SUBJECT:
WAKE TURBULENCE AWARENESS

REFERENCE PUBLICATIONS:
CAR-X
CAR-OPS1
CAR PART VIII Subpart 4

REASON:
This Safety Alert is issued to highlight the possibility of wake turbulence events in all phases of flight, including when operating in excess of the current wake turbulence separation minima on approach and departure phases of flight. It contains guidance and recommendations for air traffic controllers and flight crews and their respective employers.

GUIDANCE
The recognised ICAO standards related to wake turbulence separation minima are intended for the approach and departure phases of flight. Wake turbulence encounters do however occur occasionally in other phases of flight such as ‘enroute’ or ‘cruise’ phase. For simplicity throughout this guidance, the term ‘enroute’ will be used to refer to any time other than ‘approach’ or ‘departure’. The only globally harmonised approach to the management of wake turbulence enroute is the Strategic Lateral Offset Procedure (SLOP) that had been introduced by ICAO following the introduction of RVSM.

An international task force under the auspices of ICAO has been developing revised wake turbulence standards (known as RECAT) over the past few years, however these remain focused on the approach and departure phases primarily aimed to improve airport efficiency. There may be scope to have the issue of enroute wake turbulence addressed by ICAO but this will take some time and is not expected in the near future.

Enroute wake turbulence events can manifest as unexpected in-flight disruptions and have the potential to be hazardous. Accordingly, this Safety Alert is intended to enhance awareness of possible wake turbulence events that occur in the enroute phase of flight.

WAKE VORTEX CHARACTERISTICS
Every aircraft generates turbulence as a result of the creation of lift, this is known as ‘wake turbulence’, wake vortex/vortices’, or simply ‘wake’. The amount and severity of the wake is dependent on the size, wing...
shape, and mass of the aircraft. The vortices normally move down (~700ft/min) and outwards behind the generating aircraft, generally levelling around 900ft below the initial level, however for large aircraft they may continue to descend beyond this. The vortices can persist for several minutes after the aircraft has passed and this equates to a considerable distance in nautical miles at cruise speed.

Meteorological conditions will alter the dispersal of the vortex; prevalent strong winds or turbulence will normally contribute to a swift decay of the vortex, whereas the strength and existence is maintained for a few minutes in calm or low wind conditions. Contrails may be used as a guide however these do not behave the same as the wake vortex and are not an accurate representation of the location of the vortices.

The wake vortex is most hazardous in the approach and departure phase of flight as the high flap/low speed of the lead aircraft generates larger vortices, and the following aircraft is in a critical state with a similar configuration. In the enroute phase, the likelihood of entering the critical part of the vortex is significantly less, and the aircraft affected is in a better state to recover than when on approach/departure. Consequently, the current ICAO procedures consider that there is no need for additional separation in enroute airspace other than that normally applied for standard separation.

Existing procedures mitigate wake effects by requiring distance based on the Maximum Take-Off Mass (MTOM) of the aircraft concerned; both leading and following. This approach does not consider differences of aircraft characteristics (within the same weight category) or the effects of meteorological conditions on the movement of, or decay of the wake.

The nature of wake turbulence presents difficulty in reliably determining its exact position and strength. As a result, the procedures are designed to reduce the risk of adverse or severe encounters, but cannot remove the possibility altogether.

1 (International Civil Aviation Organization (ICAO), 1984, pp. II-5-3 Fig 1)
2 (Breitsamter, 2011, p. 93)
“It follows that the application of the wake turbulence minimum is not an assurance against a wake turbulence encounter; its application only minimizes the hazard.”

LESSONS LEARNED FROM PREVIOUS EVENTS

While reports on wake encounters during the approach phase of flight are extensive, there are considerable less reports in regard to wake encounters in other phases of flight. Nevertheless, recent investigations into incidents which occurred at higher altitudes have provided some useful guidance on best practices.

Experience has shown that the initial air crew response is critical to the outcome of an encounter, and that some actions can result in amplification of the upset and a deterioration of the situation. Due to the rotating nature of the vortex, an encounter will result in the affected aircraft normally experiencing a roll in one direction followed shortly thereafter by an abrupt roll in the other direction, and then ejection from the vortex. The time for this to occur and pass is usually very short; a matter of seconds. Therefore, it is important that any actions by the flight crew are minimised until the encounter has completed, otherwise those actions can be compounded into an adverse situation as the direction of the upset changes very quickly.

For large aircraft, under normal circumstances the autopilot is capable of managing the actual encounter, and following some stabilisation, the flight crew can perform any remaining actions to resume normality.

For aircraft with a short wing span (relative to that of the generating aircraft) the ability to counter the imposed roll induced by vortex flow is considerably more difficult. Flight Crew of these aircraft, even of the high performance type, should be especially vigilant with regard to wake turbulence.

In any event the use of rudder in reaction to cruise wake encounters is not recommended as it provides minimal assistance and can cause a sudden and large lateral deflection placing structural stress on the rudder.

Detailed training on wake turbulence characteristics provides valuable understanding for both air crew and air traffic controllers, allowing them to more reliably predict and manage wake events.

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3 (International Civil Aviation Organization (ICAO), 1984, pp. II-5-3.3.1)
4 (International Civil Aviation Organization (ICAO), 1984, pp. II-5-3.3.6.3)
5 (Airbus, 2017)
UAE REGULATIONS & GUIDANCE

The UAE has implemented wake turbulence regulations generally in line with the ICAO provisions. Where further clarification on the definition of ‘approach & departure’ is necessary, the UAE has deemed that this should be interpreted as “at or below 6000ft”.

Regulations and associated procedures require ATC to issue traffic information to a possible encountering aircraft with regards to aircraft type, distance, level and relative position of potential generating aircraft.

Air Navigation Service Providers are required to provide training to Air Traffic Controllers on wake turbulence separation and further awareness of safety issues linked to wake vortices.

A ROSI is required to be submitted for wake turbulence events where a pilot reports encountering moderate or severe wake turbulence from generating aircraft and the impact had a significant effect on the control of the aircraft, e.g. roll, pitch or altitude deviation; speed loss/gain.

SUMMARY OF THE GUIDANCE

a) ICAO wake turbulence procedures are focused on approach and departure and do not encompass enroute encounters.

b) Wake turbulence separation standards do not guarantee avoidance of encounters, they only attempt to minimise the risk.

c) Wake turbulence is somewhat predictable and can be generalised as the vortices descending at 700ft/min and extending for up to 25nm behind the aircraft.

d) Lateral offsets can reduce the risk in some circumstances. In UAE airspace any offset must be requested, and approved by ATC, prior to the application of the manoeuvre.

e) The anticipation and correct handling by flight crew is currently the best mitigation.

f) It is recommended that flight crew avoid disengagement of the autopilot, wait for stabilisation, and then resume normal operations.

g) ATC should monitor flight profiles, and consider giving wake vortex warning in the event that an aircraft will fly in the airspace below the trajectory of either a heavy aircraft, or an aircraft of a heavier weight category than the experiencing aircraft.

h) All wake turbulence events that have a significant effect on the aircraft should be reported.

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6 (UAE GCAA, 2016)
**RECOMMENDATIONS:**

**RECOMMENDATION No. SA 2017-10(01):**

Aircraft Operators should:

a) train flight crews on the recognition of potential wake situations;

b) review flight crew procedures for the management of wake turbulence encounters and provide training to flight crews accordingly; and

c) include the recommendations for flight crew below in their training programme.

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**RECOMMENDATION No. SA 2017-10(02):**

As precautionary measures, Flight crew should be aware that:

a) Passengers should be advised to keep their seat belts fastened, even when the seat belt sign is off, unless moving around the cabin. This minimises the risk of passenger injury in case of any atmospheric or wake turbulence encounter enroute.

b) As indicated in ICAO PANS-ATM, for aeroplanes in the heavy wake turbulence category or for Airbus A380-800, the word “HEAVY” or “SUPER”, respectively, shall be included immediately after the aeroplane call sign in the initial radiotelephony contact between such aircraft and ATS units.

c) Lateral offsets may provide additional mitigation in certain circumstances. All lateral offsets are subject to authorization. In the UAE specific ATC approval is required.

d) Timely selecting seat belt signs to ‘ON’ and instruct cabin crew to secure themselves constitute precautionary measures in case of likely wake encounters.

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**RECOMMENDATION No. SA 2017-10(03):**

In case of a wake encounter, Flight crew should:

a) Be aware that it has been demonstrated during flight tests that if the pilot reacts at the first roll motion, when in the core of the vortex, the roll motion could be amplified by this initial piloting action. The result can be a final bank angle greater than if the pilot would not have moved the controls.

b) Be aware that in-flight incidents have demonstrated that pilot inputs may exacerbate the unusual attitude condition with rapid roll control reversals carried out in an “out of phase” manner.

c) Be aware that if the autopilot is engaged, intentional disconnection can complicate the scenario. The autopilot will in most cases – when engaged – facilitate the response to the wake encounter.

d) Avoid large rudder deflections when encountering wake turbulences. These can create lateral accelerations, which generate very large forces on the vertical stabiliser that may compromise the structural integrity. Use of the rudder could increase the severity of the encounter and rarely improves the ease of recovery.

e) Make use of OEM guidance for their specific aircraft type.
RECOMMENDATION No. SA 2017-10(04):

Recognizing that the wake turbulence separation standards can only minimize, and not prevent wake encounters, Air Navigation Service Providers should provide detailed training and guidance to air traffic controllers on the characteristics of wake vortices, including the following wake turbulence management principles:

a) Controllers should be aware that wake vortices will likely extend beyond the applicable wake turbulence separation standards, as these separation standards are only intended to minimize the risk of severe encounters. Additionally, wake vortex encounters may be experienced during all phases of flight.

b) Controllers should factor wake vortex behaviour into their situational awareness, and provide a caution to pilots of any increased risk of a wake turbulence encounter.

c) Controllers should recognize that pilots may request lateral offsets or additional space to mitigate actual or anticipated wake turbulence. In these circumstances controllers must carefully assess such requests and accommodate them when practicable.

d) Controllers should report wake turbulence reports as much information as possible when a wake turbulence encounter occurs, including as many details as available regarding both the Generating and Experiencing Aircrafts and any known weather conditions.

RECOMMENDATION No. SA 2017-10(05):

In order to ensure that acceptable levels of safety are maintained, Air Navigation Service Providers should, using their SMS, conduct comprehensive analysis of any wake turbulence incident, including review of ATC procedures, route structure and the effectiveness of the wake turbulence management requirements indicated above.

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