Safegate International

Compliance with world standards reduces the opportunity for error using visual docking guidance systems.

Graceful Arrivals

BY WAYNE ROSENKRANS

When a large commercial jet arrives at an airport gate, navigational errors of fractions of a meter can matter. A good outcome after inaccurate parking might be simple misalignment with the airbridge and ground service equipment, possibly delaying a flight while ground technicians reposition the airplane. But should an impact occur, even while braking from a taxi speed of 2 kt, damage resulting from a collision with the airbridge, a vehicle or ground service equipment can be hazardous and expensive, as shown by incidents over the past 10 years.

Technological solutions to parking reliably and accurately, developed since the late 1960s, increasingly are considered part of an airport's advanced surface movement guidance and control system (A-SMGCS) and they are being installed worldwide, some as pricey as US$60,000 per gate. Several thousand of the visual docking guidance systems (VDGSs) described by the standards and recommended practices (SARPs) in Annex 14, *Aerodromes,* Chapter 5, "Visual Aids for Navigation" of the International Civil Aviation Organization (ICAO) — and the advanced docking visual guidance systems (ADVGSs) for which ICAO has not published SARPs — primarily are intended to help airline flight crews to safely park at airport gates with minimal or no involvement of marshallers. ICAO has not made VDGSs mandatory but, for the airlines and airports that install them, has provided guidance on the selection of appropriate systems in its *Aerodrome Design Manual,* Part 4, "Visual Aids."

ICAO required that any installed VDGS comply by Jan. 1, 2005, with the SARPs, resulting in the installation of hundreds of ADVGSs, also called AVDGSs, in recent years as upgrades or replacements for noncompliant equipment.

ICAO basically requires that a VDGS display the selected aircraft type if different types are selectable, clearly display any malfunctions to the pilot, enable pilots to monitor and adjust azimuth and stopping point without turning their heads, provide closing-rate information so the pilot gradually can decelerate the aircraft to a full stop at the intended stopping position, and provide at least the left-seat pilot with azimuth guidance and a method of determining the stopping point on the stand centerline. ICAO further recommends that the closing rate to the stopping point be displayed for at least 10 m (32.8 ft) and that the system also can be used by the right-seat pilot.

The U.K. Civil Aviation Authority (CAA) said in 2005, "The ICAO Aerodromes Panel is developing criteria for the use of … ADVGS that provide more accurate guidance information to both pilots. These systems are becoming more customary at larger aerodromes, and pilots that regularly operate to and from international hubs are becoming more familiar with them. … The human factor issues associated with handling the differences between older VDGSs and newer ADVGS systems have been cited in a number of docking incidents. … Accordingly, [U.K.] aerodromes should consider the installation of ICAO-compliant VDGSs when upgrading or renewing facilities and, on international stands that are pier-served [i.e., have airbridges], the replacement of VDGSs with ADVGSs as soon as practicable."[1]

Although exact sets of features are product-specific, typical ADVGSs show the aircraft "established on course" to the gate from a distance of about 100 m (328 ft) from the stopping point, the type of aircraft expected to dock and when the docking aircraft is detected approaching the gate. At prescribed distances, a display panel in front of the pilots shows direction to turn, deviation from the centerline and the distance to the stopping point. Upon reaching the stopping point, the system typically displays "STOP" in large letters, followed by a confirmation such as "OK." An out-of-tolerance deviation from normal operation also generates the "STOP" display, and overshooting the stopping point by a specified amount may be displayed with a message such as "STOP/TOO FAR" or "T-FAR." Some systems also display "SLOW DOWN" if the aircraft exceeds the system's maximum allowable taxi speed.

In the early days of VDGS, aircraft-sensing technologies included pneumatic devices and electrical induction loops installed in grooves cut into aprons. Designers later recognized that safety would be improved by displaying all information from a single site, eliminating the need for pilots to turn their heads to separately check azimuth and nosewheel position. Current ADVGS sensing technologies include lasers, microwaves, a laser-radar combination called ladar, and specialized video cameras linked to three-dimensional computer image processing that recognizes the aircraft outline, position and closure rate. Display designs have evolved from round red-amber-green lights reminiscent of traffic lights for motor vehicles to digital Moiré patterns, light-emitting diodes (LEDs) and transreflective/backlit liquid-crystal displays (LCDs).

Some manufacturers currently advocate consistent appearance in information display as the ideal for flight crews, however. "We believe it to be critical to achieve a worldwide standard in order to reach an acceptable level of uniformity and hence decrease the risk for misinterpretation," said Jesper Svensson of Safegate International. "We believe in limited freedom in [designing] the AVDGS display. There is still a lot of room for innovation in terms of increased functionality and safety features." Megan Knox of Siemens Airfield Solutions similarly said that consistency in requirements for appearance of messages and operational procedures would be beneficial to pilots and airports, and would not affect innovation in ADVGS technology.

Some manufacturers have added capabilities such as aircraft-type identification check; interlocks to prevent operation of the airbridge at the wrong time; a function that scans the apron area for foreign objects before and during

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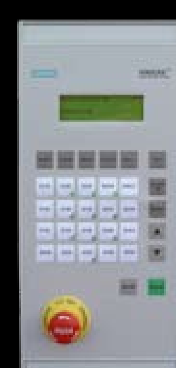
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docking and automatically stops the docking process until the detected object has been removed; an interface with gate-operating systems for automated initiation of docking; archiving images of the sequence of docking for analysis or investigation; compatibility with multiple centerlines and/or curved centerlines; backup power supply; and an interface with air traffic control so that the position of the aircraft entering and leaving the stand can be exchanged with the airport's A-SMGCS radar.

Step Ladder Becomes Shrapnel

Many VDGS-related safety recommendations emerged from a serious incident in October 2000 when the left engine of an Airbus A319 ingested a 14.5-kg (32-lb) aluminum stepladder while docking at a gate at Helsinki-Vantaa Airport in Finland.[2] The gate was equipped with an FMT aircraft parking and information system (APIS) ADVGS for self-parking. The investigators surmised that the step ladder, used temporarily for attaching and detaching an external power source, inadvertently was left outside an airbridge safety railing for about two months without being noticed. On the day of the incident, the ramp foreman arrived late because of a last-minute gate change and did not conduct any inspection to ensure a clear gate area. The airbridge operator was not required to confirm that the apron area was clear before switching on the APIS. The ladder could not be seen by the captain entering the stand because of shadows and the absence of contrasting colors. "Due to the commander's [delayed response], the aircraft stopped approximately 85 cm [33.4 in] after the system-indicated stop position and approximately 20 cm [7.9 in] left of the centerline," the incident report said.

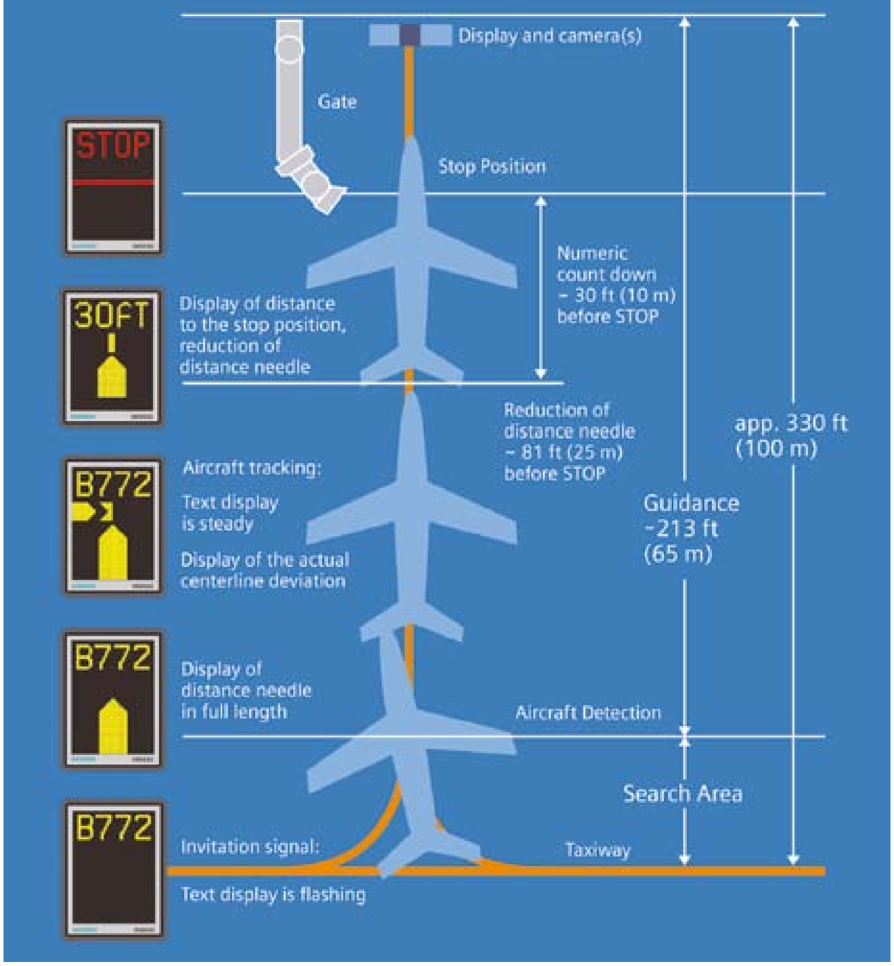
None of the ground staff members was positioned at an emergency-stop button or had time to reach the button when they noticed the ladder. Shrapnel — including a piece weighing 1.7 kg (3.7 lb) — was propelled out of the front of the engine into a space occupied moments before by the weight-and-balance agent; small bits of metal also were propelled 40–50 m (131–164 ft) behind the airplane.

The investigation in part determined that the APIS operated "flawlessly" but docking duties had not been specified adequately in ground staff operating manuals and training; procedures were missing for conducting an emergency stop of a docking aircraft; the minimum advance arrival time to a stand for ground staff was not specified; use of ladders was not strictly controlled within the apron area; a decision to discontinue parking A319s at this gate — because of revised minimum clearance distances — had not been communicated to ground staff; and differences in clearances compared with ICAO standards were not published in Finland's aeronautical information publication (AIP).

Lessons From U.K. Airports

The U.K. Air Accidents Investigation Branch (AAIB) investigated 18 VDGS-related incidents from 1997–2006 at London Heathrow Airport, London Stansted Airport, London Gatwick Airport, Manchester Airport and Edinburgh Airport. In one incident, a McDonnell Douglas MD-11 in October 1999 collided with a van while the captain was parking at Stand K23 at Heathrow, causing scuff and scratch marks to the right engine nacelle. The captain previously had used only marshallers at this airport and did not know that self-parking using azimuth guidance for nose-in stands (AGNIS) with the parallax aircraft parking aid (PAPA)[3] was in effect — even though the captain's airline had agreed that self-parking would begin that day — and did not know how interpret this guidance. The AAIB report said, "[The commander] was … 'waiting for the light to turn red,' indicating to him when to stop, but the light did not turn red. … The aircraft had overrun the parking position by 15.75 m (51.6 ft) and pushed the van approximately [1.8 m (6.0 ft)] sideways with its right engine nacelle."[4]

A Boeing 777-200 in May 2005 collided with the airbridge at Stand 50 at Gatwick causing a tear and two large



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dents in the leading edge of the left engine intake cowl and substantial damage to the airbridge. The AAIB report said, "As the aircraft approached the allocated stand, both the commander and … copilot confirmed visually that the stand was clear of obstructions. … The commander stated that as the aircraft progressed onto the stand he saw that the AGNIS system indicated that the aircraft was no longer on the centerline, and he was momentarily distracted while regaining the centerline. He stated that when he looked again at the PAPA board, it indicated that the aircraft was then approaching the stopping point for the Boeing 777-300. … He applied the brakes and, on looking up, saw that the emergency-stop light, situated next to the AGNIS, was flashing." A dispatcher and several other people ran from the airbridge when it was struck. "The nosewheels had stopped 7.3 m [24 ft] forward of the correct parking position for a Boeing 777-200," the report said. "The AGNIS and PAPA board indicator lights and the emergency-stop light were serviceable and correctly calibrated." The airline subsequently developed a computer-based training package about aircraft parking aids for its crews, informed all pilots of the parking hazards associated with AGNIS–PAPA systems and met with the airport management about using guidance not compliant with the ICAO SARPs. In July 2006, the airport required a team leader or higher grade staff member to remain in the vicinity of the emergency-stop button during docking at gates where AGNIS/PAPA systems are still installed.[5]●

Notes

1. The International Federation of Air Line Pilots' Associations (IFALPA) in 1997 proposed that the International Civil Aviation Organization (ICAO) develop criteria for standards and recommended practices (SARPs) applicable to advanced docking visual guidance systems (ADVGS). In 2002, the ICAO Visual Aids Panel proposed such an amendment to Annex 14, but two years later, the ICAO Secretariat postponed action on this amendment after considering comments from states and international organizations. "Most importantly, some new VDGS installations have been recently provided at certain airports worldwide and these installations are not in full compliance with the proposed SARPs but are considered acceptable by pilots," ICAO said. The task of further studying ADVGS was referred to the Visual Aids Working Group of ICAO's Aerodrome Panel, also created in 2004, which has absorbed the functions of the Visual Aids Panel.
2. Accident Investigation Board Finland. "Engine Damage at Helsinki-Vantaa Airport on 17th October, 2000: OO–SSH, Airbus A319." Report no. B 3/2000 L. Oct. 25, 2001.
3. The U.K. Air Accidents Investigation Branch (AAIB) said, "Azimuth guidance for nose-in stands (AGNIS) comprises two closely spaced light bars, at cockpit level, positioned side-by-side in a box at the end of the stand and thus directly ahead of the pilot. The light bars appear to the pilot as either red or green, depending on the aircraft's lateral position relative to the stand's centerline. If the aircraft is on the centerline, both light bars are green. If the aircraft is to the left of the centerline, the left light bar is red while the right one remains green, and if it is to the right of the centerline, the right light bar is red while the left one remains green. The system is aligned to be used by the pilot in the left seat only. The parallax aircraft parking aid (PAPA) is a large reference board positioned at cockpit level at the end of the stand, some distance to one side of the AGNIS unit. … There is a horizontal slot in the reference board behind which is positioned a vertical fluorescent light tube. Several vertical reference marks are painted on the board, each identified as relating to a particular type, or group of types, of aircraft intended to use the stand. As an aircraft moves along the stand centerline, the vertical light tube appears to move across the slot as a result of the parallax effect. When the light aligns with the mark for the particular type of aircraft using the guidance, the aircraft is at the correct stopping point."
4. AAIB Report no. EW/G99/10/09.
5. AAIB Report no. EW/C2005/05/04.