T-50 Flight Testing

Rhode Island C-130J Ops

US101 and CSAR-X
Hospital patients from Beaumont, Texas, en route to one of the many medical facilities set up to care for evacuees from Hurricane Rita are taken off a C-5 Galaxy from the 21st Airlift Squadron based at Travis AFB, California, on 23 September. For more on the relief efforts for Hurricanes Katrina and Rita, please see page 28.
T-50 TRIUMPHS
Supersonic Trainer Transitions From Test, To Production, To Operations

GENERATION GAP
Fifth Generation Fighters Fundamentally Change Combat

AIRCRAFT AND ARTIFACTS
Air Force History On Display At Wright-Patterson

LANDING ON THE LAWN
Hail To The Chief’s New Helicopter

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EVENTS

About The Cover
Front: The T-50 Golden Eagle supersonic trainer is in production and the Republic of Korea Air Force will soon begin training the initial cadre of instructors followed by the first class of students. Photo by Eric Hehs
Back: A formation of Hellenic Air Force F-16s from Nea Anchialos flies over snowcapped mountains near Volos in central Greece. Photo by Katsuhiko Tokunaga
“The T-50 represents a technological and manufacturing achievement for Korea,” says Hae Joo Chung, president and chief executive officer of KAI, which hosted the rollout ceremony for the first production T-50 advanced jet trainer at Sacheon in August. “Roh Moo-Hyun, president of Korea, attended the ceremony, which was broadcast throughout Korea as well as to international media outlets around the world,” he adds.
“The rollout raised awareness of the T-50 within Korea. Our citizens are proud of the aircraft because they realize their country is one of a select few with the ability to design and manufacture supersonic aircraft. That awareness increased further when we exhibited and performed air demonstration routines with the T-50 for the first time at the Seoul Air Show in October.”

T-50 familiarity is also building worldwide as the program transitions from test at Sacheon, to production, to operational status. More than 1,200 sorties were completed in the four full-scale development aircraft as of September 2005. The first T-50 aircraft was used to expand the envelope and evaluate stability and control and handling qualities. The second aircraft has been used for air loads and high angle of attack testing. The third aircraft, the first T-50 lead-in fighter trainer, or LIFT version, has been used to evaluate the avionics. The fourth aircraft (another T-50 LIFT version) has been used to test the radar and various weapons and other loadings.

Two ground test aircraft were used for durability, full-scale static, and vibration testing. The Republic of Korea Air Force, or ROKAF, is considering an extension of the flight test program to cover additional weapons testing.

“We met schedules and overcame technical risk during the last two years,” explains Enes Park, senior vice president and production director for KAI. “We completed hundreds of test points with our flight test aircraft and signed off on the first production contract with our government. At the same time, we used what we’ve learned in flight tests to improve the design and made a lot of progress on the shop floor. These changes have been introduced on the production line.”
HISTORY OF COMMITMENT

The T-50 program represents a significant investment for both Korea and KAI. The total investment in the T-50 program amounts to more than $2 billion. Seventy percent of the funding comes from the Korean government, seventeen percent from KAI, and thirteen percent from Lockheed Martin.

“Our government invested in the T-50 program for many reasons,” explains Chung. “Most importantly, government officials wanted full authority over the design and development of the aircraft so that it meets requirements set by our air force. They also wanted to use the program as an industrial tool to give Korea the capabilities needed to design, develop, test, and verify new aircraft. With the T-50, the government has achieved both of its objectives.”

Those achievements are viewed as pinnacles by the Korean government and by its aerospace industry, which has progressed from basic efforts to more advanced aerospace accomplishments during the last two decades. These accomplishments can be traced to the late 1970s when Korean Air Lines performed depot-level maintenance on US Air Force aircraft based in the Pacific. Daewoo, Hyundai, and Samsung established similar capabilities soon afterwards. KAL began assembling F-5Es for the ROKAF in the 1980s. During these formative years, Korean manufacturers consistently received high marks for their workmanship and quality. They subsequently won contracts to produce a wide range of components and subassemblies for other aerospace companies, including for Lockheed Martin.

South Korea began developing its first aircraft in 1988. This turboprop trainer, the Daewoo KT-1 Woong-Bee, first flew in 1991, entered service with the ROKAF in 2000, and has accumulated thousands of flying hours since. In the meantime, Samsung, and later KAI, became the prime contractor for the Korean Fighter Program. KFP, as it is known, involved the licensed production of more than 120 F-16s for the ROKAF. The last of these KF-16s rolled off the KAI assembly line at Sacheon in August 2004, and KAI continues to produce F-16 sub-assemblies at a plant in Changwon.

“Korea has shown its capability to design, develop, produce, manage, and deliver aircraft,” reiterates Alex Wanki Jun, T-50 international marketing director for KAI. “Today the pressure is on us to sell the airplane. The T-50 is developed; production versions are rolling off the assembly line; and deliveries to ROKAF begin in December. Now we have to find new customers.”

Several factors simplify Jun’s marketing challenge. The Golden Eagle has strong selling points, including unique features that give it the ability to bridge the gap between existing trainers and modern fighter aircraft. (The accompanying side story provides more details.) The aircraft is also part of a larger, integrated training system that includes simulators, computer-based training, cockpit and maintenance trainers, and a training management system. These systems can be tailored to the specific needs of any customer.

The advanced age of existing training fleets around the world further increases the appeal of the T-50. With most trainers in operation for thirty or forty years, many air forces facing the prospect of expensive upgrades may instead choose to overhaul the way they train pilots. The T-50, combined with its modern ground-based training systems, can significantly reduce the number of flights and flight hours required to produce a fighter pilot. Improved training and cost savings are the ultimate rewards.

POTENTIAL SALES

“We hired a consulting group in 1999 to study the potential for the T-50,” Jun notes. “They looked at two markets—advanced jet trainers and light combat—for a thirty-year period and found a worldwide requirement of 3,300 airframes.

“Since the study, purchase decisions by several countries have been delayed because of the lower priority given to the acquisition of new trainers,” Jun continues. “This new schedule creates an important timeline from 2008 to 2012 when a lot of airframes around the world will reach their age limits, and air forces will have to replace them with such aircraft as the T-50. Singapore, Greece, Poland, Israel,
and several other countries plan to purchase aircraft in that time frame.”

Several other factors affect the total number of potential sales. For one, some air forces may not seek to replace their training assets on a one-to-one basis. For another, ground-based training systems have improved so much the last few years that not as many training aircraft are required to perform actual flying.

Three or four training aircraft are competing for the roughly 2,000-aircraft potential that remains after such considerations are factored into the equation. The T-50 is widely recognized as a top contender for many of these sales. It is also the only new supersonic trainer available. Not coincidentally, several countries have expressed interest in the Golden Eagle.

Those potential customers might want to speak to Hui Man Kwon, the first company test pilot for KAI on the T-50 program. Kwon, called He-Man by his colleagues, is one of seven test pilots. Two are KAI pilots; the remaining five are ROKAF pilots. To date, Kwon has accumulated 140 hours in the T-50. He also accumulated more than 1,000 hours in the F-16 as a fighter pilot in the ROKAF, many of those hours spent as an instructor pilot. As a graduate of USAF Test Pilot School at Edwards AFB, California, he flew more than thirty varieties of aircraft.

“My F-16 experience made me very comfortable with my first flight in the T-50,” he says. “The cockpit concepts are very similar and both aircraft have exceptional flying qualities. The T-50 behaves very much like an F-16, sometimes even smoother than an F-16 in some flight regimes. Visibility from the rear seat of the T-50 is much better than from the rear seat of an F-16. The stick sensations are also quite different. The T-50 has an active stick, that is, stick movements in one cockpit—front or rear—are transmitted to the stick in the other cockpit. The active stick makes monitoring stick movements of the front cockpit easy for an instructor in the rear cockpit, and vice versa. By comparison, the F-16 stick is fixed with no transferred movement front to rear or vice versa.

“Transitioning from the T-50 to the F-16 will be very easy,” continues Kwon. “I’d say the transition could be made with ten or fewer sorties if the student pilot is comfortable in the T-50. However, any pilots transitioning from conventional fighters require at least thirty to forty training sorties to safely fly the F-16. After our air force implements the T-50 into its training system, students should be able to move directly to an F-16 with minimum transition flights.”

Off-loading training requirements from operational conversion units in terms of manpower and aircraft usage is yet another advantage of the T-50. As the ROKAF incorporates the T-50 into its force structure, this advantage will become more measurable.

The first T-50 will be delivered to the ROKAF in December. Initial instructor pilot training will start at Sacheon AB soon after. The initial instructor pilots will then move to Kwangju AB where they will generate an initial cadre of instructors. After ten to fifteen instructors are fully trained and qualified, training of the first ROKAF students will begin.
A thoroughly modern T-50 production line is geared to support those training plans. “The rollout of the first production aircraft in August was just a start for us,” notes Park. “We celebrated; now we get to work. KAI will deliver two aircraft in 2005 and eight aircraft in 2006. After that, KAI will deliver about one aircraft per month.”

The Sacheon T-50 production line can impress the most critical industrialist. A wholly digital design provides the basis for a near paperless production process. Work instructions appear on video screens at every workstation. Laser alignment systems help workers mate major assemblies with micrometer precision. On the production line, workers are physically fit and take their jobs very seriously. Teamwork is emphasized and practiced by all up and down the line.

The production line itself is another selling point. Designed for a 1.5-aircraft-per-month production capability with a single shift, the assembly process can produce up to 2.5 aircraft per month by simply adding another shift. “We don’t have a problem meeting customer requirements for twelve aircraft in one year,” explains Man Sik Park, director of the T-50 management team at Sacheon. “If a new customer signs up for T-50 trainers right now, we could deliver those aircraft in three years. Getting more customers than our line can currently handle is no problem because we can increase the production rate further with additional tools and assembly jigs.”

Potential T-50 sales enjoy another important advantage: the luxury of a relatively long production schedule. KAI currently has a firm order from ROKAF for twenty-five aircraft. Additional contracts account for the remaining sixty-nine of the planned production run of ninety-four T-50s. These ROKAF orders will span as many as three Korean budget cycles, to 2012.

“T-50 variants, such as the A-50, will likely extend that schedule,” notes Sung Sub Jang, senior vice president and general manager of the research and development division for KAI. “We are also studying more advanced single-seat versions of the aircraft, called the A-50+. The aircraft could replace ROKAF’s F-5s and extend the production run for ROKAF aircraft another six years or longer.”

“The aircraft has a lot of potential,” adds Rich Loman, deputy program director of the T-50 program for Lockheed Martin. “It is a great design with proven systems in addition to a proven engine in the F404. Nothing will stop KAI once the company completes its first international T-50 sale and shows how it can meet commitments.”

“Many countries have expressed great interest in the T-50,” concludes Chung. “The future of T-50 will be bright, with KAI’s partnership with Lockheed Martin an essential part of that future. Our relationship goes back more than twenty years with coproduction and then licensed production of our F-16s, both successful programs. We see our relationship continuing with Lockheed Martin as a major player in the T-50 program. Currently, Lockheed Martin provides technical assistance to our ongoing production program. Later, Lockheed Martin will support our development of future aircraft configurations. Together we will market T-50 sales internationally. Our relationship and our combined efforts ensure a successful program.”
The T-50 looks much like a two-seat F-16 from an overhead perspective. A blended wing/fuselage, single vertical tail, and the general planform shape are similar. With a length of forty-three feet and a wingspan of thirty feet, the T-50 is about four feet shorter than the F-16. The control surfaces and tails are larger relative to the smaller size of the T-50. The extra area improves handling characteristics at lower speeds and makes the aircraft easier to land. Other distinguishing characteristics include a canopy bow that provides additional bird strike protection; a narrower, more streamlined nose that corresponds to smaller radar requirements; and larger landing gear to absorb harder landings.

The most distinctive features of the T-50 are its twin side-mounted inlets that direct air to a single General Electric F404-GE-102 engine. The after-burning engine is a proven, reliable design. The engine incorporates dual-channel full-authority digital electronic control optimized for safety and maintainability. More than 3,700 F404s have been delivered worldwide, accumulating more than 12 million flight hours combined. The engine produces 17,700 pounds of thrust, giving the aircraft an exceptional thrust-to-weight ratio.

The maximum takeoff gross weight is 29,700 pounds; the maximum rate of climb is 39,000 feet per minute; and the maximum speed is Mach 1.5. The service ceiling is 55,000 feet. The design load factor is eight g's; the trainer airframe is designed for up to 10,000-hour service life (8,300 hours for the lead-in fighter trainer version).

The T-50 has an onboard oxygen generating system that simplifies maintenance tasks and reduces the amount of necessary ground equipment. A triple-redundant electrical system increases safety. Relaxed static stability and fly-by-wire digital flight controls offer superior aerodynamic performance and handling qualities.

Modern cockpit features include hands-on throttle and sidestick mechanization, electronic flight instruments, head-up display, up-front controls, two five-by-five-inch color multifunction displays, integrated advanced avionics and sensors, GPS/INS navigation, embedded training features, in-flight recording and post-mission debriefing capability, and a Martin-Baker zero-zero ejection seat. The seatback angle is seventeen degrees—similar to the seat angles of the F-35 Joint Strike Fighter and the F/A-22.

The aircraft is designed for low-speed approach landings. A larger tail, flaperons, and rudder make the T-50 easier to control at lower speeds. In addition, the control surfaces move at faster rates to further improve handling characteristics. By design, the aircraft lands better than most fighters. The angle of approach is lower than that of an F-16 so the pilot has a better forward view on landing. The raised aft seat gives instructor pilots a much better view in front of the airplane as well. The flight control sidesticks in the front and rear seats move together so that instructor pilots can feel student pilot inputs.

The aircraft is designed to display the performance needed to support lead-in fighter training missions. This LIFT version of the aircraft features an APG-67 multimode fire control radar, a modified M61 three-barrel 20 mm internal gun, a weapons management system, and seven hardpoints for carrying up to 9,500 pounds of a variety of air-to-air and air-to-ground weapons. (The standard T-50 has no radar or internal gun.)

T-50 Golden Eagle

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GENERATION GAP

BY WALTER BOYNE
Maj. George A. Davis and his wingman, 1st Lt. William Littlefield, patrolled alone in MiG Alley on 10 February 1952. Below them flew twelve Mikoyan-Gurevich MiG-15s about to pounce on Republic F-84 fighter bombers attacking railroad lines near Kunuri. The thirty-year-old Davis, commander of the 334th Fighter Interceptor Squadron of the 4th Fighter Interceptor Wing and the leading American ace with twelve victories, was on his sixtieth mission over North Korea.

The first American to be an ace in two wars, Davis dove his North American F-86 Sabre through the MiG formation, blowing up one MiG on his first pass and then quickly shooting down a second. Ignoring the cascade of fire coming from two flights of MiGs to his rear, he decelerated and maneuvered behind a third MiG. A hurricane of enemy 23 mm and 30 mm shells exploded into Davis’ Sabre, sending it out of control and crashing him into a hillock thirty miles south of the Yalu.

Davis’ attack completely disrupted the MiGs’ attack and allowed the F-84s to complete their interdiction mission. For that valor, he was posthumously awarded the Medal of Honor and promoted to lieutenant colonel.

Davis’ heroic fight in the Korean War underscores the importance of skill and training. It also shows that, in a fight between two aircraft, each representing the peak of second-generation jet fighter technology, the final outcome depends on such variables as surprise, position, numbers, and altitude. These same concepts, true through the first four generations of jet fighters, explain how nations with vastly different resources often managed to produce highly competitive aircraft. The Meteor offset the Me 262; the Sabre matched the MiG-15; the Mystere compared with the North American F-100; the MiG-21 countered the McDonnell Douglas F-4; and the Rafale battles the Sukhoi Su-27.

While both early flights furthered jet aviation, the first flight of a third experimental aircraft received credit for being the first jet flight. This aircraft, Italy’s Caproni-Campini CC-2, was first flown on 27 August 1940. A hybrid, it used a 900 hp Isotta Fraschini L.121/R.C.40 internal combustion engine to drive a compressor with a primitive afterburner fitted aft of the compressor. The Caproni-Campini flight was recognized as the first jet to fly by the Fédération Aéronautique Internationale, the international aviation record sanctioning body, as the first flight date of the He 178, made in secret, was not known until after World War II.

The first true jet fighter was the twin-engine Heinkel He 280, first flown 30 March 1941. The He 280 featured such advances as a tricycle
landing gear and a compressed-air ejection seat, but its airframe belonged to the piston-engine era. It was distinguished only by its HeS 8A centrifugal flow turbojets, replaced in later aircraft by the Junkers Jumo 004. Although the He 280 handily defeated a Focke-Wulf Fw 190 in mock combat, the Luftwaffe canceled the program to proceed with the world’s first operational jet aircraft, the more capable Messerschmitt Me 262 Schwalbe (“Swallow”).

The Me 262, with its 540-mph top speed and heavy armament of four 30 mm cannons, could easily have made it the best combat fighter in World War II. But slow delivery of the Junkers Jumo 004 jet engine and other factors delayed the Me 262’s combat entrance until late summer 1944. Of the 1,300 or so Me 262s built, only about 300 ever saw combat. As a result, the Me 262 had little effect on the outcome of the war.

Great Britain’s first operational jet fighter, the Gloster Meteor, had its first flight on 5 March 1943. The prototype was powered by de Havilland Halford H.1 turbojets, but production aircraft used the Rolls-Royce version of the Whittle W.2 design. The Meteor engaged in the first jet-versus-jet combat when it battled the unpiloted Fiesler Fi 103 “V-1” Buzz Bomb. To the disappointment of historians, the Meteor and the Me 262 never met in combat.

In 1942, the US Army Air Corps forfeited a chance to participate in the earliest rounds of the jet age by rejecting a Lockheed proposal for the L-133. A Kelly Johnson design, the L-133 featured a blended wing and body, canard-surfaced jet fighter powered by two axial flow turbojet engines.

Instead of the L-133, the first American jet fighter was the less-than-lethal Bell XP-59A Airacomet. The Bell design was flown for the first time 1 October 1942. Powered by two General Electric Type 1A turbojets, developed from Whittle’s work, the aircraft’s poor performance relegated it to training duties only.

The Army Air Corps did turn to Lockheed for its first production jet fighter, the P-80. The first product of Skunk Works, the XP-80 took its maiden flight 8 January 1944. While three P-80s arrived in Europe before the war ended, none saw action. Korea presented action aplenty, however, where the P-80 Shooting Star, re-designated F-80, distinguished itself in ground attack and reconnaissance roles. The basic design then extended to include the T-33 trainer and F-94 Starfire interceptor aircraft.

THE NEXT GENERATIONS

Even before World War II ended, designers sought to maximize fighter performance by tailoring the airframe to the potential of the jet engine. The most important new development of the second-generation jet fighter was true swept wings specifically designed to delay the onset of drag associated with high Mach numbers.

Such aircraft as the F-86, MiG-15, Saab J-29, Hawker Hunter, and Grumman F9F Panther and Cougar were optimized for transonic speeds. These beefed-up airframes required new types of boosted controls, improved ejection seats, better cockpit pressurization, and the refinement of aerodynamics so that the fighter provided a stable gun platform at high speeds and high-g loads.

The Saab J-29 Tunnan (“Flying Barrel”) built by Sweden was the first swept wing fighter to enter service in Western Europe. It flew for the first time on 1 September 1948. Saab built some 660 J-29s, which illustrates that a small country
can field a first-line jet fighter with performance comparable to the best of its era.

The third-generation of jet fighters heralded a proliferation of new designs and capabilities: supersonic speeds, sophisticated missiles, and high-output turbojet or early turbofan engines.

This third generation also included the remarkable Century series, which began with the first operational American supersonic fighter, the North American F-100. Within six years (from 1951 through 1956), fighter and engine design took a giant leap the world over. In that time, at least eleven world-class fighters debuted: the F-100, Convair F-102 and F-106, Lockheed F-104, McDonnell F-101, MiG-17 and -19, Dassault Etendard and Mirage III, Saab Draken, and the English Electric Lightning.

This sudden flowering of jet design incorporated many advances: delta wings, more highly swept wings, more powerful yet more fuel-efficient engines, sophisticated fire control and navigation systems, and in-flight refueling. Later aircraft of this generation were far more sophisticated and possessed much greater capability. The Republic F-105, MiG-21 and -25, McDonnell F-4, and the Saab Viggen belong in this generation.

Even as speed, altitude, and firepower increased, jet fighters still faced hard combat lessons in Vietnam and in the Middle East. Vietnam War politics restrained US forces and enabled a relatively few older MiG-17s and -19s along with the newer MiG-21s to dictate terms of combat. The result was a discouraging victory ratio for US forces that ranged from a low of one victory to two losses to a high of four victories to one loss.

These wartime lessons meshed with the emerging computer age as digital electronics were incorporated into the design and production process as well as into the new aircraft designs. What resulted was a tidal wave of technological advances in fourth-generation jet fighters: the General Dynamics (now Lockheed Martin) F-16, Grumman F-14, McDonnell Douglas F-15 and F/A-18, Dassault Rafale, Eurofighter Typhoon, MiG-23 and -29, Saab Gripen, and Sukhoi Su-27.

These vastly superior aircraft generally possessed high-output turbofan engines, infinitely more capable and reliable electronics, fly-by-wire control systems, zero-altitude ejection capability, improved ordnance, and an ever-increasing number of onboard computers.

Another development was that companies and even countries teamed to reduce research and development risk and enhance fighter capabilities. The Lockheed F-104 pioneered these efforts during the 1950s; the F-16 cemented international cooperation in the 1970s.

The increased cost of these latest fighters strained military budgets everywhere and dictated the aircraft be adapted to both air-to-air and ground attack roles.

Among these fourth-generation aircraft, the F-15 and F-16 emerged earlier than their foreign equivalents and established a reputation for air dominance unchallenged for years. As foreign-built fourth-generation contenders emerged, their US counterparts maintained their lead with significant advances in radar and engine performance as well as improved air-to-ground capabilities, including night, all-weather, and precision attack.

Even with these improvements, fourth-generation fighters fielded by the United States and its allies face serious competition by such aircraft as the Su-27,
MiG-29, and MiG-35. For example, the advantages of US F-15 fighters were put in question by highly motivated, well-trained Su-30K pilots of the Indian Air Force during Cope India exercises in 2004. Fourth-generation fighters also face more advanced ground threats in the form of “double-digit” (e.g., SA-14) surface-to-air missiles.

On the Eastern front, China is rapidly moving toward an indigenous air-and-space capability suitable for a superpower. It is plausible that China will build aircraft and missiles in numbers compatible with its population and growing wealth and will create training programs to produce pilots with skills to match their Western—and Indian—counterparts.

THE FIFTH GENERATION

The overriding characteristic of fifth-generation fighters is integrated very low observable, or VLO, stealth. Stealth relies on shape, materials, and internal weapon carriage. The result is a very low radar cross section even when fully configured for combat.

The fifth-generation fighter takes advantage of the previous generations of stealth technology developed and matured for the B-2 bomber and AGM-129 Advanced Cruise Missile to become more than just a fighter generational evolution. This combination of near-invisibility to an enemy along with fighter maneuverability establishes fifth-generation platforms as more a part of a revolution than an evolution.

A particularly important advance of fifth-generation stealth is its ease of maintenance. Stealth maintenance on the early F-117As required fifty man-hours per flight hour; at maturity, stealth maintenance on the fifth-generation aircraft will require minutes of maintenance per flying hour.

Fifth-generation fighters combine stealth with huge improvements in integrated avionics and supportability. Stealth, agility, performance, fused-information, improved situational awareness, and network-enabled operations all combine to create advantages never seen before in previous fighter evolutions.

Other critical factors include an emphasis on reliability, maintainability, and sustainability—the capability to fight day after day without extensive maintenance. Fifth-generation maintenance requirements will be one-third the maintenance requirements of the legacy aircraft they replace. They also have the ability to deploy more rapidly.

The fifth generation, therefore, is really defined by two fighters, the F/A-22 Raptor and the F-35 Joint Strike Fighter. By fielding a fifth generation of jet fighters, the United States establishes a true generation gap unapproachable by a single power or a combination of powers. The F/A-22 and F-35 offer obvious complementary advantages.

Both have all the features that define fifth-generation fighters, but the F/A-22 adds the unique features of high-altitude supercruise and extraordinary agility. These attributes allow it to more efficiently secure immediate air dominance in any environment.

Among all fighters—current as well as future, including the F-35—the F/A-22’s ability to supercruise (fly at greater than Mach 1.5 without the use of afterburner) adds to the kinetic energy imparted to its missiles at launch while simultaneously denying the enemy time in which to respond. Supercruise also allows for increased supersonic persistence and decreased adversary reaction times.

In combat, the integrated avionics system gives a God’s eye view of the combat scene to every pilot in a data-linked flight of F/A-22s, raising the concept of situational awareness to a universal level. This universal situational awareness enables Raptor pilots to concentrate on tactics. They
don’t have to spend time integrating separate data inputs from multiple sensors. The F/A-22 enables pilots to see and destroy enemy fighters and missile sites before either is aware of the Raptor’s presence. If a threat gets within dogfighting range, the incredible agility of the thrust-vectored Raptor ensures close-in success.

A less-obvious relationship between the F/A-22 and the F-35 is their unprecedented exchange of technology. Lessons learned on the F/A-22 are built into the F-35, while advances from the F-35 are retrofitted into later-block Raptors.

The extraordinary performance of the two aircraft is dependent upon their powerplants, and these are inextricably linked. The F/A-22 is powered by two Pratt & Whitney F119 engines with about 35,000 pounds of thrust each. The core section of the F119 was used to develop the P&W F135 for the F-35. General Electric is developing the F136 engine to be interchangeable with the F135.

The F-35 adds its own unique features that focus on basing flexibility, as its three versions are individually designed to operate from carriers, conventional runways, or extremely short austere strips. With both good-range and high-payload capacity in non-stealth mode, the F-35 will be able to secure immediate strike dominance.

The F-35A is optimized for the US Air Force; the F-35B offers short takeoff and vertical landing for the US Marine Corps; and the F-35C operates off large aircraft carriers. The F-35B is the world’s first stealthy, supersonic, STOVL strike fighter.

The design of the F-35 incorporates advances in electronics not immediately available to the F/A-22. These advances—fourth-generation active electronically scanned array radar with half the weight, half the cost, and twice the reliability of the third-generation F/A-22 AESA—will be retrofitted to later-block F/A-22s. The active and passive capabilities of the F-35’s radar exceed any previous radar and can generate long-range, high-resolution synthetic aperture radar maps of unprecedented size.

Other advances featured in the F-35 include a distributed aperture system, which acts as an infrared sensor and provides a protective sphere around the aircraft to alert the pilot to any threat; an internally mounted electro-optical targeting system that provides long-range, high-resolution target recognition; an integrated communications, navigation, and identification avionics suite, which provides lethal beyond-visual-range recognition and intraflight data exchange; an advanced electronic warfare and countermeasures system; and a helmet-mounted display with the most advanced head-tracking system available.

These systems combine to optimize fighter tactics through the OODA loop—observe, orient, detect, and act—as defined by fighter tactics guru John Boyd. These systems depend on the aircraft’s integrated core processor, which presents all incoming information to the pilot in an optimized form.

There is also an X factor. Ingenious future aviators will use the capability of these aircraft beyond the standard air-to-air and air-to-ground regimes. Examples could include intelligence, surveillance and reconnaissance, and advanced electronic attack, both of which show promise to radically change the use of tactical aircraft.

The F/A-22, now operating at three USAF bases, and the F-35, scheduled for first flight in 2006, will stand alone for decades to come. No other fifth-generation fighters exist and none appear on the horizon. The fifth generation will be with us for the rest of the century, and one can only speculate about the advances to be found in the sixth generation and beyond. Weapons will change over time, with directed energy coming to the fore, along with satellite-linked missiles.

And, as much as pilots may hate the idea, a generation of stealthy, agile, and lethal unmanned fighters may someday be flying under the control of pilots in sixty-year-old F/A-22s and forty-year-old F-35s.

Walter Boyne, former director of the National Air and Space Museum in Washington, DC, is a retired Air Force colonel with more than 5,000 hours in a score of different aircraft. He is also an aviation author and historian who has written more than 400 articles and forty-seven books on aviation topics.
The business end of a Lockheed P-38J Lightning
“Aviation buffs will go to a cornfield to look at an aircraft,” says retired Maj. Gen. Charles D. Metcalf, director of the National Museum of the United States Air Force at Wright-Patterson AFB, near Dayton, Ohio. “But more than the hardware, the story of the Air Force is what people come to see. Most of our visitors know little about the aircraft we have on display. They are more interested in the history of the people who flew the aircraft and the wars they fought.”

The museum, which dates back to 1923, is the oldest military aircraft museum in the world. It is also the largest military aviation museum, growing from 8,100 square feet in 1927 in the corner of a hangar at McCook Field near Dayton to seventeen acres of indoor exhibit space today. About 40,000 visitors passed through the doors of what was then known as the Air Force Museum when it first opened to the public in 1955. Today, a ninety-six person staff and more than 500 volunteers keep the museum running for the more than 1.2 million people who come through the doors annually.

The museum’s collection has grown exponentially as well. What began as a couple of World War I biplanes now includes more than 300 aircraft, missiles, and spacecraft of all types on display, many of which are one of a kind. The collection also claims more than 50,000 artifacts that range from patches, uniforms, and flight suits to an 11,000-pound runway roller, a parachute for a dog, and a pair of pajamas.

“We can usually get the aircraft we need. It’s the personal mementos we really want,” says senior curator Terry Aitken. “We are interested in the total Air Force experience. We care as much about a snapshot of an airman working at an isolated radar site as we do about a casing for a nuclear weapon.”

**Bits of History**

“We are still getting World War II-era artifacts,” continues Aitken. “Unfortunately, most are not coming from veterans. They are coming from the family of a veteran who passes away. More and more artifacts from the Vietnam era are being donated. People donate items because, in some small way, they want their personal stories told.”

Advancing technology can make telling those stories more difficult. “People gave us black and white photographs and pieces of paper in the old days,” Aitken continues. “But now, what can we do with a big floppy disk? We have no equipment to read it. While we need the artifacts and data, we also need a way to capture it. During Vietnam, people made audio cassettes instead of writing letters. But magnetic media have a limited lifetime. We also have a similar problem with 8-mm film, which gets brittle and discolored with age. A lot of history from Vietnam was recorded on Super 8 film.”

Sometimes the donations are serendipitous. During World War II, Chinese workers used solid stone rollers to construct airstrips for American aircraft. Hundreds of workers pulled one roller weighing nearly 11,000 pounds over rocks to make compressed gravel runways. These airstrips were often 8,500 feet long. “We had a display with a photo of one of these rollers being pulled in Kunming,” says Aitken. “Some Chinese visitors came in one day, and they were astounded that we cared about their stone roller. They said they still...
had one and asked if we would like to have it. Obviously we did want it, and it was shipped here using opportune airlift on a C-5.”

Within the last ten years, Vietnam War veteran communities have begun to organize themselves. “The Vietnam vets, a very diverse community, are starting to coalesce,” says Aitken. “For instance, we worked with the forward air controllers’ association and asked what their members would like to see included in their exhibit. Thank goodness for the Internet. Veterans are much more inclined to contact us, and they can reach us easily. We get previously untapped sources coming to us.”

Other military operations such as Grenada, Mogadishu, or Kosovo are short lived and don’t involve many military personnel. For example, only a small handful of Air Force personnel served in Operation Urgent Fury in Grenada in 1983. “An AK-47 rifle picked up off the ground in Grenada isn’t what we are looking for,” says Aitken. “We want memorabilia generated specifically for that operation, such as challenge coins. Those artifacts are a lot harder to find. But wouldn’t it be neat to display candid photos of Grenada instead of just official Air Force photos?”

The Dayton museum was recently recognized in Museum News, the journal of the American Association of Museums, as one of sixty international museums that “change the way one sees the world for a time.” In fact, the museum is one of only two aviation museums—the other being the National Air and Space Museum—to be included. The list includes such heavyweights as the Louvre, the Getty, and the Metropolitan Museum of Art. Of course, one of the main reasons the National Museum of the United States Air Force appears on this list is its wealth of aircraft.

**BIGGER BITS OF HISTORY**

Acquiring current aircraft for the collection is pretty easy. “We get first choice of any aircraft in the Air Force
we want,” says Aitken. “It is often a case where we choose a specific aircraft because of one specific mission. That kind of information gets documented by the Air Force. All things being equal, we prefer an aircraft with a story.

“The C-141 is a good example,” continues Aitken. “Every one of them has done a lot in its career. The aircraft known as Hanoi Taxi has done what every other aircraft has done, except it was the first aircraft into North Vietnam to repatriate the POWs. For sure, that aircraft is coming here. We have a hold on one KC-135 that brought six damaged fighters home after a mission in Vietnam. But we also have backups identified, in case the primary aircraft we want is involved in an accident before it is retired. Every aircraft we accept has a dossier, and it has to help tell the Air Force story.”

But not every aircraft is flown in, cleaned, and immediately displayed. Most of them require years of restoration. “We have at least a twenty-five year backlog of aircraft that need to be restored,” says Myrl Morris, the former chief of the museum’s restoration division.

A complete restoration is much like building a new aircraft. “We plan the restoration and how thorough it has to be. We find out what parts we have, what parts we don’t have, what parts we need to make from scratch,” says Morris. “We take photographs before and after the restoration. That way, anyone wondering why we made a certain repair—even fifty years from now—will know why. We document everything.”

The toolboxes in the two restoration hangars would be appropriate for a flightline of 1918, 1930, or 2005. “We could be working with composites on the YF-22 today and the fabric for a World War I SPAD fighter tomorrow,” Morris notes. “The restoration crew has to be flexible.”

The ultimate goal of the restoration is accuracy. “We try to get the aircraft as close to airworthy as possible,” notes Morris. That mindset extends even to the aircraft that are on display. “We recently found the correct instrument panel for the AT-11 bombardier trainer from World War II. We pulled out the inaccurate panel we had in there and installed the new one. Most people will never know the difference. But we do.”

The declining skill pool is a looming issue. Even though the average age of the restoration craftsmen is fifty-four, all are close to retirement. “We have to some way to preserve their skills or no one will know how to fabricate wood parts or how to dope cloth ten years from now,” says Morris, who himself recently retired.

TELLING A STORY

Even after restoration, the museum’s air force, which is larger than that of many countries, has to be maintained. For example, the fabric covering on the World War I-era aircraft, even when displayed under the best of conditions, will deteriorate over time. “Those aircraft will eventually have to be taken down, rewired, and re-covered,” explains Morris. “We recently repaired and replaced the fabric on our SPAD, so it is good for another fifty years.”

Like the SPAD, most of the other aircraft on display look like they just rolled off the assembly line. Others don’t. Those aircraft are displayed in what the museum calls habitats. The Curtiss P-36, the first aircraft seen in the World War II gallery, features a pilot mannequin in pajamas scrambling to get in the cockpit. That was exactly how Lt. Phil Rasmussen went to war over Hawaii on 7 December 1941. The pajamas, in fact, are Rasmussen’s.

“There are always visitors around the habitats. They draw people’s attention,” observes Metcalf. “They give visitors a feel for what was going on at one particular moment. At that point, the aircraft becomes more than just a piece of aluminum. It becomes an explanation of the history.”
In the early 1960s, the museum was housed in a converted warehouse. Partly as a function of getting around and between the support posts holding up the roof of the building, the museum installed a mazelike floor plan that presented the story of military aviation in chronological order. When the museum moved to its current location and its new split hangar structure in 1971, the existing chronology was maintained but expanded to include Vietnam. The building was completely filled as soon as it opened, and many of the larger aircraft were kept outside.

In 1988, the Air Force Museum Foundation, the facility’s nonprofit fundraising organization, and the federal government funded the Modern Flight Gallery, which parallels and is similar in appearance to the 1971 structure. More of the aircraft could be brought inside and protected, but the chronology was lost. The 1960s-era SR-71 reconnaissance aircraft, for example, was displayed next to the mid 1970s-era experimental X-24, which was displayed near a Korean War F-94 interceptor.

GETTING THE CHRONOLOGY RIGHT

The opening of the $22.7 million, 200,000-square-foot Eugene W. Kettering Building in 2003 “allowed us to get the chronology correct,” notes Metcalf. Nearly every aircraft in the collection was moved. Some were moved a few feet, while others were moved from building to building.

“When I announced we were going to move the B-36 to the Cold War Gallery, I could see the restoration staff mentally calculating if they could retire. They didn’t want to move it,” Metcalf recalls. Moving the Consolidated B-36 intercontinental bomber, with its 230-foot wingspan, required taking down the end wall of the 1971 building.

“Taking down the exhibit walls to move the aircraft forced us to examine our displays,” Metcalf notes. “Some of the exhibits dated back to the opening of the building. We recognized that some of our caretaking practices weren’t as good then as they are now. We have much better technology and can take much better care of our artifacts now.”

Visitors enter the Early Years Gallery, which traces the history of military aviation from the Wright 1909 Military Flyer and Standard J-1 (the earliest heritage Lockheed Martin aircraft on display), through World War I, through the post-war years, and the run-up to World War II. A significant gap in the chronology was filled in 2002. In 1921, Brig. Gen. Billy Mitchell proved the concept of strategic bombing by sinking the captured German battleship Ostfriesland using Martin MB-2 bombers. Because actual MB-2s simply don’t exist, the museum built an exact full-scale replica.

The Air Power Gallery, which displayed some of the World War II, Korea, and Vietnam aircraft and the spacecraft when the building opened, is now completely filled with World War II aircraft and artifacts, such as a train car used to haul prisoners of war to German stalags and an engine from the Lady Be Good, the Consolidated B-24 whose crew disappeared after overshooting their base in 1944. The wreckage was found in 1959.

The Modern Flight Gallery now contains the aircraft from the Korean and Vietnam wars. A large hallway connecting the Modern Flight Gallery with the Cold War Gallery houses an exhibit on the Berlin Airlift. Featured is a parachute made for a dog. Clarence Steber, a transport pilot during the airlift, fitted his dog, Vittles, to fly missions with him.

A unique visual greets visitors when they walk in the new gallery. The B-36, the first bomber of the Cold War, is nearly nose-to-nose with the static test article for the B-2 bomber, the last visible symbol of that forty-year superpower struggle. The latest addition to the museum’s floor plan is the Missile and Space Gallery that will eventually feature ten of the Air Force intercontinental ballistic missiles and space boosters displayed vertically.

In addition to showing the history of the Air Force in the correct timeline, the revised layout also shows the history of the aerospace industry in America. “We take great pains to make sure the names of the corporations that built the aircraft are recognized,” says Metcalf. “All of the aircraft companies come out of a pretty small gene pool.” More than fifty-five aircraft, weapons, or missiles built by Lockheed Martin heritage companies are on display.

The museum’s name—formally changed in October 2004 in recognition of its nationwide mission—places it at a name level with such peers as the National Air and Space Museum.
in Washington and the National Museum of Naval Aviation at NAS Pensacola, Florida.

**ON THE HORIZON**

“Some amazing history is out there,” Metcalf notes. “The Hanoi Taxi, which will be retired next May, may be displayed outside. Or we may keep it with the 445th Airlift Wing across base because the wing has a spare hangar. At some point, however, we’ll also acquire a C-5. We have to find a place for both. They don’t make small aircraft anymore.”

The museum’s Presidential aircraft collection is housed in a historic hangar on the controlled side of Wright-Patterson. Access is limited, and only about ten percent of museum visitors make the fifteen minute bus trip. “Many of our visitors have a great emotional attachment to the Presidential aircraft,” notes Metcalf. “We need a building on this side for those aircraft.”

Plans are already under way for a fourth exhibition building; about $8 million of the approximately $14 million needed to build the new building has already been raised. Part of the new building will house the Presidential aircraft, and a portion will be dedicated to space, with room for future accessions. Construction of the new building is expected to be under way in 2007. “The fourth building will hold us for the foreseeable future,” Metcalf says.

The current Presidential hangar will then be used for the restoration of the Consolidated XC-99, the cargo version of the B-36. Visitors to the hangar will be able to watch the restoration team at work.

“We are also looking to build an education center. A museum that doesn’t educate hasn’t paid its dues,” says Metcalf. “We need to start with the youngsters and convince them that science and math are not detrimental to their health.” Today, working out of cramped quarters, the museum sponsors nearly 1,300 educational programs. It reaches more than 90,000 students and teachers, including school groups from as far away as Pennsylvania.

Despite its success, despite its size, despite its longevity, actually finding the lone driveway of National Museum of the United States Air Force is still a challenge. “We are working on getting a gate directly off I-675 for easier access,” Metcalf observes. “Some people still haven’t figured out how to get here. The Ohio Department of Transportation initially resisted installing brown tourist attraction signs, but it became a moot point the day of our meeting—they got lost and couldn’t find the building.”

Jeff Rhodes is the associate editor of Code One.
IT IS A FAMILIAR SIGHT IN WASHINGTON. A GREEN-AND-WHITE HELICOPTER BANKS AROUND THE WASHINGTON MONUMENT AND GENTLY TOUCHES DOWN BEHIND THE WROUGHT IRON FENCE AT 1600 PENNSYLVANIA AVENUE. MINUTES LATER, MARINE SENTRIES SNAP TO ATTENTION, SALUTE, AND THE PRESIDENT OF THE UNITED STATES EMERGES FROM THE HELICOPTER AND WALKS TO THE OVAL OFFICE. BY JEFF RHODES
approximately $7 billion, is for twenty-three gram, expected to be valued at approx-

that helicopter is to be built in the United States by a team by Naval Air Systems Command, or NAVAIR, the Navy aviation acquisition agency. That helicopter is to be built in the United States by a team led by Lockheed Martin.

The new helicopter, expected to be in service for up to four decades, was officially designated VH-71A in July 2005. Greater than sixty-five percent of the VH-71 program content, which includes spares and support, will go to more than 200 US suppliers in forty-one states. The acquisition program, expected to be valued at approximately $7 billion, is for twenty-three

The Operational Aircraft will be built from nose to tail rotor in Amarillo, Texas.

PRESIDENTAL HELICOPTER TEAM

The VH-71 (not yet nicknamed) is the fourteenth variant of the all-weather, combat-proven EH101 in service or in production for the United Kingdom (where it is nicknamed Merlin), Italy, Japan, Portugal, Canada, and Denmark. The more than 100 EH101s delivered since 1997 are used for combat search and rescue, antishubmarine warfare, or carrying up to thirty combat troops quickly over long distances. The fleet has accumulated close to 85,000 flight hours—a considerable amount in a relatively short period.

The EH101 started as a joint venture between Westland Helicopters in the United Kingdom and Agusta in Italy in 1987. Those two firms merged in 1999 to form AgustaWestland. The merged companies joined Bell Helicopter based in Fort Worth, Texas, to form a single company to be the principal subcontractor to Lockheed Martin for the VH-71. Both Agusta and Westland have produced license-built versions of Bell designs for more than fifty years.

What is now known as Lockheed Martin Systems Integration began as a division of IBM. In 1956, IBM bought 800 acres outside of Owego, New York, a small town near the Pennsylvania border. There it began producing bombing and navigation electronics for B-52 bombers, a line of business the company is still in. The company became Loral in 1994 and then part of Lockheed Martin in 1996.

“We decided to become a prime contractor in the late 1970s,” says Steve Ramsey, vice president of helicopter systems at Lockheed Martin Systems Integration — Owego. “Our first major contract came a couple of years later with the SH-60B LAMPS [Light Airborne Multipurpose System] program for the US Navy. We put all the mission equipment on a platform built by another company. We have delivered nearly 200 helicopters since. We anticipate we’ll install all the weapons and systems on nearly 500 MH-60R/S aircraft for the Navy in the future.

“The US Navy referred us to the Royal Navy on Merlin, and we won the competition in 1991,” Ramsey continues. “It was a $4 billion contract to complete development of the EH101, and we have delivered all forty-four aircraft. That’s what we do—systems integration at the top level and apply it to different platforms.”

NAVAIR and HMX-1 form the government side of the Presidential helicopter team. The Secret Service also plays an advisory role. NAVAIR recently reestablished PMA-274, the Navy systems program office, to manage the acquisition and development of the VH-71. PMA-274 was disestablished in the early 1990s when the Presidential helicopter support functions were consolidated with the heavy-lift helicopter programs. HMX-1 is in the unique position of first being the tester and later the ultimate operator of the VH-71.
**TWO CONFIGURATIONS**

The new Presidential helicopter will be delivered in two distinct configurations. “Performance and capability account for the differences between the two configurations,” explains Pat Dewar, the Lockheed Martin VH-71 program manager. “The first is a rapidly developed version that is equal to or better than the Sea King used now. The second configuration will have a more sophisticated suite of communications gear and increased helicopter performance, truly an office in the sky.”

The test fleet will consist of two existing aircraft and five new-build VH-71s. These aircraft, combined with a five-ship initial production run, are collectively known as Increment 1. These helicopters will have much of the same American-made equipment and systems—or the equivalent US systems—that are on the UK and Italian helicopters, such as mission avionics, weather radar, electrical, hydraulic, and fuel systems as well as the same main rotor head, transmission, and rotor blades.

The VH-71 will differ from the EH101 in several significant areas, most importantly with an improved survivability equipment suite optimized for use in Marine One. The VH-71 will also have a VIP cabin, which includes a lavatory, a small galley, and a rear door and stair combination known as an airstair instead of a cargo ramp. The airstair is for passengers who are not the President, First Lady, or their guests.

Like other EH101 variants, the VH-71 has an active control system that cancels out rotor and transmission vibration to create an airliner-like ride. Sound-absorbing material installed throughout the VH-71 provides a quiet work environment. The new Marine One will have a six-foot-tall main cabin airstair door instead of the shorter opening on the EH101. The taller door matches the height of the cabin and it makes for better TV—the President only has to tip his head to get into Marine One, instead of having to duck down.

The President and staff will never be out of touch, as the Increment 2 VH-71s will provide an elaborate, state-of-the-art communications suite. The communications system operator, the fourth onboard aircrew member, operates the equipment that provides secure access to the White House communications network.

The Increment 2 VH-71s will have head-up displays in the cockpit, a more robust tail rotor design, a higher power gearbox, slightly redesigned rotor blades for better flight characteristics, and increased performance engines.

**TEST PROGRAM**

“The focus for Increment 1 is to deliver maximum capability within an aggressive schedule,” notes Dewar. “While we test the aircraft and gear up for production, concurrent engineering will allow a seamless transition to Increment 2. We will deliver a mission-ready aircraft four years after contract award. The fully mission capable aircraft will be delivered two years after that.”

An AgustaWestland-owned EH101, called Civil 01, is currently being flown in the high-altitude and high-temperature climate at Victorville, California, testing the General Electric CT7-8C-E1 engines that will power the Increment 2 aircraft. The CT7 engines eliminate takeoff maneuver constraints for the VH-71, allowing a smooth transition to forward flight under any conditions.

Test Vehicle 1, or TV-1, an Italian Navy EH101 flown to Owego this past June, is now being used for VH-71 initial pilot and maintainer training. Test Vehicle 2 will be used to test flight loads and avionics, but it will not have the VIP interior. TV-3, which will have VIP accommodations, will be the
primary test asset for testing the automatic flight control system and weather and instrument flight rules certification. TV-4 will be the primary electromagnetic environmental effects test platform. TV-5 will be used for noise and vibration testing as well as mission equipment suite testing. TV-6 will be used for aircraft performance evaluations and as the Increment 2 test aircraft.

The tips of the composite rotor blades on the VH-71, like those on its predecessors, are flared for aerodynamics and noise reduction. One unintended feature that will be useful on CSAR-X is the blade geometry raises a curtain, not the usual cloud of sand in low hover, eliminating brownout conditions and reducing sand ingestion by the engines and rotor wear.

“Each test aircraft primarily supports specific parts of the test plan,” says Dewar. “But we maximize test aircraft availability with an ability to perform any test card with any two of the test aircraft,” says Dewar.

YANKEE WHITE
Assembly on TV-2 begins at the AgustaWestland plant in Yeovil, England, in February 2006. That helicopter will be delivered a year later. The remaining test aircraft will come off the line at a rate of one per month after that.

The first aircraft the forty-fourth President of the United States will fly on will be available nine months after taking office. The eighteen Increment 2 production aircraft will come off a second assembly line that will be established in a new dedicated facility that will soon be under construction at Bell’s facility in Amarillo, Texas. Full Yankee White security protocols—the multi-level security program that allows access to all things Presidential—will be in force in this facility.

All aircraft will be flown to Owego for system and cabin installation, which will take about nine months per aircraft at a dedicated facility that will open in 2006. When complete, the test aircraft will be flown to Pax River. Beginning 2008, the production aircraft will be delivered to HMX-1 at Quantico. From there, the next stop is the lawn of the White House.

The current plan calls for the early production aircraft to be brought to Increment 2 standards in 2011. The VH-3D fleet will be retired in 2012; the VH-71 fleet will be fully operational in 2014.

“We negotiated with AgustaWestland to bring the 101 design to the US for a number of business opportunities,” notes Ramsey. “We won VXX with this helicopter, and we feel we are in a good position for the next competition, CSAR-X.”

NEW RESCUE HELICOPTER
CSAR-X is the Air Force’s fast-track program to replace the Sikorsky HH-60G Pave Hawk combat search and rescue helicopter. “CSAR-X is not a new development effort,” says Dan Spoor, the Lockheed Martin vice president for CSAR-X at Owego. “Twenty-four months after contract award, the first aircraft is delivered.”

Many of the features of the in-service Merlin and EH101 helicopters have direct application to CSAR-X. “This is a military CSAR platform in use now with five nations for this mission. Every sensor on the 101 has been put on some other platform, and we’ve integrated it on several different aircraft,” says Spoor.

What suited the US101 design for Presidential transport also works well for transporting pararescue jumpers and survivors. In fact, the cabin in the US101 is nearly 300 percent larger than that of the HH-60G, allowing two Stokes litters to be carried side by side with more than two feet of aisle space.

Many of the improvements coming for the VH-71 aircraft, such as an enhanced gearbox and rotor blades, will be reused on the later CSAR-X aircraft. The three engines of the US101 are also beneficial for the search and rescue mission. If a crew loses an engine in hover, there is no change in performance.

The CSAR-X program calls for 141 aircraft to replace the existing HH-60G fleet. The program is valued at approximately $25 billion including procurement and support. The Air Force issued the request for proposal for CSAR-X in early October, with contractor responses due in late November. Current plan calls for a downsell decision in the spring of 2006 with a planned IOC date in October 2012.

Jeff Rhodes is the associate editor of Code One.
Since becoming involved in the C-130J program as an Air National Guard operator more than seven years ago, I have endured opinions about how good or how bad the aircraft is. Usually, a few facts accompanied pontification, depending on what side of the fence a particular review originated. **By Col. Larry Gallogly**

In the meantime, C-130J aircraft were delivered, crews were trained, and procedures and tactics for operating the aircraft were developed. But as Gen. John Handy, the former commander of US Transportation Command and Air Mobility Command, pointed out, the aircraft needed to get off the bench and into combat. It was time to let the Super Hercules stand on its own merits.

We did exactly that in December 2004 when we stepped out with a team of Air National Guard, Air Force Reserve, and active duty members to see exactly what this aircraft could do. We intended to validate its capabilities, discover its shortcomings, and identify the practical limits of the C-130J as opposed to what appeared in the glossy brochures.
IN THE SANDBOX

Our unit, the 143rd Airlift Wing out of Quonset Point, Rhode Island, deployed to the area of responsibility, or AOR, with two C-130J Super Hercules stretch models. We were accompanied by the 135th Airlift Group from Baltimore, Maryland; the 146th Airlift Wing from California; and Reservists from Keesler AFB, Mississippi. After flying missions to the Horn of Africa, we made our first run into Baghdad three days before Christmas.

Once in the AOR, we did not have enough critical mass to stand up our own C-130J unit, so we mixed in with C-130E and C-130H units. And fit in, we did. Crew members from the older aircraft flew with us on missions when we arrived. They provided our local area orientation and got us up to speed quickly on all the rules of operating in theater. Not only did they provide tremendous help to us, but they appreciated the firsthand look at the C-130J.

As for other C-130J operators, we worked side by side with the Royal Australian Air Force and were linked telephonically to the Royal Air Force C-130J operators who were also in theater at the time. While we compared notes on tactics, the various maintenance troops often worked with each other as well. The maintainers did a great job for us.

Our mission involved moving a lot of passengers and cargo in theater. We carried an average load of seventy-five people and three pallets in a combat environment. We flew into Iraq full, hopped from base to base unloading and loading passengers and cargo, and then returned to our home base with a full load of cargo or passengers.

We flew Operation Iraqi Freedom, Operation Enduring Freedom, and Horn of Africa missions for the 120 days we were in the Middle East. We made day trips, while the C-130E and C-130H crews had to remain overnight somewhere. We flew 625 sorties and 1,371 hours. We carried 7,031 passengers and moved 1,151 pallets loaded with 2,400 tons of cargo.

The main operational lesson we learned is that size does indeed matter. The two extra pallet positions the C-130J provides and the increased maximum gross weight it accommodates were critical operational improvements. The Super Hercules proved to be a force multiplier. On one particular mission in early January, we were tasked to transport 140 troops and all their associated equipment. A move this size would have required three C-130E or C-130H aircraft. We were able to accomplish the move with only two C-130Js.

On the surface, this payload advantage may not seem like a big deal. Practically speaking, however, it has major ramifications in the combat environment. First and foremost, we exposed just eight crew members—we typically flew with a pilot, copilot, loadmaster, and a second loadmaster who also acted as a scanner—and only two aircraft to the enemy threat, as opposed to three aircraft and eighteen crew members had we used the older aircraft. Second, the Combatant Commander and the Director of Mobility Forces gained additional resources to expend on other priorities.
MORE POWER

The tremendous power in the C-130J is another significant operational advantage. The extra power was most notable during the climb out of the various fields throughout Iraq. With the threat predominantly at lower altitudes, we were able to climb above those altitudes while remaining in the less hazardous airspace within the airfield boundaries. Our ability to climb fast provided much more flexibility in our egress routes and made our actions much less predictable to the enemy.

Since we were there, other crews operating in summer operations have really seen the impact of the additional power in the C-130J. The C-130E and C-130H aircraft have an extremely limited cargo-carrying capacity in hot temperatures and high pressure altitudes. Performance data for the C-130J predicted we could increase the cargo limit under those same conditions by as much as 300 percent.

In reality, when the Super Hercules crews were assigned to those missions, they exceeded the C-130E and C-130H model capacities by nearly 400 percent. Using the C-130J on all these performance-challenged missions became standard operation. A tremendous backlog of cargo destined for Afghanistan built up during our deployment. The C-130J crews cleared that backlog in four days. We started sending a C-130J crew to Afghanistan once a week to keep the backlog from accumulating again.

When we prepared for this deployment, we spent a lot of time looking at workload management and how to acclimate the two-person cockpit into the combat environment. We found that the only time the reduced crew impacted us was when we were on the ground. With the same number of preflight duties required and fewer crew members to perform those duties, we had to adjust our time lines to get everything done.

Once the crews got out to the aircraft, the aircraft’s automation took over and made for a much quieter, much more efficient cockpit. The additional situational awareness the C-130J gave us increased efficiency, flexibility, and survivability in the combat environment.

With the high activity levels around the Iraqi and Afghani airfields, airspace deconfliction was a major concern of commander and crew alike. A lot of Predator drones and helicopters filled the air at any given time. To deal with such crowding, the airspace around the fields was divided into various sectors. Crews were required to check in at mandatory reporting points within their assigned sector as they ingressed or egressed the airfield.

Crews in the C-130J were able to program these sectors and reporting points into mission computers and get a visual depiction of them from the cockpit. This information allowed the crews to adapt quickly to the inevitable changes that occurred as they maneuvered for landings. Sectors would open and close because of Predator activity or hostile movements. Crews would be forced to rapidly adjust to their new sector assignments and still not miss their mandatory reporting points. Programming this information during preflight operations in the C-130J made such adjustments easy.

HEAT AND DUST

We were a little more than curious about how a computer-based, software-driven aircraft would hold up in the hot and dusty conditions of Iraq and Afghanistan. At one point during the deployment when many of the C-130Es were operationally restricted because of center wing box cracks, we began to task our aircraft...
at 100 percent to test their true durability. During this period, aircraft No. 1431 flew for eighteen days in a row without missing a single mission in spite of the harsh conditions. Together, our two aircraft presented nearly a ninety-four percent mission capable rate for the deployment.

Before we deployed, people up the chain told us to take extra spares. Instead, we brought the minimum amount of spares so as not to stack the deck to ensure mission success. We wanted this deployment to be a realistic test of the C-130J to produce a template for future deployments.

We were concerned how well the Enhanced Cargo Handling System and the electronic cargo pallet locks held up with all the dirt and dust. Overall, the rollers and locks held up well, although some sort of liner or cover under the flip-over roller and tie-down trays in the cargo hold might be useful to prevent dust from going into the belly of the aircraft.

Our deployment would not have occurred without a truly joint effort. We often hear the phrase, “one team, one fight,” but we lived it on several levels. The Air Mobility Command staff, and particularly the folks in the C-130J office, worked directly with us and with the C-130J System Program Office and Lockheed Martin to prepare aircraft and crews. We had the National Guard units in Rhode Island, Maryland, and California, and the Reserves in Mississippi pitch in with crews and maintenance personnel to make this deployment happen. Once in theater, we operated seamlessly with active duty counterparts as a single integrated C-130 operation.

I was pleased with the cooperation and proud to be part of the team.

As deployments continue, we learn more and more about the aircraft and about employing it. Every day we fly, operators and maintainers become more convinced we have a great aircraft—one that will be a force multiplier long into the future.

Col. Lawrence P. Gallogly is the commander of the 143rd Airlift Wing. He has more than 5,500 hours as a pilot in the C-130A, C-130E, and C-130J.
**Disaster Relief**

The US military sprang into action immediately after Hurricane Katrina hit Louisiana on 31 August and expanded efforts after Hurricane Rita struck on the Texas-Louisiana border on 24 September. Approximately 71,000 service members from all branches ultimately supported both efforts.

The Air Force delivered more than 17,300 tons of cargo, evacuated about 2,600 patients by air, and flew more than 55,400 people out of the devastated regions. More than 6,900 survivors were rescued, making the combined hurricane relief efforts the largest Air Force search-and-rescue operations since Vietnam.

The Air Force deployed a large number of its aircraft—from C-130, C-141, C-17, and C-5 airlifters, to HH-60 search-and-rescue helicopters, to the U-2 high-altitude reconnaissance aircraft. The C-130 played a significant role, with WC-130J Weatherbird crews tracking the storms through the Gulf of Mexico; Air Mobility Command and Navy C-130, Marine Corps KC-130, and Coast Guard HC-130J crews bringing in relief supplies and airlifting injured and displaced people; and the 910th Airlift Wing performing its unique aerial spray mission to combat mosquitoes. The overall combined response to Hurricane Katrina alone was the largest peacetime air operation on US soil.

On 8 October, a magnitude 7.6 earthquake hit Pakistan, and again the US military responded. The death toll is expected to be more than 30,000. Italian C-130J crews arrived with relief supplies on 10 October, and crews from the 517th Airlift Squadron at Elmendorf AFB, Alaska, carried out the first airdrop of supplies on 12 October, taking off from Bagram AB, Afghanistan. Crews dropped fourteen pallets of relief supplies totaling approximately 20,000 pounds on that mission. As of 14 October, 140,000 pounds of supplies had been airlifted to Pakistan, with C-17 and C-5 crews later bringing in more supplies and CH-47 helicopters.
Semper Viper Winner

Maj. Andrew T. Lyons, an F-16 instructor pilot with the 421st Fighter Squadron at Hill AFB, Utah, is the 2004 winner of the Joe Bill Dryden Semper Viper Award. He was selected for his professional and personal commitment to improving the lethality of the 421st FS before and during its deployment to Balad AB for Operation Iraqi Freedom in 2004. His efforts led to the first-ever successful combat employment of the GBU-38 guided bomb during OIF. Lyons’ work as the weapons phase manager in the USAF Weapons School’s F-16 Weapons Instructor Course was also recognized. The award is presented annually by Lockheed Martin to recognize excellence in airmanship and in F-16 system knowledge.

Modular Pole Model Debuts

The first tests of a new modular radar range pole model that allows large-scale physical changes were recently completed at the Lockheed Martin Helendale Measurement Facility in California’s Mojave Desert. The model’s flexible design permits customers to easily modify many preplanned regions of their vehicle’s configuration and quickly collect high-fidelity data, making the pole model a design tool rather than a demonstration device. The full-scale pole model was designed and built in less than thirteen months. The initial tests had the model configured as the Northrop Grumman X-47B vehicle built for the Joint Unmanned Combat Air Systems, or J-UCAS, program. Radar cross section testing of the vehicle will continue throughout 2006.

Flipping The Switch

The first F-35 Joint Strike Fighter came alive with electrical power on 7 September, as technicians at the Lockheed Martin facility in Fort Worth, Texas, initiated the incremental process of testing the aircraft’s circuits, electronic components, and wiring. The aircraft’s electrical power system consists of the electrical power generating system and the electrical power management system. Overall control of the system is supplied by redundant software operating in the F-35’s vehicle-management computers. Software developed by Lockheed Martin provides overall control of the system. The first test aircraft, a conventional takeoff and landing F-35A, is scheduled to make its inaugural flight in the third quarter of 2006.

F/A-22 Follow-On Test And Evaluation

The US Air Force began follow-on test and evaluation, or FOT&E, of the F/A-22 Raptor at Nellis AFB, Nevada, on 29 August. Seven Raptors were flown in a series of event-based operational scenarios. On the first day, members of the 422nd Test and Evaluation Squadron at Nellis released GBU-32 1,000-pound Joint Direct Attack Munitions on the Utah Test and Training Range. A large portion of the FOT&E missions validated air-to-ground capabilities of the aircraft. FOT&E further demonstrated the performance of the F/A-22 and its suitability and readiness for reaching initial operational capability.
An End…
The last combat mission in the forty-year operational career of the C-141 StarLifter was successfully completed early in the morning of 1 October. A crew from Air Force Reserve Command’s 445th Airlift Wing, the last StarLifter unit, returned to Wright-Patterson AFB, Ohio, after a five-day mission to Germany and Iraq, flying cargo in and injured personnel out and then back to the United States. The C-141 has been used to transport more than seventy percent of the injured or wounded out of Iraq since the war began. The 445th AW aircrews will fly the eight remaining C-141s inside the borders of the continental United States until next spring when the last StarLifter is retired.

...And A Beginning
The 445th Airlift Wing received its first C-5A in ceremonies on 3 October, as its mission is changing to strategic airlift. During the ceremony, the crew flying the wing’s first C-5 flew over the crowd, landed, and taxied up to the ramp. The aircraft (serial number 70-0457), which was transferred from Dover AFB, Delaware, was repainted with the unit’s cream and crimson tail flash and 445th AW designation on the forward fuselage. Eleven major military construction projects, valued at $62.8 million, are under way or planned through FY07 for the wing’s conversion to the C-5. The 445th AW will receive ten more C-5As through early 2007.

RERP Engine Pylon Installed
The first engine pylon for the first C-5 Reliability Enhancement and Re-engining Program, or RERP, test aircraft was installed at the Lockheed Martin facility in Marietta, Georgia, on 13 September. The new pylons are designed and built by Goodrich Aerospace. RERP, the second phase of the C-5 modernization effort, incorporates more than seventy improvements to the aircraft, including new General Electric CF6-80-C2 turbofan engines. The new engines, designated F103 by the military, will be installed later this year. The first flight of a fully modified C-5—one with both the Avionics Modernization Program and RERP upgrades—is scheduled for spring 2006. The modernized aircraft will be designated C-5M.

Technical Support Center Opens
The F/A-22 Technical Support Center, a first-of-its-kind contractor sustainment support facility, opened with a ribbon cutting ceremony on 27 September at Lockheed Martin in Marietta, Georgia. The center is a one-stop focal point for communications and technical support between the F/A-22 contractor team and the Air Force at the four bases where F/A-22s are stationed. Center technicians have access to technical data, engineers, and program officials, thereby shortening the turnaround time of support services for the F/A-22. The center reduces F/A-22 downtime caused by parts and maintenance questions.
**Submarine Rescue**

After a Russian minisub became tangled in a fishing net on 4 August during a military exercise near the Kamchatka peninsula in Siberia, a C-5 Galaxy crew assigned to the 60th Air Mobility Wing at Travis AFB, California, flew nearly 160,000 pounds of equipment and personnel out of NAS North Island, California, to help rescue the sub crew. The C-5 was used to transport two US Navy rescue submersibles along with associated equipment and personnel. Less than twenty-one hours after being notified and after two aerial refuelings, the C-5 landed in Yelizovo, Russia. The seven Russian sailors were rescued by a British submersible crew on 7 August.

**First Flights For F-35 Radar**

Northrop Grumman began initial flight testing of the advanced fire-control radar for the F-35 Joint Strike Fighter on 23 August. The active electronically scanned array radar was first flown on Northrop Grumman’s BAC 1-11 testbed aircraft. During the flights, the all-aspect search, air-track, and synthetic-aperture radar mode capabilities were successfully evaluated against airborne and ground targets. The AN/APG-81 radar is designed to enable F-35 pilots to engage air and ground targets at long range, while also providing enhanced situational awareness. In November, the first F-35 radar was delivered to the Lockheed Martin facility in Fort Worth, Texas, where it is being installed in the JSF Mission Systems Integration Lab.

**6K Fighting Falcon**

While on an Operation Iraqi Freedom mission this summer, aircraft 84-1254 became the first F-16C to surpass the 6,000-flying-hour milestone. Capt. Mark Youens, the pilot on the milestone flight, and the Air National Guard aircraft are assigned to the 147th Fighter Wing at Ellington Field, Houston, Texas, but deployed to the 332nd Air Expeditionary Wing at Balad AB, Iraq. When the aircraft was put into service in October 1985, Youens was eleven years old, and the crew chief, SSgt. Andrew Brice, was just seven. Since its arrival in theater May 2005, this aircraft, a Block 25 model, has accrued more than 500 flying hours in support of Operation Iraqi Freedom.

**HC-130J Conversion**

The US Coast Guard approved plans in September to equip six HC-130J aircraft with interoperable mission packages for long-range surveillance. Integrated Coast Guard Systems, a Lockheed Martin and Northrop Grumman joint venture, will install and test the mission equipment. This upgrade program was assigned to the Integrated Deepwater System program, the multiyear, multibillion dollar effort to modernize and replace the Coast Guard’s aging ships, aircraft, and systems. The program is designed to ensure integration and interoperability with all new and existing aviation assets, including its legacy fleet of HC-130H aircraft. The first upgraded HC-130J will be delivered in the fall of 2007.
Chapter Closes On Pacific Vikings

Commander Sea Control Wing, US Pacific Fleet, or CSCWP, was disestablished in ceremonies on 19 August at the Sea Control Squadron 41 (VS-41) hangar at NAS North Island, California. Since its establishment in April 1993, the wing has witnessed the completion of the transition from the S-3A to the more versatile S-3B for all Pacific Fleet squadrons. CSCWP was responsible for five Fleet S-3B squadrons, one S-3B Fleet replacement squadron, and two shore commands. In total, CSCWP managed the administrative, manpower, operational, and training requirements of sixty-two aircraft and more than 1,800 military and civilian personnel.

In Memoriam

Jack Garrett Real (below left), whose aviation career spanned more than fifty years, died 6 September at the age of ninety. Real began his career at Lockheed Aircraft Corporation in 1939. He worked on a number of projects, including the Model 18 Lodestar and Hudson, and served as the flight engineer on the first flight of the YC-130 prototype in 1954. He later served as vice president for the AH-56 Cheyenne attack helicopter program. He joined the Hughes Tool Company in 1971 and became the personal advisor to Howard Hughes. He later became president of Hughes Helicopters and McDonnell Douglas Helicopters before retiring in 1986.

Marta Bohn-Meyer, a precision aerobatic pilot and the chief engineer of NASA’s Dryden Flight Research Center at Edwards AFB, California, died in the crash of her Giles G-300 aerobatic aircraft on 18 September. She was forty-eight. Bohn-Meyer joined NASA’s Dryden Center as an operations engineer in 1979 and had served as chief engineer since 2001. Among her research projects were testing heat-resistant tiles for the space shuttle and using F-16XL aircraft to reduce turbulent airflow over airplane wings. She was the first crew member and one of only two women to fly in the SR-71 Blackbird. She was profiled in the April 1994 issue of Code One magazine.

All-Female Combat Crew

An all-female C-130 crew flew a combat mission for the first time in late September. Capt. Carol Mitchell, aircraft commander; 1st Lt. Siobhan Couturier, pilot; Capt. Anita T. Mack, navigator; Sg t. Josie E. Harshe, flight engineer; and loadmasters Tsgt. Sigrid M. Carrero-Perez and SrA Ci Ci Alonzo are all assigned to the 43rd Airlift Wing at Pope AFB, North Carolina, and are currently deployed to the 737th Expeditionary Airlift Squadron, flying cargo and troops in and out of Iraq, Afghanistan, and the Horn of Africa. “It was a great experience,” Alonzo said. “However, I don’t believe the Air Force should seek out all-female crews—instead, we should focus on experience.”

1,000 Missions In Iraq

In September, Australia’s C-130 detachment flew its 1,000th mission supporting Operation Catalyst—what the Royal Australian Air Force calls operations in Iraq. Since 2003, two C-130s have been deployed from RAAF Richmond, near Sydney, to the Middle East as part of the Australian government’s contribution to the reconstruction and rehabilitation of Iraq. RAAF crews have carried more than 9,400 tons of cargo and transported approximately 27,700 personnel in Iraq. On the 1,000th mission, the C-130 crew carried forty troops along with mixed cargo to Baghdad. The RAAF has flown both its C-130H and C-130J aircraft in Iraq since the deployment began.
First Oman F-16 Delivered
The first F-16 for the Royal Air Force of Oman was delivered in ceremonies at the Lockheed Martin facility in Fort Worth, Texas, on 4 August. The Sultanate of Oman plans to purchase twelve advanced Block 50 F-16s under the Peace A’sama A’safiya (Clear Skies) foreign military sales program. The first two aircraft were ferried to Oman in mid-October with the rest to follow during 2006.

Raiders’ Pride
Marines with Marine Aerial Refueler Transport Squadron 352 (VMGR-352), Marine Aircraft Group 11, 3rd Marine Aircraft Wing, welcome their new KC-130J flagship during an arrival ceremony on 27 September at MCAS Miramar, California.

Unit Patches Needed
Code One is collecting unit patches from C-130 and F-16 units worldwide. The F-16 patches will be used to update a patch poster that appeared in the April 2000 issue of Code One. The C-130 patches will be used to create a similar poster for the Hercules. Send original wing, squadron, and special patches to: Code One Magazine, Lockheed Martin Aeronautics Company, PO Box 748, Mail Zone 1503, Fort Worth, TX 76101. Submissions cannot be returned.

Follow Me
A C-130J crew from the 48th Airlift Squadron at Little Rock AFB, Arkansas, the C-130J schoolhouse, leads the Air Force Thunderbirds during a flyover of downtown Little Rock and the Arkansas state capitol in early October.

Supporting Role
An F/A-22 based at the Air Force Flight Test Center will play a supporting role in an upcoming episode of the TV series Monk. In early September, a production crew spent two days at Edwards AFB taping the episode of the show around a Raptor for several key scenes. The episode is scheduled to air in January 2006.

Helas, Helas
The second C-27J for Greece was delivered to Elefsis AB near Athens on 7 October, following acceptance flights of the first aircraft earlier this year. These are the first of twelve aircraft for the Hellenic Air Force, which will be the first operator to put the new Spartan into service.

Gas ‘n Go
An F/A-22 Raptor pilot from the 27th Fighter Squadron at Langley AFB, Virginia, takes on fuel from a KC-10 Extender based at McGuire AFB, New Jersey, en route to Hill AFB, Utah.

U-2 History Published
A definitive history of the U-2 high-altitude reconnaissance aircraft, entitled 50 Years of the U-2: The Complete Illustrated History of the “Dragon Lady,” was published in August by Schiffer Publishing in Atglen, Pennsylvania. Before writing this book, author Chris Pocock flew in the aircraft, conducted more than 250 interviews, and analyzed more than 1,000 declassified documents on the aircraft. The book has more than 450 photographs in its thirty-eight chapters and covers the long and complex history of the Dragon Lady in detail.

P-3s In Theater
AO3 Cassandra Parker, left, assigned to the Pelicans of Patrol Squadron 45 (VP-45), gives a safety signal to the air crew aboard a US Navy P-3C Orion maritime patrol aircraft during recent operations in Southwest Asia. VP-45 is currently forward deployed in support of the Global War on Terrorism.