

before 2030,” says Jérémy Caussade, co-founder and president of Toulouse-based Aura Aero.

In addition to charging infrastructure and flight testing, the collaboration between the two companies will include jointly advocating for policy frameworks that support the early adoption of electric aviation and exploring technical commonalities between their aircraft.

Munich-based Vaeridion has announced a collaboration with Bicester, England-based Evolito to develop the electric engine for the Microliner and another with MT-Propeller to explore integration of the German company’s Silent 7 propeller on the aircraft. Vaeridion also signed an agreement with the Dutch aerospace center NLR focused on flight testing, systems validation and regulatory compliance.

Dutch Backing for Hydrogen-Electric Retrofits

Dutch startup Conscious Aerospace has received confirmation from the Netherlands’ government that its planned development of a hydrogen-electric propulsion system for regional aircraft will receive €73 million (\$86 million) from

the country’s National Growth Fund.

The Hydrogen Aircraft Propulsion and Storage System (HAPSS) program aims within four years to fly a liquid-hydrogen fuel-cell powertrain on a De Havilland Canada Dash 8-300 and develop a supply chain in the Netherlands for production of hydrogen-electric powertrains.

HAPSS is the largest project within the Netherlands’ €383 million Aviation in Transition (LiT) program, Conscious says. The wider LiT program is also funding the Airbus-led ICEFlight (Innovative Cryogenic Electric Flight) project, which brings together Dutch companies to mature critical cryogenic technologies.

The Conscious-led project includes Dutch companies Aeronamic, Elysian Aircraft, EH Group Engineering, Magna Steyr Fahrzeugtechnik, Senior UK, SII Netherlands and AeroDelft. The Netherlands Aerospace Center Royal NLR and Delft Technical University are involved in the effort as well.

“The consortium we have assembled has the capability, experience and drive needed to achieve a fully certified solution,” Conscious CEO Erik Geertsema says. “With strong government backing, we can act now by designing and delivering a certified retrofitted Dash 8-300 with our novel propulsion system and start flying toward the end of this decade.”

Dutch carrier KLM and its low-cost subsidiary Transavia have signed a memorandum of understanding with Conscious to advise on seating and cargo design for a reengined Dash 8-300. KLM and Transavia have also signed an agreement with Elysian to explore requirements for deploying its E9X battery-electric aircraft, which is designed to carry 90 passengers 800 km (430 nm). ☼

—With Victoria Moores in Paris

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TOOLS & EQUIPMENT

Highland Technology

16-Ch VME Analog Output/Thermocouple Simulator Module

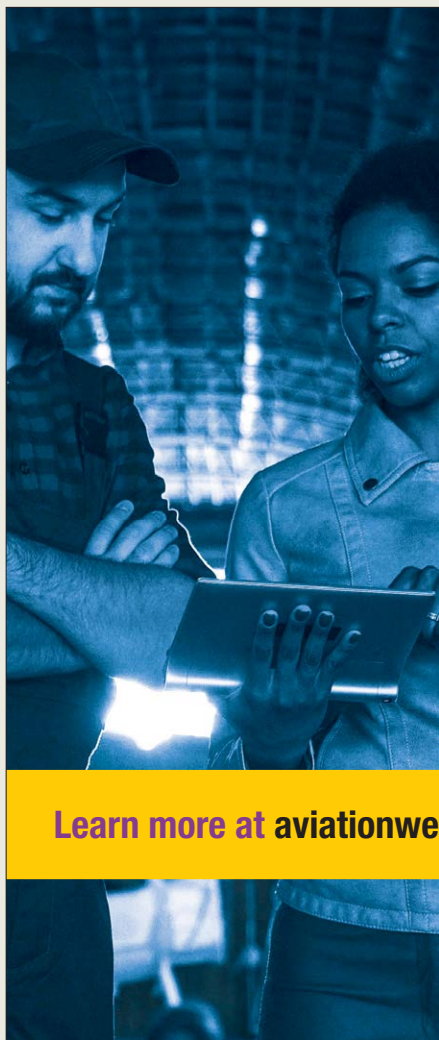
The V470 is a 6U VME module with 16 independent, isolated analog outputs that may be user programmed to operate as voltage outputs or thermocouple simulators. Users may write temperature or voltage values at VMEbus speed, and the microprocessor will transparently do all necessary calculations and update the channel electronics.



[www.highlandtechnology.com](https://marketplace.aviationweek.com/suppliers/highland-technology-inc/products/16-ch-vme-analog-outputthermocouple-simulator-module/)

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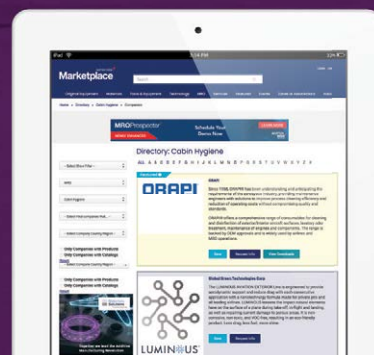
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The U.S. Needs Digital ATC Now

By **Bill Payne** and **David Hughes**

Colorado has led the way in air navigation innovation in the U.S. for decades, especially in mountainous terrain. Now the state is poised for a leap forward with a new digital tower concept serving six high-altitude ski-country airports.

Imagine one facility that is centrally located and cost-effective using advanced digital tower technologies—high-resolution visual and infrared cameras, radar, automatic dependent surveillance-broadcast (ADS-B) and wide area multilateration—to manage traffic at multiple airports. A second facility could support two of the busiest general aviation airports along Colorado's Front Range.

Each airport would have a dedicated team of controllers operating from the new facility. This approach would eliminate the need to construct costly towers at six ski airports that currently do not have towers, and it would lower the expense of replacing aging towers and equipment at others. Staffing levels could be flexibly adjusted—scaled down in the summer and increased during the busy winter ski season. Better air traffic control (ATC) at multiple airports would benefit airlines as well as business and general aviation. This model also could benefit small and midsize airports across the U.S.

The Colorado Transportation Department is already in the planning process for the two new facilities. The main hurdle? Potential FAA inaction.

The agency's changing requirements ended Colorado's previous remote tower project at Northern Colorado Regional Airport in 2023. It is time now to review that decision and support Colorado's renewed digital tower initiative.

Colorado's remote tower project aligns perfectly with Transportation Secretary Sean Duffy's commitment to overhaul the U.S. ATC system within four years. Duffy plans to secure full upfront funding for a broad ATC makeover—avoiding the traditional year-by-year drip from FAA and congressional budgets.

Consider this: Norway has leapfrogged the U.S. in modernizing air traffic control. Avinor, Norway's air navigation service provider, has launched a remote tower center in Bodø to manage 11 airports, and 10 more are due to come online soon. Many of these are small regional airports that do not require staffing 24/7. Norway has shown how flexible staffing can achieve efficiencies. Why not do the same in Colorado?

In Sweden, LFV and Saab pioneered the remote tower concept a decade ago and now operate two fully functional remote tower centers. Similarly, DFS and Frequentis have

established a remote tower center in Leipzig, Germany, serving several medium-size airports. At London Heathrow Airport, plans are underway to integrate digital technology into the existing control tower to manage aircraft on a new third runway—which would be located too far away to be monitored with the naked eye. London City Airport even controls traffic from a remote center 90 mi. away.

A recent study by the Reason Foundation, noting that

European airports have demonstrated that remote towers are both viable and reliable, calls on FAA leaders to take action on a plan to use this equipment.

The FAA has experimented with digital tower technology at both Northern Colorado Regional Airport (FNL) and Leesburg Executive Airport (JYO) in Leesburg, Virginia, using a combination of state and federal funding. Both programs were ultimately halted.

Now an RTX-Frequentis system is being evaluated and tested at the FAA's William J. Hughes Technical Center near Atlantic City, New Jersey, where it may receive system design approval next year for use in Colorado and elsewhere.

Digital tower centers reduce construction costs, use nonfederal equipment to lower FAA maintenance expenses and optimize staffing by enabling controllers to be certified for operations at multiple airports. They also simplify facility

oversight and scaling for airport growth while bypassing staffing challenges at remote locations and facilitating operations by drones and other novel air vehicles.

The FAA has rightly earned its reputation for making U.S. airspace the safest in the world. But like many large government agencies, it can be slow to adopt new technologies. The core function of ATC has not changed since the first control tower began operating in 1930, but today one remote facility can manage traffic for multiple airports with equal or greater safety than individual traditional towers on airfields that cost millions of dollars each.

Colorado is well-positioned to lead once again. It has the experience, the need and the vision—it is simply awaiting a green light from the federal government. 🟢

William E. "Bill" Payne is president and CEO of air traffic control tower design firm William E. Payne & Associates and program manager for the Colorado Digital Tower Program. David Hughes worked at Aviation Week for 20 years as a journalist, including as a bureau chief and managing editor, and then wrote about NextGen at the FAA for a decade.



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