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Bureau d'enquête sur les accidents d'aviation BEAA  
Ufficio d'inchiesta sugli infortuni aeronautici UIIA  
Uffizi d'inquisiziun per accidents d'aviatica UIAA  
Aircraft Accident Investigation Bureau AAIB

# **Final Report No. 1958**

## **by the Aircraft Accident Investigation Bureau**

concerning the serious incident

involving the A330-243 Airbus aircraft, registration A6-EKU

operated by Emirates under flight number UAE 87

and

the AVRO 146-RJ100 aircraft, registration HB-IXU

operated by Swiss International Air Lines Ltd.

under flight number SWR 162C

on 31 October 2004

at Zurich Airport

**Ursache**

Der Vorfall ist darauf zurückzuführen, dass

- der Platzverkehrsleiter eine Freigabe für einen Start auf der Piste 10 erteilte, bevor die auf die Piste 14 anfliegende Maschine gelandet war;
- die Flugverkehrsleitung ein Verfahren konzipiert und angewendet hatte, das unvollständig und schwierig anzuwenden war.

## General information on this report

This report contains the AAIB's conclusions on the circumstances and causes of the serious incident which is the subject of the investigation.

In accordance with Annex 13 of the Convention on International Civil Aviation of 7 December 1944 and article 24 of the Federal Air Navigation Law, the sole purpose of the investigation of an aircraft accident or serious incident is to prevent future accidents or serious incidents. The legal assessment of accident/incident causes and circumstances is expressly no concern of the accident investigation. It is therefore not the purpose of this investigation to determine blame or clarify questions of liability.

If this report is used for purposes other than accident prevention, due consideration shall be given to this circumstance.

The definitive version of this report is the original in the German language.

All times in this report, unless otherwise indicated, follow the coordinated universal time (UTC) format. At the time of the serious incident, Central European Time (CET) applied as local time (LT) in Switzerland. The relation between LT, CET and UTC is:  $LT = CET = UTC + 1 \text{ hour}$

For reasons of protection of privacy, the masculine form is used in this report for all natural persons, regardless of their gender.

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## Final Report

### First aircraft:

Owner	Al Dana Limited, Walker House, P.O. Box 265GT, Mary Street George Town, Cayman Islands
Operator	Emirates, P.O. Box 686, Dubai, UAE
Aircraft type	Airbus A330-243
Country of registration	United Arab Emirates (UAE)
Registration	A6-EKU

### Second aircraft:

Owner	Melik Mobilien-Verwaltung GmbH, 4002 Basel
Operator	Swiss International Air Lines Ltd., 4002 Basel
Aircraft type	AVRO 146-RJ100
Country of registration	Switzerland
Registration	HB-IXU

Location of the serious incident	Zurich Airport
Date and time	31 October 2004, 11:18 UTC

## General

### Brief description

On 31 October 2004, an Emirates Airbus A330-243 aircraft, operating under flight number UAE 87, was making an approach to runway 14 in Zurich. As it did so, immediately before landing it encountered turbulence caused by the north-easterly wind, resulting in an unstabilised final approach. The crew of UAE 87 therefore decided to go around shortly before touching down on the runway.

Immediately before this, the Swiss International Airlines Ltd. AVRO 146-RJ100 aircraft, operating under flight number SWR 162C, had been given take-off clearance from runway 10. After the air traffic control unit had noticed the go-around by UAE 87, SWR 162C was instructed to reject its take-off in order to avoid convergence of the two aircraft on their extended runway centrelines. SWR 162C rejected its take-off after the second instruction from the air traffic control unit, shortly before reaching decision speed V1. UAE 87 followed the published missed approach procedure and landed approximately 15 minutes later on runway 14 in Zurich.

**Investigation**

The AAIB was informed by the REGA and opened an investigation the same day.

The incident is attributable to the fact that

- the aerodrome controller issued a take-off clearance to a traffic on runway 10 before the aircraft approaching runway 14 had landed;
- the air navigation services company had conceived and applied a procedure which was incomplete and difficult to apply.

## 1 Factual Information

### 1.1 Pre-flight history and history of the flight

#### 1.1.1 General

The recordings of the cockpit voice recorder (CVR) and radiocommunication traffic, radar data and the statements of crew members and air traffic control employees were used for the following description of the history of the flight.

#### 1.1.2 History of the flight

On 31 October 2004, an Emirates Airbus A330-243 aircraft, operating under flight number UAE 87, was on a scheduled flight from Dubai (OMBD) to Zurich (LSZH). On this flight, the copilot was pilot flying and the commander was pilot not flying.

At 11:03:41 UTC, the crew made contact with Zurich approach control (Approach East – APE), which guided it onto the runway 14 final approach. In the course of the approach, the ATCO (air traffic control officer) twice ordered a speed restriction, at 11:09:42 UTC to 200 kt or less and at 11:11:05 UTC to 180 kt or less.

At 11:12:03 UTC, the APE ATCO issued instructions to UAE 87 to descend to 4000 ft and to turn left onto heading 180° with subsequent clearance for an ILS (instrument landing system) approach. On subsequently intersecting the approach line, UAE 87 first passed through the plane of the localizer (LOC) and drifted about ¼ NM to the west. At this time, the APE ATCO asked the crew of UAE 87 for the current wind: *"Emirates eight seven, can you give me a wind reading?"* The crew's response was: *"ja... zero six zero at around three zero knots."* At about 10 NM, the crew reported *"Established localizer now, Emirates eight seven"*.

At 11:14:11 UTC, the crew of UAE 87 were instructed to make contact with aerodrome control (ADC). The first call from UAE 87 took place shortly afterwards at 11:14:22 UTC. An ATC trainee, supervised by an assessor, was working at the ADC position.

A little later, at 11:14:54 UTC, the flight crew of SWR 162C, an AVRO 146-RJ100, first made contact with aerodrome control. At this time, this aircraft was ready for departure at the holding point of runway 10. At 11:14:58 UTC, the air traffic controller cleared SWR 162C to taxi onto runway 10: *"Swiss one six two Charlie Tower 'Grüezi' behind departing RJ one hundred line up runway one zero and wait behind"*.

At 11:15:11 UTC, when UAE 87 was at a distance of about 7 NM from the threshold of runway 14, ADC gave it landing clearance together with current ground wind information: *"Emirates eight seven wind zero five zero degrees seven knots runway one four cleared to land"*.

When UAE 87 was a little more than 2 NM from the threshold of runway 14, at 11:16:56 UTC, ADC again provided it with current wind information: *"wind check final one four, zero five zero degrees seven knots"*. UAE 87 acknowledged as follows: *"Thank you up here zero... three zero and two zero"*. At this time, the aircraft was passing 2100 ft QNH in descent.

The copilot of UAE 87 switched off the autopilot at 11:17:07 UTC. In accordance with operating procedures, auto thrust remained switched on.

At 11:17:35 UTC, the ADC ATCO cleared SWR 162C, which was ready for departure on runway 10, for take-off. At this time UAE 87 was a little over 0.6 NM from



the threshold of runway 14 and approximately 200 ft above ground. Immediately afterwards, the commander mentioned to the copilot: "*gang echli übere da, süsch stabilisiersch ne nid*" – "Go up a bit here, or you won't stabilise it". At this time the aircraft was 100 ft above ground.

At about 10 feet above ground, the aircraft's synthetic voice said: "*retard retard...eight*" and a few seconds later: "*retard...five*". At 11:17:58 UTC, a go-around was initiated and the commander took over the function of pilot flying. At this time, the aircraft was slightly to the right of the runway 14 centreline.

Three seconds later, at 11:18:01 UTC, the ADC ATCO instructed SWR 162C to reject take-off: "*Swiss one six two charlie stop take off I say again stop take off*". SWR 162C, which had already begun its take-off roll, did not react to this instruction and did not read back the order to stop take-off.

At 11:18:06 UTC, UAE 87 reported its go-around: "*Emirates eight seven go around*". At this time, the aircraft was following the published missed approach procedure for runway 14 and was already about 1200 m beyond the threshold of the runway.

At 11:18:09 UTC, the aerodrome controller repeated the instruction to SWR 162C to reject its take-off: "*Swiss one six two charlie stop take off I say again stop take off*". This time SWR 162C confirmed the instruction to stop take-off. Shortly afterwards, the commander rejected the take-off at a speed of about 100 kt. For this take-off, a decision speed V1 of 115 kt was applicable.

The lateral separation between the two aircraft at this time was some 1260 m according to the ground radar recording. The two aircraft were converging at an acute angle.

Once SWR 162C had finished braking, it vacated runway 10 via taxiway E. UAE 87 continued its missed approach procedure and switched to the APE frequency. The latter again guided it onto the runway 14 final approach. At 11:22:56 UTC, the crew replied to air traffic control's request for the reason for the go-around as follows: "*Emirates eight seven... very short final unstabilised*." For the second approach, the crew decided not to use auto thrust. The landing took place at 11:36 UTC on runway 14.

## 1.2 Injuries to persons

Onboard the Airbus A330-243 aircraft, A6-EKU, were 14 crew members and 224 passengers.

Onboard the AVRO 146-RJ100 aircraft, HB-IXU, were 5 crew members and 28 passengers.

No-one was injured.

**1.3 Damage to aircraft**

## 1.3.1 Damage to the Airbus A330-243 A6-EKU

No damage.

## 1.3.2 Damage to the AVRO 146-RJ100 HB-IXU

Since the take-off was rejected shortly before decision speed V1 was reached, the aircraft underwent a technical inspection. Subsequently, two of the main landing gear wheels were replaced.

**1.4 Other damage**

None.

**1.5 Personnel information**

## 1.5.1 Commander Airbus A330-243 A6-EKU

Person	Swiss citizen, born 1955
Licence	Airline Transport Pilot Licence ATPL (A), issued by the United Arab Emirates General Civil Aviation Authority, valid till 31 May 2005
Ratings	Multi-engined aircraft M/E land Type rating A332 as pilot in command ETOPS (extended twin operations) Instrument flying IFR CAT III
Medical certificate	Class 1, valid till 31.12.2004 Spectacles wearer
Last medical examination	29 June 2004

## 1.5.2 Copilot Airbus A330-243 A6-EKU

Person	Swiss citizen, born 1965
Licence	Airline Transport Pilot Licence ATPL (A), issued by the United Arab Emirates General Civil Aviation Authority, valid till 23 August 2008
Ratings	Multi-engined aircraft M/E land Type rating A332 as copilot ETOPS (extended twin operations) Instrument flying IFR CAT III
Medical certificate	Class 1, valid till 31.03.2005 No restrictions
Last medical examination	2 March 2004

1.5.3	Commander AVRO 146-RJ100 HB-IXU	
	Person	Swiss citizen, born 1962
	Licence	Airline Transport Pilot Licence ATPL (A), issued by the Federal Office for Civil Aviation
	Ratings	Type rating AVRO RJ/Bae 146 as pilot in command, valid till 15.04.2005 Instrument flying IFR (A) Cat III, valid till 15.04.2005 Flying instructor TRI (A), valid till 27.06.2004 Radiotelephony International RTI (VFR/IFR) Night flying NIT (A)
	Medical certificate	Class 1, valid till 14.02.2005 No restrictions
	Last medical examination	8 July 2004
1.5.4	Copilot AVRO 146-RJ100 HB-IXU	
	Person	Swiss citizen, born 1972
	Licence	Airline Transport Pilot Licence ATPL (A), issued by the Federal Office for Civil Aviation
	Ratings	Type rating AVRO RJ/Bae 146 as copilot, valid till 04.07.2005 Instrument flying IFR (A) Cat III, valid till 04.07.2005 Radiotelephony International RTI (VFR/IFR) Night flying NIT (A)
	Medical certificate	Class 1, valid till 27.01.2005 No restrictions
	Last medical examination	13 January 2004
1.5.5	Air traffic control officer A	
	Person	Swiss citizen, born 1980
	Function	Aerodrome controller (ADC), trainee
	Training	The ATCO began his training with Skyguide in October 2001. At the time of the incident, he was training to be an aerodrome controller (ADC).
	Licence	For air traffic controllers, issued by the Federal Office for Civil Aviation on 9 September 2003, with the following ratings: <ul style="list-style-type: none"> <li>• approach control (without radar)</li> <li>• approach radar control</li> </ul>

1.5.6	Air traffic control officer B	
	Person	Finnish citizen, born 1959
	Function	Aerodrome controller (ADC), assessor
	Training	The ATCO joined Skyguide in March 2000. At the time he was in possession of an air traffic controller's licence which he had obtained in Finland. He underwent conversion tailored to local requirements. The Federal Office for Civil Aviation then issued him with a Swiss licence.
	Licence	For air traffic controllers, issued by the Federal Office for Civil Aviation on 26 October 2000, with the following ratings: <ul style="list-style-type: none"> <li>• aerodrome control</li> <li>• approach control (without radar)</li> <li>• approach radar control</li> <li>• practical training</li> <li>• coaching</li> </ul>
1.5.7	Air traffic control officer C	
	Person	Swiss citizen, born 1970
	Function	Ground controller (GRO)
	Training	For air traffic controllers, issued by the Federal Office for Civil Aviation on 26 October 1994, with the following ratings:
	Licence	<ul style="list-style-type: none"> <li>• aerodrome control</li> <li>• approach control (without radar)</li> <li>• approach radar control</li> </ul>
<b>1.6</b>	<b>Aircraft information</b>	
1.6.1	Airbus A330-243 A6-EKU	
	Aircraft type	Airbus A330-243
	Characteristics	Twin-jet commercial aircraft
	Manufacturer	Airbus Industries, Toulouse, France
	Registration	A6-EKU
	Serial number	0295
	Owner	Al Dana Limited, Walker House, P.O. Box 265GT, Mary Street, George Town, Cayman Islands
	Keeper	Emirates, P.O. Box 686, Dubai, UAE
	Airworthiness certificate	Dated 22 September 1999, issued by the United Arab Emirates General Civil Aviation Authority.  Last renewed on 22 September 2004, valid till 21 September 2005.

Registration certificate	Dated 22 September 1999, issued by the United Arab Emirates General Civil Aviation Authority
Max. take-off mass	233,000 kg
1.6.2 AVRO 146-RJ100 HB-IXU	
Aircraft type	AVRO 146-RJ100
Characteristics	Four-jet commercial aircraft
Manufacturer	British Aerospace Ltd., Woodford, Cheshire England
Registration	HB-IXU
Serial number	E3276
Owner	Melik Mobilien-Verwaltung GmbH, 4002 Basel
Keeper	Swiss International Air Lines Ltd., 4002 Basel
Airworthiness certificate	Dated 22 December 1995, issued by the Federal Office for Civil Aviation, valid until revoked
Registration certificate	No. 3 dated 1 July 2002, issued by the Federal Office for Civil Aviation
Max. take-off mass	46,000 kg

## 1.7 Meteorological information

### 1.7.1 General

The information in sections 1.7.2 and 1.7.3 was provided by MeteoSwiss.

### 1.7.2 General weather situation

*„Durch das Tief im Mittelmeerraum wird feuchte Luft gegen die Schweiz gesteuert. Auf der Alpennordseite herrscht eine Bisenlage.“*

Humid air was being driven towards Switzerland by the depression in the Mediterranean area. The 'bise', a north-easterly wind, prevailed on the north side of the Alps.

### 1.7.3 Weather conditions at Zurich airport at the time of the serious incident

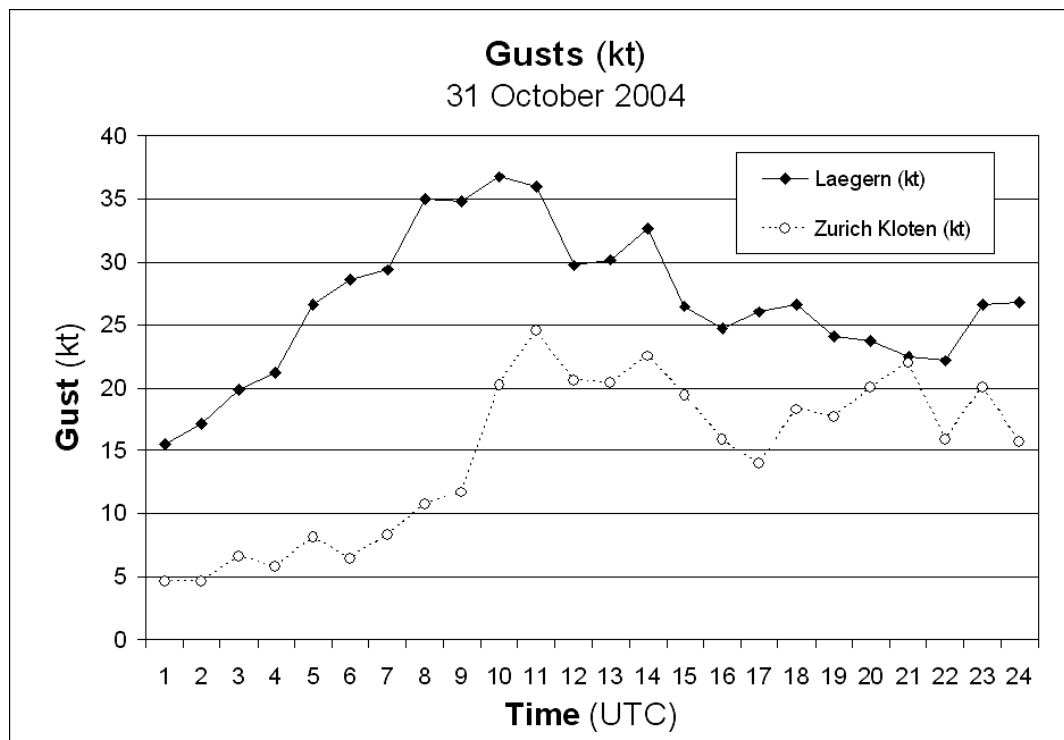
<i>„Wolken</i>	<i>6/8 auf 2100 ft AGL</i>
<i>Wetter</i>	<i>--</i>
<i>Sicht</i>	<i>9 km</i>
<i>Wind</i>	<i>Nordost mit 10 Knoten, Windspitzen um 18 Knoten</i>
<i>Temperatur/Taupunkt</i>	<i>13 °C/08 °C</i>
<i>Luftdruck</i>	<i>QNH LSZH 1011 hPa, QNH LSGG 1010 hPa</i>
<i>Gefahren</i>	<i>keine erkennbaren</i>
<i>Sonnenstand</i>	<i>Azimet: 183°</i>
	<i>Höhe: 28°"</i>

Cloud 6/8 at 2100 ft AGL  
 Weather --  
 Visibility 9 km  
 Wind north-east 10 knot, gusting to 18 knots  
 Temperature/dewpoint 13 °C/08 °C  
 Atmospheric pressure QNH LSZH 1011 hPa, QNH LSGG 1010 hPa  
 Hazards None detectable  
 Position of the sun Azimuth: 183°  
 Elevation: 28°

1.7.4 Wind measurements at Zurich Airport

METAR:	(wind RWY 14/16)	QAM (wind RWY 34)
10:20 UTC	060/09 Gust 26 kt	040/13 Gust 26 kt
10:50 UTC	060/09	030/10
11:20 UTC	050/09	040/11
11:50 UTC	050/11	020/12

1.7.5 Record of gusts at Zurich airport and Lägern throughout the day (hill west of the airport, 2779 ft AMSL)



At the time of the serious incident, the following wind was recorded at the Lägern measurement station:

030 degrees 19 kt, gusting to 30 kt

## 1.7.6 INFONET data according to Skyguide

"ATIS Zurich  
 INFO BRAVO LDG RWY 14 ILS APCH. DEP RWY 10  
 QAM LSZH 1020Z 31.10.2004  
 040 DEG 13 KT. MAX 26 KT  
 VIS 8 KM  
 CLOUD FEW 1300 FT. BKN 1800 FT  
 +11/+08  
 QNH 1011 ONE ONE  
 QFE THR 14 961  
 QFE THR 16 961  
 QFE THR 28 960  
 NOSIG  
 TRL 75 DAY 0540 NGT 1647 QNH TICINO 0840Z: 1009 HPA  
 TROPO: 35500FT, MS59

ATIS Zurich  
 INFO CHARLIE LDG RWY 14 ILS APCH. DEP RWY 10  
 QAM LSZH 1050Z 31.10.2004  
 030 DEG 10 KT  
 VIS 8 KM  
 CLOUD FEW 1400 FT. BKN 2000 FT  
 +12/+08  
 QNH 1011 ONE ONE  
 QFE THR 14 961  
 QFE THR 16 961  
 QFE THR 28 960  
 NOSIG  
 TRL 75 DAY 0540 NGT 1647 QNH TICINO 0840Z: 1009 HPA  
 TROPO: 35500FT, MS59

ATIS Zurich  
 INFO DELTA LDG RWY 14 ILS APCH. DEP RWY 10  
 QAM LSZH 1120Z 31.10.2004  
 040 DEG 11KT  
 VIS 9 KM  
 CLOUD BKN 2100 FT  
 +13+08  
 QNH 1011 ONE ONE  
 QFE THR 14 961  
 QFE THR 16 961  
 QNE THR 28 960  
 NOSIG  
 TRL 75 DAY 0540 NGT 1647 QNH TICINO 0840Z: 1009 HPA  
 TROPO: 35500FT, MS59"

## 1.7.7 Forecasts

"TAF LSZH valid 10:19:  
 05010KT 8000 SCT012 BKN120 TEMPO 1216 04012G26KT BKN015 T10/12Z  
 T11/15Z"

**1.8 Aids to navigation**

Not applicable.

**1.9 Communications**

## 1.9.1 Workstations/functions involved in air traffic control (ATC)

## 1.9.1.1 General

In the TWR/APP Zurich at the time of the incident, no systematic workstation documentation was being maintained. This means that workstation hand-overs were not documented. Workstation occupancy was therefore reconstructed during the investigation on the basis of the radio recording and statements by air traffic control employees.

<b>Workstation/function</b>	<b>Abbreviation</b>	<b>Frequency</b>
Approach control east	APE	120.750 MHz
Aerodrome control (tower)	ADC	118.100 MHz
Ground control	GRO	121.900 MHz
Reserve		119.700 MHz

## 1.9.1.2 Assignment of personal in aerodrome control

All workstations in the aerodrome control unit were occupied in accordance with Skyguide's sector allocation plan.

The ADC workstation was occupied by a trainee ATCO. He was undergoing an interim assessment under the supervision of an assessor.

**1.10 Aerodrome information**

## 1.10.1 General

Zurich Airport is located in north-east Switzerland. The airport has a system of three runways, two of which (16 and 28) intersect at the airport reference point. The extended runway centerlines of runway 10 and 14 intersect near the end of runway 10.

The dimensions of Zurich airport runways are as follows:

<b>Runway</b>	<b>Dimensions</b>	<b>Elevation of the runway thresholds</b>
16/34	3700 x 60 m	1390/1386 ft AMSL
14/32	3300 x 60 m	1402/1402 ft AMSL
10/28	2500 x 60 m	1391/1416 ft AMSL

At the time of the serious incident, runway 14 had a landing distance of 3150 m available.

The reference elevation of the airport is 1416 ft AMSL and the reference temperature is specified as 24.0 °C.

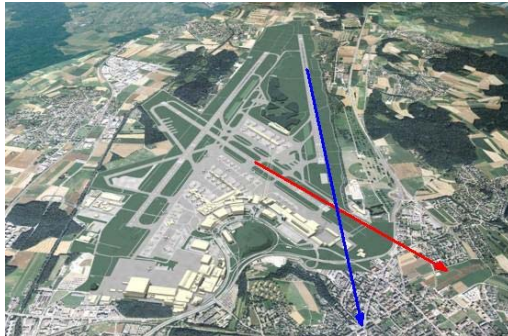


### 1.10.2 Operating concept

At the time of the incident, with a north-east wind blowing, the following operating concept was being applied at Zurich airport with regard to runway use:

Runway 10 was being used for take-offs and runway 14 for landings. If a take-off from runway 10 is not possible because of performance limitations, aircraft can take off from runway 16.

### 1.10.3 Standard procedure for departures from runway 10 and missed approaches on runway 14



Blue: Begin missed approach runway 14  
Red: Begin departure route runway 10

## 1.11 Flight recorders

Both aircraft were equipped with a cockpit voice recorder (CVR) and a flight data recorder (FDR). The data were saved.

## 1.12 Wreckage and impact information

Not applicable.

## 1.13 Medical and pathological information

Not applicable.

## 1.14 Fire

Not applicable.

## 1.15 Survival aspects

Not applicable.

## 1.16 Tests and research

None carried out.

## 1.17 Organizational and management information

### 1.17.1 Skyguide

#### 1.17.1.1 Skyguide runway 10 separation procedures / missed approach runway 14

Skyguide's procedures for the runway concept in question specified the following according to ATCM II Tower para. 4.4:

*„Start Piste 10 darf nur wie folgt freigegeben werden (Flugzeug muss Rollvorgang eingeleitet haben):*

- a) DEP Jet/Turbo: kein Anflug zwischen 3 NM Final und THR14
- b) DEP Prop: kein Anflug zwischen 6 NM Final und THR14
- c) DEP Heavy: kein Anflug zwischen 6 NM Final und THR14
- ADC1/2 informiert APP/CAP über die notwendigen Anflugstaffelungswerte
- Der DOM legt die Annahmerate fest."

Runway 10 take-off clearance may be given only as follows: (aircraft must have started take-off roll):

- a) DEP Jet/Turbo: no approach between 3 NM Final and THR14
- b) DEP Prop: no approach between 6 NM Final and THR14
- c) DEP Heavy: no approach between 6 NM Final and THR14
- ADC1/2 informs APP/CAP of the necessary approach separation values
- The DOM specifies the acceptance rate.

The chief of operations interpreted this regulation as follows: *„Nachdem ein Anflug den threshold Piste 14 überflogen hat und man davon ausgehen kann, dass die Maschine landet, darf ein Start auf Piste 10 freigegeben werden.* - Once an aircraft has flown over the threshold of runway 14 and it can be assumed that the aircraft is landing, then a take-off from runway 10 can be cleared."

Any consideration of the aircraft type of the approaching traffic was not included in the Skyguide procedural regulations.

According to statements, passing the threshold of runway 14 was primarily established visually. Another way of determining the position of the aircraft was apparently to observe the SAMAX ground radar.

#### 1.17.1.2 Traffic handling by aerodrome control

At the time of the serious incident the volume of traffic was moderate. The applied operating concept provided for departures from runway 10 and 16 and landings on runway 14. This led to a fairly complex traffic handling situation. According to statements by the assessor, the training status of the trainee was appropriate for the level of traffic and the operating concept which was being applied.

The person responsible for training the air traffic controller in TWR/APP Zurich also stated that the trainee should have been able to handle the existing situation without any problems.

The assessor considered that the trainee had not passed this interim assessment.

The assessor gave the following reasons for this evaluation:

- Not noticing the initiation of the go-around by UAE 87 in good time. He therefore had to issue the trainee with the instruction to order the RTO (rejected take-off) of SWR 162C.
- Incorrect apportionment of his concentration by the trainee; he was concentrating exclusively on the departure sequence of the aircraft which were holding short of runway 10.

1.17.1.3 Statements according to the control tower departmental management concerning the application of this procedure

According to statements by the control tower manager, the applied procedures (cf. section 1.17.1.1) had their origin in the problem of departures from runway 16 with simultaneous missed approach procedures on runway 14.

With regard to the separation of runway 10 departures and runway 14 missed approaches, the type of the aircraft on approach was essentially not taken into consideration. On the other hand, passing the threshold of runway 14 was defined as the reference for clearing a take-off from runway 10.

The control tower manager further stated the following: *„Wenn eine Maschine im Anflug auf Piste 14 nach dem Überfliegen der threshold 14 wider Erwarten einen Durchstart durchführen sollte, so sollte immer noch genügend Zeit für die Anordnung eines Startabbruchs an ein startendes Flugzeug auf Piste 10 zur Verfügung stehen, von dem nötigenfalls Gebrauch gemacht werden muss.* - If an aircraft on approach to runway 14 had to go around after having passed threshold 14, contrary to expectations, there should still always be sufficient time available to order a RTO for an aircraft taking off from runway 10, which has to be used if necessary."

The control tower manager answered the question concerning the implementation of a risk assessment at the time these procedures were introduced as follows: *„Es gab eine Fachdiskussion mit den Dienstleitern und dem Chef Ops. Soweit ich mich erinnern kann, hat sich das Bundesamt für Zivilluftfahrt (BAZL) nicht direkt eingeschaltet.* - There was a technical discussion with the daily ops managers and the chief ops. As far as I can remember, the Federal Office for Civil Aviation (FOCA) did not get involved directly."

He also stated that until the regulations for the runway 16 take-off / runway 14 go-around operating concept were tightened as a result of the AAIB interim report on airprox EZS 932 / SWR 1344 on 30 August 2003, the existing risk (runway 10 take-off / runway 14 go-around) was acceptable to him.

After that, he had apparently considered an adaptation of the runway 10 take-off / runway 14 go-around separation concept as the logical consequence. Since any necessary adaptations would have had substantial repercussions on the efficiency of traffic handling, he informed his superiors and asked them several times for pertinent solutions and mandates. He said he had also informed the FOCA about this problem and the corresponding need for action.

Up to the time of the incident, no pertinent regulations were produced either by the management of the air navigation services company or by the FOCA.

For the chief of operations tower, according to his statements, the following principle always applies: *"Avoid collisions"*. For the case in question, the ICAO regulations concerning separation are not unambiguous. He also stated: *„Diese nicht eindeutigen Vorschriften müssen von jedem FVL, sowie auch von der Leitung, nach bestem Wissen und Gewissen interpretiert werden. Infolgedessen gibt es diesbezüglich keine Skyguide internen und auch keine BAZL Vorschriften. Das kann dazu führen, dass die Interpretationen zu diesem Thema unterschiedlich ausfallen.* - These unambiguous regulations have to be interpreted by every ATCO, as well as by management, to the best of their knowledge and conscience. Consequently, in this regard there are no internal skyguide or FOCA regulations. This can lead to different interpretations relating to this topic."

He also made the following points: *„Das Betriebskonzept Anflug Piste 14 und Start Piste 10 beinhaltet ein bestimmtes Risiko. Dieses Risiko liegt darin, dass sich die Flugwege unmittelbar nach Pistenende kreuzen. Die topographischen Verhältnisse im Anflug Piste 14 können zu Turbulenzen führen, die wiederum ein erhöhtes Durchstartisiko bedeuten. Dieser Umstand verlangt direkte Sicht des ADC-FVL auf die letzte Phase des Endanfluges anfliegender Flugzeuge auf Piste 14 zur Beobachtung der attitude dieser Flugzeuge.*

*Ebenso verlangt dieser Umstand, dass der ADC-FVL visuell überprüfen kann, ob ein anfliegender Flugzeug tatsächlich aufsetzt, um das Risiko eines go-around ausschliessen zu können.*

*Tatsächlich jedoch sind die diesbezüglichen Sichtmöglichkeiten auf Piste 14 durch das Vorhandensein des Dock E und durch Waldpartien eingeschränkt. Durch diese Verhältnisse ergibt sich, dass die Möglichkeit eines von der ATC angeordneten Startabbruchs als einzige Möglichkeit verbleibt, um das Risiko eines go-around Piste 14 mit einem gleichzeitigen Start Piste 10 zu brechen.*

*Der generelle Effizienzdruck verlangt von der ATC die Anwendung von Verfahren, die sich an der Grenze eines akzeptablen Risikos bewegen. Diese Verfahren, wie sie jetzt angewendet werden, wurden von der Skyguide selber so definiert. Sie wurden von der Aufsichtsbehörde meines Wissens nicht validiert.* - The runway 14 approach and runway 10 take-off operating concept includes a degree of risk. This risk lies in the fact that the flight paths cross immediately after the end of the runway. The topographical conditions on the runway 14 approach may lead to turbulence, which in turn means an increased risk of a go-around. This circumstance requires the ADC ATCO to have direct sight of the last phase of the final approach of approaching aircraft on runway 14 in order to observe the attitude of these aircraft.

This circumstance also requires the ADC ATCO to be able to check visually whether an approaching aircraft actually touches down, in order to be able to exclude the risk of a go-around.

In actual fact, however, the relevant visibility options for runway 14 are restricted by the presence of Dock E and wooded areas. These conditions mean that a RTO ordered by the ATCO is the sole possibility of avoiding the risk of a runway 14 go-around with a simultaneous runway 10 take-off.

The general pressure on efficiency demands that ATC apply procedures which approach the limit of acceptable risk. These procedures, as they are currently being applied, were defined by Skyguide itself. To my knowledge, they were not validated by the supervisory authority."

In response to the question concerning the existing risk related to this procedure, he replied: *„Die Verfahren, wie wir sie hier anwenden, beinhalten aus meiner Sicht ein akzeptierbares Risiko.* - The procedures we apply here include, in my opinion, an acceptable risk."

The person responsible for training TWR/APP air traffic controllers made the following statements: *„Die Anwendung der festgelegten Verfahren gewährleisten eine laterale Verschiebung bei einem möglichen go around, d.h. über der Pisten-schwelle Piste 28 nähern sich die beiden Flugzeuge nicht an und es ist keine emergency separation oder essential traffic information erforderlich. Die Vorschriften gemäss ATCM II TWR können nicht alle Eventualitäten abdecken. Mit einem tiefen Durchstart, wie er hier bei der UAE 87 vorliegt, muss ein FVL nicht rechnen. Kommt es trotzdem zu einem solchen Durchstart, so ist die fachliche Kom-*

*petenz des FVL zur Problemlösung gefragt. Es gibt in einer solchen Situation mehrere Möglichkeiten, um eine Kollision zu verhindern.* - Application of the specified procedures guarantees lateral displacement in the event of a possible go-around, i.e. the two aircraft do not converge above the threshold of runway 28 and no emergency separation or essential traffic information is necessary." The regulations according to ATCM II TWR cannot cover all eventualities. An ATCO does not have to reckon with a low go-around, as is the case here with UAE 87. However, if such a go-around does occur, the technical competence of the ATCO is required to solve the problem. In such a situation there are several possibilities of avoiding a collision."

He answered the question of why passing the runway 14 threshold was defined as the reference point for clearing a take-off from runway 10 instead of the landing of the approaching aircraft on runway 14 as follows: *„Die Wahrscheinlichkeit, dass ein auf Piste 14 anfliegender Flugzeug auch landet, ist nahezu 100%. Die letzte Phase der Landung ist vom TWR aus nicht unbedingt einsehbar. Die Landung als solches ist nicht definiert. Wenn man als Landung das Aufsetzen einer Maschine und deren Verlangsamung versteht und das als Referenzpunkt nehmen würde, dann hätte das erhebliche Konsequenzen auf die Effizienz der Verkehrsabwicklung.* - The probability of an aircraft approaching runway 14 actually landing is almost 100%. The final phase of the landing is not visible from the tower under all conditions. Landing as such is not defined. If landing is understood as the touchdown of an aircraft and its slowing down, and if this is taken as the reference point, this would have considerable consequences on the efficiency of traffic handling."

He answered the question of whether an ATCO ordering a RTO, as in the present case, was a normal procedure as follows: "Ja – Yes". He also answered the question of whether the risks of the procedures applied in connection with this runway concept were acceptable as follows: "Ja – Yes". In addition, in his opinion the traffic situation in question had been handled correctly.

#### 1.17.1.4 Statements of the air traffic controllers involved in the incident regarding the application of these procedures

The trainee made the following statement concerning the RTO of SWR 162C: *„Den Startabbruch an die SWR 162C habe ich auf Verlangen des Assessors (Anmerkung BFU: Prüfungsexperte) erteilt. Zu der Zeit hatte ich noch nicht die Absicht, eine solche Massnahme zu treffen, da ich noch nicht erkannt hatte, dass die UAE 87 einen go around durchführte.* - I issued the stop take-off to SWR 162C at the assessor's (Rmk. BFU: examiner) request. At the time I still did not intend to take such a measure, as I had not yet realised that UAE 87 was executing a go-around".

To the questions of whether aircraft approaching runway 14, after passing the runway 14 threshold, no longer had to be taken into consideration for clearing aircraft taking off from runway 10, and how he had been taught regarding this during his training, he replied in both cases: *"Dazu möchte ich nichts sagen.* - I have no comment about that."

According to his statement, the trainee gave SWR 162C take-off clearance when he saw UAE 87 on approach to runway 14 overfly the runway threshold.

On the significance of a RTO, he made the following statement: *"Wird der Startabbruch von der ATC angeordnet, hat er eine hohe Bedeutung, weil z.B. die Sicherheit in Frage gestellt wird. - If the RTO is ordered by ATC, it is of great importance, for example because safety is in question."*

At the time of the incident, the assessor was sitting next to the trainee. He made the following statements about the incident: *"Nachdem die UAE 87 eine Landefreigabe erhalten hatte, habe ich sie weiter im Auge behalten. Ich beobachtete, dass die UAE 87 kurz vor dem touch down eine Bewegung um die Längsachse machte, aber immer noch weiter absank. Ich rechnete zu diesem Zeitpunkt immer noch mit einer Landung. Ich stellte dabei auch fest, dass sich die SWR 162C immer noch in take-off Position befand und stillstand oder sich kaum bewegte. Kurz darauf bemerkte ich, wie die UAE 87 in einer nose-up attitude offensichtlich zu einem go-around ansetzte. Daraufhin habe ich den trainee angewiesen, den Start der SWR 162C abubrechen. Die Aufforderung zum Startabbruch musste der SWR 162C zweimal übermittelt werden, weil sie bei der ersten Aufforderung nicht reagiert hatte. Die zweite Aufforderung wurde vom trainee selbständig auf seine eigene Initiative erteilt. - After UAE 87 had received landing clearance, I kept it in sight. I observed that UAE 87 made a movement around the longitudinal axis shortly before touchdown, but continued to descend. At this time, I was still expecting it to land. I also noticed that SWR 162C was still in the take-off position and was at a standstill or hardly moving. Shortly afterwards, I noticed how UAE 87, in a nose-up attitude, was apparently beginning to go around. I then instructed the trainee to order SWR 162C to reject the take-off. The instruction to SWR 162C to reject the take-off had to be given twice, because it had not reacted to the first instruction. The second instruction was given independently by the trainee on his own initiative."*

He further stated that he had heard the take-off clearance being given to SWR 162C. At the time, according to his visual observation, UAE 87 was approximately over the threshold of runway 14.

He had decided to stop SWR 162C from taking off because the Avro 146 would have crossed the Emirates A330 behind its flight path. This would have meant that the necessary wake turbulence separation behind this aircraft would have been violated.

Moreover, in his opinion, if SWR 162C had taken off there would have been no risk of a collision and there would not immediately have been any separation problems. In his view, sufficient separation would have existed to exclude a collision.

He added in conclusion: *"In Bezug auf den vorliegenden Fall ist mir nicht klar, weshalb für die Erteilung der Startfreigabe auf Piste 10 für auf Piste 14 anfliegende Flugzeuge als Bezugspunkt das Überfliegen der Pistenschwelle 14 gilt. - With regard to the case in question, it is not clear to me why, for aircraft approaching runway 14, passing the threshold of runway 14 applies as the reference point for clearing a take-off from runway 10."*

**1.18 Additional information****1.18.1** Serious incident (airprox) between EZS 932 and SWR 1344 on 30 August 2003

In a comparable serious incident (AAIB final report No. 1868), after a go-around on runway 14 air traffic control had tried to modify the standard missed approach procedure by a radio instruction to the flight crew. The instruction given was intended to ensure separation between the aircraft on the missed approach and an aircraft taking off from runway 16.

In this case, it turned out that in the critical flight phases, such as commencing and initiating a go-around, for the air traffic controller it is uncertain how far he can take influence on the flight path.

**1.19 Useful or effective investigation techniques**

No new methods applied.

## 2 Analysis

### 2.1 Technical aspects

Neither the flight crews nor the air traffic control unit complained about any technical problems.

### 2.2 Human and operational aspects

#### 2.2.1 Crew Airbus A330-243 A6-EKU

The range of hills east of the airport cause eddies if there is a north-easterly wind, which manifests itself as wind shear and turbulence above all for approaches on runways 14 and 16.

The highest wind speeds were measured between 10:00 and 12:00 UTC at elevated positions around Zurich Kloten airport. The serious incident occurred at 11:18 UTC and was therefore within the period with the most intensive cross-wind.

At the Lägern measurement station, which is located on a hill to the west of the airport, gusts of max. 37 kt were recorded between 09:00 UTC and 12:00 UTC. With such peak wind values, moderate turbulence at least must be expected on approach to runway 14. The wind in the surface layer of the atmosphere is characterised by major fluctuations, making approach and landing on this runway a challenge. Under such conditions, the probability of a go-around is increased.

This is why it is understandable that the crew of A6-EKU went around.

The go-around manoeuvre, as well as the flight path to be followed afterwards, had been discussed during the approach preparations.

The first phase of a go-around manoeuvre imposes a high workload on flight crews. The crew should therefore be able to expect that in this phase they can follow the missed approach procedures previously discussed. If this missed approach procedure has to be modified for operational reasons by air traffic control, this should take place in the form of a conditional instruction, such as "*In case of go-around...*", either during the approach or on conclusion of the actual go-around phase.

#### 2.2.2 Crew AVRO 146-RJ100 HB-IXU

The crew of SWR 162C only obeyed the second air traffic control instruction to reject their take-off. This circumstance is explicable because during a take-off the procedures in the cockpit demand a high degree of concentration. In addition, a RTO in the higher speed range before decision speed is reached involves certain risks and must be considered as an emergency measure.

If the flight crew of SWR 162C had not rejected their take-off, according to calculations the aircraft would have crossed the flight path of UAE 87, which was going around, some 6 seconds later. During this flight phase, the two aircraft would have converged to approximately 390 m.



### 2.2.3 Air traffic control

#### 2.2.3.1 Runway 10 departure / runway 14 missed approach separation procedures and their application

Skyguide's procedural regulations regarding separation for runway 10 take-off / runway 14 go-around specified that clearance for take-off from runway 10 may be given only if there are no aircraft on the last phase of final approach up to the threshold of runway 14. In the present case, for the take-off clearance to have been issued to SWR 162C, no approaching aircraft should have been between 3 NM final and threshold 14.

This regulation is difficult to apply for the following reasons and is incomplete:

- Difficult to apply, because from the aerodrome control location it is only possible to determine imprecisely whether the approaching aircraft has flown over the threshold of runway 14. The case in question proves this, because the air traffic controller cleared SWR 162C for take-off when UAE 87 was still 0.6 NM before the runway 14 threshold.
- Incomplete because it does not take into consideration the fact that an approaching aircraft may initiate a go-around even after having passed the runway threshold. Particularly in weather conditions with a north-easterly wind, for the above-mentioned reasons the probability of a go-around on approach to runway 14 is increased. Under these wind conditions, simultaneous take-offs from runway 10 take place.
- Also incomplete because the type of aircraft approaching runway 14 is not taken into consideration in the procedures.

A take-off from runway 10 should only be cleared after the landing of the aircraft approaching runway 14 has taken place.

If it is not possible in all cases to determine whether the aircraft is on the ground from the control tower, there is still the possibility of requesting the crew to report by radio when the aircraft has landed.

In the event of a go-around after having passed the runway 14 threshold, according to the control tower management the procedure to order a RTO on runway 10 was planned. Such an instruction from ATC is an emergency measure which in principle should not be applied as a normal procedure to guarantee systematic separation.

The incident demonstrates that the procedures were associated with safety risks. These safety risks had also already been recognised by employees of the air navigation services company in the run-up to the serious incident and had been brought to the attention of competent superiors as well as the Federal Office for Civil Aviation in writing.

Up to the time of the incident, no corresponding measures were taken.

### 3 Conclusions

#### 3.1 Findings

- The ADC workstation was occupied by a trainee ATCO and was being monitored by an assessor. The trainee was undergoing an interim assessment.
- The assessor considered that the trainee had not passed this interim examination.
- The ATCOs involved were in possession of the necessary licences.
- The crew of UAE 87, on final approach at a distance of more than 10 NM from the threshold of runway 14, ascertained that the wind was approximately 30 knots from 060 degrees.
- Because of the topographical conditions, if there is a north-easterly wind, turbulence can be expected when approaching runway 14, and this increases the probability of a go-around.
- The aerodrome controller cleared SWR 162C for take-off on runway 10 when UAE 87 was still 0.6 NM from the threshold of runway 14.
- Skyguide procedures specify that take-off clearance for runway 10 must not be given if an aircraft is situated between 3 NM or 6 NM respectively final and the threshold of runway 14.
- The Skyguide procedures do not take into account the type of aircraft approaching runway 14.
- In the event of a go-around after having passed the threshold of runway 14, application of the procedure requires ordering of a RTO on runway 10 as the procedure to be normally applied.
- On the instruction of the assessor, the trainee ordered SWR 162C to reject its take-off. The flight crew of SWR 162C did not react to this instruction and did not read back the order to reject the take-off.
- Eight seconds later, the trainee repeated the instruction to SWR 162C to reject its take-off.
- SWR 162C had attained a speed of about 100 knots when it rejected the take-off.
- Decision speed V1 for flight SWR 162C had been calculated as 115 knots.
- According to statements by the control tower management, no risk assessment was carried out for the applied procedure. There was an internal Skyguide technical discussion without FOCA participation.
- Calculations have shown that if SWR 162C had taken off, it would have crossed the flight path of UAE 87, which was going around, about 6 seconds later. In such an eventuality, the two aircraft would have converged to approximately 390 m.

### 3.2 Causes

The incident is attributable to the fact that

- the aerodrome controller issued a take-off clearance to a traffic on runway 10 before the aircraft approaching runway 14 had landed;
- the air navigation services company had conceived and applied a procedure which was incomplete and difficult to apply.

## **4 Safety recommendations and measures taken since the serious incident**

### **4.1 Safety deficiency**

On 31 October 2004, an Emirates Airbus A330-243 aircraft, operating under flight number UAE 87, was making an approach to runway 14 in Zurich. As it did so, immediately before landing it encountered turbulence caused by the north-easterly wind, resulting in an unstabilised final approach. The crew of UAE 87 therefore decided to go around shortly before touching down on the runway.

Immediately before this, the Swiss International Airlines Ltd. AVRO 146-RJ100 aircraft, operating under flight number SWR 162C, had been given take-off clearance from runway 10. After the air traffic control unit had noticed the go-around by UAE 87, SWR 162C was instructed to reject its take-off in order to avoid convergence of the two aircraft on their extended runway centrelines.

SWR 162C rejected its take-off after the second instruction from the air traffic control unit, shortly before reaching decision speed V1. UAE 87 followed the published missed approach procedure and landed approximately 15 minutes later on runway 14 in Zurich.

In this case air traffic control applied a procedure which allowed a take-off clearance on runway 10, as soon as the approaching aircraft had passed the threshold of runway 14. This procedure does not take into account a possible late go-around initiation of the approaching aircraft. On Take-offs and landings on crossing runways or on runways with crossing departure or missed approach flight paths the following must be taken into account:

- An unsuccessful completion of the landing within the parameters expected by the air traffic controller.
- Type related performance characteristics

The instruction by air traffic control to reject a take-off is an emergency procedure, which shall generally not be used as a normal procedure to ensure a systematic traffic separation.

Ordering vertical or lateral avoiding manoeuvres by the air traffic control to an aircraft during the first phase of a missed approach, to say up to approximately 2000 ft/AGL, shall generally not be used as a normal procedure to ensure systematic traffic separation.

The first phase of a go-around means a high workload to the flight crew. Therefore the crew should expect to follow the missed approach procedure laterally and vertically as briefed. If the standard missed approach flight path has to be changed for operational reasons by air traffic control, the flight crew should be advised already during the approach in order to be able to prepare themselves accordingly.

**Reminder: Serious incident (airprox) between EZS 932 and SWR 1344 on 30 August 2003**

In a comparable serious incident (AAIB final report No. 1868), after a go-around on runway 14 air traffic control had tried to modify the standard missed approach procedure by a radio instruction to the flight crew. The instruction given was intended to ensure separation between the aircraft on the missed approach and an aircraft taking off from runway 16.

In this case, it turned out that in the critical flight phases, such as commencing and initiating a go-around, for the air traffic controller it is uncertain how far he can take influence on the flight path.

At that time the AAIB recommended (safety recommendation no. 369), that the Federal Office of Civil Aviation should ensure that for such traffic situations ATC should apply to procedures that allow a minimum traffic separation under IMC and VMC under all circumstances.

**4.2 Safety recommendation no. 392**

The Federal Office of Civil Aviation shall make the necessary arrangements that Zurich airport air traffic control develops operational concepts allowing the required separation between aircraft going around and aircraft taking off with crossing flight paths or crossing runways respectively under IMC and VMC.

**4.3 Measures taken since the serious incident**

Based on the investigation results skyguide has released the service order SO OZ 2005-019E dated 28.02.2005 (see Annex 1).

Berne, 23 August 2007

Aircraft Accident Investigation Bureau

This report contains the AAIB's conclusions on the circumstances and causes of the serious incident which is the subject of the investigation.

In accordance with Annex 13 of the Convention on International Civil Aviation of 7 December 1944 and article 24 of the Federal Air Navigation Law, the sole purpose of the investigation of an aircraft accident or serious incident is to prevent future accidents or serious incidents. The legal assessment of accident/incident causes and circumstances is expressly no concern of the accident investigation. It is therefore not the purpose of this investigation to determine blame or clarify questions of liability.

If this report is used for purposes other than accident prevention, due consideration shall be given to this circumstance.

## service order

SO OZ 2005-019E



subject TO10 GA14 / Issuance of Clearance for Take Off

date of issue 2005-02-28

effective date 2005-02-28

classification Internal

status Released

## 1 References

NIL

## 2 Introduction and purpose

After an incident with a take-off on RWY10 and a go-around on RWY14 at the same time, OZ has instructed OZT to publish this SO in order to prevent similar incidents in the future.

For this reason, Pt. 4.4 in the ATCM II OZT, TWR, "Verkehrsleitung auf Pisten und Rollwegen", has to be replaced.

## 3 Scope of application

TWR Zurich

## 4 Procedures

**Separation between departures RWY10 / go-around RWY14**

An aircraft departing from RWY10 must be in rolling motion before an arriving aircraft at RWY14 has passed:

- a) 3 NM THR RWY14 if DEP TFC is a Jet or a Turbo
- b) 6 NM THR RWY14 if DEP TFC is a Prop or a Heavy

An aircraft departing from RWY10 shall not be permitted to be in rolling motion before an arriving aircraft at RWY 14 has passed the distances as indicated in a) and b) above, has landed.

*Note:*

*"Landed" according to this SO means that the aircraft has touched down on the runway with all wheels.*

- ADC1/2 shall define the appropriate arrival distances and shall likewise inform DOM TWR, APP or CAP.
- If necessary DOM TWR shall define an arrival rate accordingly.

## 5 Action


ATCM II OZT, TWR, "Verkehrsleitung auf Pisten und Rollwegen", Pt. 4.4

## 6 Cancellation

NIL

7 Validity  
WIE

skyguide  
OZT



Andreas Heiter

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