

Technology update

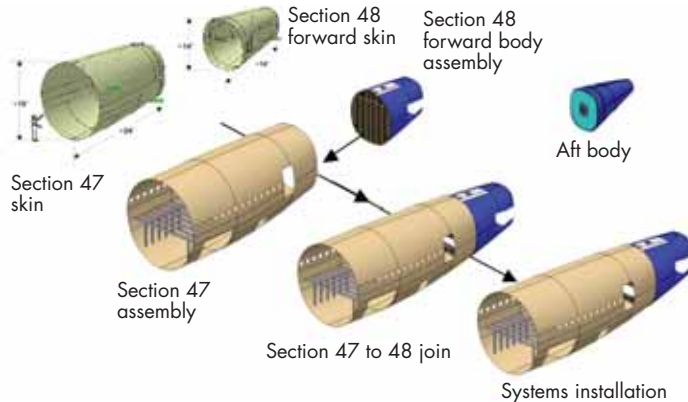
Vought and Alenia go Global in South Carolina

Just a little over a week after the Boeing 7E7 officially became the 787 amidst growing orders, Alenia North America and Vought Aircraft Industries held a groundbreaking ceremony at the site where a joint venture of the two companies, Global Aeronautica, will support the new aircraft program.

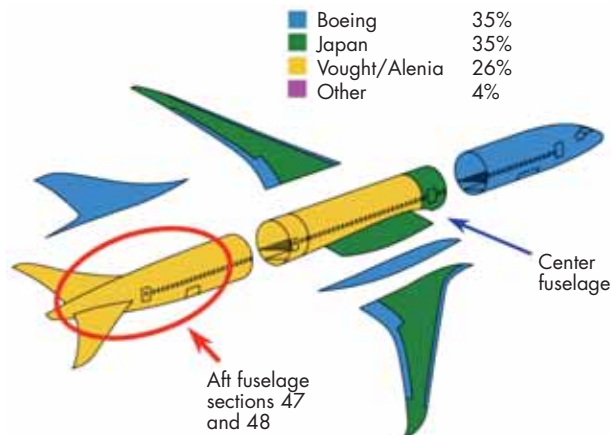
The new integration facility will be located at the Charleston International Airport in South Carolina, which was chosen for its access to a deep-water port, airport and rail-system infrastructure, available land and workforce, and economic incentives.

Although Vought has been supplying Boeing with commercial aircraft components since the beginning of the 747 program, the company has had feelers out for at least four years to do "something really big, really dramatic" for a major Boeing program, according to Vern Broomall, Vice President and Chief Technology Officer at Vought. The company was part of the Sonic Cruiser development program, which lasted from March 2001 to December 2002.

"When the Sonic Cruiser was replaced by the 7E7," said Broomall, "we were very aggressive and determined



Vought will manufacture fuselage sections 47 and 48 at a facility co-located with the Global Aeronautica facility, which will house the integration of parts from Vought, Alenia Aeronautica, and other structural suppliers.



Boeing has numerous partners involved in many different areas for the production of the 787, including the airframe. Global Aeronautica will be responsible for integration of more than 60% of the fuselage.



The Global Aeronautica groundbreaking "represents the next step in solidifying our relationship with Alenia and support of our customer Boeing on the 787 program," said Vought Chairman, President, and CEO Tom Risley, second from the left. At the far right is Giuseppe Giordo, President and CEO, Alenia North America.

from the beginning to get something substantial."

Around the same time, Vought and Alenia decided to leverage their long-term relationship to ensure victory. "We'd been trying to find opportunities for some time that we could do together," said Broomall. "We started talking about the 7E7 and it looked like an opportunity. It made sense to do it together rather than separately."

The partnership is a win-win-win situation for all three companies, allowing Boeing to reduce its cycle time, concentrate on satisfying airlines, integrate aircraft parts, and modify the product to stay current with the requirements of the

marketplace. The partnership also reduces the learning curve on manufacturing such a composite-intensive aircraft, for which there are no precedents.

"There's very little technology that we have developed together and with Boeing that we do not share on this program," said Broomall. "We have been moving the whole technology ahead, significantly, together. It's very comfortable to share the output."

The joint-venture company will join and integrate fuselage sections from Vought, Alenia Aeronautica of Italy, and other structural partners, which together represent more than 60% of the 787 fuselage. This integration work will

entail the joining of the majority of the fuselage sections and the installation and testing of the associated system elements.

Vought will manufacture the last two fuselage sections, 47 and 48, of the 787 structure, tapered parts that tend to be more difficult to manufacture than straight cylinders, no matter how massive. The sections will be manufactured in a new 300,000-ft² building that will be co-located with the Global Aeronautica integration facility.

Alenia Aeronautica will build the center fuselage sections 44 and 46 in its facilities in Italy and deliver them to the integration facility beginning in 2007. All major shipments to and from the integration facility will be accom-

plished using Boeing's new Large Cargo Freighter (LCF). The 747-based LCF will conduct substantial operations from the Global Aeronautica and Vought facilities.

Boeing announced early in the development stage of the 787 that the majority of its primary structure—including the fuselage and wing—would be made of composites, primarily the same material it uses on the tail of the 777. The increased use of composites on the aircraft contributes to reductions in weight and maintenance, but also increases passenger comfort.

The primarily metal construction of most commercial airliners contributes to a maximum altitude equivalent certification of 8000 ft to minimize structural

fatigue during normal operation. Boeing says the use of composites on the 787 will result in a pressurization of a maximum altitude equivalent of 6000 ft during normal operation because composites are not subject to the same fatigue conditions that limit the amount of pressure cycles that can be applied to an aluminum airplane. In essence, the difference in cabin pressure on the 787 will result in less fatigue for passengers and crew. More comfort is found in the fact that because composites do not corrode, the humidity in the 787 cabin can be set higher and the windows can be bigger. The 787 cabin will also be 350 mm wider than its "competition," according to Boeing.

Jean L. Broge

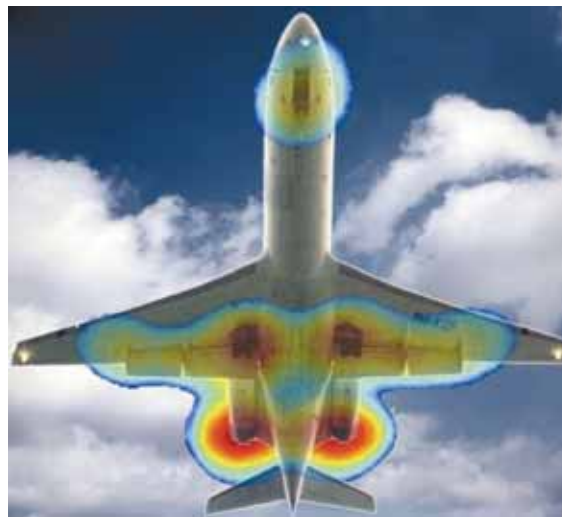
More board the Silent Aircraft

The **Cambridge University-MIT** Institute's "Silent Aircraft Initiative" has gained momentum with the announcement that the UK's **Cranfield University**, renowned for its innovative approach to aerospace engineering, has become a member of a research team that also includes major manufacturers, airport operators, and air-traffic-control organizations, all contributing to a three-year program to design an airliner that is "radically" quieter than current passenger aircraft.

According to Riti Singh, Head of the Department of Power, Propulsion, and Aerospace Engineering at Cranfield, "We often research the whole of an aircraft, or the whole of an engine, whereas typically university research focuses on one individual component or process. We are also experienced in designing unusual aircraft and taking them to the level of preliminary design."

Such aircraft include an EU-funded project to design a "Cryoplane," a passenger aircraft that would burn liquid hydrogen. Cranfield has also applied some 150 man-years to research into blended-wing body (BWB) concept aircraft. This flying-wing configuration is being taken as the starting point for designs for the Silent Aircraft.

However, the BWB is just a start for the design, which "will change considerably as we work on tackling key



During final approach, conventional commercial airliners experience noise "hotspot" areas, which are hoped to be radically changed as a result of the team behind the Silent Aircraft Initiative. (Image courtesy of the National Aerospace Laboratory—The Netherlands.)

issues such as designing an embedded propulsion system, a low-noise undercarriage system, and ways of creating drag and high lift quietly as the aircraft approaches an airport," said Karen Willcox, of MIT, who leads the Initiative's integration research.

"Another major challenge is finding accurate models for predicting the performance of an aircraft with such unconventional configurations," said Wilcox. "These currently do not exist, and this is an area where we hope that Cranfield will contribute."

At Cambridge, Ann Dowling leads the Engineering Department's Silent

Aircraft research. "The radical noise reduction being pursued in the Silent Aircraft Initiative requires a major rethink of aircraft design, with the engines and airframe much more closely coupled than in a conventional aircraft," said Dowling.

A networked approach is an essential element of the project. "To achieve a very large step-change in the performance of aircraft requires a radical, integrated approach," said Nigel Birch, Chief of Noise Engineering at **Rolls-Royce**. "We are highly committed to the project."

Embedding engines within the

aircraft's structure instead of hanging them below the wings is part of the research being carried out, with the project's Engine Team examining the issues that would be involved in ducting air to them. The distorted airflow leads to very high loads on the fan blades that would be beyond the limit of current designs.

With the airframe of an aircraft in the final approach phase producing aerodynamic noise similar to that of the mechanical and exhaust noise of its engines, the project's Airframe Team is focusing on possible solutions for generating the drag necessary to slow an aircraft for landing far more quietly than present designs allow. The whole undercarriage system including landing gear door design is central to this research work. The practicality of using steeper approaches at slower speeds is also a significant part of the Airframe Team's remit.

Stuart Birch

Collaboration bridges culture gap

The aerospace industry has long depended on the success of collaborative engineering projects. **Airbus**, with partners and business associations across the world, is a classic example of this philosophy, which sees technological, design, and commercial expertise pooled, and financial investment spread.

But for collaborative projects to succeed, one of the vital elements must be attaining, and maintaining, cross-company, cross-cultural international communication and understanding. Without it, the establishment of cohesive and integrated targets, programs, processes, design, production, and any other element of aerospace engineering can be difficult, costly, frustrating, and even impossible.

Although engineering per se uses a common basic language, relying on it to communicate a commercial message is not enough, according to Richard Pooley, a senior partner at **Canning**, an international management, training, development, and communication skills organization. Within the global

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"It is easy to forget how deep and ingrained your counterparts' attitudes (and yours) are likely to be," said Richard Pooley.



China East Airlines is using British Rolls-Royce Trent 700 engine power for its Airbus A330-300s. Pooley believes successful cross-cultural communication is vital for international deals.

aerospace industry, millions of dollars are lost every year when "mergers collapse, tenders are lost, and international teams cannot work together," he said.

Even after decades of collaborative engineering experience, Pooley claims that it remains "rare" for senior executives to take cross-cultural differences seriously when making decisions on mergers, acquisitions, joint ventures, and licensing agreements in the international area.

"There is plenty of evidence—even an embarrassing abundance of it—that cross-cultural differences are a major reason why so many of these cross-border joint ventures or other types of business agreement fail," he said.

Cross-cultural international communication and understanding is certainly important when projecting the finer points of a company's technology and engineering to potential customers. Mike Corne, Head of Marketing Services at **Rolls-Royce** Aero Engines, says the company does recognize the importance of communication "across

cultures" and uses Canning to facilitate training simulation.

"This [training] helps Rolls-Royce to support, develop, and train its existing and potential sales team members," he said. "Rolls-Royce provides the technical sales and selling expertise through the guidance of members of their sales executive. Canning contributes by coaching the teams and team members on how best to communicate with their buyers, using real-life Rolls-Royce customers brought in to add to the reality of the simulation. With recent successes with **China East Airlines** and **All Nippon Airlines** worth \$2 billion, the benefit to Rolls-Royce is clear."

This year marks the 40th anniversary of Canning's involvement in helping organizations find and deliver the desired mix of solutions to cross-cultural issues. Different deals require different solutions.

"Sometimes, the answer can lie in providing a combination of intensive language training and cross-cultural training for key personnel," said Pooley. "Or we may join in the kick-off meeting

for a new multinational team and help its members learn about the cross-cultural differences and similarities of their new colleagues."

At other times, a series of generic cross-cultural courses may be run to try and make staff realize that "the way we do things around here" is not necessarily the way that Klaus or François (or Françoise) do things there.

"You can only handle cross-cultural differences properly if you understand that you yourself are far from being a neutral observer, but are starting with many ingrained prejudices and preconceptions of your own," he said. This stance is something that is particularly significant in the constantly evolving, high-technology environment that is aerospace engineering in the 21st century.

Pooley lists four key stages in achieving practical expertise in dealing with cross-cultural differences. "First, know yourself. Identify and be aware of what constitutes your 'normal' behavior. What are your values? How do you see the world? What kind of behaviors and preconceptions in social and business settings do you regard as the norm? And understand that what you regard as the norm is not really an objective norm but only your take on it.

"Second, understand the factors that have determined what your counterparts in different countries regard as the norm. It is easy to forget how deep and ingrained your counterparts' attitudes (and yours) are likely to be.

"Third, know how you are seen by others, and, particularly important, be aware of any negative perceptions they might have about your culture.

"Fourth is to learn to adapt whilst remaining true to your own values."

Stuart Birch

C130 helps the A400M program

Risk-reduction flight trials for the new **EuroProp International** (EPI) TP400-D6 turboprop engine are to be carried out by **Marshall Aerospace**. The engine is destined for the **Airbus Military A400M** Military Transporter, but for the flight trials it will be installed on a **Lockheed Martin C130**. It will be flown for some 100 h to study in-flight characteristics.

The C130 is particularly well suited to checking engine performance and control at low speeds, according to Marshall. When fitted to the A400M, the engine will be operated at cruise speeds up to 0.72 IMN (indicated Mach number). The C130 will allow characteristics to be checked to 0.64 IMN.

As well as flight trials, Marshall will also be responsible for the design and installation of the necessary modifications to the C130. Up to 750 parameters will be measured during the trials, which will begin next year and continue for 15 months.

Marshall carried out a similar program for Lockheed Martin during



Powered by four new engines from EuroProp International, the Airbus Military turboprop A400M is being designed to operate in harsh environmental conditions.

development of the **Rolls-Royce/Allison** D2100 engine for the C130J.

EPI is a European joint-venture company, its members being Rolls-Royce, **Snecma Moteurs**, **MTU Aero Engines**, and **Industria de Turbopropulsores**.

The four-engine A400M, scheduled to fly in early 2008, is predicted by Airbus to become "the most powerful Western turboprop" and will have both strategic and tactical mission performance. The TP400-D6 is a three-shaft engine with potential over 11,000 shaft hp at sea level, installed. It drives a 17.5-m diameter **Ratier-Figeac** FH386 eight-bladed advanced composite variable pitch, fully reversing propeller, with electrical de-icing along the leading edge.

The blades incorporate a carbon spar in a composite shell. The shell has a polyurethane coating to protect against erosion. Further erosion protection is provided by a nickel guard to the outer part of the blade leading edge. Propeller control is integrated into the FADEC (full-authority digital engine control), which looks after blade pitch angle to achieve a constant, optimum efficiency speed. Maximum propeller rpm is 840. The FADEC also provides an auto-feathering capability upon automatic detection of an engine failure, according to Airbus.

The A400M will have an overall

length of 42.2 m and wing span of 42.4 m. Maximum take-off weight is expected to be 130 t, with a maximum landing weight of 114 t. Maximum payload is 37 t.

Maximum operating altitude would normally be 37,000 ft with range carrying maximum payload of 1700 nmi,

increasing to 3550 nmi with a 20-t payload (both using long-range cruise speed and with full logistic reserves based on European Staff Requirement). Tactical take-off distance is 3000 ft with aircraft weight at 100 t and in soft field, ISA, sea-level conditions.

Stuart Birch



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Nedtech supports JSF technology

The Dutch company **Nedtech Engineering** has won a contract from **Rolls-Royce** for design work on the F136 engine being developed with **General Electric** for the **Lockheed Martin** F-35 Joint Strike Fighter (JSF). Nedtech will focus on the design of what are termed "key structural parts" for the engine. Another Dutch company, **Philips Aerospace**, is also involved with the F136, supplying fan cases and compressor blisks.

The GE Rolls-Royce Fighter Engine Team comprises GE Aircraft Engines in Cincinnati, OH, and Rolls-Royce in Bristol, England, as well as Indianapolis, IN. According to Rolls-Royce, the contract for Nedtech confirmed the commitment to involve JSF partner nations in the F136's development.

It was in July last year that the F136

embarked on a program of full engine-development testing, capping a successful Phase III Pre-System and Development Demonstration for the JSF program. A second development engine for STOVL (short takeoff and vertical landing) operations is scheduled for testing shortly at GE's Peebles, OH, facility.

GE has responsibility for 60% of the program, including development of the core compressor and coupled turbine system components, controls, and accessories. The remaining 40% is down to Rolls-Royce, which is responsible for the front fan, combustor, stages 2 and 3 of the low-pressure turbine, and the gearboxes. The two companies are jointly developing an integrated high-pressure/low-pressure counter-rotating turbine design.

Stuart Birch



Nedtech Engineering is now involved in the F136 engine program for the JSF, part of a team that includes General Electric and Rolls-Royce.

Ultra cracks WIPS contract

Ultra Electronics is to provide systems integration and controlling software plus associated electrical and electronic equipment for the Wing Ice Protection System (WIPS) of the **Boeing** 787. The system incorporates electro-thermal ice protection for the leading edge slats of the wings.

GKN and **Thermion Systems** are in partnership with Ultra. Under a separate contract, GKN will provide electro-thermal heater mat assemblies, which incorporate Thermion material, for the aircraft's slats. Thermion heaters are made from finely dispersed metal-coated carbon-fiber elements and can be integrated into composite or polymer material structures.

Ultra describes the electro-thermal WIPS as a new fuel-efficient approach to wing ice protection. It also avoids the use of bleed air from the engines and the problems associated with channeling hot gas tubing through complex wing and fuselage structures, according to Stratford, CT-based Thermion. The



Boeing's 787 will use new ice-protection technology that is part of a team effort that includes Ultra Electronics, GKN, and Thermion Systems.

complete WIPS comprises controlling software, distributed power controllers, extending and retracting electrical harnesses, and the slat heater mats. The 787 is scheduled to enter service in 2008.

Other areas of Ultra Electronics' aerospace systems applications include airborne compressors, UAVs,

cockpit equipment, airframe fatigue monitoring, and missile support. Thermion will also be supplying the propeller blade de-icers for the **Airbus Military** A400M, while a number of other ice-protection applications on fixed and rotating wing aircraft are currently under development.

Stuart Birch

Extended family from Toulouse

Airbus is to expand its airliner family further with the addition of the A350, which will be based on the A330. There will be two versions of the A350: the -800 with a typical seating configuration of 245 passengers, and the -900 with a shorter range and seating 285 passengers. The new aircraft, slated to enter

acquisition costs, maintenance costs, and increased time on wing," claims Airbus. The engine has fewer compressor stages and some 50% fewer high-volume airfoils than other engines of this class segment, adds the company, with 75% of all line replacement units able to be removed within 15 minutes, while all

life-limited parts are designed to have the same long lives, thus leading to reduced maintenance costs.

The engine meets Stage 4 noise requirements and CAEP6 engine emissions requirements "with margin." The engine is FAR33 certified.

Stuart Birch



The new Airbus A350-900 will initially be powered by two General Electric GEnx 72A1 engines that will use a pylon design originally developed for the A380.

service in early 2010, will benefit from technologies, materials, and manufacturing processes used on the twin-deck A380.

In effect, the two A350 variants with a range up to 8600 nmi (-800) will be longer-range A330s. Pilots of A330s will not require type conversion onto the A350 due to Airbus's cockpit-commonality philosophy.

The initial A350s will be powered by two new-generation **General Electric GEnx 72A1** engines that Airbus says use "new technologies to generate a double-digit improvement in fuel economy." The engines will use a pylon design originally developed for the A380.

The A350's structure will incorporate the use of lightweight materials including CFRP (carbon-fiber-reinforced plastics) and aluminum-lithium alloys. The aircraft's wing, which will be the responsibility of **BAE Systems**, will be largely manufactured using CFRP. The cabin will use solid-state lighting. The aircraft will be assembled at Toulouse.

Meanwhile, the 500-h flight-test program of the Airbus A318 powered by new **Pratt & Whitney PW6000A (PW6124A)** engines is under way, with certification scheduled for late this year.

The engine is targeted particularly at short-haul, high-use operators and is designed to offer "significant reduction in

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Aerospace research expands in Asia

Complex aerodynamic simulation and precision manufacturing systems will be two areas of focus at a newly established **Rolls-Royce** Singapore Advanced Technology Center. Rolls-Royce will work with Singapore's Agency for Science, Technology, and Research (**A*STAR**) and its research institutes on "a broad portfolio of technology challenges."

Establishment of the center will extend Rolls-Royce's collaboration with universities and government institutes in several countries. "It will be the first in Asia and is unique as our first 'one-stop' technology center," said Mike Howse, Rolls-Royce's Engineering and Technology Director.

Rolls-Royce has founded 24 University Technology Centers over the past 15 years in the UK, Germany, Italy, Sweden, and the U.S., where subjects studied include high-temperature materials, vibration, fuel cells, and noise. The company says that this work has achieved "rapid" delivery of new technologies for product developments. The new center will operate on what Rolls-Royce describes as a "virtual"



High-temperature materials will be one area of focus for Rolls-Royce and Singapore's A*STAR organization. Here, preparations are made for an engine blade-off test.

basis—with no central base but with much of the work allocated to specific A*STAR institutes.

Initial projects will involve work now under way in Singapore, embracing high-performance computing for

aerodynamic design, materials science, and modeling for fuel cells. Further projects are anticipated in the area of manufacturing systems and automation.

Stuart Birch

Managing Merlin's health

An advanced maintenance-management product is supporting UK **Royal Navy** and **Royal Air Force** three-engined EH101 Merlin helicopters. It is **Aerosystems International's** (Ael) Sapphire, which has been accepted into service by **AgustaWestland** and the UK **Ministry of Defence's** Merlin Integrated Project Team (IPT) as the core element of the Enhanced Health and Usage Diagnostic System (EHUDS), together with a Health and Usage Monitoring (HUM) processing application plus AgustaWestland's Integrated Electronic Technical Manual (C-ITEP). According to Ael, the combination forms "a coherent closed-loop maintenance-management environment," with EHUDS marking a step-change for the Ministry of Defence in the management of aircraft logistics because it facilitates an optimized maintenance regime.



Ael's Sapphire maintenance management is used in support of Royal Air Force and Royal Navy Merlin helicopters.

Sapphire is Ael's fourth-generation forward-deployable maintenance solution, providing generic functionality to electronically track, manage, and record aircraft configuration, asset status and location, and maintenance activities. It has been designed to enable the maintainer to enter data in a "simple workflow process," reducing human

error within the maintenance recording cycle.

Sapphire has been developed in J2EE using commercially available tools and is compliant with the Open Systems standards for J2EE application and the requirements of MIL-STD-498 and RTCA-DO/178B level C software. No proprietary software or hardware is required

to support the Sapphire software, says Ael. The Sapphire architecture and implementation follows the DII COE Java Development Guidelines prepared by the Joint Interoperability and Engineering Organization at the U.S. Defense Information Systems Agency.

Stuart Birch

Boeing tests for attack

In late January **Boeing** engineers completed all wind-tunnel testing for the EA-18G electronic-attack aircraft under the EA-18G System Development and Demonstration (SDD) program, validating that the F/A-18F airframe is suited to perform the electronic attack mission. According to Mike Gibbons, EA-18G Chief Engineer for Boeing, the results will be used to complete the detailed design of the EA-18G weapon system and present it to the **U.S. Navy** at the Critical Design Review next month.

The program involved five different wind-tunnel tests at several laboratories, beginning in June 2004. The Boeing team conducted a total of 1412 h of wind-tunnel testing.

High-speed performance testing was conducted on an 8% model at the **Ames Research Center** transonic wind tunnel in Mountain View, CA. Configuration testing and lateral-directional stability and control testing were also conducted with the 8% model at Ames.

Low-speed lift testing occurred at



Arnold Engineering Development Center (AEDC) Lead Outside Machinist Larry Towry inspects the 10% scale EA-18G parent aircraft and captive trajectory system store models in the wind tunnel.

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The 10% EA-18G model in the AEDC 16-ft transonic wind tunnel is configured with ALQ-218 pods on the wing tips, an AGM-88 HARM on the left outboard station, 480-gal fuel tanks on the inboard stations, and an ALQ-99 low-band pod on the centerline station.

the Boeing STOVL (short takeoff and vertical landing) wind tunnel in Philadelphia with a 15% model. Separation and jettison characteristics

for the ALQ-99 electronic jamming pods, external 480-gal fuel tanks, and the AIM-120C missiles were conducted using 10% models at the **Arnold Engineering Development Center** in Tullahoma, TN.

The final test, using a new 16% aerodynamic force and moment model, analyzed the high angle of attack for the aircraft. The test gauged the upright and inverted high angle-of-attack stability and control effects. It was conducted at the **Langley Full Scale Tunnel**, operated by **Old Dominion University** in Norfolk, VA.

According to Bob Feldmann, EA-18G Program Manager for Boeing, the EA-18G will provide improved capability and readiness, while offering a dramatic reduction in operating and support costs.

"The electronic-attack system on the EA-18G provides the flexibility to counter the threats of today and to dominate

the RF spectrum in the future, especially in the area of communications countermeasures," he said.

The EA-18G was designed by an industry team led by Boeing and **Northrop Grumman**. It is expected to provide near-term capability and the capacity to incorporate receiver advancements, integrated AESA (active electronically scanned array) radar operations, next-generation jammers, and other enhancements.

The SDD program, which runs through early FY09, encompasses all laboratory, ground test, and flight tests for the EA-18G. First flight is expected in September 2006. The EA-18G will reach initial operational capability in the Navy by 2009.

Jean L. Broge

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