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In this issue

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Editorial

We hope you enjoyed reading the July issue. The month of July saw many incidents and accidents associated with heavy rains and wet runways, the worst being the A320 crash at Sao Paulo, Brazil.

In two earlier issues(Dec.2006 and April 2007) we discussed runway overrun accidents during landing. In this edition, we look into a Southwest Airlines B737 overrun a wet runway while landing which resulted in a bad damage to aircraft and two serious injuries.

Next, from the Flight Safety Foundation ALAR briefing notes, all the details of landing distances, factors that influence them, causes for runway excursions and overruns under wet conditions, and strategies and lines of defense to prevent these are summarized. Runway accidents that occurred during July are summarized in the end.

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

Southwest Airlines B737 wet runway overrun during landing

based on NTSB Aircraft accident brief AAB0204, June 2002 & FSF accident prevention vol.60.no.7 July 2003

On March 5, 2000, 1811 Pacific standard time (PST), Southwest Airlines Flight 1455, a Boeing 737-300, overran the departure end of runway 8 after landing at Burbank-Glendale-Pasadena Airport (BUR), Burbank, California. The aircraft touched down at approximately 182 knots, and 20 seconds later, at approximately 32 knots, collided with a metal blast fence and an airport perimeter wall. The aircraft came to rest on a city street near a gas station off of the airport property. Of the 142 on board, 2 passengers sustained serious injuries; 41 passengers and the captain sustained minor injuries. The aircraft sustained extensive exterior damage and some internal damage to the passenger cabin. During the accident sequence, the forward service door (1R)escape slide inflated inside the aircraft; the nose gear collapsed; and the forward dual flight attendant jump seat, which was occupied by two flight attendants, partially collapsed. The flight, which was operating on an IFR flight plan, was conducted under 14 CFR Part 121. Twilight lighting VMC conditions prevailed at that time.

The accident flight was the flight crew's first flight of a 3-day flight sequence that consisted of five flights. The accident flight originated at McCarran International Airport (LAS), Las Vegas, Nevada, and was scheduled to depart at 1445 for BUR. The first officer (FO) arrived at LAS at 1245, and the captain arrived at 1400. The FO met the captain on the way to the gate. The accident aircraft arrived at LAS from Los Angeles International Airport, Los Angeles, California, at 1630, almost 2 hours behind schedule, because of rain and gusting winds in the LAS area. The accident flight crew indicated that the preflight inspection was normal and that no maintenance discrepancies were noted.

Flight 1455 departed the gate at 1650, more than 2 hours behind schedule. The captain was the pilot flying. The takeoff and en route portions of the flight to BUR were normal and uneventful.

After the flight crossed the PMD VOR navigation transmitter at 8,000 feet, the FO obtained information Oscar from the BUR airport terminal information service (ATIS), which indicated that winds were from 260° at 18 knots, gusting to 26 knots, and that aircraft were landing on runways 33 and 26. At 1754:21, the captain stated, "plan on three three at the moment. Approach descent checklist when you get the chance."

At 1802:52, the Southern California terminal radar approach control Woodland controller told the flight crew that the ATIS information Papa was current and that they should expect an ILS landing on runway 8. At 1803:29, when the aircraft was about 20nm north of the BUDDE outer marker at an altitude of 8,000 feet MSL, the Woodland controller instructed flight 1455 to turn left to a heading of 190° and to descend to and maintain 6,000 feet MSL. The FO acknowledged the instructions.

At 1804:02, when the aircraft was about 19 nm north of the outer marker at 7,800 feet MSL, the approach controller stated, "*Southwest fourteen fifty five, maintain two thirty or greater 'til advised please.*" The captain acknowledged the airspeed adjustment assignment. *[The approach controller imposed the speed restriction to sequence this flight between Southwest flight 1713 and Executive Jet flight 278.]*

The FO obtained information Papa and switched back to the approach control frequency. At 1804:42, he informed the captain that *the target airspeed for the approach would be 138 knots* and, at 1804:49, that winds were "*down to six knots*" and the aircrafts were landing on runway 8.(*As per the airline's FCOM approaches with a tailwind should be flown at VREF +5 knots.)*

At 1805:08, when the aircraft was about 16 nm north of the outer marker at 6,000 feet MSL, the controller instructed flight 1455 to "*turn left heading one six zero.*" At 1805:13, the captain indicated to the FO that ATC "*wants two hundred thirty knots or greater, for a while".*

According to the investigators, *this vector put the aircraft in an unfavorable position for final approach, complicating the flight crew's approach plan and contributed to the unstabilized approach.*

At 1805:54, the approach controller cleared flight 1455 to descend to and maintain 5,000 feet and advised the pilots that they were following company traffic (Southwest Airlines flight 1713) that was at their one O'clock and twelve miles ahead of them turning onto the final out of forty six hundred. The FO acknowledged the clearance.

The crew did not use the aircraft's On-board Performance Computer (OPC) landing performance module which provides specific AFM performance data, such as landing speeds, landing distances and power settings, based on aircraft gross weight & flap configuration, and runway condition.

Southwest airlines procedures indicate that the OPC landing module should be used when landing performance capabilities are in question and when tail wind conditions exist, the aircraft has a high gross weight, or the aircraft is landing on a short runway.

At 1807:43, the approach controller cleared flight 1455 to descend to and maintain 3,000 feet. The FO acknowledged the clearance. At 1808:18, the FO notified ATC that he had the Southwest traffic in sight. At 1808:19, the approach controller issued an altitude restriction by stating, *"cross Van Nuys at or above three thousand, cleared visual approach runway eight."* The FO acknowledged the clearance. At 1808:36, as the aircraft was descending through 3,800 feet MSL, the captain began turning to the left for the final approach.

As per the report, although the controller's instruction to maintain at least 230 knots was no longer warranted by the traffic situation, the controller did not cancel the instruction.

Canceling the speed restriction would have permitted the captain to begin reduce his speed about 37 seconds earlier, giving him more time to properly execute the approach to land.

During the approach, the captain's navigation radio was tuned to the ILS frequency for runway 8, and the FO's radio was tuned to the Van Nuys VOR. They indicated that the autopilot was engaged in the VOR/LOC mode and that the aircraft captured the localizer course but then overshot the centerline before correcting back. *As the flight passed 2 miles west of Van Nuys at 3,000 feet at approximately 220 to 230 knots, the captain told that he had deployed the speed brakes.*

As per CVR, at 1809:28, when the aircraft was at an indicated airspeed of 220 knots, the captain called for "*flaps five."* At 1809:32, the flaps began to extend.

At 1809:43, the captain called for "*gear down*" and at this point in the flight, he noted a 20-knot tailwind

indication on the FMS screen.

At 1809:53, the approach controller stated, "*Southwest fourteen fifty five, wind uh. two one zero at six, runway eight, cleared to land.*" Simultaneously, the captain called for "*flaps fifteen*." At 1810:01, the captain again called for "*flaps. fifteen*" *and twenty five."*

From 1810:24 until 1810:59, the GPWS alerts were being continuously broadcast in the cockpit, first as "*sink rate*" and then, at 1810:44, switching to "*whoop, whoop, pull up*." At 1810:29, the captain stated, "*flaps thirty, just put it down."* At 1810:33, the captain stated, *"put it to forty. It won't go, I know that. It's all right. Final descent checklist."* After the GPWS "*whoop, whoop, pull up*" alert sounded at 1810:47, the captain at 1810:53 stated, *"that's all right"*. A final 'sink rate' warning was recorded at 1810:55.

The FO stated in a post accident interview that instead of reading the final descent checklist, he visually confirmed the checklist items and remembered seeing the captain arm the ground spoilers. The FO also stated that when the captain called for flaps 40°, the airspeed was 180 knots and went as high as 190 knots during the approach. The FO indicated that he pointed to his airspeed indicator to alert the captain of the flap limit speed of 158 knots at flaps 40°.

The captain told Safety Board investigators that he remembered hearing the "*sink rate*" warning from the GPWS but that he did not react to the warning because he did not feel that he had to take action. He stated that he did not remember any other GPWS warnings during the approach. The FO indicated in a post accident interview that he heard both the *"sink rate."* and the *"pull up."* GPWS warnings but that he believed that the captain was correcting.

The FO also indicated to investigators that he selected the "Progress" Page on the FMS cockpit display unit but that he could not recall what the wind values were during the approach. He stated that he was concerned that the ground speed was faster than normal but added that he did not verbalize his concern to the captain. The FO further indicated to investigators that he felt that the approach was stabilized and that they were in a position to land.

In the post accident interview, the captain stated that he was aware that Southwest Airlines' standard procedure was for the captain and FO to call "1,000 [feet above ground level (AGL)], airspeed, and sink rate" when descending through 1,000 feet. However, no such callouts were recorded by the CVR. The captain also stated that he visually perceived that the aircraft was 'fast' as it crossed the approach end of runway 8. CVR and FDR data indicate that the aircraft touched down at 1810:58 with flaps extended to 30° at 182 knots; flaps then extended to 40° during the ground roll at 145 knots.

The captain told the investigators that after touchdown, the end of the runway appeared to be closer than it should have been and that he thought they might hit the blast fence wall. The captain indicated that he braked 'pretty good' while attempting to stop the aircraft. FDR data indicate that the captain unlocked the thrust reversers 3.86 seconds after touchdown and the thrust reversers deployed 4.91 seconds after touchdown. The FO told investigators that the captain applied wheel brakes before the aircraft had decelerated to 80 knots and that, as the aircraft passed the Southwest Airlines passenger boarding gates, he joined the captain in braking the aircraft and applied the brakes as hard as he could. The captain indicated that as the aircraft neared the end of the runway, he initiated a right turn using only the nose wheel steering tiller (not the rudder pedals).

At 1811:20, the cockpit area microphone (CAM) recorded impact sounds. The aircraft departed the right side of the runway at 30° from the runway heading, penetrated a metal blast fence and an airport perimeter wall, and came to a stop on a city street off of the airport property.

At 1811:37, the captain announced on the airplane's Public Address System, "folks, remain seated. Remain seated. We're all right". He did not order an evacuation. He then shut the engines and told the FO, "*Well, there goes my career.*"

An emergency evacuation ensued, and all crewmembers and passengers successfully exited the aircraft.

The report noted that the aircraft structure was intact, and the entire airframe was accounted for at the accident site. Major damage was confined to the nose section (mainly on the left side and the nose wheel–well area), and a section of the fuselage which collapsed circumferentially. The nose gear was severed from the drag brace and driven aft into the electronics bay.

The NTSB, USA determined that the probable cause of this accident was

- the flight crew's excessive airspeed and flight path angle during the approach & landing and flight crew's failure to abort the approach when stabilized approach criteria were not met.

- Contributing to the accident was the controller's positioning of the aircraft in such a manner as to leave no safe options for the flight crew other than a go-around maneuver.

Runway Excursion/Overrun Prevention

Adopted from Flight Safety foundation's ALAR TOOL KIT - FSF ALAR Briefing notes

Nearly 20% of the approach and landing accidents are runway excursions or overruns. These can occur after any type of approach and in any lighting or environmental conditions.

Before getting into the details of runway excursion/overruns and various factors involved let us look into the definitions of runway, landing distances and the factors that influence them.

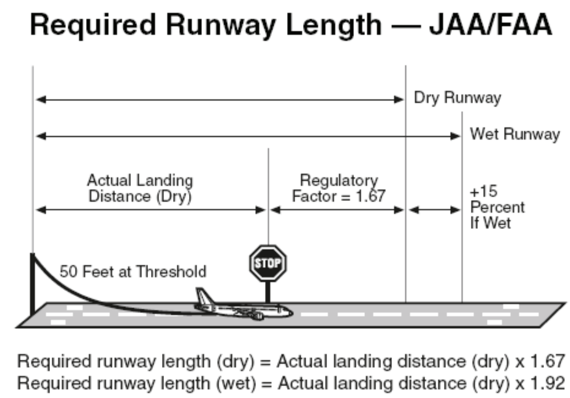
JAA defines Dry runway as "one which is neither wet nor contaminated, and includes those paved runways which have been specially prepared with grooves or porous pavement and maintained to retain 'effectively dry' braking action even when moisture is present."

JAA considers a runway as damp "when the surface is not dry, but when the moisture on it does not give it a

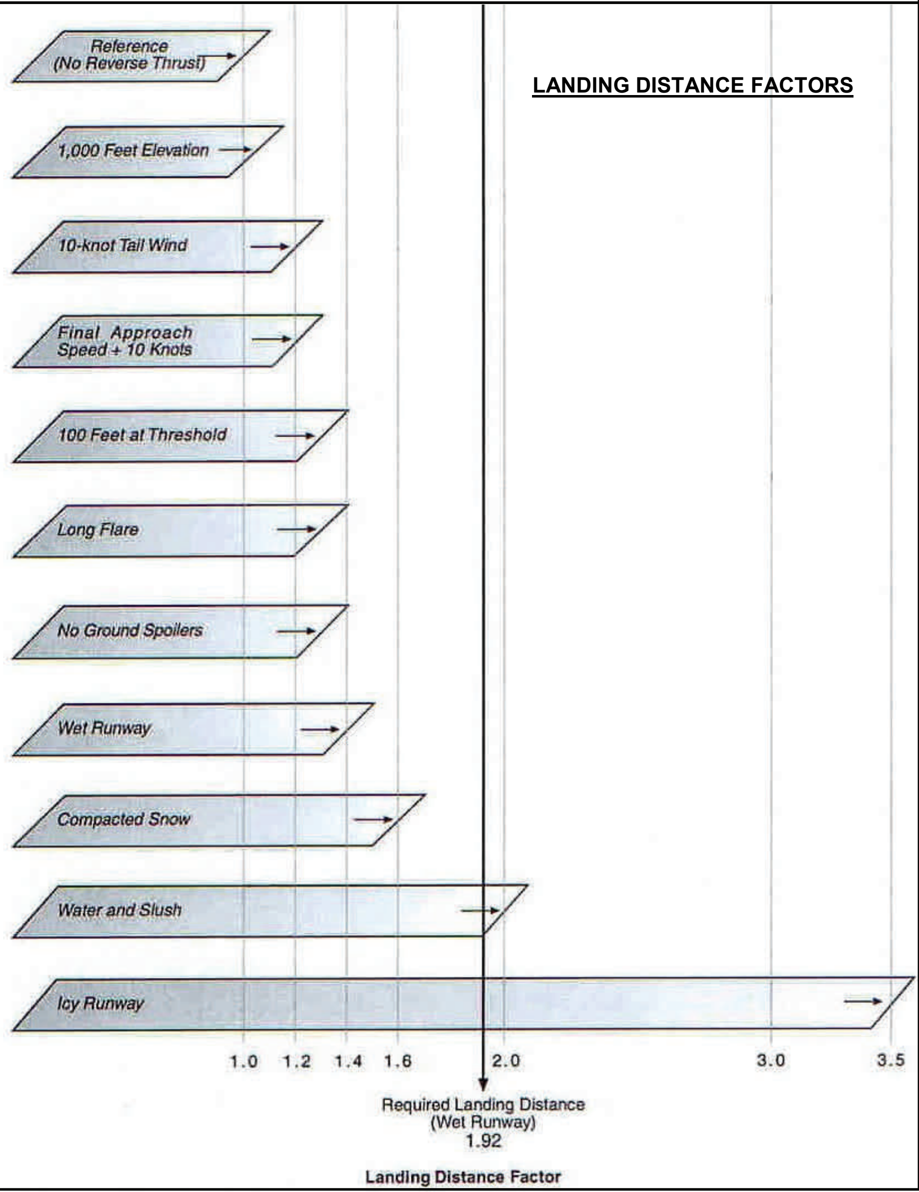
Actual landing distance is defined as the distance used in landing and braking to a complete stop (on a dry runway) after crossing the runway threshold at 50 feet.

Required landing distance is the distance derived by applying the landing factor to the actual landing distance.

Actual landing distances are determined during certification flight tests without the use of thrust reversers.



JAA = (European) Joint Aviation Authorities
FAA = (U.S.) Federal Aviation Administration



shiny appearance."

JAA considers a <u>runway as wet</u> "when the runway surface is covered with water, or equivalent, less than specified (for a contaminated runway) or when there is sufficient moisture on the runway surface to cause it to appear reflective, but without significant areas of standing water."

JAA considers a <u>runway to be contaminated</u> "when more than 25% of the runway surface area (whether in isolated areas or not) within the required length and width being used is covered by the following:

- "surface water more than 3.0 millimeters(0.0125 inch) deep, or by slush or loose snow, equivalent to more than 3.0 millimeters(0.0125 inch) of water;
- "snow which has been compressed into a solid mass which resists further compression and will hold together or break into lumps if picked up (compacted snow); or,
- " Ice including wet ice."

<u>The US FAA considers runway to be contaminated</u> "whenever standing water, ice, snow, slush, frost in any form, heavy rubber, or other substances are present."

When discussing landing distances two types are considered—the actual and the required landing distances.(see the figure at the top for definitions)

Required landing distances are used for dispatch to select the destination airports and alternate airports.

Actual landing distance is affected by various operational factors which include

- High airport or high density altitude, resulting in increased ground speed;
- Runway slope or gradient;
- Runway conditions(dry, wet, contaminated);
- Wind conditions;
- Type of braking–pedal braking/ autobrakes, use of thrust reversers;
- Anti-skid system failure;
- Final approach speed;
- Landing technique(e.g. height and airspeed over the threshold, thrust reduction and flare);
- Standard Operating Procedures (SOPs) deviations (e.g. failure to arm ground spoilers);
- Minimum equipment list (MEL)/ dispatch deviation guide (DDG) conditions (e.g. thrust reversers, brake unit, anti-skid or ground spoilers inoperative); and
- System malfunctions (e.g. increasing Final approach speed and/or affecting lift-dumping capability and/or braking capability).

The effect of these factors on landing are shown in the figure above. As shown in the figure, a tail wind of 10Kt can increase the landing distance by 20%, no ground spoilers will increase the distance by 30% and a wet runway will increase the landing distance by 40%. When considering multiple factors, the cumulative effect of each of these factors have to be borne in mind.

Runway excursion occur when aircraft veers off the runway during landing roll; or aircraft veer off the runway or taxi-way when exiting the runway.

Runway overrun occurs when the aircraft rollout extends beyond the end of the landing runway.

The factors involved in these are due to weather, aircraft systems, crew technique and decisions.

Factors involved in runway excursions

Runway excursions are the result of one or more of the following factors:

Weather factors

- Runway condition i.e. wet or contaminated by standing water, snow, slush or ice
- Wind shear
- Cross wind
- Inaccurate information on wind conditions and/or runway conditions
- Reverse-thrust effect in a crosswind and on a wet or contaminated runway.

Crew technique/decision factors

- Incorrect crosswind landing technique
- Inappropriate differential braking by the crew
- Use of nosewheel-steering tiller at airspeeds that are too fast
- Airspeed too fast on the runway to exit.

Systems Factors

- Asymmetric thrust (forward on one side and reverse on the other side);
- Uncommanded differential braking.

Factors involved in runway overruns

Runway overruns are usually the result of one or more of the following factors:

Weather factors

- Unanticipated runway condition (worse than expected)
- Inaccurate surface wind information
- Unanticipated wind shear or tailwind.

Performance Factors

- Incorrect assessment of landing distance following a malfunction or MEL/ dispatch deviation guide (DDG) condition affecting aircraft configuration or braking capability
- Incorrect assessment of landing distance for prevailing wind and runway conditions

Crew technique/decision factors

- Unstable approach path
  – Landing fast and excessive height over threshold
- No go-around decision when warranted
- Decision by captain (PNF) to land, countermanding first officer's decision to go around; Extended flare (allowing aircraft to float and to decelerate in the air)
- Failure to arm ground spoilers (usually associated with thrust reversers being inoperative)
- Power-on touchdown(i.e. preventing auto-extension of ground spoilers, as applicable)
- Failure to detect non-deployment of ground spoilers(e.g. absence of related standard call)
- Bouncing and incorrect bounce recovery
- Late braking (or late takeover from autobrake system, if required)
- Increased landing distance resulting from the use of differential braking or the discontinued use of reverse thrust to maintain directional control in cross wind conditions.

Systems Factors

- Loss of pedal braking
- Anti-skid system malfunction or
- Hydroplaning

Accident prevention strategies

The recommendations of ALAR task force is two fold. It recommends company strategies for accident prevention and personal lines of defense.

Policies

- Define a policy to promote readiness and commitment to go around (discouraging any attempt to "rescue" a situation that is likely to result in a hazardous landing);
- Define a policy to ensure that inoperative brakes ("cold brakes") are reported in the aircraft logbook and that they receive attention in accordance with the MEL/DDG;
- Define policy for a rejected landing (bounce recovery);
- Define policy prohibiting landing beyond the touchdown zone; and
- Define policy encouraging a firm touchdown when operating on a contaminated runway.

Standard Operating Procedures

- Define criteria and standard calls for a stabilized approach, and define minimum stabilization heights in SOPs;
- Define task-sharing and standard calls for final approach and roll-out phases in SOPs; and
- Incorporate in SOPs a standard call for "… [feet or meters] runway remaining" or ".. [feet or meters] to go" in low-visibility conditions, based on
  – Runway lighting color change;
  – Runway-distance-to-go markers (as available); or
  – Other available visual references (such as runway/taxiway intersections).

Performance data

- Publish data and define procedures for adverse runway conditions and
- Provide flight crew with a specific landing-distance data for runways with a downhill/high elevation

Procedures

- Publish SOPs and provide training for crosswind-landing techniques;
- Publish SOPs and training for flare techniques;
- Publish SOPs for the optimum use of autobrakes and thrust reversers on contaminated runways;
- Provide recommendations for the use of rudder and differential braking/nose wheel steering for directional control, depending on airspeed and runway condition; and
- Publish specific recommendations for aircraft lateral control and directional control after crosswind landing.

Crew awareness

- Ensure flight crew awareness and understanding of
  –all factors affecting landing distances;
  –conditions conducive to hydroplaning;
  –crosswind & wheel-cornering issues;
- Ensure flight crew awareness of wind shear and develop corresponding procedures (particularly for the monitoring of ground speed variations during approach)
- Ensure flight crew awareness of the relationships among braking action, friction coefficient and runway-condition index, and maximum cross wind components recommended for runway conditions and
- Ensure flight crew awareness of runway lighting changes when approaching the runway end:
  – Standard centerline lighting: white lights changing to alternating red and white between 3000ft and 1000ft from runway end, and to red lights for the

last 1000ft ; and

– Runway edge lighting (high intensity runway light system); white lights changing to yellow lights on the last 2000ft of the runway.

Summary

Runway excursions and runway overruns can be categorized into six families of events, depending on their primary causal factor as follows

1. Events resulting from unstabilized approaches;
2. Events resulting from incorrect flare technique;
3. Events resulting from unanticipated or more-severe-than-expected adverse weather conditions;
4. Events resulting from reduced braking or loss of braking;
5. Events resulting from an abnormal configuration (e.g. aircraft dispatched under MEL conditions or DDG conditions, or because of an in-flight mal-function; and
6. Events resulting from incorrect crew action and coordination, under adverse conditions.

Corresponding company accident-prevention strategies and personal lines of defense can be developed to help prevent runway overruns by:

– Adherence to SOPs;
– Enhanced awareness of environmental factors;
– Enhanced understanding of aircraft performance & handling techniques;
– Enhanced awareness for flight-parameter monitoring, deviation calls and crew cross-check.

Stabilized approach is a major key to avoid possible runway excursion/overrun accidents. An approach that becomes unstabilized below 1000ft above airport elevation in IMC or below 500 ft above airport elevation in VMC requires an immediate go-around. This should be strictly adhered to.

Wet runways combined with adverse weather conditions like thunderstorms, windshear or tail winds and heavy rains make the landings that much demanding and difficult. SOPs become very critical and should be adhered to in all cases.

Recent runway overrun accidents

The month of July this year saw five wet runway overrun accidents, the most disastrous being the TAM Lineas A320 crash at Sao Paulo, Brazil. Three of these accidents occurred in India, with monsoons active in the region with associated heavy rain & thunderstorm.

1. On the night of July 1, at Holkar airport, Indore, India, a Jet Airways Boeing 737 skidded off the runway after its wheels broke while landing during heavy rains. Of the 49 onboard, 6 passengers received minor injuries and an airhostess suffered spine injuries.

2. On July 3, an Air Sahara Boeing 737 skidded off the runway at the International airport, Cochin, India in rainy monsoon conditions.

3. On July 6, at the international airport, Cochin, India, an Air India Express Boeing 737-800 operating in the Muscat-Thiruvananthapuram-Kochi sector with 61 passengers while landing on wet runway lost directional control and ran 200m off the end. The aircraft was badly damaged.

4. On July 17, a TAM Lineas Aereas Airbus A320 crashed at Congonhas airport, Sao Paulo, Brazil during landing in rainy weather conditions killing all 176 onboard.

5. On July 17, an Embraer 190 of Aero republica skidded off the wet runway of Simon Boliviar airport in Santa Marta, Columbia.

In each of these cases, one or several factors discussed here would be involved in the accident.

In the TAM A320 case, though initially the runway condition was debated as a major factor for the accident, it is now confirmed that the aircraft was dispatched with engine 2 thrust reverser inoperative as per MEL.

WEB WATCH

http://www.iasa.com.au — *International Aviation Safety Association site dedicated to safety issues– has good database on safety and specially addresses in-flight fire related issues*

PHOTO OF THE MONTH

Tail strike during takeoff

On July 28,2004, Malaysian Airlines flight MA9, a Boeing 777-2H6(ER) while taking off from Zurich-Kloten airport LSZH, Switzerland, had a tail strike.

After dumping fuel for 40 minutes it made an emergency landing. There was damage to the fuselage aft structure. The aircraft is currently flying.

What caused the tail strike, incorrect rotation speed, over enthusiastic pilot, wrong weight and c.g. The guess is yours?!

The Confidential Aviation Hazard Reporting System (CAHRS) provides a means of reporting hazards and risks in the aviation system before there is loss of life, injury or damage. It is open to anyone who wishes to submit a hazard report or safety deficiencies confidentially and non-punitively. Reports help to identify deficiencies and provide safety enhancement in areas of aviation. CAHRS forms can be collected at different location of KAC (i.e. Flight Dispatch) Premises. Completed forms can be dropped in FS&QA allocated box at Flight Dispatch or e-mailed to kwioeku@kuwaitairways.com or faxed to 00965-4749823 or mail to Flight Safety and Quality Assurance office, Operations Department, P.O. Box 394, Safat 13004, Kuwait Airways –Kuwait.