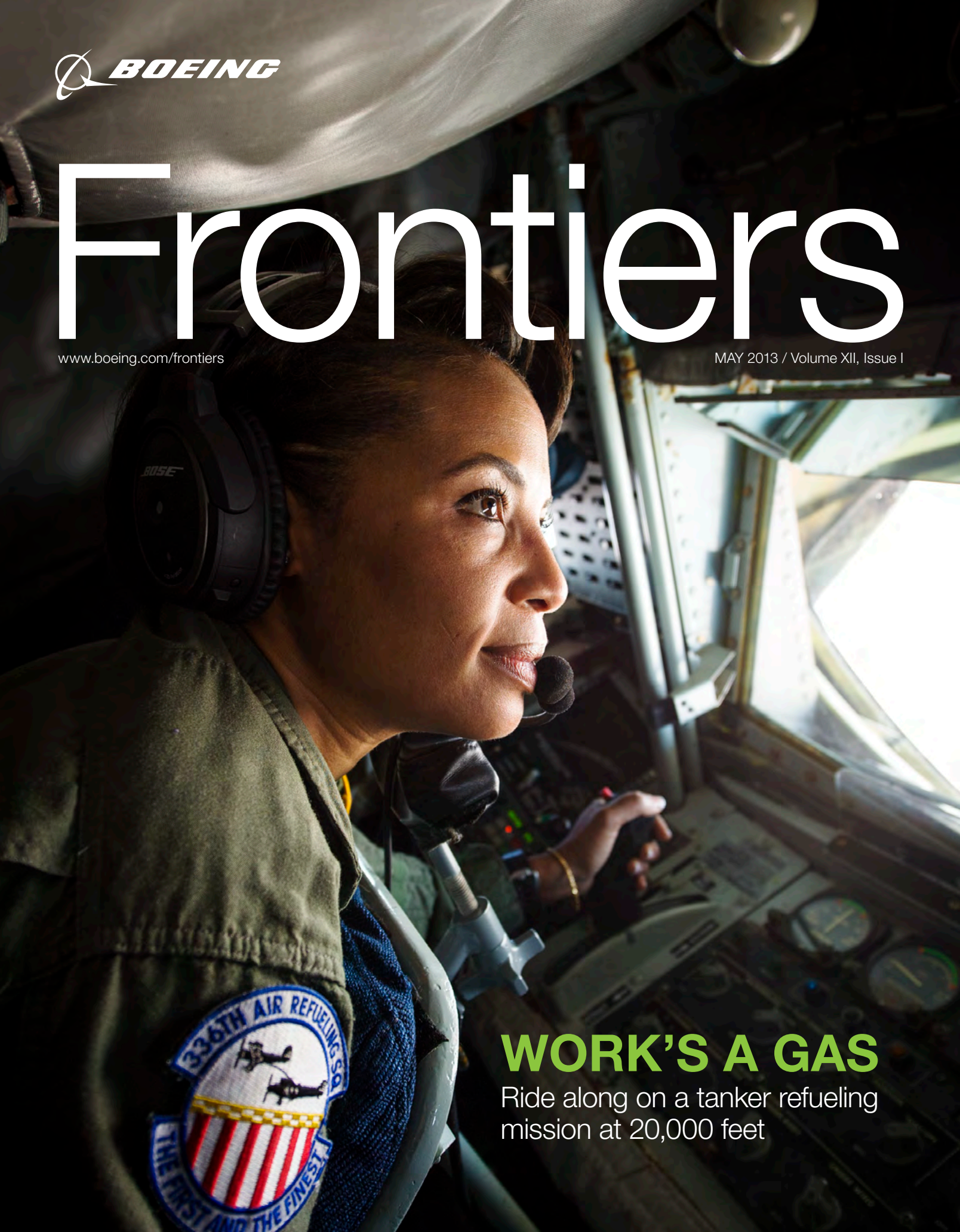
BOEING

Frontiers

www.boeing.com/frontiers

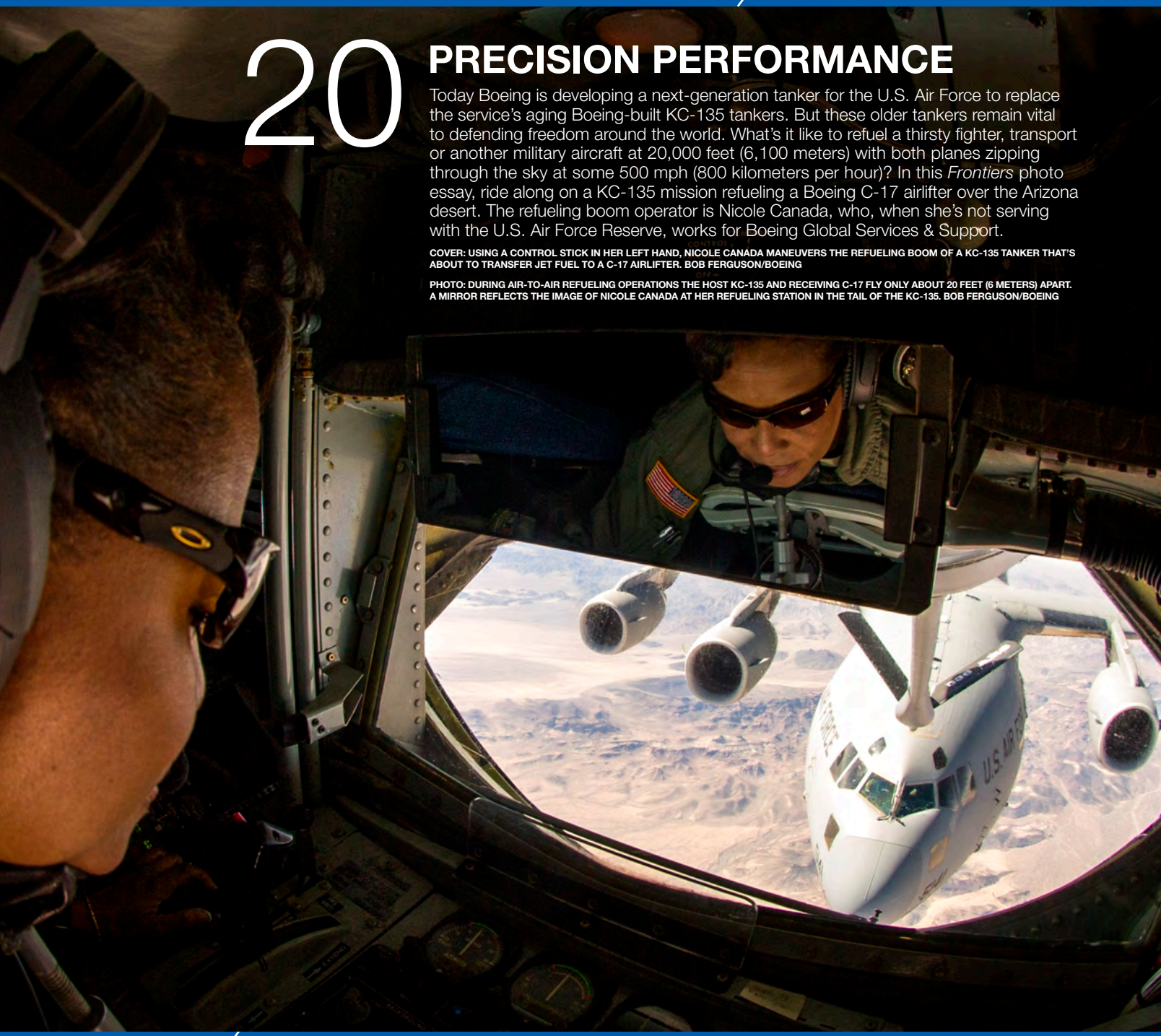
MAY 2013 / Volume XII, Issue I



WORK'S A GAS

Ride along on a tanker refueling mission at 20,000 feet


EMARSS, ON APPROACH.
The Enhanced Medium Altitude Airborne Reconnaissance and Surveillance System (EMARSS) provides the U.S. Army flexible and modular multi-intelligence capability to detect and track surface targets with unprecedented accuracy. The prototype has already achieved first flight and continues its flight testing—part of a total commitment to assure the Army of enduring capability and a best-value solution.
BOEING



20 PRECISION PERFORMANCE

Today Boeing is developing a next-generation tanker for the U.S. Air Force to replace the service's aging Boeing-built KC-135 tankers. But these older tankers remain vital to defending freedom around the world. What's it like to refuel a thirsty fighter, transport or another military aircraft at 20,000 feet (6,100 meters) with both planes zipping through the sky at some 500 mph (800 kilometers per hour)? In this *Frontiers* photo essay, ride along on a KC-135 mission refueling a Boeing C-17 airlifter over the Arizona desert. The refueling boom operator is Nicole Canada, who, when she's not serving with the U.S. Air Force Reserve, works for Boeing Global Services & Support.

COVER: USING A CONTROL STICK IN HER LEFT HAND, NICOLE CANADA MANEUVERS THE REFUELING BOOM OF A KC-135 TANKER THAT'S ABOUT TO TRANSFER JET FUEL TO A C-17 AIRLIFTER. BOB FERGUSON/BOEING

PHOTO: DURING AIR-TO-AIR REFUELING OPERATIONS THE HOST KC-135 AND RECEIVING C-17 FLY ONLY ABOUT 20 FEET (6 METERS) APART. A MIRROR REFLECTS THE IMAGE OF NICOLE CANADA AT HER REFUELING STATION IN THE TAIL OF THE KC-135. BOB FERGUSON/BOEING

AD WATCH

The stories behind the ads in this issue of *Frontiers.*

Inside cover:

This new ad for Enhanced Medium Altitude Airborne Reconnaissance and Surveillance System, or EMARSS, highlights progress Boeing is making in providing the U.S. Army with this critical intelligence, surveillance and reconnaissance capability. The ad currently appears in trade publications.

Page 6:

The Boeing Store's Custom Hangar is a select collection of authentic, limited-edition Boeing artifacts, collectibles and apparel designed for true aviation fans. This ad features Custom Hangar, 737 MAX and Boeing logo merchandise for Father's Day gift ideas. Learn more at your local store or at *www.boeingstore.com.*

Pages 36–37:

This ad congratulates recipients of Boeing's Supplier of the Year awards and reflects last month's Boeing Global Supplier Conference theme of "One Team … Leading the Future."

Back cover:

This ad shows Boeing's appreciation for and gratitude toward the U.S. armed forces. It will run in *The Washington Post* and *The Seattle Times*, as well as in regional, trade and military publications, over the U.S. Memorial Day holiday. Boeing will air a similarly themed commercial on the "Meet the Press" television program.

FSC LOGO

Publisher: Tom Downey
Editorial director: Anne Toulouse

EDITORIAL TEAM

Executive editor:
Paul Proctor: 312-544-2938

Editor:
James Wallace: 312-544-2161

Managing editor:
Vineta Plume: 312-544-2954

Graphic designers:
Brandon Luong: 312-544-2118
Cass Weaver: 480-216-4539

Photo director:
Bob Ferguson: 312-544-2132

Commercial Airplanes editor:
Don Smith: 206-766-1329

Defense, Space & Security editor:
Diane Stratman: 562-797-1443

Engineering, Operations & Technology editor:
Junu Kim: 312-544-2939

Human Resources and Administration editor:
Len Vraniak: 312-544-2351

Shared Services Group editor:
Beriah Osorio: 425-577-4157

Staff writer:
Eric Fetters-Walp: 425-266-5871

ONLINE PRODUCTION

Web manager:
Wendy Manning: 312-544-2936

Web designer:
Michael Craddock: 312-544-2931

Web developers:
Lynn Hesby: 312-544-2934
Keith Ward: 312-544-2935

Information technology consultant:
Tina Skelley: 312-544-2323

HOW TO CONTACT US:

E-mail:
boeingfrontiers@boeing.com

Mailing address:
Boeing Frontiers
MC: 5003-0983
100 N. Riverside Plaza
Chicago, IL 60606

Phone:
312-544-2954

Fax:
312-544-2078

Web address:
www.boeing.com/frontiers

Send all retiree address changes to
Boeing Frontiers, MC 6Y-66
P.O. Box 3707
Seattle, WA 98124-2207

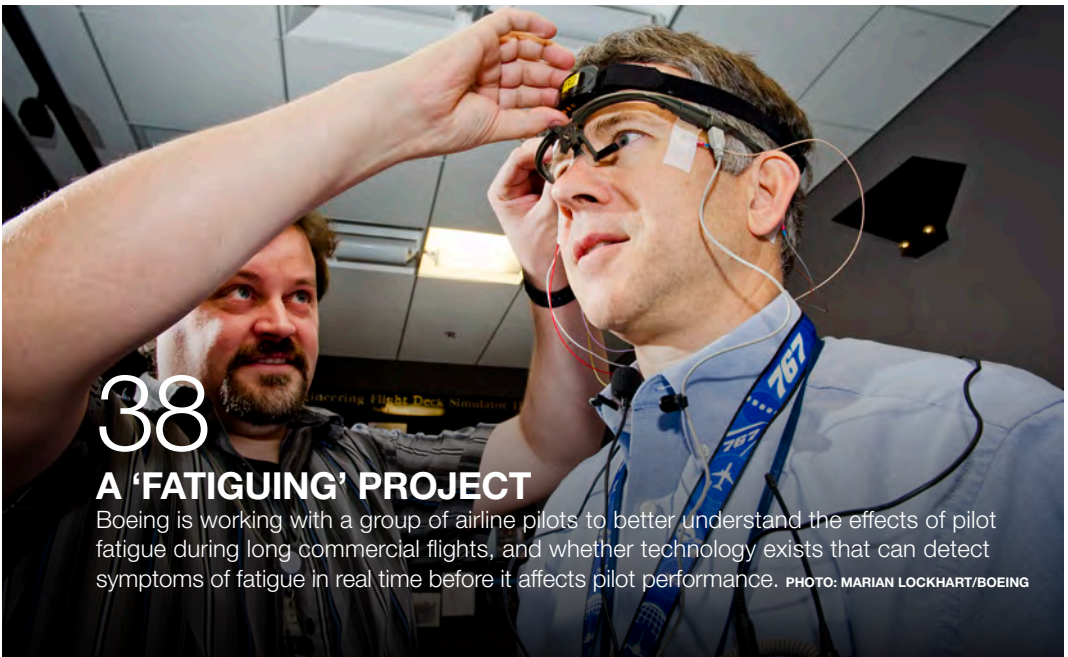
Postmaster: Send address corrections to
Boeing Frontiers, MC 6Y-66
P.O. Box 3707, Seattle, WA 98124-2207
(Present addressees, include label)

10
HISTORICAL PERSPECTIVE
It was a time when air travel was a grand adventure and passengers dressed up to enjoy the romance of flying across the country or an ocean. Nothing symbolized that era better than Boeing's 314 Clipper, which first flew 75 years ago next month. (The first Clipper is shown here after launch from the slipway at Boeing Plant 1 in Seattle in 1938.) PHOTO: BOEING ARCHIVES

14
ALL IN WITH BOEING
Boeing and Alaska Airlines enjoy a special bond. They not only share a hometown, Seattle, but Alaska is an all-Boeing customer and recently took delivery of its 100th Next-Generation 737. And it will be first to fly both the 737 MAX-8 and MAX-9 jetliners. PHOTO: BOB FERGUSON/BOEING

30
BUILT TO LAST
The UK is a major customer for Boeing military and commercial products and a key Boeing supplier. This special partnership began 75 years ago. (Boeing is part of a team at Royal Air Force Waddington that provides Distributed Synthetic Air Landing Training, shown, to Royal Air Force pilots and British Army forward air controllers and artillery personnel.) PHOTO: CROWN COPYRIGHT

26
TAKING THE HEAT
An innovative engine nozzle about the size of a Smart car and made of a ceramic matrix composite that can withstand very high temperatures has been ground-tested by Boeing and its partners. It's part of a Federal Aviation Administration program to accelerate new technologies that will help reduce aircraft fuel burn, emissions and noise. The next step will be flight testing of the nozzle on Boeing's 2013 ecoDemonstrator jetliner, a 787. PHOTO: BOB FERGUSON/BOEING



38
A 'FATIGUING' PROJECT
Boeing is working with a group of airline pilots to better understand the effects of pilot fatigue during long commercial flights, and whether technology exists that can detect symptoms of fatigue in real time before it affects pilot performance. PHOTO: MARIAN LOCKHART/BOEING

Inside

07
LEADERSHIP MESSAGE
For years, Boeing has been advocating for trade reform to allow U.S. companies to better compete in the global market. Now, after nearly four years in the making, new U.S. trade rules will have far-reaching effects on aerospace, says Kathryn Greaney, vice president of Global Trade Controls.

08
SNAPSHOT/ QUOTABLES

16
WHY WE'RE HERE

17
CUSTOMER PROFILE

41
MILESTONES

46
IN FOCUS

Trade transformation

New U.S. trade rules will have far-reaching effect on aerospace, defense

Kathryn Greaney
Vice president, Global Trade Controls

As one of the largest U.S. exporters and a major importer of parts and supplies, Boeing has been advocating for trade reform for many years to allow U.S. companies to compete effectively in the global market while ensuring the tightest controls on critical national technology.

Almost four years in the making, the first set of rules under U.S. President Barack Obama's Export Control Reform take effect this October. These rules will mean changes in how we design and build products, how we market and talk about those products, and ultimately how we ship products and spare parts and provide service to customers.

Global Trade Controls (GTC), a part of the Office of Internal Governance, has been preparing for this since President Obama announced the reform effort in 2009. Boeing representatives from GTC and Government Operations have served on industry advisory groups during the rule-making process and provided input to help ensure the reform meets its goal. A variety of other organizations have also supported export reform, including Business Roundtable (an association of CEOs of leading U.S. companies) and the President's Export Council (which advises the president on trade policy and programs to further the administration's goal of doubling U.S. exports over five years). Both are chaired by Boeing Chairman, President and Chief Executive Officer Jim McNerney.

GTC also has been on its own reform mission. Our trade experts have made it easier for anyone in Boeing to get help with trade questions; deployed new tools and systems to make compliance easier; shortened internal cycle times; and improved quality and service.

We embedded GTC employees in the businesses to support efforts such as "design for export," an initiative where GTC works with programs and functions, like Engineering and Program Management, to take trade rules into account in product inception and design. Down the road, having designs that already meet export requirements could simplify international marketing and sales and give us a competitive advantage.

Boeing also imports components and supplies from around the world and ships products and parts between a multitude of countries. So the Global Trade Controls team is responsible for enabling compliance with the trade rules of more than 100 nations. Despite this broad-ranging expertise remember that trade compliance, like all compliance issues such as safety regulations, is a personal responsibility for all Boeing employees.

In Global Trade Controls we are committed to help Boeing employees as well as our subsidiaries, suppliers and partners ensure we meet our trade standards, which in many cases exceed government requirements. Whether it is knowing where we can or cannot market our products, providing guidance to lower the costs of import fees to make our products more affordable, or helping the businesses understand the impact of export reform, GTC trade experts are a resource to help ensure Boeing's success.

As export reform rolls out in the U.S. and trade rules evolve around the world, we continue to deepen our coordination with our business partners. Let us know whenever we can support the success of your part of Boeing—and help keep the company a global leader in trade and trade compliance. ■

PHOTO: PAUL PINNER/BOEING

Center of attention

Flanked by a Cargolux 747-8 Freighter, an engine of which is shown here on the left, and an ANA 787 Dreamliner, Boeing employees gather to celebrate the opening of the new Everett Delivery Center April 3. The center, where 787, 777, 767 and 747 jetliners made at the Everett, Wash., factory are handed over to customers, features three times the office, conference and operational space as the old facility. Curved architecture allows airplanes to pull up close to the building. And customized boarding bridges make it easy for customers to access their new planes. A dramatic photo of the delivery center at night can be downloaded as wallpaper for your computer screen at www.boeing.com/frontiers/downloads. PHOTO: GAIL HANUSA/BOEING

"The C-17 is one of the greatest tools ever presented to the U.S. military."

– Lt. Gen. Darren McDew, commander, 18th Air Force, Scott Air Force Base, Ill., speaking at delivery ceremonies for the U.S. Air Force's 220th C-17 Globemaster III March 27 at Boeing's Long Beach, Calif., final assembly facility. This C-17 was the last scheduled for delivery to McChord Air Force Base in Washington state. Boeing News Now, March 29.

"This is a great time to be in the space exploration business."

– Virginia A. "Ginger" Barnes, newly named vice president and program manager for Boeing's Space Launch System program. Boeing is designing and developing the core stages of a new heavy-lift rocket that will be able to send astronauts on missions beyond Earth's orbit. The first flight for Space Launch System is scheduled in 2017. Boeing News Now, April 14.

"We're pleased to deliver a world-class airplane in this world-class space."

– Tom Maxwell, vice president, Everett Delivery Center, commenting on delivery of the first plane, a Thai Airways 777-300ER (Extended Range), from the just-completed Everett, Wash., facility. Boeing News Now, April 10.

Romancing the sky

Long before the 747 came along, Boeing Clipper was 'Queen of the Skies'

By Mike Lombardi

It has come to symbolize a time when the romance of air travel was a grand adventure. Even its name, "Clipper," evokes images of tall ships crossing the seas.

This majestic giant, the Boeing 314 Clipper, skimmed over the waters of Elliot Bay and took to the skies above Seattle on its first flight 75 years ago next month. At the time it was the world's largest production commercial airplane, and would become the ultimate in transoceanic elegance. Like its descendant, the 747, the Clipper was crowned "Queen of the Skies."

The Clipper story begins with Boeing engineer Wellwood Beall, who was asked about trans-Pacific air travel while on a trip to China in 1935 to finalize a contract for the sale of 10 Boeing P-26 fighters.

"It will be 10 to 15 years before that sort of thing is commercially practical," he was quoted as saying.

Later, on the long boat trip back from China, Beall began to regret that statement. Upon his return to Boeing, Beall saw the work being done on the giant wing for an experimental airplane, later known as the XB-15. It was the largest plane in the United States at the time, and that wing became the spark of inspiration for an ocean-spanning flying boat.

Beall drew up the design for the flying boat at home, working at his dining room table. His efforts paid off. In July 1936, Pan American Airways presented Boeing with a formal order for six and an option for six more of the airplanes known as the Model 314 Clipper.

Two years later, on June 7, 1938, Boeing test pilot Eddie Allen took the Clipper up from Seattle's Elliott Bay on its first flight. During the 38-minute trip the Clipper flew north to Everett, where Boeing would later build the 747 and its other twin-aisle jetliners, before landing in Lake Washington on the east side of Seattle, where Boeing had set up a flight-test facility.

Early in the flight-test program, Eddie Allen determined that the 314 did not have enough lateral control and the airplane's single tail was replaced with a new, triple-tail design.

Following certification, and after a shakedown flight from San Francisco to Hong Kong, the Clipper entered service flying passengers

PHOTO: The "California Clipper," operated by Pan American Airways, arrives over San Francisco Bay. PAN AMERICAN WORLD AIRWAYS COLLECTION, UNIVERSITY OF MIAMI LIBRARIES

across the Pacific—San Francisco to Singapore. In June 1939, regular trans-Atlantic passenger service began from New York to Marseille. The service was twice weekly, weather permitting, and took about 23 hours. The cost one way was $395, or about $6,500 in today's dollars.

Those who could afford to fly in the Clipper were treated as if in a luxury hotel. Although the plane could accommodate 10 crew and 74 passengers, most overnight flights carried fewer than 30 passengers. The 314's interior included a separate honeymoon suite known as the "Deluxe Compartment," fully set dining room tables, a bar, a full-service galley, and passenger compartments with plush chairs, sleeping berths and vanities.

But the 314 was introduced as war clouds gathered over Europe, making the Atlantic routes covered by the Clipper a vital military lifeline. Of Pan American's 12 Clippers, three were used by British Overseas Airways Corp. and the rest drafted into service with the U.S. military. One of those military Clippers served as the first "Air Force One," transporting Franklin D. Roosevelt from Miami to the Casablanca Conference in Morocco in January 1943, where the U.S. president met with British Prime Minister Winston Churchill to discuss war strategy.

As amazing as the Clippers were, the rapid pace of technology during the war drove flying boats into obsolescence. Even as the Clipper entered service, aircraft such as the Focke-Wulf FW-200 Condor and the pressurized Boeing 307 Stratoliner were able to cross the Atlantic, foretelling a future dominated by land-based transports.

After a mere decade of service the Clippers disappeared—all were scuttled or scrapped. But the Clipper began the Boeing heritage of pioneering large, globe-spanning commercial planes that would eventually make airline service possible for everyone, not just a privileged few.

Today, Boeing's emphasis on an outstanding passenger experience on all of its jetliners, especially the 787 Dreamliner, is a tribute to the romance of flight symbolized by the Boeing Clipper, a plane that after 75 years still serves as a reminder that air travel once was, and can still be, a thrilling adventure. ■

michael.j.lombardi@boeing.com

Read more about the Clipper on Page 30.

To see a related video, visit www.boeing.com/frontiers/videos/may2

Those who could afford to fly in the Clipper were treated as if they were in a luxury hotel.

PHOTOS: (Top left) The Clipper on its first flight over Seattle's Elliott Bay, June 1938. The single tail was later replaced with a triple-tail design. (Top right) Fine cuisine was served in the dining compartments. (Right) A new Clipper prepares for first flight at Elliott Bay. The 314A Clipper had a 152-foot (46-meter) wingspan and an almost 5,200-mile (8,400-kilometer) range. BOEING ARCHIVES

All Boeing and proud of it!

Alaska Airlines and Boeing are neighbors—and partners in success

Seattle-based Alaska Airlines recently took delivery of its 100th Boeing Next-Generation 737. Mark Eliasen, the airline's vice president of finance and treasurer, talks about the long-term relationship between Boeing and Alaska Airlines.

Everyone remembers their first commercial flight. Mine was aboard a small charter plane operated by Winship Air Services on Dec. 17, 1976, from Dutch Harbor, Alaska, to Anchorage. I'd just spent five months working on a king crab fishing and processing boat—long before the "Deadliest Catch" made crab fishing cool. My second flight, aboard a spacious, red-tailed Northwest Orient 747 jumbo jet, could not have been a nicer, more comfortable way to ride home to family and friends in Seattle.

Winship ceased operations long ago and Northwest is now part of Delta. But after more than four decades, the 747 is still flying around the world. That's because Boeing wisely continued to improve it with the -400 series and now the 747-8.

This reminds me how change is constant in aviation. One good thing that hasn't changed, though, is the partnership between Boeing and Alaska Airlines. It's a great relationship that's endured for nearly half a century—ever since we bought three 727s in 1964. We're proud to share a hometown with the company that builds all our airplanes and has played a pioneering role since aviation's early days.

One definition of a partnership is an arrangement where parties agree to cooperate to advance mutual interests. Those words capture our relationship well. Thousands of us at Alaska and Boeing are focused on making the 737 successful, which has and will continue to advance both companies.

It's not always easy. Just as there's constant change, there's no shortage of challenges in the airline business. Skyrocketing fuel costs, multiple bankruptcies and mergers, and never-ending competition are just a few. When Alaska was struggling with these challenges and needed to transform itself in the early 2000s, our hometown partner stepped up to help us.

We'd been flying the 737 for years, but our acquisition of Next-Generation 737s represented a milestone that helped us spread our wings and become a national airline. Since 2001, we've added 16 cities east of the Rocky Mountains to our network. The 737-800 also gave us the capability to fly nonstop to Hawaii's four major islands, helping our customers avoid changing planes in Honolulu and creating a great growth market for Alaska Airlines.

> "We're proud to share a hometown with the company that builds all our airplanes and has played a pioneering role since aviation's early days."
>
> – Mark Eliasen, vice president of finance and treasurer, Alaska Airlines

Our customers are pleased with the Next-Generation 737 and so are we. The aircraft's fuel efficiency has significantly reduced our costs and is the primary factor in cutting our carbon emissions by nearly one-third since 2004. The operational versatility of the NGs—and the added capacity of the -900ERs (Extended Range) we started flying last fall—are crucial so we can offer our customers low fares and compete more effectively against our biggest competitors: low-cost carriers. Our quest for efficiency is also why Alaska placed firm orders for another 50 airplanes, plus options, last fall to keep our growing fleet modern and why we decided to be the first airline to fly both the MAX-8 and MAX-9. Alaska's future depends on the MAX meeting its promised fuel burn savings and delivering on schedule. Thanks for doing your part.

Alaska Airlines took delivery of our 100th 737-NG in February. Like all of our aircraft, the nose bears a decal that no other airline has and it says, "Proudly All Boeing." To you, our friends and neighbors at Boeing, thank you for building the world's greatest airplanes! And we appreciate it when you choose to fly home with us.

See you around town. ■

PHOTOS: (Far left) Mark Eliasen, vice president of finance and treasurer, Alaska Airlines. BOB FERGUSON/BOEING (Above) An artist's concept of the 737 MAX-8 in Alaska Airlines livery. ALASKA AIRLINES

Going the distance

For this office administrator, teamwork and focus are key

By Kay McVey and photo by Peter George

My official job title is Office Administrator. That means a lot of different things, but in essence it means making sure my manager can do his job of providing support for F-15 aircraft customers. I know he can't focus on his job if he has to spend his time on routine administrative tasks. So I do those things—like correspondence, schedule management, meeting setup and travel arrangements—that free him to do what he does best.

I've found that success as an office administrator depends on three things. The first is teamwork. It may seem like office administrators are solo workers, but a lot depends on communication and networking. Since no one person is an expert in everything, office administrators, or OAs, have to work together to understand and to maximize all the systems Boeing uses. For instance, I may need others' help in procurement. Or someone may need my help in coordinating international travel. I learned a long time ago that it's not just about supporting our immediate supervisors or teams; it's about asking for help when I need it and helping others as they support their teams.

Another quality that comes in handy for an OA is recognizing that every person and every job is important. Although my first responsibility is to my immediate manager, opportunities often come up to help other OAs help their teams, and vice versa. I can't have the attitude "that's your job, not mine." We're here to help one another succeed. It's like the links in a bicycle chain. Every link in the chain is needed to keep the bike moving.

The third thing that helps me as an OA is focus. I recently completed the Ironman World Championship Triathlon in Kona, Hawaii. I successfully completed a 2.4-mile (4-kilometer) swim, a 112-mile (180-kilometer) bike ride and a 26.2-mile (42-kilometer) run. To succeed, I had to learn to focus on each individual component, not everything at once. I had to first focus on qualifying. Once in the race, I couldn't think about the bicycle while I was swimming, and I couldn't worry about how tired I would be for the marathon before I finished that bike ride. I had to keep my focus on the immediate task at hand. One step, one stroke, one mile at a time.

I use that same focus at work. That doesn't mean I don't have to multitask at times, but for the most part I focus on the finish line for each individual task until it's complete.

The job of an office administrator is often behind the scenes. But that doesn't bother me. I know my job is important. OAs are like the timekeeper in a race. You don't notice the timekeeper until the clock's not working. Although my job is behind the scenes, I enjoy keeping that clock ticking! ■

kathleen.mcvey@boeing.com

DELTA force

After a strong performance last year, Delta Air Lines is flying high

By Tim Bader

Fortune magazine called Delta Air Lines one of the Most Admired Companies in 2012, ranking it first in the airline industry.

And in 2013, the airline is clearly still on the move.

"It is a particularly exciting time to be at Delta given the momentum we have garnered," said Richard Anderson, Delta's chief executive officer. "We are running a better airline than at any other time in our history."

Delta made progress with several strategic initiatives to enhance customer service, strengthen market share and mitigate fuel costs, according to Anderson. For example, the airline expanded at LaGuardia Airport in New York. It also announced a venture with Virgin Atlantic Airways, which greatly expands Delta's presence at London Heathrow Airport. Delta focused on growing its Latin America presence with partners such as GOL and Aeromexico.

Delta also made a bold move to control fuel costs by purchasing the Trainer refinery, near Philadelphia. The refinery is capable of processing 185,000 barrels per day.

The airline is also taking two additional steps in its ongoing domestic fleet optimization initiative, Anderson noted. This year, Delta will welcome two new mainline (non-regional fleet) airplane models, the Next-Generation 737-900ER (Extended Range) and the 717. Delta launched its domestic fleet revitalization in 2010, focusing on improving profitability while enhancing customer experience.

PHOTO: DELTA AIR LINES

"We are running a better airline than at any other time in our history."

– Richard Anderson, chief executive officer, Delta Air Lines

"A key component of Delta's strategy is making prudent investments for the future while maintaining our financial and capacity discipline," Anderson explained. "With the Next-Generation 737-900ER, we can give our customers a superior in-flight experience while improving shareholder returns."

The 737-900ERs will primarily be replacing aging 757, 767 and Airbus A320 airplanes in Delta's fleet.

The 717s come to Delta through an agreement with Southwest Airlines and Boeing to acquire 88 717-200s currently in service with Southwest subsidiary AirTran Airways. The airplanes—a full-size twinjet manufactured by Boeing after its merger with McDonnell Douglas for the short-range 100-seat regional airline market—will offer an enhanced customer experience and greater cost efficiency compared with the small 50-seat regional jets they will replace, according to Anderson.

The 717s and 737-900ERs are part of Delta's investment in the customer experience, Anderson said. That also includes investing more than $3 billion in technology, employee training, fleet upgrades and enhancements to airport facilities worldwide.

But Delta's success, Anderson pointed out, is ultimately a credit to its 80,000 employees.

"Thanks to the hard work and dedication of our employees worldwide, we are industry leaders in operational excellence, financial performance and customer satisfaction," Anderson said. "Our investments in the customer experience continue to pay off, but it is the investment in our people where we see the results every day." ■

tim.s.bader@boeing.com

GRAPHIC: Delta is scheduled to receive its first Next-Generation 737-900ER (Extended Range) in September. BOEING

GOAL!

‘Boeing on the Move’ is back, with more opportunities for employees to be active

By Alex Wilson and photos by Alan Chalfin

As goalie for an ice hockey team in Ridley Township, Pa., Bill Ripley feels he’s in the best position in the rink.

“I’m the safest guy on the ice,” said Ripley, chief engineer, Joint Multi-role Technology Demonstrator Program, and a Boeing on the Move team captain. “I’ve got all the pads.”

Since a group at the site began playing hockey together two years ago, Ripley is one of the team’s success stories. With the Boeing fitness center in Ridley Township and hockey, he has lost nearly 70 pounds (31 kilograms) and consistently is the team’s Boeing on the Move high stepper, averaging more than 20,000 steps a day.

“It’s about finding the thing that isn’t work,” Ripley said of what motivates him to exercise. “Boeing on the Move was something we could do as a team. And everything is easier when you’re doing it with a team.”

This year, the team will have a chance to compete again in Boeing on the Move. Registration is open from May 13 to May 31, and the eight-week challenge runs from June 10 to Aug. 4 for active employees worldwide.

As an incentive to keep moving, Boeing on-site fitness centers will be free to new and current employee members in June and July. Employees in the United States without access to an on-site center can look to the Boeing Discount Program for discounts on community fitness center memberships and exercise equipment.

Now in its fourth year, Boeing on the Move has been very successful, said Tony Parasida, senior vice president of Human Resources and Administration.

“Participation has been growing and it’s paying off—putting us on the road to better health,” he said.

Last year, Parasida noted, more than 79,000 employees participated, a 34 percent increase from the year before. This year, the challenge will be two weeks longer and employees can enter activity online through the new ShapeUp website, which offers an enhanced tracking tool.

The Ridley Township hockey team of engineers and mechanics from the site is looking forward to this year’s challenge, according to Frank Travaglini, chief engineer for the Chinook UK Mk6 program.

“We have young guys, entry level, senior managers, and we all feel like equals,” he said. “We’re all ages, from 23 to 53.”

Travaglini said the Sunday night hockey games force him to keep his conditioning up.

“It also allows the site to bond,” said Mike Marano, the team’s winger and manager of system safety for Chinook programs. In fact, after a championship season this past winter, an image of the teammates with their trophy rotated on the site’s monitors.

More than camaraderie on the ice, teammates help one another stay motivated in their workouts and during the Boeing on the Move physical activity challenge. They work out together at the Boeing fitness center, have created their own Boeing on the Move team (called “Wildebeests on the Move” after their hockey team, the Wildebeests), and push one another to stay fit for that week’s game.

“Hockey gives me a goal,” Marano said. “I know I need to run that extra five minutes. And every week, I can see my results.”

Participants who are based in the United States will be able to text their activity for automatic uploading to the ShapeUp website, and worldwide participants can link fitness devices and mobile apps, such as Fitbit, RunKeeper and BodyMedia, to the ShapeUp website for automated tracking.

Teams are limited to 20 people this year to encourage more interaction and accountability. The ShapeUp website also promotes social networking opportunities, such as the ability to invite others to be “supporters” and engage colleagues in challenges.

Next month, Ridley Township’s hockey players will be encouraging one another to exercise just that little bit more during Boeing on the Move, Ripley said, adding he feels better after losing weight.

His advice for employees who are interested in transforming themselves the way he did: “We all have families, friends and fixed schedules. You just need to make time.” ■

alexander.m.wilson@boeing.com

PHOTOS: (From far left) Dave Kohl, foreground, skates to the puck; No. 26 Kevin Fegely, from left, Bill Ripley III, Bill Ripley Jr. and Tom Cavanaugh; Bill Ripley III pushes the puck up the ice; Nate Deforest, foreground, and Frank Travaglini watch from the bench.

EXTRA MOTIVATION

Employees can earn up to $100 in gift cards, or the equivalent in local currencies for international locally hired employees. To earn $50, employees need to track activity at least one day for each week and average 6,000 steps or 15 exercise minutes per day. To earn $100, employees need to track activity at least one day for each week and average a total of 12,000 steps or 30 exercise minutes per day.

For more information, visit Boeing TotalAccess and click My Well Being.

A ‘booming’

career

PHOTOS: (Left) In the tail of a KC-135 tanker, U.S. Air Force Reserve member and Boeing employee Nicole Canada lies on her stomach with her chin in a support rest as she maneuvers the tanker's "flying boom" to a connection. The receiver aircraft, a C-17airlifter (above right), is reflected in her sunglasses.

Outside her regular job at Boeing, this employee pumps gas … at 20,000 feet

By Diane Stratman
Photos by Bob Ferguson

Lying flat on her stomach in the tail section of the KC-135R Stratotanker, Nicole Canada waits for rocky air turbulence and strong winds to calm down. Turbulence and sudden gusts of wind can add thrilling aspects to Canada's job, but can also prevent her from carrying out her particular mission as a boom operator on board the Boeing-built tanker.

Fortunately, within minutes the rocking ceases, the wind dies down, and Canada peers through a small window, ready to proceed. The tanker pilot confirms the KC-135 is in proper position to refuel the thirsty receiver aircraft flying just behind. Canada deftly maneuvers the tanker's refueling boom into the receiver aircraft's receptacle and begins pumping thousands of pounds of fuel. When done, she disconnects the boom and the receiver aircraft is good to go and able to continue its mission—without having to land for fuel.

It's a precisely orchestrated ballet of skill, experience, precision and teamwork that has played out at 20,000 feet (6,100 meters) and 500 mph (800 kilometers per hour). Just another day on the job for this Boeing employee, who's also a U.S. Air Force reservist based at March Air Reserve Base in Riverside, Calif.

"They say the dream job is the one you'd do for free," said Canada, a senior master sergeant with the U.S. Air Force Reserve and a boom operator for the past 21 years for the KC-135. "I have that dream job."

And her Boeing job with Global Services & Support is almost an extension of what she does for the military—one she is equally proud of.

Canada is based in Long Beach, Calif., where she's an

"Being a boom operator is one of the most exciting jobs in the Air Force Reserve. Not only have I been able to see the world, but my perspective of the big picture is much clearer as the Air Force carries out its various missions."

– Nicole Canada, international program manager, C-17 Globemaster III Integrated Sustainment Program

PHOTOS: (Clockwise from left) Fuel is transferred from the KC-135 to the C-17 over the Arizona desert; Nicole Canada enjoys a lighter moment in the KC-135 before the demanding refueling operation begins; a patch worn by Canada's U.S. Air Force Reserve squadron reflects the long history of air-to-air refueling; the KC-135 flight deck; a tanker pilot coordinates with air traffic control before taking off from March Air Reserve Base in Riverside, Calif.

international program manager for the C-17 Globemaster III Integrated Sustainment Program. She and her team ensure the Royal Canadian Air Force has the maintenance and parts it needs to keep its fleet of Boeing C-17 airlifters operating.

"In many ways, my job at Boeing feels like a continuation of my military service," Canada said. "Of course, it's a little less dramatic than my role in the Air Force, but I feel every job is vital. Doesn't matter if it's on the front lines or behind the scenes."

Canada said she finds it rewarding to work at Boeing while serving in the Air Force Reserve.

"There's camaraderie both in the military and at Boeing," she said. "You take care of each other; you support one another … much like a family."

She has worked for Boeing for 12 years, and been in the U.S. Air Force and the Reserve for 24 years. She was a KC-10A personnel program manager while on active duty.

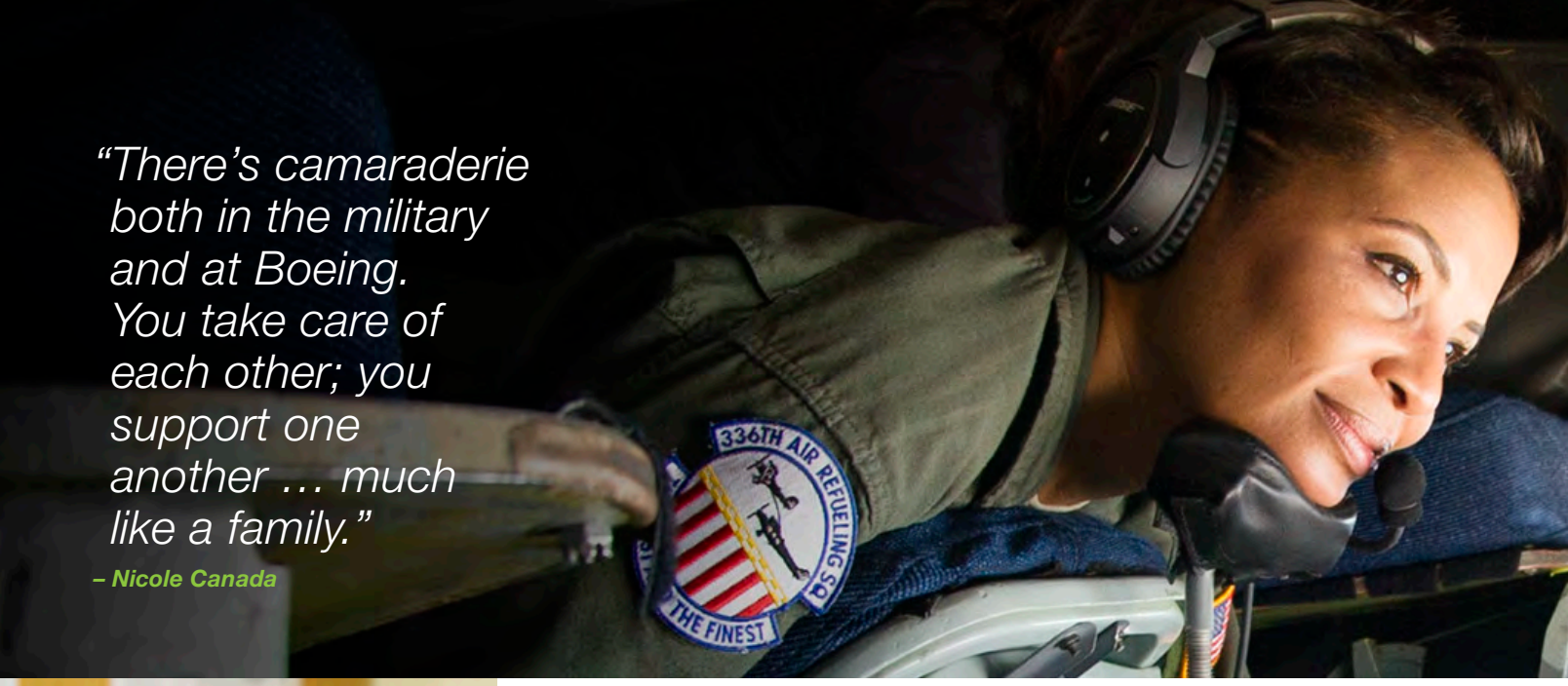
Appropriately, the kind of "flying boom" that Canada operates was developed by Boeing engineers.

Boeing has long been a pioneer of in-flight refueling, starting in the 1920s when a simple hose was used to transfer gas between Boeing and Douglas biplanes. After World War II, Boeing converted 92 of its B-29 bombers into KB-29M aerial refueling tankers, the first full-time tankers to be operated by the U.S. Air Force.

But the Air Force wanted a faster and more efficient method of transferring fuel than the hose used at the time, so Boeing engineers developed a rigid telescoping boom that had two ruddevators, which resemble two small wings, at the end. It not only delivered fuel at a much higher rate, but the ruddevators allowed the boom to be more easily guided into the receptacle of the receiving aircraft. This new boom was initially outfitted on 116 converted B-29 bombers designated KB-29P, which were followed by Boeing's propeller-powered KC-97 tankers, and later on the first jet tanker, Boeing's KC-135, which took to the skies in 1956 and can carry passengers and cargo.

Boeing built 732 KC-135 tankers between 1956 and 1965. Today, approximately 400 of the original tankers remain in service with the U.S. and allies. Boeing continues to maintain, upgrade and support the KC-135 fleet through its Global Services & Support division. The Boeing team also performs Program Depot Maintenance and Engineering Support to international customers Chile, France, Singapore and Turkey.

Eventually, the tankers, which are much older than the pilots who fly them, are to be



"There's camaraderie both in the military and at Boeing. You take care of each other; you support one another … much like a family."

– Nicole Canada

replaced by Boeing's new 767-based next-generation, multi-role tanker, the KC-46A. Boeing remains on plan to deliver the initial 18 combat-ready tankers by 2017.

Despite the technological advancements, the midair rendezvous of a refueling operation still requires clear communications and precise coordination, according to Canada.

The two aircraft need to be about 12 feet (3 meters) from one another in order to make a fuel connection. The KC-135 pilot stays in constant communication with the receiver aircraft to bring it in close to the tanker, Canada explained. Once the two aircraft are within a half-mile of each other, the boom operator takes over, guiding the receiver aircraft into precise position for refueling behind the tanker. Next, the boom operator guides the refueling boom to the receiver aircraft's refueling receptacle. Once contact is made, fuel pumping begins. When the fuel's been transferred, the boom operator triggers a disconnect, the boom is released, the two aircraft separate and the receiver aircraft departs.

"Being a boom operator is one of the most exciting jobs in the Air Force Reserve," Canada said. "Not only have I been able to see the world, but my perspective of the big picture is much clearer as the Air Force carries out its various missions including the fight against terrorism."

She has served as a KC-135 boom operator in just about every major conflict over the past several decades, including Desert Shield, Desert Storm, Enduring

Freedom, New Dawn, Kosovo and Restore Hope. “There’s a great sense of satisfaction in knowing we help maintain air superiority around the world for the U.S. and its allies,” Canada said. “I’ve always enjoyed the sense of purpose and camaraderie that comes with real-world missions.”

One of those missions included flying from Masirah Air Base on the island of Masirah in Oman in March 2003. During what she thought was a routine air refueling mission, Canada’s crew received a change in orders directing them to cross into Iraqi airspace.

“It wasn’t until we returned to base that we learned we were a vital part of the ‘shock and awe’ operation that launched the invasion of Iraq,” she said.

Canada’s also flown humanitarian missions with her tanker crew. The most meaningful, she said, was in support of Hurricane Andrew victims at Homestead Air Force Base in Florida. The base was all but destroyed when it took a direct hit from the Category 5 hurricane in August 1992. The mission was to fly military members and their families—who had been moved to a safe location before the hurricane—back to the base to gather any belongings that had been spared.

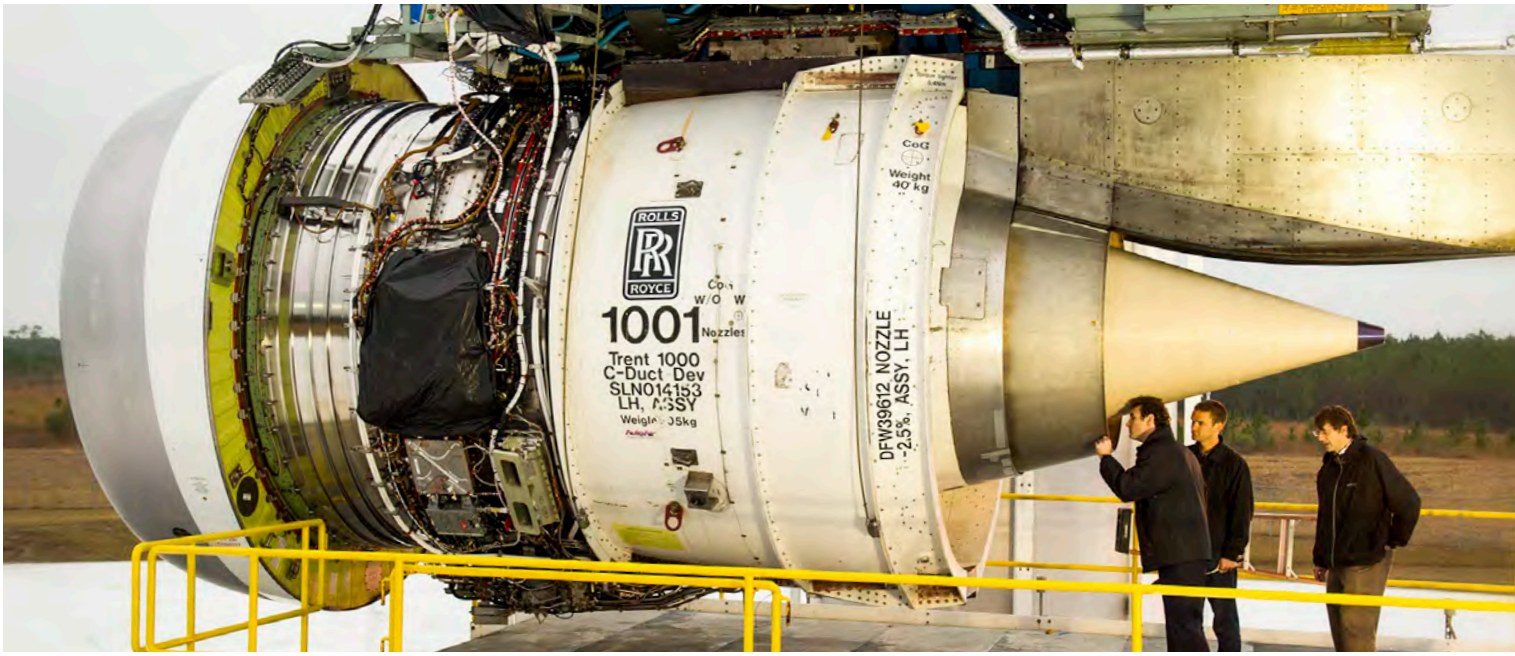
“I will never forget the power of this storm and its massive destruction,” Canada recalled. “It was a bit unnerving flying in the aftermath of that kind of weather. But, to this day, I cherish the role I played in helping devastated families recover from the wreckage and how thankful they were for our assistance in helping them salvage whatever they could of their lives before the storm.” ■

diane.l.stratman@boeing.com

PHOTOS: (Clockwise from top) Canada keeps an eye on the C-17 while it is receiving fuel; March Air Reserve Base in Riverside, Calif., is home to a number of KC-135 tankers; the refueling mission complete, Canada is back on the tanker flight deck monitoring aircraft systems; during a preflight briefing, Canada and the KC-135 crew review mission details.

A CLEEN FUTURE

Innovative engine technology could improve fuel efficiency—and help the environment *By Nathan A. Hulings and photos by Bob Ferguson*



Deep in the Mississippi swamps of Hancock County, a Rolls-Royce airplane engine roared to life against a palette of purple and pink skies of a winter sunset.

Installed on the back of the engine at NASA's Stennis Space Center was an exhaust nozzle made of ceramic matrix composite (CMC) material, designed to make engines quieter, lighter and more efficient.

Watching the test from a Stennis control room was Boeing's Mitch Petervary, the team leader overseeing development of the nozzle. As data poured in, he and the rest of the test team grew increasingly confident of what it would reveal several weeks later: The material performed as promised.

"This was a big step forward for the technology, and I know our customers are going to appreciate the benefits," Petervary said of the Stennis ground tests conducted earlier this year.

The tests represent a major milestone for Boeing and a Federal Aviation Administration program known as CLEEN, short for Continuous Lower Energy, Emissions and Noise. The five-year, jointly funded research-and-development effort by the FAA and industry includes ground and flight demonstrations of airframe and engine technologies to speed the reduction of aircraft fuel burn, emissions and noise.

As part of FAA's Next Generation Air Transportation System development effort, the program was open to competitive bidding, and the FAA selected Boeing and four other companies to participate, including Rolls-Royce. Boeing Research & Technology is leading.

Boeing was working on these technologies before the CLEEN program. But the joint effort exemplifies how Boeing teams on technology research-and-development activities to make discoveries faster and more efficiently than it could on its own, said Don Winter, vice president of Flight and Systems Technologies with BR&T.

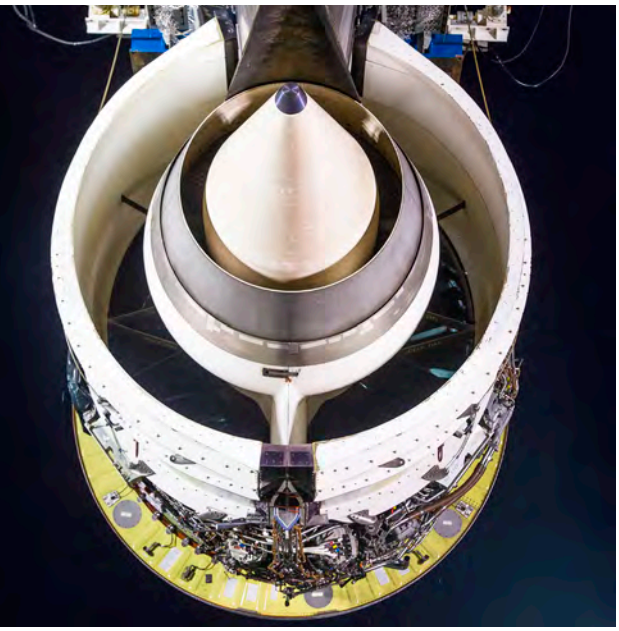
"By collaborating with the FAA and our partners and suppliers in this program, Boeing intends to accelerate the maturation of these promising technologies," Winter explained. And by taking a "One Boeing" approach, he added, "these technologies can be integrated onto commercial airplanes more quickly for the benefit of our environment, airline customers and the flying public."

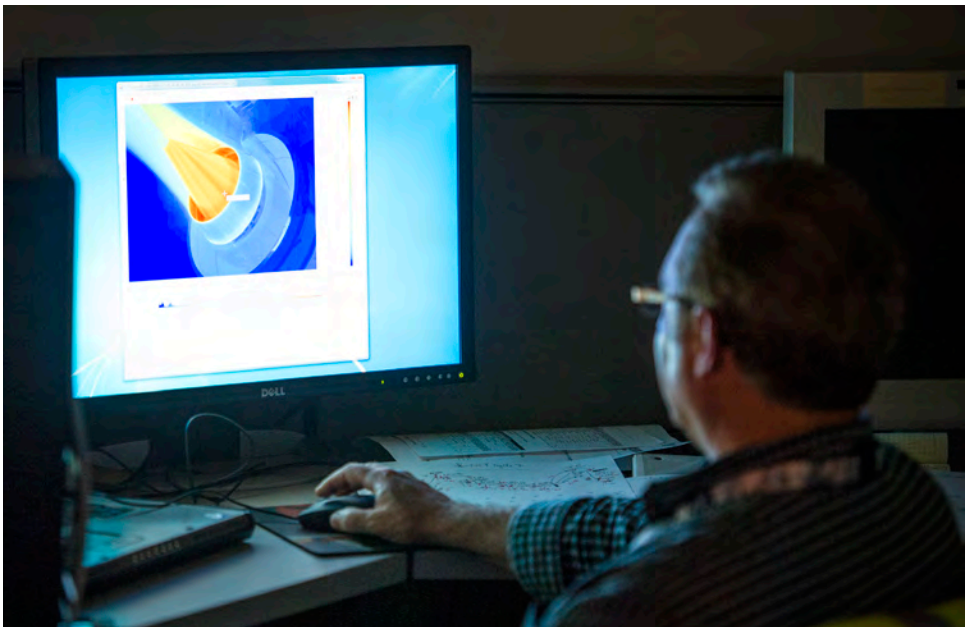
It won't be long before the nozzle gets its day in the sky. With ground tests wrapping up, the nozzle will be installed on what will be the second aircraft in Boeing's ecoDemonstrator program, a 787 Dreamliner scheduled to fly later this year.

As part of the CLEEN program, Boeing and its partners are also working on other technologies to make airplanes more fuel-efficient while reducing emissions and noise. Some of this innovative technology was flight-tested last year on the first Boeing ecoDemonstrator,

> "Boeing intends to accelerate the maturation of these promising technologies."
>
> – Don Winter, vice president of Flight and Systems Technologies with Boeing Research & Technology

PHOTOS: (Left) At twilight, a Rolls-Royce airplane engine equipped with a ceramic matrix composite, or CMC, nozzle roars to life at the NASA Stennis Space Center. (Above) Boeing CLEEN team members inspect the nozzle prior to testing.





"This was a big step forward for the technology, and I know our customers are going to appreciate the benefits."

– Mitch Petervary, Boeing team leader

PHOTOS (Clockwise from top left): The Boeing and Rolls-Royce team makes final preparations inside the Stennis control room; Boeing team leader Mitch Petervary; inside the control room before nozzle testing begins; computer monitors keep close watch on the test site; a monitor shows thermal readouts from the test; a Rolls-Royce engine and CMC nozzle (center).

a Next-Generation 737-800. (For more about the ecoDemonstrator program, see Page 20 in the October 2012 issue of *Frontiers*.)

Getting the ceramic matrix composite engine nozzle to this point, where it is about to be flight-tested on an airplane, represents a significant engineering accomplishment, according to Petervary and others with the program.

In addition to benefits such as longer life, lighter weight and noise reduction, the nozzle can withstand extremely high temperatures. And that's critical. Because today's high-efficiency jet engines emit hotter exhaust gases, they require materials capable of withstanding higher temperatures than titanium or superalloys, which have been industry standards for decades.

But no one had used the ceramic matrix composite material in this way before, and that was one of the significant challenges engineers faced.

Researchers spent several years in the laboratory testing and developing materials of increasingly large scale before more intense testing began earlier this year. They started with flat samples of the material, slowly scaling up to the full-size nozzle.

Frank Doerner, vice president of Materials, Processes & Structures Technologies for BR&T, noted that engineers created the largest ceramic matrix composite structure ever made.

The nozzle is about the size of a Smart car, but weighs 30 percent less than a similar-size nozzle made of traditional materials.

"In the past five years, finding new applications and innovative designs based on these types of materials has gone from labs to flight-ready," Doerner said, adding that engineers have demonstrated that ceramic composites "will be part of the future of flight."

The successful ground tests on the full-scale engine nozzle represent a huge milestone for the technology, providing insight into how the nozzle will perform during upcoming flight tests on ecoDemonstrator, according to Petervary.

A key to this significant accomplishment, he added, was Boeing's close working relationship with the propulsion team from Commercial Airplanes' Product Development organization and with Rolls-Royce.

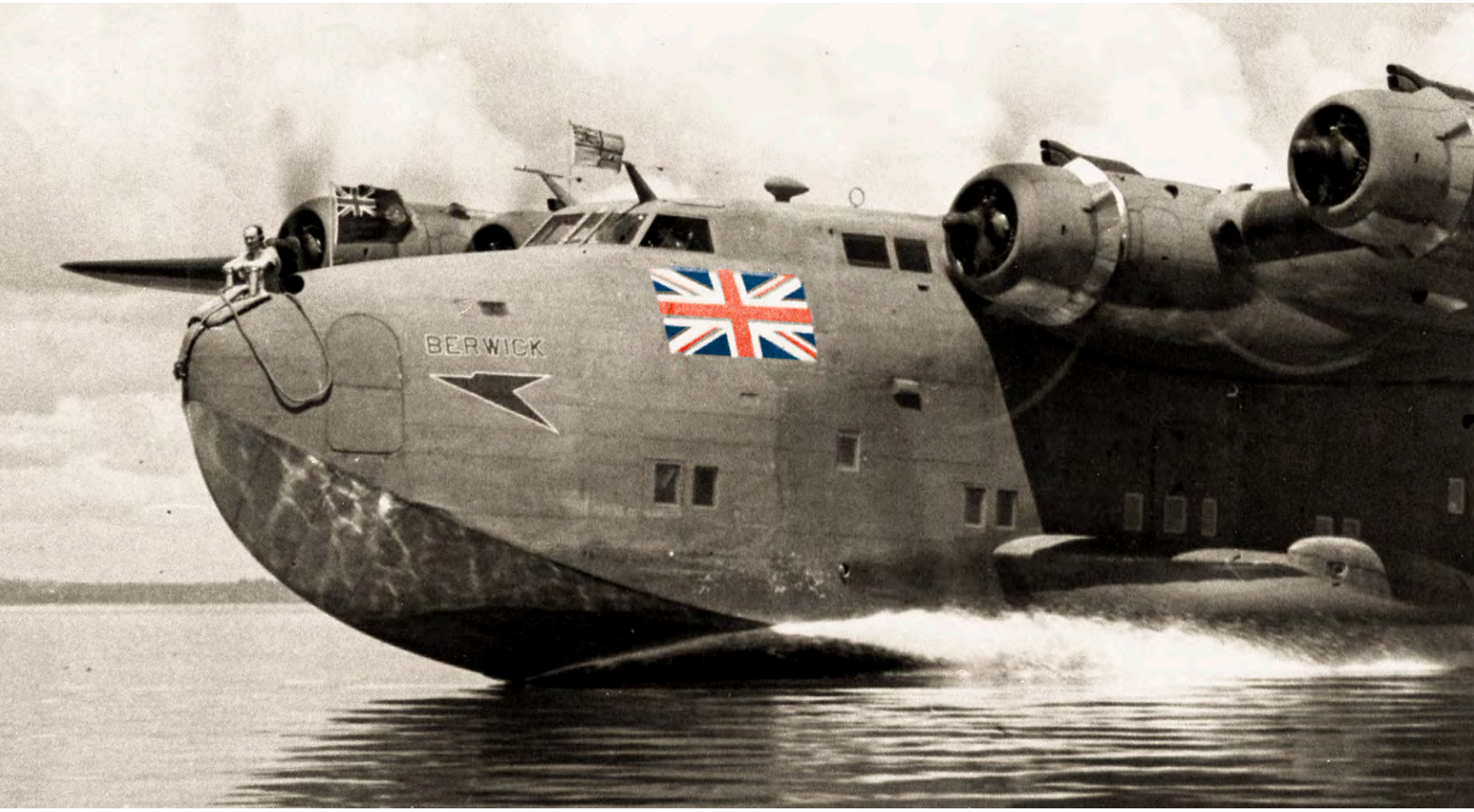
"Everyone is benefiting from the knowledge being shared," Petervary said.

That message is underscored by Larry Schneider, vice president of Product Development, Boeing Commercial Airplanes.

"The potential of CMCs to improve airplane fuel efficiency," Schneider said, "is exactly the type of revolutionary technology that we are looking to accelerate through collaboration with the FAA and the entire Boeing enterprise, and flight testing on the ecoDemonstrator." ■

nathan.a.hulings@boeing.com

Atlantic affinity



Boeing and the UK celebrate 75 years as friends and partners

By Bill Seil

June 1938 marked an important milestone in commercial aviation—and the beginning of a vital partnership between Boeing and the United Kingdom.

The first flight of the Boeing 314 Clipper flying boat on June 7 opened the door to luxurious trans-Atlantic air travel. The Model 314 remains one of the most iconic and beloved aircraft in the history of aviation.

A less visible, though historically significant, event occurred later that month, on June 22, when the British Air Ministry signed a contract with North American Aviation, a Boeing heritage company, for the purchase of 200 NA-49 Harvard combat trainers. This year, Boeing is celebrating the 75th anniversary of that major purchase, which marked the beginning of Boeing's long-standing relationship with the United Kingdom.

The partnership was strengthened in 1939 when the Air Ministry announced it was purchasing an additional 200 Harvards, and Pan American Airways announced it was inaugurating the first regular passenger service from New York to Southampton, England, using Boeing 314 Clippers.

During World War II, the British military continued to use aircraft from Boeing and its heritage companies, including the Boeing B-17 bomber, the Douglas Dakota military transport (based on the DC-3),

PHOTOS: (Clockwise from above) This Boeing 314 Clipper was one of three transferred from Pan American Airways to British Overseas Airways Corp. for military service during World War II; the NA-49 Harvard trainer, shown under construction in 1939 at North American Aviation's production facility in Inglewood, Calif.; this Douglas DB-7—known as the "Boston" in Royal Air Force service—was built under license in Seattle by Boeing. BOEING ARCHIVES

"Our relationship with the United Kingdom is characterized by its long duration and by the breadth, depth and quality of that partnership. ... There is a true alignment of values in the way we work together."

– Shep Hill, president, Boeing International

"Our activities here in the past 75 years have created a high level of customer respect for the Boeing brand."

– David Pitchforth, managing director, Boeing Defence UK

PHOTOS: (Above) Captain Wales, commonly known as Prince Harry, left, and a member of his squadron view the Apache flight line at Camp Bastion in Afghanistan last year. The British Army Air Corps flies Apache AH.1 helicopters co-manufactured by AgustaWestland under license from Boeing. ASSOCIATED PRESS (From far left) In 2006, Boeing formally began work on the 34-year Through Life Contractor Support program for the Royal Air Force's fleet of Boeing Chinook helicopters. VECTOR AEROSPACE Boeing UK and the University of Nottingham in 2011 launched a major collaborative investment in carbon fiber recycling research. UNIVERSITY OF NOTTINGHAM The Boeing C-17 Globemaster III was formally accepted into Royal Air Force service in 2001 and made its operational debut with the RAF during the Afghanistan conflict. PAUL PINNER/BOEING

Douglas' Boston attack bomber and North American Aviation's P-51 Mustang.

Today, the United Kingdom is a major customer for Boeing military and commercial aircraft. It is also a key Boeing supplier and source of technology.

Boeing has more than 1,300 employees at sites across the United Kingdom, and more than 800 of them are employed by Boeing Defence UK, which supports Ministry of Defence and U.S. military programs. Boeing is investing in UK technology and expertise through research and development programs with the universities of Cambridge, Cranfield, Nottingham, Strathclyde and, in particular, Sheffield, where the company supports the Advanced Manufacturing Research Centre.

Shep Hill, president, Boeing International, and senior vice president, Business Development and Strategy, said the United Kingdom has a great aviation heritage, which makes it a strong ally for Boeing.

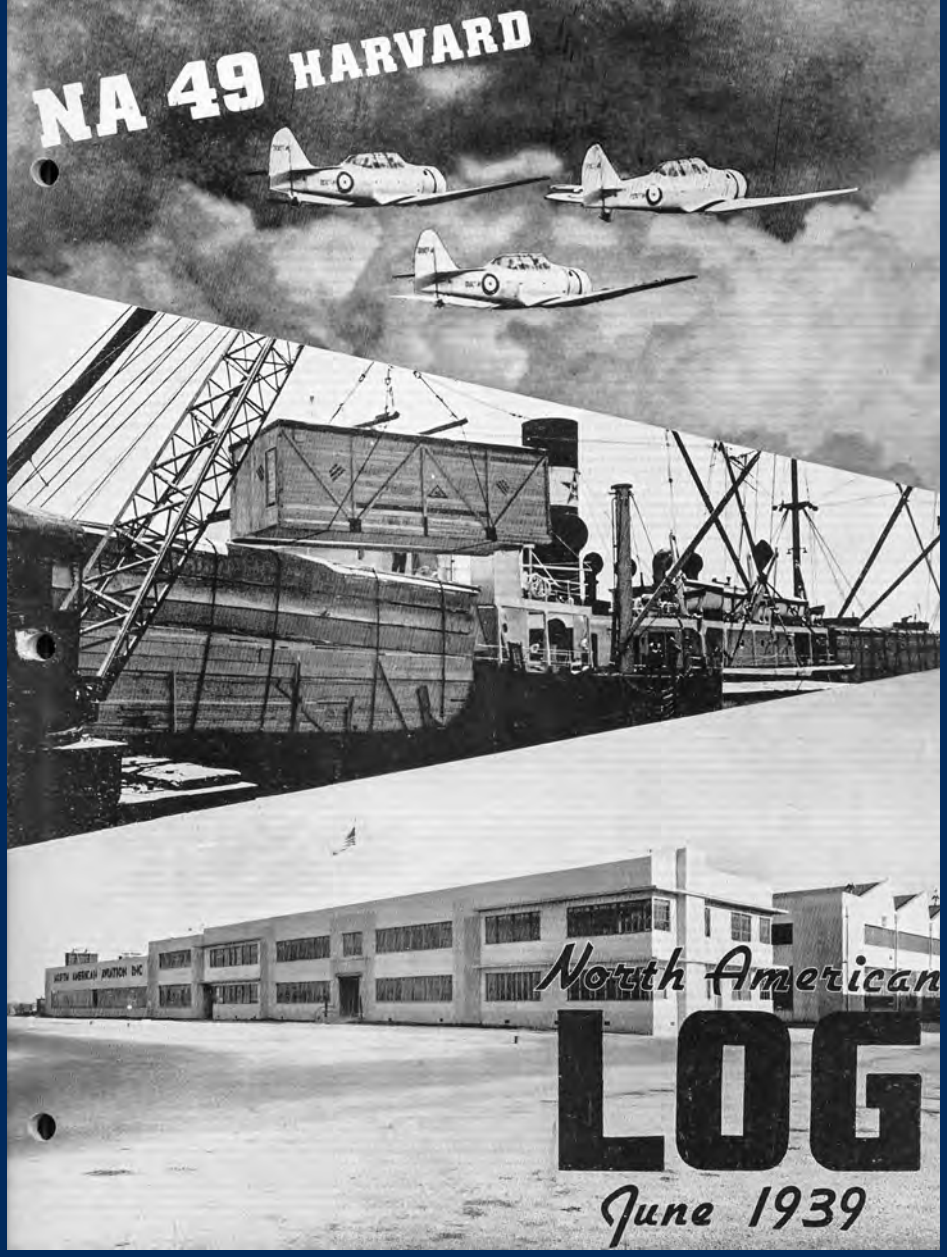
"Our relationship with the United Kingdom is characterized by its long duration and by the breadth, depth and quality of that partnership," Hill said. "That's what has made it so sustainable. There is a true alignment of values in the way we work together."

Hill noted that UK airlines have flown and contributed to all of Boeing's jetliners, and the company has many important collaborative relationships with UK businesses and universities. The consolidation of Boeing's Defense, Space & Security operations in the United Kingdom under Boeing Defence UK five years ago has continued to strengthen defense-related sales and partnerships.

Sir Roger Bone, president, Boeing UK, said the company will be celebrating the anniversary throughout the year, with a number of special events planned in London and at company sites throughout the United Kingdom. For example, it will be a theme in Boeing's annual sponsorship of the British Military Tournament in early December in Earl's Court, London.

"All of us in the United Kingdom feel a genuine pride in what we're doing here to sustain this important partnership," Bone said. "This anniversary gives us a tremendous opportunity to highlight that work and look ahead to building on the important relationships that have developed over the years. It gives us an ongoing sense of achievement."

David Pitchforth became managing



'CHEERIO, NA-49'

In July 1938, employees of North American Aviation, a Boeing heritage company, welcomed "Our British Cousins" to the company's production facility in Inglewood, Calif.

That's how the *North American Log*, the official publication of North American Aviation employees, described representatives of the British Air Ministry who had arrived to supervise the manufacture of the NA-49 Harvard trainer.

The *Log* provided a detailed account of the airplane purchase, which marked the beginning of Boeing's long-standing partnership with the United Kingdom.

In June 1938, after an extensive tour of American aircraft plants by a commission of British air experts, the British Air Ministry announced the award of a contract to North American Aviation for the construction of 200 Harvard combat trainers.

"For your information," the *Log* reported, "the NA-49 has been officially christened the 'Harvard' by the British government, this name being chosen because of the fact that the ship is of the training type and of American manufacture. Therefore, the name of an American institution of learning was deemed as appropriate."

After a period of intense activity, the mock-up model was completed in September 1938 and preparation began for the first flight of the Harvard.

Late in the afternoon of Sept. 28, the first Harvard, bearing "N7000" in large black letters and the Royal Air Force insignia on its fuselage and wings, was rolled out onto the factory flight ramp at Los Angeles Airport for its initial flight. Air Ministry representatives were on hand, and the *Log* reported that the initial flight was "routine."

The Harvard was test-flown more than 38 hours before it went into production.

"On the NA-49, everything was tested that could possibly be tested …" the *Log* said. "The machine gun was tested by the simple expedient of flying the beauty over to the field the other side of Redondo Boulevard and firing the gun into a huge pile of dirt that the W.P.A. [Works Progress Administration] had been obligingly piling up since sometime last year." The aircraft was painted "a violent yellow, which saved the flight crew many a headache by enabling them to pick the ship up many miles away," the *Log* noted. "This was especially helpful during spin tests."

After the Harvard was tested and approved, production began and North American began shipping the airplanes to the United Kingdom.

"The process of crating an aeroplane for export shipment constitutes in itself a fascinating chapter in the story of the Harvard," the *Log* explained. "A waterproof box, 8 feet by 10 feet 7 inches by 21 feet 8 inches [2.4 by 3.2 by 6.6 meters], is constructed. The fuselage, with the landing gear in full retracted position and the motor, wings and empennage surfaces detached, is securely fastened to the floor of the box."

On Oct. 24, 1938, a shipping crate containing Harvard number N7000 was taken to Los Angeles Harbor and loaded on board the English vessel, MS *Lochatrine*, bound for Liverpool, England. It was then transported to the Shawbury Aerodrome near Shrewsbury for final flight tests.

The British Air Ministry, in January 1939, announced that it would purchase an additional 200 Harvard airplanes from North American Aviation, making the Harvard contract one of the largest U.S. aircraft manufacturing export programs at that time.

The *Log* summed up the program this way: "The Harvard Trainer, or NA-49, will carry the insignia of N.A.A. [North American Aviation] to Old England with flying colors. Cheerio, NA-49, best of luck!"

– Bill Seil

director of Boeing Defence UK in December 2012, after serving for more than four years as managing director of Boeing's UK Rotorcraft Support business. He said the amalgamation of Boeing Defence UK in 2008 established Boeing Defense, Space & Security as a local entity, which opened the door to stronger military sales and partnerships in the United Kingdom. He believes Boeing's 75-year history in the United Kingdom has strengthened its business opportunities today.

"You can feel the reputation we've built and the respect that our customers have for us," Pitchforth said. "Our activities here in the past 75 years have created a high level of customer respect for the Boeing brand. It's also built a high regard for our technical capability, which is very important to our customers."

Todd Nelp, vice president, European Sales, Boeing Commercial Airplanes, said the United Kingdom has historically been a wonderful market for Boeing jetliner sales and promises to remain so for many years to come. The company has a strong, long-time United Kingdom customer base for all airplane models and an array of services. The United Kingdom, with its wide-ranging aerospace capabilities, also plays an important role in Boeing's supply chain.

"I think Boeing and our British customers have a real affinity for each other—much like the relationship between our two countries," Nelp said. "There is a feeling of mutual respect and we work very well together. It's a relationship that's built on trust and one that has a lot of legs for the future." ■

william.j.seil@boeing.com

For more about the Boeing 314 Clipper, see Page 10. Learn more about Boeing's long and important relationship with the United Kingdom in the July 2012 issue of Frontiers *and at www.boeing.co.uk/75.*

PHOTOS (Clockwise from far left): The June 1939 cover of the *North American Log* featured the NA-49 Harvard trainer. BOEING ARCHIVES Thomson Airways' first revenue biofuel flight in the UK carried passengers from Birmingham, UK, to Lanzarote, Spain. THOMSON AIRWAYS British Overseas Airways Corp. began operating Boeing 747 flights between London Heathrow and New York in 1971; Air United Kingdom in 1988 became the first airline based outside the United States to operate the Boeing 737-400 jetliner. BOEING ARCHIVES


TOGETHER, WE SHARE A GLOBAL SUCCESS.

Ball Aerospace & Technologies Corp.

California State University Long Beach – College of Engineering

Folsom Tool Corp.

The Goodyear Tire & Rubber Company

Infotech Enterprises

Kaman Engineering Services

Korea Aerospace Industries, Ltd.

Korean Air Aerospace Division

LMI Aerospace, Inc.

NextGen Aeronautics, Inc.

PETERSEN, INC.

Quality Tech Mfg, Inc.

RB ENTERPRISES, INC.

Skanska USA Building, Inc.

TEAGUE

TW Metals, Inc.

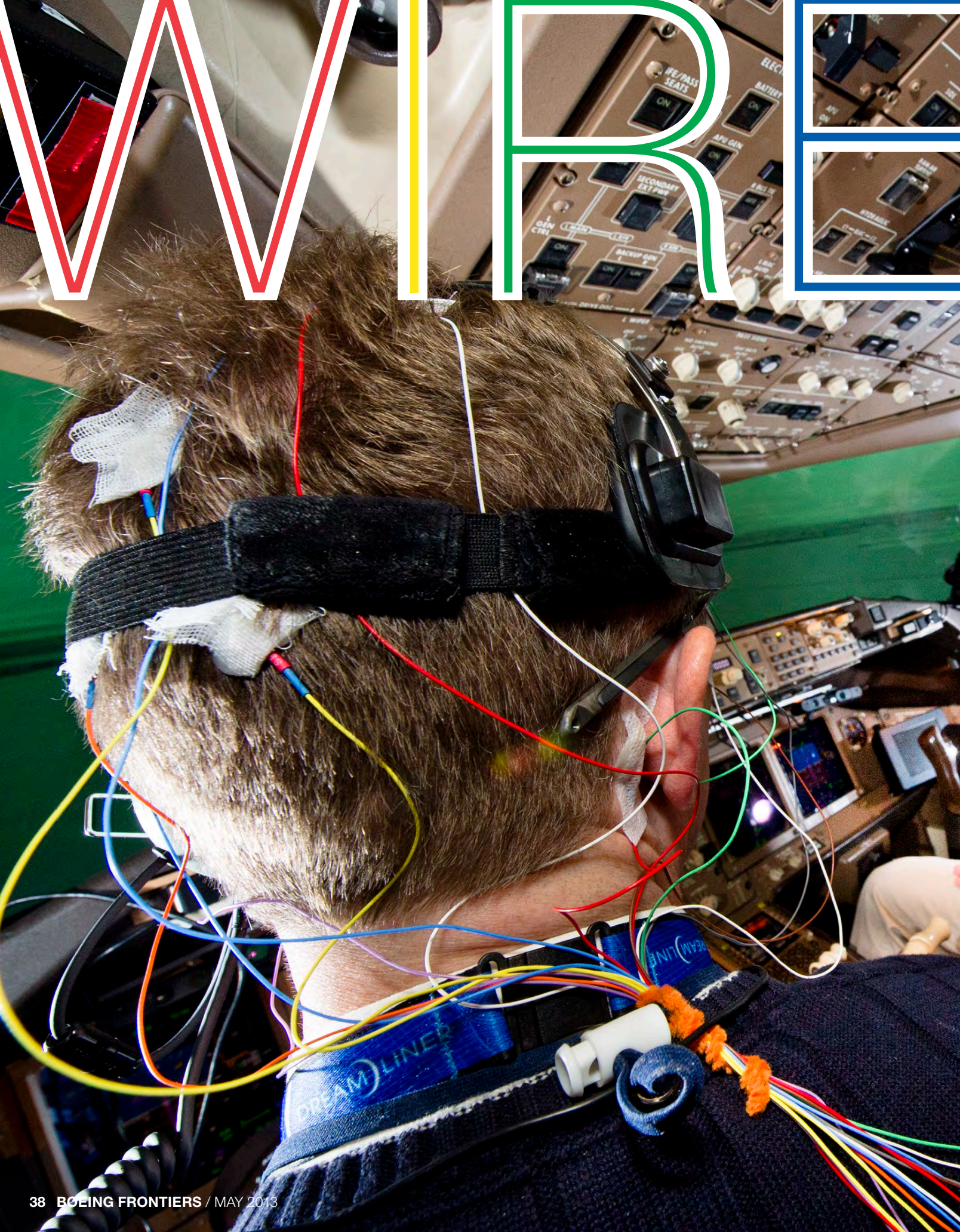
Victory Solutions, Inc.

Visit **boeingsuppliers.com/recognition** to learn more about recognition programs or for a list of the 2012 Performance Excellence Award recipients.

Congratulations to our 2012 suppliers of the year—your extraordinary vision and superior performance have helped us all achieve a shared success.

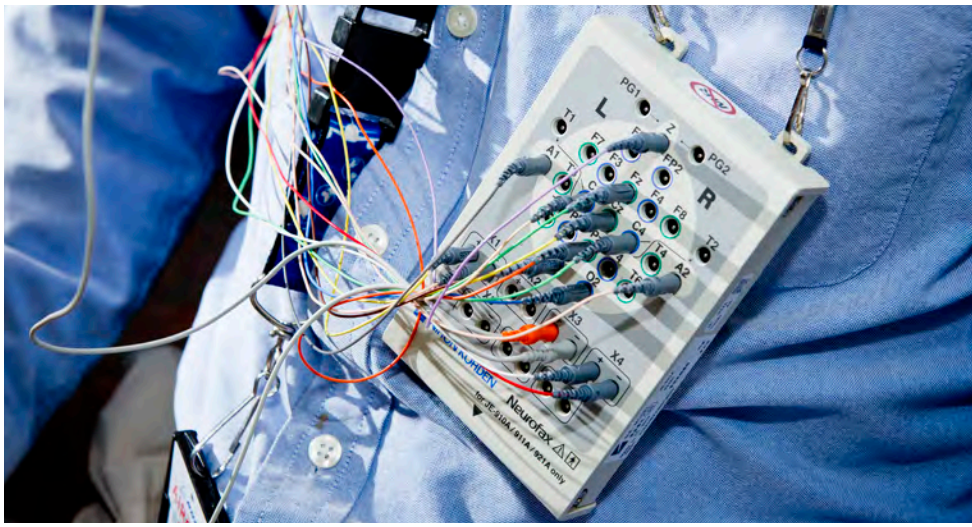
BOEING

WIRE



Boeing study will help industry better understand pilot fatigue

By Bret Jensen and photos by Marian Lockhart



When customer airline pilots visit Boeing, the company usually rolls out the red carpet. But for the next 18 months, Delta pilots will be strapping into a simulator and taping wires to their heads. The wires are all part of a study to better understand the impact of pilot fatigue on commercial flight operations.

Volunteer two-pilot crews from Delta Air Lines—32 crews in all—will perform simulated flights under rested and fatigued conditions in the Seattle study. The research will help Boeing determine if technologies exist that can detect symptoms of fatigue in real time before it affects pilot performance.

"The fact that Boeing is doing something about this issue and trying to put together a study is really exciting," said Delta pilot Stan King.

A "One Boeing" team from across the enterprise devised the test methods and will analyze the data once the study is complete. The project is managed by the Commercial Airplanes Flight Deck Product Development group with help from Boeing Research & Technology mathematicians and statisticians. There are also adviser

> "The fact that Boeing is doing something about this issue and trying to put together a study is really exciting."
>
> *– Stan King, pilot, Delta Air Lines*

PHOTOS: Close-ups of sensor arrays attached to Boeing test pilots Harry Westcott, left, and Brian Behrend as they prepare for a long flight in the simulator. The sensors, part of a Boeing–Delta Air Lines joint study on the impact of fatigue on pilots, monitor their bodies' reaction to the lengthy trip.

> "What we find out here may extend beyond aviation into other ... industries, even the medical industry."
>
> *– Harry Westcott, Boeing technical pilot*

PHOTOS: (Above) Boeing test engineer Rob Grube, left, wires up Boeing pilot Brian Behrend with body monitoring devices for a simulator session. (Below) Boeing engineers Chris Gast, from left, Kim Craig and Grube monitor the pilots' brain waves and other physical reactions during the simulated long flight.

experts from universities around the world.

"It's gratifying to be on the forefront of an ambitious scientific study like this one," said Kimberly Craig, Commercial Airplanes project manager.

"Crew fatigue is one of the hot-button regulatory issues in commercial aviation," Craig added. "We're bringing a lot of new data to the discussion. We hope this data will guide Boeing's technology investments for the future and may influence how we equip our airplanes."

Pilots in the study will be fitted with a variety of sensors that monitor biometric factors such as brain waves and heart rates, as well as those that monitor eye movement and body posture. Crews then fly simulated flights both rested and fatigued.

The rested sessions are daytime flights after sufficient rest; the fatigued sessions are overnight flights after a period of extended wakefulness. The simulator sessions consist of one 6.5-hour flight or four consecutive, short flights in a 777.

Pilots will be constantly evaluated to determine the impact of fatigue on the different workloads. In total, Boeing should collect more than 1,000 pilot hours of audio, video and simulator data.

"Through this research, we can better learn how pilot performance is affected by flights across time zones that disrupt circadian rhythms," explained Boeing Technical Pilot Brian Behrend. "The knowledge gained may help develop ways to mitigate or recognize fatigue in real time."

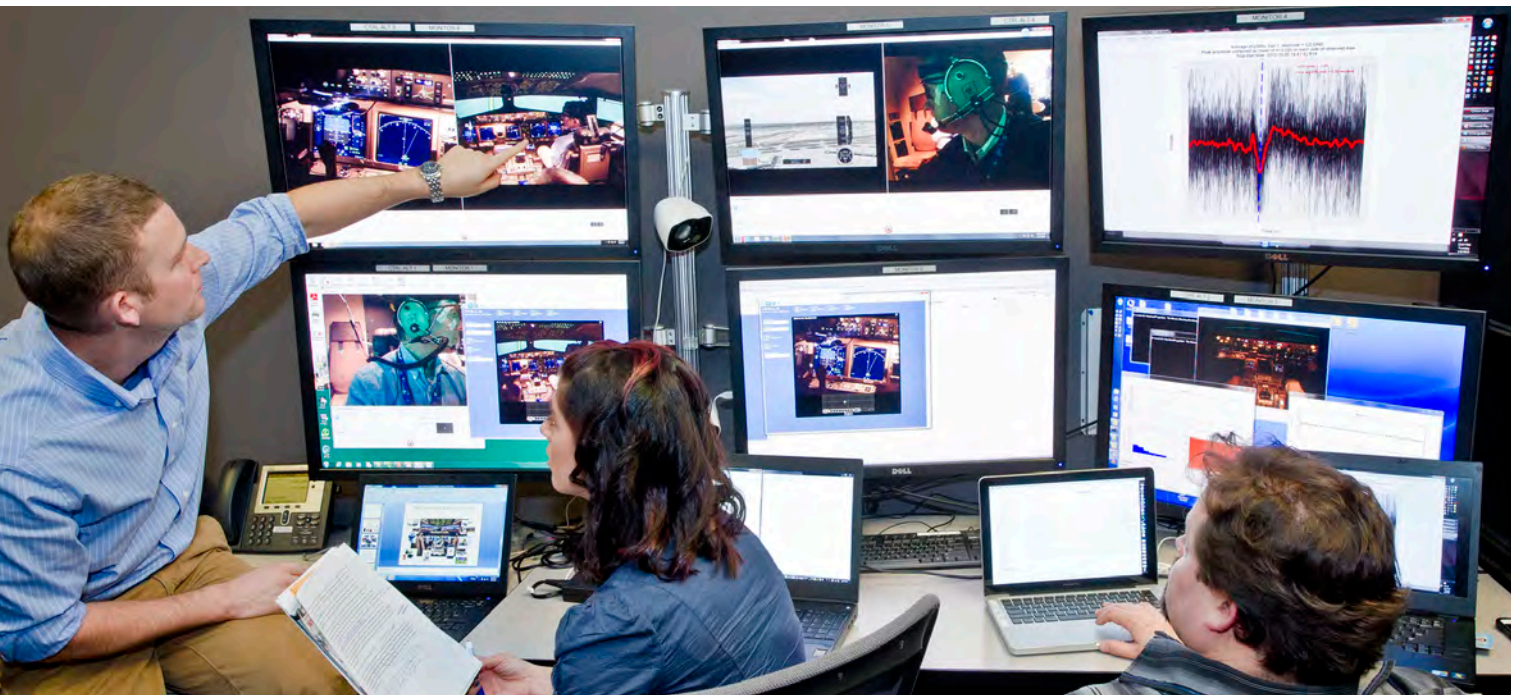
While studies on fatigue have been performed in other industries, the aviation environment presents unique challenges. Boeing and subsidiary Jeppesen have been working closely to develop technologies to manage flight-crew alertness and performance. This became even more critical to airlines when the U.S. Federal Aviation Administration last year issued a new rule regarding crew duty limitations and rest requirements. One of those technologies, the CrewAlert app available on iTunes, is a product of the Boeing and Jeppesen collaboration.

Results of the Seattle study should help Boeing and Jeppesen determine whether a technology or a suite of technologies can unobtrusively detect fatigue and find links between crew performance and fatigue. In addition to helping ensure aviation safety, the study may prove helpful to others as well.

"What we find out here may extend beyond aviation into other transportation industries, even the medical industry," said Harry Westcott, another Boeing technical pilot. "The video and data archive could be mined for information for decades." ■

bret.r.jensen@boeing.com

To see a related video, visit www.boeing.com/frontiers/videos/may




SKYTEAM
BOEING 737-800
1000th
BOEING AIRPLANE FOR CHINA
5756

A THOUSAND REASONS TO CELEBRATE

Dancers perform a ceremonial lion dance to welcome delivery in March of a 737-800 to China Eastern Airlines—the 1,000th Boeing jetliner delivered to China. The jet has the Boeing Sky Interior and is painted in special peacock livery. It will be operated by China Eastern Yunnan Airlines. Headquartered in Shanghai, China Eastern Airlines is one of the three major airlines in mainland China. PHOTO: JESSICA OYANAGI/BOEING


Argonne
Normandy
Midway
The Chosin Reservoir
Khe Sanh
Dak To
Medina Ridge
Tora Bora
Fallujah
These are the places we remember,
to honor the lives of those we'll never forget.
BOEING