New Approach

Transponder landing systems are designed for airports in areas with insufficient space for an ILS.

BY LINDA WERFELMAN

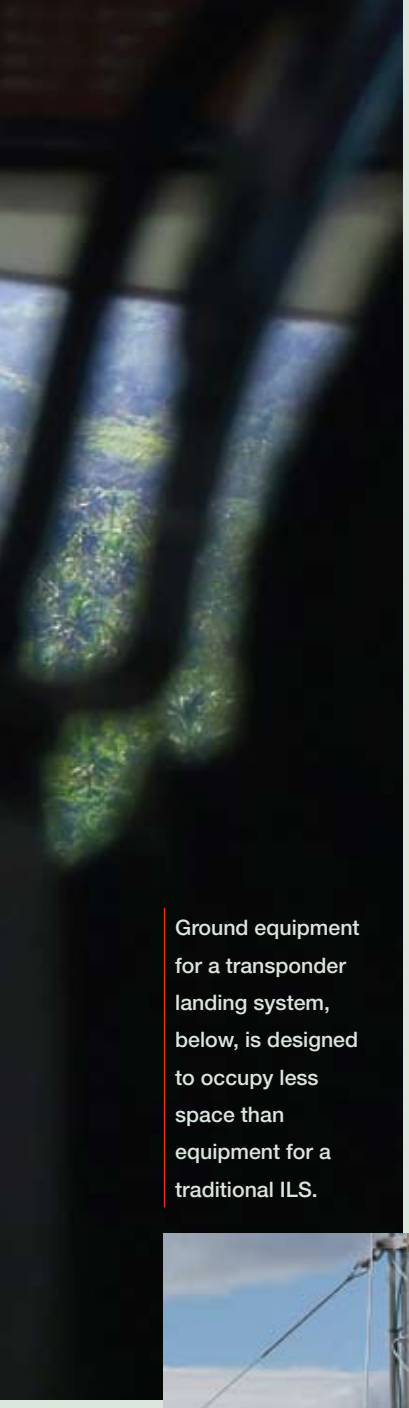
Jeff Mains is on the lookout for what he calls "terrain-challenged airports."

Airports with short runways or those surrounded by rugged terrain are considered ideal sites for a transponder landing system (TLS), a precision approach system manufactured by the Advanced Navigation and Positioning Corp. (ANPC), of which Mains is the CEO.

"There are many airports that would love to have an instrument landing system (ILS) but can't for a variety of reasons, usually because of the surrounding terrain or runway length," Mains said. "These make up 80 to 90 percent of the world's airports."

ANPC, the only manufacturer in the world of the TLS, received approval in mid-2010 from the International Civil Aviation Organization (ICAO) as a supplier of the system.

Both the ILS and the TLS are designed to provide pilots an approach path with exact



Ground equipment for a transponder landing system, below, is designed to occupy less space than equipment for a traditional ILS.

lateral alignment and vertical descent guidance on final approach to a runway.

An ILS uses ground equipment consisting of two directional transmitters — the localizer and the glideslope — as well as two or three marker beacons to provide additional positioning information.

However, the glideslope equipment sometimes is difficult or impossible to install at airport sites that are on or near rough terrain, "and in some cases, cannot be used without extensive earth removal to reduce errors induced by multipath [radio wave propagation], or ground-based reflections," ANPC says. "Additionally, ILS localizer performance can be diminished by multipath from large buildings located on the airport property. … At some airports where the runway is shorter and ends at obstacles like water, an ILS localizer installation may not be possible that achieves the ICAO-required tailored width of 700 ft at threshold and a maximum 6.0-degree localizer course width."[1]

A TLS can overcome these problems, ANPC says, because it uses existing airborne ILS localizer, glideslope and transponder equipment, and basic ground equipment — a transponder interrogator, sensors to detect an aircraft's lateral and vertical positions and an ILS frequency transmitter. The ground-based TLS sensors detect an aircraft's position by interrogating its transponder; the ILS frequency transmitter then guides the aircraft along the approach path.

"The pilot can then fly a precision approach to Category 1 minimum decision heights, just like flying an ILS," ANPC says.[2]

ANPC also manufactures a transportable TLS — characterized by Mains as "a complete airport in a box" — which is intended primarily for use in military operations or in humanitarian relief operations after natural disasters in which airport infrastructure has been heavily damaged. The system can be set up by two trained people in less than 10 hours, the company says. When the system is no longer needed, it can be uninstalled and prepared for shipment in less than two hours.

TLS operators must attend a 20-day training course, which includes discussion of equipment site selection and installation, how to configure the monitor, maintenance and diagnostic techniques for identifying system problems and replacing faulty systems.

Mains said that a TLS is now being used in civilian operations at King George Island in Antarctica, where, in addition to its "substantially smaller footprint at the airfield, it provides scientists and other humanitarians more access to Antarctica to research environmental trends and explore the ecological richness" of the continent.

A TLS approach can provide similar site-selection and safety benefits at other airports, Mains said.

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"The flexible siting of TLS allows it to work in the most constrained real estate environments," he said. "The TLS provides a full precision approach, which allows pilots to safely access an airport with both lateral and vertical guidance to minimums as low as 200 ft above ground level (AGL) and 1/2-mi [0.8-km] visibility. This allows higher safety and accessibility of these airports and communities.

"Pilots will always tell you that it is safer and they prefer to fly into airports that provide lateral and vertical guidance to the runway."

Aviation safety advocates, including Flight Safety Foundation, have for years stressed the superiority of conventional precision approaches such as ILS — and newer satellite navigation-based precision-like approaches — over nonprecision approaches and visual approaches. Data compiled by the Foundation's Approach and Landing Accident Reduction Task Force showed that nonprecision approaches have been five times more hazardous than precision approaches and that more than half of all accidents and serious incidents involving controlled flight into terrain (CFIT) have occurred during step-down nonprecision approaches.

The transportable TLS is being operated by the Spanish Air Force, which first used the systems in Afghanistan and then deployed them for training in Spain, and by the Royal Australian Air Force, which uses the TLS in training operations. Other systems have been commissioned for use in Brazil, and oil companies have discussed installing them on offshore platforms, Mains said.

In the past, a TLS was used by FedEx at Subic Bay in the Philippines, but it was decommissioned when the company moved its Asian operations to China, Mains said.

Within the next two years, ANPC expects a substantial increase in the number of systems in use, especially in the Arctic, Asia, Europe and South America, Mains said, estimating that the company probably will deliver 30 systems for use in civilian operations and 40 for military use. Additional deliveries are likely in Africa, he said.

The only civilian TLS in the United States is a Federal Aviation Administration (FAA) test system at the agency's technical center in Atlantic City, New Jersey. However, although the FAA in 1998 certified the TLS as at least meeting ICAO standards for Category I ILS signals and in 2001 granted type acceptance to ANPC's TLS, the systems are not likely to be widely used in the United States.

In recent years, the FAA has instead emphasized the development of instrument approach procedures using the wide area augmentation system (WAAS), a space-based navigation system with a ground-based network of reference stations and master stations that the agency says will not only enhance safety by adding precision-like approach capability but also eliminate the need for installation and maintenance of local airport-based approach equipment.

FAA data show that, in mid-November, there were 2,341 WAAS-based localizer performance with vertical guidance (LPV) approaches in the United States.[3] The FAA's goal is to publish 500 new WAAS-based instrument approach procedures annually "until every qualified runway in the [national airspace system] has one."[4]

WAAS was commissioned in 2003 to enhance the accuracy of information obtained from global positioning system (GPS) satellites. It has been described by the FAA as "a core element in transitioning to the satellite-based air traffic control system of the future."

A TLS is intended to help pilots fly into airports surrounded by mountains or other difficult terrain.

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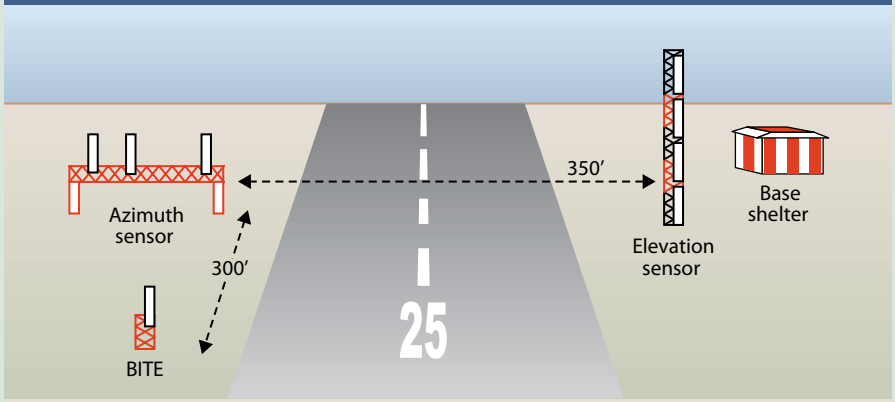
Common Configuration

The most common configuration for a TLS installation features an azimuth sensor on one side of a runway and an elevation sensor on the other, connected by underground cables (Figure 1), ANPC says. However, the configuration can vary, according to the requirements

TLS Ground Components



BITE = built-in test equipment

Source: Advanced Navigation and Positioning Corp.

Figure 1

of a specific site, and in some cases, all components can be placed on the same side of a runway. In addition, some components — because of their frangible design — can be installed within airport obstacle areas.

Regardless of configuration, the components occupy relatively little space.

An aircraft can be flown on a TLS approach without the installation of any additional equipment or avionics, as long as it already is equipped with an ILS localizer and glideslope receiver, a horizontal situation indicator or a course deviation indicator, and a Mode 3/A or Mode S transponder.

Minimal Training

Pilots fly a TLS approach just as they would an approach using an ILS, ANPC says, so "to the pilot, there is virtually no difference." For example, TLS approach charts look like ILS approach charts; a failure of ground-based equipment to provide lateral or vertical guidance results in a red flag on a cockpit instrument, as it would in an ILS or other instrument approach; and a TLS approach always includes a missed approach procedure — although the TLS itself does not provide missed-approach guidance.

Minimal training is required before a pilot can use a TLS and includes briefings on TLS approach plates and ground operator communications.

ANPC's outline of the operational sequence begins with tuning in the TLS frequency, "just as the pilot would do for an ILS," and following TLS guidance to the decision height.

To begin, a pilot or air traffic control (ATC) must call the TLS operator — located either in an air traffic control tower or offsite — to confirm that the system is available. Typically, the pilot then tells ATC that he or she wants to fly the approach and receives ATC vectors to the initial approach fix. (In some cases, however, the pilot conducts an approach intercept procedure depicted on the TLS approach plate.) After ATC clears the pilot for the TLS approach, either the pilot or ATC informs the TLS operator of the aircraft's transponder code. The TLS operator confirms the code and instructs the TLS "to acquire the aircraft." Then the TLS broadcasts guidance for the approach, and the pilot follows that guidance, maintaining the final approach path in accordance with a course deviation indicator (CDI) and glideslope indicator.

"By measuring the angle- and time-of-arrival of aircraft transponder replies, the TLS is able to obtain significantly more accurate positioning information than other multilateration systems," ANPC says. "The minimum decision height and visibility for a given approach procedure are determined using TERPS/PAN-OPS [*United States Standard for Terminal Instrument Procedures*/ICAO *Procedures for Air Navigation Services–Aircraft Operations*] analysis and must be in accordance with the available runway markings and approach lighting."

The FAA, in its *Aeronautical Information Manual*, likens the concept of a TLS approach to that of "an air traffic controller providing radar vectors, and just as with radar vectors, the guidance is valid only for the intended aircraft."[5]

Notes

1. ANPC. *TLS — Transponder Landing System*. <www.anpc.com/prod_tls.cfm>.
2. The Category I minimum decision height can be as low as 200 ft AGL, with a runway visual range as low as 1,800 ft (550 m), provided that the runway has touchdown zone and centerline lighting or the pilots are using an autopilot with an approach coupler or a head-up display.
3. FAA. *Navigation Services — Global Navigation Satellite System*. <www.faa.gov/about/office_org/headquarters_offices/ato/service_units/techops/navservices/gnss/approaches/index.cfm>.
4. FAA. *Fact Sheet — Wide Area Augmentation System (WAAS)*. <www.faa.gov/news/fact_sheets/news_story.cfm?newsId=6283>.
5. FAA. *Aeronautical Information Manual*, 2011 Edition. Chapter 1, "Air Navigation," 1-1-22, "Precision Approach Systems Other Than ILS, GLS and MLS."