
Loss of steering on a slippery taxiway on the Easyjet Boeing B737-700, registration G-EZJM, at Amsterdam Airport Schiphol on 22 December 2003

Micro-summary: This Boeing 737-700 skidded on ice while taxiing and collided with a lamp post.

Event Date: 2003-12-22 at 2059 UTC

Investigative Body: The Dutch Safety Board, The Netherlands

Investigative Body's Web Site: <http://www.safetyboard.nl/>

Cautions:

1. Accident reports can be and sometimes are revised. Be sure to consult the investigative agency for the latest version before basing anything significant on content (e.g., thesis, research, etc).
 2. Readers are advised that each report is a glimpse of events at specific points in time. While broad themes permeate the causal events leading up to crashes, and we can learn from those, the specific regulatory and technological environments can and do change. ***Your company's flight operations manual is the final authority as to the safe operation of your aircraft!***
 3. Reports may or may not represent reality. Many many non-scientific factors go into an investigation, including the magnitude of the event, the experience of the investigator, the political climate, relationship with the regulatory authority, technological and recovery capabilities, etc. It is recommended that the reader review all reports analytically. Even a "bad" report can be a very useful launching point for learning.
 4. Contact us before reproducing or redistributing a report from this anthology. Individual countries have very differing views on copyright! We can advise you on the steps to follow.
-

**Loss of steering on a
slippery taxiway**
of the Easyjet Boeing B737-700,
registration G-EZJM,
at Amsterdam Airport Schiphol
on 22 December 2003

The Hague, (investigation number 2003133)

The reports of the Dutch Safety Board are public.
All reports are also available on the website of the Dutch Safety Board
www.safetyboard.nl

THE DUTCH SAFETY BOARD

The Dutch Safety Board has been established with the responsibility to investigate and establish what the causes or probable causes are of individual or categories of incidents in all sectors. The sole aim of such an investigation is to prevent future accidents or incidents and if the results of this should give cause to do so, to attach recommendations to this. The organization consists of a Board with five permanent members and has a number of permanent committees. Specific advisory committees are formed for specific investigations. A staff that comprises investigators and secretarial reporters as well as a support staff support the Dutch Safety Board.

The Dutch Safety Board is the legal successor to the Dutch Transport Safety Board. The present investigation is initiated and partly carried out by the Transport Safety Board but published under the auspices of the Dutch Safety Board.

Chairman:	Board prof. mr. Pieter van Vollenhoven	Chairman:	Aviation Committee dr. ir. J.P. Visser
	mr. J.A. Hulsenbek mw. A. van den Berg prof. dr. ing. F.J.H. Mertens dr. ir. J.P. Visser		mr. J.A. Hulsenbek J.T. Bakker B.M. van Balen ⁴ J. Marijnen mr. H. Munniks de Jongh Luchsinger ir. J.G.W. van Ruitenbeek
		Secretary:	ing. K.E. Beumkes
General Secretary: Head of recommendations department:	Office management Mw. mr. M. Visser drs. J.H. Pongers	Project leader:	Projectteam H. van Ruler mw. drs. K.N.R. Verhoeve
Visitors address:	Anna van Saksenlaan 50 2593 HT Den Haag	External expert: Correspondence address:	mr. J. Biemond Postbus 95404 2509 CK Den Haag
Telephone: Internet:	+31 (0)70 333 7000 www.onderzoeksraad.nl	Fax:	+31 (0)70 333 7077

⁴ Tot 1 februari 2006.

CONTENTS

Consideration	5
Synopsis	10
List of abbreviations	11
1 Factual information	13
1.1 History of the flight.....	13
1.1.1 <i>General</i>	13
1.1.2 <i>The airport</i>	14
1.1.3 <i>The air traffic control</i>	16
1.1.4 <i>The cockpit crew</i>	17
1.2 Injuries to persons.....	18
1.3 Damage to the aircraft.....	19
1.4 Other damage.....	19
1.5 Personnel information.....	19
1.5.1 <i>The aircraft crew</i>	19
1.5.2 <i>Airport personnel</i>	20
1.6 Aircraft information.....	20
1.6.1 <i>General</i>	20
1.6.2 <i>Weight and centre of gravity</i>	20
1.6.3 <i>Technical state of the aircraft</i>	20
1.7 Meteorological information.....	20
1.7.1 <i>General situation</i>	20
1.7.2 <i>Observations</i>	21
1.7.3 <i>Forecast</i>	21
1.7.4 <i>ATIS information</i>	21
1.7.5 <i>Information exchange AOM-KNMI</i>	22
1.8 Aids to navigation	22
1.9 Radio communications.....	22
1.10 Aerodrome information	22
1.10.1 <i>General</i>	22
1.10.2 <i>Taxi procedure</i>	22
1.10.3 <i>Taxiway lighting</i>	23
1.11 Flight recorders.....	23
1.12 Investigation of clues and information of the collision.....	24
1.13 Medical and pathological information.....	24
1.14 Fire	24
1.15 Survival aspects.....	24
1.16 Test and research.....	25
1.17 Organizational and management information.....	25
1.17.1 <i>Amsterdam Airport Schiphol</i>	25
1.17.2 <i>The air traffic control</i>	29
1.17.3 <i>Easyjet</i>	30
1.18 Other information.....	33
1.19 New investigation techniques.....	34
2 Analysis	35
2.1 The airport.....	35
2.2 The air traffic control.....	39
2.3 Easyjet.....	40
2.4 Similarity with other accidents.....	42

3	Conclusions	44
3.1	Findings.....	44
3.2	Causes.....	46
4	Recommendations	47

Annexes

- A. A summary of the relevant ATIS reports.
- B. The transcript of the communication between EZY5112 and the traffic control services.
- C. The transcript of the communication between "Ground West" and "Checker 1".
- D. A summary of the various types of alarm AAS.
- E. Two plots of the ground radar.
- F. A drawing from the AIP of the location of the taxi route to 36L.
- G. A graph of the taxi speed during the final part of the taxi route, according to the information of the FDR.

In accordance with Annex 13 to the Convention of Chicago as well as Directive No.94/56/EC of the Council for the European Communities, which established the fundamental principles governing the investigation of civil aviation accidents and incidents, the investigation of the Dutch Safety Board is not intended to apportion blame or liability.

N.B:

This report is published in the Dutch and English languages.

In the event of conflict in interpretation, the Dutch text will be deemed binding.

CONSIDERATION

INTRODUCTION

This consideration contains an extensive summary of the investigation report. The Dutch Safety Board's duty is to investigate and establish the causes and probable causes of incidents. The sole aim of such investigations is to prevent such accidents or incidents in future. If the outcome of the investigation gives cause to do so, it is also the Board's duty to attach recommendations to its findings.

THE ACCIDENT

On 22 December 2003, at about 21:55 hours, at the Amsterdam Airport Schiphol, a Boeing 737-700 from the English airline Easyjet, was taxiing towards the runway. In the aircraft there were 98 passengers and five crewmembers. At that moment, the weather was characterized by precipitation, with an exterior temperature slightly below freezing point. As far as the weather was concerned, the Schiphol information report (ATIS)² for crews of arriving and departing aircrafts reported 'slippery spots' on all taxiways and aprons.

When taxiing, the crew chose another taxiway route than the one instructed by air traffic control. As the taxiway was covered with ice, the aircraft, when taking a turn, no longer reacted to the nose wheel steering. As a consequence, the aircraft skidded to the side of the apron (P6) and the left wing of the aircraft collided with a lamppost. The collision seriously damaged the aircraft and the lamppost. One passenger sustained light injuries during the accident, another passenger had physical complaints after being evacuated from the aircraft.

ANALYSIS

The Dutch Transport Safety Board conducted an investigation into the accident. The Dutch Safety Board, the legal successor to the Dutch Transport Safety Board as of the first of February 2005, continued the investigation. The role of the various parties involved when the accident came about and when assistance was provided after the accident occurred will be taken into account.

Airport

The airport is divided in an 'airside' part that is not accessible to the public and where the runways, taxiways to and from these runways and aprons are located, and a 'landside' part where the public roads are located. As regards actions against slipperiness Schiphol has two states of readiness: "*gladheid klein*" (local slipperiness on landside and airside) and "*gladheid groot*" (slipperiness on landside and airside). The 'airside operations manager' is responsible for actions against slipperiness at the airport. The co-ordination of the actual deployment of the actions against slipperiness is carried out by the so-called 'snow office' of the airport. In the event of slipperiness, there is spraying on the airside and a product against slipperiness is gritted on landside.

The internal procedure of the airport as regards actions against snow and slipperiness was laid down in the 'snow and iciness control measures 2003-2004'. As a result of the weather forecast, the state of readiness "*gladheid klein*" had been in force at the airport from 11:30 hours onwards. When this state of readiness applies a number of persons and vehicles are available for taking action against slipperiness. There is no actual slipperiness as yet. This state of readiness, therefore, does not mean that the actions against slipperiness are actually taken; this only happens on the instruction of the airside operations manager.

Although, according to the regulations 'snow and iciness control measures', in the event of "*gladheid klein*", it is instructed that a consultative body, i.e. the 'snow desk' (not to be confused with the 'snow office'), convenes for dovetailing between the airport and the *external* parties, this was not done. This was not considered necessary because the slipperiness was assessed as limited in scope.

² Automatic terminal information service (ATIS): automatic provision of information by an airport aimed at departing and arriving aircrafts.

The prescribed issuing of a so-called 'snow tam' -a notice to inform aircraft crews of the actions against snow and slipperiness at the airport- after the actions against slipperiness were carried out, did not happen either.

Given the weather forecast, the decision was taken at 16:45 hours to grit preventatively landside, so that, if necessary, it would be possible to deploy the available staff and means for actions against slipperiness on airside. Because the request for preventative gritting probably only came in at the snow office after 18:00 hours, the preventative gritting of landside was only started at around 18:30 hours. It was not possible to find out why it took more than one hour and a half to start preventative gritting landside.

At the moment preventative gritting was started on landside (18:30 hours), the first report of slipperiness on airside came in. It was decided to spray those spots correctively with three available vehicles and to spray the hazardous locations on airside preventatively. At around 19:30 hours various reports of slipperiness came in. Although it appeared from the reports that the level of slipperiness was more than local ("*gladheid klein*") and it was therefore necessary to upscale to the state of readiness "*gladheid groot*", this did not happen. It was decided to spray the main taxiways that were in use. For this scope of action against slipperiness on airside the amount of available staff and means (three vehicles, out of which one vehicle only suited to combat slipperiness of roads) were insufficient to treat the entire part of the taxiways in use within an acceptable time frame. Priorities were therefore set, whereby some parts of airside that were in use were not treated. The parallel taxiway and the apron on which the Easyjet aircraft skidded, were among those not treated. The decision not to treat certain parts of airside was not reported to air traffic control, nor was the ATIS-reporting adjusted in this respect.

The regulation 'snow and iciness control measures' provides that preventative spraying (airside) and gritting (landside) are mandatory when there is a danger of slipperiness and that it is paramount that spraying and gritting are started in time. As the maximum duration of effectiveness of salt is 12 hours, it is common practice that, in actions against slipperiness at the Schiphol airport, the gritting of landside is carried out well before the slipperiness is expected. After that, the staff and vehicles present are available for possible actions against slipperiness on airside. The actions against slipperiness on airside are taken when there is some level of certainty about the moment the expected slipperiness will set in. This is related to the briefer duration of effectiveness of potassium acetate (eight hours) and the higher costs of this spraying product. Between 17:00 hours and 17:30 hours the meteorological service gave out an intermediate warning of a quick temperature drop by telephone. It is difficult to grasp why the preventative spraying on airside was only started after the first report of slipperiness and not earlier already (when this report by phone came in).

Given the above, the Dutch Safety Board establishes that the actions against slipperiness on landside were taken later. Moreover, when the weather worsened and after reports of slipperiness on airside (at 18:30 hours), there was no deployment of more staff and means for actions against slipperiness on airside. The Dutch Safety Board reaches the conclusion that the actions against slipperiness were started too late, regarding both landside and airside.

The regulation "snow and iciness control measures 2003-2004" is part of the Schiphol manual. Therefore, the regulation is part of the quality system as described in the airside safety management system. Apart from the annual assessment after the winter season, though, the regulation in question was not a subject of internal audits. The regulation is a part of the safety management system, but was not subjected to a risk assessment and monitoring of safety objectives. Therefore, possible flaws were not recognized in an adequate and timely fashion.

The fact that no snow desk was convened, the fact that preventative actions against slipperiness were not taken on time, the setting of priorities between landside and airside, the failure to upscale the state of readiness, the failure to issue a snow tam and the failure to inform air traffic control lead to the conclusion that the development of the slipperiness and the slipperiness situation as such were underestimated.

The investigation also shows that the measurement of the friction and the actions against slipperiness on airside were virtually solely aimed at the runways. This also applies to the other airports in the Netherlands. (Inter)national regulations and procedures on measurement of the braking action/friction and the actions against slipperiness on runways and aprons are virtually non-existent.

There is also room for improvement as regards the provision of information to aircraft crews. After the first report of slipperiness on airside at 18:30 hours, traffic control was only requested to include a report on this in the ATIS one hour later. The first notice was issued at 19:49 hours, mentioning '*All aprons slippery spots*', which was neither correct nor complete. It was not correct because the term 'slippery spots' is not standard ICAO terminology and it was not complete because the taxiways were not mentioned. A partly corrected version was issued at 20:14 hours with the mention '*All taxiways and aprons slippery spots*'. The time gap between the moment the airside operations manager was informed of the slipperiness on taxiways and aprons and the notice in the final, still not correct, information in the ATIS was 1 hour and 45 minutes. In fact, the reporting in the ATIS was incomplete as of 18:30 hours. At the very least, the air traffic controllers should have been informed, possibly followed by a mention in the ATIS.

This is all the more worrying as the predecessor of the Dutch Safety Board, the Transport Safety Board, in the investigation report that was issued on 20 December 2001,³ made a recommendation to the parties involved responsible for the weather reports at the airport (the airport of Schiphol, Air Traffic Control the Netherlands and the KNMI [Royal Dutch Meteorological Institute]) that the system of the (coming about of) weather reporting at Schiphol and the actions stemming from it needs reviewing. As a consequence of this recommendation, the KNMI's role as regards entering the data in the ATIS has been abolished and taken over by air traffic control. The accident with the Easyjet in 2003, however, shows that the system of information reporting is still very vulnerable to errors due to human failure.

The Dutch Safety Board holds the view that the accident entailed a great fire hazard for the occupants, as there was fuel in the fuel tank in the wing, there was a risk of ignition of sparks due to the collision with the lamppost and the engine, which had been switched off by the crew, but which was still hot. Although the actions against slipperiness in the turnout routes of the three fire stations were recognized as a priority, these routes were nonetheless subjected to the actions against slipperiness taken for the ring roads, which have a low priority. For two out of three fire stations the turnout route had been treated. For the fire station closest to the place of the accident this had not yet been done. It took longer than normal before the fire engines from that fire station reached the aircraft. Nonetheless, all fire engines reached the aircraft within the legally set time of three minutes. However, it should be ensured that emergency vehicles can be present as soon as possible. Therefore, there is room for improvement as regards the priority setting concerning the treatment of aprons for the fire stations and turnout routes.

Air traffic control

At the place where the accident occurred the air traffic control must give a positive instruction to aircraft crews regarding the use of a certain taxiway. However, it was common practice there for air traffic control to leave the choice to use a taxiway up to the flight crews. The air traffic controllers had not been informed of the fact that the parallel taxiway and a number of aprons had not been sprayed and could therefore be slippery, but in this case they knew, from their own observation, that it was very slippery there. In connection with the slipperiness, the flight crew of the Easyjet aircraft was given an instruction on the taxiway route. The crew, when given that instruction, was not specifically told of the slipperiness on the parallel taxiway and aprons and was not informed of the deviation of the ATIS-message.

It has not been established that the work pressure of the air traffic controllers did not allow them to give information on the slipperiness to the aircraft crew. The work pressure of the air traffic controllers was low, at that point in time. There were two aircrafts on the radio frequency, out of which the Easyjet aircraft was one. Moreover, after the crew had confirmed the taxi-instruction on the radio, the aircraft was not (constantly) watched by the air traffic controllers. The aircraft was very visible from the "Ground West" tower. Although, in general terms, air traffic controllers are not obliged to constantly monitor the aircrafts located in their work area after an instruction has been read back adequately or has been cleared, the Dutch Safety Board holds the view that in this specific case it would have been reasonable to do so. Therefore, the Dutch Safety Board considers it surprising that, in its own investigation, Air Traffic Control the Netherlands reaches the conclusion that the accident was only caused because the crew did not follow up the instruction and that there are no lessons to be learned, no items for improvement arising from this.

³ Transport Safety Board report 1999011: "*The El Al Boeing 747, registration 4X-AXK, ran off the end of the runway.*"

Easyjet

The crew had been given a positive instruction by the air traffic control to follow a taxiway route. No further information had been provided on the state of the parallel taxiway and the aprons. This instruction cannot be ignored and must be followed up. However, the choice was made to follow an alternative taxiway route. The explanation for this is that the crew was familiar with the situation at Schiphol of flights coming first and, when carrying out previous flights, no instruction had been given when taxiing via this taxiway to follow a certain taxiway route. As Schiphol does not have a system by which the taxiway route is indicated by lighting that only illuminates the route to be used (taxiway guidance system) the lighting of the parallel taxiway and aprons was on, although they were not usable. In addition, when using the parallel taxiway, the turns the aircraft had to make were less sharp and the use of this route, given the weather conditions, seemed an obvious choice. It is striking that there was no consultation between the flight crewmembers before deciding to use the alternative taxiway route (crew resource management), which would have been natural in the circumstances.

During the taxiing, the flight crew failed to notice a message from another aircraft regarding slipperiness. This happened because the flight crew were talking amongst themselves during the long taxi route to runway 36L (the 'Polderbaan'), those conversations were unrelated to the flight. Pilots can be expected to be aware of messages from other aircrafts (situational awareness), notably given the weather conditions. It follows from the fact that the crew slowed down the taxi speed and used another taxiway, although it was the wrong one, because that route led to less steep turns to be taken, that the crew was aware of the weather and of the state of the taxiway.

CONCLUSIONS

The fact that the flight crew did not follow up the instructions from air traffic control and decided to follow another taxiway route led to the pilot flying not being able to keep the aircraft under control, due to the slipperiness on that other route.

The decision to take another route can be explained, among others, by the common, though incorrect, practice to let flight crews choose which taxiway they use in connection with the illumination of the taxiway lighting of both parallel taxiways and the lighting of the aprons. The crew had not been informed and could not be aware of the nature and degree of slipperiness on the scene.

The Dutch Safety Board does hold the view that Air Traffic Control the Netherlands must point out to its air traffic controllers that they should comply with existing procedures.

The information of the ATIS was not correct, both in terms of phraseology and in terms of the actual situation. Moreover, it took too long before this not entirely correct information became available to flight crews. The accident with Easyjet shows that the (management) system regarding the entire chain of realization of information reporting at the Schiphol airport up to and including the actions stemming from said reporting creates risks of human failure.

Given the recommendations made in the past, the Dutch Safety Board deems that the parties responsible for the entire chain of information reporting to airmen at Schiphol could have done more towards taking their (joint) responsibility regarding the decrease of risks in the information reporting up to and including the subsequent actions as regards fighting slipperiness at the airport. Therefore, the Dutch Safety Board holds the view that there is a structural safety shortage. The Easyjet flight crewmembers did not consult with one another on the fact that another taxiway route had been chosen than the one instructed by air traffic control. It also appears from other events that the crew paid insufficient attention to all aspects of the work during this part of the flight. The assignment of tasks and the communication between the two flight crewmembers was not optimal and not compliant with the crew resource management concept.

Finally, it appeared there were flaws in parts of the manual of Amsterdam Airport Schiphol. The 'snow and iciness control measures'-regulation was not subject to a risk assessment and to monitoring of safety objectives. The manner in which the friction was measured on taxiways and aprons turned out to be mentioned in a very concise fashion. This also appeared to be the case at the other airports in the Netherlands.

RECOMMENDATIONS

All parties at Amsterdam Airport Schiphol, who are responsible for the system of provision of information to airmen, should give a more adequate substance to their (joint) responsibility as regards diminishing the risks involved in the reporting of information. In this respect, the use of the non-ICAO term "slippery spots" needs to be assessed.

It is recommended to Amsterdam Airport Schiphol to assess the functioning of the business manual and the underlying regulations, such as the 'snow and iciness control measures 2003-2004' and remedies the flaws therein.

It is recommended to Air Traffic Control the Netherlands to give more adequate substance to the task of air traffic controllers in special circumstances, such as in the event of slipperiness.

It is recommended to Easyjet to include the flaws pertaining to the crew resource management in its training courses and to take appropriate action to prevent this in future.

It is recommended to the Minister of Transport, Public Works and Water Management to encourage further rules to be set, both at national and international level, as regards the operational state of taxiways and aprons at airports.

Professor mr. Pieter van Vollenhoven
Chairman of the Dutch Safety Board

mr. M. Visser
General secretary

A handwritten signature in black ink, appearing to read 'Pieter van Vollenhoven', written over a large, faint circular stamp.A stylized handwritten signature in black ink, consisting of several sharp, sweeping strokes.

SYNOPSIS

On 22 December 2003 flight EZY5112 was scheduled to make a flight from Amsterdam Airport Schiphol to London Gatwick. The aircraft had landed at Schiphol earlier that evening and was to depart according to schedule at 21:50 hours. Before departure from Schiphol the crew listened to the ATIS report. This report contained a warning "*all taxiways and aprons slippery spots*".

While taxiing the crew received the instruction from air traffic control to taxi via taxiway V to runway 36L. However, the captain decided not to taxi via this taxiway, but via the parallel taxiway VS. He took this decision because, among other things, the aircraft would then need to take fewer sharp turns. During earlier flights which he had made to Schiphol, when taxiing at this location he himself had always been able to select the taxiway, either V or VS.

When the aircraft had made the turn towards taxiway VS, it appeared that the aircraft no longer responded to the steering and skidded towards the left side of the taxiway. There the aircraft collided with its left wing against a lamppost. Taxiway VS and the de-icing area P6 located there both turned out to be completely covered with ice. Both the aircraft and the lamppost were seriously damaged.

It appeared that, despite the status of "*gladheid klein*" (minor slipperiness) being in force at the airport and the snow and ice control being carried out, taxiway VS was not treated.

LIST OF ABBREVIATIONS

	Abbreviations	Afkortingen
AAS	Amsterdam Airport Schiphol (the organization)	Amsterdam Airport Schiphol (de organisatie)
AFO	airport fire officer	officier van dienst van de luchthavenbrandweer
AFS	Aircraft Fuel Supply	gezamenlijke vliegtuigtankdiensten
AIP	aeronautical information publication	luchtvaartgids
ALS	addressable lighting system	schakelbaar rijbaanverlichtingsstelsel
AM	airside aerodrome manual	bedrijfshandboek
AMS	Amsterdam airport (IATA code)	luchthaven Amsterdam (IATA code)
AOC	air operator certificate	vergunning tot vluchtuitvoering
AOM	airside operations manager	airside operations manager
AOO	airside operations officer	airside operations officer
APU	auxiliary power unit	hulpmotor t.b.v. vliegtuigsystemen
ATC	air traffic control	luchtverkeersleiding
ATIS	automatic terminal information service	automatische uitzending van informatie betreffende vertrek en landing
ATPL(A)	airline transport pilot license (aircraft)	bewijs van bevoegdheid als verkeersvlieger (vleugelvliegtuigen)
AVMS	airside safety management system	airside veiligheidsmanagementsysteem
BECMG	becoming	geleidelijke verandering (van het weer)
C	Celsius	Celsius
CA	cabin attendant	cabinepersoneel
CAA	Civil Aviation Authority	Britse burgerluchtvaartautoriteiten
CB	cumulonimbus	cumulonimbus bewolking
CCIS	closed circuit information system	intern informatie netwerk van Schiphol
CI	cirrus	cirrus bewolking
CQS	corporate quality and safety (of ATC)	afdeling kwaliteit en veiligheid (van LVNL)
CRM	crew resource management	crew resource management
CU	cumulus	cumulus bewolking
CVR	cockpit voice recorder	cockpit voice recorder
ECAC	European Civil Aviation Conference	Europees burgerluchtvaartoverleg
EHAM	Amsterdam airport (ICAO code)	luchthaven Amsterdam (ICAO code)
FCL	flight crew license	bewijs van bevoegdheid als vliegtuigbestuurder
FDR	flight data recorder	vluchtdatarecorder
FEW	few	weinig (1/8 t/m 2/8 bewolkingsgraad)
FL	flight level	vluchtniveau, hoogte t.o.v. 1013,2 hPa referentievlak in voeten, gedeeld door 100
G	gusting	windstoot
GC	ground controller	grondverkeersleider
GHOR	medical assistance at accidents and disasters	geneeskundige hulp bij ongevallen en rampen
ICAO	International Civil Aviation Organization	internationale organisatie voor de burgerluchtvaart
IR	instrument rating	bevoegdverklaring instrumentvliegen
IVW-DL	Civil Aviation Authority, the Netherlands	Inspectie Verkeer en Waterstaat, divisie Luchtvaart

JAA	Joint Aviation Authorities	gemeenschappelijke Europese luchtvaartautoriteiten
JAR	Joint Aviation Requirements	gemeenschappelijke Europese luchtvaartregelingen
JAR-OPS 1	Joint Aviation Requirements-operations (commercial air transportation)	regeling inzake commercieel luchtvervoer, opgesteld door de JAA
KA	potassium acetate	kaliumacetaat
KNMI	Royal Dutch Meteorological Institute	Koninklijk Nederlands Meteorologisch Instituut
kt	knot(s)	knopen (1 kt is 1,852 km/u)
LGW	London Gatwick	luchthaven Londen Gatwick
LVNL	Air Traffic Control the Netherlands	Luchtverkeersleiding Nederland
MAC	mean aerodynamic cord	gemiddelde vleugelkooord
NOTAM	notice to airmen	bericht aan luchtvaarders
NSC	no significant change	geen belangrijke verandering (van het weer)
OM	operations manager (landside)	operationeel manager (landside)
OVV	Dutch Safety Board	De Onderzoeksraad voor veiligheid
PF	pilot flying	bestuurder
PNF	pilot non-flying	assisterende bestuurder
QNH	pressure setting to indicate elevation above mean sea level	atmosferische druk op het aardoppervlak, herleid tot gemiddeld zeeniveau in de ICAO-standaard atmosfeer
RCL	Regulation for Certification of Aerodromes	Regeling certificering luchtvaartterreinen
RTL	Regulation for Aviation Inspection (a part of the Dutch aviation regulation)	Regeling Toezicht Luchtvaart
SAFA	safety assessment foreign aircraft	safety assessment foreign aircraft
SFT	surface friction tester	meetapparatuur om de baanstroefheid te meten
SCT	scattered	verspreid (3/8-4/8 bewolingsgraad)
S & G	snow and iciness control measures 2003-2004	Sneeuw- en gladheidsbestrijding 2003-2004
SHGSSNRA	showers of grain, snow and rain or combinations thereof	hagel-, sneeuw- en regenbuien of combinaties daarvan
SNOWTAM	snow notice to airman	bericht aan luchtvaarders over sneeuw- en gladheidsbestrijding
SPL-C	Schiphol-Centre	Schiphol-Centrum
ST	stratus	stratusbewolking
TAF	terminal aerodrome forecast	luchtvaartterreinweersverwachting
TEMPO	temporarily trend	tijdelijke (weers)verandering
T/TD	temperature/dew point	temperatuur/dauwpunt
TWR/APP	tower/approach	toren- en naderingsverkeersleiding
UTC	coordinated universal time	gecoördineerde wereldtijd
VCSH	showers in vicinity	buien in de omgeving
VDV	regulations for air traffic services	voorschriften dienst verkeersleiding
VNV	Dutch airline pilots association	vereniging van Nederlandse verkeersvliegers
VOS	aircraft accident Schiphol (alert state)	vliegtuigongeval Schiphol (alarmvorm)
Z	zulu time	gecoördineerde wereldtijd

1 FACTUAL INFORMATION

Place : Amsterdam Airport Schiphol
Date and time : 22 December 2003, 21:59 hours⁵
Aircraft : Boeing 737-700
Registration : G-EZJM
Flight number : EZY5112
Airline company : Easyjet
Crew/passengers : 5/98, two passengers slightly injured
Type of flight : commercial passenger flight
Phase of the flight : taxiing
Type of accident : loss of steering followed by a collision with a lamppost.

1.1 HISTORY OF THE FLIGHT

1.1.1 General

Flight EZY5112 of Easyjet, which was carried out with a Boeing 737-700 with registration G-EZJM, concerned a regular service from Amsterdam Airport Schiphol (AMS) to London Gatwick (LGW) on 22 December 2003. The aircraft had landed earlier that evening at AMS at 2106 hours. The scheduled departure time for the return flight was 2150 hours. There were five crewmembers on board (two pilots and three cabin crew staff members) and 98 passengers.

At 2139 hours the crew received the clearance to start the engines of the aircraft. The air traffic controller of ATC indicated that ATIS information Oscar was in force. The ATIS report contained among other things the warning: *"All taxiways and aprons slippery spots"*. At 2145 hours the crew received the instruction to taxi via taxiways A6 and B-North to runway 36L.

After about ten minutes the crew of EZY5112 reported to ATC 'Ground West' with the message that they were located at the place of the reporting point VM (see Annex A). The air traffic controller answered: *"Good evening EZY5112 continue taxiway V and V3 is available if you like"*. The clearance of the air traffic controller was answered by the crew with: *"V for V3 is fine, thanks, EZY5112"*. However the crew chose not to taxi via taxiway V but to taxi via the taxiway situated next to it, taxiway VS to the intersection V3. Taxiway VS leads via the two holding points P6 and P7, where ice can be removed from aircrafts (de-icing), directly to V3. The holding points are widened parts of the taxiway and are illuminated by means of lampposts.

When making the turn to P6 the aircraft no longer responded on the nose wheel steering and taxied straight on with the aircraft skidding to the side of the apron. At the end of the holding point P6 the aircraft collided with its left wing against one of the lampposts. The collision took place at 21:59 hours. The crew switched off the engines a few seconds before the collision took place. After the collision the aircraft swerved and the aircraft came to a standstill after about 20 meters. The nose wheel stood in the grass; the main landing gear had come to a standstill on the edge of the apron against the cover plates of electricity wells⁶. The aircraft and the lamppost were seriously damaged. The air traffic controllers who saw the collision occur, used the alarm telephone to alert the emergency services. The airside operations manager⁷ (AOM) activated alarm type VOS1.⁸

The taxiway VS and holding point P6 turned out to be almost completely covered with a layer of ice and consequently were very slippery. In connection with the slipperiness on P6 the disembarkation of the passengers was delayed until the apron had been sprayed.⁹ After about half an hour the passengers could begin to disembark. At 22:48 hours all the passengers had left the aircraft and had been taken to the terminal building by buses.

⁵ All the times in this report are local times (UTC + 1 hour) unless stated otherwise.

⁶ Cables and switches for the runway lights can be accessed via these wells.

⁷ The AOM is responsible on behalf of the Airport Commandant for the operational procedure on airside of Schiphol. (See Section 1.17.1)

⁸ Aircraft Accident Schiphol 1 (VOS 1) is the most minor type of alarm with regard to an incident with an aircraft. (See Section 1.17.1)

⁹ Because snow and ice control takes place with the aid of liquid potassium acetate, this is called spraying instead of gritting.

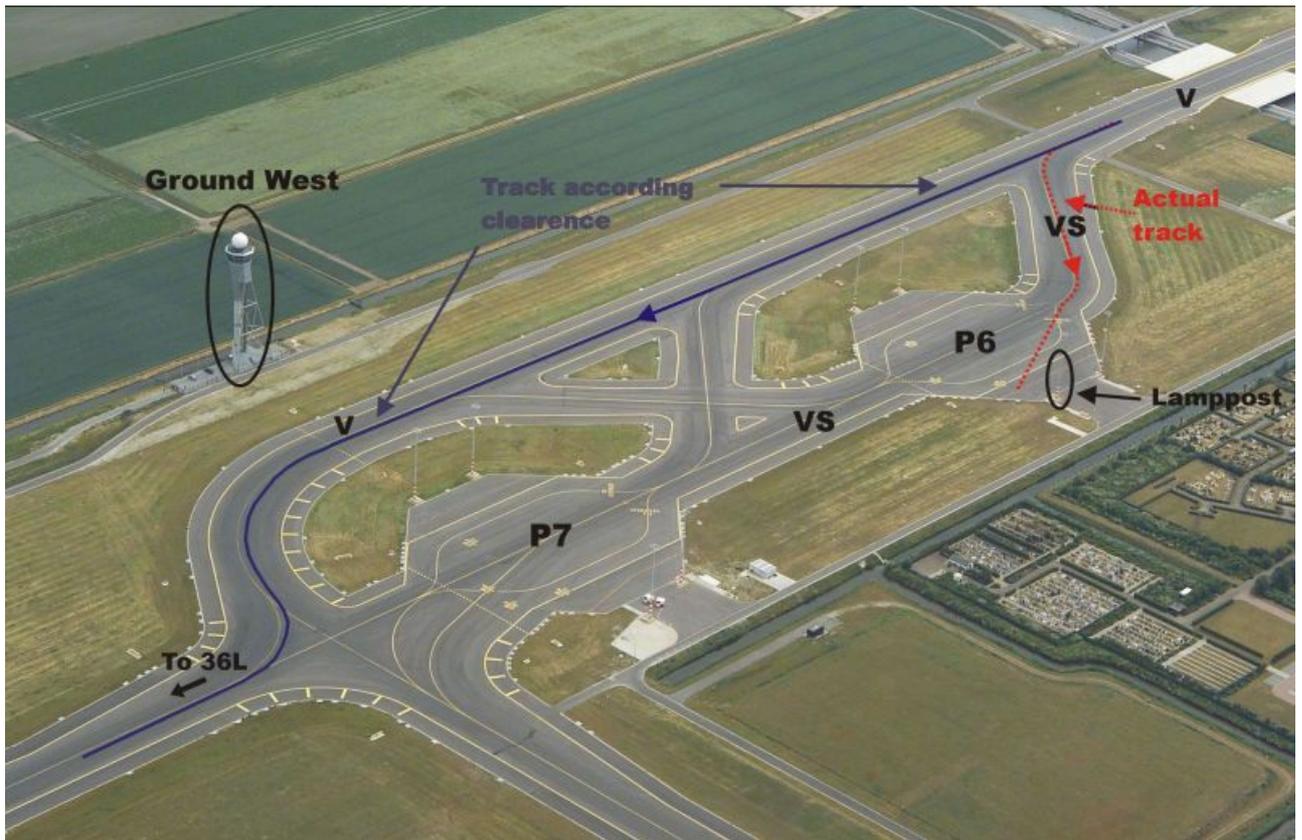


Figure 1: aerial photo of the route and the place of the accident (photo KLPD)

1.1.2 The airport

Snow and ice control

The procedures, rules and definitions with regard to the snow and ice control at AMS are described in the "snow and iciness control measures 2003-2004" (Regeling S & G) [regulations Snow and Ice 2003 – 2004]. See section 1.17.1.

From reports of Amsterdam Airport Schiphol (AAS) it appears that in connection with the forecast weather conditions at AMS the preparedness type "*gladheid klein*" was in force from 11:30 hours. This means that there is *local* slipperiness both on airside¹⁰ as well as within the public area (landside¹¹). Besides "*gladheid klein*" the preparedness type "*gladheid groot*" exists which means slipperiness both on airside as well as within the public area.

Although there was not yet actually a case of slipperiness, by activating "*gladheid klein*", a number of staff members and vehicles were available for fighting slipperiness on airside and landside. The 'Regeling S & G' mentions that seven persons and five vehicles can be deployed. However, these figures are indicative and one can deviate from them, depending on the circumstances and the available manpower. From interviews and reports it appears that at about 1645 hours the AOM decided to implement preventive gritting on landside, because of the weather forecast at that moment which said there might be slipperiness after nightfall. According to the AOM the reason for this decision was to have more capacity in case the airside would have had to be sprayed in connection with slipperiness. It appeared from statements that this is the usual course of events in the event of slipperiness at Schiphol airport: given the duration of effectiveness of salt (twelve hours), it is possible to grit landside well before the expected slipperiness. After that, the staff and vehicles present are available for fighting slipperiness on airside if necessary. The action against slipperiness on airside is only taken when there is some degree of certainty about the time the slipperiness is expected to set in. This is related to the shorter duration of effectiveness (eight hours) of potassium acetate (KA) and the higher cost of this spraying product.

¹⁰ Airside is the part of Schiphol which is not accessible to the public, where the taxiways and runways, etc. are located.

¹¹ Landside is the part of Schiphol where the public roads are located.

From interviews with personnel who were involved with the snow and ice control it appeared that the request of the AOM to start the snow and ice control very probably arrived at the snow office¹² after 1800 hours. The actual gritting of landside, with four vehicles, began at 1830 hours. The telephone calls which are made by the AOM are not recorded. Although the manuals specify that the time at which the request of the AOM arrives must be noted, this time is not mentioned on the deployment list. The snow and ice control vehicles were ready to be used and could drive off within a few minutes.

Documents of the AAS show that the first report of slipperiness on airside was made at 1830 hours. The AOM then decided to have corrective spraying there, and spraying as a preventative measure carried out at high-risk locations on airside. It appears from reports that three vehicles actually started spraying airside at 1840 hours. One vehicle was used for gritting the ring roads where there is road traffic. The two other vehicles were used to fight slipperiness at the landing area. From the report of the AOM it appears that it was also the intention that P6 and P7 would be sprayed. According to his statement he informed the snow office of this. However, the employees of the snow office state that they never received this request. Moreover P6 and P7 are not noted on the deployment list which states all locations which the AOM asks to be treated. From another report of a conversation it appears that the AOM later stated that P6 and P7 were not sprayed in connection with setting priorities and because he had understood that the air traffic control "*would not come there anyway*".

From the documents of AAS it appears that at 1930 hours the slipperiness had spread and there were various notifications of slipperiness at different locations at Schiphol. Subsequently the AOM decided to have all main taxiways sprayed. Taxiway V was sprayed between 1937 hours and 1947 hours. Moreover, the driver of the de-icer vehicle drove up to intersection V3. P6 and P7 were not sprayed. From the report of the deployment it appears that the driver had not received any order for this. After inspection it appeared that the runways which were in use were dry and skid resistant and therefore did not need to be treated.

From the documents it appears that about 2150 hours the crews of two aircrafts which had landed on runway 06 reported that the exits runway 06 were starting to become slippery. As a result of these notifications, the AOM gave the instruction to measure the friction of runway 06 with the surface friction tester (SFT).

AOM maintained continuous contact with various parties concerned until 2200 hours. The "*gladheid klein*" status was maintained but the personnel deployment was extended to eight persons so that, as the report of the AOM shows, a small snow fleet¹³ could be formed if necessary. According to the report of the AOM slipperiness was suddenly occurring from 2200 hours.

From the deployment schedule it appears that between 1830 and 2200 hours seven vehicles were deployed (four for landside and three for airside) for fighting slipperiness at the airport. From the reports it appears that just before the time of the accident the 'supervisor snow and ice'¹⁴, because of the consumption of the spray and gritting products, was considering whether to have the status scaled-up by the AOM to "*gladheid groot*". This decision, however, was not taken because at that moment the accident took place for which alarm type VOS1 was activated.

In the context of the internal investigation, the AAS interviewed a number of persons involved. Of which five persons said that for some considerable time before the accident there had been slipperiness on airside. Earlier in the evening the AFO had passed on to the AOM that the turnout routes for the fire brigade garages were slippery. From the statement of the AOM it appears that he passed this on to the supervisor "snow and ice" with the request to treat these routes. From interviews with personnel of the snow office it appears that the treatment of the aprons and turnout routes at the fire stations do have priority but are "included" in the snow and ice control on the ring roads. At the moment of the accident the aprons in front of two of the three fire stations were already treated, but the snow and ice control at the third fire station, Sloten, had not been done.

¹² The snow office is the department of AAS from where the snow and ice control is coordinated if there is a standby snow and ice.

¹³ A small snow fleet consists of a limited number of vehicles that are deployed for snow control.

¹⁴ The supervisor "snow and ice" is responsible for the implementation of the snow and ice control for "minor slipperiness".

Moreover the investigation showed the following:

- The actions against slipperiness on roads on landside and airside are carried out with salt and the runways, aprons and taxiways on airside with potassium acetate. According to the S & G regulations of AAS, salt is active for twelve hours and potassium acetate is active for eight hours. *"(Danger of) slipperiness is in principle counteracted with chemicals, whereby preventative spraying and/or gritting is always used. It is paramount that spraying and gritting are done in time."*
- The AOM did not call a meeting of the snow desk¹⁵ nor issue any SNOWTAM¹⁶ as described in the S & G regulations. The AOM stated that he had not thought it necessary because the slipperiness was limited in size.
- A number of important telephone connections are not recorded so that the statements of the parties concerned must be relied on.
- The term 'slippery spots' has been used at AMS for decades by the responsible authorities to indicate the condition of the surface of taxiways or aprons for the snow and ice control. This term is used in SNOWTAM or in the ATIS information. This term does not appear in the relevant ICAO publications and there is no definition known which gives further meaning to this term. Neither does the term appear in the 'Regeling S & G' of AAS. In chapter 3 of the "regulations for air traffic services VDV 2", Schiphol TWR/APP, airport services, the term '(some) slippery spots' appears under the heading 'deposits', as a possible form of precipitation which could effect the condition of runways, taxiways and aprons.

The organization of the snow and ice control at AAS is mentioned in section 1.17.1.

Actions after the accident

From the interviews it appears that at the moment the alarm was activated the AOM was located on the other side of the airport. Consequently it took a long time before he arrived at the place of the accident. The AFO was the first person present at the aircraft. The AOM asked for further particulars from the air traffic controllers of "Ground West" who had the aircraft in sight and he was apparently told according to his statement that there would be no injured persons and no slides were visible. The AFO stated that he wanted to communicate with the crew to be informed of the situation on board of the aircraft and to inform the crew about the situation outside the aircraft. The AFO is able to receive the aviation channels and has for some time been able to communicate on these. According to the guidelines of AAS only the AOM is permitted to make contact with an aircraft crew via the aviation radio channel. The AFO stated that he therefore communicated from the apron with the captain via the cockpit window. The captain stated that he found it a restriction that he could not communicate by radio with the AFO and consequently could not be informed properly of the situation outside the aircraft.

1.1.3 The air traffic control

The air traffic control in the area around runway 36L takes place from a separate ATC tower which is situated next to taxiway V and is called "Ground West". The air traffic controller and the assistant ground traffic controller stated that they had seen a de-icer vehicle driving on taxiway V and intersection V4 and it drove back via the taxiway VS and the holding points P6 and P7. In connection with the darkness they could not see whether it was actually spraying. About 2100 hours they saw a vehicle of the bird control of the airport, Checker 1, drive over the holding point P6. They gathered that it was slippery there because of the slipping movements of the car. After some radio communication between the controller and the driver of the car, it appeared that it was indeed slippery there. The driver informed him that he would report the slipperiness to the airport authorities. The controllers stated that they were surprised that it was slippery there. They had assumed that it had been sprayed there because they had seen the de-icer vehicle driving there. About 20 minutes later Checker 1 reported to ATC that *"the slipperiness at P6 and P7 is being worked on"*. At the request of ATC, Checker 1 also provided the information that taxiway V was all right for driving but that it *"was also completely wrong"* at the intersections V1 and V2. According to the air traffic controller this was not a problem *"because he would not be going there anyway"*. ATC was not informed by AAS that P6 and P7 could not be used in connection with the slipperiness.

¹⁵ A snow desk is a consultation between AAS and other parties at Schiphol Airport. (See Section 1.17.1)

¹⁶ A SNOWTAM is a report by means of a prescribed model which gives information to aviators about the presence or the removal of hazardous situations caused by (half melted) snow and (half melted) ice on landing fields and aprons.

After the first officer of EZY5112 had reported to "Ground West", the air traffic controller instructed him to taxi further via taxiway V with which the aircraft could taxi via intersection V3 onto runway 36L. This instruction was correctly read back by the first officer. The controller did not make any statement about the slipperiness on VS and P6. The two controllers stated that they did not keep the aircraft continuously in sight. At the moment when the air traffic controller looked at the aircraft, the aircraft was already taxiing on track VS. When the controller wanted to warn the crew that it was slippery on P6, he saw how the aircraft had already begun to skid and a little later collided against the lamppost. The assistant ground traffic controller immediately activated the alarm by means of the alarm telephone.

The controllers of "Ground West" stated that it is not generally indicated whether an aircraft has to taxi via taxiway V or via taxiway VS. This does not make any difference to air traffic control movement because there is usually no traffic in the opposite direction. The controller had in this case given a clearance for taxiway V because he knew that VS was slippery. A few other aircrafts who had departed earlier from runway 36L, had, after they had received an instruction for this, also taxied via taxiway V.

1.1.4. The cockpit crew

The crewmembers stated that they had flown together various times. The duty rotas showed that they had flown together on 19 December 2003 which included their carrying out a flight from LGW to AMS and back. Both crewmembers had been at AMS about five times before and they had been on the airport both during the day as well as in the evening. They stated that prior to the flight from LGW to AMS they had received and studied the relevant NOTAMs and weather information. Before the landing at AMS the crew had listened to the ATIS landing information. They stated they could not remember which version they had listened to but that in the report it had said among other things "all taxiways and aprons slippery spots". Although they did not know this term as standard phraseology, they interpreted it as small slippery spots of about 1 to 2 m² on the taxiways and aprons. During the incoming taxiing however they had not noticed anything about these slippery spots.

The turnaround time of EZY5112 was shorter than planned, 25 minutes instead of 30 and according to the crew they were not in a hurry to meet the scheduled departure time of the return flight. The information which the crew received before the departure from the ground handling consisted of the current information of the number of passengers and the load. Current weather information was not issued. The captain was the pilot of the aircraft (pilot flying, PF). The first officer (pilot non-flying, PNF) took care among other things of the radio communication and the flight information. The PNF listened through to the end of the ATIS. The PF stated that he could not remember whether he himself was also informed of the contents of the report. The PF did say he was informed of the ATIS report which he had heard before the landing at AMS and that he assumed that this was not changed in the short period of the turnaround time. The crew had carried out the briefing for the return flight in which among other things the probability of ice forming on the body and wings was discussed. The PNF had inspected the aircraft on the outside and the crew did not find it necessary to have the aircraft treated preventatively against possible ice forming. They further decided in connection with the possible slippery spots on the taxiways to amend the taxi speed and to taxi calmly. Because the aircraft had had a short turnaround time and the conditions were not changed, the crew did not request any new NOTAMs and weather information.

While taxiing to runway 36L the "before take-off" checklist was completed. The anti-ice system of the engines and wings was switched on, as described in the manuals under "Cold Weather Operation". After the aircraft had reached point VM, the PNF reported himself to ATC "Ground West". He confirmed the clearance to taxi via taxiway V to V3. The captain stated that he had heard this clearance but he had not realized that this was an instruction. All the previous times that he had departed from AMS from runway 36L he had been able to choose himself whether he would taxi via taxiway V or via taxiway VS to the take-off runway. Furthermore he saw that the lighting of both taxiways V as well as VS was illuminated. This was for him a sign that both taxiways were available and could be and were allowed to be used. He stated that at many airports the availability of taxiways is indicated by the track lighting being illuminated or not. The captain stated that he had decided to taxi via taxiway VS to runway 36L because via this route he did not have to make so many sharp turns with the aircraft which he thought was safer in connection with the possible slipperiness. An additional advantage was that the illuminated lighting on the holding points P6 and P7 made it possible to check the wings for the presence of ice forming. Furthermore he assumed that these aprons would in any case be free of ice because in view of the weather conditions these

could be used to de-ice aircrafts. He could not remember whether he had discussed his decision with the first officer.

When taking the turn to the left, the PF felt that it was slippery but the aircraft steering could still be kept under control. When taking the right turn, towards P6, he felt that the aircraft skidded straight on and did not respond to the nose wheel steering¹⁷. He still tried to steer the aircraft by braking asymmetrically, but the aircraft continued to slip in the direction of the edge of the apron. When he saw that a collision with the lamppost was not to be avoided, he switched off the engines before the collision took place and, on the PNF's instruction, turned off the engines and gave the PNF the instruction to turn on the auxiliary power unit (APU). After this the collision with the lamppost followed.

After the collision the crew informed ATC and asked for the emergency services. The captain stated that he then informed the passengers of the situation via the public address system. Then he carried out a damage inspection in which he observed that the wing's front edge of the left wing was damaged and a small amount of liquid leaked from the wing. After an inspection by the Airport Fire Officer (AFO) who was first on the scene, it turned out that this was not a fuel leak but that it was hydraulic oil. After consultation with the AFO the captain decided not to have the passengers evacuated but to let them remain in the aircraft until the apron had been sprayed. He stated that he had taken this decision because he thought it was dangerous to let the passengers disembark onto the slippery apron. Furthermore according to him there was no danger of fire and the situation in the cabin was calm.

An instructor-pilot of Easyjet was present in the cabin as passenger. He stated that during the times that he had used runway 36L at AMS, he had never had an instruction from the traffic control to follow a particular route, taxiway V or VS. In addition, the track lighting of both taxiways had always been illuminated. He had used both taxiways without the traffic control saying anything about this and without having asked for permission for this.

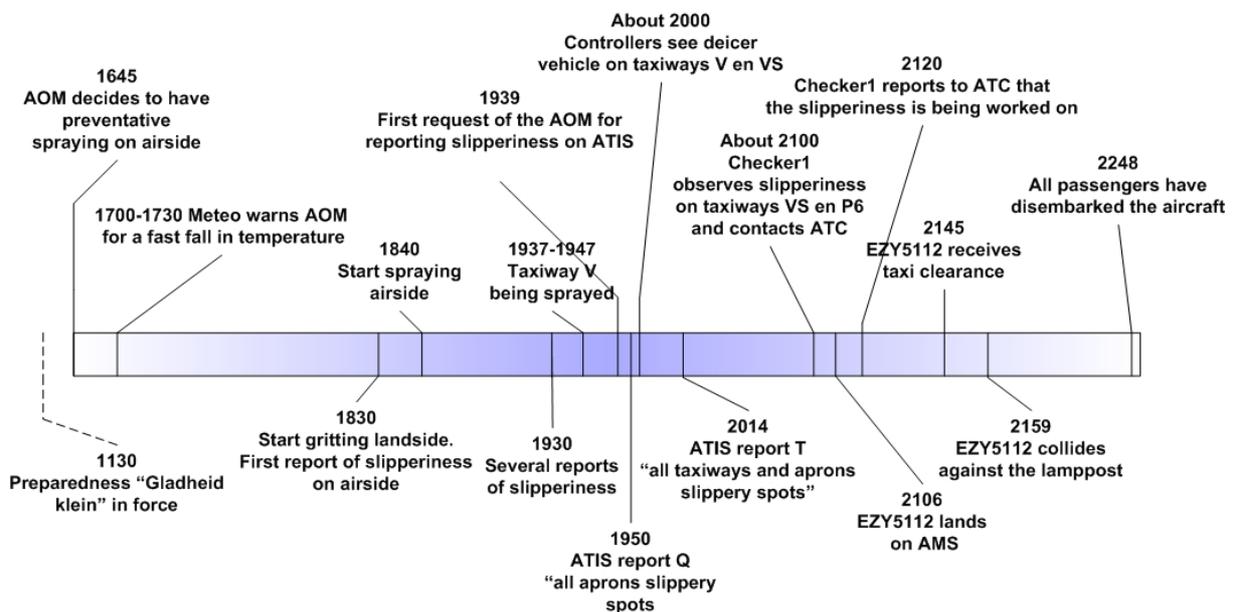


Figure 2: Time line of the most important events

1.2 INJURIES TO PERSONS

Injury	Crew	Passengers	Third parties
Fatal	-	-	-
Serious	-	-	-
Slight/None	5	98	-

¹⁷ During taxiing the nose wheel steering takes place with the aid of a small steering wheel, the so-called tiller which is operated from the left seat.

1.3 DAMAGE TO THE AIRCRAFT

A large part of the sheeting on the bottom and top of the left wing was damaged and had to be renewed. Furthermore a part of the left wing's leading edge with the pipelines lying behind it and the leading edge valves were destroyed. There was no fuel leak. The damage was repaired by Boeing personnel. After inspection in March 2004, the aircraft was declared airworthy after which Easyjet put it back into regular service.



Figure 3: Photos of the damage to the left wing

1.4 OTHER DAMAGE

The lamppost which was hit by the aircraft was seriously damaged and was later replaced.

1.5 PERSONNEL INFORMATION

1.5.1 The aircraft crew

Captain	: Male, New Zealand nationality, 30 years old
License	: ATPL(A), valid to 16 February 2008
Aircraft ratings	: Boeing 737/300-700 series/IR
Proficiency check	: 3 August 2003
Medical certificate	: valid to 14 May 2004
Employed by Easyjet	: since January 2003
Total flying experience	: 4.876 hours
On type	: 4.615 hours
Last 90 days	: 156,16 hours
Last 7 days	: 22,52 hours
Last 24 hours	: 11,41 hours
Working period prior to accident	: 8,25 hours
Rest period prior to work	: 19,07 hours
First officer	: Male, British nationality, 47 years old
License	: ATPL(A), valid to 2 September 2008
Aircraft ratings	: Boeing 737/300-700 series/IR
Proficiency check	: 4 December 2003
Medical certificate	: valid to 16 April 2004
Employed by Easyjet	: since October 2002
Total flying experience	: About 5000 hours
On type	: About 700 hours
Last 90 days	: 171.54 hours
Last 7 days	: 25,08 hours
Last 24 hours	: 11,41 hours

Working period prior to accident : 8,25 hours
Rest period prior to work : 14,20 hours

1.5.2 Airport personnel

AOM on duty : Male, Dutch nationality, 43 years old
Employed by AAS : since 1998
Independently on duty as AOM : since 1999
Relevant training : internal training courses, one year "on the job training AAS"
Rest period prior to work : more than 24 hours

1.6 AIRCRAFT INFORMATION

1.6.1 General

Type : Boeing 737-700
Year of manufacture : 2002
Registration : G-EZJM
Serial number : 30248
Certificate of airworthiness : valid to 23 April 2005
Total flying hours : 5.816
Total number of flights : 4.246
Maximum take-off weight : 62,595 kg

1.6.2 Weight and centre of gravity

According to the load sheet that was completed before the departure of the flight, the take-off weight was 52,889 kg and the centre of gravity was 24.2% MAC.

1.6.3 Technical state of the aircraft

The aircraft had no outstanding technical complaints concerning the steering, hydraulic systems, brakes or the anti-skid system. The aircraft had a valid "Certificate of release to service & maintenance statement".

1.7 METEOROLOGICAL INFORMATION

1.7.1 General situation

The Royal Netherlands Meteorological Institute (KNMI) gave the following description of the weather: "*Between a low pressure area above the Baltic states and a high pressure area south-west of Ireland, a decreasing north-westerly current carries cold, polar and unstable air. West of the line Leeuwarden-Nijmegen, isolated sometimes clustered wintry showers occur.*"

Comments from the KNMI in the description:

"Besides the showers, there were also substantial bright periods in this north-westerly current. During these bright periods just before sunset the temperature fell quickly both on the ground and at observation height (1.5 meter). It was only towards the end of the requested period (23:00 hours) that the temperature rose again to values above the freezing point because of increasing clouds. An intermediate warning about the fast fall in temperature was sent by telephone to the Airside Operations Officer¹⁸ and to KLM between 17:00 and 17:30 hours. Then just before 19:00 hours the AOO informed the meteorologist on duty about the first occurrence of slipperiness at the airport at about 18:30 hours.

In view of the extensiveness of the aerodrome in combination with the small scale of the shower activity it is very probable that the temperature with respect to the whole airfield was very varied: from above freezing point to below it depending on the degree of cover from the clouds present."

¹⁸ This means the AOM.

Natural light conditions : darkness
 Visibility : more than 10 kilometres
 Clouds : FEW, CU, basis 2,000 feet, tops 22,000 feet or higher, SCT, CI, at 22,000 feet or higher
 In a shower : sct, cb, basis 1,500 feet, tops above FL100, sct, st, basis 600 feet
 Temperature at 1.5 m : between 0 and -2° C
 0° Celsius level : on the ground
 Icing up : in showers moderate to severe
 Turbulence : in showers moderate
 Thermal : none

1.7.2 Observations

Station	Time	Wind	Vis.	Weather	Clouds	T/TD	QNH
EHAM	20:27	260/04	9999	VCSH	Few 008 Few 022 CB	01/-00	1026 ¹⁹
EHAM	20:55	280/05	9999	Nil	Few 030	-00/-01	1026
EHAM	21:25	230/05	9999	NSC		-01/-02	1026
EHAM	22:05	230/06	9999	NSC		-01/-02	1026

1.7.3 Forecast

TAF EHAM 221807

221904 300/05 9999 FEW 025 Tempo 1924 2500 SHSNGSRA SCT 006 SCT 015 CB²⁰

1.7.4 ATIS information

The ATIS report contains information about the weather conditions and operational information about runways. The reports with landing information are transmitted separately from the reports with departure information. These reports are updated every half hour unless it is necessary to make an intermediate adjustment. The reports with landing information are indicated by the letters A - M; departure information is indicated by the letters N - Z.

The personnel of LVNL provide the distribution and amendment to the contents of the ATIS report. The contents of the report are also available on CCIS, the internal Schiphol information network. From the information of the LVNL it appears that the AOM requested the tower traffic controller at 1939 hours to include the warning about slippery spots on the taxiways and aprons in the CCIS report and therefore also in the ATIS report. After internal processing at LVNL, from 1949 hours the warning "All aprons slippery spots" was included in the ATIS report Q(uebec).

After the AOM had noticed that the ATIS report was incomplete, at 2010 hours he requested ATC to include "all aprons **and taxiways** slippery spots" in the report. The report was subsequently amended by the LVNL. From 2014 hours the warning in the ATIS report T(ang) read: "All taxiways and aprons slippery spots". This warning was maintained via the ATIS until one hour after the accident.

At the landing of EZY5112 at Schiphol at 2106 hours, the (arrival) information that was given in the ATIS report J(ulliet) was valid. The information in this report read: "main landing runway 06, all taxiways and aprons slippery spots, transition level 40, 260 degrees three knots, visibility one zero kilometres, FEW 3,000 feet, temperature minus zero, dew point minus one, qnh 1026 hectopascal, nosig, acknowledge information Julliet at first contact".

The (departure) information which was given in the ATIS report N(ovember) commencing 20:54 hours was: "main departure runway 36L, main landing runway 06, all taxiways and aprons slippery spots, 260 degrees three knots, visibility one zero kilometres, few 3000 feet, temperature minus zero, dew point minus one, qnh 1026 hectopascal, acknowledge information November at first contact".

¹⁹ In aviation an observation is always issued in a standard format. The meaning of this line is: observation from station Amsterdam Airport Schiphol at 20:27 hours: wind from the direction of 260°, with a force of 4 knots. Visibility more than 10 kilometres. Showers in the vicinity. Clouds: few, at a height of 800 and 2,200 feet. Cumulonimbus clouds. Temperature 1 degree Celsius and dew point minus zero Celsius. Air pressure 1026 hPa.

²⁰ This line means: report valid on 22 (December) from 1904 UTC. Wind from the direction of 300° with a strength of 5 knots. Visibility more than 10 kilometres. Few clouds at 2,500 ft. Temporarily between 1900 and 24.00 hours UTC showers with snow, hail and rain, semi-cloudy at 600 ft and 1500 ft. Cumulonimbus clouds.

The (departure) information which was given in the ATIS report O(scar) commencing 21:27 hours was: *"main departure runway 36L, main landing runway 06, all taxiways and aprons slippery spots, 220 degrees four knots, visibility one zero kilometres, no significant clouds, temperature minus one, dew point minus two, qnh 1026 hectopascal, acknowledge information Oscar at first contact"*.

For the relevant ATIS reports see Appendix A.

1.7.5. Information exchange AOM-KNMI

From the incident report of the AOM it appears that according to the first weather forecast for the evening and night the temperature would fall too slightly below zero degrees in the late evening. After that the weather would be changing significantly; the visibility values would decrease and the showery conditions would decrease and turn to drizzle. After contact had been made various times between AOM and the KNMI, the forecast was adjusted to an earlier time. The temperature would be falling to below zero degrees fairly quickly after it became dark. In addition local showers could fall. Besides the freezing up of already wet taxiways, the greatest risk was thought to be the wintry precipitation in view of it remaining on the ground, probably in the form of hail.

Furthermore, it appears from the record of the KNMI that the KNMI gave the AOM and KLM an intermediate warning between 1700 and 1730 hours about a rapid temperature drop, see section 1.7.1.

1.8 NAVIGATION AIDS

Not applicable.

1.9 RADIO COMMUNICATION

Before the departure the PNF maintained contact with three different air traffic control stations: "Schiphol Delivery", "Schiphol Ground" and "Ground West". The radio equipment operated normally. He did not confirm on start-up that he was informed about the current ATIS information. During the taxiing the aircraft had radio contact with "Schiphol Ground". After crossing over runway 18C the PNF, according to instruction, sought and received contact with "Ground Control Tower West" (Ground West). He read back correctly the instruction to taxi via taxiway V to intersection V3. The transcript of the radio communication between EZY5112 and the traffic control services is enclosed as Annex B.

The radio communication between the control tower, fire service and vehicles of AAS which are located in the landing field is carried out on the operational channel designated for this, the 'runway' channel. The communication on this 'runway' channel with regard to the slipperiness on VS and P6 between "Ground West" and "Checker 1" has been described. The transcript is enclosed as Annex C.

1.10 AERODROME INFORMATION

1.10.1 General

Schiphol airport has several taxiways which are made available to the air traffic control based on the preferential runway assignment system. At the time of the accident runway 36L was available for take-offs and runway 06 available for landings. Of all the runways, runway 36L is the furthest removed from the terminal. It takes 15 to 20 minutes to taxi from the terminal to the beginning of this runway.

1.10.2 Taxi procedure

In the Aeronautical Information Publication (AIP) Netherlands, EHAM AD 2-2-3.1 which was valid at the moment of the accident, there is no compulsory taxiing direction indicated at the location of the taxiways V and VS. This page has meanwhile been replaced as of 23 December 2004 and a compulsory taxiing direction is indicated by means of arrows via taxiway V to runway 36L. Aircrafts which have landed on runway 18R are compelled to taxi via taxiway VS.

The compulsory taxiing direction was also not indicated on the Jeppesen aviation charts which aircraft crews used during the taxiing at the time of the accident.

1.10.3 Taxiway lighting

The taxiways at AMS are indicated by means of green centre line lighting and blue edge lighting or retro reflecting 'edge markers' on the edges of the taxiways. AMS does not have a 'taxiway guidance system' consequently it is not possible to operate the taxiway lighting per taxi track. On the aviation charts of AMS, which are used by the aircraft crews, it does not indicate that the airport does not have a system in which the taxi route is indicated by illuminated taxiway lighting. Research shows that this system is available on a limited number of European airports such as London Heathrow, Madrid and Munich.

AAS has divided the airport into 13 service areas. The lighting is operated per service area. Taxiways V and VS are situated in service area T. It appears from the information of AAS that all the taxiway lighting in service area T was illuminated at the time of the accident and was burning with strength of 10%. According to the information of an employee of the airport that was a normal strength considering the prevailing visibility conditions.

Also the apron lighting of the de-icing aprons P6 and P7 were illuminated. No rules have been drafted with regard to the use of apron lighting.



Figure 4: Fork of V and VS with P6 (left)

1.11 FLIGHT RECORDERS

The investigation has used the flight data recorder (FDR) and the cockpit voice recorder (CVR). The aircraft was equipped with a solid-state memory FDR and a solid-state memory CVR, both of the Honeywell brand. Both recorders were undamaged. The recordings of both recorders were stopped at the moment when the engines were switched off just before the collision with the lamppost.

Information from the FDR shows that the highest recorded speed of the aircraft while taxiing to runway 36L amounted to 22 knots. In the final 30 seconds before the accident the taxiing speed fell from 15.5 to 12.5 knots. This was the last taxiing speed recorded before the accident.

A graph with the data of the taxiing speed is enclosed with this report as Annex G.

The CVR has four channels available; the first channel is used to record the conversations on the external communication channel between the ground personnel and the crew. The second and third channels are used to record the audio signals of the captain and the first officer and the fourth channel contains the audio signals received by the cockpit area microphone. All conversations between the captain, the first officer and the traffic control were clearly understandable.

From the recordings it appears that the first officer listened to the ATIS report N(ovember) before the start. This report is not audible on the recording of the captain. The two pilots do not talk together about the contents of the report. During the taxiing the pilots talk about various subjects which are not related to the implementation of the flight. During these conversations the statement of another aircraft crew is audible who during taxiing states to the traffic control that it is "*slippery indeed*", to which the traffic control answers that measures are being taken. From the sound recordings it does not appear that the crew has heard this information. When the aircraft reaches point W3, it is audible that the captain says: "*W3, check, greens all the way*".

Furthermore it appears from the recordings that the instruction of the traffic controller to follow taxiway V to intersection V3 of runway 36L is clearly audible on both channels. The confirmation of this instruction by the first officer is also clearly audible on the channel of the captain. From the recordings it further appears that the crew do not speak to each other about the decision to use taxiway VS instead of following the designated route via taxiway V. The first officer does not make any comment to the captain about him not following the assigned route. Shortly before the collision the captain states that the aircraft is skidding after which it is audible that the first officer gives the order to stop the engines and the captain gives the order to start the auxiliary power unit (APU). After that the recordings stop. At the time the crew is in contact with the air traffic control of

“Ground West” it appears from the recordings that the air traffic controller, at that time, is in touch with another aircraft. This aircraft reported in about 40 seconds after EZ5112 at point VM.

1.12 INVESTIGATION OF CLUES AND INFORMATION OF THE COLLISION

The aircraft stood with its nose in an alignment of about 270° to apron P6. On the apron a tire track was visible on the ice running from the left side of the apron diagonally to the right up to the edge of the apron where the wheels of the main landing gear stood against the electricity wells. The nose wheel stood in the grass and had made a straight track from the edge of the apron. The tip of the left wing was situated in front of the lamppost, looking in the direction of the front of the aircraft. The damage on the left wing was located at a short distance from the wing tip, towards the body. This damaged part of the wing was located a few meters to the right in relation to the lamppost.

In connection with drainage, apron P6 slopes down slightly to the left side.



Figure 5: Photos of the aircraft after the accident and the tracks on the apron

1.13 MEDICAL AND PATHOLOGICAL INFORMATION

After the collision it appeared that one passenger was slightly injured. After the emergency services had arrived at the scene, a medical team went on board and treated the wounded person in the aircraft. After the evacuation it appeared in the airport terminal that a second person had physical complaints. These were treated by medical personnel onsite.

1.14 FIRE

Not applicable.

1.15 SURVIVAL ASPECTS

After ATC had activated the alarm, the airport fire brigade with six vehicles, including the vehicle of the AFO, went to the place of the accident. Because the turnout route in front of the garage of fire station Sloten was slippery, it took longer than normal, according to the AFO, before the vehicles arrived at the aircraft. All vehicles of the fire brigade were within the legally established time of three minutes at the place of the accident. The AFO was the first at the scene. After the other members of the airport fire brigade were at the scene, it appeared that it was so slippery on the apron that a few of them slipped.

In connection with the slipperiness on the apron the captain, in consultation with the AFO, decided to let the passengers remain in the aircraft until the apron was sprayed and was no longer slippery. He stated that he had made this decision because he thought the risk was too great that the

passengers after embarking onto the apron would slip and become injured. He had taken into consideration the conditions in which the passengers all remained claim, there was no danger of fire, and no other reason to quickly evacuate the aircraft. The fire brigade kept two fire engines on standby at the aircraft.

1.16 FURTHER INVESTIGATIONS

Not applicable.

1.17 ORGANIZATION AND MANAGEMENT INFORMATION

1.17.1 Amsterdam Airport Schiphol

General

AAS is a division of the Schiphol Group and consists of three parts of which the "Business Unit Airlines" is responsible for the whole process on airside. The airport manager is responsible for the daily supervision of the good order and safety on the aerodrome. The AOM is charged with this task as regards on airside by means of a functional authorization. In accordance with Article 136, paragraph 1 of the 'Regeling Toezicht Luchtvaart' (RTL) [a part of the Dutch aviation regulations] the airport manager of a controlled aerodrome always informs the local ATC in good time about which part of the landing field can be used for the traffic with aircraft. In accordance with Article 136, paragraph 3 of the RTL the local ATC determines based on considerations about the traffic situation which section of the part of the landing field being used is actually designated for the landing and take-off of aircraft and the movements related to this.

Organization snow and ice control AAS

The international and internal rules regarding snow and ice control are established, among other places, in ICAO Annex 14 (Aerodromes), ICAO Annex 15 (Aeronautical Information Services), ICAO Airport Services Manual part 2 and the AIP Netherlands.

The internal procedures of AAS are established in the regulations "snow and iciness control measures 2003-2004" (Regeling S & G) [Snow and ice Regulations]. The latter regulations were operational in the period 15 November to 31 March inclusive. The objective, organization, responsibilities, method and procedures are described in these regulations in detail.

In addition the users of the aerodrome are kept informed about the current situation by means of SNOWTAMs, ATIS information, etc. and if necessary reports of ATC.

The 'Regeling S & G' includes the following items about tasks and responsibility:

- *The control of snow and ice has the second highest priority, second only to calamities.*
- *The airport manager has final responsibility for the good order and safety on the aerodrome.*
- *The AOM acts on behalf of the Airport Manager in the operational airport process on airside.*
- *The Operational Manager Passengers (OM) acts on behalf of the Airport Manager in the operational airport process on landside.*
- *In the framework of good order and safety the AOM may decide to deviate from the 'Regeling S & G'*
- *The AOM sets the priorities for controlling snow and ice in the framework of keeping the runways, taxiways, aprons and roads operational, and with disruptions of airport handling processes.*
- *The AOM establishes the type of preparedness in consultation with the snow leader.*
- *In case of impending snow and ice the AOM informs the Airport Fire Officer (AFO) and the Operational Manager Passengers (OM).*
- *The AOM informs third parties in order to prevent disruptions to the operational process or to be able to attend to these as much as possible.*
- *The AOM is responsible for the measuring of friction levels on the runways.*
- *The snow leader is responsible for the entire organization in his department concerning the implementation of the snow and ice control.*
- *The snow leader is actually present at the airport when 11 or more persons are deployed.*
- *The supervisor snow and ice manages and is functionally responsible for about 10 employees in case of slipperiness.*
- *The supervisor snow and ice ensures and supervises the implementation of the snow and ice control (...).*

- *The supervisor snow and ice is responsible for an accurate registration in case of deployment of his team for slipperiness.*
- *The deployment of personnel amounts to seven persons for "gladheid klein" and 24 persons for "gladheid groot". These numbers are approximate.*
- *At the commencement of minor snow or minor slipperiness the AOM is obliged to call a meeting of the snow desk²¹*
- *After the control of snow and ice the status of the airport has to be reported to the airmen. This happens by means of the so-called SNOWTAM.*

It appears from the regulations that in case of "*gladheid klein*" outside office hours the snow leader is at home and maintains contact by telephone with the AOM. The supervisor then manages the snow office internally. It appears from interviews this was also the case on the evening of the accident. The AOM informs the snow office which locations need to be treated. The supervisor notes on the deployment list the location and time when this request is received. Then he divides up the locations to be treated among the drivers of the vehicles to be deployed. The drivers of the vehicles in turn fill out drivers' forms in which they note the locations, the times and the quantity and nature of the product used. After finishing they hand in these forms to the supervisor who copies the information onto the deployment list. There is regular feedback taking place between the supervisor and the AOM. Requests of the OM to treat the locations on landside are also received by the AOM who passes these requests to the snow office.

The quality standard is in accordance with the 'Regeling S & G', and this includes:

- *Always a minimum of one take-off/landing runway operational with a measured minimum braking action Medium-Poor (...).*
- *Between 0530 and 2300 hours as quickly as possible, but at the latest about 40 minutes after the end of the passing of snow/icy showers a second take-off/landing runway operational with minimum measured braking action Medium-Poor (...).*
- *For taxiways with through traffic a minimum measured braking action Medium-Poor (...) applies.*

With regard to the treatment of the aprons in front of the fire brigade stations, Article 14.2 of the 'Regeling S & G' provides as follows:

- *After the AFO and the fire station captains have been informed of the preparedness type, the AFO contacts the snow office with the request to control the slipperiness and/or to remove the snow at the locations he specifies.*
- *The product used to control the slipperiness on ring roads is salt.*
- *If speed is necessary and the gritting vehicles are located on the landside routes, it is permitted to spray the turnout routes with potassium acetate.*

Some time ago the procedures had a provision that said the crews of the various fire stations were to provide the snow and ice control of their respective turnout routes. This method was stopped because in practice it appeared that during the implementation of this the required turnout times could no longer be met.

Assessment of snow and ice regulations

The snow and ice regulations of AAS are assessed after each winter season and adjusted if necessary. After the assessment of the 'Regeling S & G' the following points for improvement arose which are relevant to this investigation:

Improve and keep to the route layout for gritting and de-icing vehicles.

Better management of the snow and ice operation.

Concerning the last point, AAS has purchased software which makes it visible to the snow leader where the gritting and de-icing vehicles are located and which route they have taken. In addition AAS has purchased a slipperiness alarm system which measures details of the track by means of sensors at various points on the take-off and landing runways and taxiways. In particular the temperature, air humidity and the state of the applied ice control product are measured so that the development of any slipperiness can be observed within good time.

Both systems were not yet operational when the present report was written.

²¹ Snow desk is a consultation platform for the purpose of coordination between AAS and external parties. The snow desk consists of: the AOM, a representative of the handling companies, a representative of the ATCNL, a representative of AFS and if required a representative of the airline companies.

Aerodrome manuals

In general

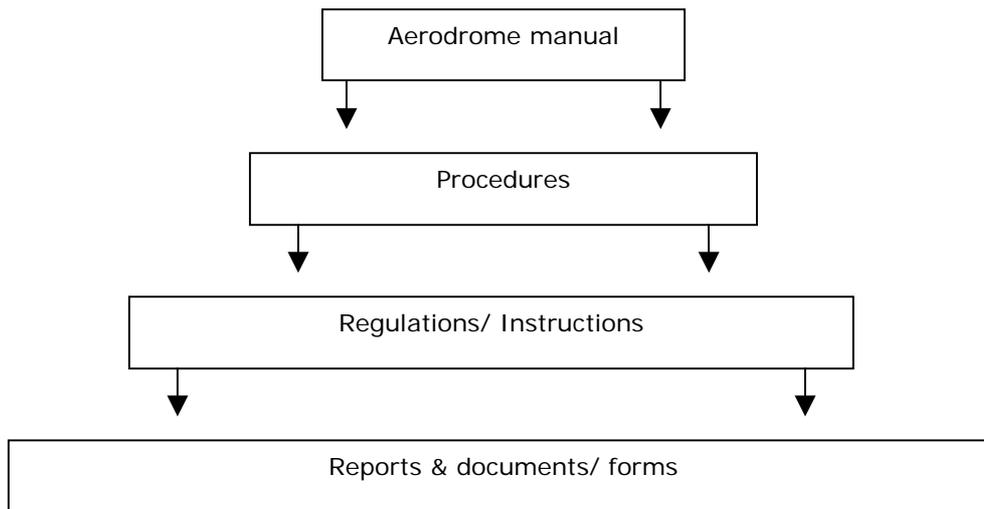
At the time of the accident, all the regulations and procedures that were applicable at AAS were mentioned in the "Airside Aerodrome Manual", the AM. The AM is the company manual of the Business Unit (BU) Airlines. The AM contains a description of the tasks, responsibilities, competencies and work arrangements for the management of the safety and the environmental issues of the management of the Business Unit and, as such, is the basis of BU Airlines' airside safety management system (AVMS). In 2003 AAS started implementing a new business manual. This was completed in March 2004, after which the 'AAS business manual' came into force. During the transitional period, the contents of the AM were not updated for some parts, such as objectives and summing up of the greatest risks. These dated back from 2001 but, as they were still topical in 2003, they remained valid for 2003, as appears from statements made by employees of AAS.

The Airside Aerodrome Manual

The AM contains the chapters: Policy; Structure and organization; Company processes and risks; Planning and control; Laws and rules; Regulations; Procedures and instructions.

The content of the chapters relevant to the present investigation is described below:

- Policy: this describes the policy as regards safety on airside by the management of BU Airlines.
- Structure and organization: this part describes the structure of the Airside safety management programme. The 'Deming circle' (the Plan, Do, Check and Act cycle) in which permanent improvement takes place, is an important part of this safety management system of the BU Airlines. Documentation has been compiled for the safety system of the BU Airlines in which the system is described in its entirety and in which, to the extent possible, reference is made to existing documentation. The documentation consists of the following parts: the AM, procedures, regulations/instructions and reports & documents/forms. Below a scheme of the structure:



There is also the Airside Safety Information System. This system contains a registration of incidents and process information.

- Company processes and risks: this chapter describes how, using a risk assessment, critical processes are identified and the risks are made manageable by means of procedures and/or instructions. The BU Airlines made a risk assessment of the ten largest risks in 2001. As a fifth risk is mentioned: "weather conditions (*taxiway incidents due to insufficient specific meteorological information, friction/braking action on the runways*)".
- Planning and control: this chapter describes, among other issues, how to deal with deviations from the (safety) standard. It also describes how internal and external audits are carried out.
- Laws and rules: this describes the legal rules applicable on airside.
- Procedures: this chapter describes procedures that have been set up to manage critical processes or activities. A procedure contains work arrangements for managing these critical processes or activities.

For this investigation the following is relevant:

- Procedure P-03.02 "*Making strips available*"
This procedure solely pertains to making start runways and landing strips available. It mentions, among others, that the airport makes start runways and landing strips available to the LVNL and can also put these strips out of use because of, among others, unsafe situations.
 - Procedure P-03.04 "*Procedure on measuring the braking action/friction*"
This procedure describes when and in which way the braking action is measured on start runways and landing strips. Nothing is mentioned as regards the measurement of slipperiness on taxiways or aprons.
 - Procedure P-03.06. "*Operational quality monitoring of start runways, landing strips and taxiways*".
Although this is not excluded in this procedure, nothing is described concerning the monitoring of quality of taxiways in connection with slipperiness due to snow and/or ice.
- Instructions/Regulations
This part contains the instructions and regulations managed by the respective departments. These include, among others, the 'Sneeuw en gladheidsbestrijding 2003-2004'; the alert regulation and the business emergency plan.

The S & G regulation of AAS is assessed after each winter season and, as this regulation was linked to the AM, it was also part of the audits. It appears from information from AAS that there was no internal audit on 'snow and iciness control measures'. AAS was unable to provide a reason why this did not happen.

AAS's own investigation

In accordance with Article 4, paragraph 2i, of the 'Regeling Certificering Luchtvaartterreinen' (RCL) [Regulations for Certification of Aerodromes], AAS instigated an internal investigation based on the procedure "analysis and handling of accidents, incidents, shortcomings and defects" of the ASMS. As a result of this investigation a number of recommendations were drafted which are to be adopted. These recommendations are:

- Take care to ensure that pilots no longer take the taxiway VS via P6 to runway 36L.
- Perform an additional investigation into the knowledge of pilots and the air traffic control about the slippery spots/friction levels of runways and taxiways.
- Perform an investigation into the snow and ice control organization (how are communications exchanged between AOM/Snow leader/third parties, is the writing of reports adequate, are the clearing plans sufficient, is the correct status used, is there an adequate response to a suddenly occurring slipperiness, etc.), include in this the procedure of contacts with the met official of the KNMI (are the forecasts of the KNMI reliable, is the number of contacts between KNMI and AOM sufficient during snow and ice).
- Include in the investigation the method of documentation and completion of forms, etc. of all actions taken for the purpose of snow and ice and check whether these need to be revised.
- Log the following telephone extensions: 2420, 2001, 2210 and find out as soon as possible whether mobile phones can be logged. Also log the conversations which go via the Satellite.
- Make the checkers aware that people should not pass on subjects to the air traffic controllers about the control of slipperiness (always have this routed via the AOM).
- Put the meteorological information of the last 24 hours in the shift report airside operations instead of the meteorological information of the 24 hours previous to that.
- Make a snow and ice record sheet for the AOM.

As is indicated in Section 1.10 the first item has meanwhile been given substance. As regards the implementation of the other recommendations AAS reported the following. The additional investigation concerning the second recommendation has been delayed. Before carrying out the investigation regarding recommendations 3 and 4, the report of the Dutch Safety Board is awaited. As far as recommendation 5 is concerned, it is known that logging the telephone numbers is possible. The last three recommendations have been implemented.

Supervision by IVW-DL

The RCL has been in force since 30 November 2002. In accordance with these regulations, the Minister of Transport and Public Works issues a certificate to the aerodrome operator, if the operator has demonstrated, by means of the safety management system and the implementation thereof, that the construction, the layout, the equipment and the safe use of the aerodrome is assured in accordance with the regulations which are applicable. In response to an application of the N.V. Luchthaven Schiphol for a certificate, a certification investigation was carried out between 16 May 2003 and 25 May 2004 by the Traffic and Water Management Inspectorate Aviation

department, Ministry of Transport (IVW-DL). According to the report which was drafted as a result of the investigation it was reviewed "to what extent the construction, layout, equipment and safe use of the aerodrome are in accordance with the applicable regulations and that this is assured by the safety management system of the operator as well as the implementation of and compliance with this". Furthermore, there was a review about whether the airport manages the safety risks on the aerodrome and strives for a continuous improvement to safety. The runway friction level and snow and ice control formed a part of the investigation. The result of this investigation was that the requirements which the RCL set for the aerodrome were fulfilled. According to the report, "the safe use of the aerodrome was in general well assured. However, the safety management system is still not routine". The following (relevant in this context) findings and items for improvement were observed:

- *The AVMS is not yet rooted in the organization. The safety objectives are not always known on the shop floor. (...)*
- *The correct functioning of the control system for the timely solving of items for improvement, observed in internal audits, is not yet evident.*
- *It is not evident that the complete RCL is covered by the current audit programme.*
- *There was no comment during the investigation that the S & G regulations were not included in the manual and therefore not assured by the ASMS.*

According to IVW-DL, the aforementioned issues had no influence on the issuing or non-issuing of a safety certificate. The reason for this was that an audit programme is only mandatory after the operator is granted a certificate and the internal audit programme of the airport was still in a conceptual stage.

1.17.2 The air traffic control

Procedures and guidelines

The ICAO document 4444, Procedures for Air Navigation Services –Air Traffic Management, states procedures and guidelines for the provision of air traffic services. A few guidelines which are relevant to this investigation are:

§ 4.5.4.1 *"Clearances shall contain positive and concise data and shall, as far as practicable, be phrased in a standard manner".*

§ 7.4.2 *"Essential information on aerodrome conditions shall include information relating to the following: (...)*

*c) snow, slush or ice on a runway, a taxiway or an apron;
(...)*

§ 7.4.4 *"When a not previously notified condition pertaining to the safe use by aircraft of the manoeuvring area is reported to or observed by the controller, the appropriate aerodrome authority shall be informed and operations on that part of the manoeuvring area terminated until otherwise advised by the appropriate aerodrome authority".*

Chapter 12 mentions recommended phraseologies. The phrase for a taxi route is (§ 12.3.4.7): *"Taxi via....." (identification of taxiway)*

Rules of traffic control service

The "Voorschriften dienst verkeersleiding 2– Schiphol TWR/APP" (VDV) [Rules of air traffic control service] includes among other things rules with regard to taxiing traffic on taxiways. It mentions the following about taxiways V, VS, VN and VE:

"In order to create more flexibility for sequencing and the de-icing on and near the aprons P6 and P7, there is no standard taxi route applying to the taxiways V, VS, VN and VE. The GC (ground controller) therefore gives positive instructions to have aircrafts follow these taxiways".

Quality system

The LVNL has, according to the information provided, chosen an integral management system in which the aspects of quality and safety management are covered. The processes which have a direct effect on the quality and safety of the service provision are controlled and continuously evaluated and improved according to the specify-plan-do-check-act cycle, also known as the "Deming circle". There is a staff department Corporate Quality and Safety (CQS) for the assurance of quality and safety. This department consists of the departments "Survey" and "Incident Investigation" which work pro-actively and reactively, respectively, in order to identify and analyze the expected and/or current safety risks in the operational field. Beside this, quality co-

coordinators have been appointed in the line organization to facilitate the quality and safety management from within the line organization.

By means of the independent assurance of quality and safety, LVNL meets the details of the international and national requirements in this field. In addition LVNL is certified according to ISO9001:2000.

LVNL's own investigation

As a result of the accident the Incident Investigation department of LVNL set up an internal investigation. The conclusion of this investigation was that the accident would not have taken place if the aircraft crew would have kept to the taxi clearance. According to this investigation there does not appear to be items for learning or improvement for the LVNL.

1.17.3 Easyjet

General

The airline company Easyjet was established in March 1995. The company offers regular services within Europe. Easyjet consists of two companies: Easyjet in the United Kingdom and Easyjet Switzerland. The company has grown rapidly since it was established; at the moment it is the third largest airline company in the United Kingdom and the fleet has grown from two leased aircrafts in 1995 to 97 aircrafts in December 2004. The prognosis is that the fleet will consist of 114 aircrafts at the end of 2005.

Easyjet has an informal company culture with an extremely flat management structure, in which unnecessary and expensive management levels are avoided. Due to the strong growth it has been decided to change the organizational structure as of January 2005 because the existing structure no longer appeared to suit the size of the company.

The operational management of Easyjet is aimed at minimizing the costs and at the efficient use of the aircrafts. One of the ways to achieve this is by shortening the turnaround times (the time needed for arrival, offloading, loading and departure) to 30 minutes or less.

Easyjet manuals

Easyjet uses a large number of manuals for the operations with aircrafts. The manuals which are relevant to this investigation are:

Boeing 737 Flight Crew Training Manual

The Boeing 737 Flight Crew Training Manual contains information and recommendations of the manufacturer regarding manoeuvres and techniques, which are used in the use of the aircraft. The manual states that it is the responsibility of each airline company to state whether the contents of the manual are applicable to their own operations. Easyjet has determined that this training manual is part of their own operations manual. Subjects from the training manual are regularly dealt with during the annual tests and training courses.

In Chapter 1 under the heading "*Callouts*" of the training manual which is used by Easyjet, the following is also mentioned: "*Avoid casual and nonessential conversation during critical phases of flight, particularly during taxi, take off, approach and landing. Unnecessary conversation reduces crew efficiency and alertness and is not recommended when below 10,000 feet MSL/FL100*".

Chapter 2 gives attention among other things to taxi speeds. The manual states: "*Taxi speed should be closely monitored during taxi out, particularly when the active runway is some distance from the departure gate. Normal taxi speed is approximately 20 knots, adjusted for conditions. On long straight taxi routes, speeds up to 30 knots are acceptable, however at speeds greater than 20 knots use rudder pedal steering only. When approaching a turn, speed should be slowed to an appropriate speed for conditions. On a dry surface, use approximately 10 knots*".

Furthermore, Chapter 2 discusses the subject: "*Taxi – Adverse weather*". A translated and abbreviated account of this chapter states that for taxiing on a slippery or contaminated surface, the speed must be adjusted. The turning of the aircraft is facilitated by the use of the different power of the two engines. Large steering wheel deflections must be avoided in order to prevent slipping away. Further comments are:

"A slippery surface is any surface where the braking capability is less than that on a dry surface. Therefore, a surface is considered "slippery" when it is wet or contaminated with ice, standing water, slush, snow or any other deposit that results in reduced braking capability".

Operations Manual

Chapter 8.3.8 of the operations manual of Easyjet gives attention to adverse and hazardous atmospheric conditions. The section "rain, snow and other precipitation" also mentions: *"Manoeuvring may require the use of slower taxiing speeds to allow for the reduction in braking performance in snow, slush or standing water"*.

Nothing is mentioned about recommended taxi speeds in the aircraft operations manual of the Boeing 737-700,

Quality system of Easyjet

JAP-OPS 1.035 (Quality System) states the requirement (to put it briefly) that an airline company shall have a quality system and a quality manager shall be appointed with responsibility for this system. The quality system shall also contain a quality monitoring system. The JAR-OPS further requires that both systems need the approval of the national (aviation) authorities and that the whole quality system must be described.

The quality system of Easyjet is established in the so-called "Quality Manual"²². This quality manual is part of the Easyjet operations manual in which the rules and procedures for the operations of aircrafts are described.

The quality system is approved by the British Civil Aviation Authority (CAA).

The quality monitoring system is used to monitor the quality system. The Senior Quality Manager is responsible for this system. The system also provides for audits. These audits focus on:

- Airport operations
- Flight operations
- Technical operations
- Management and organization

In the context of the investigation into this accident the audits with regard to the airport operations at AAS were investigated further. The subjects which were raised during the audit were: handling passengers and safety, flying operations and load, apron and aircraft handling, supply of fuel, bird control and aircraft ice prevention and de-icing. These subjects are assessed on a number of items according to the national/international requirements. An audit is performed each year in January at AAS. The findings of the last two audits were the observation of two non-compliances in 1993, and five non-compliances in 1994. These non-compliances had no relation to the present accident.

Safety management system Easyjet

Furthermore Easyjet has described the safety system, as is prescribed in JAR-OPS 1.037 (Accident prevention and flight safety programme), in the "safety management system" manual.²³

The five main processes described in this are:

- Safety training
- Communication
- Risk assessment procedure
- Monitoring performance, review and incident/accident reporting
- Incident and accident investigation

Easyjet's own investigation

Easyjet set up an internal investigation into the accident on the basis of the Safety Management System. As a result of the provisional report, a number of provisional recommendations were drafted, these stated:

- *"Control of aircraft on contaminated taxiways and runways, be reviewed by the training department to include any advice in the winter operations booklet"*.
- *"Crews be notified about the taxi layout at P6 and P7 and that crews be instructed not to taxi into that area unless specifically instructed to do so or for de-icing action"*.

²² In connection with organisational changes within Easyjet the structure of the organisation, manuals and programmes with regard to the quality system were changed on 1 January 2005.

²³ In connection with organisational changes within Easyjet this manual has been rewritten and this was replaced by the "Safety and Accident Prevention Program" on 1 January 2005.

The measures which Easyjet has taken to date to prevent a repeat of a similar accident in the future are:

- Adaptation of the Operations Manual
- On 13 August 2004 the following text was included in the "Amsterdam" chapter in the operations manual: *"Ensure de-icing areas are not entered unless required. Careful tax route identification is required following landing on RWY 18R, or when taxiing to or depart on RWY 36L."*
- "Winterbrief 2004".
- Before the start of the winter season 2004-2005 Easyjet distributed a "Winterbrief" among the pilots which dealt with the various aspects of aircraft operations in the winter period. The subjects included: flight preparation, de-icing, taxiing, take-off, the flight and landing in wintry conditions.
- Compact disc "Winteroperations".
- The "Flight Safety" department issued a CD in which all aspects and dangers of flying under wintry conditions were dealt with in pictures and text.

Training

Each cockpit crewmember of Easyjet receives route training in which he is made familiar with the design of, and situations on an airport which is a destination of the company. In addition each crewmember takes part in a line check at regular intervals, in which he/she is assessed by an instructor during a flight to a destination. The familiarity with an airport forms part of the line check.

In accordance with JAR-OPS 1.943 (Initial Operator's Crew Resource Management (CRM) training) each cockpit crewmember of an airline company shall have completed an initial Crew Resource Management (CRM) training. According to JAR-OPS the purpose of the CRM training is: *"the improvement of the communication and management skills of the crew members concerned. The emphasis lies in the non-technical aspects of the functioning of the cockpit crew."*

During the initial training a large number of subjects are handled such as human errors, safety culture, coping with stress, dividing one's attention, making choices, communication and coordination in and outside the cockpit and leadership and group behaviour. A CRM refresher course must be completed every three years. At Easyjet during the refresher course special attention is given to the cultural differences between the various nationalities and relatively limited experience which some crews have. The latter is in connection with the large expansion which Easyjet has experienced in recent years.

In addition the crew's application of the CRM principles is assessed during the training courses and tests which the crewmembers follow and take.

From the training reports it appears that both pilots performed alternately above and considerably above standard during the various training courses and tests in which the CRM was also assessed.

Supervision

Easyjet is in the possession of a British Air Operators Certificate (AOC). The British aviation authority, Civil Aviation Authority (CAA), is the licensing authority responsible for the supervision of Easyjet. It appeared from the information of the CAA that they were unable to state what the result of inspections and audits had been. The CAA did state that in view of the fact that they had issued an AOC to Easyjet, it could be concluded that the Easyjet fulfilled the (aviation) requirements. The Dutch authorities limit the supervision of foreign aviation companies to the so-called SAFA inspections (Safety Assessment Foreign Aircraft). These inspections of foreign visiting companies is performed by the countries who are members of the European Civil Aviation Conference (ECAC). The inspections are directed at the mandatory safety requirements in the field of operation, technical aspects and the safety of passengers.

From the information of IVW it appeared that during the SAFA inspections which were carried out on the aircrafts of Easyjet, no nonconformities were observed which have a relation to this accident.

1.18 OTHER INFORMATION

Similar accidents

On 8 February 1999 a serious incident took place at AAS which was investigated by the then Dutch Transport Safety Board and of which a report²⁴ was published on 20 December 2001. The incident concerned a cargo aircraft that could not come to a standstill in time after landing in connection with the slipperiness on the landing runway and moreover came to a standstill in the mud at the end of the runway. The factors which influenced the origin of this incident, and which to a lesser or greater extent are similar to the present accident, were:

- Changing weather conditions with snow showers resulting in quickly changing conditions with regard to the braking action.
- The precipitation just before the moment of the landing led to the effect that the real frictional value for the northern part of the runway was even poorer than had been measured previous to that.
- A misunderstanding caused by the use of non-standard phrases in the radio communication.
- Inadequate weather information regarding the frictional value on the designated landing runway with the result that this runway was accepted by the captain.

The following recommendations were made in the report:

- Airport Schiphol, Air Traffic Control The Netherlands and The Royal Netherlands Meteorological Institute (KNMI) shall revise the existing procedures with regard to the use of the CCIS/ATIS system in order:
 - to eliminate as much as possible the influence of erroneous human action;
 - to investigate possibilities to be able to inform crews in good time also under rapidly changing conditions.
- Both the traffic control and the crews must use standard ICAO radio communication phrases.

As a result of this recommendation the LVNL changed the internal procedure in order to adapt the CCIS/ATIS. At the moment when the information about runway conditions arrives at the LVNL, this information is available within a few minutes for the traffic controllers who in turn can pass this on orally to the aircraft crews. The modification of the information to CCIS and ATIS will because of the actions take slightly longer but will on average be carried out within a quarter of an hour. The role of the KNMI, to input the data, is discontinued and taken over by the LVNL.

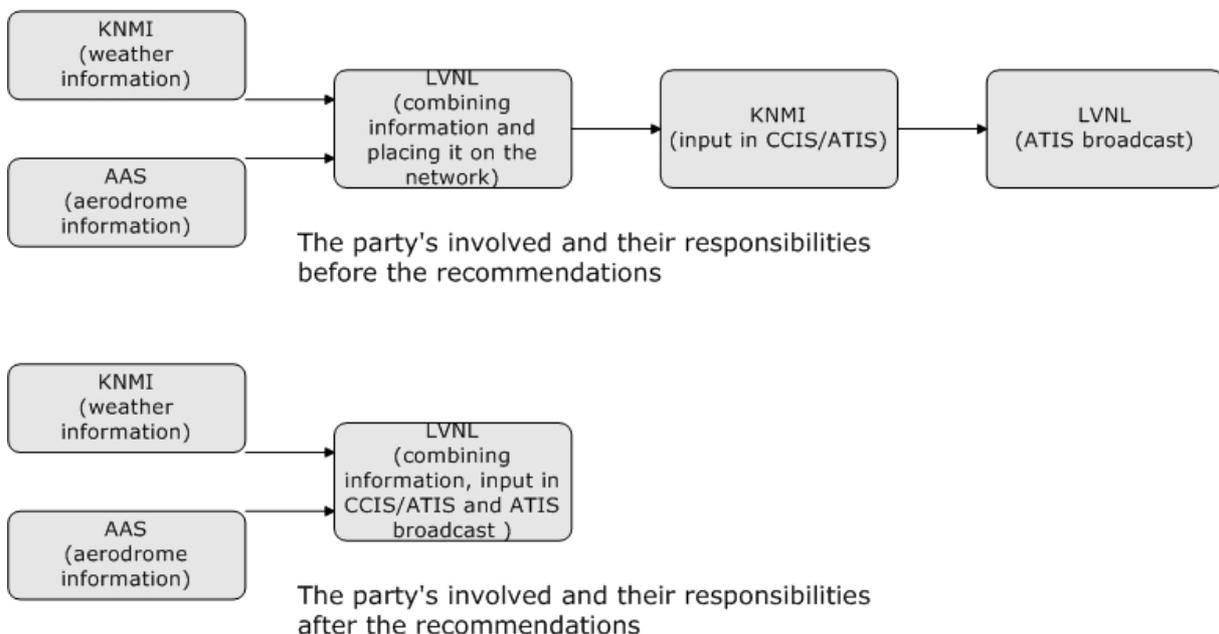


Figure 7: diagram representing the creation of the ATIS report

²⁴ Transport Safety Board report 1999011: "landing overrun with the EI AI Boeing 747, registration 4X-AXK, at Amsterdam Airport Schiphol on 8th February 1999."

Plots of ground radar

The LVNL made two plots of the ground radar on which the last part of the taxi route of the aircraft is visible. Among other things, the time in UTC and the ground speed of the aircraft are visible on these. The employee of the LVNL made an annotation to this that the time is reliable but the ground speed is not. It is visible on the plots that the aircraft taxied on taxiway V at 20:57:06 (UTC) with an indicated speed of 21.8 knots. At 20:58:22 the aircraft starts on the turn towards taxiway VS with which the indicated speed according to the ground radar has fallen to 5.2 knots. The last recording is at 20:58:54 with which the speed amounted to 3.2 knots according to the plot. The plots are enclosed with this report as Annex E.

1.19 NEW INVESTIGATION TECHNIQUES

The Tripod-Beta analysis method has been used in the investigation.

The Tripod theory has been developed to be able to explain and control the occurrence of human error. The Tripod method helps in a structured way to identify in sequence:

- What happened?
The events are identified in succession. There is a matter of a hazard (danger) and a target (object) in each event. The hazard is released energy which damages the target in the event. This hazard is controlled or managed by a control. The target is protected by a defence. Both a control and a defence form a barrier.
- How did this happen?
In order to be able to damage the target, the hazard has to be insufficiently controlled, or the target inadequately protected. This is possible when barriers are missing or have failed. In each trio of event - hazard - target the missing and/or failing barriers are identified.
- Why did this happen?
Barriers do not fail or are missing without reason. The reason why it was missing or failed is investigated per barrier. An active failure (direct cause) is a technical or human error which caused the barrier implemented by the organization to fail. The preconditions (context) which enlarged the chance of this error are then identified. In conclusion there is an investigation into which structural shortcomings in the organization are responsible for these preconditions.

2 ANALYSIS

The Tripod-analysis showed that a number of barriers that could have prevented the accident were broken through. Below you will find a chronological overview of the safety barriers that were broken through, per organization that was involved. The analysis provides an analysis of the "active failures" and "preconditions" per organization:

Airport:

- an adequate assessment of the development of the slipperiness
- timely start of preventative actions against slipperiness
- an adequate setting of priorities with regard to the actions against slipperiness
- an adequate performance of the actions against slipperiness
- timely upgrade to a higher state of readiness
- timely informing those concerned
- a good communication between fire brigade and crew
- an accurate determination of the braking action on the taxiways

Air traffic control:

- an adequate provision of information to the Easyjet crew
- a good monitoring of the Easyjet aircraft

Easyjet:

- a correct follow-up of the command issued by air traffic control
- an adjusted taxi speed in a curve
- a good application of crew resource management

2.1 THE AIRPORT

Development of the slipperiness and actions taken against it

In connection with the expected slipperiness at the airport the state of readiness "*gladheid klein*" applied as of 11:30 hours. From the moment that said state of readiness applied, there was no automatic (preventative) gritting or spraying. From the various reports it appears that the expected slipperiness was initially expected late in the evening and in the night and that this expectation was adjusted towards an earlier time in the beginning of the evening; at nightfall the temperature would very probably drop below zero. As there were regular consultations between the meteorologist and the Airside Operations Manager (AOM) and given the warning he received from the Royal Dutch Meteorological Institute (KNMI) between 17 hours and 17:30 hours, the airside operations manager (AOM) was aware of this development early on. He acknowledged the danger of possible slipperiness on the runways and taxiways, notably on wet concrete and at 1645 hours he took the decision to grit preventatively landside, in order to have more capacity in the event spraying airside would become necessary. This was the ordinary course of events at the Schiphol Airport.

When it appeared the slipperiness was developing fast and there was slipperiness both on airside and within the public area (landside) the decision was taken to continue with the existing state of readiness "*gladheid klein*", although it appeared from the reports that the extent of slipperiness was larger than the local slipperiness that corresponds to this state of readiness. The extent of this slipperiness was such that it fit the description "*gladheid groot*". After consultation between the AOM and the snow leader, though, it was decided not to upscale to this state of readiness, because he held the view that there was enough manpower on the premises to fight the slipperiness. It follows from the fact that it quickly turned out this was not the case that the development of the slipperiness was not assessed accurately.

Although the decision to grit preventatively landside was taken at 1645 hours, the actual gritting only started at 1830 hours. The reason for this delay has not become apparent. It is plausible that the request came in at the snow office after 1800 hours. The vehicles and the staff that were to carry out the actions against slipperiness were all set already and they had no interest whatsoever in waiting before carrying this out. Due to the lack of a recording or log system for the telephone lines that were used, it was not possible to verify how the communication took place exactly.

The statements made by the persons involved were the only thing to go on. It was established that, with the available staff, more means were deployed (seven vehicles) than according to the indication given by the regulation 'Sneeuw & Gladheidsbestrijding 2003-2004' in the event of the state of readiness "*gladheid klein*".

At around 1830 hours the first reports of slipperiness on airside came in. This made it necessary to fight the slipperiness at the airport preventatively and repressively, both airside and landside, with a relatively small team of seven vehicles. As five (gritting) vehicles carried salt in order to fight the slipperiness on roads both landside and airside, only two spraying vehicles were available to fight the slipperiness at the landing area. This problem would perhaps have been prevented if the preventative gritting on landside had started earlier, as was the initial intention (at 1645 hours instead of 1830 hours). This would also have been compliant with the S & G regulation, which stresses the importance of timely preventative gritting. Another option would have been to put a higher priority on fighting the slipperiness on airside at the moment the reports of slipperiness came in (1830 hours) by deploying more staff and more vehicles. Other vehicles would have to be used in that case (for spraying potassium acetate), but it appears from statements that these vehicles were ready.

Given the above, the Dutch Safety Board establishes that the implementation of the actions against slipperiness on landside started later than planned. Moreover, when the weather worsened and after slipperiness on airside reports came in (at 1830 hours), this did not lead to more staff and more means being deployed for fighting slipperiness on airside. The Dutch Safety Board concludes that the actions against slipperiness started too late, on both landside and airside.

Given the development of the slipperiness and the scope of the area, the available capacity was insufficient to treat the entire part of the runway system that was in use within an acceptable time span. That is why the AOM set priorities whereby he chose to spray taxiway V, but not VS, P6 and P7.

The assumption that air traffic control "*would not come there anyway*" turned out to be incorrect, this appeared to be the area beyond intersection V3. The AOM did not communicate this decision to air traffic control. Therefore, in principle, ATC was not aware of the impracticability of VS, P6 and P7. This is not in compliance with the Dutch civil aviation regulations (RTL), which states that the airport manager must promptly inform ATC of which part of the landing area can be used. It was also not possible to treat the aprons and roads for all the fire stations, although the Airport Fire Officer had indicated that these were slippery.

It also appears that no snow desk was convened and no SNOWTAM was issued, although the "snow and iciness control measures 2003-2004" ('Regeling S & G') prescribes this. Pursuant to this regulation the AOM, who has the final responsibility, can take decisions that deviate from said regulation, but only in the context of public order and safety. It has not appeared that there were circumstances on the basis of which one could deviate from the regulations on grounds of public order and safety. Because these actions did not take place, the individuals concerned were not correctly informed about the situation at the Schiphol airport.

The airside operations manager's actions

The airside operations manager is responsible, on the airport manager's behalf, for the operational matters at the landing area (airside) of Schiphol and for actions against snow and ice at Schiphol. Looking at the full picture, the actions against snow and ice could have been performed better. The level to which the slipperiness was going to develop was underestimated and the instruction to fight this slipperiness could have been given earlier. If the actions against slipperiness had started earlier, a large part of the slipperiness could have been prevented, given the duration of effectiveness of potassium acetate (KA) of eight hours. When it became apparent that the capacity that was present was not enough to fight the slipperiness it would have been appropriate to upgrade to the higher alert state 'Gladheid groot' in which 24 persons would have been available. It is striking that there is a substantial difference between the two states of readiness regarding the number of people to be brought into action, 7 compared to 24, Amsterdam Airport Schiphol (AAS) could consider adjusting the difference in this respect.

The Dutch Safety Board acknowledges that during this investigation it appeared that the AOM has large responsibilities and must take decisions without being able to consult other people at his level. It is true that he consults those concerned, such as in this case the snow leader or the air traffic service, but this is limited to an advisory level. The AOM takes the final decision. The 'Regeling S & G' provides the boundaries within which the actions against slipperiness can be carried out, but the AOM eventually decides which measures are to be taken. It is plausible that the AOM, because of the multitude of decisions and measures he had to take, lost track of the

situation to a certain extent. This would also explain why in some cases, such as the request to include the slipperiness on aprons and taxiways in the ATIS decisions took some time.

Provision of information

It is striking that there is a substantial difference in time between the slipperiness situation reported on by the AAS and the time this was included in the ATIS-information. The Aim's reporting indicates that at 18:30 hours there were already slippery spots on the taxiways and aprons, whereas the request to the ATC to include the warning in the CCIS and in the ATIS information was only made at 19:39 hours. Because initially the content of the warning was not included in its entirety in the message of 19:39 hours. "*All aprons slippery spots*", it was only at 20:14 hours that a warning came about "*All aprons and taxiways slippery spots*". It took about one hour and 45 minutes to make this information known to the airmen. The Dutch Safety Board deems this to be unacceptably long. If one finds that there are circumstances that can be a potential danger for aviation, all those concerned should be informed as soon as possible. It has not become clear why this warning was not passed on earlier.

As mentioned above, the ATIS report mentioned that the aprons and later the taxiways too, had slippery spots. Considering the route the Easyjet aircraft took, whilst sliding, at the location of the accident, and taking into account the statements from the crew about the controllability of the aircraft and the statements from the emergency services on site, it is clear that the warning that had been given about slippery spots on the taxiways and aprons was absolutely insufficient. In all probability the braking action on site could be qualified as "poor" at that time. The term "slippery spots" for all taxiways and aprons notably gave the wrong picture of the state of slipperiness of those parts of the taxiway system that had not (yet) been treated with anti-slipperiness means.

It appears from the above that AAS failed to adequately fulfil its role in the chain of provision of information. Both the time that had lapsed before the information was available on the ATIS and the inaccuracy of the contents of the ATIS notice show how vulnerable this chain is due to human actions (i.e. errors). The Dutch Safety Board also recommends an assessment of the non-ICAO term "slippery spots" by the AAS, in co-operation with other people concerned on the airport.

Measurement of the friction on the taxiways

The relevant ICAO publications (notably Appendix 14 and the Airport Services Manual part 2), the AAS business manual and the 'Regeling S & G' describe the way of measuring and reporting the friction on runways in detail. These documents provide very little information on the way in which braking action on taxiways and aprons has to be established, said documents do not provide clarity in this respect. As this has not been established, the indication of slipperiness on taxiways and aprons depends on the attentiveness of the users or of the AAS staff. The AOM can only take action to fight the slipperiness if required when the slipperiness has been established and the AOM has been informed of it. Moreover, the AAS manuals do not deal with what to do about taxiways that have become impracticable because of ice and/or snow. The manuals presume the taxiways are always available, unless they have been put out of use with regard to maintenance or failures. This, too, should be adapted.

After an investigation at other airports in the Netherlands it appeared that there too, there are no set procedures on the manner of measuring friction on taxiways and aprons. As in the meantime AAS has implemented a monitoring system enabling a structural measurement of the slipperiness on runways and taxiways it can be expected that in the future, possible slipperiness on these runways and taxiways can be anticipated more easily.

The Dutch Safety Board deems it unsatisfying that, at an international level (ICAO), no further rules have been laid down on the manner in which the braking action/friction of taxiways and aprons in airports should be established and on the frequency of the measurements of the braking action/friction. Therefore, the Board orders the Minister of Transport, Public Works and Water Management to lay down further rules at national level as regards the operational state of taxiways and aprons at airports and to promote the development thereof at an international level.

Actions against slipperiness routes fire brigade

After the alert had been given and the fire brigade turned out, it appeared that the turn out-route near one of the fire stations had not yet been scattered and was slippery therefore. This led to a delay when the fire engine drove off (without the maximum turnout time being exceeded). It appeared that in the past the fire brigade staff itself carried out the actions against slipperiness on the turnout routes but that this procedure was modified on operational grounds. It is currently a part of the regular actions against slipperiness, whereby the turnout routes have priority but are included in the actions against slipperiness on ring roads.

It can therefore happen that the turnout routes are not immediately scattered after a request from the AFO, as became apparent in this investigation.

The Dutch Safety Board deems this to be undesirable and holds the view that emergency service vehicles should be able to turn out as quickly as possible because their role can be crucial in the event of calamities. It is therefore desirable to review the procedures for actions against slipperiness on turnout routes in the 'Regeling S & G'.

Taxiway lighting

According to the statement made by the captain he based his decision to use the taxiway VS in part on the fact that the lighting thereof was on. The current system of taxiway lighting on AMS does not provide the possibility to indicate a taxiway route by means of lighting that is on and in which those taxiways that cannot or should not be used are not lighted; the taxiway guidance system. Said system is not prescribed by law.

Quality and safety management system

The investigation showed that the 'Regeling S & G' is assessed and, if need be adjusted, after each winter season but has not been subjected to internal audits. The Regulation was therefore only assessed by the department in question and not by individuals who are not involved in actions against snow and slipperiness. Therefore, the regulation did not comply with the quality guarantee as described in the airside safety management system: AVMS. The consequence is that the Regulation is not subjected to the periodical risk assessment and monitoring of safety objectives. Therefore, possible flaws could not be acknowledged correctly and timely. The Dutch Safety Board considers it important that this happens as soon as possible.

In the context of the AVMS the AAS started an investigation into the cause of the accident and made recommendations to prevent such an accident from happening again. Eight recommendations were made, out of which one, the mandatory driving direction on taxiway V and VS, has been implemented in the meantime. AAS has indicated that, in the meantime, three of the other recommendations have also been implemented.

When deciding to institute an alert state, the AOM had to rely on the data available to him at that point. It was the notice of "Ground West" to the AOM. The AOM had asked the traffic controllers who could see the aircraft for further details and he was told that there would be no people injured and that no slides were visible. Given the nature of these notices and given the fact that the captain had also not declared it to be an "emergency", the alert state the AOM used, i.e. "VOS 1", was sound at that moment. Neither did the subsequent provision of data or the observations by the AFO on site give cause to further upgrade this alert state.

The conclusion is that the state of readiness was correct on the basis of the applicable procedure and the situation at the time.

It arises from the interviews that the AFO and the aircraft crew felt restricted by not being able to communicate with one another directly. When the accident in question occurred the AOM was at the other side of the airport and the AFO reached the aircraft first. As it was possible to communicate through the cockpit window, the AFO and the captain could consult each other about which measures should be taken. Because, in such cases, it could be advisable for the AFO to be able to communicate directly with the crew of an aircraft through the aviation radio, the Dutch Safety Board considers it desirable that AAS looks into the possibilities of adjusting the regulations in this respect. The AFO's vehicle is already equipped with the devices required, it is therefore merely a matter of adapting the procedures.

Certification

After an investigation conducted by IVW-DL, the Minister of Transport, Public Works and Water Management gave a certification to the airport in the context of the RCL (*Regulation for certification of airports*) mid-2004. This shows that AAS has been built, set up and equipped according to the applicable rules and that all this is sufficiently guaranteed by the safety management system. The three findings and matters for improvement (the AVMS is not yet rooted in the organization; the adequate operation of the security system is not yet evident and it is not evident either that the RCL is covered by the audit programme) were related to the draft audit programme. An internal audit programme must be carried out at least once a year **after** an airport has received a certificate. These items for improvement, therefore, had no relation with the accident.

2.2 THE AIR TRAFFIC CONTROL

The air traffic controllers

It shows from the interviews that the traffic controllers were surprised when it turned out that the taxiway VS and de-icing area P6 were slippery, they had assumed they had been sprayed as they had seen that the sprinkler had been driving there. Because of the slipperiness, VS and P6 were actually impracticable. In accordance with the 'Regeling Toezicht Luchtvaart' [*part of the Dutch aviation regulation*] this should have been reported to the air traffic service, on the airport manager's behalf. However, this did not happen. As Checker 1 had reported the slipperiness, the air traffic controllers of Ground West knew about it. They also knew that the AOM was aware of it. The use of this part of airside was not suspended by the air traffic control service till AAS had taken measures, as prescribed by the guidelines of section 7.4.4. of ICAO document 4444.

Although Checker 1 reported that something was being done about the slipperiness, it was still slippery on VS and P6 when EZY5112 contacted 'Ground West'. That was the reason that the controller gave the positive instruction to EZY5112 to taxi via taxiway V. When doing so, he did not indicate that the current state of taxiway VS did not match the ATIS information (which is also known to traffic controllers) and that VS and P6 were so slippery that they could not be used. It could have been recognized that the use of VS and P6 could have led to dangerous situations and should have been prevented in any event. On the one hand, the air traffic controller had given the instruction to follow taxiway V, and he was entitled to assume that the crew would comply with this instruction, on the other hand, the situation was so dangerous that extra vigilance would have been appropriate. This is all the more true as it was common practice not to give a positive instruction and as, under ordinary circumstances, aircrafts were allowed to use both taxiway V and VS. The fact that the air traffic controllers also state they did not observe the aircraft permanently also leads to the conclusion that the situation was underestimated. It appears from the radio communication that, apart from EZY5112, there was one other aircraft in the Ground West area. It follows, therefore, that the work pressure of the air traffic controllers was not excessively high at that moment. Though air traffic control performed its task and was entitled to assume its instruction would be followed up, the Dutch Safety Board holds the view that the slipperiness on VS and P6 could have been reported more explicitly to the crew of EZY5112.

Pursuant to the applicable procedures for air traffic control, such as the ICAO set in Annex 10 and in Document 4444, standard phraseology must be used as much as possible and instructions must be given in a positive, brief and concise manner. This did not happen in the case at hand as regards standard phrases and conciseness. The instruction "...continue taxiway V and V3 is available if you like", has been understood correctly, given the confirmation from the crew. Nonetheless, the Dutch Safety Board holds the view that the extra "if you like" in the last part of the sentence entails a risk of misunderstandings. Although it pertains to the use of V3, it is possible that the aircraft crew, if it did not pay close enough attention, understands it as pertaining to the use of V as taxiway. This risk is undesirable.

The Dutch Safety Board, however, realizes that in the daily practice of air traffic control the terms prescribed by ICAO are not used all the time, without this leading to lack of clarity or dangerous situations.

The taxi route

It appeared from the statements made by the air traffic controllers and the crew that the clearance to taxi to runway 36L by means of taxiway V was not usual. There was no standard taxi route and it was usually left up to the crews by means of which taxi route they wanted to taxi to runway 36L. This is possible because usually at this location there was traffic that taxied in one direction, without there being any oncoming traffic. This behaviour from ATC is not consistent with the regulations in the VDV [*Regulations for air traffic services*] that prescribe a positive command for the use of a certain taxiway. In the case at hand, however, the controller acted in accordance with these regulations. The clearance from the traffic controller is no longer necessary because, as of 23 December 2004, a mandatory driving direction to and from runway 36L/18R has been set.

Provision of information

It appears from the investigation that the LVNL, in the chain of provision of information pertaining to the CCIS/ATIS-system, carried out its task properly. Due to the changes made as a result of the recommendations from the investigation report regarding the serious incident at Schiphol on 8 February 1999, the information, once it was known to the LVNL, was available on the ATIS within a short time (11 minutes). The fact that an incomplete notice was entered in the first instance, however, shows that the system is still vulnerable to human error.

ATC has no influence on the part of the chain before the notice is given to the LVNL. As mentioned before, the verbal provision of information by the air traffic controllers to the crew of EZY5112 was insufficient.

The internal investigation

The Dutch Safety Board is surprised that, after the internal investigation, the LVNL reached the conclusion that the accident was only caused because the crew of the aircraft did not comply with the taxi clearance. It is true that this was an important factor for the accident, but as described above, the LVNL has also played a role. The report does not mention anything on the general practice not to give a positive instruction for taxiway V or VS, as stated in the VDV, but to leave this up to the aircraft crew. There is also no mention whatsoever about the method of communication of traffic control and about the fact that the traffic controllers have not observed that the aircraft followed another route than the one that it had been ordered to follow. The Dutch Safety Board does not share the LVNL's view that there are no lessons to learn or matters to improve with regard to the LVNL.

2.3 EASYJET

General

The crew was licensed and had enough experience to carry out the flight with the aircraft. Both members of the crew had been to AMS and had been on various flights together. The legal working and rest periods had been complied with.

The aircraft had a valid certificate of airworthiness and the maintenance documents were sound. The weight and the centre of gravity of the aircraft were within the limits. There are no indications that the cause of the accident was a technical defect.

Familiarity with the weather conditions at Schiphol

Before take off of the flight to AMS the crew had been informed of the weather conditions at AMS by means of the meteo-information they received on LGW. They had also, before the landing at AMS, received the ATIS-notice that was valid at that time. This notice contained the warning "*all taxiways and aprons slippery spots*". The ATIS-information that was sent before the departure of EZY5112 was unaltered with respect to this part of the content in the 30 minutes of turnaround time.

The pilot non-flying (PNF), who took care of the communication, listened to the ATIS-information November before the start, whereas the ATIS-information Oscar applied at the moment the engines were started. In the radio contact the PNF had with ATC, it was mentioned twice that the information Oscar was applicable. The PNF did not listen to the ATIS again to check whether the content was still the same. He was therefore not aware of the most current ATIS-information. In this case this had no consequences because the content of the notice had not changed. In spite of the fact that the PNF did not discuss the content of the ATIS with the pilot flying (PF) both crew members were aware of the weather conditions such as they were at AMS according to the information available, including slippery spots on the taxiways and aprons. This is confirmed by the fact that the captain decided to adjust the taxi speed and to taxi carefully. Both members of the crew indicated that they interpreted the description of the slipperiness as local, small slippery spots. Although the term slippery spots has been in use at AMS in ATIS information for a long time already, it has become apparent that this is not an official ICAO term and that no definition of this term is known. The meaning of this term must therefore be derived from common parlance, in which the English word "spots" is translated by the Dutch word "plekken", and it is in this manner that the crew understood the term.

The possibility of ice formation on the fuselage and the wings was discussed and the anti-ice system of the engines and wings was switched on as described in the manuals for "cold weather operations". All this indicates that the crew was aware of the weather conditions at AMS and took the possibility of ice formation and local slipperiness into account. At that moment, however, they had no indication whatsoever that virtually the entire platform P6 was covered with ice, and had become impracticable because of it. Had they known this, they would not have chosen to taxi via P6. Because of the unfamiliarity with this slipperiness one of the barriers that could have prevented the accident disappeared.

The taxi speed

The crew indicated that it was not in hurry because the turnaround time was shorter than planned. The pilots indicated their taxi speed had been slow because of the possible slipperiness. The taxi speeds have been recorded on the FDR and the ground radar. A significant difference between

these two values has been noted. The speeds on the plot of the ground radar are not taken into consideration, given the unreliability.

It appears from analysis of the data of the last part of the taxi route that the highest measured speed of 22 knots was reached on the first part of the long, straight taxiway V. A taxi speed of 22 knots on the straight part of taxiway V corresponds to a speed of around 20 knots, deemed normal according to the Boeing 737 training manual. It is true that on long, straight lengths, such as the largest part of taxiway V, a taxi speed of 30 knots is deemed acceptable, but this applies to good circumstances, which were not present in this case.

It arises from the comparison between the time on the plot of the ground radar and the velocity data from the FDR that the turn to VS was taken with a speed of 15,5 knots. This speed is above the speed of around 10 knots recommended according to manuals when taking a turn on a dry surface and is not a 'speed adjusted to circumstances', as described by the manuals. Looking at the whole picture, one can conclude that, although the crew states its taxi speed was moderate, it did not (fully) comply with the Easyjet procedures concerning taxi speed on possibly slippery taxiways. The possibility exists that the long time required to taxi from Schiphol-Centrum to runway 36L invited the crew to use a higher taxi speed, particularly because for a large part the taxiways are straight and long. It is also known that AMS authorities that aircrafts that taxi to or from runway 18R/36L generally drive at a high speed.

Given the fact that the taxiway VS was very slippery, the Dutch Safety Board holds the view that the speed played a secondary role with regard to the accident; had the aircraft taken the turn at a lower speed, it would probably also have slid.

The choice of VS as taxiway

The PF followed the first part of the taxi route he had been instructed to follow to runway 36L. After the PNF had reported to ATC "Ground West", he was given the clearance to taxi by means of taxiway V to intersection V3 of runway 36L. The PNF confirmed this command. The command and the confirmation thereof from the PNF can be heard clearly on the three channels of the CVR. After the accident, the members of the crew also stated that they had heard the clearance. Both crewmembers were therefore aware of the command from the traffic controller. This clearance was given when the aircraft approached point VM. After that, it took about two minutes before the aircraft reached the bifurcation of taxiway V with taxiway VS. During a large part of the taxiing the crewmembers discussed various matters unrelated to the flight. The PF stated he had heard the command but had not realized that it was a positive order. This might have been caused because of the casual talk and his earlier experiences at AMS, because of which he had come to expect that it did not matter whether he taxied to runway 36L via taxiway V or via VS. He considered the fact that the taxiway lighting system was on for both V and VS as an indication that it was possible and permitted to use both taxiways. This approach is confirmed because of the fact that on the CVR recording one can hear the PF check the availability of the route at the beginning of taxiway V and confirm this with the term "greens all the way", which apparently pertains to the taxiway lighting that was on. In this respect, he has not sufficiently taken into account the fact that AMS, as applies to other airports too, does not indicate the availability of taxiways by means of switching the taxiway lighting on or off. Although this is not indicated on the aerodrome charts Easyjet uses, the PF could have known this, on the basis of his experience at AMS and his route training.

The combination of circumstances, i.e.: previous experiences in which the route to be followed was left at the discretion of the crew; the illumination of the taxiway lighting at both taxiway V and VS and the illumination of the lighting at the de-icing aprons; the lack of a clear warning by the air traffic controller that taxiway VS could not be used in connection with the slipperiness; the diminished focus because of casual conversations and the consideration that using taxiway VS meant taking less steep turns explain why the PF chose to taxi via taxiway VS.

It is also clear that all these circumstances can never be an argument to disregard a clearance from a traffic controller, such as the one given in this case, and not to follow it up. In this case the PF could have asked the air traffic controller for permission to use taxiway VS. The controller, in turn, could have provided information on the slipperiness of that taxiway in that case. It is obvious that not following up the clearance of the traffic controller removed one of the barriers that could have prevented the accident.

Crew resource management

As regards the choice of taxi route, it is striking that the PF does not discuss his choice for the route via VS and that the PNF in turn does not point out to the PF that the command was given to taxi to taxiway 36L via taxiway V. It also appears from other events, such as not listening to the most recent ATIS information and not discussing the content of the ATIS information, as well as

from the casual conversation unrelated to the flight, that the crew did not pay enough attention to all aspects of the work during this part of the flight.

Although it appears from information that the crew of EZY5112 took the mandatory Crew Resource Management (CRM) program, which covers among other issues improvement of skills in the field of focused attention, assignment of tasks and communication of aircraft crews, it can be concluded that the assignment of tasks and communication between the two crew members was not optimal. This eventually led to the last barrier in the chain to be broken through when the choice was made to take another taxiway route without consultation.

After the collision

The Dutch Safety Board holds the view that the accident held a great risk of fire for the occupants, given the fuel in the fuel tank in the wing, the risk of ignition of sparks as a consequence of the collision with the lamppost and the engine that was hot (and had been switched off).

The crew decided to switch off the engines when it became apparent that a collision with the lamppost was inevitable. This was a good decision because the risk of fire and therefore the risk for the passengers was reduced. A disadvantage caused by the engines being switched off is that the flight recorders both stopped recording data. In the meantime it has become apparent that ICAO has acknowledged this problem. A study is being done to provide the system of measuring and recording data by the CVR and FDR with its own emergency power supply. In this way, the absence of such data can be prevented in the future.

After the collision, the crew decided not to evacuate the passengers immediately after the accident but to have them remain in the aircraft until the slipperiness on the apron was counteracted. Given the circumstances of that moment the Dutch Safety Board considers this decision to be sound. Indeed, there was no panic and no imminent risk of fire. Therefore, the greatest risk for the passengers would have been to slip on the platform if they had left the aircraft immediately. After the slipperiness had been counteracted, they were able to use the platform without danger and were able to step into the busses that were ready for them.

The reconstruction of the collision

It appeared from the reconstruction that was carried out on the basis of marks, statements and damage, that the G-EZJM slid laterally in a forward movement to the left side of the apron because the apron runs downhill to the left. After that, the left wing touched the lamppost, after which the front side of the aircraft turned left as a reaction, and the wing came loose from the lamppost whilst the aircraft was still moving forward. At the moment the nose wheel ended up in the grass, the rolling movement of the nose wheel stopped and the nose wheel rolled straight ahead. Because the main gear with the wheels continued sliding, this caused a reaction whereby this main gear slid to the right and slipped. The motion stopped when the main wheels came to a standstill against the electricity pits.

The organization

Easyjet has a quality system that has been approved by the British authorities. One can therefore assume that the system meets the JAR-OPS requirements. Having audits carried out is part of Easyjet's quality system. The audits Easyjet carried out at AMS, however, pertained to a number of subjects, not including actions against snow and slipperiness at AMS. Possible flaws in the procedures could therefore not become apparent during an audit.

The safety management system, which is a part of the quality system, meets the JAR-OPS requirements. The parts of the main processes safety training, communication and the risk assessment procedure concern processes that have to diminish the risk of an accident or incident. The two other parts, monitoring performance, review and incident/accident reporting and incident and accident investigation pertain to procedures after an incident or accident. It can be concluded that the three processes mentioned first were not able to indicate the risk of such a case or were not able to indicate it in a sufficient manner. Easyjet has done enough with regard to the two last processes mentioned by taking the measures mentioned above (adjusting the Operations Manual and distributing documentation on operations in the winter time).

2.4 SIMILARITY WITH OTHER ACCIDENTS

It appeared from the investigation report drafted with reference to the serious incident at AAS in 1999 that the entire chain of provision of information to aircraft crews was vulnerable to errors due to human actions. With regard to that accident the stress was on the failure at the end of the chain, at the point where the information was made available to the aircraft crews (See chapter

1.18). Due to the changes made to the process at LVNL this part of the provision of information is satisfactory. With regard to the accident with Easyjet, on the other hand, the bottleneck was at the beginning of the chain, where the information is gathered and transmitted to the LVNL in order for it to be included in the CCIS/ATIS system. This information was incomplete and it took a long time before it was available to aircraft crews. In both cases the exchange of information in its entirety did not work well enough. This was caused by human actions when passing on information, the so-called interfaces. Therefore, it is important that all those concerned make the risk of errors in the chain of provision of information, specifically with respect to interfaces, as small as possible.

3 CONCLUSIONS

3.1 FINDINGS

Amsterdam Airport Schiphol

- As of 11:30 hours the state of readiness "*gladheid klein*" was applicable at Schiphol airport. No actual actions against slipperiness were taken at that point.
- On the basis of the initial weather and slipperiness forecast, which was adjusted afterwards, the state of readiness that was in force "*gladheid klein*" was maintained.
- At 16:45 hours the AOM took the decision to first scatter preventatively landside of the area. This was actually started at 1830 hours. At that time the first notices of slipperiness on airside came in.
- With the available staff, more means were deployed than are indicated in the event of the state of readiness "*gladheid klein*" according to the "snow and iciness control measures 2003-2004" (seven vehicles instead of four for airside and landside together).
- The "snow and iciness control measures 2003-2004" provides that, in the event of (the danger of) slipperiness, preventative gritting/spraying is mandatory, whereby the preventative gritting/spraying must be started in time.
- The choice was made to, next to the preventative scattering landside, to scatter correctively airside, with limited manpower. With regard to the taxiways this was started at 1840 hours. The choice was not made to eventually deploy more staff and means for fighting slipperiness on airside.
- The actions against slipperiness were started too late both on landside and airside.
- The deployment of three vehicles for fighting slipperiness on airside (out of which one could only be used for the roads) was insufficient to treat the part of the taxiway system that was in use within an acceptable time span. Therefore, priorities had to be set, whereby not all the taxiways, aprons and roads could be treated on airside.
- Corrective spraying was done on various aprons, also on the outbound taxi route to the taxiway36L which was in use and on taxiway V till V3.
- Taxiway VS and the de-icing area's P6 and P7 were not sprayed. The LVNL was not informed of this.
- The lighting of the area of both taxi routes as well as the apron lighting of P6 and P7 was on. The de-icing aprons were not in use as such.
- After the first report of slipperiness on airside it took over an hour before the request was made to LVNL to include the slipperiness in the ATIS report. Because, at first, the wrong content was transmitted, it took
- About one hour and 45 minutes in all before the slipperiness on the taxiways and aprons were (accurately) included in the ATIS report.
- The qualification "slippery spots" did not match the current status of the taxiway VS and the aprons P6 and P7.
- There is a lack of clarity about the application and the meaning of the term 'slippery spots'.
- No SNOWTAM was issued and no snow desk was convened.
- Because the turn-out routes of the fire brigade do not have the highest priority but are scattered simultaneously with the ring-roads, one of the turn-out routes had not been scattered when the fire engines had to turn out.
- Given the expectation and the development of the slipperiness and given the measures that were taken, it is observed that the seriousness of the situation was underestimated. The 'regeling Sneeuw & Gladheidsbestrijding 2003-2004' stresses the importance of timely preventative spraying; this has not happened in a sufficient manner. The spraying was mostly corrective.
- AAS did not fulfil its role in passing on information in the chain of provision of information in a sufficient manner.
- After the accident the AOM, on the basis of the data provided to him, instituted the alert state VOS I. Given the nature and scope of the accident, setting this alert state is deemed to be sufficient.
- In the AIP Netherlands, which was applicable at the time of the accident, two taxi routes are mentioned for outbound traffic to runway 36L, one via taxiway V, and one via VS, across P6 and P7.
- The airport is not equipped with a taxiway guidance system.
- AAS is an airport with certification, pursuant to the applicable legislation and regulations.

- The organization and implementation of the actions against snow and slipperiness have been elaborated in detail and set forth in the 'regeling Sneeuw & Gladheidsbestrijding 2003 – 2004'.
- After each winter season, the 'regeling Sneeuw & Gladheidsbestrijding 2003-2004' is assessed and adjusted if necessary. This regulation was a part of the Airside Aerodrome Manual and was therefore subjected to the internal audit. However, said audit did not take place. Both in the relevant ICAO publications and in the AAS manuals, the manner of measuring the braking action/friction and the actions against slipperiness on taxiways and aprons are mentioned in a very concise manner. The same applies to the other airports in the Netherlands. The braking action/friction is not clearly mentioned.
- The AAS manuals do not mention taxiways that are impracticable because of snow or slipperiness.
- There is a large difference in manpower between the alert states 'slipperiness large' and 'slipperiness small'.
- Currently there is no procedure in which radio contact is possible between the cockpit and the AFO.
- A number of essential fixed and mobile telephone connections are not logged.

Air traffic control

- Air traffic control had not been officially informed of the slipperiness on VS, P6 and P7.
- The air traffic controllers of Ground West came to know about the slipperiness on VS and P6 after they had seen the car of the airport "Checker 1" drive there and had communicated with the driver.
- The use of VS, P6 and P7 was not suspended by the air traffic control service until AAS had taken action, as described in the ICAO guidelines, document 4444.
- Because the air traffic controller was aware of the extent of slipperiness on VS, P6 and P7, he gave the crew the clearance to taxi via V. In doing so, he did not warn them about the slipperiness on VS.
- It was common practice that the crew of aircrafts was free to choose whether to taxi to way 36L via V or VS. This is not in accordance with the VDV regulations.
- Because the air traffic controllers did not continuously watch EZY5112 closely, they could not warn the crew about the slipperiness when the aircraft drove up the junction to taxiway VS.
- After the Aim's request came in, it took over half an hour before the slipperiness on taxiways and platforms had been correctly included in the ATIS report.
- The investigation report from LVNL is not critical enough towards the functioning of its own organization.

Easyjet

- The crew was licensed to carry out the flight.
- The aircraft had a valid certificate of airworthiness and was well maintained.
- The weight and gravity centre of the aircraft were within the limits.
- There are no indications that the cause of the accident was a technical defect.
- At the beginning of the flight the crew did not listen to the most recent ATIS information. Nonetheless, the crew was aware of the weather conditions on AMS as they had been made known.
- The crew was unfamiliar with the term "slippery spots", but interpreted the term according to ordinary language use.
- Taxiway VS and the aprons P6 and P7 had become impracticable because of slipperiness and ice formation. The crew could not be aware of this slipperiness.
- With regard to the taxi speed the PF did not fully comply with the Easyjet regulations. This taxi speed played a secondary role as far as the accident is concerned.
- The PF did not follow up the clearance from traffic control and decided to take another route than the one that had been instructed. The PF based his decision among other things on his previous experiences at AMS and on the fact that the taxiway lighting was on.
- The crew members have not communicated with one another about the decision to take another route than the one that had been instructed.
- The division of tasks and the communication between the two members of the crew was not optimal and not in accordance with the Crew Resource Management concept.
- The aircraft became unmanageable when it taxied on the taxiway VS and apron P6.
- Due to the collision with the lamppost the left wing of the aircraft was seriously damaged.
- The crew acted adequately by keeping the passengers in the aircraft until the slipperiness on VS and P6 had been remedied.
- Easyjet's quality system and safety management system were unable to acknowledge the risk of such an accident.

- After the accident Easyjet took measures in order to prevent such an accident from happening again.

3.2 CAUSES

The accident was caused because the pilot, because of slipperiness, was unable to control the aircraft during the taxiing, causing a collision between the left wing of the aircraft and a lamppost.

The causal factors were:

- The actions against slipperiness were not optimal.
- The slipperiness situation at VS, P6 and P7 was not in accordance with the information the crew had.
- The circumstances and the habit to leave the choice up to the aircraft crews did not exclude the use of taxiway VS.
- The AOM and the air traffic controllers were insufficiently conscious of the slipperiness situation and the potential danger it entailed.
- The taxi command given by air traffic control was not followed up by the pilot flying.
- The crew did not make sufficient use of the skills crew resource management offers.

The underlying factors were:

- The 'regeling Sneeuw –en Gladheidsbestrijding 2003-2004' is not sufficiently guaranteed in the safety management system of Amsterdam Airport-Schiphol.
- Neither the business manual nor the 'regeling Sneeuw- en Gladheidsbestrijding 2003 – 2004' provide an adequate method for measuring the braking action/friction and for fighting slipperiness on taxiways and aprons.
- Easyjet's quality system was not able to acknowledge the risk of such an accident.
- The chain of collection of information and the actions and provision of information to third parties stemming from that holds great risks of human failure.

4 RECOMMENDATIONS

- 4.1 All parties at Amsterdam Airport Schiphol, who are responsible for the system of provision of information to airmen, should give a more adequate substance to their (joint) responsibility as regards diminishing the risks involved in the reporting of information. In this respect, the use of the non-ICAO term 'slippery spots' needs to be assessed.
- 4.2 It is recommended to Amsterdam Airport Schiphol to assess the functioning of the business manual and the underlying regulations, such as the "snow and iciness control measures 2003-2004" and remedies the flaws therein.
- 4.3 It is recommended to Air Traffic Control the Netherlands to give more adequate substance to the task of air traffic controllers in special circumstances, such as in the event of slipperiness.
- 4.4 It is recommended to Easyjet to include the flaws pertaining to the crew resource management in its training courses and to take appropriate action to prevent this in future.
- 4.5 It is recommended to the Minister of Transport, Public Works and Water Management to encourage further rules to be set, both at national and international level, as regards the operational state of taxiways and aprons at airports.

The bodies or individuals towards which a recommendation has been issued must take a stance regarding the follow-up of this recommendation within a year of publication of this report to the Minister of Transport, Public Works and Water Management. A copy of this reaction must simultaneously be sent to the Chairman of the Dutch Safety Board.

Referentie : CQS/Inc.Inv. 19879
 Versie : 1.0
 Dossierverwijzing : 2003-12-22 EZY5114
 Audioband- & arrestnummer(s) : 325/543
 Frequenties & werkposities : Departure ATIS

RECORDERVERSLAG

Atis

Tijd (UTC):	Tussen:	Inhoud:	Tijd (UTC):	Tussen:	Inhoud:
18:30:02	Atis/dep	This is Schiphol departure information papa Main departure runway 36L secondary departure runway 36C main landing runway 06 independent parallel departure is in progress 270 degrees five knots secondary 250 degrees three knots visibility one zero kilometres few two thousand two hundred feet sct four thousand two hundred feet temperature zero dewpoint minus one qnh 1025 hectopascal acknowledge information Oscar at first contact			
18:49:58	Atis/dep	This is schiphol departure information Quebec Main departure runway 36L secondary departure runway 36C Main landing runway 06 All aprons slippery spots Independent parallel departure is in progress 270 degrees five knots			

Atis

Tijd (UTC):	Tussen:	Inhoud:	Tijd (UTC):	Tussen:	Inhoud:
		secondary 250 degrees three knots visibility one zero kilometres few two thousand two hundred feet sct four thousand two hundred feet temperature zero dewpoint minus one qnh 1025 hectopascal acknowledge information Quebec at first contact			
18:54:13	Atis/dep	This is schiphol departure information Romeo Main departure runway 36L secondary departure runway 36C Main landing runway 06 All aprons slippery spots Independent parallel departure is in progress 250 degrees one knots secondary 250 degrees three knots visibility one zero kilometres few two thousand two hundred feet cumulus nimbus sct three thousand five hundred feet temperature minus zero dewpoint minus one qnh 1025 hectopascal acknowledge information Romeo at first contact			
19:09:05	Atis/dep	This is schiphol departure information Sierra Main departure runway 36L secondary departure runway 36C Main landing runway 06 All aprons slippery spots Independent parallel departure is in progress 020 degrees four knots variable between 010 degrees and 14 0degrees secondary 340 degrees one knots visibility seven kilometres light showers with snow few 1800 feet cumulus nimbus bkn 3500 feet			

Atis

Tijd (UTC):	Tussen:	Inhoud:	Tijd (UTC):	Tussen:	Inhoud:
		temperature minus zero dew point minus one qnh 1025 hectopascal acknowledge information Sierra at first contact			
19:14:02	Atis/dep	This is schiphol departure information Tango Main departure runway 36L secondary departure runway 36C Main landing runway 06 All taxiways and aprons slippery spots Independent parallel departure is in progress 020 degrees four knots variable between 010 degrees and 140 degrees secondary 340 degrees one knots visibility seven kilometres light showers with snow few 1800 feet cumulus nimbus bkn 3500 feet temperature minus zero dew point minus one qnh 1025 hectopascal acknowledge information Tango at first contact			
1923:06	Atis/dep	This is Schiphol departure information Uniform Main departure runway 36L secondary departure runway 36C Main landing runway 06 All taxiways and aprons slippery spots Independent parallel departure is in progress 020 degrees four knots variable between 010 degrees and 140 degrees secondary 340 degrees one knots visibility seven kilometres light showers with snow few 1800 feet cumulus nimbus bkn 3500 feet temperature minus zero dew point minus one			

Atis

Tijd (UTC):	Tussen:	Inhoud:	Tijd (UTC):	Tussen:	Inhoud:
		few 800feet few 2200 feet cumulus nimbus temperature one dewpoint minus zero qnh 1026 hectopascal acknowledge information Zulu at first contact			
19:54:46	Atis/dep	This is Schiphol departure information November Main departure runway 36L Main landing runway 06 All taxiways and aprons slippery spots 260 degrees three knots visibility one zero kilometres few 3000 feet temperature minus zero dewpoint minus one qnh 1026 hectopascal acknowledge information November at first contact			
20:27:46	Atis/dep	This is Schiphol departure information Oscar Main departure runway 36L Main landing runway 06 All taxiways and aprons slippery spots 220 degrees four knots visibility one zero kilometres no significant clouds temperature minus one dewpoint minus two qnh 1026 hectopascal acknowledge information Oscar at first contact			
20:52:55	Atis/dep	This is Schiphol departure information Papa Main departure runway 36L Main landing runway 06 All taxiways and aprons slippery spots 220 degrees six knots visibility one zero kilometres			



Reference : CQS/Inc.Inv. 19875

Version : 1.0

Filereference : 2003-12-22 EZY5112

Tape- & arrestnumber(s) : 322/541

Frequencies & working positions : 121.975MHz, SPL delivery/start up control combined HT

TAPE TRANSCRIPT

Del = Delivery/SUC EZY = EZY5112

Time (UTC):	Between:	Contents:	Time (UTC):	Between:	Contents:
-------------	----------	-----------	-------------	----------	-----------

20:28:42	EZY-Del	Delivery hello EZY5112 and we like to have our clearance for London Gatwick please			
20:28:48	Del-EZY	EZY5112 information is Oscar the clearance London Gatwick Refso one victor departure runway 36 left squawk 7330			
20:28:58	EZY-Del	Runway 36 left Refso one victor with the squawk 7330 EZY5112 and we are on delta four			
20:29:05	Del-EZY	EZY5112 Readback correct you are fully ready sir			
20:29:08	EZY-Del	Negative			
20:29:09	Del-EZY	Roger report fully ready			
20:29:11	EZY-Del	Roger			
20:39:45	EZY-Del	Clearance hello EZY5112 on delta four now fully ready request to start			
20:39:52	Del-EZY	EZY5112 startup approved information oscar contact			

Del = Delivery/SUC

EZY = EZY5112

Time
(UTC):

Between:

Contents:

Time
(UTC):

Between:

Contents:

		ground 121.7			
20:39:58	Del-EZY	Startup approved and 121.7 EZY5112 Good evening			



Reference : CQS/Inc.Inv. 19876
 Version : 1.0
 Filereference : 2003-12-22 EZY5112
 Tape- & arrestnumber(s) : 322/541
 Frequencies & working positions : 121.8 MHz, SPL groundcontrol noord HT

TAPE TRANSCRIPT

GND = groundcontrol EZY = EZY5112

Time (UTC):	Between:	Contents:	Time (UTC):	Between:	Contents:
20:40:09	EZY - GND	Ground good evening EZY5112 requesting push from D4			
20:40:22	GND-EZY	EZY5112 push back is approved			
20:40:26	EZY-GND	Push approved EZY5112			
20:43:42	EZY-GND	EZY5112 for taxi please			
20:44:06	EZY-GND	Ground EZY5112 for taxi please			
20:44:10	GND-EZY	EZY5112 taxi runway 36L leave via alfa 8 pick up bravo north			
20:44:17	EZY-GND	36L alfa 8 bravo north EZY5112			
20:45:01	GND-EZY	EZY5112 to leave via alfa 6 please and than bravo taxitrack			
20:45:06	EZY-GND	Alfa 6 EZY5112			
20:50:14	GND-EZY	EZY5112 to cross 18C at W3, when vacated contact			

GND = groundcontrol EZY = EZY5112

Time (UTC):	Between:	Contents:	Time (UTC):	Between:	Contents:
-------------	----------	-----------	-------------	----------	-----------

		121.9			
20:50:21	EZY-GND	Cross W3 121.9 EZY5112			



Reference : CQS/Inc.Inv. 19877
 Version : 1.0
 Filereference : 2003-12-22 EZY5112
 Tape- & arrestnumber(s) : 325/543
 Frequencies & working positions : 121.9 MHz groundcontrol toren west combined HT

TAPE TRANSCRIPT

GND = ground TWR west EZY = EZY5112

Time (UTC):	Between:	Contents:	Time (UTC):	Between:	Contents:
20:55:58	EZY-GND	Ground good evening EZY5112 approaching VM			
20:56:02	GND-EZY	Good evening EZY5112 continue taxiway V and V3 is available if you like			
20:56:09	EZY-GND	V for V3 is fine thanks EZY5112			
20:56:11	GND-EZY	roger			
20:59:00	GND-EZT	Firebrigade is on the way			
20:59:05		Clicking of mike			
20:59:06	EZY-GND	EZY5112 emergency services to the aircraft please, we ehh.. slipped off the taxiway			
20:59:11	GND-EZY	Yeah they're on the way sir, they're on the way			
21:00:10	EZY-GND	EZY5112			
21:00:11	GND-EZY	Go ahead			
21:00:12	EZY-GND	Are you notifying the emergency services also that the ehh.. there is sheets of ice all over taxiway for them			
21:00:19	GND-EZY	Okay yeah we will do that			

GND = ground TWR west EZY = EZY5112

Time (UTC):	Between:	Contents:	Time (UTC):	Between:	Contents:
21:00:21	EZY-GND	Thank you			
21:02:35	GND-EZY	EZY5112			
21:02:36	EZY-GND	5112 go ahead			
21:02:38	GND-EZY	Yeah all the emergency services are on the way, they are rather slow at this one moment due to the ehh.. slippery spots over there all eh all around, they are approaching from back and from the right hand side			
21:02:49	EZY-GND	Yes sir that's ehh.. fully understood and ehh.. at some stage we will need to disembark all our passengers at this location please if you can assist with ehh.. bus transport			
21:02:59	GND-EZY	Okay yes that's copied we are taking care of that			
21:03:01	EZY-GND	Thank you sir			



Referentie : CQS/Inc.Inv. 19878
 Versie : 1.0
 Dossiervwijzing : 2003-12-22, EZY5112
 Audioband- & arrestnummer(s) : 322/541
 Frequenties & werkposities : baankanaal TWR/TWRW HT

RECORDERVERSLAG

TWR = TWR west (satellite) CKR = Checker (vogelwacht)

Tijd (UTC):	Tussen:	Inhoud:	Tijd (UTC):	Tussen:	Inhoud:
20:02:28	TWR-CKR	Is het glad daar?			
20:02:31	CKR-TWR	Heeft u het tegen de checker ehh.. satellite?			
20:02:34	TWR-CKR	Ja, is het glad?			
20:02:35	CKR-TWR	Ja het is spekglad hiero satellite			
20:02:38	TWR-CKR	Ik dacht al dat ik u een beetje zag glijden			
20:02:40	CKR-TWR	Correct ehh..(onverstaanbaar)... maar het is inderdaad zeer glad hiero dus			
20:02:50	CKR-TWR	Ik ga het even doorgeven ehh... satellite			
20:02:55	TWT-CKR	Sorry checker, kunt u het bericht herhalen?			
20:02:58	CKR-TWR	Ik ga het even doorgeven dat ze hier kunnen gaan sproeien ehh... satellite.			
20:03:04	TWR-CKR	Sorry checker one nog eenmaal het bericht herhalen graag			
20:03:09	CKR-TWR	Hoe is deze uitzending ehh... sateliite?			
20:03:12	TWR-CKR	Op zich goed maar vanwege de andere ehh.. frequentie ehh.. die we er hier tussendoor horen hoorde ik het niet zo goed.			

TWR = TWR west (satellite) CKR = Checker (vogelwacht)

Tijd (UTC):	Tussen:	Inhoud:	Tijd (UTC):	Tussen:	Inhoud:
20:03:17	CKR-TWR	Ja dat is voor mij hetzelfde ehh... ik ga het even doorspelen dat ze hier kunnen gaan sproeien			
20:03:23	TWR-CKR	Checker one dat is begrepen dank u			
20:23:18	CKR-TWR	Satellite van checker one			
20:23:31	TWR-CKR	Zegt u het maar			
20:23:32	CKR-TWR	Ja ehh... de gladheid ter hoogte papa zes en zeven wordt aan gewerkt			
20:23:37	TWR-CKR	Dat is begrpen dank u wel en ehm.. rijbaan victor is tot nu toe ... (onverstaanbaar) ...?			
20:23:44	CKR-TWR	Ja ehh.. rijbaan victor de normale route zoals de kisten nu rijden is goed maar richting ehh.. victor twee zeg maar en een is het ook foute boel			
20:23:53	TWR-CKR	Okay, nou ik ben niet van plan om daar te komen, maar dank u wel			
20:23:55	CKR-TWR	De normale route is geen probleem			
20:23:58	TWR-CKR	bedankt			

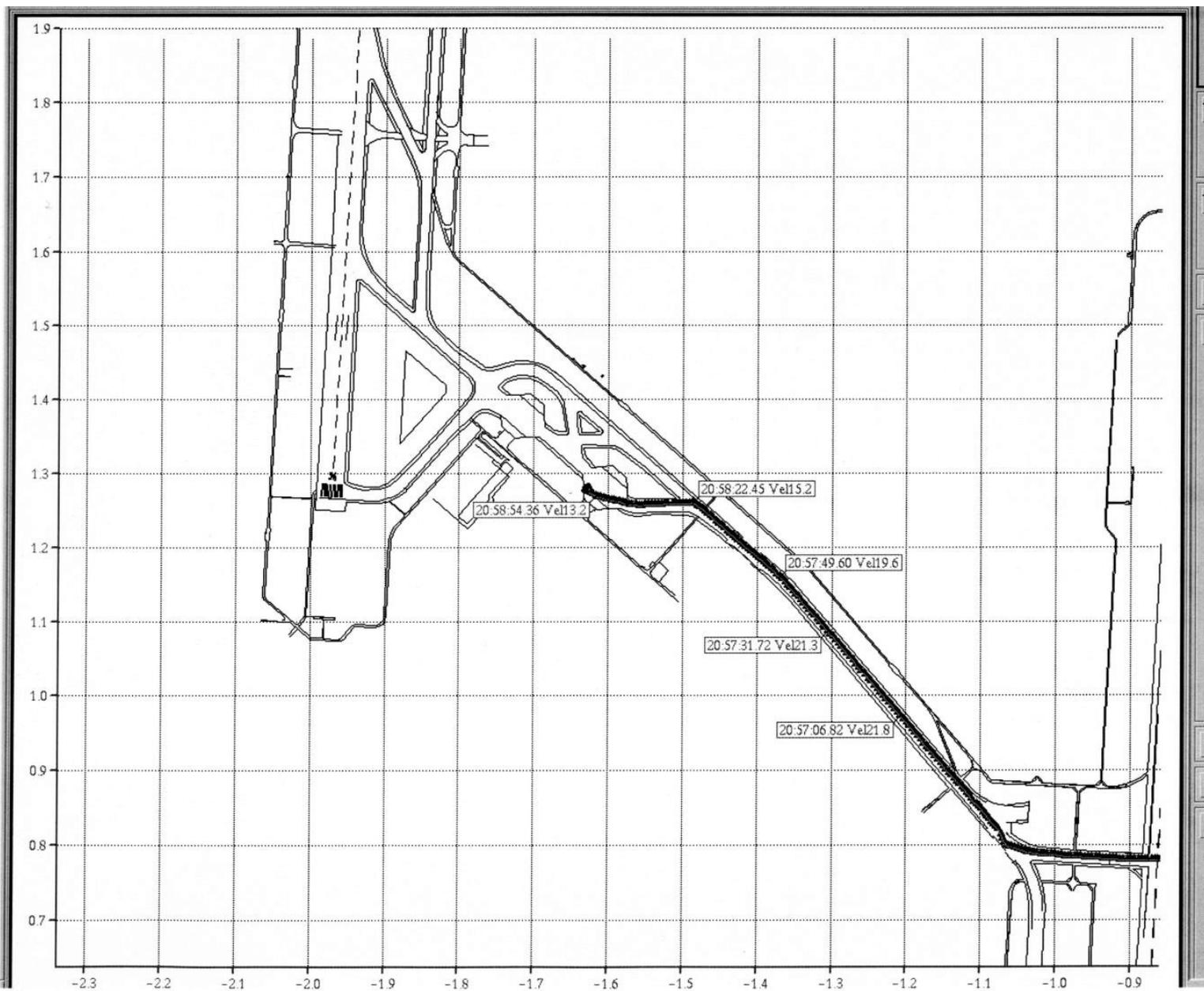
Overzicht VOS alarmvormen

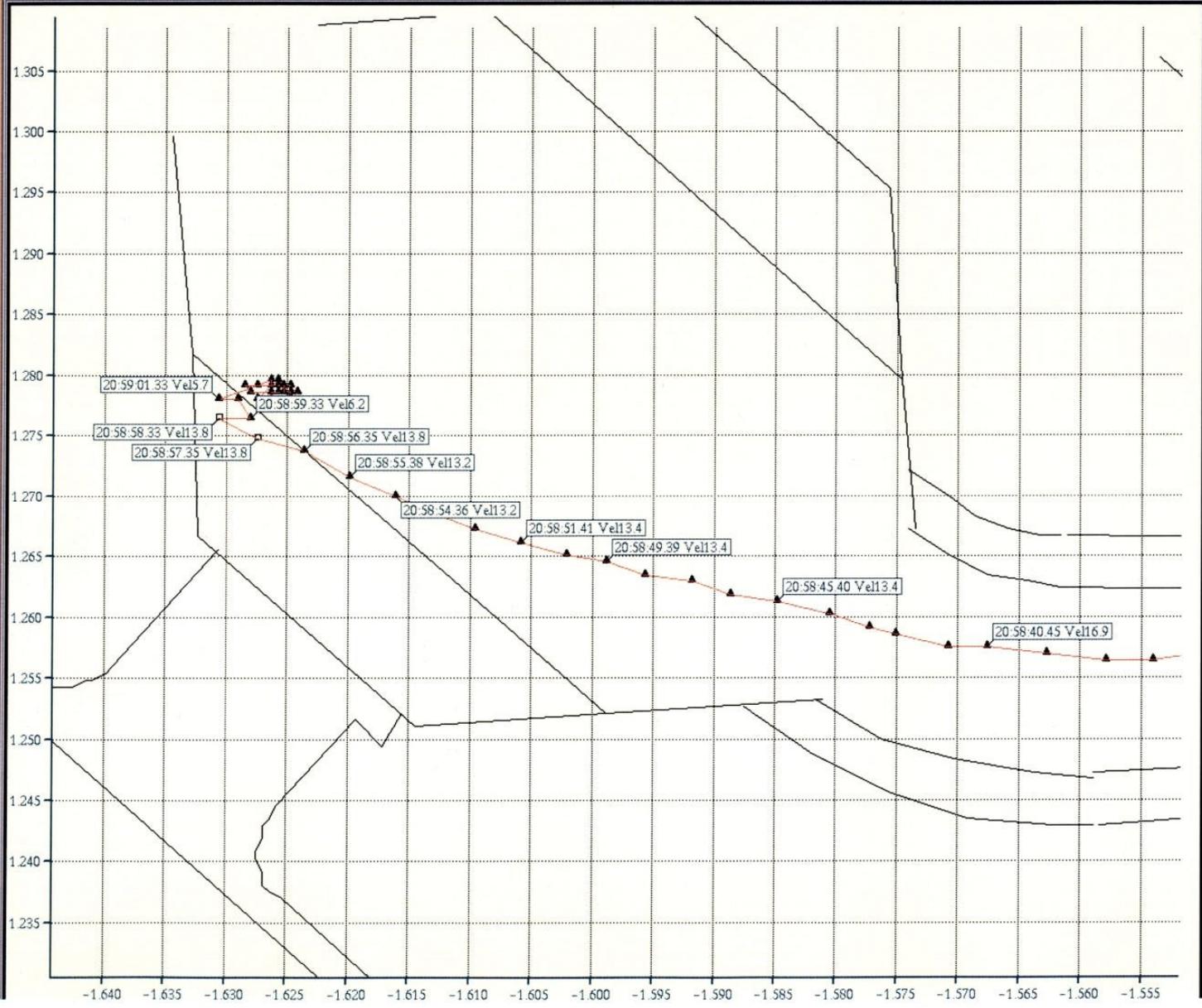
In onderstaande tabel staat het overzicht van de VOS alarmvormen

Alarmvorm	Van toepassing bij	Plan dat van toepassing is
VOS 1	<ul style="list-style-type: none"> • een panpancall van een vliegtuig in de lucht • een klein incident met een vliegtuig onderweg van of naar een afhandelingsspositie; • een klein incident met een vliegtuig op een afhandelingsspositie. 	3.1.1 Plan bij alarmvorm VOS 1
VOS 2	<ul style="list-style-type: none"> • een maydaycall van een vliegtuig met 1 - 50 PAX plus crew aan boord; • een ongeluk met een vliegtuig op een afhandelingsspositie met 1 - 50 PAX plus crew aan boord. 	3.1.2 Plan bij alarmvorm VOS 2 t/m 4
VOS 3	<ul style="list-style-type: none"> • een maydaycall van een vliegtuig met 50 - 250 PAX plus crew aan boord; • een ongeluk met een vliegtuig op een afhandelingsspositie met 50 - 250 PAX plus crew aan boord. 	3.1.2 Plan bij alarmvorm VOS 2 t/m 4
VOS 4	<ul style="list-style-type: none"> • een maydaycall van een vliegtuig met meer dan 250 PAX plus crew aan boord; • een ongeluk met een vliegtuig op een afhandelingsspositie met meer dan 250 PAX plus crew aan boord. 	3.1.2 Plan bij alarmvorm VOS 2 t/m 4
VOS 5	<ul style="list-style-type: none"> • een crash van een vliegtuig met 1- 50 PAX plus crew aan boord; • een ongeluk met een vliegtuig onderweg van of naar een afhandelingsspositie met 1- 50 PAX plus crew aan boord. 	3.1.3 Plan bij alarmvorm VOS 5 t/m 7
VOS 6	<ul style="list-style-type: none"> • een crash van een vliegtuig met 50 - 250 PAX plus crew aan boord; • een ongeluk met een vliegtuig onderweg van of naar een afhandelingsspositie met 50 - 250 PAX plus crew aan boord. 	3.1.3 Plan bij alarmvorm VOS 5 t/m 7
VOS 7	<ul style="list-style-type: none"> • een crash van een vliegtuig met meer dan 250 PAX plus crew aan boord; • een ongeluk met een vliegtuig onderweg van of naar een afhandelingsspositie met meer dan 250 PAX plus crew aan boord. 	3.1.3 Plan bij alarmvorm VOS 5 t/m 7

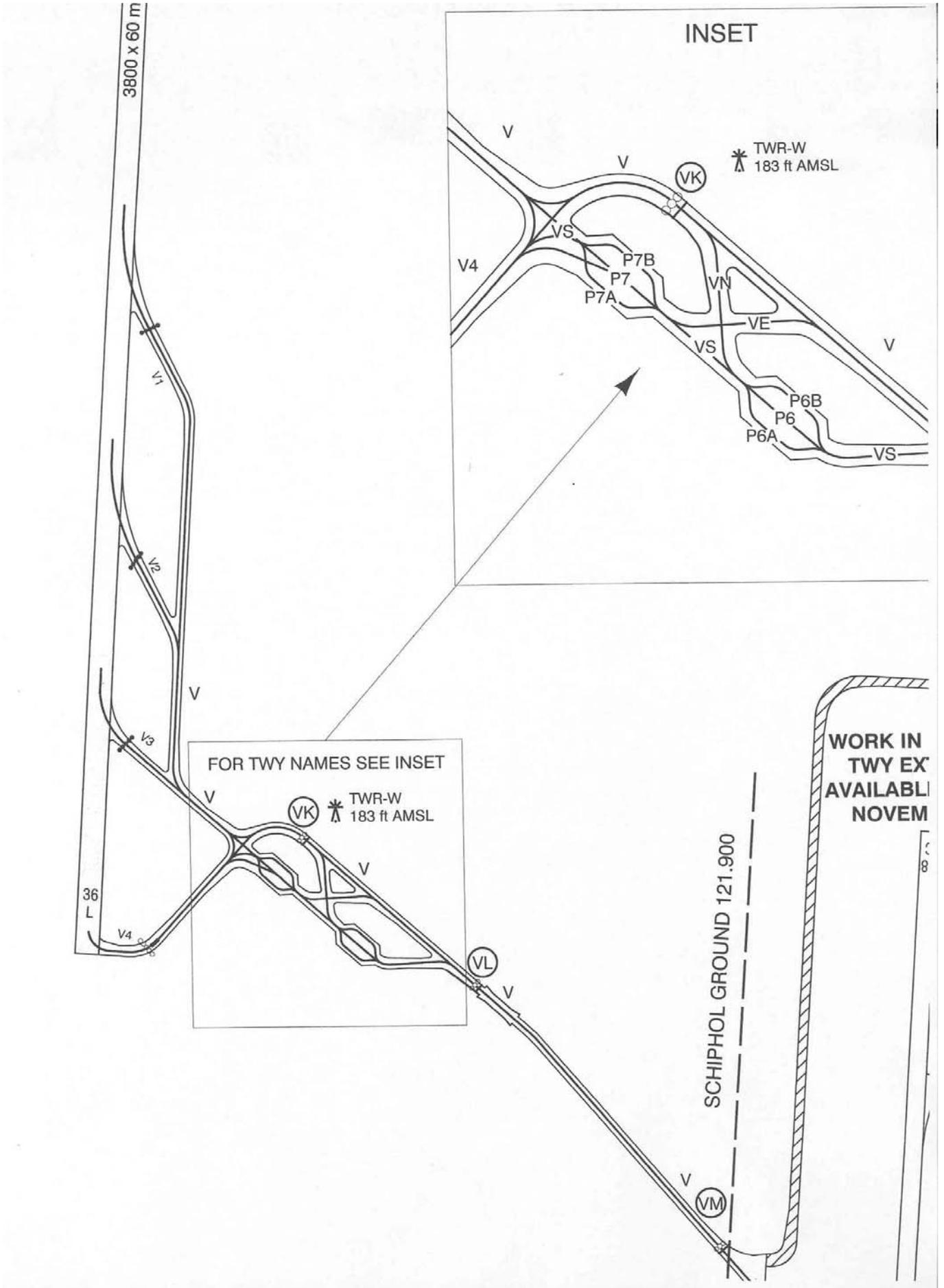
Beslismatrix

Voor het vaststellen van de juiste VOS alarmvorm zie ook '2.1.1a Bijlage: beslismatrix alarmvorm VOS'





*:
*:
Tim
To
T
E



5

G-EZJM

