KUWAIT AIRWAYS

FLIGHT SAFETY

AN IN-HOUSE NEWSLETTER OF OPERATIONS DEPT.

Vol.4, No.11 Flight Safety & Quality Assurance Division November 2009

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EDITORIAL

Commercial air transport accident statistics reveal that majority of them occur during landing and runway overrun is the main contributor. Both aviation industry and regulatory agencies are working towards the prevention of runway overruns.

While the regulatory agencies have come with a new requirement for landing distance computations, Industry has come with technological solutions to improve safety. Honeywell has developed a system called Smartrunway Smartlanding system. Airbus has developed a Runway Overrun Prevention System (ROPS) for their aircraft. We look into these systems, their features and benefits.

As we approach winter, we are reminded of low temperatures, snow, icing, wet and slippery runways and the associated problems. From operations point of view, we need to refresh on icing on ground and in flight, anti/de-icing. We have a brief on icing and associated flight safety issues.

As always, we look forward to your feed-back, suggestions and contributions which can be sent to our office address given in this page. Happy reading and many more safe landings.

RUNWAY OVERRUNS & THEIR PREVENTION

Dr.M.S.Rajamurthy

On May 30, 2008, at 09:40 local time, TACA International Airlines flight 390, an Airbus A-320-233 while landing at Toncontin Airport in the Honduran capital Tegucigalpa, overran the runway, skidded across a street, struck cars and came to rest against an embankment. The cockpit was smashed under a billboard, and fire fighters hosed down at least two cars trapped under the Airbus 320's left engine. No fire erupted although lot of fuel spilled out of the jet.

Of the 124 onboard, three including the captain were killed. Two others were killed on ground when the plane smashed their car. More than 50 were also injured. The Miami-bound Flight 390 was arriving from El Salvador.

The 1.86 Km long asphalt runway was wet with rain from Tropical Storm Alma. The cloud ceiling was very low resulting in low visibility during approach. It was the second attempt to land in rain and low visibility, after the first attempt to land was not successful resulting in a go-around. The plane touched down the runway much ahead of the displaced threshold in tailwind condition, resulting in inadequate runway to brake and stop.

Yet another example of a runway overrun accident resulting in loss of life and the aircraft.

Runway excursions during the landing phase represent the largest category of accidents in air transport, amounting to nearly 20 percent of all reported occurrences. Runway safety has now become a global priority. Airplane manufacturers, regulators,

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airlines and pilot associations have all come together to form the Flight Safety Foundation's Runway Safety Initiative (RSI) to address the challenge of runway safety.

Runway excursion/overrun prevention was discussed in quite some detail in the Aug. 2007 issue of Flight Safety where we discussed Southwest Airlines B737 landing overrun accident and the means to prevent landing overruns.

Many factors contribute to runway overruns during the landing phase. Unstable approaches has been and remains, a major contributor to runway overrun accidents. In an unstable condition, without actual information on the risk of a consequent runway overrun, the crew may be tempted to continue an approach in the belief that they may recover the situation, or that they have sufficient landing distance margins.

The industry has responded to unstable approaches by emphasizing training and procedures. Flight Safety Foundation's Approach-and-Landing Accident Reduction (ALAR) addresses it quite comprehensively.

Other factors contributing to landing overruns are:

- Wind shift at low altitude
- Long flare
- Long de-rotation
- Late selection of thrust reversers
- Cancellation of reversers at 70 knots
- Runway friction coefficient lower than expected (contaminated runway, snow, ice or runway more slippery than reported)
- Late/weak manual braking
- Technical failures affecting the landing distances during the landing (tyre burst, braking system failure, etc.).

Runway excursion/overruns often happen due to loss of situational awareness, which can become severe due to pilot fatigue.

Following in-service experience, the Certification Authorities felt the need for new regulations for the in-flight computation of the Landing Distances published in the Airplane Flight Manuals.

A Take-off and Landing Performance Assessment Aviation Rulemaking Committee (TALPA ARC) was formed for this purpose comprising of representation from regulators, airlines, airport operators, associations and manufacturers. This Committee has now finalized its proposal for new regulation for in-flight landing distance assessment.

Meanwhile, the industry has come with its own answer to improve runway overrun prevention during landing.

Honeywell using its vast experience in Avionics has come up with a fairly inexpensive technological solution to address runway incursions and excursions. Honeywell launched SmartLanding and SmartRunway system in June 2009 during the Paris Air show.

In Sept. 2009, Honeywell secured technical standard order (TSO) approval from the FAA. Emirates is the launch customer for this system and will be installed on its fleet of Boeing 777, Airbus A330 and A340s. Boeing is offering SmartRunway as an option on the 747-8 and 777 aircraft, and plans to offer it on the 737 early next year.

Airbus has developed a Runway Overrun Prevention System (ROPS) which is being certified on their A380s. In may 2009, Airbus gave a demonstration of this system on A380 to a group of Pilot/Journalists. It will be available on their other models progressively.

These two systems are described in the articles that follow.

Honeywell SmartRunway & SmartLanding system

Honeywell SmartRunway and SmartLanding are designed to increase safety during approach, landing, taxi and take-off by breaking the chain of events leading to a runway incursion or excursion.

SmartRunway and SmartLanding are available now for airlines and business aviation aircraft currently equipped with Honeywell's MK V or MK VII Enhanced Ground Proximity Warning System (EGPWS). These products complement Honeywell's Electronic Flight Bags (EFB) and Integrated Primary Flight Displays (IPFDs) but provide the extra comfort of global runway situational awareness.

SmartRunway

A runway incursion is any instance on a runway involving an aircraft, vehicle, person or object that creates a collision hazard or results in the loss of a minimum safe distance between aircraft and other objects on the runway.

SmartRunway, is the next generation upgrade to Honeywell's Runway Alert and Advisory System(RAAS) introduced in 2004. SmartRunway improves situational awareness by providing timely advisories and graphical alerts to the flight crew and advises them of their position during taxi, takeoff, final approach, landing and rollout. SmartRunway includes the previous routine and non-routine advisories offered with Honeywell's RAAS technology with two new advisories and a new graphical alerting feature. SmartRunway will also utilize Automated Dependent Surveillance-Broadcast (ADS-B) as it is adopted.

Various configurations of SmartRunway are available to best suit individual operating environments, including volume control and inhibit switches. Honeywell's SmartRunway also complements EFB solutions, through heads-up aural advisories, and supports quiet cockpits with graphical alerts on the EGPWS display. Honeywell's SmartRunway capitalizes on Honeywell's worldwide terrain and runway database.

SmartLanding

A runway excursion takes place when an aircraft exits the runway at the side or off the end of the runway. It may result from technical issues, but could also result if an aircraft is landing or taking off on a runway shorter than is required.

SmartLanding provides a cost-effective, near-term solution to prevent runway excursion incident risk and preserving pilot and passenger confidence.

SmartLanding does this by providing timely alerts to crewmembers when the aircraft is approaching the runway too high, too fast or is not configured properly—common components of an unstable approach. The new SmartLanding software package complements company SOPs and FOQA programs to improve safety by encouraging compliance with the following general stabilized approach criteria:

– Aircraft should be stable at 1000 feet above the field

– Aircraft MUST be stable at 500 feet above the field

– Aircraft is properly configured to land

– Aircraft is on the correct vertical path

– Aircraft is at the correct speed (available on some platforms).

The SmartLanding feature includes callouts for long landing if the aircraft extends beyond a predetermined touch down zone, together with callouts of runway distance remaining during landing and rollout. Also included is a check for inadvertent barometric altimeter correction errors which have been a contributing factor for incidents and accidents during approach and landing in the past.

Both SmartLanding and SmartRunway require only a minimal amount of aircraft downtime and pilot training.

Runway Overrun Prevention System (ROPS)

Airbus has developed the Runway Overrun Prevention System (ROPS) as a response to runway overrun events during the landing phase.

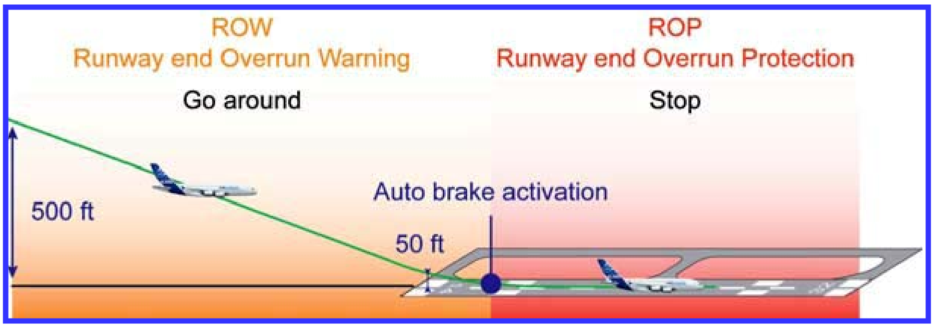
This system has two functions

1. It keeps flight crew informed during approach, through its intuitive interface, so that they can better make the necessary decision on whether or not to go-around. This it does through a warning function, called **Runway Overrun Warning (ROW)**, which applies in flight and is go around oriented.

2. It assists and warns the flight crew after touch down on the necessary actions to reduce the risk of runway overruns, or to limit the overrun speed. This is done by an active protection function, referred to as **Runway Overrun Protection (ROP)**, which applies on ground and is stop oriented.

The ROPS is presently being certified for the A380, under a new specific EASA performance regulation, in conjunction with the Brake To Vacate (BTV) system (refer to Oct.2009 issue of Flight Safety for the description of BTV system).

The two functions of ROPS system functionality described in the following with the assumption that the ROPS is working in BTV mode, as it allows the operation of all available system functionalities.



The Runway Overrun Warning

From 500ft Radio Altitude (RA) until Auto-Brake activation, ROW computes and displays predicted DRY and WET lines on the Navigation Display (ND). It Triggers alerts in case of predicted runway overrun conditions.

The DRY line provides a landing distance that can be reasonably achieved, under normal operating conditions, on a dry runway. This assumes:

- A realistic manual or automatic landing, normal flare and de-rotation technique
- A deceleration equivalent to Auto-Brake in High mode
- A realistic dry runway with normal rubber contamination
- Idle reversers
- Margins for the system's accuracy.

The WET line provides a landing distance that can be reasonably achieved, under normal operating conditions, on a wet runway. This assumes:

• A realistic manual or automatic landing, normal flare and de-rotation technique

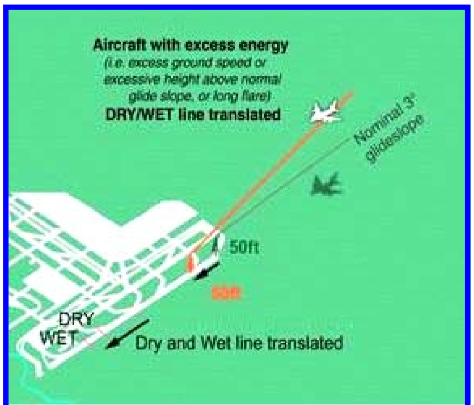
• A deceleration equivalent to Auto-Brake in High mode

• A realistic wet runway with normal rubber contamination

• Max reversers

• Margins for the system's accuracy.

Above 500ft RA, the computation of the DRY and WET lines is based on predicted data, in the frame of Brake To Vacate achievable operational landing distance check function.



Impact of excess energy approach at Landing without overrun risk

Whenever a significant change of conditions occurs after BTV preparation and operational landing distance check (TWR wind and de-rotation technique change inserted in FMS for appropriate speed managed, RWY condition change), a quick new operational landing distance check is possible with minimal crew workload.

Below 500 ft RA, computation of DRY and WET lines is based on measured data, by computing the operational landing distance realistically achievable, in real time.

This landing distance is calculated by taking account of the aircraft weight, ground speed, wind conditions, landing configuration and vertical/horizontal trajectory with respect to the runway threshold.

Runway overrun alerts

If the WET line moves beyond the end of the runway, it turns amber on the Airport Navigation Display and a "**IF WET : RWY TOO SHORT**" caution is displayed on the PFD.

If the DRY line moves beyond the end of the runway, the DRY and WET lines turn red on the Airport Navigation Display, and a "**RWY TOO SHORT**" . In addition, a "RUNWAY TOO SHORT!" repetitive audio callout triggers below 200ft.

The Runway Overrun Protection

From Auto-Brake activation until the aircraft stops, the Runway Overrun Protection (ROP) will:

• Compute and display a stop bar on the Navigation Display

• Automatically increase the braking to maximum braking and trigger appropriate alerts under predicted runway overrun conditions. This braking is equivalent to that developed in a rejected take-off by the Auto-Brake in RTO mode, which represents the maximum physical braking capacity of the system.

ROP: The stop bar on the ND

The green stop bar indicates the best possible estimation of the remaining landing roll-out distance, integrating the current aircraft ground speed, deceleration rate and distance to the runway end. It is continuously updated taking account of the actual braking conditions (runway friction and slope, thrust reversers, anti-skid, etc...).

ROP:Automatic braking increase & alerts

If the landing is performed despite the ROW warnings, or if the aircraft's deceleration is not sufficient, the ROP stop bar will appear, or move, beyond the end of the runway. In this situation, the path and stop bar turn red on the Airport Navigation Display, and a "**MAX REVERSE**" warning is displayed on the PFD.

Max physical braking is automatically applied (if Auto-Brake or BTV selected). In addition, a repetitive "MAX REVERSE!" aural alert is triggered if max reversers are not both selected. This message will be repeated until the crew selects both max reversers.

The "**MAX REVERSE**" warning remains on the PFD as long as the stop bar shows a runway overrun condition, whether or not Max Reverse is set.

If the stop bar still shows a runway overrun condition at 80 knots, a "KEEP MAX REVERSE!" audio callout is triggered once, to warn against undue Max Reverse de-selection as recommended in SOP.

Whenever the stop bar comes back inside the runway, and no longer predicts a runway overrun condition, the ROP reverts and allows normal BTV braking operation to resume.

PFD and ND in case of "WET" ROW alert

PFD and ND in case of "DRY" ROW alert

ND in normal condition

ND in case of ROP alert

ROPS combined with the BTV mode allows the operation of all available system functionalities:

• The system is informed of the landing runway selected by the crew during the approach preparation

• Until 500ft RA, the crew may benefit from the display of the "predicted" DRY and WET lines on the ND

• From 500ft RA, the crew will benefit from the display of the "real time" DRY and WET lines

• From 500 ft RA, the crew will benefit from the ROW alerts

• At Auto-Brake activation, the crew will benefit from all ROP functions: STOP bar display on the ND, automatic braking assistance and PFD/audio alerts.

When landing in classic Auto-Brake mode, without the BTV:

• The system is not informed of the selected landing runway until it automatically detects it in short final

• The crew will only benefit from the ROW alerts once the landing runway is identified

• The DRY and WET lines will not be displayed on the ND

• All ROP functions, however, will be available at Auto-brake activation.

The ROW/ROP functions are available:

• For all aircraft landing configurations (weight, CG, slats/flaps configuration, etc.)

• Without any wind or visibility limitations

• For all airports available in the Airport Navigation database.

With the runway shift function, the system is able to integrate a temporary change of available runway length (NOTAM, Land & Hold Short Operations for instance). The table above summarizes ROPS warnings and actions.

	ND (< 500 ft)	PFD (< 500 ft)	Audio (< 200ft)	Actions
ROW (WET)	WET line DRY line	IF WET, RWY TOO SHORT	None	GA decision (crew)
ROW (DRY)	WET line DRY line	RWY TOO SHORT	RWY TOO SHORT !	GA decision (crew)
ROP	RED stop bar	MAX REVERSE	MAX REVERSE ! KEEP MAX REVERSE ! (< 80 KIAS)	Max Braking (Auto) Max REV (crew)

In the near future, the protection offered by the ROPS will be available as well in manual braking mode. This "manual ROPS" is expected to be proposed on the A320 and A330/A340 families by 2011/2012. The ROPS will be basic on the new A350 under development. The extension of the ROPS capabilities to contaminated runways is currently under study.

Reference:

1. Armand Jacob, Robert Lignée, & Fabrice Villaumé., "The Runaway Overrun protection System", in Safety First #9, Airbus safety mag. July09.

ICING ISSUES AND FLIGHT SAFETY

Dr.M.S.Rajamurthy

As even a very light coating of frost, snow or ice that is hardly visible could have adverse effect on the airplane performance, awareness of icing effects and the procedures to ensure clean wing and other surfaces is very important for safety.

As icing effects can be catastrophic, the airworthiness and civil regulatory agencies keep reminding the operators of the hazards associated with it.

Any deposit of frost, ice, snow or slush on the external surfaces of an aircraft drastically affect its flying qualities because of reduced aerodynamic lift, increased drag, modified stability and control characteristics. Furthermore, freezing deposits may cause moving parts, such as elevators, ailerons, flap actuating mechanism etc., to jam and create a potentially hazardous condition. Engine/APU systems performance may deteriorate due to the presence of frozen contaminants to intakes, fan blades and components.

Also, engine operation may be seriously affected by the ingestion of snow or ice, thereby causing engine stall or compressor damage. In addition, ice/frost may form on certain external surfaces (e.g. wing upper and lower surfaces, etc.) due to the effects of cold fuel/structures, even in ambient temperatures well above 0° C.

In our previous winter issues (Dec.05, Dec.06, Dec.07, and Nov.08) we have discussed in quite some detail the criticality of ice formation on aircraft and the need for ground and in-flight de/anti-icing.

Ground de-icing/anti-icing are intended to ensure that the aircraft is clear of contamination so that degradation of aerodynamic characteristics or mechanical interference will not occur and, following anti-icing, to maintain the airframe in that condition during the appropriate holdover time.

The de-icing and/or anti-icing procedures should therefore include requirements, including type-specific, taking into account manufacturer's recommendations and cover:

(i) Contamination checks, including detection of clear ice and under-wing frost. [Note: limits on the thickness/area of contamination published in the AFM or other manufacturers' documentation should be followed];

(ii) De-icing and/or anti-icing procedures including procedures to be followed if deicing and/or anti-icing procedures are interrupted or unsuccessful;

(iii) Post treatment checks;

(iv) Pre take-off checks;

(v) Pre take-off contamination checks;

(vi) The recording of any incidents relating to de-icing and/or anti-icing; and

(vii) The responsibilities of all personnel involved in de-icing and/or anti-icing.

Under certain meteorological conditions de-icing and/or anti-icing procedures may be ineffective in providing sufficient protection for continued operations. Examples of these conditions are freezing rain, ice pellets and hail, heavy snow, high wind velocity, fast dropping OAT or any time when freezing precipitation with high water content is present. No Holdover Time Guidelines exist for these conditions.

The flight deck crew, particularly those flying the Europe and US sectors are strongly advised to review our previous winter issues and revisit the NASA Glenn Research center site (see links in the web watch) and go through the pilot's guide on ground icing and in-flight icing.

In August 2009, the US FAA changed its certification standards for transport category airplanes to require either the automatic activation of Ice Protection Systems (IPS) or a method to tell pilots when they should be activated.

The new rule requires an effective way to ensure the IPS is activated at the proper time, by adding another level of safety to prevent situations where pilots are either completely unaware of ice accumulation or don't think it's significant enough to warrant turning on their ice protection equipment.

Under this revised certification standards, new transport aircraft designs must have one of three methods to detect icing and to activate the airframe IPS:

- An ice detection system that automatically activates or alerts pilots to turn on the IPS;
- A definition of visual signs of ice buildup on a specified surface (e.g., wings) combined with an advisory system that alerts the pilots to activate the IPS; or
- Identification of temperature and moisture conditions conducive to airframe icing that would tip off pilots to activate the IPS.

Further it requires that after initial activation, the IPS must operate continuously, automatically turn on and off, or alert the pilots when the system should be cycled.

The FAA had previously addressed activation of pneumatic deicing boots on many aircraft models by requiring activation of boots at the first sign of ice accumulation. This certification standard applies to all types of IPS not just pneumatic deicing boots.

The first method of ice detection is the use of a primary Ice Detection System (IDS). A primary IDS usually has two ice detectors.

The second method of ice detection is the use of an advisory IDS along with visual cues. The major difference between a primary and an advisory IDS is that the primary is the principal means to determine when the airframe IPS should be activated and has two ice detectors. In contrast, an advisory IDS is a backup to the flight crew and has only one ice detector.

The third method of ice detection is a definition of conditions conducive to airframe icing that will be used by the flight crew to activate the airframe IPS. This definition will be included in the Airplane Flight Manual.

The least cost alternative is to activate the airframe IPS whenever the airplane is operating in conditions conducive to airframe icing based on a specific air temperature threshold and the presence of visible moisture. Since there are no additional certification or production costs to manufacturers through this alternative, there are no costs associated with such compliance.

According to FAA, this final rule has benefits that justify its minimal costs. The FAA has found that accidents and incidents occurred where the flight crew did not operate the airframe IPS in a timely manner resulting in concerns over the flight crew workload required to operate an airframe IPS that the flight crew must manually cycle.

The final rule addresses these concerns by ensuring that flight crews are provided with a clear means to know when to activate the airframe IPS and by reducing the workload associated with an airframe IPS that operates cyclically.

While there is no requirement to modify existing airplane designs, unless they undergo significant changes, FAA is considering a similar rulemaking that would cover aircraft not affected by this rule.

The FAA is also developing a proposed rule to address supercooled large drop icing, which is outside the icing envelope considered by the current icing certification requirements. The proposed rule would improve safety by taking into account supercooled large-drop icing conditions for transport category airplanes most affected by these icing conditions, mixed-phase and ice-crystal conditions for all transport category.

The ground de-icing/anti-icing procedures established in the KAC OPM-section 4.5 should be followed in conjunction with the aircraft-specific operations manuals.

WEB WATCH

http://www.honeywell.com/runwaysafety — *For information on Honeywell Runway Safety systems*

http://aircrafticing.grc.nasa.gov/courses_ground.html — ***a pilot's guide to ground icing** - all about ground icing problems, de/anti-icing fluids and anti-icing aircraft*

http://aircrafticing.grc.nasa.gov/courses_inflight.html — ***a pilot's guide to in-flight icing** - all about in-flight icing problems*

PHOTO OF THE MONTH

White Whale in Canada

On February 6, 2006, Airbus A380-841 (F-WWDD) was in Iqaluit (Frobisher Bay) (YFB / CYFB), Canada - Nunavut. For evaluation in icing conditions?!

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