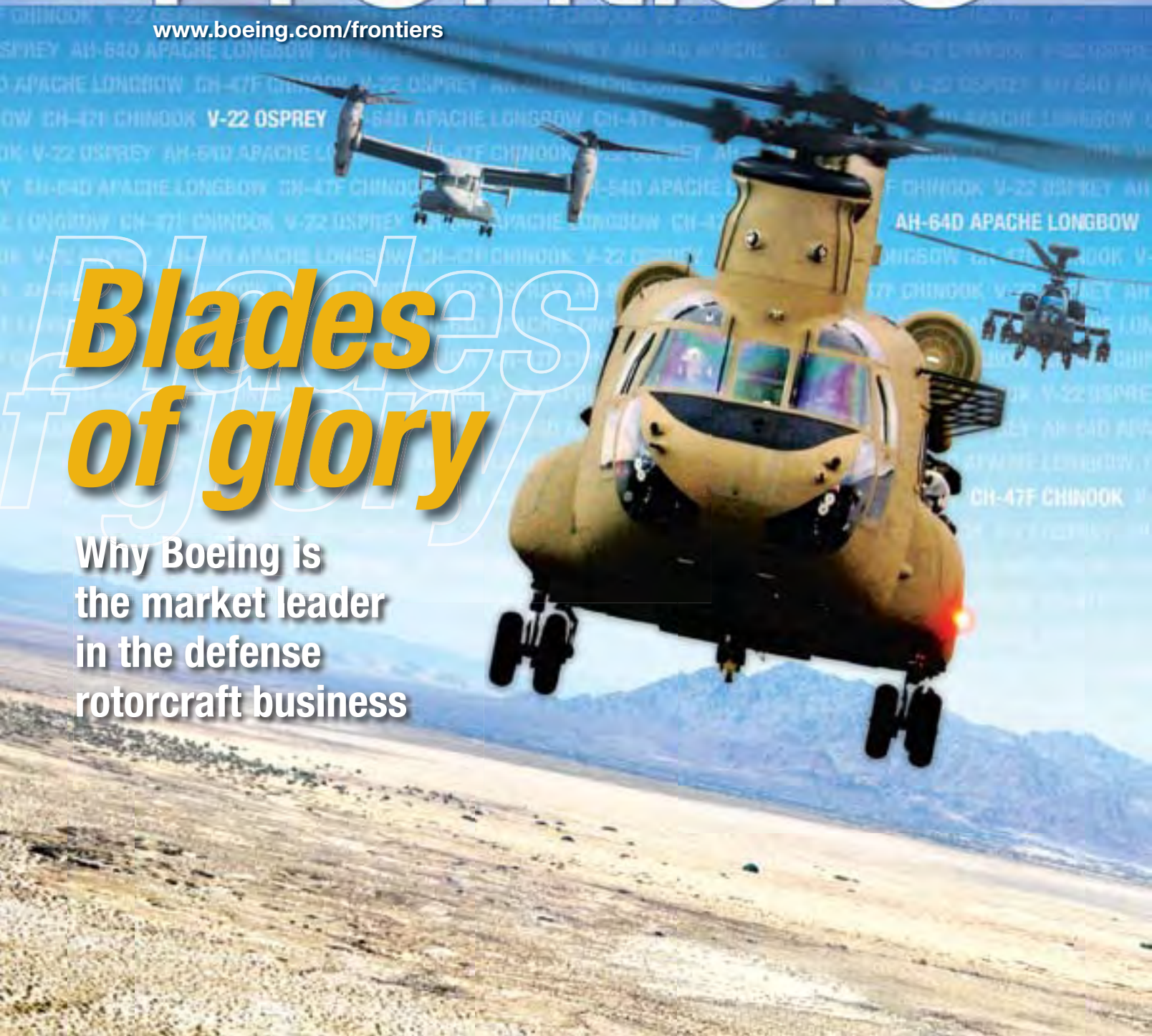


Frontiers

www.boeing.com/frontiers

Blades of glory

Why Boeing is
the market leader
in the defense
rotorcraft business



The advertisement features a view of Earth from space, showing the Americas. Several satellite orbits are depicted as glowing white lines. Labels for various satellite programs are placed along these orbits: GPS, DIRECTV, SPACEWAY, GOES, WGS, TDRS, XM RADIO, THURAYA, UHF, and SYNCOM. The text 'A STANDARD OF EXCELLENCE THAT CIRCLES THE GLOBE.' is centered across the middle of the image. To the right, a paragraph of text describes Boeing's track record in satellite program management. At the bottom center is the Boeing logo.

A STANDARD OF EXCELLENCE THAT CIRCLES THE GLOBE.

Boeing's track record in satellite program management and innovation is extraordinary by any measure. Beginning with the launch of Syncom 45 years ago, Boeing has built more than 250 satellites, accumulating more than 2,500 years of on-orbit service. From broadband on the move to global positioning, intelligence, direct-to-home broadcasting, satellite radio and weather monitoring, we've built a standard of excellence around the globe. Excellence our government and commercial customers can count on every day.

BOEING

This new Integrated Defense Systems print ad will run throughout the year to support various Boeing satellite programs. The ad is designed to showcase Boeing's industry leadership, demonstrated by 2,500 years of accumulated satellite service. It also highlights Boeing's broad range of satellite capabilities and the company's long track record of performance and execution. The ad will appear in key space and satellite trade publications.

ON THE COVER: An artist's conception of the V-22 Osprey, the CH-47F Chinook and the AH-64D Apache Longbow.
GRAPHIC BY BRANDON LUONG



BOB FERGUSON PHOTO

COVER STORY

Leading edge | 12

Jules Maddon, an Apache manufacturing/ordnance technician in Mesa, Ariz., is one of the 9,500 teammates in Rotorcraft Systems. Here's what the team has done to help Boeing become a leader in the defense rotorcraft market.

FEATURE STORY

Potential fulfilled | 42

Leaders "bring out 100 percent of their people's potential as well as their own," Boeing Chairman, President and CEO Jim McNerney told attendees of the sixth annual Global Diversity and EEO Compliance Summit. Here's a look at the happenings and lessons shared at this gathering, which took place last month.

Greener and Leaner | 20

Three Boeing facilities (Exmouth, Australia; Everett, Wash.; and Portland, Ore.) have earned ISO 14001 certification. Here's why this internationally recognized standard is important to Boeing's efforts to improve its environmental performance—and how Lean+ fits into this effort.

I see the light | 24

Thanks to a new tool at the Everett, Wash., paint hangar, the task of painting a commercial airplane's livery has become easier and more accurate. The new tool, which involves a system of networked lasers and computer programs, replaces a decades-old process.

On-sight assistance | 27

Through some quick action and first-aid know-how, Mike Borkan, a 737 functional test technician in Renton, Wash., helped a teammate who accidentally had hydraulic fluid sprayed in her eyes.



24 Brian Maglalang pulls a mylar roll from a storage cart in the Everett, Wash., paint hangar. The Everett paint hangar team is using a new laser-based tool to replace most uses of mylars.

ED TURNER PHOTO



Icing Tunnel mechanic Michael Myers (left) and Engineering Technical Fellow Gene Cain measure ice formed during a test in the Boeing Research Aerodynamic Icing Tunnel in Seattle.

ED TURNER PHOTO

30

Making a difference | 28

Avoiding rework and waste is particularly challenging in an area such as Boeing Fabrication Auburn Machining/Emergent Operations in Auburn, Wash., where one-of-a-kind and last-minute parts are being built. Yet employees there are involved in efforts to improve quality, and the numbers show their efforts have been paying off.

Chillin' at work | 30

Welcome to the Boeing Research Aerodynamic Icing Tunnel, one of only seven icing tunnels in the world. This Seattle facility, operated by Flight Operations, Test & Validation employees, is an essential tool in the commercial-airplane product development and certification processes.

INSIDE

6 Letters
7 Notebook

8 Historical Perspective
10 New and Notable

Training kept a-rollin' | 32

With several milestones on tap for 2008, Boeing is accelerating its activities in developing and delivering the cutting-edge Distributed Mission Operations training network for the U.S. Air Force. This work has invigorated the Boeing team supporting this effort.

No repair waits | 36

A team of Boeing employees in Fort Walton Beach, Fla., tackles the critical job of keeping U.S. Air Force Special Operations Forces aircraft ready for missions. The customer has recognized this Boeing team's achievements, in terms of cost, quality and speed.

Tracking the flow | 38

Boeing engineers have helped design a special tile that will test airflow on the outside of the Space Shuttle. The data from this experiment will help NASA in its efforts to develop new spacecraft such as the Orion crew exploration vehicle.

The paper chase | 40

Last year, teammates on Boeing's KC-10 Contractor Logistics Support program in San Antonio delivered their first "paperless" aircraft. That means easier access to information, fewer worries about lost records, better process oversight and improved cycle time for servicing an important warfighting asset.



40 Bobby Mehne, a maintenance modification mechanic in San Antonio, uses the iCapture wireless touch-screen tablet during a review of a nonconforming discrepancy inside a thrust reverser from the Number 3 engine of a KC-10A Extender.

LANCE CHEUNG PHOTO

45 Stock Charts
46 Milestones

49 Around Boeing
50 Spotlight

Frontiers

Publisher: Tom Downey
Editorial director: Anne Toulouse

EDITORIAL TEAM

Editor:
 Paul Proctor: (312) 544-2938

Managing editor:
 Junu Kim: (312) 544-2939

Designer:
 Brandon Luong: (312) 544-2118

Commercial Airplanes editor:
 Dick Schleh: (206) 766-2124

Integrated Defense Systems editor:
 Diane Stratman: (562) 797-1443

Engineering, Operations & Technology editor:
 William Cole: (314) 232-2186

Shared Services editor:
 Mick Boroughs: (206) 919-7584

Human Resources and Administration editor:
 Geoff Potter: (312) 544-2946

Copy editor:
 Walter Polt: (312) 544-2954

ONLINE PRODUCTION

Production manager:
 Alma Dayawon: (312) 544-2936

Web designer:
 Michael Craddock: (312) 544-2931

Graphic artists:
 Brandon Luong: (312) 544-2118
 Cal Romaneschi: (312) 544-2930

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 3T-12, P.O. Box 3707, Seattle, WA 98124-2207

Postmaster: Send address corrections to *Boeing Frontiers*, MC 3T-12, P.O. Box 3707, Seattle, WA 98124-2207 (Present addressees, include label)

“Dedication to your profession affects more than you.”

—William Vawter, Titusville, Fla.



DEDICATION RECOGNIZED

Just a comment on the individual on Page 20 of your February 2008 issue: Bob Robinson is, without a doubt, one of the most dedicated people on this planet. As a Boeing spacecraft technician on the SPACEHAB contract, I experienced the great privilege of observing Bob's dedication and ability to stay focused on a task for hours on end.

Bob came to the SPACEHAB facility in Cape Canaveral, Fla., to upgrade and correct software issues associated with a Shuttle mission. I observed him at work at about 7 a.m. tapping away on the keyboard and intently focused on the monitor in front of him. He was in that spot for more than 13 hours, only stopping long enough to take a restroom break and to grab a drink. When invited to lunch, his response was, “I have to get this done.”

More than once, Bob has spent in excess of 10 hours in

front of a monitor making software do its job. His success rate is shown in the history of the SPACEHAB missions.

I am grateful for Bob's incredible contributions to the success of that contract. Boeing has an array of awesome talent, and Bob is a very strong light in that array. Congratulations to Boeing for recognizing that.

Bob may not even remember who I am, but I will never forget the lesson he taught: Dedication to your profession affects more than you.

—William Vawter
 Titusville, Fla.

REMEMBERING THE 707

I enjoyed your Historical Perspective article about the Boeing 707 in your December 2007/January 2008 issue. It stirred some 50-year-old memories. Tex Johnston, Jim Gannet and Tommy Layne were all old friends.

On Dec. 20, 1957, I was home in Brooklyn getting ready for Christmas. I was recently back from three weeks in Seattle where I had been attending Boeing's first jet performance class for the 707, an airplane that had yet to make its first flight. The class was for Pan Am performance engineers and engineering pilots, but there were also included a couple of new members of the Boeing flight-test group. One was Tommy Layne, and the other was Jack Waddell. We would have close

relations with both of them over the years.

On the 707, the pilot who spent more time with us than any other was Jim Gannet. Tex was on at least one of the transatlantic survey flights we conducted in October 1958 before the start of scheduled service.

On all of these flights we were the only airplane in the sky over the ocean at our speed and altitude. I remember one flight returning west-bound from Santa Maria in the Azores. We were halfway across before Ocean Control had our flight plan. A little while later they came back to us, “We now have you as friendly on our circuit.” That was a comforting thought, since those were still the Cold War days.

—Bob Blake
 Seattle

EDITOR'S NOTE

This edition of *Boeing Frontiers* features design changes that represent the latest step in the design evolution of the magazine. These changes align with Boeing's brand standards. To learn more about the Boeing brand, including what the brand stands for and how to present it properly, visit the Boeing Brand Center at <http://brandcenter.web.boeing.com> on the Boeing intranet.

Letters guidelines

Boeing Frontiers provides its letters page for readers to state their opinions. The page is intended to encourage an exchange of ideas and information that stimulates dialogue on issues or events in the company or the aerospace industry.

The opinions may not necessarily reflect those of The Boeing Company. Letters must include name, organization and a telephone number for verification purposes. Letters may be edited for grammar, syntax and size.

Looks like the dark side of... Is this a riff of a famous album cover from the 1970s? Nope; it's a view of airglow layers at Earth's horizon—as photographed by STS-122 crewmembers on the Space Shuttle Atlantis, which successfully completed its 13-day mission last month. Boeing is the major subcontractor to United Space Alliance, NASA's prime contractor for shuttle operations.

SNAPSHOT

NASA PHOTO



QUOTABLES

In the next five to 10 years, we can have a significant impact on the market and on the carbon footprint of aviation.”

—Bill Glover, Boeing director of Environmental Strategy, on the potential environmental benefits of biofuels, in the Feb. 8 issue of the newspaper *The Australian*

It is the perfect aircraft in the emerging market.”

—Rusdi Kirana, Lion Air founder and president director, about the 737-900ER (Extended Range), in a Feb. 19 Associated Press report. The airline and Boeing said last month that Lion Air had ordered another 56 737-900ERs, bringing its combined orders for the jetliner to 178

These programs and others like them combine the best of our people and technology, with BCA and IDS teaming to provide the right solutions for our customers.”

—Jim McNerney, Boeing chairman, president and CEO, speaking about derivative aircraft programs such as the P-8A Poseidon and International Tankers, during a Jan. 31 conference call with financial analysts

IAM PROMOTIONS

No promotions listed for periods ending Jan. 25 and Feb. 1, 8, 15 and 22

ETHICS QUESTIONS?

You can reach the Office of Ethics & Business Conduct at 1-888-970-7171; Mail Code: 14-14; Fax: 1-888-970-5330; TDD/TTY: 1-800-617-3384; e-mail: ethicsLine.ethics@boeing.com; Web site: <http://ethics.whq.boeing.com>



A group of Women Airforce Service Pilots walks by a Boeing B-17. More than 1,000 American women joined the WASP during World War II.

BOEING ARCHIVES PHOTO

True trailblazers

Women Airforce Service Pilots did everything short of combat flights

BY EVE DUMOVICH

During World War II, 1,074 American women left homes, families and jobs to risk their lives as the country's first female military pilots. As Women Airforce Service Pilots, they flew more than 60 million miles on every type of mission except actual combat. Although 38 died in service, more than 30 years passed before Congress recognized WASP as war veterans.

These pilots trained, flew and served as hard, and as well, as their male counterparts. They trained new male and female pilots, tested new planes and towed targets through live ammunition. In 1943 and 1944, the WASP took more than 12,000 aircraft, from P-51 fighters to the big Boeing bombers, to battle theatres. Yet unlike the male pilots in the Army Air Forces

(renamed U.S. Air Force in 1947), WASP were considered part of the Civil Service and received no military benefits. In fact, when a WASP member made the ultimate sacrifice for her country, her family and friends paid for her unceremonious final trip home.

Jacqueline Cochran spearheaded the formation of WASP in 1942 when there was a shortage of male pilots, and training women as pilots would release more men for air combat. Cochran was an accomplished aviator who in 1953 would become the first woman to break the sound barrier, in North America's F-86 Sabre jet, and the first woman to fly at twice the speed of sound, in a North American A-5 Vigilante. She went on to serve for 30 years as a member of the board of directors of North American Aviation, a predecessor of Boeing.

In her final report to Army Air Forces Gen. Henry "Hap" Arnold in 1944, Cochran wrote: "It was of importance to prove that a whole group of women, without special selection except for physical requirements, could be assigned to the Fortresses

or the B-26s or the B-25s, pass through their transition training as successfully as male pilots and thereafter carry on regularly in operations without undue fatigue or higher-than-normal accident rate."

Cochran convinced Arnold and U.S. President Franklin D. Roosevelt of the value of this concept after she ferried a Lockheed Hudson bomber across the Atlantic in 1942. At the time, both England and Russia were using women to ferry airplanes.

By September 1942, the U.S. Air Transport Command authorized the employment of women flyers, and the Ferry Command was training women as pilots. Cochran headed the 319th Army Air Force Flying Detachment, based in Houston. Nancy Love, another skilled pilot, headed the Air Transport Command Squadron, designated the Women's Auxiliary Ferry Service, based at New Castle Army Air Base, Del. The two units operated separately until 1943, when Arnold consolidated them as the WASP, directed by Cochran. Love became staff director of WASP serving with the Air Transport Command.



BOEING ARCHIVES PHOTO

Jackie Cochran, who helped with the formation of the Women Airforce Service Pilots, sits in the P-51B Mustang that she flew in the 1946 and 1948 Bendix Trophy Race.

While legislation giving women pilots complete military status waited for Congressional approval, WASP trainees were accepted as federal employees on temporary Civil Service status, so they did not qualify for flight pay or other standard military benefits.

More than 25,000 women applied and 1,830 were accepted for WASP training. Of these, 1,074 graduated. Applicants had to pass a tough physical exam, be interviewed by Cochran or her representative, and have a high school education and at least 35 hours of flying time.

The 27 weeks of WASP training included more than 400 hours of ground school and 210 hours of flight instruction. With the exception of formation and aerobatic flying required for combat, the training was identical to that taken by male cadets.

The first class of 28 recruits began training Nov. 16, 1942, at the Howard Hughes Municipal Airport in Houston. New classes began every month, and soon the Houston facility became too crowded. On Nov. 1, 1943, WASP relocated to Avenger Field in Sweetwater, Texas. For a brief period they shared the facility with the last class of male cadets; after that Avenger Field became a women-only training center.

At WASP graduation ceremonies in 1944, Arnold presented the WASP with a bronze plaque dedicated to the “Best Women Pilots in the World.” He told the new graduates that women pilots could do everything needed, short of combat.

But by February 1944, plans for the coming invasion of Europe shifted the military emphasis to ground troops. Thousands of men in Air Forces training programs, in-

cluding the Civil Aeronautics Administration’s War Training Service Program and the contract schools for cadets, were dismissed. They were no longer eligible for the draft-deferred status many held as reservists and would likely be drafted into the infantry. These pilots lobbied Congress to squash House Bill 4219, designed to grant the WASP full military status, and with it, insurance coverage, hospitalization and burial benefits, and veteran status.

The Military Service Committee agreed with Arnold that the WASP should be commissioned. However, the powerful Civil Service Committee claimed Congress never authorized the formation of the WASP and voted to discontinue the program. On June 21, 1944, the bill was defeated by 19 votes.

On Oct. 1, 1944, each WASP received a letter from Arnold saying that all the Women Airforce Service Pilots would be released Dec. 20, 1944. At bases across the United States, WASP hung up their parachutes and paid their own way back home.

“I salute you and all WASP. We of the Army Air Force are proud of you and we will never forget our debt to you,” Arnold told the last group of WASP at Sweetwater. Yet America did forget. For 30 years, records of WASP service at the air bases were sealed and stamped “top secret.”

Then, in 1972, a reunion of 315 former WASP at Sweetwater sparked a new fire. By their next reunion in 1974, a Militarization Committee under the guidance of Col. Bruce Arnold (retired) —the son of deceased Gen. Arnold— started a process of new Congressional bills and hearings.

Former WASP Doris Brinker Tanner was among those who testified before Congress. In an article called “We Also Served,” published in the November 1985 issue of *American History Illustrated*, she wrote: “On May 21, 1971, the Assistant Secretary of the Air Force, Antonio Chayes, presented the first authentic WASP discharge, stating that ‘the efforts and sacrifices of a talented and courageous group of women have been accorded (retroactive) status as military veterans ... and inspire the 47,000 Air Force women who now follow in their footsteps.’ The unknown, gutsy women of the World War II Army Air Forces at last occupied their rightful place as the first female military pilots in American history.” ■

eve.m.dumovich@boeing.com

WASP displays



BOEING ARCHIVES PHOTO

This group of WASP pilots completed B-17 transition training.

A Women Airforce Service Pilots display is currently part of the Personal Courage Wing at The Museum of Flight in Seattle. The traveling WASP exhibit “FLYGIRLS of WWII” is on display through April 1 at the Mayborn Museum Complex of Baylor University in Waco, Texas.

Scenes from around the company

Boeing had a busy February. Here's a look at some of the many happenings that month from around the enterprise.



BEVERLY D. NOWAK PHOTO

Japan tanker sets off for delivery

The first Japan KC-767 Tanker—the first aerial refueling aircraft in Japan's history—last month left the Boeing site in Wichita, Kan., on its way to the Itochu Corp. and delivery to Japan's Air Self-Defense Force. Japan Ministry of Defense Air Staff conducted a final review in Wichita before the aircraft made its 12-hour nonstop flight to Gifu, Japan, near Nagoya. Itochu will deliver the KC-767 Tanker to the MoD following in-country acceptance processes.

Japan has ordered four convertible freighter 767s, providing flexibility in carrying cargo or passengers while maintaining its primary role as an aerial refueling tanker. Boeing will deliver the second Japan tanker immediately following acceptance of this first Japan delivery. In addition, Boeing is building four tankers for Italy; delivery of the first two aircraft is planned in 2008.



BILLY GLOVER PHOTO

Virgin, Boeing, GE team on historic flight

A Virgin Atlantic 747-400 prepares to take off on a historic flight: the first commercial aviation flight using a sustainable biomass-to-liquid fuel mixed with traditional kerosene-based jet fuel. This flight, for which Boeing partnered with GE, Imperium Renewables and Virgin Atlantic, marked the first step in a broader industrywide technology initiative to commercialize alternative fuel sources for aviation. It also represents a significant step toward a long-term vision of fully sustainable, low-carbon-lifecycle fuel solutions for the aviation industry to help reduce impacts to climate change. On this London-to-Amsterdam trip, one engine used a kerosene/biofuel blend including babassu oil and coconut oil provided by Seattle-based Imperium Renewables.



TONY ROMERO PHOTO

Albaugh: Working together matters

At his address at last month's 2008 IDS Senior Leadership Meeting, Jim Albaugh, Integrated Defense Systems president and CEO, stressed the importance of working together across IDS and Boeing to deliver the finest products and services to customers—especially to meet growth goals for international business.

Challenging the team to grow international business from 13 percent to 20 percent over the next decade, Albaugh told the nearly 1,000 attendees: "Will it be easy? No. Is it critical to our long-term growth and competitiveness? Absolutely. Growing internationally takes time, patience and perseverance. It takes strong customer relationships and understanding their needs. With international customers, they don't see IDS; they don't see [Commercial Airplanes]. They see Boeing, and we need to leverage this."

In his speech, Albaugh also recognized the achievements of the 71,000 IDS employees over the last year. In addition, he outlined a 10-year vision for IDS, which includes next-generation development programs, additional market share, and the attraction and retention of the very best talent.

Look ahead, stay **Lean**

BCA's Skin & Spar team finds way to support simultaneous needs of 2 new-airplane programs

By JEFF WOOD AND ROBIN MCBRIDE

Around this time last year, Boeing Fabrication ran into a big challenge to its Lean operations: finding a way to support two new-product development programs whose requirements overlapped one another on the calendar.

The Skin & Spar team members in Frederickson, Wash., faced a host of issues related to double booking their complex manufacturing resources. The schedule for Skin & Spar, a Fabrication manufacturing business unit of Commercial Airplanes, required the team to begin fabrication of wing parts for the first 777 Freighter during early 2008. At the same time, the unit was scheduled to build key wing components for the first P-8A Poseidon, a new military derivative of the Next-Generation 737-800 that Integrated Defense Systems will deliver to the U.S. Navy in 2009.

Trying to juggle multiple manufacturing requirements in one factory can be difficult, especially when the Fab team's goal is to remain Lean. Skin & Spar's solution came through development of a "build ahead" plan that would avoid overlap and risks of missed deliveries to its Airplane Programs customers.

By working together with Engineering, Skin & Spar would complete much of its 777 Freighter work before beginning P-8A production. To enable the plan, Engineering provided early release of drawings and models of wing-box stringers, wing-skin panels, channel-vent stringers, spar chords and webs.

"There was a lot of synergy between manufacturing and program engineers working together," said John Donohue, 777 Freighter project leader. "In the process, the team found a way to use the same production engineering, planning and numerical programming concepts for both the 777 Freighter and P-8A programs. They can be

proud of the efficiencies they developed, including a new, flexible manufacturing plan that now can be passed on to help the 747-8 Program."

To coordinate project information, visual cues with "need dates" showed team members every requirement from raw material procurement to fabrication and acceptance. In addition, supply-chain management analysts released to suppliers material transfer and production orders several months ahead of normal lead time.

Regularly communicating the build-ahead plan across the organization became critical, so a cross-functional team met weekly to adjust plans whenever unexpected developments emerged.

"The flexibility of our team and the shared understanding of our plan allowed us all to focus on solving problems together. That was key to our success," said Verna Warrick, production engineering representative.

Ensuring that parts were completed on time wasn't the team's only challenge, however. Finding room to put the finished parts was, literally, the biggest issue.

In 2003, Skin & Spar implemented a just-in-time production system. Normally, completed wing parts are kitted in racks or loaded directly into transportation modules for shipping and delivery just days before they're needed at factories in Everett and

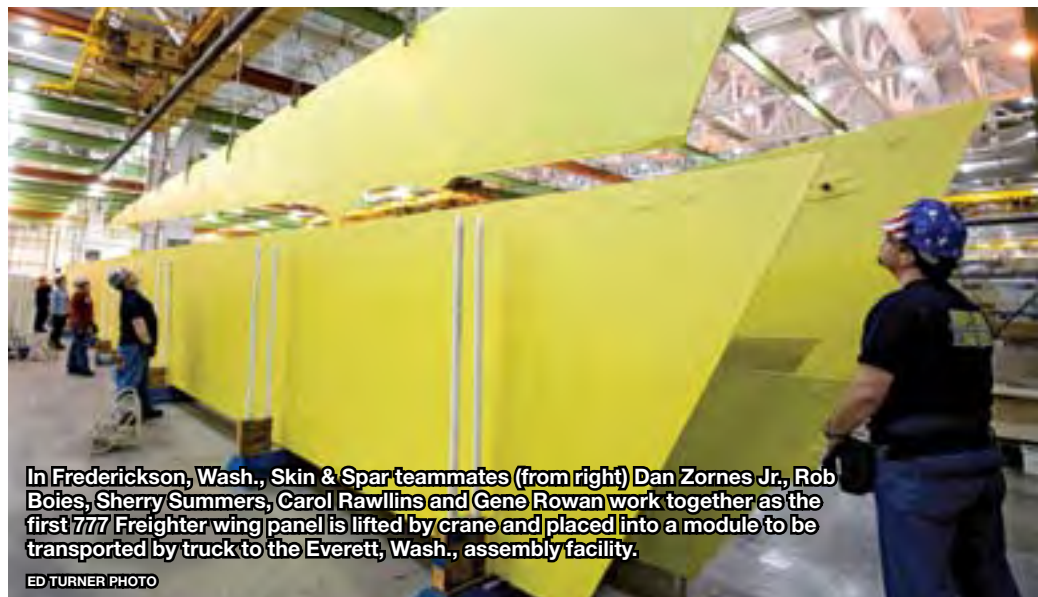
Renton, Wash. But that meant Skin & Spar didn't have the room to store the hundreds of huge "sleeping" parts measuring some 97 feet (30 meters) long and weighing up to 1,500 pounds (680 kilograms).

The team's storage solution for 777 wing panels was to use temporary racks and transportation modules previously dedicated for 747 wing panels. For wing stringers, the team elected to bundle them in their fabrication cradles until they could be transferred into racks for shipment. For temporary storage of channel vents, the team used cure racks that minimize handling and preserve the high quality of the components.

By the second week of February, the team's creative problem-solving paid off, when the first wing components were delivered to Everett—just in time to take their place on the 777 Freighter assembly line.

"Despite growing production requirements and resource challenges, we worked together as a team and implemented a plan to support critical new product development," said Robin Carsten, Skin & Spar, kitting, delivery and tooling manager. "And we did it without impacting daily delivery commitments to our customers. Each and every day, I am truly amazed at how this team finds a way." ■

richard.j.wood@boeing.com
robin.m.mcbride@boeing.com



In Frederickson, Wash., Skin & Spar teammates (from right) Dan Zornes Jr., Rob Boies, Sherry Summers, Carol Rawlins and Gene Rowan work together as the first 777 Freighter wing panel is lifted by crane and placed into a module to be transported by truck to the Everett, Wash., assembly facility.

ED TURNER PHOTO



Chopper Toppers

In the defense-rotorcraft business, Boeing is using its time-tested formula for success: continuously improving capabilities, and paying close attention to the needs of its customers

BY DEBBY ARKELL

Humankind has long been fascinated by vertical flight, with initial concepts dating back to the 5th century. However, the earliest viable helicopters didn't get off the ground—literally and figuratively—until the early 20th century.

While the general public might associate Boeing with fixed-wing aircraft, the company has a successful defense rotorcraft business. The Boeing helicopter heritage traces its roots to the 1960s. Forged from aviation legends including Howard Hughes and Frank Piasecki, Boeing-manufactured helicopters now make up a rotorcraft family renowned for providing vital military and humanitarian services to armed forces and communities around the world.

Led by program Vice President and General Manager Chuck Allen, Boeing

Inside

Get to know the business: *Boeing Frontiers* looks at the Rotorcraft Systems business and its three in-production helicopters. [Page 12](#)

Humanitarian role: The Chinook has taken part in major relief efforts this decade. [Page 14](#)

Tale of the tape: Here's a look at some facts and figures about Boeing helicopters. [Page 15](#)

Chuck Allen Q&A: *Boeing Frontiers* talks with the head of Rotorcraft Systems. [Page 16](#)

The competition: What companies are going up against Boeing in this market? [Page 17](#)

CSAR-X: Rotorcraft Systems officials like Boeing's chances to again win this pact. [Page 17](#)

Rotorcraft Systems teammates: Here's a look at some of the many employees who support this business. [Page 18](#)

Rotorcraft employees manufacture the venerable Apache and Chinook, and the unique V-22 Osprey for customers that include the U.S. Armed Forces and many nations worldwide. All three platforms will continue to play critical roles in combat and humanitarian missions for decades to come.

"Rotorcraft Systems had a great year in 2007," Allen said. "Our success is a direct result of the tremendous amount of hard work, dedication and teamwork you'll find in our factories and in our offices at both of our Rotorcraft plants."

In 2007, Rotorcraft Systems delivered 36 Chinooks (the most since 1995), 42 Apaches and 15 Osprey fuselages, along with contributing to the delivery of 14 complete V-22 aircraft from the Bell plant in Amarillo, Texas.

"Our business outlook for the next five to 10 years is solid, and we're showing outstanding growth," Allen said. "Our challenge is to keep everyone focused on the future."

Indeed, Rotorcraft leaders expect continued long-term growth for their businesses across the board.

Chinook program leader Jack Dougherty expects the Chinook program to have a useful service life of 75 to 100 years. And under the \$10 billion U.S. Army Modernization Program, that won't be far off the mark. The first of more than 452 new and renewed CH-47F helicopters was certified combat-ready by the U.S. Army and fielded to the first operational unit last August.

The AH-64D Apache Longbow also is successfully in service and on order with



BOB FERGUSON PHOTO

The AH-64D Apache Longbow is a multirole, heavy-attack combat helicopter that can transmit real-time digitized information to air and ground forces.

the U.S. Army—and nine allied defense forces as well. Efforts are under way to deliver the first Apache Block III helicopter to the Army in 2011. Indeed, the enhancements featured in the Block III Apache will offer crews and battlefield commanders the right mix of technology and performance—network-centric capabilities, increased sensor ranges, enhanced survivability and greater agility—and continue to address customers’ changing needs.

Bell Boeing is expected to implement a multiyear procurement program beginning this year for the V-22 Osprey. The multiyear effort involves 167 aircraft: 141 for the U.S. Marine Corps and 26 for the U.S. Air Force Special Operations Command—about half the current full program requirement of 458 aircraft. A follow-

on multiyear procurement to complete the program by 2017 is likely to follow in 2008. Bell Boeing expects to produce aircraft for several international customers as well, though those discussions are preliminary.

The following pages provide an introduction to the capabilities of this triad of fielded, proven rotorcraft products; they also will demonstrate how Boeing employees continue a tradition of flawless execution and create products that meet the needs of customers—now and into the future.

AH-64D APACHE LONGBOW

Apaches have been in production since the mid-1980s. The AH-64D Apache Longbow, first delivered to the U.S. Army in 1997, is the successor to the original production attack helicopter, the AH-64A Apache. The Apache Longbow is a multirole, heavy-attack combat helicopter capable of transmitting real-time digitized information to air and ground forces.

Boeing in May 2007 delivered to the Army its first new-build, wartime replacement AH-64D Apache Longbow. Before that delivery, Boeing delivered 501 Apache Longbows—remanufactured AH-64As—for the U.S. government under two multiyear contracts. The Army has 47 new-build Apache Longbows and 96 remanufactured AH-64Ds on order. The first Block III helicopter will be the first Army aviation platform with the capability to be part of the network and connect to the Global Information Grid.

“Intimate product and customer knowledge are key to maintaining the competitive advantage of the Apache program in today’s rotorcraft market,” said Al Winn, vice president, Apache programs. “Teammates working in all facets of Apache design, production, delivery and service—and within the support areas—bring expertise and extensive experience, enabling customer relationships to be established and grown for the benefit of the customer and the company.”

CH-47F CHINOOK

The CH-47 Chinook is a twin-turbine, tandem-rotor helicopter that first saw military service in 1962. A multimission,



FRED TROILLO PHOTO

The tandem-rotor Chinook helicopter has gained worldwide renown for humanitarian and medical evacuation missions, in addition to its support of military conflicts around the world.



FRED TROILLO PHOTO

The V-22 Osprey is a complex aircraft that brings unique, transformational capabilities to the U.S. Armed Forces. The first operational U.S. Marine Corps squadron deployed to Iraq in 2007.

heavy-to-medium-lift transport helicopter, the Chinook's primary role is to move troops, supplies and a variety of other equipment on the battlefield. However, Chinooks have gained worldwide renown conducting humanitarian and medical evacuation missions, disaster relief and fire fighting and supporting heavy construction and civil development.

Boeing has built a variety of CH-47 models over the years, the most advanced of which is the CH-47F. Certified combat-ready by the Army, the new Chinook was first fielded in August 2007.

"Boeing Rotorcraft is the original equipment manufacturer of five U.S. military platforms (H-47, AH-64, V-22, OH-6, CH-46)," said Jack Dougherty, Chinook program leader. "This level of experience with different platforms means Boeing engineers can pull on knowledge and expertise from around the company to provide customers cutting-edge technology and solutions."

One of the principal features of the Chinook program is that it strives to have employees take ownership in the products they produce. Dougherty also noted the Chinook program has an ongoing Lean initiative, which focuses on lead- and cycle-time and cost reduction. In recent years this Lean manufacturing program

has successfully saved the U.S. Army millions of dollars. Under the current Army modernization program, Chinooks will remain in service through 2035—a service life exceeding 75 years.

V-22 OSPREY

The V-22 Osprey, built jointly by Boeing and Bell Textron, promises to transform the U.S. Armed Forces. The V-22 Osprey takes off, hovers and lands like a helicopter; however, its rotors can be tilted in flight so the aircraft flies like a turboprop airplane, making it capable of high-speed, high-altitude flight. The Osprey is a multi-role helicopter used for assault, cargo and search-and-rescue operations.

"The V-22 brings unique, transformational capabilities to our Armed Forces," said Gene Cunningham, vice president, Bell Boeing. "It's a potentially huge competitive advantage for Bell Boeing, and no one else can match the versatility of this aircraft."

Boeing is responsible for the V-22's fuselage and all subsystems, digital avionics, and fly-by-wire flight-control systems; Bell is responsible for the wing, transmissions, empennage, rotor systems and engine installation. The first V-22 was delivered in 2005, and the aircraft currently is transporting U.S. Marines in Ramadi, Iraq.

"Now that V-22s are deployed over-

seas, we expect to see growing interest in the operational capabilities of our revolutionary tiltrotor aircraft," said John Rader, V-22 program manager. "We've increased our production rates to enable the Marine Corps and Air Force Special Operations to field V-22s as quickly as possible, and we're focusing closely on quality to ensure our servicemen and servicewomen receive superlative aircraft to complete their missions." ■

debra.j.arkell@boeing.com

Chinook's relief role



As part of a post-earthquake relief effort in 2005, members of an Australian Defence Force team unload relief goods in Dhanni, Pakistan, from a U.S. Army Chinook helicopter.

AUSTRALIAN DEPARTMENT OF DEFENCE PHOTO

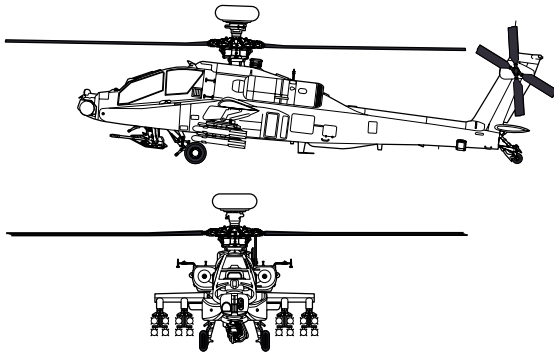
Indonesia, Dec. 26, 2004: tsunami.
Louisiana, Aug. 29, 2005: Hurricane Katrina.
Louisiana, Sept. 24, 2005: Hurricane Rita.
Pakistan, Oct. 8, 2005: earthquake.

These four dates mark some of the most significant natural disasters the world has experienced in recent years. One constant in these four crises—and others since—is the CH-47 Chinook.

CH-47s are ideally suited to humanitarian relief efforts because of their ability to handle useful loads up to 24,000 pounds, among the heaviest lift capabilities today. Its tandem rotor configuration also provides exceptional handling qualities that enable the CH-47 to operate in climatic, altitude and crosswind conditions that typically keep other helicopters from flying.

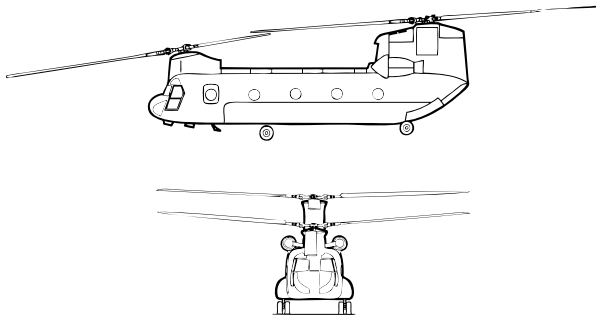
Tale of the tape: Boeing Rotorcraft products

AH-64D Apache Longbow



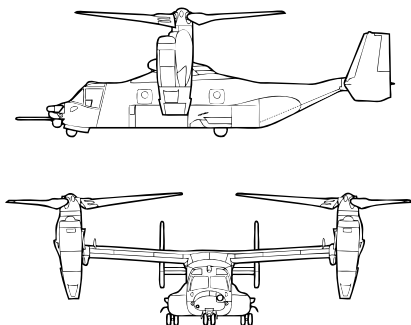
Length	58 feet (17.7 meters)
Height	16 feet (5 meters)
Fuselage width	17 feet (5.2 meters)
Mission gross weight	16,600 pounds (7,530 kilograms)
Vertical rate of climb	1,475 feet per minute (450 meters per minute)
Cruise speed	141 knots (261 kilometers per hour)
Other models	AH-64A
Customers	United States, Egypt, Greece, Israel, Saudi Arabia, United Arab Emirates, Japan, Kuwait, The Netherlands, Singapore, and the United Kingdom
Number ordered/delivered to date (all models)	More than 1,600
Place of manufacture	Mesa, Ariz.
Program leader	Al Winn

CH-47F Chinook



Length	52 feet (15.8 meters)
Height	19 feet (5.8 meters)
Fuselage width	12.4 feet (3.8 meters)
Mission gross weight	50,000 pounds (22,680 kilograms)
Vertical rate of climb	1,980 feet per minute (604 meters per minute)
Cruise speed	155 knots (287 kilometers per hour)
Other models	CH-47A/B/C/D, MH-47E/G
Customers	United States, Argentina, Australia, Canada, Egypt, Greece, Iran, Italy, Japan, South Korea, Libya, Morocco, The Netherlands, Republic of China, Singapore, Spain, Thailand, United Kingdom
Number ordered/delivered to date (all models)	More than 1,500
Place of manufacture	Ridley Park, Pa.
Program leader	Jack Dougherty

V-22 Osprey



Length	57 feet (17.4 meters)
Height	20 feet (6.1 meters)
Width, rotors turning	83.3 feet (25.6 meters)
Mission gross weight	47,500 pounds (21,546 kilograms)
Vertical rate of climb	2,320 feet per minute (707 meters per minute)
Cruise speed	250-300 knots (463-556 kilometers per hour)
Other models	N/A
Customers	U.S. Marine Corps, Air Force and Navy
Number ordered/delivered to date (all models)	About 458 (projected)
Place of manufacture	Amarillo, Texas (final assembly and delivery)
Program leader	John Rader



In Philadelphia, Chuck Allen (left), Rotorcraft Systems vice president and general manager, reviews a CH-47F Chinook airframe with Frank McCabe (center), with the Primary 1-3 Fuel Shop, and Craig Moore of IDS Technical Training.

FRED TROILO PHOTO

Focusing on the future

Chuck Allen became vice president and general manager of Rotorcraft Systems in March 2007. *Boeing Frontiers* recently spoke with Allen to discuss his goals for the organization and gain some insight into Rotorcraft's top leader.

Q: What are your top priorities for your organization?

A: First, making it a place where mutual trust and respect for everyone is a hallmark. Second, be an organization renowned for world-class quality in everything we do—our products, our business systems, our HR processes, and on and on. When we accomplish those two things, we will see our business expand more than even I can imagine. And I have a vivid imagination!

Q: Integrated Defense Systems' vision is to be the preferred partner based on integrity, innovation, performance and value. Of those four things, which do you feel is the biggest challenge for your organization?

A: They are all important and all have their own challenges. I'm going to say integrity—certainly not because I think we're lacking there today, but because none of the others are really possible without unquestionable integrity, and one lapse in judgment by one person can do such enormous damage.

Q: What's the forecast for rotorcraft in the coming decades?

A: We are very fortunate to be in a growing market for some time to come. On the other hand, our competitors see the same forecast and are working to displace Boeing as the market leader.

I know we have the best products and the best people, so we need to be sure we have the right vision, the right discipline in execution and the right commitment to keep that from happening.

I've been pleasantly surprised at how solid our business outlook is for the next five to 10 years. We're showing outstanding growth, and it's in firm or near-certain work. The challenge is to keep everyone focused on the future and how good we really can be rather than focused on how much we've improved in the last five years, because that improvement has been phenomenal.

Q: You served in the U.S. Marine Corps for 13 years before joining Boeing. How did this prepare you for a career in aerospace?

A: Did I mention that discipline thing? Seriously, it taught me how important it was to build trust and confidence in a team. The only thing more sobering than realizing your life can literally depend on other people doing what they promised is to realize they feel the same way about you.

Q: Do you have a pilot's license, and did you pilot any helicopters during your time with the Marines?

A: I do have a pilot's license, but the only time I flew helicopters was while a student in Test Pilot School. And they only let us fixed-wing guys fly them enough to convince ourselves all helo pilots were supermen!

—Debbly Arkell

What is CSAR-X?

When pilots are downed, or soldiers, sailors or Marines wounded or injured on the battlefield or in hostile territory, it's of paramount importance to find them and return them to safety.

The Combat Search and Rescue mission belongs to the U.S. Air Force and relies upon state-of-the-art equipment to answer the call. However, the service's current helicopter, the Sikorsky HH-60G, is aging and suffers from low mission-capable rates. Fielding a new helicopter through the CSAR-X competition is one of the Air Force's highest acquisition priorities. In November 2006, the service chose Boeing's HH-47 helicopter as the platform for the lifesaving job.

Both the global war on terror and humanitarian relief operations demand a helicopter that can operate in high altitudes and rough terrain and provide medical and transport capabilities safely. The HH-47, based on the Chinook, met and exceeded the Air Force requirements. But following the award, competitors Lockheed Martin and Sikorsky protested the selection based on evaluation and calculation of the Most Probable Life Cycle Cost. This resulted in a work-stoppage order to Boeing. After being upheld twice by the Government Accountability Office, the protests led to the reopening of the competition last November.



BOEING GRAPHIC

In 2006, the U.S. Air Force chose Boeing's HH-47 helicopter for its Combat Search and Rescue mission. The competition was reopened in November 2007, and Boeing officials said they're confident about the company winning this contract.

"We are pleased that the process can now move forward, and remain confident Boeing's HH-47 is the best choice," said Rick Lemaster, HH-47 CSAR program manager. "In the end, we feel the HH-47 will be again selected by the Air Force, based on its exceptional capability and low risk."

The three competitors submitted new proposals Jan. 7, and the Air Force is expected to reaward the contract this fall. The contract is worth an estimated \$15 billion and, should Boeing win again, Rotorcraft Systems will build 141 new aircraft at its Ridley Park, Pa., facilities.

—Debbly Arkell

Other rotorcraft players

Boeing has fared well in the defense helicopter market. But by no means is it the only company in this business. Here are short profiles of some of the world's other helicopter manufacturers that compete with Boeing. (This summary is not intended to be all-inclusive; instead, it looks at a sample of companies with in-production aircraft.)

AgustaWestland

AgustaWestland, based in Italy and the United Kingdom, is a provider of light- to medium-heavy-lift helicopters. The company teamed with Lockheed

Martin and Bell Helicopter Textron in 2005 to win a contract to build the new U.S. presidential helicopter—*Marine One*—which is a variant of the AgustaWestland EH101. That aircraft made its first flight in July. AgustaWestland was the prime contractor for the AH-Mk1, the British version of the AH-64D Apache Longbow. Boeing was the prime subcontractor to AgustaWestland.

Bell Helicopter Textron

Bell Helicopter Textron Inc., headquartered in Fort Worth, Texas, produces military and commercial vertical-lift aircraft in the light- through medium-lift categories. Bell has built approximately 35,000 helicopters since 1946. Bell now partners with Boeing on the tiltrotor V-22 Osprey.

EADS Eurocopter

EADS Eurocopter Group is a wholly owned subsidiary of European Aeronautic Defence and Space Company, or EADS. The Eurocopter product line includes light,

attack and medium-lift helicopters. As of 2007, more than 9,800 Eurocopter helicopters were in service with more than 2,500 military and civilian customers in 140 countries. Eurocopter teams with Agusta and Stork Fokker to build the NH-90 medium-lift helicopter.

Mil Moscow Helicopters (now Oboronprom Corp.)

Mil Moscow Helicopter Plant, founded more than 55 years ago, has designed and produced some 15 baseline helicopter models. It produces helicopters of all types and classes, including unique heavy helicopters. Mil recently merged with Kamov and Rostvertol, forming Oboronprom Corp., but has retained the Mil brand name.

Sikorsky

Sikorsky Aircraft Corp., headquartered in Stratford, Conn., was founded in 1923 by Igor Sikorsky—the designer of the R-4, the first helicopter to go into full-scale production. Sikorsky produces light, medium and large helicopters, most notably the S-70/H-60 Black Hawk series. One of its newest models, the S-92, is operating with several commercial operators and will enter military service as the CH-148 Cyclone with the Canadian Forces in 2009. Boeing worked with Sikorsky on the RAH-66 Comanche, a twin-turbine, two-seat armed reconnaissance helicopter. The Army canceled the program in 2004 as part of a reorganization of Army Aviation.

—Debbly Arkell



In this 2005 photo, the new U.S. presidential helicopter, the US-101 medium-lift executive aircraft (VH-71 test 1), lands at its future home, Marine Corps Air Facility Quantico, Va.

U.S. MARINE CORPS PHOTO BY SGT. DONALD BOHANNER

They keep the blades turning

Boeing has succeeded in the defense helicopter market thanks to the combined efforts of the 9,500 dedicated employees in the Rotorcraft Systems business. Below, some of these many individuals talk about their roles on the team.



FRED TROILLO PHOTO

Name: Fred Bergner
Title: Operations analyst, Chinook program
Worksite: Philadelphia
Job description: My group is responsible for studying and analyzing current and future rotorcraft systems for both domestic and international customers. I support the international and domestic sales organization for Business Development with studies, analyses, briefings, brochures and marketing materials.



FRED TROILLO PHOTO

Name: Cathy Anthony
Title: Chinook Business Development
Worksite: Philadelphia
Job description: I am the Boeing face to the U.S. Army customer, and my job entails attending state conferences, welcome-home events and change-of-command ceremonies. At these events we conduct "after-action reviews" where we talk with our customer about what went well with the Chinook while deployed,

Proudest Rotorcraft moment: The Chinook is the longest-running production program for Boeing, which makes me very proud to say that the great products we build today deliver the capability our customers demand and will continue to do so well into this century.

and what can be improved.

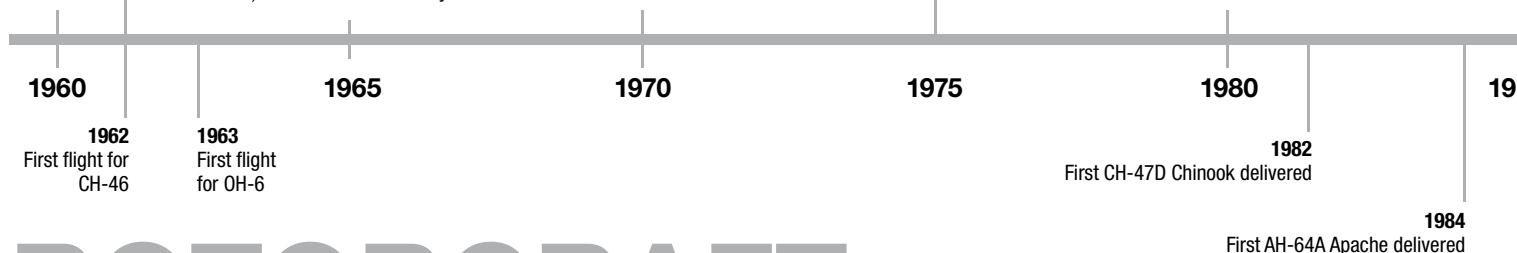
Proudest Rotorcraft moment: The soldiers I interact with tell me they love Boeing and they love our products. Some might think of Boeing as an airplane company or a rocket company, but my customers all know Boeing for the Chinook.



1962
 First CH-47 Chinooks (models A, B, C used in Vietnam War) introduced to U.S. Army



1975
 First Apache prototype flies



ROTORCRAFT TIMELINE



BOB FERGUSON PHOTO

Name: Bob Harmon
Title: Apache program liaison
Worksite: Fort Hood, Texas
Job description: I am the Fort Hood liaison between the plant in Mesa (Ariz.) and the customer—which includes the U.S. Army, the National Guard, the reserves, as well as international customers such as the Kuwaitis and Dutch.

Proudest Rotorcraft moment: I've been here since we started fielding the Longbow. Early on I participated in a unit-fielding

program where units trained with me at Fort Hood for nine months. Many of those unit members are now in leadership positions with the Army, and I'm proud of the strong relationships that have come from that experience.



FRED TROILO PHOTO

Name: Andrea Allen
Title: V-22 Program Project Management
Worksite: Philadelphia
Job description: As part of V-22 Operations I'm responsible for rate readiness—essentially ensuring we get our V-22s out to the customer on time. As we look to increase rates, we work together to determine requirements to execute at a higher production rate, and I work with the team proactively up front to identify issues before they become obstacles.

Proudest Rotorcraft moment: My proudest Rotorcraft moment was when the "Transformers" movie came out. The V-22 was in the movie, and I pointed it out to my son when we watched it. My son asked me, "How come [the V-22] doesn't transform in the movie like the others?" I told him, "Because it transforms in real life!"



BOB FERGUSON PHOTO

Name: Jules Maddon
Title: Apache manufacturing/ordnance technician
Worksite: Mesa, Ariz.
Job description: I currently work in Final Assembly in Position 8, where we install the components in cockpits, fairings, upper controls, actuators, upper windows and more. My specialty is fairing work, which is composite; most of the fairings on the Apache are either kevlar or carbon. Our current project is remanufacturing "A"-model aircraft to "D"-models.

Proudest Rotorcraft moment: I never get tired of watching the Apache fly. We were featured on the National Geographic TV show "Ultimate Factories" about a year ago—it was great! My proudest moments, though, are when the pilots come in to visit. They tell us stories of their time in Iraq or Afghanistan, how much they love our aircraft and how safe they feel flying in them.



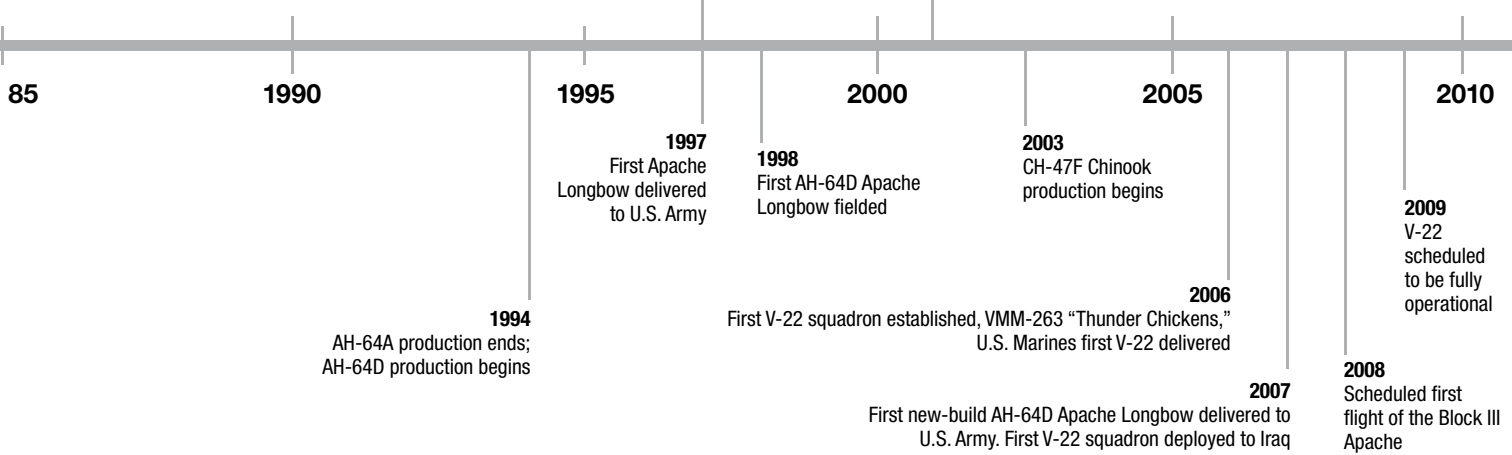
JASON BARRAS PHOTO

Name: Michael Fries
Title: V-22 Assembly Aircraft Mechanic
Worksite: Philadelphia
Job description: I install and swage hydraulic lines in the V-22 cabin and aft sections. I also install actuators, hoses, filters and other components in the aft section.

Proudest Rotorcraft moment: I came to Boeing after serving 20 years in the U.S. Air Force working on various military aircraft. When I retired, I figured my contribution to the war effort was over. My proudest Rotorcraft moment occurred last year when I learned that a squadron of MV-22s were on the way to Iraq—aircraft that I worked on. I knew right then that even though I was no longer in uniform I was still directly contributing to the war effort.



1997 V-22 production begins
 2001 First flight for CH-47F



The Boeing site in Everett, Wash., earned its ISO 14001 environmental management certification in 2006. Boeing's goal is to have all its major manufacturing facilities be ISO 14001-compliant by the end of 2008.

ED TURNER PHOTO

14001

A number of reasons

ISO 14001 certification will play a major role in companywide effort to boost environmental performance

By JUNU KIM

What does the number 14001 have to do with Boeing? It's not a Zip Code of a major Boeing site. And it's not the numerical designation of a well-known Boeing airplane.

At Boeing, 14001 is important for environmental reasons—specifically for ISO 14001, the worldwide environment-related standard. ISO 14001 is the internationally recognized gold standard for organizations that want to implement or improve an environmental management system.

So far, three Boeing facilities have earned ISO 14001 certification: Exmouth, Australia; Everett, Wash. (see Page 25 of the February 2007 *Boeing Frontiers*); and Portland, Ore. Those sites have documented numerous environmental improvements (see box on Page 22). Boeing's objective is for all of its major manufacturing sites to earn their ISO 14001 certification by the end of this year, Environment, Health and Safety executives said.

ISO 14001 certification will help the company continue to improve its environmental performance. This gives Boeing the foundation to do better in this important area by establishing a clear organization and management system to lead improvements—while also bringing together existing companywide efforts.

“Adopting ISO 14001 is an important early step that supports other environmental actions,” said Mary Armstrong, vice president, Environment, Health and Safety. “That certification will help all of Boeing do a better job of reducing our waste and pollution, being better neighbors, and critically to embed the thoughts and actions into our work that will drive further improvements in environmental performance for our products and services.”

INSIDE ISO 14001

ISO 14001, overseen by the International Organization for Standardization, provides a model for organizations that want to implement or improve an environmental management system so they can improve their environmental performance. More than 100,000 organizations worldwide have earned their ISO 14001 certification.

An environmental management system is set of processes, systems and practices an organization uses to reduce its environmental impact and to operate more effectively. “A common environmental management system is a powerful tool

that lets us track our performance across the company,” said Aileen Yankowski, director, Compliance and Services, the EHS organization that's leading the ISO 14001 effort across Boeing. “It drives continual improvement, which enhances our environmental and business performance.”

ISO 14001 doesn't mandate performance targets; in other words, it doesn't demand that a company cut its greenhouse gas emissions by a certain percentage. Instead, it bolsters an organization's ability to monitor and continually improve its environmental performance. It includes requirements, examples, descriptions and options that help with implementing an environmental management system.

What does it take to earn certification? Representatives from the certified sites said that every employee at that location had to know how his or her activity affects the environment. They also need to know that there's an environmental management system, and that the site has an environmental policy that includes their organization's commitment to pollution prevention, compliance, environmental protection and continual improvement. Also, employees were reminded that they have a role in helping reduce their impact through cutting waste, conserving materials and energy, and preventing spills.

Jutta Jaunzemis, environmental advisor in Exmouth, recalled that at the outset

of her site's ISO 14001 journey, employees there feared that the certification process would mean a lot of work and would significantly affect their ability to get their own jobs done. But that skepticism changed, she said, once employees realized that this wouldn't mean extra work—and, in fact, "was already part of the way in which they conducted their daily activities."

Also helping the effort, Jaunzemis said, was having a designated person on hand who could help implement, maintain and provide ongoing support to the different work areas and personnel. "Initial and ongoing awareness training and actually experiencing benefits produces more positive attitudes," she said.

Once a site earns its certification, it needs to look for ways to continually improve its environmental management system.

The priority at Everett this year is to "drive environmental stewardship," said Frank Migaiolo, Environmental Affairs manager in Everett. "We have some very aggressive environmental performance targets to reduce Everett's environmental footprint in the next five years."

Making those targets challenging is increases in airplane production, after Commercial Airplanes' three straight years of 1,000-plus jetliner orders. Yet, Migaiolo said, "Everyone wants to help reduce our environmental footprint, so employees are self-motivated to find improvements." He added that teams in Everett are evaluating opportunities to make additional improvements in many environment-related fields, including greenhouse gas emission, water usage, recycling and participation in alternative commuting.

Steve Mason, Environment, Health and Safety manager at the Boeing Fabrication Facility in Portland, Ore, added that the major component of ISO is about the people. "Employee involvement in our program through suggestion systems, communication, events and training is key to maintaining certification. Our culture is one of no secrets and everyone part of the solution, which enables us to keep our commitment," he said.

WORKING FROM ONE PLAYBOOK

A critical part of ISO 14001 is developing and implementing robust environmental management systems. If an organization has a common environmental management system, the organization's entities can work from the same playbook.

The ISO 14001 team at Boeing current-

ly is implementing these common tools with sites that are participating in the certification effort:

- A single Environmental Policy
- A single Environmental Management System Manual
- A single database to report significant environmental effects and the site's plans to reduce the environmental impact
- A single ISO 14001 registrar for the company
- Common communication tools and templates

In addition, the EHS team is creating a suite of Lean+ tools, including one to help teams use an Accelerated Improvement Workshop to measure their carbon footprint.

"Other industries have incorporated environmental thinking into their business. We need to get this right, so we're building the tools that will help all of Boeing," said Mark Arvizu, Employee Engagement leader for Environment, Health and Safety. Arvizu added that employees should expect to see more information about these tools in upcoming months.

To ensure that Boeing is indeed making

improvements, its environmental strategy incorporates metrics, transparency and accountability.

The company has already rolled out its environmental-performance goals (see Page 10 of the February 2008 *Boeing Frontiers*). These targets were set by the Environment, Health and Safety policy council. In addition, Boeing will roll out an environmental report later this year. The report will summarize Boeing's environmental strategy and its commitment to action—including reporting the company's footprint, improvement targets and performance to plan.

To bolster its accountability, Boeing is a member of groups of businesses aiming to improve their performance in this area.

- Boeing is one of more than 40 companies on the Pew Center on Global Climate Change's Business Environmental Leadership Council. The center—a nonprofit environmental advocacy organization supported by The Pew Charitable Trusts, an independent organization that aims to serve the public interest—created the leadership council based on the belief that



Thanks to an idea from Jeff Speak, the Boeing site in Portland, Ore., now recycles the plastic packaging used for cutters and tooling inserts for five new machines at this facility.

MICHAEL WARD PHOTO

business engagement is critical for developing efficient, effective environmental solutions.

- Boeing is a member of the World Business Council for Sustainable Development, a global association of about 200 companies. Through the council, member companies can explore sustainable development, share knowledge, experiences and best practices, and advocate business positions on these issues.

- Boeing is participating in the Climate Leaders program organized by the U.S. Environmental Protection Agency. Climate Leaders participant companies commit to complete a companywide inventory of their greenhouse gas emissions, set long-term reduction goals—which Boeing

already undertakes—and annually reports their progress to the EPA.

In addition, Boeing’s Shared Services Group, which is responsible for site services, energy conservation and much facilities work, leads Boeing’s participation in the joint U.S. Department of Energy and EPA Energy Star program for energy management. It also heads Boeing’s role in the U.S. Green Building Council, a nonprofit organization dedicated to sustainable building practices that develops and administers the Leadership in Energy and Environmental Design building standards.

THE ROLE OF LEAN+

ISO 14001’s connection to continual improvement should sound familiar to

Boeing employees: This concept is a tenet of Lean+, one of four Boeing company-wide growth and productivity initiatives. The objective of Lean+ is to continually seek and implement process improvements—and to share these ideas with others around the company.

Because Lean+ behaviors are part of the Boeing culture, Boeing employees can support ISO 14001 and Boeing’s environmental activities by applying their existing ways of thinking.

“Lean+ is a natural ally of the environment,” said Jerry Lancour, Lean+ integration leader for Environment, Health and Safety. “When you drive out inefficiency to boost productivity, you almost always save energy and reduce real waste,

By the numbers: Environmental improvements

Boeing sites in Exmouth, Australia; Everett, Wash.; and Portland, Ore.—all of which are ISO 14001 certified—have documented myriad improvements in environmental performance. Shared Services Group and the operating groups at these locations have played a key role in implementing these and many other projects focused on reducing Boeing’s environmental footprint and increasing operating efficiency. Here’s a look at some of the many numbers relating to this work.



Norm McLeod (left), a shift supervisor at the power plant, and Jutta Jaunzemis, environmental advisor, check water-filtration equipment at the Exmouth, Australia, site, which is ISO 14001-certified.

6,000

Megawatt hours saved in Everett through electrical system improvements. That’s enough to light more than 2,000 homes for one year and equals a reduction of more than 1,200 tonnes (1,323 tons) of greenhouse gas emissions.

15.8 billion

Number of BTUs Everett saved by improvements to a natural-gas system. This amount of energy equals 840 tonnes (926 tons) of greenhouse gas emissions.

1,100

Pounds (500 kilograms) of R-22 refrigerant, an ozone-depleting compound, no longer used in Everett’s 40-83 building, thanks to retrofitting air-conditioning equipment. This change also cut electrical energy consumption by 256,000 kilowatts annually.

44.5

Percentage reduction in the volume of waste sent to landfills by Exmouth in 2007, compared to 2006, thanks to recycling efforts.

25

Percentage decrease in water consumption at Exmouth in 2006, compared to the previous year.

8.7 million

Pounds (4 million kilograms) of metal recycled by Portland in 2007.

93.9

Percentage of all solid waste recycled—which includes metal chips—by Portland in 2007.

and you often reduce space requirements. All of that adds up to environmental improvement.”

That statement isn't lost on Jeff Speak, a Numerical Control Mill Operator at the Boeing Fabrication facility in Portland, Ore.

Last fall, Speak and his teammates were setting up a new flow line for the machining of 787 engine mounts. That flow line included five new machines, and the components for these machines featured lots of plastic packaging for both cutters and tooling inserts.

At first, this packaging wound up in a refuse bin, but Speak wondered whether it could be recycled. He mentioned this idea to officials at Portland. After some inquiries

and a meeting with relevant representatives from Boeing Fabrication and Environment, Health and Safety, the decision was made in December to put the components in with the recyclables. Perhaps not so coincidentally, the Portland site in 2007 recycled 93.9 percent of its solid waste—including metal chips.

Said Speak: “It’s really great that we’re always looking for better ways to do things around here.” ■

junu.kim@boeing.com

St. Louis electronics recycling event set

Are you a St. Louis—area Boeing employee or retiree—or a family member of one—with unwanted electronic equipment? If so, a group of Boeing employees in St. Louis can help you recycle these items.

Boeing Employees for Environmental Protection (BEEP), a Boeing-sponsored club, will conduct an electronics recycling collection event on Thursday, March 27. Unwanted electronic equipment can be dropped off from 7:00 a.m. to 9:00 a.m. in the 270G parking lot (across Campus Parkway from the 270 building) in St. Louis and from 3:00 p.m. to 5:00 p.m. in the 505H parking lot in St. Charles.

BEEP is partnering with Web Innovations and Technical Services (WITS), a St. Louis—based nonprofit corporation that specializes in reuse and recycling of electronic equipment, for this event. WITS specializes in rebuilding and recycling PCs and making donated systems available to local individuals and organizations that are unable to afford new equipment. WITS will accept any items that run on electricity, except large appliances; all unusable electronics are recycled.

WITS charges a donation of \$10 for each television and \$5 for each monitor, laptop and microwave oven; all other electronics items are taken for free. Please note that this event is for personal items only—and not for Boeing-owned equipment. WITS cannot accept anything with a Boeing property sticker.

BEEP and WITS conduct collections in March, June and September.

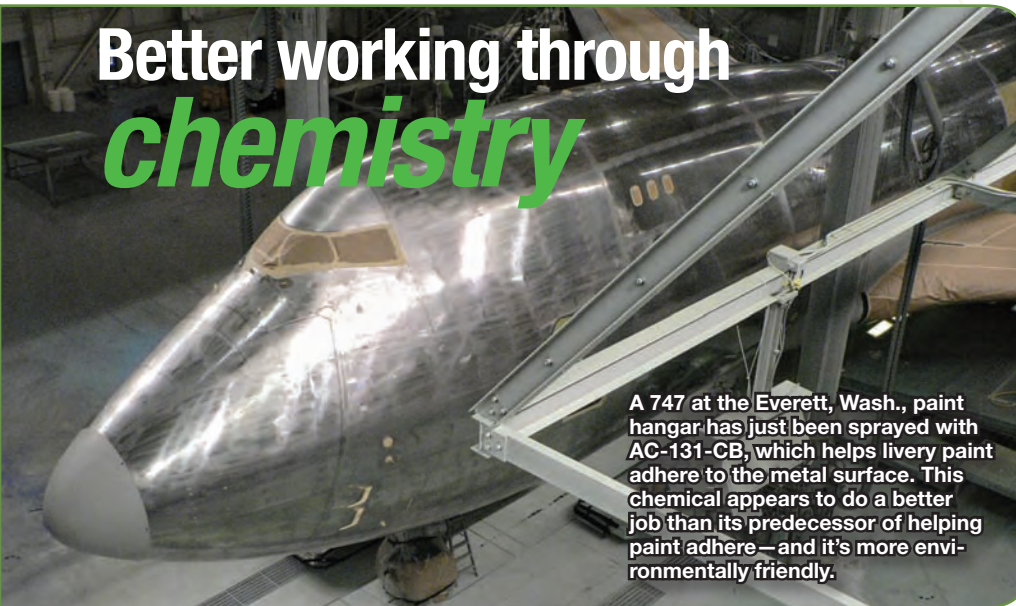
BEEP encourages the company’s St. Louis—area employees to participate in recycling and reuse programs that help the environment. It also provides a means for participating in these efforts in the workplace. For more information about BEEP, visit <http://beep.stl.mo.boeing.com/aboutBEEP.jsp> on the Boeing intranet. To learn more about WITS, visit www.witsinc.org.

gallons/606,000 liters in 2007) and eliminated hazardous wastewater. What’s more, the change may finally resolve the paint-adhesion problems on rivets—which would improve customer satisfaction.

AC-131-CB is scheduled to be implemented at the paint hangars in Seattle and Renton, Wash., by this month.

—Junu Kim

Better working through chemistry



A 747 at the Everett, Wash., paint hangar has just been sprayed with AC-131-CB, which helps livery paint adhere to the metal surface. This chemical appears to do a better job than its predecessor of helping paint adhere—and it’s more environmentally friendly.

Airlines are proud of the liveries painted on their airplanes. It follows, then, that they’re unhappy with the condition known as “rivet rash”—the loss of paint from aluminum rivet heads, which can detract from an airplane’s livery.

As part of an effort to reduce rivet rash, the Everett, Wash., paint hangar switched out a chemical in the painting process—and also contributed to environmental improvements. This change demonstrates how business improvements can have an environmental benefit.

To help paint adhere to the metal surface, the hangar previously used a chemical called Alodine 1000. This substance contains a chromium compound and needed to be washed off the airplane, which created wastewater containing hazardous chemicals.

Last April, the Everett paint hangar switched from Alodine 1000 to AC-131-CB. The sub-

stance is a Boeing-invented sol-gel-based material, manufactured by AC TECH under license from Boeing. AC-131-CB is chromium-free and forms the chemical bond on the surface of the airplane after evaporation—meaning it doesn’t need to be rinsed off.

According to Ronald Wu, chemical engineer with Material & Process Technology Chemical Technology, paint shop employees had mixed feeling about this product initially, but they understood that AC-131-CB had quality, cost and environmental benefits. “We did many test trials and received valuable inputs from the paint hangar employees,” Wu said. “Together with the painters, we improved the AC-131-CB application method significantly to make it a successful implementation.”

With this chemical substitution, the paint hangars reduced rinse water usage (160,000

A close-up photograph of a person's hand, wearing a white long-sleeved shirt, touching a light-colored surface. A bright green laser line is projected across the surface, passing through the hand. The background is a plain, light-colored wall.

The guiding light

New laser-guided tool boosts efficiency and accuracy at the Everett paint hangar

By DEBBY ARKELL

A commercial airplane's livery is the ultimate expression of an airline brand. With specs down to the hundredths of an inch, quality and attention to detail are critical when applying an airplane's paint scheme.

But a new tool makes that job a lot easier—and more accurate—for painters at the Everett, Wash., paint hangar. The tool, called the Laser Exterior Marking System (LEMS), is a system of networked lasers and computer programs that translate airplane and livery data into laser-light patterns reflected on an airplane's exterior. These patterns show painters exactly where to mask off elements of a carrier's livery—and replaces mylars, a series of plastic templates painters affix to an airplane to guide them through the masking process.

"The idea behind the LEMS tool is to use computer-aided-design tools to design a customer's livery once and store those specifications in a database—using a 3-D approach instead of a 2-D approach—to generate laser-light templates and improve efficiency," said Domingo Mayor, Everett Delivery Center senior project manager.

The benefits of this new approach are many. It helps cut the "touch time" tooling and design engineers need on an airplane. It trims the time needed to create new templates when customers change liveries or add a new model to their fleets. It also reduces storage at Boeing and at customer locations, as all LEMS datasets are stored electronically, not in bulky rolls in huge crates and carts like mylar templates. The tool also is an enabler for the 787 program.

"We knew we wanted a no-mylar system to paint 787s," said Jack Jones, Everett Delivery Center director. "The paint process can be a bottleneck when rates increase. And with the 787's plan



Brian Maglalang, a painter at the Everett, Wash., paint hangar, uses the green laser light from the eye-safe Laser Exterior Marking System to guide him as he masks off an area for painting. The laser facilitates a level of precision 10 times greater than required.

ED TURNER PHOTO

to significantly reduce Final Assembly flow, we knew that we needed a new approach. That philosophy was a big driver for this new tool.”

PAINTING WITH PRECISION

The system got its start several years ago when Mayor was talking with a Tooling manager whose team was having difficulties completing mylars. As flow times were being reduced and moving lines were implemented, it was getting harder for the Tooling team to get access to specific airplane models to ensure measurements were accurate. Competition for touch time

on the airplane was fierce—and bound to get worse.

Engineering, Tooling, Manufacturing and Material and Process Technology (M&PT) all agreed that there had to be a better way to make templates.

M&PT began working with state-of-the-art CATIA V5—an engineering design tool that easily moves between two- and three-dimensional design—to develop a way to merge airplane data with customer livery data and create 3-D renderings of those liveries. They ended up integrating a system of laser-light projectors with common Boeing software and a commercial off-the-shelf ap-

plication. Initial tests on a spare fuselage section yielded promising results, giving them the confidence to test the LEMS in the rudder shop prior to building up an entire system in the paint hangar.

“Lasers aren’t unique, but they’ve never been used on this scale and networked together before,” said Sean Grier, Everett Delivery Center project manager. “The interface is very simple, and painters operate the LEMS completely on their own.”

From the outset the team had good success, Grier said.

“Tooling is currently working with M&PT and Engineering to validate data sets, when-

ever we can catch an airplane in the factory or in the hangar to check those sets,” he said. “We’re finding that they are projecting light with a great degree of accuracy.”

The first customer aircraft painted using LEMS was an Air France 777 in February 2007. Since then, Everett site painters have painted more than 20 777s, the first 787, and the rudder for ANA’s 787.

“We’re expecting to be able to paint 40 to 50 airplanes a year using this tool,” Grier said. “And we’re finding already that the tool enables us to apply complex paint jobs more quickly, more easily and more accurately than before.”

MASKING WITH MYLARS

To fully appreciate LEMS, it’s important to understand the process it’s replacing.

Generally speaking, airplanes have been painted the same way for decades via a labor-intensive and time-consuming process. Once customers define their liveries and design engineers generate the engineering data, Tool Engineering and Tool Fabrication use that data to create mylar template tools.

Tooling Operations Manager Franz Ruijters said to produce mylar templates, Tooling must first go to the factory and gain access to an airplane of the same model. They then use 2-D drawings of the airplane in the planned livery to carefully measure, lay out and temporarily mark ar-

eas of the design on the aircraft exterior.

“Tooling must constantly measure and check to ensure the dimensions and indexing are correct per the customer’s intent,” Ruijters said. “It’s truly a balance between artist’s intent and tooling precision.”

Once the lines are defined, toolmakers put mylar plastic on the airplane and copy the tape-line pattern created by hand and eye. What’s more, each customer livery requires a set of mylars for each model in its fleet. And every time a customer orders a new model or modifies its livery, the process is repeated, taking up to 22 months from artist’s concept to mylar completion.

As Boeing shortens flow times, implements the Boeing Production System in its factories and puts engineering design tool enhancements into place, the need for tools or systems that enable a moving line is critical. At the very least, it stands to reason that for airplanes built on a moving line, the traditional process of creating mylars would be extremely difficult.

ADVANTAGES, BIG AND SMALL

The Everett site has installed the LEMS in two of its three paint hangars (the third is due to be operational by June). Today’s twin-aisle Boeing airplanes are painted using either all mylars or all LEMS. Grier said the team is transitioning from legacy tools to LEMS data as new customer liveries are introduced.

Though legacy work remains, painters at the Everett site already are seeing how LEMS will help them. Thanh Ly has been a painter for 18 years and is well-versed in the use of mylars, but finds the new tool beneficial. “I’m still getting used to the new tool, and even though it’s a little harder now, I can see how it’ll be an improvement down the line,” he said.

One area of improvement is accuracy—which has increased tremendously.

“Our accuracy with LEMS is to a 30-thousandths-of-an-inch level of tolerance,” said Paul Solecki, M&PT engineer. “Paint tolerances are much looser than that, but with LEMS we are able to work to a level of accuracy that is 10 times greater than what’s allowable.”

LEMS also creates many efficiencies. It lets painters mask both sides of the aircraft simultaneously, since mylars are produced only for one side of the airplane (painters remove them and flip them over for use on the aircraft’s other side). Also, painters no longer need to repeatedly leave the painting platform to get templates, said Decorative Paint Operations Manager Bill Dill. And since mylars aren’t created for every aspect of a livery, toolmakers don’t have to compete with factory workers for precious touch time on an aircraft in production. (Painters still may need mylars for liveries that extend into areas LEMS can’t reach.)

Also, Jones noted that the time needed for customers to make livery decisions has been cut from 220 days to 90—and that several airline customers have expressed interest in this tool. Airline customers also keep sets of mylars for use in their Maintenance, Repair and Overhaul businesses.

“It’s important to note that this tool will not mean that we need a reduction in labor,” Jones said, adding that the goal is to have 80 percent of paint processes covered with this new tool. “It simply allows our painters, toolmakers and engineers to work more efficiently.”

The team that created the Laser Exterior Marking System tool isn’t resting on its laurels. It’s already looking at ways the tool can be improved and further integrated into paint processes. Enhancements under consideration include developing ways to use the tool to paint highly curved engine cowling surfaces and how to use LEMS in the Clean, Seal, Paint and Test area for wing painting. ■

debra.j.arkell@boeing.com



Painter Thanh Ly prepares the exterior of a 777 in the Everett, Wash., paint hangar, prior to activating the Laser Exterior Marking system.

ED TURNER PHOTO

Taking *fast* action

First-aid knowledge,
quick action prevent
serious eye injury

By JEFF WOOD AND ROBIN MCBRIDE

Marsha Grover, an inspector on the Next-Generation 737 final-assembly line in Renton, Wash., was walking by a hydraulic test bench connected to a 737 airplane when a hose suddenly broke loose. A solid stream of hydraulic fluid drenched her head and shoulders with the highly irritating liquid.

Although she was wearing eye protection, the force of the stream knocked the safety glasses aside and flooded into her eyes. "It felt like needles in my eyes," Grover said. "You can't do anything but shut your eyes and hope that help comes."

Fortunately, Mike Borkan, a 737 functional test technician, saw the whole event from several yards away. Having had experience with hydraulic fluid, he knew what to do.

"My first thought was to get Marsha to running water," Borkan said. The eye-wash stations located around all the work areas are sufficient for minor splashes or splatters, but with the amount of fluid in this incident, large volumes of running water were essential.

Borkan guided Grover straight to the nearest wash basin and kept the running

water flowing over Grover's eyes. He knew it can take 30 minutes or more for an effective rinse. He also knew how painful even a little hydraulic fluid can be if it gets into the eyes. "Sometimes you get a few drops on your hands or your sleeve. You think you've washed it off, but it clings to the skin. You can accidentally rub it into your eyes even hours later, and it hurts," he said.

As the flowing water began to clear the fluid from Grover's eyes, Borkan used the lotion soap at the basin to wash the oily fluid from Grover's hair, preventing more fluid from dripping into her eyes. "She was just soaked with the fluid," Borkan said. "Her clothes, her hair, everything was a possible source of additional contamination."

Meanwhile, the functional test mechanics at the work site called for help and assisted the patient until Boeing Fire aid units arrived. Thanks to Borkan's knowledge of the first-aid procedures and prompt action, Grover was able to return to work in a few days and is recovering.

To capture the lessons learned, Borkan is working with the functional test group

to develop a safety presentation for this sort of unusual incident.

"We have training to deal with the most common occurrences, but this was out of the ordinary," he said. "It's important to know where the eye-wash stations are located. But it's just as important to know when that's not enough. When seconds count, it's no time to be reading the instructions."

Following the incident, an investigation team including shop management, operators, Equipment Engineering, Equipment Services, and Environment, Health and Safety employees met to initiate the identification of root causes and preventive action. Several possible causal factors (e.g. manufacturer defects, work practices, and more) have been identified and the team is now determining the degree to which these may have contributed to the accident. The team will continue to meet to determine and implement corrective measures. ■

richard.j.wood@boeing.com
robin.m.mcbride@boeing.com



Mike Borkan (right) guided Marsha Grover straight to running water when a return line from a hydraulic test bench came loose and sprayed her with hydraulic fluid. Grover credited Borkan's fast action with preventing serious injury.

DANIEL THOMPSON PHOTO

Let's get



Daniel Zwink (left), Quality process team leader and machinist, and John Conant, machinist, examine the workmanship on a 777 part at Boeing Fabrication's Emergent Operations site in Auburn, Wash.

JIM COLEY PHOTO

In Auburn, employees take charge of quality and make huge strides

By KATHRINE BECK

“I get employees who come up and want to argue,” said Daniel Zwink happily.

Zwink is the quality process team leader in Boeing Fabrication Auburn Machining/Emergent Operations, an area at the Auburn, Wash., site that makes production parts as well as emergent parts—one-of-a-kind replacement machined parts manufactured on an emergency basis to keep commercial airplane production lines moving.

“They’ll come up and argue about a \$79 scrap rate charged to them and say, ‘We shouldn’t have been charged for this.’ And I’m thinking, ‘That’s great!’ Those are involved employees,” Zwink said.

The scrap rate is an important part of how the organization measures waste and rework. And ever since Zwink spearheaded an all-out effort to get employees involved in quality, that scrap rate has plummeted. It’s gone down 33 percent in three years and it’s still moving south.

It’s an especially notable accomplishment because avoiding rework and waste is particularly challenging in an area where one-of-a-kind and last-minute parts are being built. Employees are working under time pressure and they have to make every part right the first time.

FOSTERING COMPETITIVENESS

To save time, everyone works the process concurrently as much as possible. The Screening group gets the job committed, Planning sets the manufacturing steps, Supply Chain Management sets up the order release and materials, Numerically Controlled Programming prepares the data sets, Quality Assurance prepares for final inspection, and then the

involved

machinist starts manufacturing the part.

“It’s an environment that fosters competitiveness for the good of the customer,” said Mike LeClair, senior manager, Emergent Operations.

When asked about quality, Emergent Operations machinist Gary Atkins, working on a splice fitter for a 767, laughed and said, “You know what drives quality around here? You don’t want to scrap a part in front of your peers.”

Building on that professional pride, the organization has developed a quality process that includes all work areas and job functions.

It’s based on the idea that the only people who can achieve first-pass quality are the people who do the work. “Improvements are usually best made by those who are doing the job, and that is exactly what is taking place in our organization,” LeClair said.

WORKING TOGETHER COUNTS

Zwink, a journeyman machinist who’s also received two years of Leadership Development Program training, said that the basis of the new approach was to work together.

“We created a quality focal for each area, then formed a team with all the quality focals, and we included people from Engineering, Quality Assurance, Planning and Programming,” he said. “The cross-functional team is expected to quickly address quality issues as they arise.”

Last month the team celebrated a month-long quality campaign with coffee mugs for crews, light blue shirts with a quality message for focals, posters, contests—and a quality newspaper including obituaries for defective parts.

“We all work together,” Zwink said. “We made the inspectors part of the team. Now, they let us know right up front if there’s a problem. Before, they’d write something up and we’d find out later. The quicker you can address a quality issue, the better you fix it.”

The inspectors agree that things have changed for the better. Quality Assurance

inspector Barbara Jones said, “I’ve really seen so much progress. It’s wonderful how QA and the shop work together. It’s not ‘us’ and ‘them.’”

Zwink said another important part of a successful quality program is getting solid information to the shop floor. Quality focals on his team have weekly meetings with crews. “We go over every single defect that area had for the previous week. Nothing is missed. And we have the meeting whether the manager is there or not. This whole thing is a real grassroots effort,” he said.

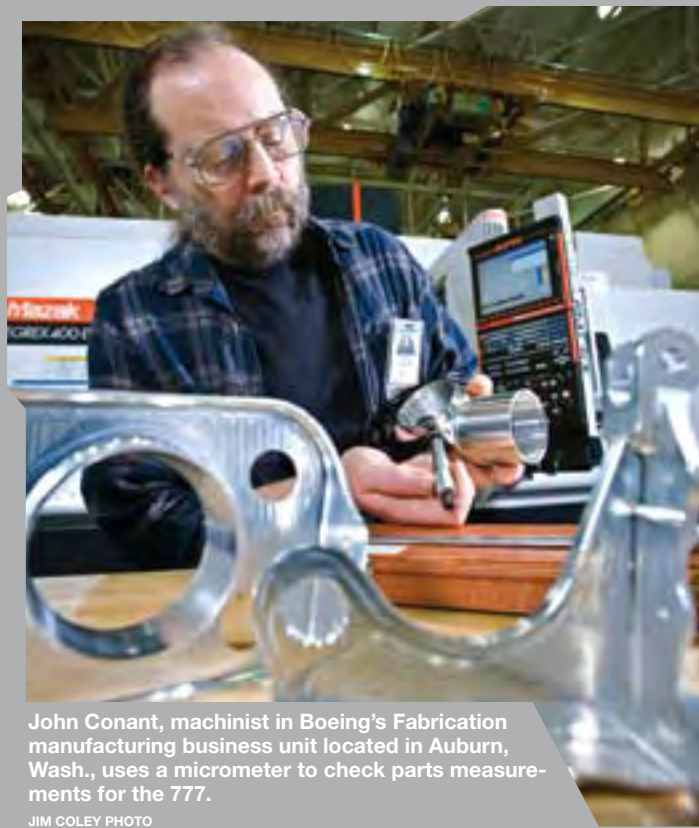
The weekly meetings include detailed information about the past week’s defects, photos or drawings of the affected parts, and the cost in dollars of the defects. The process also sets targets that are easily understood by everyone involved.

And, there’s a reward system in place, with special lunches in honor of achieving monthly quality targets.

Crews are well aware of the targets and of their performance. One reason: Zwink’s hand-crafted “defect visibility machine,” a device he designed and built that uses color-coded poker chips and plastic tubes to display just how the area is doing in terms of quality—and how close they are to getting the three green chips in a row that means a catered lunch.

“The reason we’re able to get all these areas involved is because we developed ways to get the data stream to the crew, giving them all the information so they know exactly what things they need to fix,” Zwink said.

And it’s because the data is available to everyone that Zwink sometimes finds himself in an argument about quality data—like a \$79 scrap rate. And why he’s happy to hear the complaining.



John Conant, machinist in Boeing's Fabrication manufacturing business unit located in Auburn, Wash., uses a micrometer to check parts measurements for the 777.

JIM COLEY PHOTO

“I’m just the facilitator,” Zwink said. “We developed a process to get the shop employees involved and taking ownership of their own quality. It’s amazing how we’ve turned things around.”

His first-line supervisor, Loren Neighbors, said the key to success was employee involvement in the solution.

“It’s got to be from the bottom up, not the top down. People really need to be involved,” he said. “These guys are the ones who can make improvements. . . . Our quality progress is astounding.” ■

kathrine.k.beck@boeing.com

Icing Lab Tunnel helps design, validation process

By SANDY ANGERS

Inside a nondescript building just south of Seattle, the air temperature is below freezing, and the wind is blowing at nearly 300 miles per hour (483 kilometers per hour). There you'll find Boeing employees bundled in warm jackets, gloves and hats.

They're watching ice form.

The setting is the Boeing Research Aerodynamic Icing Tunnel, one of only seven icing tunnels in the world. Operated by Flight Operations, Test & Validation employees, the BRAIT is an essential tool in the product development and certification processes.

The tunnel, measuring 4 feet wide, 6 feet high and 20 feet long (1.2 meters by 1.8 meters by 6.1 meters), is the third largest in the world. It allows engineers and flight-test pilots to validate aerodynamic designs and the performance of the ice-protection systems in an efficient laboratory environment rather than in real-world conditions, which can be time consuming, hazardous and expensive.

"We help assure the safety of an airplane to fly in natural icing conditions," said Gene Cain, Boeing Technical Fellow and the tunnel designer. "And we provide this capability in a cost-effective manner."

Lab employees create ice on experimental wing sections by creating airflow through the tunnel at 250 knots (288 miles per hour/463 kilometers per hour), the typical speed at which commercial jets encounter icing. Test engineers then set the temperature in the tunnel between 32 and -22 degrees Fahrenheit (0 and -30 C). A cloud of water is created by an upwind spray array, and ice begins to form on a test surface within seconds.

After a typical 30- to 45-minute test, ice shapes several inches thick form on the representative wing section. These shapes represent the icy buildup that could occur during a worst-case in-flight scenario, such as when icing conditions are severe and the deicing system fails.

Using computing analysis of the ice shapes, as well as still photos and video, engineers extrapolate and replicate the ice shape for an entire wing. The artificial shape is then installed on a flight-test airplane for stability and control flight testing.

Nice ice, baby

Ice builds up on an experimental wing section at the Boeing Research Aerodynamic Icing Tunnel, one of only seven icing tunnels in the world.

BOEING RESEARCH AERODYNAMIC ICING TUNNEL PHOTO

"We create the ice shapes in the BRAIT, which are then manufactured utilizing rapid prototyping techniques and installed on an airplane to demonstrate, through certification flight testing, that an airplane can fly safely with those shapes on the wings," said Cain.

Built in 1991 to support the then-brand-new 777, the BRAIT has helped Boeing dramatically reduce the cost and time involved in the certification process. Prior to the icing tunnel, test pilots spent 60 to 70 hours flying airplanes in natural icing conditions to satisfy certification requirements. Only a fraction of that time—eight hours—is needed today, thanks to the BRAIT.

"The value the tunnel gives Boeing is

a significant return of investment dollars. With the tunnel we can do the work much cheaper and shorten the certification process. It adds up to a huge cost savings," Cain said.

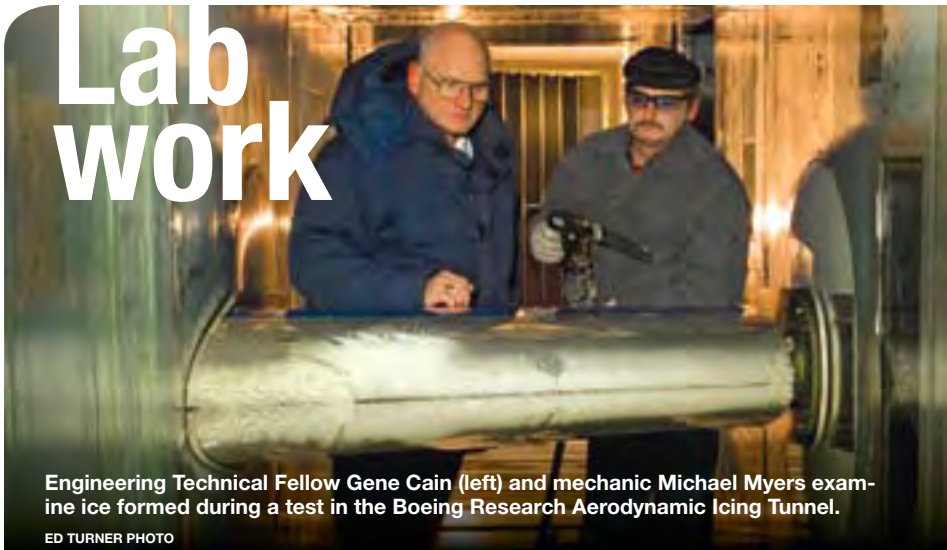
The BRAIT design-and-build team's greatest moment of satisfaction came at the end of the certification process for the 777 ice protection system, Cain said.

"Just knowing that the successful testing in the BRAIT led to the certification of the system with minimal 'natural icing' flight test was a great achievement. That feeling of accomplishment still exists today as we continue to support Boeing airplane programs such as the P-8A Poseidon, V-22 and the 787," he said. ■

sandra.l.angers@boeing.com



Lab work



Engineering Technical Fellow Gene Cain (left) and mechanic Michael Myers examine ice formed during a test in the Boeing Research Aerodynamic Icing Tunnel.

ED TURNER PHOTO

Before a new airplane model is built, about 1,500 Flight Operations, Test & Validation employees thoroughly test and validate that the airplane design meets certification requirements and Boeing standards. Much of that work happens among more than 250 Boeing-owned laboratories in Washington state. Here's a look at a few of the Commercial Airplanes test labs:

Aerodynamic wind tunnels: BCA owns and operates three wind tunnels: the Boeing Research Aerodynamic Icing Tunnel (see story on Page 30); the Boeing Transonic Wind Tunnel (for high-speed models up to Mach 1.1); and the 9-x-9 Low Speed Propulsion Aero Wind Tunnel, which includes nacelle inlet performance and thrust reverser testing.

Noise labs: Several Seattle-area labs use sophisticated and sensitive recording instruments and microphone-array systems to measure cabin, ramp and flyover noise. Flyover noise certification testing at Glasgow, Mont., is supported by a mobile laboratory.

Propulsion lab: The Propulsion Laboratory, at Boeing Field in Seattle, can perform a wide range of activities: scale-model tests, FAA certification tests, fire extinguishing tests, full-scale engine test support, fuel flow-meter calibration and fuel system tests.

Structural Dynamics Lab: To evaluate the dynamic behavior of structures, the SDL performs component vibration tests and wind tunnel flutter-model and ground vibration tests, and provides real-time data-processing support of flight flutter tests conducted by Boeing flight-test organizations.

Integrated Airplane Systems Laboratories: Employees at the IASL in Seattle test avionics, flight controls, electrical, hydraulic, payload, propulsion and mechanical systems on the ground, individually and combined, allowing for a smoother transition to flight testing and service introduction. The IASL also contains six flight simulators with fully operational flight decks where pilots test simulated flight characteristics.

Structures Laboratories: The Structures Labs validate the design strength, damage-tolerance predictions and the minimum expected service life of airplanes. Boeing uses a building-block approach to these tests, starting with small parts and progressively scaling up to a fully assembled airplane. Loads applied during tests often are far greater than any load that may be encountered in flight, and can help determine how much growth remains in the structure for future derivative airplane models.

Metrology Laboratories: These labs calibrate, repair and maintain the company's measurement and test equipment. Employees measure a wide range of conditions and materials, including chemical, low-frequency and radio frequency/microwave, electromagnetic fields, optical radiation and physical and dimensional parameters.

When not being used to test and develop Boeing products, these laboratories are available for use by non-Boeing entities through Boeing Technology Services. BTS provides access to all Boeing test facilities throughout the United States. For more information, visit <http://www.boeing.com/commercial/techsvcs/boeingtech/contact.html>.


—Sandy Angers

BY THE NUMBERS:

Icing tunnel

- 91** The number of test programs conducted for Boeing airplanes since the Icing tunnel's inception
- 7** The number of icing tunnels in the world
- 2** The number of icing tunnels larger than the Boeing Research Aerodynamic Icing Tunnel
- 6** The number of nationally recognized experts in the field of icing tunnel testing, including Boeing Technical Fellow Gene Cain

The *right* connections



Consultant Bob Lemmon, a retired U.S. Air Force colonel, demonstrates one of the full-mission trainers destined for the F-15E Mission Training Center at Mountain Home Air Force Base, Idaho, to show how the fidelity level gives aircrews a visceral sense of combat-mission rehearsal.

RON BOOKOUT PHOTO

Boeing provides USAF with a cutting-edge network for training

BY DOUG CANTWELL

In St. Louis or Seattle, it's tough to find Boeing employees who work on the U.S. Air Force's Distributed Mission Operations training network who aren't truly excited about it.

"DMO is on the cutting edge of network-centric operations in the aircrew training world," said Darrell Smith, project manager for F-22 DMO in St. Louis, "whether you're talking communication standards, interoperability, security issues or road-mapping the future."

DMO is a simulated training environment in which pilots use network-connected, high-fidelity trainers around the world to "fly" a mission. There's no fuel burned, no ordnance fired, and no wear and tear on

the aircraft—which drastically reduces the cost without compromising the quality of training. Pilots can fly over hostile "territory" without going into harm's way and can review their missions almost immediately in a comprehensive debrief.

With several milestones on tap for 2008, Boeing is accelerating its activities in developing and delivering the cutting-edge DMO training network. The St. Louis team activated the second DMO-enabled F-15E Mission Training Center last December at Seymour Johnson Air Force Base, N.C. They had stood up the first MTC for the E at Mountain Home AFB, Idaho, in October. RAF Lakenheath in the United Kingdom will be the next F-15E site; then Mountain Home and Seymour Johnson will each receive a second MTC later this year.

At the same time, the F-22 group is working to integrate the first Raptor MTC at Langley AFB, Va., into the DMO network by May 2009. They're also installing the second Raptor MTC at Elmendorf AFB, Alaska, which will be the first

site that is fully DMO-enabled from the start. Boeing has delivered and currently operates five F-15C MTCs around the globe, including Kadena Air Base, Japan; RAF Lakenheath; Eglin AFB, Fla.; Elmendorf; and Langley. In addition, the company operates three F-16 MTCs at Shaw AFB; Misawa Air Base, Japan; and Spangdahlem Air Base in Germany.

3 FIGHTERS, 3 CHALLENGES

Smith recalls the different hurdles the team has faced in integrating the three platforms into DMO. With the F-15C, which came first, it was mostly a case of raising the bar of fidelity and shifting to a rhythm of continual updating.

"What DMO brings to the table," he said, "is daily, on-demand training capability." In other words, the network doesn't simply wire together remote locations; it allows those facilities to link up at will, generate an air tasking order (ATO) on fairly short notice, divide up the ATO into mission fragments, or "frags," assigned to the respective players, and execute the mission.

Before DMO, Smith recalled, training sessions were planned and staged “something like county fairs.” Planning would start six months in advance; all the players would have to coordinate their frags to make sure all were on the same page; then everyone would converge on a few temporarily connected sites, execute the mission, hold a debrief after a lengthy collection of data, then pack it all up and go home for six months.

“When DMO came along, it was not just an advance in training capability. It represented a paradigm shift,” said Greg Coady, F-15C program manager. “They were used to stand-alone, one-on-one trainers that involved a single pilot and instructor.”

DMO first introduced a local area network that allowed the training centers to wire together a “four-ship” of simulators. This was a major leap, because it enabled the first level of mission training: coordinating with your wingmen to divide up a sortie into fragments. Next came the wide-area network that allowed F-15C pilots to receive an ATO and related data from a simulated AWACS command/control center at Tinker AFB, Okla.

“Now you’re approaching full-up mission rehearsal,” Coady said, “using databases that cover most of the hot spots in the world. Before you send guys to Iraq or Afghanistan, you can have them go practice missions you think they’ll actually be flying.”

With the F-15E coming on board, it

was the versatility of the Strike Eagle’s all-weather, air-to-air and ground-attack capabilities that created most of the challenges for the DMO team. Not only was there the densely featured ground environment to emulate, but also a much messier electromagnetic ambience with the addition of terrain-following and ground-based integrated air defense systems.

Besides that, the E’s air/ground weapons suite includes various combinations of more than 30 individual armaments, each with its own set of mission tactics. By comparison, the C carries only three different air-intercept missiles.

SWEATY PILOTS

In the mid-1990s, Gen. Richard Hawley, then chief of the Air Force’s Air Combat Command, laid out his vision of a distributed mission training capability and set the acquisition wheels in motion. Junper wanted “sweaty pilots” to emerge from the simulators. In other words, the fidelity of combat simulation should engage them at a visceral level, give them the sense that they were truly airborne and engaging the enemy—but also acclimate them to flying and fighting as one of a four-ship formation as well as a joint force made up of diverse aircraft.

“In those days, there was a lot of doubt that the technology—especially the network throughput and bandwidth—would be there to support this vision,” recalled Geoff Waldron, lead engineer for

Air Force training systems in St. Louis. “We were still trying to figure out how we’d get to the level of fidelity desired by the Air Force—never mind the DMO connectivity.”

Hawley also foresaw the transformational need to work up multiplatform mission tactics. He wanted his wing commanders to be able to “play” in a distributed environment so they could learn how a mix of fourth- and fifth-generation fighters might work together to best advantage. The latter—the F-22, for example, with its stealth characteristics and advanced avionics—could be more effective if used in an air dominance role to “kick down the door” and secure a corridor of airspace from any threat of opposing aircraft.

The fourth-generation strike fighters such as the F-16C could then use that corridor to suppress adversarial air defense systems. Once they had locked down the air defenses, the F-15Es could follow them in to execute their ground attack against high-value targets without fear of either airborne interceptors or ground-based missile or artillery attack.

“DMO gives pilots an environment where they can try new mission tactics—and weed out the failed missions—without putting themselves in harm’s way or wasting expensive live-flying hours,” said Joe Hendrickson, deputy director of F-22 Mission Systems and Software and DMO program manager in Seattle.



One of the key features of the Distributed Mission Operations-enabled Mission Training Centers is the debrief station, which allows players at all locations to review the mission they’ve just flown together—what went wrong and what went right—as soon as it’s concluded.

RON BOOKOUT PHOTO

Distributed Mission Operations-enabled Mission Training Centers will help aircrews realize the U.S. Air Force's transformational goal of multiplatform missions that make the most effective use of fourth- and fifth-generation fighters such as the F-15C (right) and F-22, shown here during an exercise over North Carolina.



U.S. AIR FORCE PHOTO BY TECH. SGT. BEN BLOKER

A TALE OF TWO CITIES

Members of the F-22 pilot training team in Seattle knew they had their work cut out for them. They also recognized, as Scott Milton, DMO project manager for F-22 in Seattle, observed, “The right way to do it was to bring St. Louis and their experience into it.”

It’s often been noted that one of the pitfalls of working at a massive, sprawling aerospace firm is the stovepipe effect. Specifically, individual programs tend to drive the development of technologies—often along tightly focused trajectories that don’t take into account their larger possibilities or potential applications.

Yet with DMO, knowledge-sharing was not only mutually beneficial to the Boeing F-15C, E and F-22 training units, it was critical to the customer’s needs. A key objective of the Air Force’s distributed mission training need was to enable different platforms with different performance parameters and weapon systems to work together as efficiently as possible—not only to improve their tactical effectiveness but to enhance their survivability.

This brought into play a longstanding Boeing concept. “Design anywhere, build

anywhere—and also support anywhere—is at the heart of this program,” Hendrickson said. Seattle had the F-22 platform systems-design talent as well as most of the software-design and integration/test capability it needed for the task, but it lacked the direct experience with DMO and with designing user/instructor interfaces, both of which St. Louis’ engineering Integrated Process Team could provide.

F-22: TRAINING FORCE MULTIPLIER

“When the F-22 is in the fight, all joint force aircraft perform more effectively,” said Pam Valdez, director of F-22 Sustainment. “By the same token, inserting the Raptor into the DMO network will act as a training force multiplier.”

The task of adding F-22 to the mix is complicated by the Raptor’s sophisticated technology more than by its mission versatility. That’s especially the case for the near-term assignment, which is to focus on the aircraft’s kick-down-the-door mission of securing air dominance during the first hours of a conflict. Adding the aircraft’s ground-attack mission will come later.

The F-22’s advanced, fully integrated avionics, low observability and electronic warfare capabilities require higher-fidelity

simulation from all DMO participants. “If I’m an F-16,” Smith explained, “I need to provide data to ensure that higher-fidelity avionics systems such as the Raptor’s will definitely read me as an F-16.”

In the old days of lower-fidelity training, simulators would simply throw an F-16 symbol onto the radar screen rather than actually challenge the identification-friend-or-foe capability of the avionics’ mission systems to ID the approaching aircraft.

ADDING SECURITY TO THE MIX

Aside from raising fidelity to the standards required by its advanced avionics, the F-22 has brought security issues to the DMO table. While the objective is to link all of the Air Force’s tactical fighters and command/control platforms together in order to simulate complex missions, it won’t involve bringing all aircrews up to the security level required to operate the F-22. That wouldn’t be prudent or practical from a security standpoint.

The solution: Integrate the fifth-gen fighter’s characteristics into the system and distribute them to the other MTCs—while shielding the actual performance parameters from the fourth-gen players.



KEVIN FLYNN PHOTO

When it came to integrating the F-15E's air intercept/ground attack all-weather mission versatility into the Distributed Mission Operations network, Boeing engineers found the E's weapons suite—of more than 30 armaments used in various combinations—made their job a lot more difficult. Here, an E at RAF Lakenheath, U.K., the base next in line for a Mission Training Center, takes on a brace of AIM-120C missiles.

Building this multilevel security into the DMO system has been one of the major challenges in adding the F-22 to the mix. It's part of what Smith calls "road-mapping the future" of the distributed

training experience. "We know that we want to reach a particular level of training fidelity across the entire network by the end of 2009," he said. "What do we have to do to get all the players up to speed by then?"

Providing effective aircrew training is arguably the Air Force's most critical mission. The Boeing employees who support this effort would also claim that it's one of their most challenging. Nor is it getting any easier, what with the Air Force's transformational mandate to combine forces with the Army, Navy and Marine Corps as well as fight in coalition with allied forces.

"Creating a high-fidelity training system is as challenging as building the actual airplane," Coady said, "except that you don't get to spend years on the research and development like the airplane guys do."

Developing DMO—and raising the bar of training fidelity to meet the Air Force's network-centric needs—has reinforced awareness of how critical the individual human being is in the training loop. "We could easily build a system that meets all the technical requirements, yet still fail to give the operators the capability to do their jobs," said Barry Cossel, F-22 training manager in Seattle. "Every pilot has individual needs, but good solid software requirements take this into account and enable the system to adapt to the human beings who use it." ■

doug.cantwell@boeing.com



Part of the challenge in making high-fidelity network-enabled trainers effective has been to create agile user-interface software that adapts to the individual—both trainee and operator. F-22 pilots are shown at Elmendorf Air Force Base, Alaska, during the base's August 2007 opening as the F-22's second operational base. In 2009, Elmendorf will receive the first Mission Training Center that's fully DMO-enabled at installation.

LOCKHEED MARTIN PHOTO BY JOHN ROSSINO

Retrofit & repair technical specialists Mike Banning (left) and Steve Fick perform an operational check on a 30MM Gun and Trainable Gunmount. The Fort Walton Beach, Fla., site provides services for more than 180 parts on U.S. Air Force Special Operations Forces aircraft.

MICHAEL MCCORMICK PHOTO



More than a job

A Boeing site in Florida services aircraft used by Special Ops Forces

BY FORREST GOSSETT

Mike Shaw knows sand. He points to a battle management display from a U.S. Air Force ground attack airplane (AC-130U Gunship)—a workhorse in the global war on terrorism. He runs his finger across the display's dusty surface and pronounces: "No doubt, Iraq. Look at the color. Sand from Afghanistan is darker, almost red."

Another thing Shaw knows: Wherever sand comes from, it damages equipment. The harsh environments of Iraq and Afghanistan are tough on the planes, and lots can go wrong. So Shaw, an avionics repair laboratory lead, begins his day at Boeing's Special Operations Forces Repair Center in Fort Walton Beach, Fla., by troubleshooting the monitor, looking for bad wiring.

The Repair Center—launched in 2000 after Boeing won a contract to support Air Force Special Operations Forces—tackles the critical task of keeping the fleet of planes at nearby Hurlburt Field ready for missions. Thirty Boeing employees at the center repair avionics, provide logistics services, and staff a wire shop and a gun systems test and repair station.

The customer has recognized this Boeing team's achievements, both in terms of cost and quality. Air Force Capt. Chad Messinio, program manager for the Air Force Special Operations Forces Systems Group, said the Air Force has saved \$103 million over the last seven years and more than \$17 million in 2007. As primary liaison officer between the Air Force and the Repair Center, Messinio said the center is viewed by the Air Force as a unique establishment and a model for working with industry.

"Historically, Boeing has come in below repair times and under budget. They've made assets available to the warfighter quickly and inexpensively," he said.

NO JOB SITS AND WAITS

Mike Estes, a 10-year Boeing veteran and retired Air Force chief master sergeant, manages the Repair Center. Estes finished his military career at Hurlburt Field before joining Boeing. In fact, nearly all staff members are Air Force veterans or retirees, and many served with Special Operations Forces.

Each day, one of Estes' staffers makes the rounds at Hurlburt Field to pick up parts in need of repair and to deliver repaired items. These parts range from avionics to damaged wire bundles to malfunctioning guns. Once parts arrive at the Repair Center, they are immediately routed to the appropriate person for testing and repair.

Estes said the facility has one simple rule: no repair job sits and waits. "I am proud of the job these folks are doing. They take great pride in assessing the issues, making repairs and getting equipment back in the hands of the warfighter as quickly as possible," he said.

Prior to the formation of the Repair Center in 2000, support for the AC-130U Gunship fleet was difficult to obtain, ex-



Retrofit & repair technical specialists Bruce Smith (left) and Kevin Ervin repair a Trainable Gunmount Actuator in Fort Walton Beach, Fla. The customer has recognized the cost- and quality-related achievements of the Boeing team at this location.

MICHAEL MCCORMICK PHOTO

pensive and time-consuming. With a fleet of 13 planes and no single repair source, each part needing repair was bid to a different business. When he was on active duty, Estes recalled it wasn't unusual for a part repair to take three to six months.

Since Boeing launched operations at the SOF Repair Center, turn-around time has been drastically cut to about three days. Equally important, the defect rate is zero.

When the Repair Center first opened, Boeing offered repairs on fewer than a dozen instruments for the planes, mostly avionics displays. Today, it provides services for more than 180 parts, and the list is growing each day.

But even with that record, the Repair Center is constantly looking to improve. Last year, some of its employees—implementing Employee Involvement principles under the leadership of Tom Hembree (EI lead for the Boeing Fort Walton Beach site)—streamlined processes and eliminated wasted time and effort by completely reorganizing the wire shop layout. The bottom line was an 80 percent reduction in cycle time for the customer.

Estes said workers at the site are proud of their efficiency and quality record, but even prouder to serve the warfighter. "We understand what is at stake," he said. "This is serious business, and we want to make a difference."

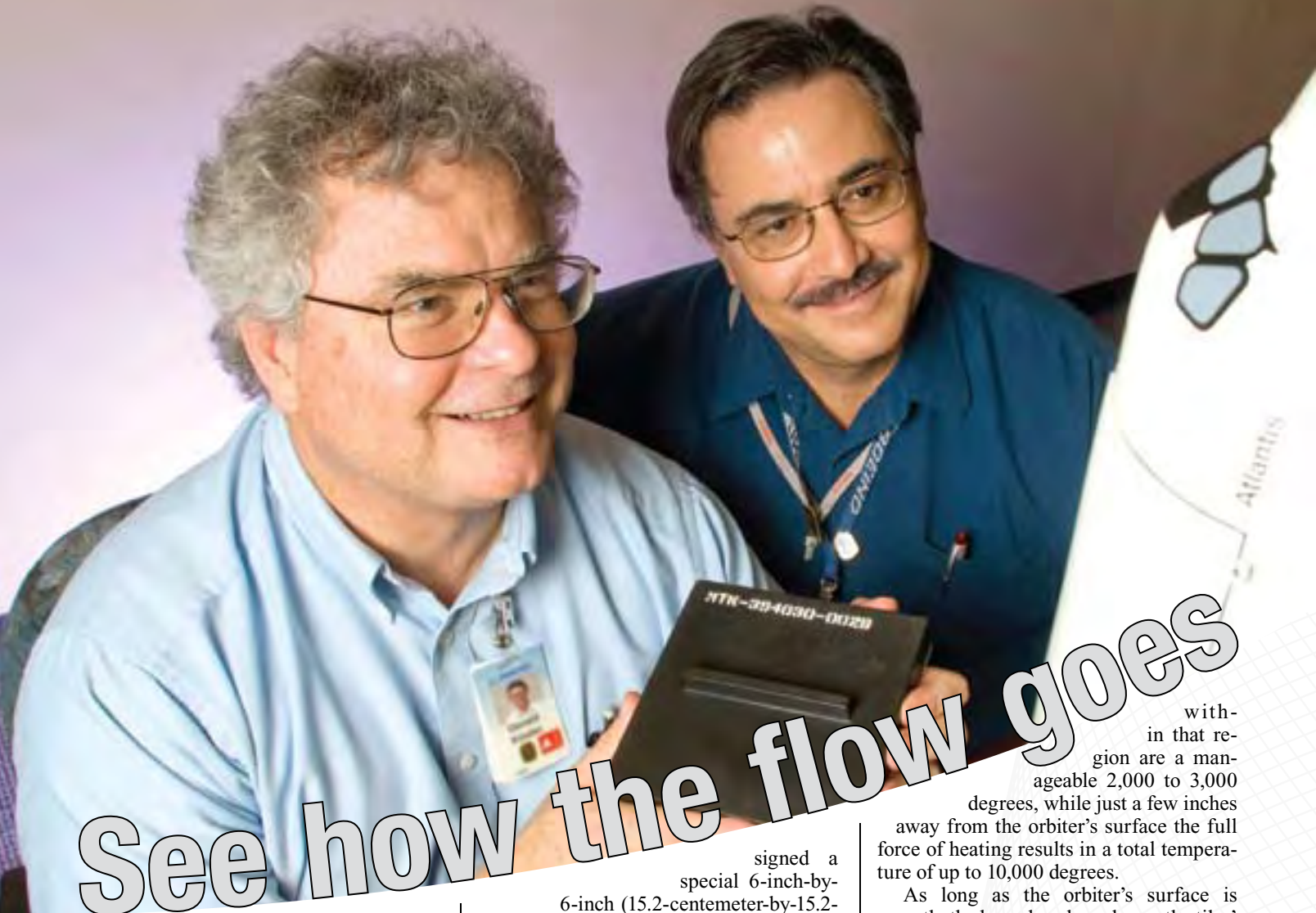
Supply chain specialist Tony Robinson added: "The warfighter needs us to help keep these planes in the air. This is important work. It's about life and death." ■

forrest.s.gossett@boeing.com



Retrofit & repair technical specialist Linda Nelson assembles an aircraft wiring harness. She's with a Boeing team in Fort Walton Beach, Fla., that provides repair and logistics services for U.S. Air Force Special Operations Forces aircraft.

MICHAEL MCCORMICK PHOTO



See how the flow goes

Test tile to measure shuttle's re-entry airflow

By Ed MEMI

When the Space Shuttle re-enters Earth's atmosphere at 25 times the speed of sound, its Thermal Protection Tile surfaces experience searing temperatures as high as 3,000 degrees. Even with 119 successful shuttle flights on the books—including one that took place last month (see story on Page 39)—there's still a lot that's unknown about airflow around the vehicle, because it's impossible to duplicate similar conditions on the ground.

To get a better understanding of re-entry airflow, Boeing, United Space Alliance and NASA engineers have de-

signed a special 6-inch-by-6-inch (15.2-centimeter-by-15.2-centimeter) test tile, to be installed on the lower side of the orbiter port-side wing near the main landing gear door. The tile will test airflow on three upcoming shuttle flights, beginning with the STS-119 *Discovery* flight this December. The goal is to understand boundary layer transitions, and the data from this experiment will help NASA in its efforts to develop new spacecraft such as the Orion crew exploration vehicle. The data also will help with any hypersonic vehicle and can be extrapolated and correlated to differently shaped spacecraft.

Each orbiter has more than 20,000 tiles. The tiles as well as reinforced carbon-carbon panels and thermal blankets protect the orbiter from heat while on orbit and during re-entry into Earth's atmosphere.

During re-entry, the compression of air on the leading edge of the shuttle forms a protective "blanket," called a laminar boundary layer, around the orbiter. Temperatures

within that region are a manageable 2,000 to 3,000 degrees, while just a few inches away from the orbiter's surface the full force of heating results in a total temperature of up to 10,000 degrees.

As long as the orbiter's surface is smooth, the boundary layer keeps the tiles' temperature within the limits of their design. But any interruption in the air flow causes a boundary layer "trip," where turbulence behind the trip point brings down to the surface of the shuttle the extreme heat that was outside the laminar boundary layer. This could cause the tiles to overheat and damage the underlying surface.

The phenomenon is similar to a smooth (laminar) flowing river and water moving uniformly downstream. If you put a large rock in the middle, you'd see that the water before the rock stays in a steady state, but the water flowing past it is very turbulent.

"We don't know when the boundary layer actually trips due to a protuberance. We are installing a calibrated protuberance to measure and record the air speed at which the boundary layer trips as well as the downstream temperature increase that results from the trip," said Project Manager Chris Dolas, who is leading a 20-person

Boeing engineer Jerry Kinder (left), along with project manager Chris Dolas, displays a mock-up of a special test tile that will be installed on the Space Shuttle for the STS-126 mission.

TONY ROMERO PHOTO

Boeing team responsible for the test. “The information that is lacking is how hot it really gets when a trip occurs.”

NASA is providing analysis support and some laboratory testing. NASA supercomputers will be used to come up with flow-field computations for the test scenario. Extensive analysis by NASA, USA and Boeing engineers has confirmed that the location of this protuberance tile will not compromise flight control or safety.

Along with the specially designed trip tile, whose protuberance is 0.25 inches high and 4 inches long (0.64-by-10.2 centimeters), the shuttle will have about 10 temperature sensors embedded in the tiles downstream of the trip tile to measure temperatures during re-entry. During the first test flight on STS-119, engineers expect to trip the boundary layer at speeds around Mach 15.

Plans call for additional testing with a 0.35-inch (0.89-centimeter) protuberance on STS-127 for a transition closer to Mach 18. The last test is a 0.45-inch-high (1.1-centimeter) protuberance on STS-128, which would transition at Mach 19. A final phase will add a catalytic coating material on one of the tiles, which would gather catalytic/turbulent heating interaction data. Recorded data will be retrieved after each landing.

“We’ll use the data to correlate and fine tune our aero models so that when we build the next generation of spacecraft, we can adjust the shape and materials used based on our understanding of this complex airflow and heating during reentry,” said Jerry Kinder, a Boeing engineer in Entry Aerodynamics. ■

edmund.g.memi@boeing.com



Shuttle comings and goings

February was a busy month for the Space Shuttle Program at Boeing, as the team supported a shuttle mission and prepared for another that’s scheduled to launch shortly.

Space Shuttle *Atlantis* completed the 13-day STS-122 mission when it landed Feb. 20 at Kennedy Space Center, Fla. (above). The mission’s crew members traveled to the International Space Station to install the European Space Agency’s Columbus laboratory, which increases the orbital outpost’s scientific capabilities. The mission also delivered a new crew member to the ISS and replaced an expended nitrogen tank on the station’s Port One Truss.

Meanwhile, in preparation for the forthcoming STS-123 mission, Space Shuttle *Endeavour* (below), atop the well-lighted mobile launcher platform, arrived at Launch Pad 39A at Kennedy Space Center in the predawn darkness on Feb. 18. The journey from the Vehicle Assembly Building took about five hours. On STS-123, *Endeavour* and its crew will deliver the Japanese Experiment Logistics Module, the first section of the Japan Aerospace Exploration Agency’s Kibo laboratory, and the Canadian Space Agency’s two-armed robotic system, Dextre. Launch is targeted for March 11.

Boeing is the major subcontractor to United Space Alliance, NASA’s prime contractor for shuttle operations, and is the prime contractor for the ISS. Boeing defined the interface requirements between Columbus and the Harmony utility node, the connecting point for the new research laboratory.





In San Antonio, Jeff Keith (left), program focal for I-Gold/iCapture, discusses the I-Gold software interface with maintenance modification mechanics Raymond Luna (center) and William Orcutt II.

LANGE CHEUNG PHOTO

A clean sheet

KC-10 program delivers paperless maintenance

By DEBORAH VANNIEROP

In the past, when Boeing returned a KC-10A Extender to the U.S. Air Force, the pilot or flight crew received several books of ship records that documented work maintenance, modification or repairs. Today, they receive one compact disc.

Last year, Boeing's KC-10 Contractor Logistics Support program employees in San Antonio delivered their first "paperless" aircraft. Gone are the boxes of paper listing every action on the aircraft. That information now is tracked through I-Gold, a third-party business-planning database program that integrates inventory databases with shop-floor management programs. The end result: Easier access to information, fewer worries about lost records, better process oversight and improved cycle time for servicing an important war-fighting asset.

"By having the maintenance records in an electronic format, we have easier access throughout the program to gather data and perform trend analysis," said Mike Wright, Boeing's KC-10 program director. "We will be able to use this information to reduce aircraft cycle time and perhaps reduce costs."

The journey to a paperless aircraft, however, wasn't easy or popular, and it had a few obstacles. "Bottom line, we made it work, and now there's no looking back,"

said Jeff Keith, KC-10 planner and I-Gold/iCapture program focal.

The team first looked at the entire KC-10 CLS program to determine how to begin the paperless implementation without interrupting the work flow. The Air Force operates nearly 60 KC-10 aircraft, which receive extensive checks or regularly scheduled maintenance every 12 to 24 months at San Antonio. Due to their high operational tempo, the aircraft must be serviced regularly to satisfy mission requirements.

It was decided the best time to integrate everyone into the paperless process was during the aircraft Time Compliance Technical Order modifications. These typically involve small aircraft-modification packages that are limited in scope. "That maintenance period provided us with the best opportunity for training while still allowing us to meet the customer's schedule," said Carlis Brady, KC-10 CLS deputy program manager.

The next step was to ensure that everyone was involved in training. The team included KC-10 management and mechanics, as well as specialists from I-Gold, Information Technology, Finance, Quality, Industrial Engineering, and even KC-10 CLS suppliers.

However, before anyone began inputting data to I-Gold, subject matter experts were chosen to learn I-Gold and iCapture, a wireless tablet that links to the I-Gold system and is used by mechanics and maintenance supervisors to identify needed aircraft maintenance or repair.

While the mechanics were taught how to

use the systems, the subject-matter experts were there to assist with training. For many employees, this was the hardest part of the paperless implementation. "It was a challenge to teach everyone that things don't just happen automatically because you're using a computer," said Eric Cavenaux, KC-10 I-Gold project manager.

The KC-10 team also drew upon its strong Employee Involvement and Lean knowledge, and found ways to streamline the training process. "Lean and EI contributed toward the design and location of the computer workstations," Brady said.

Following months of preparation, the program returned its first paperless aircraft in April 2007. While the team is pleased with the results, customers have also expressed their pleasure. "The crews like the fact that less data is now needed when they accept their aircraft, and the home station maintenance crews have access to all of the maintenance records for any given aircraft," said Brady. "This has also eliminated the potential for lost or missing records."

The team believes the process is still evolving and continuing to improve.

"The ability to see the real-time aircraft status, such as what jobs are complete versus what jobs still need to be accomplished, is a huge reward," said Cavenaux. "The ability to see exactly where all your employees are assigned and working is another benefit. But the most notable difference is that the KC-10 team has a better understanding of how the program operates." ■

deborah.a.vannierop@boeing.com



An officer and a gentleman

In late 2007, the UK Ministry of Defence awarded the lead role of system-of-systems integrator for its Future Rapid Effect System to a joint Boeing-Thales UK team. Jonathan Bailey serves as deputy director, Boeing Defence UK.

PETER ASHBY-HAYTER PHOTO

Meet Jonathan Bailey, head of FRES program in the United Kingdom

BY MADONNA WALSH

Jonathan Bailey's life has been anything but dull. The quintessential Englishman—with a cool and composed demeanor—is a retired British Army major general, an award-winning soldier and an author.

Following his name are such acronyms as MBE (Member of the British Empire) for services in Rhodesia, and CB (Companion of the Order of the Bath) for services in Kosovo. He holds a doctorate from Cranfield University's Defence College of Management and Technology. His articles and books on military history and strategy include "Field Artillery and Firepower," "Great Power Strategy in Asia 1905-2005" and "Contemporary Operations, Reflections On And Of Empire."

So, with Bailey's credentials, it was no surprise the Boeing Defence UK team was eager to have him join them as they

pursued the system-of-systems integrator role with partner Thales for the UK's Future Rapid Effect System.

The aim of the FRES program is to provide the British Army with a network-enabled and highly deployable medium-weight armored vehicle force that will complement the UK's existing heavy and light forces. FRES will have utility across the spectrum of conflict, supporting peacekeeping and peace enforcement operations, providing a rapid intervention capability and providing support to major combat operations.

Upon retiring from the British Army in 2005 after 33 years of service, Bailey hadn't planned to continue working in the defense industry. He pursued areas in higher education, worked as an industry analyst and continued writing.

So why did he change his course and join Boeing as a leading member of the capture team for the FRES program?

"I wanted to be part of something that grows; I felt working at Boeing to deliver equipment needed by soldiers in the field was the best use of my time and abilities," he said. "I found the FRES competition exciting, the Boeing-Thales approach in-

teresting, and overall I thought it would be satisfying to be a part of a start-up program with unlimited potential and Boeing's enormous resources."

It was a good choice. In late 2007, the UK Ministry of Defence awarded the lead role of system-of-systems integrator to the joint Boeing-Thales UK team. Bailey is serving as deputy director, Boeing Defence UK.

"From the beginning, it never entered my mind that we would lose," Bailey said. "There was never any room for doubt. Now that we've been selected, we're challenged with delivering, and that's just what we're going to do."

Bailey sees Boeing's role in FRES as a foothold for Boeing's expansion of its organic capability in the UK and European defense markets. "Applying our integration skills, providing support services on existing programs, and establishing long-term teaming partners will position Boeing in the UK to better meet the requirements of the MoD's Defence Industrial Strategy as they look 10, 20 and 30 years into the future," Bailey said. "We're presented with a great opportunity here in the UK. Why stop now?" ■

At Diversity Summit, attendees learn how inclusion and sharing fit into efforts to create the strongest Boeing

By GEOFF POTTER

The fundamental thrust of diversity at Boeing is to unleash the full potential of employees' collective talents, backgrounds and perspectives so everyone can help deliver on the company's promising future, leaders said recently.

Tapping into the skills and experiences of Boeing's diverse work teams and leveraging that knowledge is crucial to help the company reach the overarching goal outlined at the 2008 Diversity Summit by Boeing Chairman, President and CEO Jim McNerney: to build the strongest, best and best-integrated aerospace company in the world, for today—and tomorrow.

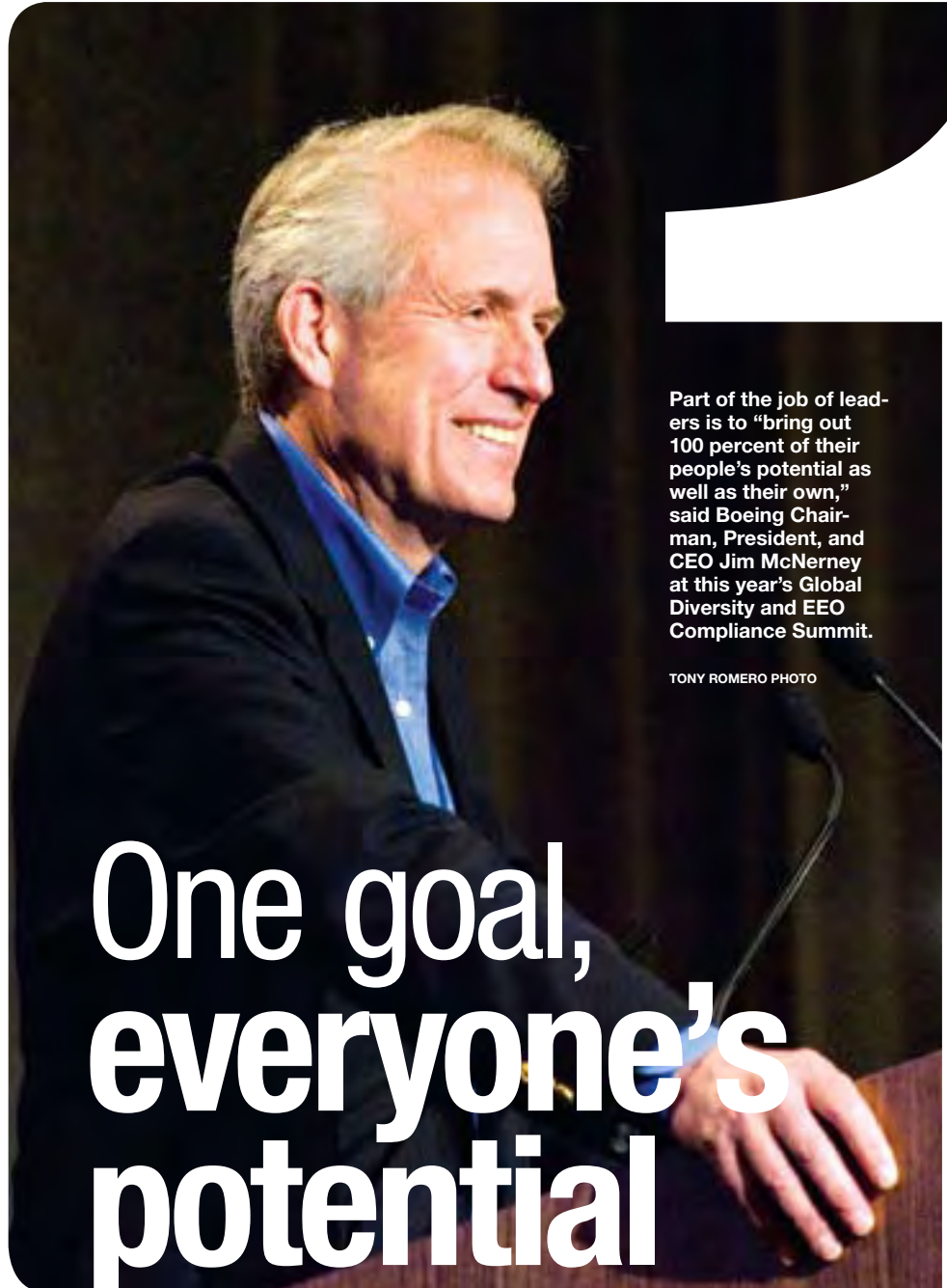
That takes leadership, and part of the job of leaders is to "bring out 100 percent of their people's potential as well as their own," McNerney reminded the nearly 1,300 attendees of the sixth annual Global Diversity and EEO Compliance Summit. The event, titled "Leveraging Unique Contributions for Business Success," took place last month in Irvine, Calif.

McNerney tied the concept of diversity—in all its facets, including race, ethnicity, gender, work background and life experience—directly to productivity and growth.

"At Boeing, we are just as committed to continuous improvement in diversity and inclusion as we are to continuous improvement in our business performance," he said. "Like growth and productivity, each fuels the other."

For the company to keep up with its customers over time, Boeing needs to gather different perspectives, break down barriers—between individuals, geographic locations and business units—and share knowledge to accelerate innovation, McNerney said.

No single individual knows all the answers, especially in the complex and ever-changing aerospace market, McNerney said. "Innovation comes far more often from a diverse team, freely exchanging ideas, than it does from a solitary genius or an insulated team with the occasional 'aha'



Part of the job of leaders is to "bring out 100 percent of their people's potential as well as their own," said Boeing Chairman, President, and CEO Jim McNerney at this year's Global Diversity and EEO Compliance Summit.

TONY ROMERO PHOTO

One goal, everyone's potential

moment along the way," he said.

"No one person or group corners the market on good ideas," added Boeing Chief Financial Officer James Bell at the summit. "Great technology is not all invented here. Leveraging different perspectives, experiences and capabilities helps diverse teams achieve more creative solutions to better address our customers' needs."

Citing examples of how Boeing business units have benefited from exchanging people and ideas, McNerney counseled: "Reach out to others. Share what you know,

and pull from what they know. When our culture is inclusive and supports sharing across Boeing, the company wins ... and we all win."

Here's a look at some of the other happenings and lessons shared from this year's event.

DIVERSITY = PRODUCTIVITY

Is having a diverse work force important? According to a University of Michigan professor cited by McNerney and others at the summit, it's essential.



MICHAEL GAIL PHOTO

This year's Diversity Summit drew 1,300 people—up 30 percent from the 2007 event. Among this year's participants were 519 managers, a record number.

In his new book, Scott Page, a professor of complex systems, political science and economics at Michigan, demonstrates that incorporating variety in staffing and work teams—listening to individuals with different ethnicities, cultural backgrounds and perspectives—creates enterprises with greater innovation, better solutions and higher productivity.

In a recent *New York Times* profile, Page described the findings of the math model detailed in his book: “What the model showed was that diverse groups of problem solvers outperformed the groups of the best individuals at solving problems. The reason: the diverse groups got stuck less often than the smart individuals, who tended to think similarly.”

“It would follow that in a business setting the more diverse group would bring its company the greater competitive advantage,” McNerney said.

WELCOME, MANAGERS

Attendance at the annual summit has grown substantially as more and more managers find that the discussions, classes and guest speakers can help them to identify and remove barriers to inclusion and to build and lead increasingly diverse—and productive—work teams.

This year's summit drew about 1,300 participants. That figure represents an increase of 30 percent from last year and is three times the number that attended the first summit in 2003. Importantly, more than 730 of the 2008 participants had never attended a Diversity Summit before. And the number of managers who attended—519, up 41 percent from 2007—reached a record high.

“There was so much interest in the Summit this year that registration had to close more than a month ahead of schedule,” said Joyce Tucker, senior vice president of Global Diversity and Employee Rights. “Our leaders recognize that understanding, embracing and leveraging diversity is critical to our business success.”

Seeing the benefits of the event's content, more Boeing managers have begun to budget for their team members to attend the event, Tucker said. They usually rotate their teams' participants so more employees have the chance to attend and learn, she added.

David Bowman, vice president and general manager of IDS Global Mobility Systems, brought his entire leadership team. “The summit knocked their socks off, and I had great team and individual discussions with each of them during the

week,” he said. “They're all going back and putting thoughts to plans and plans to actions. They want to be measured on their performance in this important area.”

Attendees are expected to return to their teams and lead meetings and one-on-one discussions to educate their colleagues about diversity and inclusion, including tools and techniques that encourage employees of diverse backgrounds to contribute their insights and help teams overcome business challenges.

SPREADING THE WORD

Surveys indicate that the nearly 1,000 employees who participated last year spread much of what they learned at 2007 summit to a minimum of 30,000 Boeing people. And all participants were asked to create a detailed action plan to foster inclusion at their work sites and spread valuable learnings from the event to colleagues who did not attend. ■

geoffrey.potter@boeing.com

For more on the Global Diversity Summit, see page 44.

Greatness, despite disabilities

The audience for the keynote address of Karen Meyer (seated), a deaf TV reporter who gave the keynote address at this year's Global Diversity and EEO Compliance Summit, gives the visual signal for applause after her speech.

MICHAEL GAIL PHOTO

Lance Armstrong. Beethoven. FDR. Magic Johnson. Homer (the ancient Greek poet, not the cartoon dad).

These individuals are known for their exceptional skill in a profession. They gained fame and accomplished much, despite facing what for many others has been a crippling disability (respectively, their disabilities were cancer, deafness, polio-caused infirmity, HIV/AIDS, and blindness). And each encountered the disability as an adult, yet went on to achieve greatness.

That last fact was a central point of an address made by Karen Meyer, a keynote speaker at this year's Boeing Global Diversity and EEO Compliance Summit. Meyer is a Chicago TV reporter who was born deaf.

Meyer called attention to the fact that "the disabled" is the one minority group that anyone can join, at any time, because of the random nature of health issues. As Jeffery Sykes, president of the Boeing Employees Ability Awareness Association, put it: "We're all just one step away from joining this club."

In the face of disabilities, however, many people accomplish a tremendous amount—certainly not without struggles, pain and occasional self-doubt, which can make their achievements all the more remarkable, impressive, and inspiring.

Meyer offered her own youth as an example. She wasn't diagnosed as deaf until she entered elementary school. She completed college without an interpreter, subsequently earning a graduate degree. And yet she was fired from her first job solely because she was deaf—even though she was ranked second overall in sales.

Meyer said 70 percent of working-age Americans with disabilities are unemployed, despite possessing a wide range of skills, knowledge and talents, as well as demonstrable experience at overcoming challenges. In her talk, Meyer cited a disabled accountant she interviewed for a news profile who went on more than 200 interviews before landing a job.

"Karen was able to convey the frustration that deaf individuals have when trying to enter the work force," said Ryan Gibson, a Commercial Airplanes design engineer who has a hearing disability. "So many deaf people lose

the potential to show off their talents, skills and perspectives of the world around them and within their field simply because of the communication barrier. The good news is that there is a wealth of technology and services available to overcome that barrier."

Finally, Meyer reminded "TABs"—or Temporarily Abled Bodies, as some call people without disabilities—to recognize that men and women of all backgrounds have the potential to make profound contributions to Boeing, as well as the world's economy—and society.

"Don't be afraid to talk to us or ask us any question," counseled Boeing's Sykes, who is wheelchair-bound. "The only dumb question is one that's not asked. How else are you going to learn?"

—Geoff Potter

Pick a topic

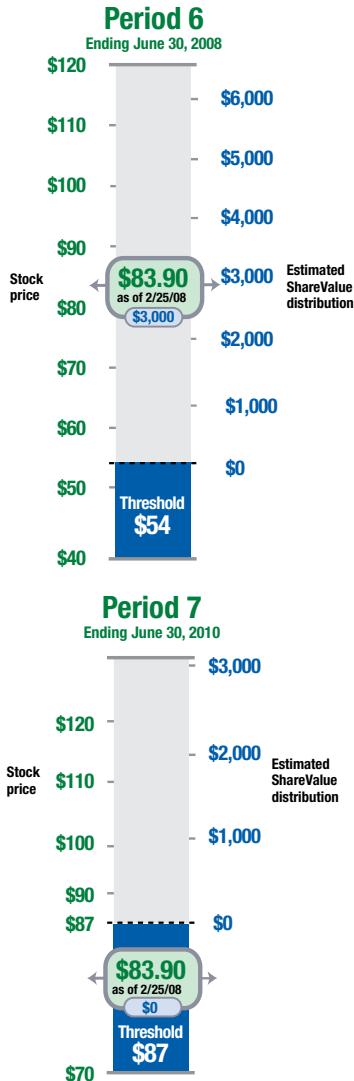
This year's Global Diversity and EEO Compliance Summit offered attendees 26 workshops and 10 panel discussions as well as executive and guest speaker presentations. Here's a sample of the selections.

- Generational Diversity and its Impact to Boeing
- Mentoring Strategies: Creating Inclusion and Equity
- Supplier Diversity: Working Together
- The Polished Professional in the Global Arena
- Addressing Workplace Issues Fairly & Equitably
- Critical Thinking & Decision Making
- Diversity and Inclusion: The Competitive Advantage
- Mindful Matters: Inclusion Begins with Knowledge
- Using GlobeSmart to Understand International Cultural Differences
- Winning Communication Strategies for Cross-Cultural Teams

Boeing stock, ShareValue Trust performance

ShareValue Trust is an employee incentive plan that allows eligible employees to share in the results of their efforts to increase shareholder value over the long term.

The program—which runs for 14 years and ends in 2010—features seven overlapping investment periods. The program is currently in Periods 6 and 7.



The above graphs show an estimate of what a “full 4-year participant” ShareValue Trust distribution (pretax) would be for Periods 6 and 7 if the end-of-period average share prices were the same as the recent price shown.

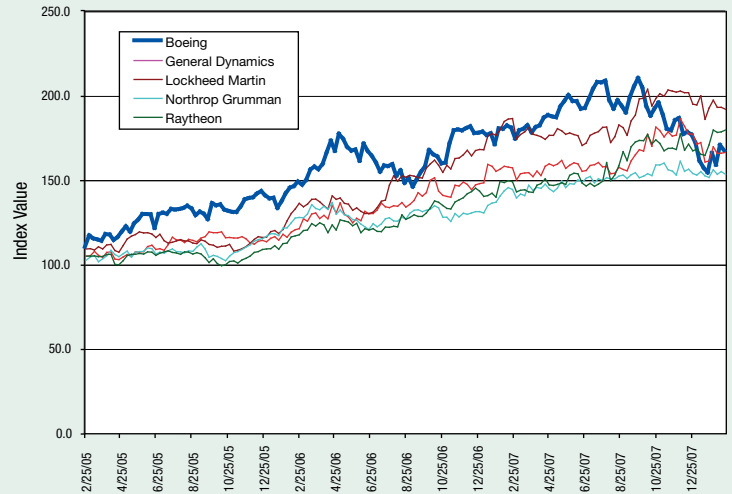
The share price shown is the average of the day’s high and low New York Stock Exchange prices. Updates to participant/employment data will be made periodically.

For more information on the ShareValue Trust, visit <http://www.boeing.com/share>.

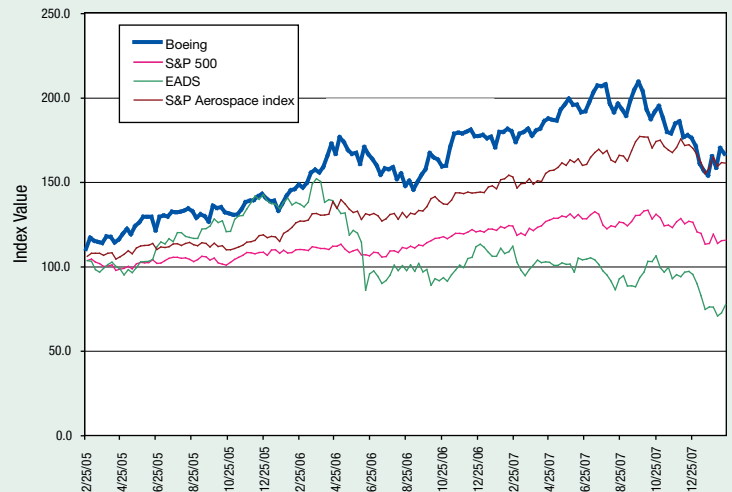
STOCK WATCH

The chart below shows the stock price of Boeing compared to other aerospace companies, the S&P 500 index and the S&P 500 Aerospace and Defense index. Prices/values are plotted as an index number. The base date for these prices/values is Feb. 25, 2005, which generates three years of data. The prices/values on that date equal 100. In other words, an index of 120 represents a 20 percent improvement over the price/value on the base date. Each data point represents the end of a trading week.

Boeing vs. U.S.-based competitors



Boeing vs. stock indexes and international competitors



Comparisons: 4-week, 52-week

	Price/value as of 2/22/08	Four-week comparison		52-week comparison	
		Price/value as of 1/25/08	Percent change	Price/value as of 2/23/07	Percent change
BOEING	83.04	77.03	7.8%	90.28	-8.0%
U.S. COMPETITORS					
General Dynamics	83.65	81.13	3.1%	79.05	5.8%
Lockheed Martin	105.12	105.49	-0.4%	102.11	2.9%
Northrop Grumman	79.09	78.07	1.3%	74.42	6.3%
Raytheon	66.04	62.82	5.1%	54.82	20.5%
INT'L COMPETITORS					
EADS *	17.88	17.51	2.1%	25.86	-30.9%
U.S. STOCK INDEXES					
S&P 500	1353.11	1330.61	1.7%	1451.19	-6.8%
S&P 500 Aerospace and Defense Index	420.18	412.80	1.8%	398.89	5.3%

* Price in Euros

Philip Wagner, 20 Years
 Vincent Walker, 21 Years
 Gary Waller, 35 Years
 Wesley Walloch, 10 Years
 Dennis Walter, 28 Years
 Richard Warner, 26 Years
 Irene Waters, 18 Years
 Thomas Watson, 30 Years
 Robert Watt, 5 Years
 Stephen Wax, 27 Years
 Joel Webber, 26 Years
 Douglas Weber, 22 Years
 Donald Weiss, 38 Years
 Edward Weryn, 17 Years
 Sidney Wheeler, 42 Years
 Danno White, 20 Years
 William Whitley, 35 Years
 Barbara Whorton, 11 Years
 Thomas Wicks, 21 Years
 Charles Wilcox, 39 Years
 Astrid Williams, 24 Years
 Bettie Williams, 30 Years
 Quentin Williams, 43 Years
 Linda Wolfgang, 17 Years
 Clarence Wong, 21 Years
 Eugene Woods, 32 Years
 Linda Woods, 19 Years
 Michael Woods, 25 Years
 Philip Wright, 29 Years
 Dale Wunn, 28 Years
 Cleola Wyatt, 37 Years
 Vickie Yahne, 16 Years
 Kim Yarnell, 28 Years
 Mary Ziegler, 17 Years

IN MEMORIAM

The Boeing Company offers condolences to the families and friends of the following employees.

Paul Black, production technician; service date Jan. 14, 2002; died Jan. 12

Barry Bryant, business & planning analyst; service date Aug. 24, 1987; died Jan. 4

Gennaro Composano, assembly & installation inspector; service date July 12, 1988; died Jan. 20

Stanley Delgado, quality engineer; service date Nov. 13, 1987; died Jan. 27

Patricia Deinas, materials processing/requisition facilitator; service date Oct. 31, 1988; died Feb. 12

Juan Gonzalez, test evaluation engineer; service date April 14, 1998; died Jan. 26

Arunkumar Ingle, structures & payload design engineer; service date Jan. 2, 1991; died Jan. 21

Andrew Jones, design & analysis engineer; service date July 10, 1986; died Feb. 10

James Jones Jr., engineering technical specialist; service date Oct. 10, 1997; died Feb. 5

David Kimura, plumbing & pipefitting mechanic; service date May 6, 1974; died Feb. 9

Wayne Koenig, machine repair mechanic; service date July 5, 1988; died Feb. 3

Arthur Loock, mechanical systems design & analysis engineer; service date Nov. 13, 1972; died Jan. 25

John Meyer, supply chain management analyst; service date April 19, 1982; died Jan. 9

Michael Ottinger, structures assembler/installer; service date Feb. 24, 1989; died Feb. 3

Loretta Peters, applicator decalcomania transfers; service date Oct. 3, 1979; died Jan. 24

Carolyn Sue Poteet, contract & pricing administrator; service date March 15, 1999; died Jan. 11

Francie Russell, materials processing/requisition facilitator; service date Sept. 4, 1984; died Feb. 12

Richard Smith, machinist; service date June 6, 1966; died Jan. 18

Wayne Stoddart, boiler operator—high pressure; service date March 30, 1981; died Feb. 5

Edward Valerio, systems engineer; service date Nov. 23, 1998; died Feb. 7

Sheila Walker, procurement agent; service date June 11, 1984; died Jan. 16

Michael Wiltse, quality systems specialist; service date March 1, 1986; died Jan. 27

AROUND BOEING

BOEING AWARDED CONTRACT TO DEVELOP HARPOON UPGRADE

The Harpoon weapon system, a venerable workhorse of the U.S. Navy, is entering a new phase in its career.

Harpoon has long provided antiship and land-strike capabilities. Now the Block III upgrade, with its GPS and data-link capabilities, brings the weapon into the era of network-centric operations.

In January, Boeing was awarded a \$73.7 million system design and development contract for the Harpoon Block III missile. The contract calls for design and development of a kit to upgrade existing Navy missiles and shipboard command and launch system equipment. This contract will be followed by a production contract to upgrade 800 existing Navy surface and air-launch Harpoon missiles and 50 ship-

launch systems to the Block III configuration. The system is scheduled to be fielded in 2011.

“Harpoon has a long history of naval service, and Block III takes the system to the next level and beyond,” said Jim Young Jr., program manager. “We have worked with our Navy customers to build on Harpoon’s success to develop a missile that will play a key role in tomorrow’s integrated battle space.”

The addition of Block III advanced technologies brings network-enabled surface warfare to the system. The datalink and enhanced GPS capabilities further increase Harpoon’s accuracy, provide for in-flight target updates and position the system for future network enhancements.

“The Block III upgrade is the next progression in Harpoon history. By retrofitting existing missile assets we are providing a cost-effective solution to our customer,” Young said.

Boeing (then McDonnell Douglas) received its first Harpoon development contract in June 1971, and the first launch was 16 months later. The Harpoon now is in service with the armed forces of 29 countries. More than 7,000 Harpoons have been delivered.



Weapons Programs employee Russell Evans prepares a Harpoon missile for installation in a submarine launch capsule. Boeing recently was awarded a system design and development contract for the Harpoon Block III missile.

RICHARD RAU PHOTO

The “What Others Dream. We Do.” Video Production Team

When the Boeing Advertising and Brand Management organization needed a compelling, up-to-date video that told the story of Boeing, its products and its people, Boeing Creative Services—which also supports *Boeing Frontiers*’ graphics needs—assembled a team to create the video and make sure it complemented the Boeing TV ads created by an outside advertising agency. The TV campaign, “That’s Why We’re Here,” incorporates comments from employees across Boeing sites in the United States.

Our team of Creative Services producers and videographers from Southern California, Chicago, St. Louis and the Puget Sound region shot video of employees in their work environments explaining how they feel about Boeing and the work they do. Team members from Communications helped us schedule and set up interviews and kept us focused on the right message. We were in different locations, but we had regular virtual meetings to make sure we were on track.

We used this opportunity to support the SSG Creative Services Lean Video initiative by shooting footage for two additional videos at the same time. We interviewed and spoke with 80 employees and leaders for the three different videos. This resulted in cost savings of 25 percent, and also provided us with material we can use in future projects.

The next video in the pipeline was “We Are Diversity at Boeing,” and it will be followed by a new-hire orientation video. Production costs for these projects are low because we already have the footage we need. We’re saving money, reducing cycle time—and using the voices of our fellow employees to tell the Boeing story.

The first video, “What Others Dream. We Do.,” came together in St. Louis, where it was edited and combined with a musical soundtrack to tell the story with drama and excitement. It was one of the first Boeing videos to be shot, edited and projected in high definition. And, it was also a highly successful example of our organization’s Lean Video initiative. ■

From top St. Louis (from left): Kevin Flynn, Video Services; Tim Reinhart, Producer
PETER GEORGE PHOTO

Puget Sound region (from left): Jim Lally, Video Services; Debra Buck, Video Services
JIM COLEY PHOTO

Southern California (from left): Andre Berry, Video Services; Laurie Starkey, Video Services
GINA VANATTER PHOTO

Chicago (from left): Kirk Dalgaard, Video Services; Ruth Savolaine, Human Resources–Diversity Communications; Anne DeAngelis, Executive & Internal Communications; Karen Forte, Employee Communications; Fritz Johnston, Advertising and Brand Management
CAL ROMANESCHI PHOTO





WE HAVE MORE IN COMMON THAN WE KNOW.

And that may be the one true link that brings us all together,
regardless of race, creed or color. That's why we support
those courageous enough to make discrimination, history.



Global corporate citizenship refers to the work Boeing does—both as a company and through its employees—to improve the world. These efforts, combined across the enterprise, can yield sustainable improvement in the communities where Boeing employees live, work and support. This ad emphasizes Boeing's commitment to initiatives that promote diversity and mutual understanding.



FACT: COMBAT PROVEN, PRODUCTION READY.



The search and rescue mission of the U.S. Air Force has never been more urgent. It's not surprising then that the HH-47, with its combat-proven capabilities, was first selected to fulfill this critical requirement. Offering superior range, speed and payload, the HH-47 also takes advantage of existing production—so it can be fielded more rapidly. For the warfighter in harm's way, there's not a minute to lose.

 **BOEING**

This new Integrated Defense Systems print ad supports the selection of HH-47 as the U.S. Air Force's next-generation combat search and rescue platform. The ad reinforces the key reasons the HH-47 was originally selected by the Air Force and should be selected again in the CSAR-X competition. The ad will appear in key military trades, congressional publications and targeted base papers.