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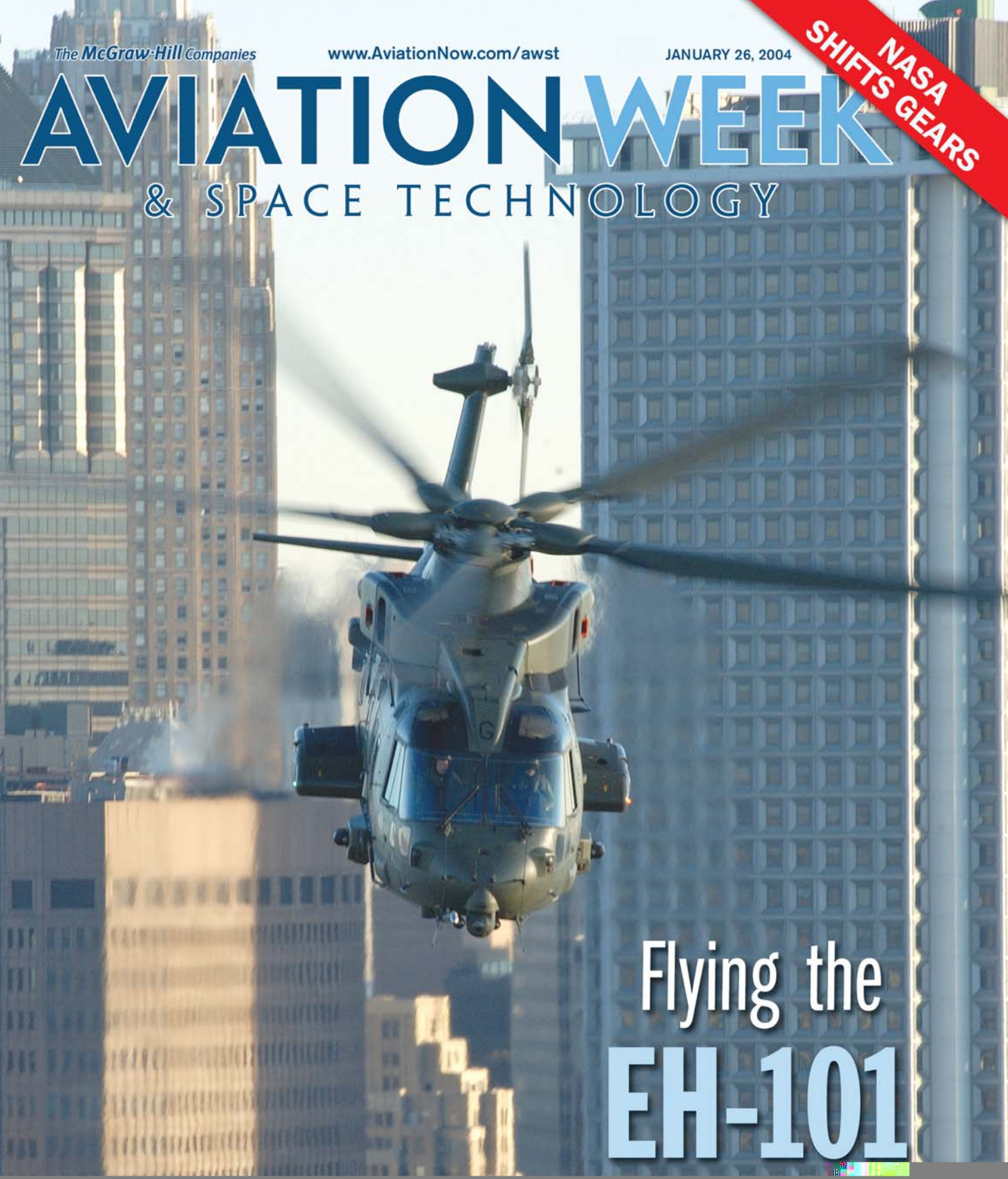
NASA SHIFTS GEARS



Flying the EH-101

Heritage Payoff

The EH-101 is put through its paces—for the most part, the review is favorable. Its abilities, coupled with strategically linked teaming, make it a viable contender for the presidential role.

DAVID M. NORTH/STAFFORD, VA.

Following the publication of the Sikorsky S-92 pilot evaluation in the Sept. 29, 2003, issue of* Aviation Week & Space Technology, *I received a letter from USAF Maj. Regan Patrick, a HH-60G Pave Hawk pilot in a combat search-and-rescue unit at Nellis AFB, Nev. Patrick chided me, noting that because I am not a rated helicopter pilot, I had omitted some specific performance parameters that would have been of interest to helicopter pilots in better evaluating the S-92. I discussed these points with him, and asked what queries should have been posed during the flight. He, and other pilots of the 66th Rescue Sqdn., sent a substantial list of questions for me to ask while flying the AgustaWestland EH-101. I have attempted to incorporate the answers into this pilot evaluation of the Merlin Mk. 3.

The team of AgustaWestland, Bell Helicopter and Lockheed Martin are counting on the more than 45,000 flight hours and proven operational record of its EH-101 to help them in their quest to provide the next helicopter for presidential service. The team is also banking on the inherent strength of the three-engine helicopter's design and performance, along with its U.S. partners' experience, to defray the home-court advantage held by Sikorsky Aircraft. That U.S. manufacturer has a strong contender for the presidential mission in its S-92, and has supplied helicopters for the executive travel role since the 1950s (*AW&ST* Sept. 29, 2003, p. 44).

Recently, the joint team strengthened its case by choosing General Electric's CT-6 engine to power its US101 candidate, rather than the alternate Turbomeca engine utilized by some countries' EH-101s. AgustaWestland and Lockheed Martin officials also are quick to point out partner Bell Helicopter's heritage, and that the Texas-based company would be chief builder of the US101.

The EH-101 had its inception in 1984 with a joint development contract between Italy and Great Britain. There were nine preproduction helicopters built starting in 1992, and 10,000 hr. were devoted to development flying. This included two EH-101s delivered to Bristow Helicopters which were flown by the support company an average of 4 hr. a day on a six-day-week basis for four years. That test phase ended in 2001, and according to Royal Air Force Wing Cdr. David Stubbs, AgustaWestland discovered that the tires, and bearings in the tail rotor, were wearing out faster than expected. Both those deficiencies were corrected, according to Stubbs.

The Royal Navy began receiving the first of its 44 Merlin Mk. 1 helicopters in 1998 for maritime patrol, anti-submarine warfare, troop transport and vertical replenishment missions. At about the same time, the Tokyo Metropolitan Police started to operate its EH-101s. The Marina Militaire Italiana received the first of its initially planned 20 EH-101s in 2000. The Italian service uses the helicopter for special operations and various traditional roles.

The Royal Air Force has been using Merlin Mk. 3s since 2000, and has received its 22 helicopters to be used in the support role. Early in 2003, the RAF sent four Merlins to fly anti-surface missions in support of the U.S. Navy in Operation Iraqi Freedom. The RAF had one Merlin in the air at all times, and the four Merlins accumulated 800 hr. total flying and 200 hr. in a 14-day period, Stubbs said. Only one sortie was scrubbed, and that was for maintenance reasons. Another two of the Mk. 3s from the RAF squadron have been operating in Bosnia since April of last year. The average availability of Mk. 3s has been 90.2%, with a high of 96.7% and a low of 84.6%.

Two RAF Merlin Mk. 3s have been performing demonstrations in the U.S. during the past few months. The service operates 22 of the medium-lift helos in the support role. This month, they were at the U.S. Navy Patuxent River, Md., facility for evaluation. The helicopters, versions of AgustaWestland EH-101, recently flew in New York. The Verrazano Bridge is in the background (right).

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The EH-101 is equipped with rear ramp, airstair and sliding cargo doors. Royal Navy and RAF experience has indicated that the interior can be altered to suit mission requirements in less than 14 hr.

EH-101 SPECIFICATIONS

Powered by three engines with either GE T700-T6A1 turbine engines with 2,145 shp. each at takeoff or RTM 322 turbine engines with 2,270 shp. each.

Length overall	74.8 ft.
Rotor disk diameter	61 ft.
Fuselage width	14.8 ft.
Cabin length	23.3 ft
Cabin width	8.2 ft.
Cabin height	6.0 ft.
Maximum takeoff weight (current)	32,187 lb.
Maximum takeoff weight (VXX)	34,400 lb.
Maximum payload	12,500 lb.
Maximum fuel load (5 tanks)	9,484 lb.
Maximum range (internal fuel)	750 naut. mi.
Maximum speed	167 kt.
Hover in ground effect (MGW)	13,000 ft.
Hover out of ground effect	4,000 ft.

The lower-than-expected rates were due to the long supply chain for parts from England, exacerbated by the fact that there were only two supply flights a week.

I had the opportunity to fly an EH-101 in the RAF Mk. 3 configuration from the general aviation Stafford Airport south of Washington in late November. Two of the Merlins had been shipped to the U.S. to support Naval Air Systems command test-and-evaluation flying planned for this month. The flight was in ZJ 121, the fifth production Merlin Mk. 3, which had returned from operations in Bosnia late last year. The flight was with the leader of 28th Sqdn., Al Dale, who had recently returned from Bosnia. The flight's crew leader was Pete Appleby; second crewman was Shaun Chanc.

Dale gave me a walk around briefing of the Merlin Mk. 3 prior to the flight. The EH-101 is at least 6,000 lb. heavier than the S-92 in the RAF version, although both helicopters would increase in size for the presidential mission, the US101 version by some 2,200 lb.

The Mk. 3 is equipped with a comprehensive integrated defensive system, including Northrop Grumman AN/AAQ-24 Nemesis Dircm, Raytheon laser detection, BAE Systems AN/ALE-47 chaff/flare dispensers and Sky Guardian 2000 RWR. The flight data and cockpit voice recorder are housed in a round container near the tail, which detaches if the helicopter goes into the water.

Unlike the S-92, where the fuel is contained in two large sponsons, fuel in the EH-101 is located below the cabin in self-sealing tanks. Program officials were quick to point out that during development testing and operational flying, the operation and integrity of the fuel system has not been a problem, and is as safe as other means of fuel storage. The EH-101 has the internal plumbing required for an inflight refueling system, but a probe has not been installed on RAF helicopters. Sikorsky officials also believe their S-92 benefited from its later certification date and newer technology, granting longer mean time between failures and time between overall for some of its components. AgustaWestland officials counter that while initial U.S. certification came in 1994, full production EH-101 civil certification was granted in 1999 and differences between requirements have only changed slightly. They also claim infinite component lives for many items, and say that rotor main blades have a 10,000-hr. life.

RAF Sqdn. Leader Al Dale, demonstrating insertion of troops capability, descends into a relatively small grass field. Four RAF Merlin Mk. 3s flew in Operation Iraqi Freedom for five months on anti-surface, troop delivery and long-range delivery missions.

The RAF helicopter was rigged for the utility role with side-facing web seats in the interior. Walking up the rear ramp into the helicopter, I noted the impressive cabin size. It is larger than that of the S-92, befitting its overall larger size and higher gross weight. While the cabin height is virtually the same in both helicopters, the EH-101 cabin is 1.5 ft. wider and more than 3.3 ft. longer. The overall larger size requires the EH-101 to be fitted with "low rider" wheels prior to being loaded on a Boeing C-17. The tail has to be prefolded, but in the naval EH-101 an electrical system is installed, and folding takes about 2 min., according to Lockheed Martin officials. The main rotor blades have to be removed, but when they are refitted on the helicopter after it's taken from the cargo aircraft, without rigging adjustments, the first flight is to confirm operation, rather than a required test flight. Time required for preparation for stowage or reassembly is under the 5-hr. target, company officials say.

Dale took the right seat, I flew from the left. The auxiliary power unit was operating so we had power to the cockpit. The RAF version of the helicopter is equipped with an eight-Smith-cathode-ray tube display for the instrument panel. Dale said the EH-101s destined for the Danish air force this year would have six LCDs installed in place of the CRTs. The Danish helicopter also will have current TCAS and GPWS installed plus a second GPS—the same configuration as on the presidential mission submission.

Continuous deicing of tail rotor blades **and sequenced deicing** of main rotor blades are provided

I found the system displays to be easy to read, and with a little study, could understand how they operate. You could tell that pilots supplied input to the engineers in the design process. The primary flight displays also were very functional, and taken overall in the flight, provided excellent situational awareness. A moving map display will be added to RAF Merlins, but is standard equipment on later versions of the EH-101. The cockpit is night-vision-goggle capable, as is the cabin, with the activation of one switch. Dale said the RAF uses the goggles for all night flights.

We started the No. 1 engine first. The left engine is tied to the auxiliary gearbox and does not directly turn the main rotors. The middle, or No. 2 engine, once started, had the main rotor turning. The No. 3 engine functions much like the No. 1. Dale said they have demonstrated the ability to go from cold helicopter to takeoff in 90 sec. While he would activate this capability later, he said that they often shut down the right engine in cruise to provide more range or greater loiter time. Nominal range for the Mk. 3 is close to 750 naut. mi. with internal fuel, but with the right engine off during cruise, can be extended to near 1,000 naut. mi. Dale said the engines have presented no problems during RAF operations, including the center engine in hot and sandy conditions.

Maj. Alex Thomson, a Canadian Air

JOHN HARRINGTON PHOTOS

Later versions of the EH-101 will be equipped with six LCDs, replacing the CRTs in Merlin series helicopters. The Merlin is fitted with Ahars and one GPS.

Reserve pilot, has flown the EH-101 Cormorant since October 1999 and confirmed Dale's statement on the reliability of the EH-101 in operational service. He said the Cormorant, equipped with General Electric turbine engines, has had no difficulties. The GE engine is not fitted with Fadecs in the Canadian version, but would be for the US101 presidential helicopters.

Dale demonstrated a short takeoff roll from the general aviation runway, with liftoff at approximately 40 kt. and we started our cruise toward a grass field in a U.S. Army restricted area. The top cruise speed of the Merlin Mk. 3 is 150 kt., so we cruised at 1,500 ft. at 140 kt., which was quite comfortable in relation to vibration and noise. Top airframe speed of the EH-101 is 167 kt. and best range speed is 130 kt. I was easily able to write on a kneeboard at the cruise speed. AgustaWestland has addressed vibration dampening in two ways. The EH-101's rotor is the same diameter as the Sikorsky H-3 series, but an advanced blade design with larger width near the tip delays the rapid rise of vibration at high speed.

Vibration dampening is primarily the task of the Active Control of Structural Response (ACRS) system. By the use of 10 sensors in the cockpit and cabin, vibration measurements are processed and canceling signals are computed and transmitted to hydraulic actuators within four transmission support struts. The ACRS system is designed to adapt to different flight regimes, and can operate in a degraded mode, if necessary. At 138 kt. Dale turned the ACRS system off, and the difference in vibration was noticeable; I was unable to write on my kneepad.

In a somewhat different approach to multifunction displays I have flown recently, speed and altitude were displayed on round dials; rate of climb with a bar. The bottom display was used for horizontal navigation while the screen to the right of the primary could have been used for the radar or infrared system in the helicopter. The RAF Merlin has a chin-mounted BAE Systems infrared system. The two center displays are used for system and engine monitoring. The EH-101 is equipped with a Health and Usage Monitoring System (Hums). And, as with most current helicopters, the EH-101 has a dedicated avionics cabinet with its own cooling systems.

Dale demonstrated how the Mk. 3 would be used for either troop extraction or insertion by flying into a relatively small grass field surrounded by trees. A second RAF Merlin was flying overhead to provide suppression fire, if required. This exercise underscored the extent of Dale's vast pilot experience as we let down and hovered in the small area. I also realized that visibility from the left seat was excellent as I looked at the ground, surrounding area and the helicopter flying overhead.

When the demonstration was completed, I took the controls and we headed for the Potomac River. Engine limits for both maximum continuous and a 2.5-min. power are shown as bugs on the torque meter scale. A torque margin indicator showed whether we might be engine or torque limited. Specific engine performance and predicted power required for hover was displayed on the aircraft management computer. Although it was somewhat alien to this fixed-wing pilot, Dale quickly explained what the parameters and limits meant in relation to the helicopter's performance. Maximum operational altitude of the EH-101 is 15,000 ft.

The flight control system compensates for yaw in turns so the EH-101 can be

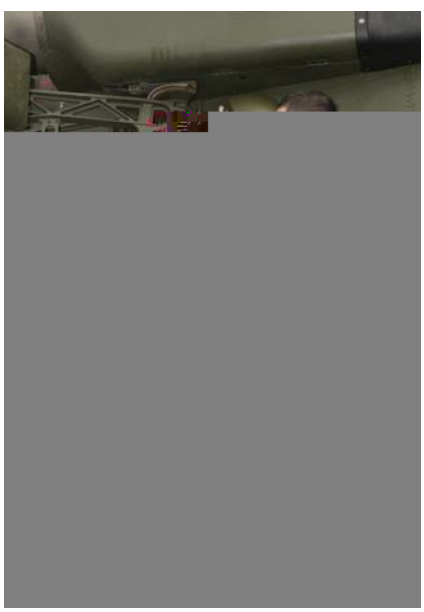
flown with feet off the pedals in flight. I found bank control to be very positive and precise once I learned the needed inputs. Pitch control was somewhat dampened, but again, the nose went where it was placed.

As we approached the Potomac, Dale had me slow the Mk. 3 to 100 kt. and engage the autopilot. With hands off, we decelerated to a hover speed and descended to 60 ft. We further let down to 20 ft. and with a hover display showing, we positioned the EH-101 over an imaginary person in the water to allow a hoist operator to assay a rescue. With my hands resting lightly on the stick and collective at the hover, Dale said not to worry as the automatic functions on the Merlin Mk. 3 have proven to be very reliable. This same automatic leveling, deceleration and hover capability can be tied to the autopilot's coupled VOR/ILS mode for landing approaches.

DURING THE FLIGHT back to Stafford I asked Dale about the deicing function of the helicopter. The EH-101 has a full electrical system, providing anti-icing to the airframe, including engine intakes and pitot tubes. Continuous deicing of tail rotor blades and sequenced deicing of main rotor blades are also provided. At present, the EH-101 is cleared for continuous operation in icing conditions down to -8C, but the company is working to expand that to -45C. Thomson, the Canadian pilot, said the system works very well and that in eastern Canada's harsh winter conditions there were times when the Cormorant was the only helicopter flying.

I continued to fly the Mk. 3, making an approach to the runway at Stafford and touching down at near 20 kt. Dale said maximum speed for a roll-on landing is near 40 kt. He then took the helicopter to a grassy area near the runway and had me operate the rudder pedals while he held on the collective and stick in the hover. Rotation in the hover was quick and I realized that, at hover, the helicopter was in a horizontal attitude. I then individually took control of the stick and collective, while Dale operated the two other controls. Following a hover at 20 ft. where we stayed almost stationary, I landed the Merlin in the grass. Following this exercise, I felt more comfortable as a helicopter pilot.

Dale then performed a takeoff and shut down the No. 3 engine on the downwind to the Stafford runway. In the cockpit, you could not tell the difference at 100 kt., and Dale indicated that plenty of power margin was left, and there would be ample margin remaining if we had been at maximum gross weight. Engine and transmission limits with one engine out still make available more than 75% of the power to the pilot.



RAF Merlins are equipped with dual-rescue hoists with hover trim controller. Turbomeca engines power RAF helos; Canadian Cormorants use GE engines.

Al Dale (far left) shows David North the Flir mounted in the Merlin Mk. 3. The helo also is equipped internally for inflight refueling, although the external probe is not installed.

The flight lasted for 1.2 hr. in which time four landings were executed.

While the competition for the next presidential helicopter is more imminent and a win would be very important for AgustaWestland, Bell and Lockheed Martin, the combined team is also looking at other potential programs. A candidate for a future combat search-and-rescue helicopter for U.S. forces would be based on the US101 aircraft and engine combination, along with the same rear ramp configuration and dynamic systems. The avionics suite and defensive electronics also could be similar to that proposed for the presidential replacement helicopter.

A US101 version will be proposed to the U.S. Coast Guard, as well, when the service reaches later phases in its "Deepwater" program and is looking for increased range for the helicopter fleet.

Win or lose in their quest for the presidential helicopter buy, the combined team is doing its best to promote the time in service and operational successes of EH-101 as well as US101's U.S. roots and connections. Whether the combined team was able to oust the entrenched Sikorsky team and its S-92 contender should be known by mid-2005.

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IT TAKES A LEADER.

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Leadership: it means experience – 45,000 flying hours and counting. It means performance during adversity: proven by our coalition forces in Iraq, fielded in Bosnia and operational around the world. And it means the ability to offer solutions and create value. The US101, American built, will create American jobs and