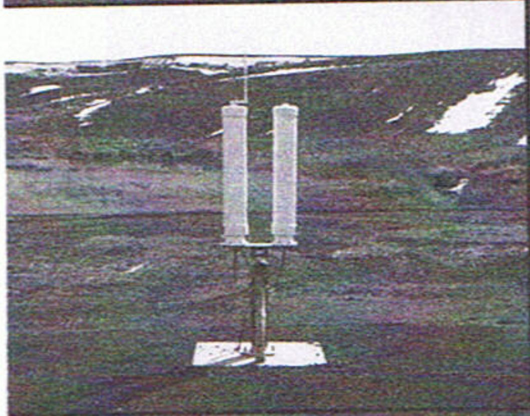
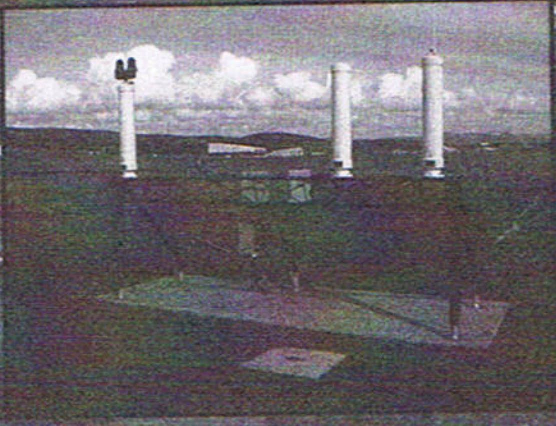
TRANSPONDER LANDING SYSTEM

Precision and Flexibility, Too

A small company in Oregon has developed an instrument approach system that provides ILS precision to terrain-challenged airports and reduces site selection and setup hassles. For most aircraft, no new equipment would be needed.

By Harry Kraemer





The Transponder Landing System (TLS), developed by Advanced Navigation & Positioning Corp., includes the following elements (above, left to right): an interrogator transmitter, azimuth sensor, electronics shelter housing processing elements, elevation sensor and calibration/built-in test (BIT) assembly.

PRECISION, ACCURACY, STAbility—these are what a pilot wants in a precision instrument approach. The instrument landing system (ILS) has provided these qualities for years; however, the Federal Aviation Administration (FAA) is installing fewer new ILSs, anticipating the eventual widepread use of GPS precision approaches.

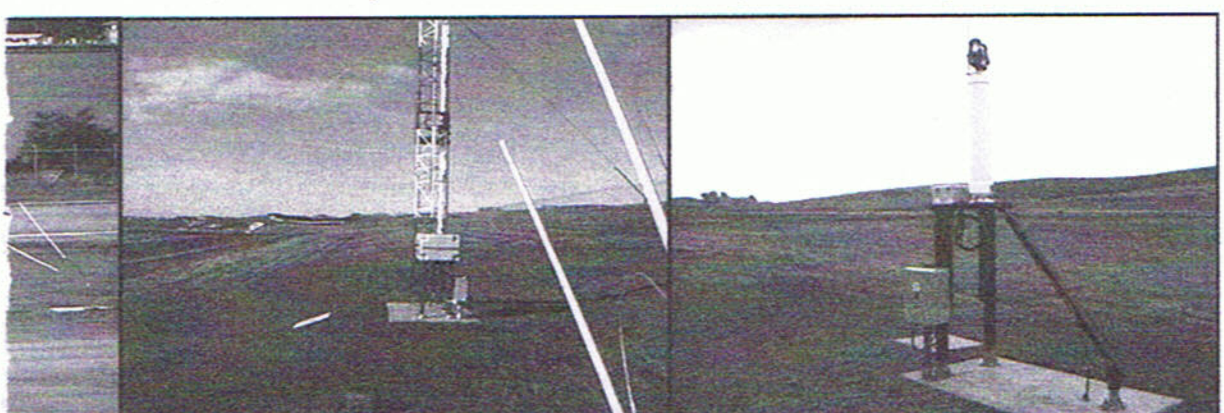
No one is sure when the transition to GPS precision approaches will take place. But when it does, it will undoubtedly require avionics upgrades, as well as significant pilot training.

Meanwhile, Advanced Navigation & Positioning Corp. (ANPC), Hood River, Ore., has taken some of the old equipment in many aircraft and made it more useful and versatile for precision landings—at no extra cost to the aircraft owner/operator. Developing a new twist on ILS, ANPC has created a Transponder Landing System (TLS) which enables ILS precision in areas where traditional ILS can not be used. All that is required is a transponder—all types, including Mode S—as well as the existing ILS receiver and display and two-way radio. The only difference for the pilot is a few added voice radio steps or calls.

Recognizing the value in TLS, FAA has granted type acceptance (for Part 121 and 135 operators that fly with two crew members and dual nav/coms) and certified the landing aid to Category 1 minimums. The agency also has contracted ANPC for up to 27 TLS over the next five years.

Now Available

Basically, a TLS is a computer-generated localizer and glide slope signal. It uses standard localizer and glide slope frequencies. The ground equipment consists of a transponder interrogator, ILS frequency transmitters, and sensor arrays for detecting lateral and vertical positions. It also uses dual computers that constantly check each other and will shut the system down if differences in signal accuracy are detected.



GPS precision approaches may be imminent, but for some airports, the TLS is a readily available alternative. A TLS ground system costs about the same as an ILS (approximately $1.5 million). Its maintenance costs are comparable, too. Prime candidates for a TLS ground system are airports with runways that do not have ILS and may have nearby hills or obstacles that could cause interference to an ILS. Airports in Alaska, for example, have shown interest in TLS. In addition, officials at Boeing field (in Seattle) and Hong Kong's Macau airport see the added precision offered by TLS as a potential way to achieve noise abatement.

TLS Advantages

Perhaps the main advantage of TLS is that, unlike satellite approach systems, it is available now. It also can offer precision approach guidance over terrain that prohibits "image," "capture effect," and "End-Fire"-type ILS glide slope equipment. Basic image ILS, which uses the ground reflection of the RF transmission as an integral component of the glide slope signal, is limited by the terrain under the approach path. Capture effect ILS attempts to improve performance at sites with rough terrain within a few thousand feet of the equipment. The End-Fire ILS from Watts Antenna Co., Herndon, Va., also aims to provide good ILS signals by placing the transmit array closer to the runway, where the grading of the ground tends to be smoother.

A problem with traditional ILS is that its signal transmissions can reflect off hills and terrain and yield excessive bias and/or noise in the receiver on board the aircraft making the approach. This, in turn, often creates unacceptable glide slope needle movement.

TLS, however, provides accurate precision approach guidance over terrain that would cause unacceptable errors to the signal produced by ILS glide slope equipment, according to ANPC. The TLS system uses a proprietary system calibration process that enables it to compensate for the effects of ground-based signal reflections from the transponder reply, thus eliminating false needle movement.

TLS also reduces installation costs by avoiding the expensive ground conditioning that usually is required to install an ILS. It also offers considerable flexibility when selecting a site for ground equipment. All TLS components can be located within a small footprint on the airport property—about 300 square feet (28 square meters) of field for the base station, 300 square feet for the glide slope system and 50 square feet (5 square meters) for the localizer, says ANPC.

"A very big difference between ILS and TLS" involves the placement of the system, says Karl Winner, ANPC's director of product management. ILS must be placed at an exact location since the guidance signal determines critical signal parameters such as glide path alignment, course alignment and threshold crossing height. "Since TLS, by contrast, tracks the aircraft and generates the approach guidance through a simple trigonometric projection, the TLS can be located hundreds of feet from the desired runway centerline," he says. And unlike ILS, which has the azimuth transmitter located at the opposite end of the runway from the glide slope transmitter, TLS ground equipment can be positioned at one location. The elevation and azimuth sensors can be on the same side of the runway or can straddle the runway.

Such siting flexibility makes it easier to establish "critical areas," to prevent ground vehicles and aircraft on taxiways from operating near ILS localizer and glide slope antennas. Critical areas are to prevent the interference or distortion of an ILS signal transmitted to an approaching aircraft, causing hazardous misleading information (HMI). According to an ANPC official, a TLS critical area can be about 20 percent smaller than a critical area for ILS, which measures approximately 1,000 feet (305 meters) by up to 400 feet (122 meters).

At airports with a control tower, air traffic controllers will instruct taxiing aircraft and ground vehicles to operate clear of the ILS critical area in adverse conditions, generally, where ceiling is less than 800 feet (244 meters) and/or visibility 2 miles (3 km). At airports without a tower, aircraft and ground vehicles may blunder into this critical area, which, for the unsuspecting aircraft on an instrument approach, can be hazardous. However, a TLS critical area can be where taxiing aircraft and ground vehicles normally don't operate.

The TLS glide slope also offers flexibility. It can vary up to 4 degrees (up to 10 degrees for military operations). Such a range can be useful at locations where terrain and other obstacles preclude the 3-degree glide slope provided by ILS.

TLS also can support the maximum offset allowed by terminal instrument procedures (TERPS)—up to 15-degrees from the runway—and still be capable of providing glide slope information. And, though it is not yet approved to do so, TLS has the potential to provide guidance for curved approaches.

Portable, Too

ANPC has developed a transportable TLS landing system, the Firefly, two of which are being used by the Royal Australian Air Force. Equipped with a power generator, the Firefly permits instrument flight rule (IFR) operations on makeshift runways used for such missions as search and rescue, firefighting support, air ambulance, disaster relief and humanitarian aid. Once on site, the TLS ground system can be unloaded, installed, surveyed and calibrated in just six hours by three individuals.

ANPC also is developing a Humvee-mountable system for the U.S. Marine Corps under its Rhino project. Like the Firefly the USMC system will be transportable aboard a C-130 aircraft.

Both types of systems will provide an ILS signal just about anywhere. They allow for portable ground-controlled approaches (GCAs) and can offer the operator a precision approach radar (PAR) display for ground-controlled approaches.

How to Fly the TLS

FedEx is the only Part 121 operator approved so far to use the TLS. The cargo carrier uses TLS at Subic Bay in the Philippines, its Asian hub. The hilly terrain surrounding Subic Bay prohibits the use of an ILS on one approach, yet FedEx requires a precision instrument landing system for the approach, particularly in the monsoon season. Feedback has been positive; pilots are said to be "amazed" at how well TLS works under Subic Bay's difficult conditions. The U.S. Congress also has paid for three TLS installations, in Rhinelander, Wis. (near Oshkosh), Pullman Wash., and the FAA Technical Center in Atlantic City, N.J.

Pilots will find little difference between using ILS and TLS. TLS requires added radio communications to the TLS operator to assure the system's availability. (The operator can be located at the airport or offsite, within two-way radio range of the airport.) The pilot then requests the approach from approach control. Approach control, in turn, will vector the pilot towards the initial approach fix (IAF). Or, in some cases, the pilot will conduct the approach intercept procedure indicated on the approach plate. Beyond the IAF, the pilot then will contact the TLS operator again, to begin the approach. The TLS operator will enter the transponder code that the aircraft is squawking, and the system will begin searching for that code. Once the system locates the aircraft and begins tracking, the needles in the cockpit come alive and respond just like an ILS.

Short Learning Curve

A pilot transitioning to GPS navigation will spend around 10 hours in system familiarization. Much more training will be required to shoot instrument approaches in instrument meteorological conditions (IMC). Instrument rated pilots, however, already should possess the basic skills to perform the additional communications required for TLS. Pilots gain FAA approval to conduct TLS instrument approaches through the local flight standards district office (FSDO) and the carrier's principal operations inspector. ■

COMPANY PROFILE

Hood, Ore.-based Advanced Navigation & Positioning Corp. (ANPC) was launched in 1991 by aerospace engineer John Stoltz, the company's chairman and chief executive officer. He left a post at Lockheed Martin with the intent of developing a precision landing aid to serve airports in mountainous and other, less ideal conditions. Stoltz left ANPC to retire in 2000. However, his idea reached fruition in 2001, when ANPC's transponder landing system (TLS) received FAA type acceptance. Today the shareholder-owned company produces two versions (one is portable) of the TLS. It employs some 25 engineers, technicians, manufacturing personnel and administrative staff.

ANPC's president and chief executive officer, Jeff Mains, has a background in software development. He formerly was vice president of sales and marketing with LANQuest. His management team includes former NASA official, Tom DeMarino, as vice president of operations; Amy Lee, formerly with General Dynamics, as vice president of engineering; Andre Young, chief financial officer; Brad Dezurick, vice president and general counsel; Michael Fox, vice president of business development; and Pete Kinkead, vice president or marketing.

ILS: A BRIEF HISTORY AND UPDATE

The concept of instrument approaches dates back to the early 20th century, when mail pilots were guided by half-billion candlepower floodlights. In the late 1920s, Jimmy Doolittle completed the first "all blind" flight, including the landing. Working with industry luminaries, such as Elmer Sperry and Paul Kollsman, he helped develop the early flight instruments that have led to our modern-day electronic cockpits. Also about that time, the National Bureau of Standards and the Washington Institute of Technology began work on what became the ILS. By the late 1930s Pennsylvania Central Airlines had completed the first instrument landing by a scheduled airline.

The instrument landing system (ILS), as we now know it, was introduced in 1946, according to the Manual of Avionics. But it took 25 years of further development and improvement to ensure sufficient integrity (thanks to solid state circuitry) for the categorization of coupled approaches and landings.

ILS since has become almost synonymous with the term "precision approach." It has served aircraft operators well. However, there long has been a quest for an ILS replacement. In the 1980s, the Federal Aviation Administration (FAA) proposed the microwave landing system (MLS). But by the early 1990s, it lost favor to precision landing systems that use GPS positioning data.

ILS' future appears tentative. Twenty to 30 ILS approaches were funded and installed each year between 1990 and 1995. But FAA decided to cut back purchasing ILS, in part, because GPS promised even more precision. From 1999 to 2002 only 73 ILS approaches were installed or funded for installation. Although there are no FAA plans for new ILS installations this year, funds for several new systems may emerge in 2004.

The annual preventative maintenance cost for a single ILS can run as high as $25,000 and averages about $19,000 to $20,000. GPS landing systems promise lower maintenance cost, which is one reason why FAA hopes to replace ILS.