GENERAL INFORMATION

Identification number:	2004006_088
Classification:	Serious incident
Date, time[1] occurrence:	29 January 2004, 11.30 hours
Location of occurrence:	Amsterdam Schiphol Airport

Aircraft 1

Aircraft registration:	D4-CBG
Aircraft model:	Boeing 757-2Q8
Type of aircraft:	Twin-engined passenger aircraft
Type of flight:	Scheduled passenger flight
Phase of operation:	Taxi out
Damage to aircraft:	None
Number of cockpit crew:	Two
Numer of passengers:	Unknown
Injuries:	None

Aircraft 2

Aircraft registration:	PH-BDC
Aircraft model:	Boeing 737-306
Type of aircraft:	Twin-engined passenger aircraft
Type of flight:	Scheduled passenger flight
Phase of operation:	Approach
Damage to aircraft:	None
Number of cockpit crew:	Two
Numer of passengers:	Unknown
Injuries:	None

Other damage:	None
Light conditions:	Daylight

SUMMARY

When taxiing out to runway 36C the flight crew of a Boeing 757, inadvertently entered the active runway 36R that was being used for landing. The crew of a Boeing 737, approaching this landing runway was ordered by air traffic control to perform a go-around.

[1] All times in this report are coordinated universal time (UTC) unless otherwise specified. At the time of the incident, local time at Amsterdam Schiphol Airport was UTC + 1 hour.

FACTUAL INFORMATION

History of the event

A primarily white painted[2] Boeing 757 aircraft was parked at gate D3 for a scheduled passenger flight to Amilcar Cabral International Airport, Cape Verde. The departure runway would be runway 36C. Once the permission to start the engines was obtained (from the start-up controller), the crew changed to the ground control frequency. Runway 36R was used for landing aircraft.

After being pushed-back from gate D3 the ground controller cleared the aircraft to 'taxi runway 36C, to leave via A10 and taxi via the south' (see green track on figure 1). When the intersection with taxiway Alpha was reached, the flight crew turned to the left instead of to the right. This was noticed by the ground controller, who subsequently instructed the flight crew 'at A12 first right now for taxiway Bravo, right and then left at A12, straight ahead' (blue track on figure 1). The clearance was read back as 'Copied, right now to A12, then taxi Bravo, Cabo Verde 625'. The flight crew made a right turn along A11 whereupon the ground controller instructed the Boeing 757 to turn left now for Bravo. The flight crew read back the clearance, turned left on taxiway Bravo and then turned right and entered the active landing runway 36R via E4 (red track on figure 1). The ground controller resumed other activities[3] and did not notice that the Boeing 757 had entered runway 36R.

A Boeing 737 aircraft was on final approach for runway 36R. An apron controller, employee of the airport organisation, noticed that the Boeing 757 had entered the active runway and contacted the ground controller by intercom. As soon as the ground controller was aware of the position of the Boeing 757, he requested the runway controller next to him to have the Boeing 737 execute a go-around. The Boeing 737 performed a go-around and the Boeing 757 was instructed to vacate the runway via the first left exit. Both aircraft continued their respective operations without further anomalies.

Snow clearing activities were taking place and some aircraft were being de-iced at the P-holding ramp (see de-icing ramp in figure 1) prior to departure.

INVESTIGATION AND ANALYSIS

Aerodrome lay-out

Taxiways & runway entrances

At the time of the incident the runway layout at entrance E4 was such that aircraft taxing north along taxiway Bravo had easily access, by making a 45 degrees right turn, to runway 18L/36R. Entries E3, E4 and E5 were all situated in the area indicated as hot spot area[4] in official publications and information charts at that time.

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[2] During the investigation it was not completely certain whether the aircraft was white or grey. However, Cabo Verde Airlines confirmed that D4-CBG had been white at the time of the incident.

[3] These activities are unknown. However, it is likely that the ground controller resumed his attention to other traffic under his control.

[4] Hot spot area: location on an aerodrome movement area with an increased risk of collisions or runway incursions.

Since the last half of 2006 E4 has been changed by a bend in the entry. The junction to the runway now allows a better view from a cockpit on the runway and emphasizes that the aircraft is not longer on taxiway Bravo. In aeronautical publications[5] only entry E5 is still within a defined hot spot area.

Entry E4 is 2470 meters from the landing threshold of runway 36R. Depending on circumstances the calculated landing distance of a Boeing 737-300 approximately varies from 1700 till 2400 meters.[6] For wide body aircraft the required landing distances are longer.

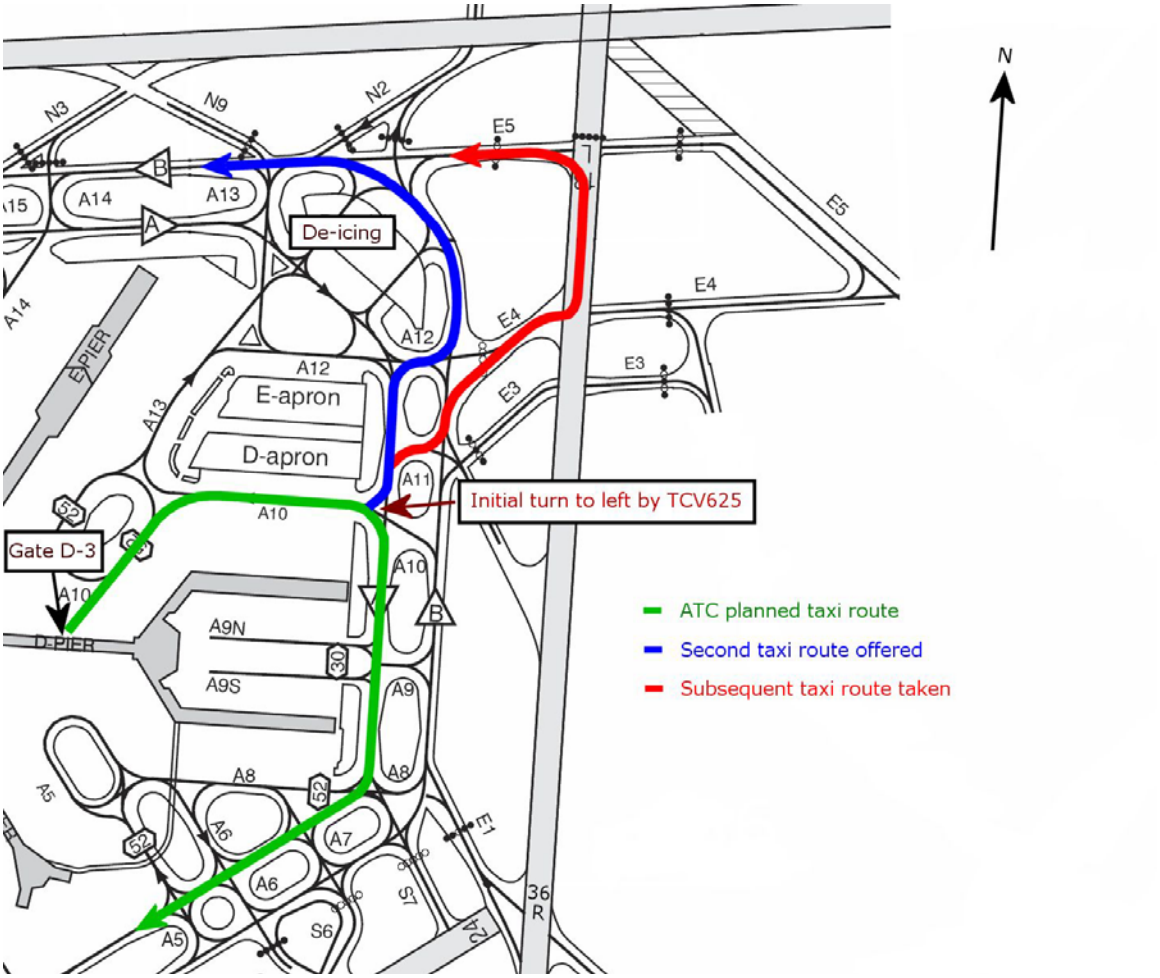

Figure 1: the planned and actual taxi routes for this flight [7]

Weather

The reported visibility at the time of the incident was ten kilometers or more. There were few clouds at 1500 feet and scattered clouds at 2000 feet. An internal investigation document of Air Traffic Control the Netherlands (LVNL) revealed snow sweeping activities at the time of the event.

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[5] The Aeronautical Information Publication (AIP) reveals that entries E3 and E4 are no longer within a hot spot area (EHAM ground movement chart, 25 September 2008).

[6] Maximum landing weight, flaps 30 degrees, temperature 3 °C and no wind apply. Apart from these factors landing distances can also significantly differ by variations in auto-brake selection, runway braking action (friction), landing technique and the availability of the auto-brake system and/or engine thrust reverse.

[7] The departure runway 36C is not depicted on this chart. It is situated west (left) of the picture shown.

Flight crew
In 2007 the first officer of the Boeing 757 was interviewed at Schiphol by an investigator of the Dutch Safety Board. This interview revealed that Cabo Verde Airlines pilots fly to Schiphol at least three times per month. He considered himself as familiar with the airport and he did not have complaints about it. He generally felt satisfied about the way LVNL controls the traffic at Schiphol. In his opinion the signs and markings on the concrete and lights are good and well located at Schiphol.

Standard operating procedures require that the expected taxi instruction is being mentioned in the taxi and take-off briefing. The first officer could not exactly remember the briefing, push back and taxiing, but he felt sure there had not been warnings, a disturbing cabin call or other distractions in the cockpit. In relation to the cockpit atmosphere he felt comfortable with this captain.

In the interview the left turn at A10 and the right turn to E4 could not be explained. The first officer explained that he personally did not consider the clearance 'taxi via the south or north' as confusing. He mentioned that the captain asked him to have their taxi routing confirmed by LVNL because of de-icing of another aircraft. Throughout the interview the first officer repeated a couple of times that in his recollection they believed they taxied 'well and hence there was not a reason to stop'. This was also the case when they entered the runway. He explained that Cabo Verde Airlines pilots are trained to stop when something is not right.

According to the first officer Cabo Verde Airlines pilots now have colored hot spot maps for runway incursions at Schiphol showing more detail than the standard black and white Jeppesen charts.
Cabo Verde Airlines explained to LVNL that pilot training and procedures have been changed to better account for runway incursions and air traffic control clearances.
Cabo Verde Airlines suggested to LVNL to use the designated taxi routing names so the (in particular new or unfamiliar) pilots can easily understand their routing. Clearances containing a phrase that could confuse or disorient pilots must be discouraged.

The pilot in command of the landing Boeing 737 reported that the instruction to go-around was received with the aircraft at an altitude "below 50 feet". In his air safety report he noted that "…as the [other] aircraft colour was grey and the runway was highly reflective due to water and sun, we only observed the aircraft during our go-around".

Air Traffic Control

Staff
The tower occupation at the time of the occurrence was not recorded by LVNL, as it was not considered to be relevant.

Supervisor
It is unclear whether a supervisor was present in the tower at the time of the event.

Investigation revealed that the function of the supervisor in daily operation is often combined with (runway) controller duties. The tower supervisor is an on duty air traffic controller with additional authority to supervise. Generally, he is an experienced controller. It is not a requirement for him to be present in the tower control room at all times. LVNL indicates the supervisor manages the operational process and it is not the task of the supervisor to act as a safety net in the first place.

One of the recommendations in the Delta investigation report[8] states that 'a tower supervisor should not have additional duties' as it was concluded that insufficient supervision had been a causal factor in the Delta-incident. As follow-up (re)action LVNL reported to the Dutch civil aviation authority at that time that 'this recommendation has been complied with'. According to the Board it suggested that the safety net had been improved.

As from 25 September 2008 the tower supervisor duties and responsibilities have been laid down in the manual 'Regulations Department Traffic Control 2', indicated as VDV 2.

The tower supervisor is in charge of the tower unit and performs general co-ordinating tasks:

- Safeguards the optimal traffic flow within the Schiphol control zone.
- Determines the traffic flow strategy and the capacity of Schiphol tower/approach in conjunction with the approach supervisor, area control supervisor, flow management position control and if necessary establishes flow control measures.
- Considers requests regarding special flights within the Schiphol control zone.
- Contributes to informing and taking measures at Schiphol.
- Safeguards the staff performance, procedures, working methods, systems and equipment of the tower.
- Is in charge of the handling of emergency situations within the tower area of responsibility and coordinates all actions.

Additional questions were asked to LVNL about supervision and how it related to a safety net. In its response LVNL did not clarify why it stated in 2001 to the Dutch civil aviation authority if had complied with the recommendation from the Delta report, and by that improving the safety net, whilst investigation now reveals that supervision is not primarily meant to create a safety net.

Runway controller

From his position the runway controller was working in the tower with landing traffic on runway 36R on the east side and departing traffic on 36C on the west side of the tower. The combination required the runway controller to change his view frequently from one side of the tower to the other. The runway controller stated that by far most of the landing traffic was using exits E1 or E2, so his focus was on the southern end of runway 36R. He stated that his scan of the rest of the landing runway was not so detailed. He was convinced that he had seen the last landing aircraft leaving the runway.

It is reported by an investigator of LVNL that the runway controller had not seen the Boeing 757 at first due to a window frame obscuring the view of E4 from his working position. It can be anticipated by use of ground radar. In view of the Corporate Quality & Safety/Incident Investigation department of LVNL it is not considered as a real problem, however, it may occasionally obscure whatever is behind it.
In view of the runway controller it is not sure that a stop bar could have prevented the incident. In the recent past it appeared that many pilots easily crossed an illuminated stop bar.

Ground controller

In view of the ground controller it was busy, but not so busy to split the ground controller's work between him and another controller. The ground controller did note that a second controller was preparing to join him as the workload was increasing. The runway controller had the impression

[8] Final report 98-85/S-14. Dutch Transport Safety Board; N193DN, Boeing 767, 10 December 1998 Amsterdam Airport Schiphol.

that the workload of the ground controller at the time of the incident did not appear to be very high, though he was not aware what traffic was under his control.

To the ground controller's opinion it is not certain that an illuminated stop bar at E4 would have prevented this incident as pilots not always respect stop bars. At the time of the incident there was a switchable stop bar at E4 for low visibility conditions.

Additional information from controllers reveals that for a (ground) controller it is not possible to monitor all movements continuously and it is often assumed, as was the case with the Boeing 757, the aircraft taxies as instructed. There is not always enough time to keep on monitoring the same aircraft. Once aircraft seem to be following their correct routing or when the read back of the provided instruction is correct, controllers have often got to shift their attention to other traffic under their control and tasks (scanning and multi-tasking). In this respect the ground controller also leans on the effectiveness of the markings and signs on taxiways, entries and runways.

Tower assistant 2
His task is described as a general assisting role and it includes amongst other things to support the runway controller as a safety net. The ground controller reported that the tower assistant 2 was busy with winter operations activities (de-icing and snow sweeping) at the time of the incident.

Runways in use
The next runway configuration was in use at the time of the occurrence: runway 36C for departing traffic and runway 36R for landing traffic.

Other relevant air traffic control procedures
Low visibility procedures were not in effect.

For taxi in and taxi out the VDV 2 manual states: "When necessary the ground controller may mention 'via the north' or 'via the south' for taxi clearance. At that time Jeppesen chart 10-9 of Schiphol contained an explanation of the routing instruction via north (taxi via taxiway Alpha and north side of airport) and south (taxi via taxiway Sierra).

Radio Telephony
A radio communication transcript is depicted in appendix A.

Amsterdam Airport Schiphol

Stop bars
Both E3 and E5 entrances, south and north of E4, are part of fixed towing routes and are guarded by permanent switchable stop bars. Also when low visibility procedures are not in effect stop bars at E3 and E5 illuminate when the runway is in use or when the runway lights are on.

The hold for the runway at E4 is marked by yellow hold lines (two continuous lines and two discontinuous lines) at 90 meters from the runway centre line and mandatory signs. The runway entrance at E4 is guarded by a low visibility switchable stop bar. This type of stop bar is only illuminated under low visibility conditions when runway 18L/36R is available to LVNL for use or when the runway lights are on.

Other investigations and findings

LVNL Incident report of the event with the Boeing 757
Amsterdam Airport Schiphol (AAS) participated in the investigation conducted by LVNL. LVNL wrote an incident report (2004-01-29 TCV625 – KLM 1108), produced by the Corporate Quality & Safety/Incident Investigation department.

LVNL concluded that:
- The Boeing 757 entered a runway in use for landing, because the flight crew did not comply with an instruction for taxi as expected by the ground controller. Hence, this created a runway incursion.
- A landing aircraft was instructed to execute a missed approach procedure. The flight crew of the Boeing 757 was not aware of the runway incursion.
- It is considered to be likely that the flight crew of the Boeing 757 had a "loss of situational awareness".

LVNL assessed this incident with the highest severity category (category A) of the runway incursion severity classification system[9], and characterized the event as a pilot deviation. The air traffic control system was not analysed in relation to this occurrence and no recommendations were made.

LVNL runway incursions report
For the years 2005 and 2006 LVNL wrote the internal report "Runway incursions at Schiphol airport"[10] in co-operation with AAS. It elaborates a list of investigated incidents, analysis, recommendations and points of interests.

In this report the next recommendation to the Dutch CAA can be quoted in relation to the incident with the Boeing 757:
- Increase oversight on airport qualifications for not Schiphol based carriers.

In this report the next points of interest for LVNL can be quoted in relation to the incident with the Boeing 757:
- To be attentive to taxiing traffic when crews visit the field less or are unfamiliar with the field.
- Arrange more capacity for monitoring to prevent runway incursions by timely using a second ground controller to reduce individual workload.

[9] This runway incursion classification has been compiled by LVNL and AAS and included in the Position Paper of the Runway Safety Team, a group of experts representing Dutch operators, air traffic control, airport authority, oversight and pilot union.

[10] Runway incursions op de luchthaven Schiphol, years 2005 en 2006, version date 16 April 2007, R&D/PIA department. It attuned to the first long-term runway incursion investigation of the year 2004.

CONCLUSION

Based on the Tripod Beta analysis model it is concluded that unwanted events occur when barriers or safety measures fail (i.e., failed barrier) or are not in place (i.e., missing barrier). The descriptions of the situations or failed active barriers, missing or inadequate barriers and (possible) preconditions have been identified and listed below:

- Standard or unambiguous radio telephony (taxi instructions) did not result in taxiing the correct route by the crew. A number of (possible) unfavourable conditions were identified: their position and aerodrome chart versus traffic situations and complex taxiways, (interpretation of) ambiguous instruction and visible signs and markings considering stop bar situation and effects of fallen precipitation.
- The ground control monitoring process did not prevent that the Boeing 757 entered and taxied on runway 36R. Assumptions, other tasks and traffic, procedures and runways in use were identified as (possible) unfavourable preconditions.
- The infrastructure did not prevent the crew to enter the runway. The angle of intersection between E4 and runway 18L/36R 'invited' the crew to enter the runway.
- The crew of the Boeing 757 did not stop for the hold line. Visibility in relation to precipitation and/or combined with light reflection cannot be excluded as unfavourable preconditions to clearly see the hold line. Runway 36R was used for landing.
- There was a switchable stop bar which in accordance with procedures was not activated because there were no low visibility conditions. Hence, the stop bar is identified as a 'missing or inadequate barrier'.[11]
- The landing crew had not observed aircraft on runway. Reflective runway and non-contrasting aircraft colour may have affected the ability for observation.
- The supervisor was not present or did not intervene. A precondition might be that air traffic control did not consider supervision as a safety net.

[11] 'Missing or inadequate barrier' is a common phrase used in the Tripod Beta analysis model.

APPENDIX A

Radio communication transcript

The texts below are reproduced from a transcript made by LVNL. The following abbreviations are used to identify the parties speaking:

TWR Runway Controller
GND Ground Controller
APC Apron Controller
TCV Flight crew Boeing 757 (flight Cabo Verde 625)
CYP Flight crew Cyprus Airways flight

	Communication		
Time	Between		Content
11.22:21	TCV-GND		Cabo Verde 625, request taxi
11.22:23	GND-TCV		Cabo Verde 625, taxi runway 36C, to leave via A10 and taxi via the south
11.22:32	TCV-GND		Taxi via south to 36C, A10, Cabo Verde 625
11.22:40	GND-TCV		Correct, with a right turn to leave A10
11.22:43	TCV-GND		Right to A10
11.25:23	GND-TCV		Cabo Verde 625, at A12 first right now for taxiway Bravo, right and then left at A12, straight ahead
11.25:31	TCV-GND		Copied, right now to A12, then taxi Bravo, Cabo Verde 625
11.25:46	GND-TCV		Cabo Verde 625, to the left now for Bravo
11.25:49	TCV-GND		Copied, to the left, taxi Bravo, Cabo Verde 625
11.26:02		KLM-TWR	KLM1108, established 36 right
11.26:06		TWR-KLM	KLM1108, goeiedag, you're number one, wind 300, 21 maximum 27
11.26:10		KLM-TWR	Roger, KLM1108
11.26:37		TWR-KLM	KLM1108, runway 36 right, you're cleared to land, wind 300, 21 maximum 27
11.26:42		KLM-TWR	Roger, cleared to land, 36R, KLM1108
11.27:04	APC-GND		Die Caboverdiaan zit op de baan *(intercom)* (Cabo Verde is on the runway)
11.27:07	GND-APC		[exclamation] *(intercom)*
11.27:08	APC-GND		Ja. ja, kijk uit *(intercom)* Yes, yes, watch it
11.27:10	GND-TWR		Ik zit op de baan…met die Cabo Verde I have the Cabo Verde on the runway *[controllers next to each other]*
11.27:12	APC-GND		Ja inderdaad *(intercom)* Yes, that's right
11.27:13	GND-TWR		Kan je rond? Hij is op de baan Is a go-around possible? It is on the runway *[controllers next to each other]*
11.27:15	APC-GND	TWR-KLM	[name], hoi Hey KLM1108, go-around
11.27:17	TCV-GND GND-TCV		Ground, this is Cabo Verde 625 Cabo Verde *(simultaneous transmission)*
11.27:19	GND-TCV		Cabo Verde 625, Cabo Verde 625, continue taxi first left to vacate the runway
11.27:20		KLM-TWR	KLM1108, go-around
11.27:24	TCV-GND		First left, vacate runway, Cabo Verde 625
11.27:27	GND-TCV		You entered the runway, Cabo Verde 625, take it… continue taxi now and take it first left to vacate
11.27:32	TCV-GND		First left, 625
11.27:45		TWR-APP	1108 ging rond, baan was obstructed 1108 made a go-around, the runway was obstructed

	Communication		
Time	Between		Content
11.27:50		APP-TWR	Check, hij mag koers 90 Check, heading 90 is allowed
11.28:05	GND-TCV		Cabo Verde 625, straight ahead now, Bravo taxiway for runway 36C
11.28:07		TWR-KLM	KLM1108 when able right heading 090
11.28:10	TCV-GND	 KLM-TWR	Straight ahead now, taxi Bravo, 36 Centre Cabo Verde 625 We're able for the right turn now, you want us to maintain 1500?
11.28:15		TWR-KLM	Eh… you can climb to 2000 feet, KLM one one o eight, and eh… yeah we had a runway incursion
11.28:20		KLM-TWR	Roger, 2000 feet, right heading 090, KLM1108

Note: This report has been published in English and Dutch language. If there are differences in interpretation the Dutch text prevails.