Flight Operations in Low Visibility Conditions

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Meeting to enhance State Coordination between MET, AIM, and ATM fields
Mexico City, Mexico, 26-28 July 2016
Agenda

1. All weather operations
2. Importance of Meteorology
3. Cost-benefit analysis
4. Flight operations in low visibility conditions
5. Pilot’s perspective
6. The human element in ground visual aid use
7. Runway visual range – RVR, slant visual range - SVR and visual segment
8. Examples
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All Weather Operations

✈ The aim is to improve traffic regularity in limiting visibility conditions maintaining the accepted safety levels

✈ Pilot is part of the system

✈ It demands a high-level of reliability, integrity and accuracy

✈ ATS, AIS and MET participation in a coordinated way is key for the success of the mission
Importance of Meteorology

- Contributes to enhance safety and efficiency
- Pilots can create an accurate scenario in their minds of the expected departure, enroute and arrival meteorological conditions for the planned trip
- Pilots can select strategically the best course of action for the success of the mission
- Accepted level of safety is maintained
- Optimized operations contribute positively to minimize the impact of the activity in the environment
Cost-Benefit Analysis

✈ The provision of all weather landing facilities involved considerable expenditure
   ✈ On ground and airborne facilities

✈ Benefits are the improved regularity and safety and make the activity sustainable

✈ Higher workload for installations, certifications, authorizations, training and maintenance by aerodromes, operators and States
Flight Operations in Low Visibility

✈ Major pilot concern is that the instrument phase of the approach is lengthened and the visual phase is shortened

✈ Instrument phase: pilot seeks to known the aircraft's position is likely to be when visual contact is made

✈ Visual phase: pilot must verify the aircraft's position and decide whether to continue the approach and land or go around

✈ When aircraft is at the minimum Cat II DH of 30 meters the runway is less than 5 seconds away
Pilot’s Perspective

✈ Human beings are two-dimensional; as we take to the air we add a third dimension

✈ Continuous simultaneous corrections in all three dimensions are necessary in order to follow a correct flight path

✈ Aircraft may be controlled:
  ✈ Manually or by means of automatic pilot
  ✈ By reference to the instruments or to the visual cues in the outside world
An approach and landing is the intersection of two planes at right angles

1. Extended center line of the runway
2. Approach slope

Aircraft must cross the runway threshold with a safe margin of height and speed

Speed and rate of descent must be reduced in the flare

After touchdown, the pilot needs directional guidance to keep the aircraft in the runway and then to taxi to the parking position
Inner 300 m approach and runway lighting for precision approach runways Category II and III

Source: ICAO
Examples of approach and runway lighting
Examples of approach and runway lighting

CAT II y III
The human element in ground visual aid use

Air System standardization: is extremely important
- Pilots see the approach and runway lighting in perspective
- Pilots see them complete only in good meteorological conditions
- They are moving continuously

Air Individual differences: must be considered
- Age
- Fatigue
- Adaptation to light levels
- Pilot proficiency, etc.
The human element in ground visual aid use

Mechanics of seeing: must be understood

- Approach and runway lighting patterns emphasize center line
- Intensity setting must match ambient conditions
- Intensity of the various section (colours) of the system must also match

Consider that:

- Fovea of the eye is only 1.5 degrees in width
- Average time for a pilot to switch from outside visual cues to instruments and back is about 2.5 seconds
- High performance aircraft will travel 150 meters in this period
The human element in ground visual aid use

Airplane
Visual workload: is important

Airplane
Pilots data processing capability and reaction is extensive if situation unfolds as expected

Airplane
This capacity may break down where input data are ambiguous or transitory

Airplane
Visual workload is best moderated by standardization, balance and integrity of elements to avoid momentary disorientation, visual illusions or induce error

Airplane
Other elements are: pilots eye position, cockpit cut-off angle, meteorological conditions, day or night, instruments, avionics, etc.
Edge and center lights as seen by the pilot during landing and take-off

Source: ICAO
Runway Visual Range - RVR

Airplane

Permits pilots to appraise aerodrome visibility conditions and to determine whether these conditions are above or below aerodrome minima

Airplane

Indicates visual guidance along the runway and some indication of seeing conditions on final approach
Additional Concepts

Airplane Visual Range (SVR): determines the distance between the pilot's eye and the farthest light he can see.

- The distance to the nearest light depends on the altitude and the cockpit cut-off angle.

Visual segment: is the length of the approach light pattern in view at any one instant of time.

Cockpit cut-off angle: between the longitudinal axis of the aircraft fuselage and an incline plane below up to the limit at which the pilot can view.

- Around 11° to 15° for different aircraft.
Variations in Visual Segment

-The pilot needs for assimilate and interpret the visual cues:
  - A sufficient exposure time to the lights
  - A minimum visual segment during the final approach

-Transition from instruments to visual reference
  - From 200 ft to the point where the runway threshold lights disappear from view is 10-12 seconds
  - At 100 ft exposure time is 3-5 seconds
  - Rough guide for the minimum acceptable is a 150 meters segment (5 lights) ahead of the aircraft
Variations in Visual Segment

DC-9-32
FLAPS: 50°
V: 1.3Vs + 5 kts
MID C.G.
PITCH ATTITUDE: +2.4°
COCKPIT CUT-OFF ANGLE: 13.1°
CORRECT EYE POSITION
APPROACH LIGHT SYSTEM: 900 M
HOMOGENEOUS FOG
SVR: 400 M
ZERO WIND

Source: KLM
Examples of approach and runway lighting
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Summary

- Successful low visibility operations require a team effort that begins in the weather forecast phase
- Low visibility operations are highly demanding
- Proper coordination among ATS, AIM and MET are key for the success of the mission
- Safety levels must be maintained
- ICAO is committed to lead the international aviation community in promoting the highest standards of safety
THANK YOU!

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