Statens haverikommission
Swedish Accident Investigation Board

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Report RL 2007:12e

Aircraft accident to LN-RDA at Kalmar airport, H county, Sweden, on 6 April 2006

Case L-08/06

SHK investigates accidents and incidents with regard to safety. The sole objective of the investigations is the prevention of similar occurrences in the future. It is not the purpose of this activity to apportion blame or liability.

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Translated by Interpreter Centre, City of Göteborg, from the original Swedish at the request of the Swedish Accident Investigation Board.

In case of discrepancies between the English and the Swedish texts, the Swedish text is to be considered the authoritative version.

Statens haverikommission
Swedish Accident Investigation Board

2007-08-27 L-08/06

The Swedish Civil Aviation Authority

SE-601 73 NORRKÖPING, Sweden

Report RL 2007:12e

The Swedish Accident Investigation Board has investigated an incident that occurred on 6 April 2006 at Kalmar airport, H county, to an aircraft registered LN-RDA.

In accordance with section 14 of the Ordinance on the Investigation of Accidents (1990:717) the Board herewith submits a report on the investigation.

The Board will be grateful to receive, by 28 February 2008 at the latest, particulars of how the recommendations included in this report are being followed up.

Christina Striby Stefan Christensen

Duplicate copy to EASA

Statens haverikommission (SHK) Swedish Accident Investigation Board

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Aircraft; registration and type	LN-RDA, DHC8-Q 400
Class/airworthiness	Normal, valid Certificate of Airworthiness
Registered owner/Operator	SG Three Kumai/SAS
Time of occurrence	6 April 2006, at about 16:50 in daylight *Note:* All times are given in Swedish daylight saving time (UTC + 2 hours)
Place	Kalmar airport, H län, (posn. 56° 41.1′ N, 016° 17.3′ E, 5 m above sea level)
Type of flight	Commercial air transport
Weather	According to METAR ESMQ at 16:50: wind 220°/12 knots, visibility more than 10 km, scattered clouds at 2300 feet, broken clouds at 2900 feet, temp./dewpoint +5/± 0 °C, QNH 1007 hPa
Persons on board:	
crew members	2+2
passengers	69
Injuries to persons	None
Damage to aircraft	None
Other damage	None. No known environmental effects
Commander:	
Sex, age, licence	Male, 61 years, ATPL-A
Total flying time	13200 hours, of which 1980 hours on type
Flying hours previous 90 days	116.9 hours, all on type
Number of landings previous 90 days	91
Co-pilot:	
Sex, age, licence	Female, 41 years, CPL, IR-ME
Total flying time	5685 hours, of which 997 hours on type
Flying hours previous 90 days	120.8 hours, all on type
Number of landings previous 90 days	99
Cabin crew members	Two females

The Swedish Accident Investigation Board (SHK) was notified on 6 April 2006 that an aircraft with registration LN-RDA had an incident at 16:50 hours on that day at Kalmar airfield, H county.

The accident has been investigated by SHK represented by Christina Striby, Chairperson, Stefan Christensen, investigator in charge and operational investigator, Henrik Elinder technical investigator, and Gerd Svensson, Human Factors investigator.

The investigation was followed by Ulrika Svensson, Swedish Civil Aviation Authority.

Summary

The aircraft departed from Stockholm/Arlanda Airport for a scheduled flight to Kalmar. On board were four crew members and 69 passengers. The first part of the flight proceeded normally, with the commander as PF (pilot flying). During the flight a technical failure occurred which meant that the right side propeller overspeeded. According to the emergency checklist a number of actions are to be taken, ending with feathering the faulty propeller and switching off the engine to reduce the air resistance (drag) of the propeller.

The commander decided however to keep that engine at flight idle during the approach, which meant that the angle of the propeller blades remained flat to the aircraft direction, thereby causing severe drag.

This severe drag caused great control problems for the aircraft and the commander thus had to use a power output from the other engine that exceeded the maximum permitted power.

The approach was not stabilised and the final stage was at a very low height.

The crew had not practised dealing with faults in this system during approach and landing, and considered that the emergency checklist was unclear. During the three week period immediately preceding the incident, three failures of the same type occurred on this individual aircraft. In no case had the crew completely followed the instructions in the emergency checklist. Nor had the technical fault been located correctly.

The incident was caused by the fact that the emergency checklist was not completed, and a combination of the pilots not being aware of the risks due to leaving an unfeathered propeller in flight idle, unclear operations documentation concerning the propeller overspeeding type of propeller fault, and deficient follow-up of previous similar occurrences.

Recommendations

It is recommended that EASA:

- Makes efforts to set up a working group, with representatives of the manufacturer and the airline, and possibly other operators of the Q 400. The purpose should be to improve both the content and the method of application of the emergency checklist for the Q 400 *(RL 2007:12e R1)*.

1 FACTUAL INFORMATION

1.1 History of the flight

1.1.1 The flight

The crew had checked in at Stockholm/Arlanda to carry out the first flight of the day's sectors, SK 197 to Kalmar. The conditions for flying were good, and no difficulties were expected, either operationally or due to weather. Before starting, a technician was called in because there had been a system warning (Power Plant) in the cockpit. After rebooting the system the warning disappeared and the commander received clearance from the technician that everything was now in order. In a review of the aircraft flight log before starting, the commander failed to note that there had been three previous notifications concerning the right side propeller, with subsequent propeller overspeeding.

The take-off and flight towards Kalmar proceeded in accordance with normal routines, with the commander as the pilot flying (PF), and the co-pilot as the pilot not flying (PNF). On board were four crew members and 69 passengers, of whom five were crew members from the same airline, who were "dead-heading" to Kalmar in order to take up duty later.

1.1.2 The approach – from the cockpit

SK 197 began a normal ILS[1] approach to runway 16. At a height of just above 4000 feet the warning lamp for the right side Propeller Electronic Control (PEC) lit. At this time the aircraft was descending to 2000 feet on a track of 223°, which was to lead to the final approach heading of 149°. About two seconds after the warning lamp came on, the speed of the right side propeller increased from 850 rpm to 1064 rpm. At that time both the power levers (PL) were at their flight idle positions and the autopilot was switched on. The commander noted the increase in propeller speed and said "We have a prop overspeed."

The power from the left engine was increased to about 40 % Torque, Tq[2], while at the same time the PF kept the right engine PL at the flight idle position (Tq -6 %). The aircraft continued its descent on autopilot, with differing power from the engines. During the discussion that ensued after the fault, the co-pilot wanted to "secure" the right side engine, i.e. feather the propeller and switch off the engine so as to minimise drag. However the commander rejected this proposal, referring to the fact that the approach had now begun, and that he understood that in this situation one should not start a shut-down sequence but continue the approach and land.

When the aircraft levelled out at 2000 feet, the PF gradually increased the power from the left engine to 90 % Tq. The right engine remained at flight idle. The first officer once again asked the commander if she should "secure" the right engine, but again received a negative answer.

At this stage the autopilot automatically disconnected, due to the increased asymmetric power, and the aircraft had to be flown manually. At the same time the automatic "up-trim" system in the engine increased the power from the left engine to 100 % Tq. At about this position, where the aircraft should have commenced a left turn towards the extended runway centreline, it began instead to sink fast, in a slight right turn. Soon afterwards one of the aircraft warning systems, the EGPWS[3] (see 1.16.11) was activated, and audible warnings "Terrain, Terrain, Pull up", followed by "Sink rate, Sink rate" were heard in the cockpit. The aircraft was still sink-

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[1] ILS= Instrument Landing System
[2] Tq= Torque on the propeller shaft. Used to express the power obtained from the engine
[3] EGPWS= Enhanced Ground Proximity Warning System

ing, and was about 1200 feet above ground level. From the FDR the calculated sink rate was at this time 3700 feet per minute. The commander then increased the power from the left engine past the normal maximum detent to the end position of the control movement, which meant that the power became 125 % Tq. This power level was maintained for 1 minute and 15 seconds. The aircraft was taken out of its descending right turn and started a climbing left turn towards the correct course.

At this point the power situation of the engines was extremely asymmetrical, with -6 % Tq from the right engine and 125 % Tq from the left engine. Printouts of the information recorded by the Flight Data Recorder (FDR) show that the maximum aileron and rudder deflection was used to be able to control the aircraft in this configuration. At a later point in the approach the commander asked “Why have we......?” The first officer answered: “We haven’t feathered – that’s why”.

1.1.3 The approach – from the control tower

In accordance with the flight plan, SK197 was cleared for approach to runway 16 using own navigation. This meant that the air traffic controller in the Kalmar air traffic control tower only followed the progress of the flight sporadically on radar and could see that the aircraft was initially following a normal track towards the approach path during its descent to 2000 feet. When a few minutes later the air traffic controller looked again at the radar screen, the aircraft had passed the approach path, and was on an approach course from the right. The height information showed that the aircraft was climbing, from 1200 feet, at a point where according to the approach procedure it should have been at 2000 feet. This made the air traffic controller realise that something was wrong. At the same moment the co-pilot reported to the tower that they had a problem with one engine and wanted to continue on the present course for a visual approach.

The air traffic controller understood that this was a serious situation and intended to provide radar assistance to SK 197. The co-pilot replied (in a remarkably calm voice, according to the air traffic controller): “We don’t need any assistance – it will be a normal landing”. The air traffic controller replied to this by asking if this meant that the alarm should not be raised, and that the rescue vehicles would not need to be called out. He received the following answer from the aircraft: “2500” .....“of fuel”. At this stage the air traffic controller decided that the situation really was serious and set off the alarm. When the alarm is activated at the tower, apart from a signal to the local fire and rescue service, an alarm is also sent to the SOS emergency services in Kalmar. The alarm caused the SOS emergency services to contact the Kalmar air traffic control tower by telephone.

During the telephone conversation with the SOS emergency services, in which the air traffic controller described the situation, he obtained visual contact with SK 197. The aircraft was about 1 nautical mile from the runway threshold, in level flight at a very low height. At this moment the air traffic controller was convinced that there would be an accident, and therefore said to the SOS emergency services: “Come out with all you’ve got – he’s going to crash!”

1.1.4 The landing

According to the FDR information the final part of the approach was characterised by major control problems. The power from the left engine reduced for a period of about two minutes before landing, but thereafter increased to 125 % Tq. The right engine remained with the propeller unfeathered in the flight idle position, which meant -6 % Tq. This power situation remained until touchdown.

The aircraft went to the right of the extended runway centreline when there was just over one kilometre remaining to the beginning of the runway. The crew had to make a correction to the left in order to get back on to the correct line. This part of the approach was performed at heights between 200 and 300 feet. The aircraft lined up immediately before the runway threshold, and flew in over the threshold at 15-20 feet height.

Touchdown occurred at about 20 metres along the runway. According to the FDR printouts the vertical acceleration (g-load) at touchdown was 1.55 g, with the nose attitude at 7.2° "nose up". Roll-out on the runway took place with no further problems. The rescue vehicles which were in place followed the aircraft to its parking place on the apron.

1.1.5 *After landing*

The last part of the roll-out and braking were normal, and the aircraft could taxy in under its own power to the terminal building. The commander told the passengers what had happened, and also offered to provide more information inside the terminal for those who wished it. The co-pilot held a debriefing on board for the cabin crew.

At the airport's traffic office the crew made two attempts to send an Urgent Flight Occurrence Report via the CDRS internal reporting system, but neither attempt succeeded. The commander than telephoned the flight department's Duty Manager, who happened to be the Fleet Chief Pilot Q 400, and reported the incident.

The crew then flew as passengers back to Arlanda on another aircraft belonging to the company. The co-pilot went off duty in accordance with her roster, but the commander continued to fly on active duty after a brief respite at Arlanda and completed his duties at an outstation, with a subsequent night stop. The next day both pilots were taken off duty to investigate the incident.

1.1.6 *The commander's account*

The commander considered that he had quickly identified and diagnosed what had happened as overspeeding of the right engine's propeller. He had also followed the checklist's "memory items", and carried out and/or checked the first items: "*Power Lever….Retard Toward Flight Idle.*" and "*Airspeed…..Reduce*". The reason why he did not complete the checklist and switch off the faulty engine was that he thought the Q 400 had so much power that this was not necessary. There was also a risk of shutting down the wrong engine, which he thought should be taken into consideration. The commander said during the interview with SHK that during the whole of the approach he had regarded the faulty right engine as "dead", i.e. mentally thought of the problem as the loss of one engine.

During the approach he found that controlling the aircraft became more and more difficult. The commander soon felt "he had his hands full and was being resisted" and had to use his entire capacity to try to control the aircraft. At that time he did not associate the major control difficulties with the unfeathered propeller on the right engine, but focused entirely on the landing. Flaps were set to 5° by the co-pilot on an order from the commander, but he set the flaps himself to 10° since he felt that the aircraft was very quickly nearing the stall limit[4].

The reason why he did not accept the proposal from the co-pilot to feather the propeller was that they would soon land and he felt that he had been taught not to begin the engine shut-down procedure at this stage, just to continue the approach and land. He found it difficult to understand why

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[4] Stall limit = Red marking on the speed indicator, indicating that the aircraft is entering a speed range that is too low

the aircraft was so hard to control, and even suspected for a moment that there could be a fault in the other engine or in the spoilers. He remembered that the pilots had agreed that a go-around[5] would not be possible if the landing did not succeed.

He had completed his OPC[6] the week before, which included practising propeller overspeed on take-off. On the other hand, he had never practised dealing with this kind of fault during an approach. The first item on the checklist, which said: "*Power Lever.....Retard Toward Flight Idle*" he thought had been completely met, since both power levers were in the flight idle position when the fault occurred. No-one had explained to him that one should not leave a power lever in flight idle, or that this could be a potentially dangerous situation. The commander also thought that it was difficult to interpret the checklist on this item; if flight idle was a dangerous position – why were there no instructions for actions in the case of a propeller overspeed with the power levers in flight idle?

1.1.7 The co-pilot's account

The account given below is based on interviews with the co-pilot and on the transcript from the CVR.

The co-pilot remembered the flight as being perfectly normal until the PEC warning occurred. She was ready to start the PEC checklist when the commander identified the fault as propeller overspeed. The co-pilot was aware that this was a serious problem and had the impression that the commander had said aloud to himself that the power levers were in flight idle and that the revolutions were constant. On the two occasions when she suggested to the commander that they should "secure" the engine, he first answered that "it'll keep it mechanically there", and the second time with: "No, we'll leave it."

After the autopilot had disconnected in connection with levelling out at 2000 feet, the co-pilot noted that the airspeed reduced very quickly. She remarked on this to the commander, and he then increased the power of the working engine. She also had a mental picture of an engine failure, i.e. she regarded the right engine as "dead".

The co-pilot said to the commander not to use so much aileron, but received the reply that he was forced to use full aileron deflection. It was at this time, together with the warning from the EGPWS system, that she became aware of the gravity of the situation and therefore gave the commander continuous height and airspeed information during the remaining part of the approach and landing. At a late stage of the approach she remembered that she too had become convinced that they would not reach the runway, but instead come down into one of the adjacent crop fields.

She felt that the approach had various phases. After the first phase, with the appearance of the fault and its initial consequences, there followed a relatively "quiet" phase when the aircraft had come back up to the glidepath and the course was stable. It was at this moment that the control tower was informed that this would be a normal landing. The final phase began when the crew experienced a reduction in power when they had entered the glidepath, which meant that their ability to maintain speed and hold height quickly deteriorated.

The final phase, according to the co-pilot, was dramatic, when the left engine power returned to 125% while at the same time the aircraft found it difficult to maintain height. During a five second period just before the aircraft crossed the runway threshold, the co-pilot said "don't sink" four times.

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[5] Go-around = Acceleration and climb out in the case of an unsuccessful landing attempt
[6] OPC = Operator's Proficiency Check (Competence check in a simulator)

The training she had been given in connection with simulator tests had not covered propeller overspeed while landing. She only remembered propeller overspeed training in conjunction with take-off. She found it surprising that there was no warning in the checklist that an unfeathered propeller at flight idle was dangerous in the case of propeller overspeeding.

The fact that she did not insist on her proposal to the PF to feather the propeller was possibly due, according to her, to the fact that that she had been affected by earlier events in the company.

She had recently participated in a discussion concerning technical faults that had occurred and that resulted in propeller overspeed. On that occasion she had also had an LCP (Line Check Pilot)[7] accompanying in the cockpit. The checklist for propeller overspeed had not been followed, instead the approach and landing had been carried out with the propeller in its unfeathered position. She thought that she had been influenced by this knowledge during the current incident, and that this subconsciously affected her opinion that the actual configuration of the aircraft need not be regarded as dangerous.

After landing, when the aircraft was parked on the apron, the co-pilot remembered that both she and the commander reacted to the right engine's propeller spinning. During the entire approach she had considered the engine as being dead, so it had come almost as a surprise to find that the engine was still running.

1.1.8 *Graphical overview of the approach*

The following illustration shows the positions of the aircraft during the approach at different times. The graphs were compiled from data taken from the aircraft Flight Data Recorder. The red lines show the actual path of the aircraft towards the runway. The upper red line shows the height deviation relative to the normal glidepath (the centre green line), and the lower red line shows the lateral deviation relative to the localiser centreline (the green line at the centre).

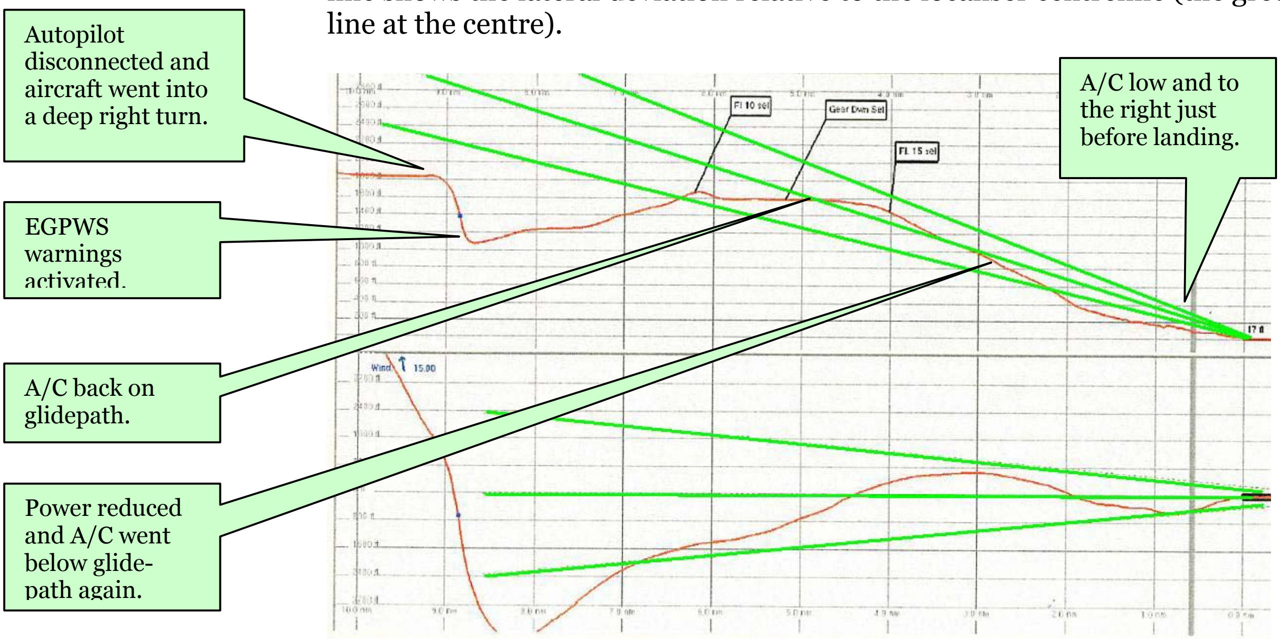

Fig. 1. The approach

The illustration shows that there were major deviations in both height and direction during different phases of the approach. When the aircraft

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[7]Line Check Pilot = Specially assigned pilot who accompanies in an extra seat in the cockpit in order to check that the company's standards and procedures are complied with and are feasible

reached the glidepath the power was reduced on the left engine, and the aircraft sank below the glidepath again. The final part of the approach took place at a very low height from a position that was well to the right of the runway extended centreline.

The incident occurred at position 56 41.1′ N, 016 17.3′ E in daylight.

1.2 Injuries to persons

	Crew members	*Passengers*	*Others*	*Total*
Fatal	–	–	–	–
Serious	–	–	–	–
Minor	–	–	–	–
None	4	69	–	73
Total	4	69	–	73

1.3 Damage to aircraft

None.

1.4 Other damage

None. No known environmental effects.

1.5 Personnel information

1.5.1 *Commander*

The commander, male, was 61 years old at the time and had a valid Airline Transport Pilot Licence.

Flying hours			
previous	*24 hours*	*90 days*	*Total*
All types	0.8	116.9	13200
This type	0.8	116.9	1980

Number of landings this type previous 90 days: 91.
Flight training on type carried out in 2002.
Latest PC (Proficiency Check) carried out on 28 March 2006.
Latest OPC (Operator's Proficiency Check) carried out on 10 August 2005.

All simulator tests performed in the most recent three years had approved results, according to the commander's PC/OPC reports.

1.5.2 *Co-pilot*

Co-pilot, female, was 41 years old at the time and had a valid Commercial Pilot Licence with Instrument Rating-Multi-Engine.

Flying hours			
previous	*24 hours*	*90 days*	*Total*
All types	3.3	120.8	5685
This type	3.3	120.8	997

Number of landings this type previous 90 days: 99.
Flight training on type carried out in 2004.

Latest PC (Proficiency Check) carried out on 15 December 2005.
Latest OPC (Operator's Proficiency Check) carried out on 14 May 2005.

All simulator tests performed in the most recent three years had approved results, according to the co-pilot's PC/OPC reports.

1.5.3 Cabin crew members

Two females.

1.5.4 The crew members' duty schedule

The crew had checked in at Stockholm/Arlanda at 15:15 to begin their duty with SK 197 to Kalmar.

Both pilots stated that they felt rested at the time of starting duty. They had flown with each other on several occasions and stated in interviews that their mutual co-operation worked well.

In respect of both the planned period of duty and the actual period, they were within the permitted limits. The requirements for rest periods and breaks from duty were met in accordance with the applicable regulations. That day was the first in a five day duty period for the commander, and the third day for the first officer in a three day duty period. The accumulated weekly duty points at the time of the incident were 206 for the commander and 173 for the co-pilot. The maximum permitted number of points planned for any week was 270.

For both the pilots the current duty period had been preceded by a long consecutive off-duty period.

1.6 The aircraft

1.6.1 General

The aircraft		
Manufacturer	Bombardier Ltd., Canada	
Type	DHC-8-402	
Serial number	4013	
Year of manufacture	2000	
Flight mass	Max. authorised take-off/landing mass 28998/28009 kg, actual 27707/26757 kg	
Centre of mass	Within permitted limits. The loaded index was 27, where the permitted forward and rear limits were 10/33 respectively	
Total flying time	9931 hours	
Number of cycles	12258	
Flying time since latest inspection	1675 hours	
Fuel loaded before event	3,400 kg	
ENGINES		
Manufacture	Pratt and Whitney	
Model	PW150A/4580SHP	
Number of engines	2	
Engines	*No. 1*	*No. 2*
Total operating time, hrs	8044	7490
Operating time since overhaul	8044	7490
Cycles since overhaul	9720	8973

Propellers	
Propeller manufacturer	Dowty R 408
Propeller 1, operating hours	8369 hours
Propeller 2, operating hours	9099 hours

The aircraft had a valid Certificate of Airworthiness.

1.6.2 *Introduction of the type into the company*

This company was the "launch customer" for the Q 400, which meant that it was the first airline to receive the aircraft for commercial flights. Bringing the aircraft into service was problematical, with poor technical reliability during the initial period. According to the company, the problems were not restricted to one particular area, but were distributed among several of the aircraft systems.

In their interviews the pilots stated that as pilots of the Q 400 they had become used to the fact that this type of aircraft often suffered technical failures. From the outset the aircraft had a high failure rate and the pilots thought that they always had to be mentally prepared that a fault would occur.

1.6.3 *Engines*

This aircraft type has two turboprop engines, each developing 4580 hp (90 % Tq) – Shaft Horse Power (SHP). If necessary, additional power – e.g. if an engine failed – could be provided for a limited time to the extent of 5071 SHP (100 % Tq). If a really acute emergency should arise, it was also possible to temporarily increase the engine power to 6339 SHP (125 % Tq).

The respective engine functions are controlled by a computerised Full Authority Digital Engine Control (FADEC) system. This system includes a safety function that restricts the fuel supply to the engine if the propeller speed for some reason exceeds 1173 rpm.

1.6.4 *Propellers*

The engine drives the propeller through a reduction gear. The propeller has six adjustable blades made of composite material. The blade angle can be altered from the feathered position, which is used during starting and shutting down the engine, to a negative angle used when reversing.

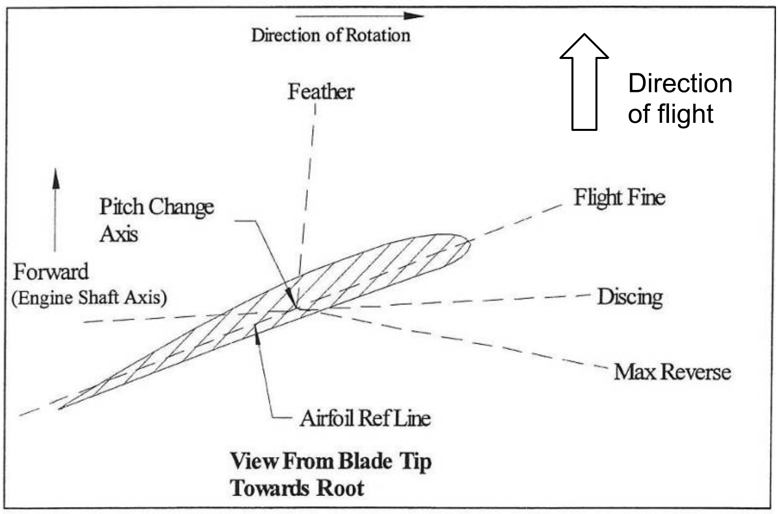

Fig. 2. Propeller blade angles

The propeller setting is controlled by a computerised Propeller Electronic Control (PEC) system. To perform this task the PEC receives information from various parts of the engine/propeller regulation system. Some of these signals come from the Condition levers (CL), Power levers (PL) and Magnetic Pickup Unit (MPU).

The PEC has one function, autofeather, which automatically feathers the propeller if an engine failure occurs while in flight, to reduce drag. At the same time a signal is sent to the FADEC of the good engine to increase its output power by 10%. The autofeather function is only activated during take-off and climb out, which are the most critical phases of a flight, and is then to be switched off when the climb checklist is read.

If a fault arises in the propeller blade angle setting system, this is automatically recorded in the PEC in the form of a coded fault message. This fault message then acts as a basis for fault tracing, which is carried out in accordance with a prescribed program, based on the fault code.

It is possible to manually feather the propeller by activating the hydraulic system that mechanically operates the propeller setting. This is done using a separate switch in the cockpit – alternate feather.

1.6.5 Propeller speed indications in the cockpit

The speeds of the propellers are indicated on instruments in the cockpit, one for the propeller on each side. The value is expressed in rpm, and is indicated by a digital value as well as a pointer against a scale.

During normal operation the indication is green. At propeller speeds between 1020 and 1071 it turns yellow, finally becoming red above 1071 rpm. (See fig. 3.)

Propeller RPM Indicators (N_P)	
Over-limit (red pointer/digits)	above 1071 rpm
Maximum (red radial)	1.071 rpm
Caution (yellow arc)	1020 to 1071 rpm
Normal operating (green arc)	660 to 1020 rpm

Fig 3. Table from the company's OM B.

If a fault occurs in the PEC which results in a propeller overspeed, the propeller speed will be controlled by the Over Speed Governor, OSG, (see 1.6.9), which normally limits the rpm to about 1064. This propeller speed will then be indicated in the yellow arc on the cockpit instrument, which is normally defined as a "caution" indication.

In the company's OM B, section 1.8.2, the operational limitations for, among other things, propeller speed are stated. Item 5 b states that the maximum permitted continuous overspeed is 1071 rpm: *"Maximum allowable continuous Np overspeed is 1071 rpm"*

1.6.6 Propeller de-icing

The propeller blades have an electrical de-icing system. The power supply to the propeller hub is fed via a current collector disc located between the rear of the propeller hub and the reduction gear. Current is taken from the current collector disc via an insulated bus bar to each propeller blade. (See fig. 8.)

1.6.7 Condition levers (CL)

The speed of each propeller is regulated by a control, the Condition Lever (CL), located on a pedestal between the pilot's seats (see the illustration below). The propeller speed increases if the CL is pushed forward and is reduced if it is pulled back. The propeller speed is normally constant during the various phases of flying, 1020 rpm on take-off and landing, 900 rpm when climbing and 850 rpm in cruising flight.

If a CL is pulled back further than the 850 rpm position, the propeller is feathered. This position is used during starting and shutting down the engine, and also to reduce the drag of the propeller if an engine failure occurs while in flight.

If a CL is pulled to its furthest back position – FUEL OFF – the engine is shut down.

1.6.8 Power levers (PL)

The power levers (PL) control engine power by adjusting the propeller blade angles for altered power output. If for example the power is increased by pushing a PL forward, the propeller is adjusted to a coarser blade angle, i.e. the propeller "cuts thicker slices" of the air in front of it. The propeller speed, however, remains constant at different power outputs. When airborne the PL operates along the angle range from flight idle and upwards. If a PL remains in the flight idle position while airborne, the propeller moves to its fine position, i.e. "cutting thinner slices" through the air in front without providing power. This position also means that the propeller exerts greater drag, due to the finer angle, which in effect produces a greater braking surface against the aircraft's direction of flight.

In association with landing, the engines can generate braking power by setting the propeller blades to a negative angle, i.e. reverse thrust. To set the PL to reverse thrust a gate on the PL must be lifted while the lever is being pulled back.

Drag and engine power are measured as Torque (Tq), which is a measure of the propeller shaft torque.

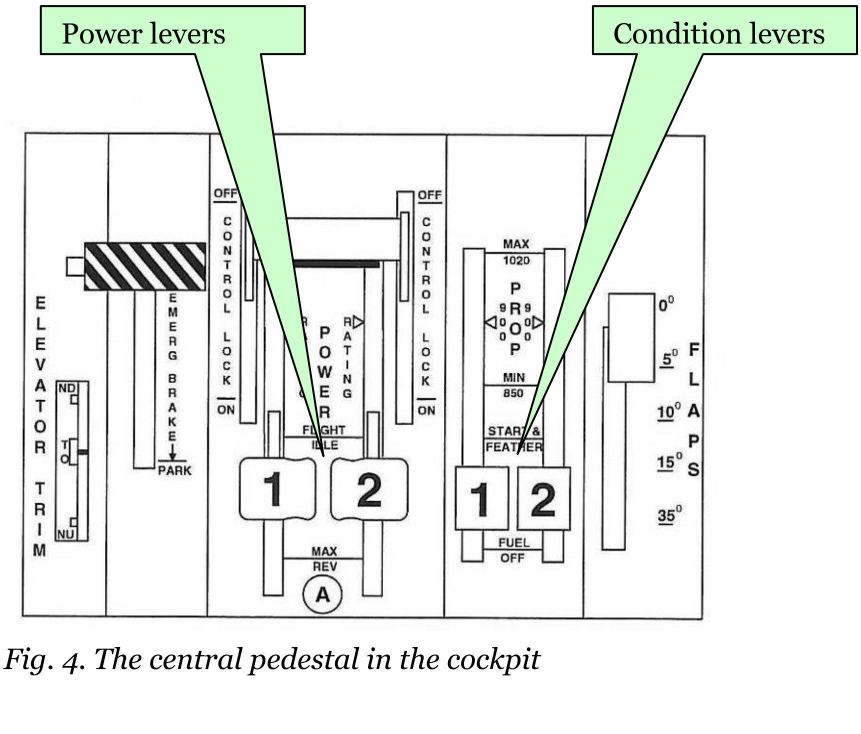

Fig. 4. The central pedestal in the cockpit

1.6.9 Over Speed Governor (OSG)

Within the normal speed range of the propeller, the speed is controlled by the PEC. If a fault occurs in the PEC which results in an abnormal propeller speed, overspeed protection is initiated, by the Over Speed Governor (OSG), which restricts the maximum speed to 1071 rpm.

1.6.10 Magnetic Pickup Unit (MPU)

In order to calculate the propeller speed, the PEC uses a signal from the Magnetic Pickup Unit (MPU), which is a magnetic sensor located on the propeller shaft in association with the current collector disc for the propeller de-icing system. The speed information is registered as electrical pulses generated at the external circumference of the current collector disc.

1.6.11 EGPWS

The aircraft is equipped with a terrain warning system, the EGPWS (Enhanced Ground Proximity Warning System). This system continuously monitors the aircraft attitude at heights between 50 and 2500 feet AGL[8], and warns the pilots by lighting warning lamps and at the same time emitting a voice message. While approaching and landing, this may happen in the following situations:

- Excessive angle of bank.
- Excessive sink rate.
- Excessive descent rate towards the ground.
- Insufficient height relative to the terrain.
- Too low height in relation to the electronic glidepath.

The EGPWS system has a built-in memory unit that records warnings generated within a certain time interval. The warnings that were recorded in connection with this incident were played and printed out under SHK supervision.

1.6.12 Rudder and flight control system in the Q 400

The Q 400 flight control system consists primarily of the rudder to control yaw, elevators to control pitch and ailerons to control roll (angle of bank). Further control of the aircraft bank angle is provided by spoilers, which consist of two panels which can be raised, located at the rear edge of the top of each wing (see Fig. 5). Spoilers are used to reinforce the effect of the ailerons at low speeds (less than 185 knots).

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[8] AGL: Above Ground Level

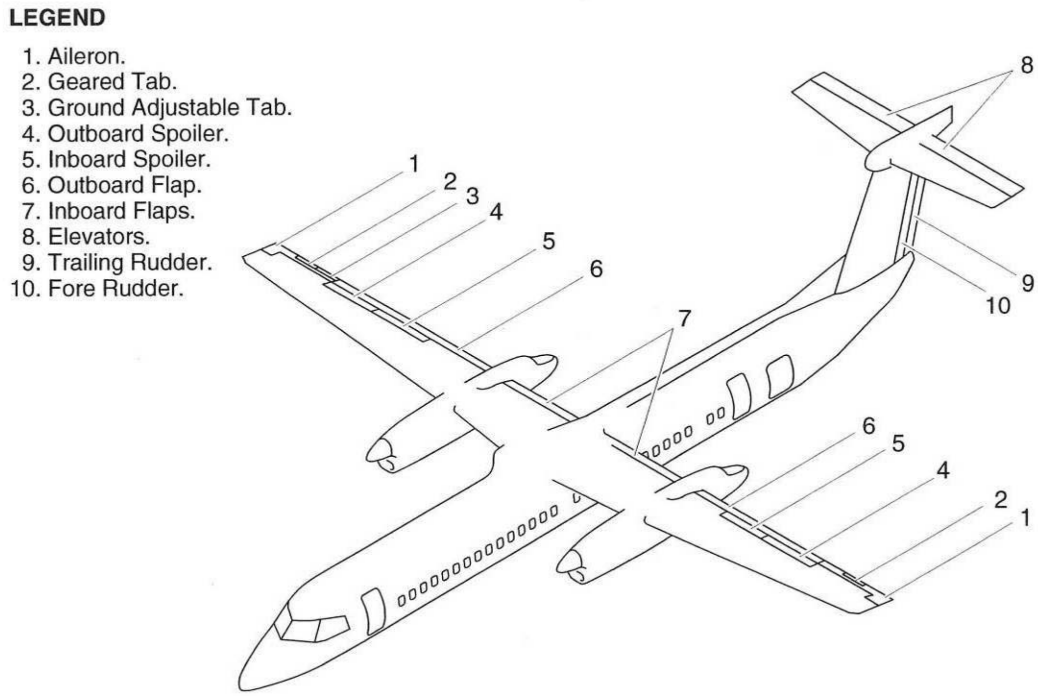

Fig. 5. General view of the flight control system

On the approach, first the inner spoilers are activated, and when the speed has reduced to less than 165 knots, the outer spoilers are also activated. In addition to using activated spoilers to reinforce the effect of the ailerons, they also increase the drag of the aircraft.

When the main wheel oleos compress on landing, the spoiler aileron control function is disconnected, and all four spoilers extend fully to reduce the lift from the wings, which increases the braking efficiency and drag.

Printouts from the FDR showed that both full rudder and full aileron deflection were used during the approach. This was confirmed by the SHK interview with the commander, who said that he had the feeling that “there was not enough aileron or rudder” during the approach. Large movements of the ailerons at low speeds also increase drag, since both the inner and outer spoilers are activated. The wing surface behind the unfeathered propeller produced less lift, due to the reduction in airflow over that part of the wing. This contributed to the greater need for aileron compensation.

The wing flaps are categorised as a secondary flight control system on the Q 400. The flaps are located along the rear edge of the wing, and are used to increase the camber of the wing to achieve more lift at lower speeds. The flaps can be extended in fixed steps at angles of 0°, 5°, 10°, 15° and 35°, and are normally only used for take-off and landing.

1.6.13 Control of the aircraft in different configurations

When determining certain minimum speeds, such as for approach and landing, among other things used as a reference is the lowest determined speed at which the aircraft can be controlled when approaching on one engine, followed by increased power. These speeds, which have been tested with various flap settings and aircraft weights, are increased by a safety factor, and then become the minimum speeds to which the pilot refers during practical flying.

In a situation such as the actual incident – just before landing – the demonstrated reference speed is defined by the manufacturer as Vmcl (Minimum Control Speed Landing). This speed, the determined value of which is included as a requirement for certification of the aircraft, has the following criteria:

- Power for approach on a 3.0° glidepath.
- Engine failure without the autofeather function.
- 100 % power on the good engine.
- The failed engine propeller will transition through flight idle during the procedure of securing (PL to flight idle, CL to fuel off) the failed engine.
- Full rudder deflection.
- Maximum of 5° bank on the side of the good engine.

The lowest speed required to maintain directional control of the aircraft in different configurations and in the conditions described above, is then defined as Vmcl.

In the configuration that applied in the incident, 125 % power from the good engine and the other engine with an unfeathered propeller at flight idle, directional control could not be maintained without exceeding the 5 % bank angle. This configuration is not therefore defined within the aircrafts' permitted manoeuvrability range, and is not included in the flight testing that the manufacturer must perform for the certification process, but is considered to be outside the aircraft's "envelope"[9]. By definition, the manufacturer cannot guarantee that the aircraft will be controllable when the configuration lies outside the flight envelope for the aircraft.

1.6.14 Documentation and checklists

When certifying the aircraft (applicable both to FAR 25 and JAR 25)[10] the AFM[11] is only included as an operational basis when the aircraft type is to undergo the procedure for type approval. The AFM mainly includes the following principal areas:

- Operational instructions and limitations.
- Performance data.
- Minimum equipment list.
- Checklists for normal and abnormal/emergency conditions.

When an aircraft is delivered to an operator it is also accompanied by complementary documentation in the form of an AOM[12] and a QRH[13]. The AOM can be considered as being a user-friendly handbook for pilots. The company then prepares an operating manual for its pilots, OM B, which consists of appropriate parts of the AOM complemented by appropriate parts of the applicable regulations (JAR OPS 1). This manual is reviewed and approved by the inspection authority, STK[14].

The emergency checklist for the Q 400 is called the QRH (Quick Reference Handbook) and is the document pilots refer to for instructions and/or information in an emergency or if an abnormal situation occurs in the aircraft. The QRH current at the time contained procedures and actions to be taken in the case of faulty functions in respect of all the systems in the air-

[9] Envelope = The certified manoeuvrability range of the aircraft in different configurations
[10] American and European certification regulations respectively for a particular aircraft class
[11] AFM = Airplane Flight Manual
[12] AOM = Aircraft Operations Manual
[13] QRH = Quick Reference Handbook
[14] STK = Skandinaviska Tillsynskontoret (the joint Scandinavian inspection authority for the company)

craft. Some of these procedures are classed as “memory items”, which means that the pilots must know these procedures by heart. There are at present 17 procedures in the checklist that, completely or partly, are classed as memory items.

The QRH is not subject to special approval during certification of an aircraft, because the procedures in the QRH are already described in the AFM. For the same reason the QRH is not reviewed/approved by the inspection authority as a separate document. The procedures for emergencies and/or abnormal conditions that are described in the AFM do not necessarily agree with those in the aircraft’s QRH. In the AFM the memory items referred to above are only described as actions. Clarification that certain procedures must be learned by heart (marked by a continuous black frame around the appropriate procedure), first becomes known when they are published in the QRH. The difference between the procedures in the AFM and the QRH is that the latter document is “reinforced” to adapt to the user’s routines. On being asked by SHK whether certification of the aircraft only included the AFM as an operational document, the manufacturer replied:

“We also produce a QRH based on the Flight Manual and amplified, where appropriate, for airline use”.

If a change is needed in the QRH there is a dialogue directly between the operator and the manufacturer, which means that both the discussion and the result are usually outside the control of the inspection authority. A separate list containing all memory items for the Q 400 was prepared by the company in June 2005 as an aid to pilots.

1.6.15 Dialogue with the manufacturer

The procedures in the AFM and QRH respectively that deal with actions in the case of situations with propeller overspeed have not been changed by the manufacturer since the aircraft was certified. In interviews with the company’s Fleet Chief Pilot for the type it emerged that faults in the propeller control system, with associated emergency actions, had been a problem area for a long time. According to the Chief Pilot a number of other companies had suffered subsequent problems as a result of misuse or misunderstanding of the actions to be taken in the case of faults of the propeller overspeeding type.

For example one company had completed a flight of 1 hour 20 minutes with one propeller overspeeding at 1070 rpm after failing to understand the QRH. The problem with the checklist has been referred to the manufacturer from several operators, insisting that the checklist must be changed, both because the actions must be clearly stated and easy to understand, and also to prevent misunderstanding and thereby potentially dangerous situations.

Up to February 2002, propeller overspeed was defined as “RPM greater than 1071”. This definition was then changed to “Propeller overspeed is defined as propeller [speed] greater than selected, e.g. 1020 – 900 – 850”. The motive for this change was that if the propeller exceeded its structural limit of 1071 rpm, it would have to be changed before the next flight of that aircraft.

According to the Chief Pilot a draft of a more lucid checklist had been obtained from another operator. Using this as a basis the company had made its own suggestion of a checklist for use in propeller overspeed situations. This proposal did not however receive the approval of the manufacturer. Instead the manufacturer brought out an amendment to the AFM, based on the company's ideas. On being asked by SHK if an operator is allowed to change the QRH without receiving approval from the manufacturer, the manufacturer replied:

"We are aware of the (operator's) proposal, to which we have not agreed. However, we have produced a revision to the Flight Manual which, based on the (operator's) concerns, more clearly guides the pilot in managing a propeller overspeed malfunction"

1.6.16 Procedures in the case of propeller overspeeding

A faulty function that causes the propeller to overspeed and thereby operate under the control of the OSG has no separate warning lamp. In the case of such a fault the PEC warning lamp lights on the warning panel and the pilots then have to localise the fault by looking at the propeller tachometers. According to the manufacturer the definition of a propeller overspeed is that the speed exceeds 1020 rpm, and/or the rotation speed exceeds that set via CL (850, 900 or 1020 rpm).

This procedure has been classed as a "memory item", which is indicated by the frame around the actual text, as shown in Fig. 6 below. By observing the procedure detailed in section 1.17.4 the PNF, on receiving the order from the PF, is to immediately carry out the prescribed procedure, without reading the checklist.

After performing the "memory item" actions, the PNF must with the aid of the QRH check that the actions have been taken, before proceeding further in the checklist with possible further actions. The main purpose of the checklist is that the faulty (overspeeding) engine shall be "secured", i.e. the propeller shall be feathered and the engine shut down. The restrictions in respect of securing the engine are that the propeller's uncontrollability shall be confirmed and that the propeller shall feather when the condition lever is placed in the start/feather position, or when using the alternative system with the back-up pump. The reason why the engine shall not be shut down if the propeller does not feather is that the drag is higher for a stationary (or windmilling[15]) propeller, than one which is overspeeding and providing a certain amount of power.

SHK has asked the manufacturer about the need to have the propeller overspeed checklist in the form of a memory item. This format indicates that there must be no time lost before the actions are taken, since there is not enough time to look it up in the ordinary checklist. This should be compared with the fact that a normal overspeed situation (about 1064 rpm) is only associated with the yellow arc, i.e. caution, on the tachometer, while at the same time the limitation section in the AOM permits continuous operation with an overspeed of up to 1071 rpm.

The manufacturer replied as follows to this question:

"It is assumed that the pilot is aware of the system limitations in the Limitations section of the AFM. Therefore, the crew knows that the occurrence of an overspeeding propeller, that has not exceeded 1071 RPM, is not cause for undue haste in managing the malfunction."

[15] Windmilling = The propeller is rotated at a certain speed by air pressure due to the aircraft airspeed

The checklist below was being used by the company at the time of the incident: The frame around the procedure shows that it is a memory item.

DHC-8-400

PROPELLER OVERSPEED

Affected Engine:

- **Power Lever .... Retard Toward Flight Idle**
- **Airspeed .... Reduce**

IF unable to control propeller RPM:

- **Condition Lever .... Start/Feather**
- **Alternate Feather (if req'd) .... Fthr**

Note: *If the engine is not shutdown immediately after feather the propeller with the Alternate Feather system, the propeller may unfeather. Re-select the ALT FTHR switch to feather the propeller.*

IF propeller <u>does not</u> feather:

- **DO NOT SHUT DOWN ENGINE.**
- Maintain minimum airspeed and altitude.
- Land immediately at nearest suitable airport

IF propeller feathers:

- **Complete ENGINE FAIL/ FIRE/ SHUTDOWN (page 5.10)**

Fig. 6. Extract from the operator's QRH

The first item "**Power Lever........Retard Toward Flight Idle**"

The point of this action is to reduce the power/load on the faulty propeller, and to some extent decide whether the propeller can be controlled. It is not stressed in the checklist, however, that the PL shall only be moved <u>towards</u> flight idle, never all the way <u>to</u> flight idle.

Second item, "**Airspeed..Reduce**"

Reduced airspeed helps to reduce the rotational speed of the propeller, and reduces the pressure on the propeller overspeed governor.

After the second item follows guidance information, which decides how the rest of the checklist is to be performed:

"IF unable to control propeller RPM."

SHK can see that the checklist does not contain any definition of how this is to be determined, and therefore asked the manufacturer for a definition of a controllable propeller, receiving the following answer:

"The AFM/AOM do not define controllable/uncontrollable with respect to the propeller rpm. Pilot aircraft knowledge and training is assumed to provide the necessary basic knowledge of what constitutes normal and abnormal propeller operation."

Put another way, this means that the definition of whether a propeller is controllable or not is not included in the documentation. The pilots' knowledge and training are assumed to provide sufficient understanding of what signifies normal and abnormal propeller operation.

Third item, **"Condition Lever...........................Start/Feather"**

In order to prevent further stress on the propeller and gearbox, or a negative development of the fault, the engine should be shut down. The first step in this process is to feather the propeller in order to create as little drag as possible. The third item in the checklist is to position the CL at start/feather, which should feather the propeller. If this does not work, the alternative feathering system must be used:

Fourth item, **"Alternate Feather (if req'd).........................Fthr"**

This item means that the pilot should use the alternative back-up pump to feather the propeller. This item is followed by a note that the propeller may return to an unfeathered position if the engine is not shut down immediately after using the alternative system.

The checklist is then divided into two alternatives: whether the propeller has feathered or not. In the case where the propeller, despite attempts, does not feather, the engine is not to be shut down. Minimum speed and height are to be maintained and landing must take place at the nearest available airport. In the case where the propeller has feathered, a transfer to the next checklist in the QRH is advised as the final memory item:

Fifth item, **"Complete ENGINE FAIL SHUTDOWN (page 5.10)"**

This item means that the engine is to be shut down in a controlled manner, along with its associated systems and accessories.

1.7 Meteorological information

According to METAR ESMQ at 16:50: wind 220°/12 knots, visibility more than 10 km, scattered clouds at 2300 feet, broken clouds at 2900 feet, temp./dewpoint +5/± 0 °C, QNH 1007 hPa.

1.8 Aids to navigation

The aircraft carried out an ILS approach with the aid of ordinary ground and airborne navigational equipment.

No faults or abnormal operation were found in the navigational aids that were used for the approach.

1.9 Communications

Communications between the air traffic control officer in the Kalmar control tower and SK 197, and certain rescue services at the airport were recorded. Selected parts of the communications were transcribed, and are integrated into Appendix 2 where, among other things, the transcriptions from the CVR are reviewed.

1.10 Aerodrome information

The airport status was in accordance with AIP[16] Sweden.

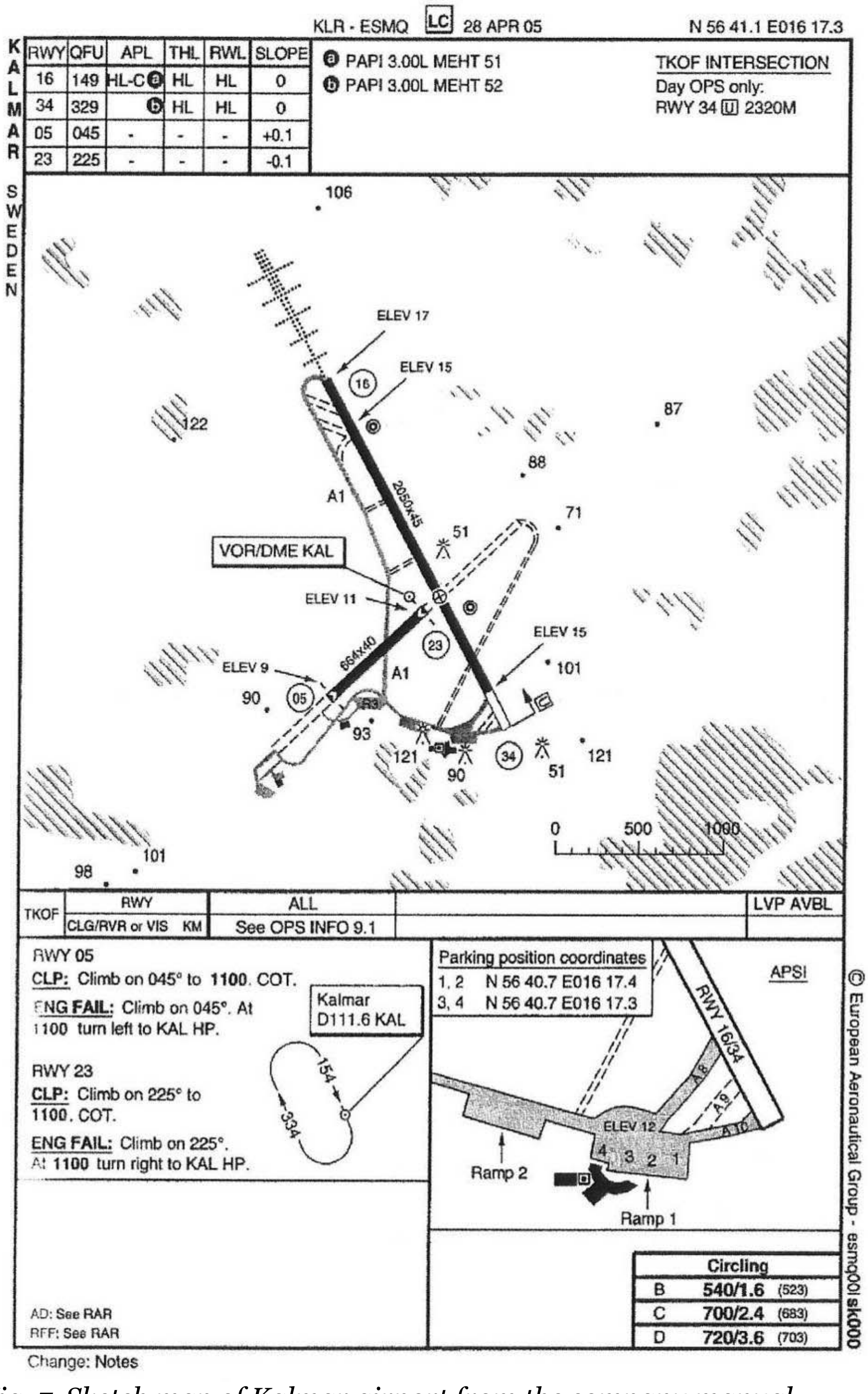

Fig. 7. Sketch map of Kalmar airport from the company manual

[16] AIP – Aeronautical Information Publication

1.11 Flight recorders

1.11.1 Flight Data Recorder (FDR)

The aircraft was equipped with a Flight Data Recorder of Honeywell type, which recorded parameters concerning the actual flight. Relevant data from the FDR was used by SHK in the investigation.

1.11.2 Cockpit Voice Recorder (CVR)

The aircraft was equipped with a Cockpit Voice Recorder (CVR) of Honeywell type which had the capacity of recording audible sounds in the aircraft for 2 hours. Sounds recorded during the course of the events have been analysed and selected parts transcribed, which are attached as Appendix 2 of the report.

1.11.3 Enhanced Ground Proximity Warning System (EGPWS) audible warning recording

The aircraft was equipped with a terrain warning system, EGPWS, which warns the pilots of abnormal or dangerous situations (see 1.6.11). The EGPWS system has a built-in memory unit that records warnings generated within a certain time interval. The warnings that were recorded in connection with this incident were played and printed out under SHK supervision.

At a height of 1198 feet above ground level the audio warning "Terrain Terrain Pull up" was heard for six seconds. At the time the warning was activated, the sink rate of the aircraft was 3715 ft/min. During the manoeuvring to stop this downward movement, a vertical load of 1.5 g was registered.

At a later stage of the approach the audio warning "Glideslope Glideslope", was recorded, indicating that the aircraft had deviated from the nominal approach angle provided by the ILS system. At the time the warning was activated, the height of the aircraft above ground level was 597 feet, and the descent rate was 1175 ft/min.

1.12 Incident site and aircraft wreckage

1.12.1 Incident site

The event took place in the airspace between the airport and about 10 km north thereof.

1.12.2 Aircraft wreckage

Not applicable.

1.13 Medical information

Nothing was discovered to indicate that the psychological or physical condition of the pilots was degraded before or during the flight.

1.14 Fire

There was no fire.

1.15 Survival aspects

1.15.1 General

Not applicable.

1.15.2 Actions by the rescue services

The air traffic control officer in the control tower realised, despite the co-pilot's statement that the landing would be normal, that a serious situation did in fact exist, and set off the warning alarm. The air traffic control officer quickly made contact with the airport rescue leader via radio, briefly informing him that an incoming aircraft had engine problems and would land within two minutes. Immediately thereafter the fire and rescue vehicle left the fire station and received permission to drive along taxiway A to the north. The known information on the remaining amount of fuel was not passed on to the airport fire and rescue service due to the extreme haste.

In addition to the airport fire and rescue service, the SOS centre in Växjö was automatically called by the warning alarm. The alarm operator at the SOS centre, in accordance with established procedure, called the air traffic control officer in the control tower to obtain information about the reason for the warning alarm. After this the local district rescue services were given an alarm and called out, with three vehicles from the fire station in Kalmar.

Once the aircraft had landed the airport fire service rescue vehicle followed it along the landing runway and checked that there was no danger and that a rescue intervention was not required.

The local district rescue services and an ambulance that had been called out, along with the police, were recalled before they arrived at the airport.

1.16 Tests and research

1.16.1 Technical investigation

During the technical investigation that was carried out on the right-hand propeller's pitch adjustment system after the incident it was found that chafing damage had occurred to the de-icing system bus bar. The damage showed that mechanical contact and sparking had taken place between the bus bar and the fixture in which the MPU was mounted. (See fig. 8 below.) After the bus bar was repaired, the system operated normally.

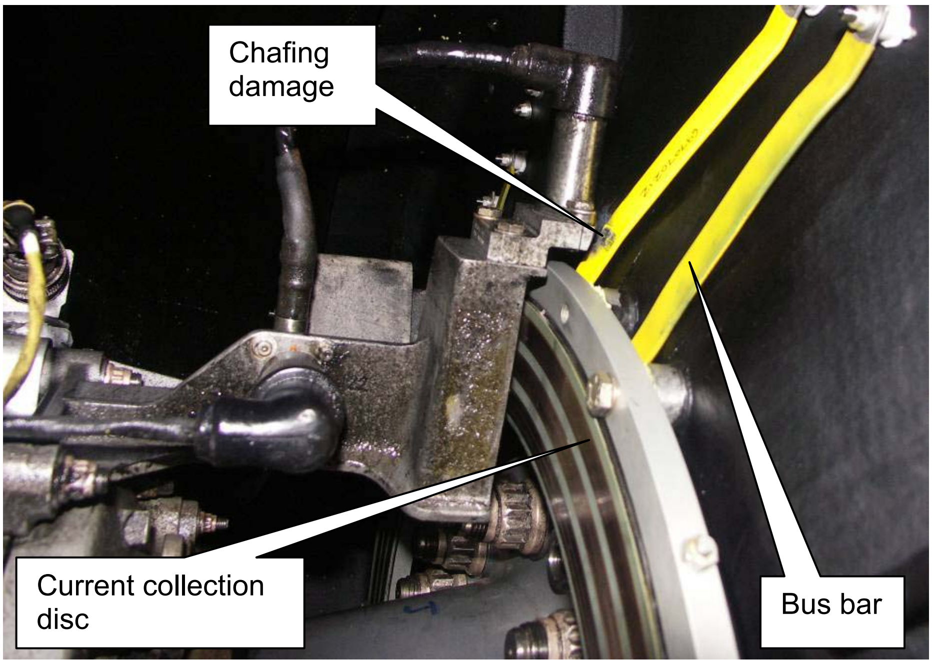

Fig. 8. Chafing damage to the bus bar after contact with the MPU securing fixture

1.16.2 Power provided by the left engine

The increased power demand from the left engine (125 % Tq) during part of the sequence of events did not cause any technical damage to the engine. The only action required after the incident was a technical inspection in accordance with the manufacturer's instructions.

1.16.3 Interview with the Q 400 Fleet Chief Pilot

The Fleet Chief Pilot (FCP) had this to say:

He had the operational responsibility for Q 400 operations within the company. Contacts with the manufacturer had been fraught due to the fact that the technical reliability had been low, but had recently improved somewhat. It had been possible to raise some questions in concert with other Q 400 operators, which had contributed to making the manufacturer take the problems more seriously.

At first, the company was under the impression that they were alone in having problems with understanding and using the emergency checklist relating to propeller overspeed. After contacts with other operators it emerged that several others had also had problems in interpreting the checklist.

There is also conflicting information in the operational documentation. According to the explanatory text in AOM 3.2.11 it says: *"Propeller rpm above 1020 should be viewed as an overspeed"*. In the description of the procedure in AOM 3.3-10, under the heading Prop overspeed, a different definition is given in parentheses: "(*Rpm greater than 1071)"* These definitions are regarded as confusing by both the flight operations and training departments, in respect of which information should be forwarded to the pilots. However, the pilots in the company do not have direct access to the AFM and the AOM.

In the three previous incidents relating to the same individual aircraft (see 1.20.1) "nothing had happened". All the failures had taken place while there was positive thrust from the engine, i.e. the power levers had not been in the flight idle position. Since nothing of a serious operational character was judged to have happened in connection with these three events, no particular attention had been paid to the incidents. The FCP had not considered that no-one had followed the emergency checklist. Therefore the reports on the incidents had not been followed up in any detail.

In the case of the current incident with SK 197 the FCP was also on duty in the flight operations department. It was therefore he who received the telephone call from the commander after the landing at Kalmar. During the conversation it had emerged that the commander had not had full control over the aircraft, but not how close they had been to possible limitations or the aircraft boundary values. There was no discussion about not following the emergency checklist during the incident. On the other hand the commander was asked why he did not feather the engine's propeller during the incident. The essence of the discussion had concerned the technical failure causing propeller overspeed. During the conversation with the commander, the FCP had not realised the full significance of the incident, and therefore had not removed the crew from active duty.

The fact that the crew had not used the checklists he put down to a question of misunderstanding and lack of knowledge of the possible consequences of mishandling. Older pilots can find it more difficult to remember all the memory items in the QRH. This human factors problem can also be considered to arise when training pilots who are transferring from jet turbine to turboprop aircraft. A jet engine that is left in flight idle does not generate extra drag. On the other hand, the propeller of a turboprop engine generates a lot of drag if it is left unfeathered in flight idle. No particular weight was attached to the information concerning this in connection with transfer/training on the Q 400.

The FCP had had a discussion with the technical department, concerning the fact that the same technical fault could recur several times on the same aircraft without the problem being solved. If the crew on the occasion of the first incident had followed the checklist, feathered the propeller and shut down the engine, the technical department would probably have approached the problem differently. Instead of systematically going through the fault tracing list step by step, they would have changed the component that they thought was causing the fault.

1.16.4 *Interview with the Q 400 Chief Flight Instructor*

The Chief Flight Instructor (CFI) had this to say:

He was responsible for the training and recurrent training on the Q 400. The company's own instructors performed the training. Most of the practical work was done using hired simulators at the SAS Flight Academy.

The basic training followed prescribed training plans, and OPC/PC continuation training was in conjunction with the flight operations department. OPC/PC were preceded by a theoretical segment (Computer Based Training – CBT), in which all important systems in the aircraft were revised in a three-year cycle. The systems revised via the CBT usually recur as practical training in the simulator. The co-operation with the flight operations department in respect of OPC/PC was seen by the CFI as working well.

Prop overspeed had been included in the OPC/PC scenarios during the previous three years. This fault had however only been practised in association with take-off and climb out, these being the most critical phases. Simulator training had not suffered from the cost savings that the company had in general implemented. On the contrary, certain parts of the basic training had been granted an increased number of simulator sessions.

According to the limitation section of the AFM, the propeller speed in an overspeed situation must not exceed 1071 rpm continuously. At the same time, the pilots are expected to understand that they must carry out a memorised checklist "by heart" if the speed exceeds 1020 rpm. The CFI thought that a possible explanation for the crew choosing not to follow the checklist and thereby not feather and shut down the engine, was that the engine was working and that no limit values had been exceeded.

Operations with the Q 400 were originally carried out by a sister company (see 1.171.1), but were then taken up by the parent company. According to the CFI there was no sub-culture from the earlier company form that could negatively affect the pilots during a propeller overspeed incident. If such a sub-culture had existed, this would have become apparent from the management of other emergency procedures or routines.

1.16.5 *Interview with the Line Check Pilot*

The Line Check Pilot (LCP) had this to say:

Service as an LCP means that one works in the flight operations department to ensure that the company standards and procedures are complied with and function properly. He had also worked earlier as a simulator instructor on the Q 400. As the LCP he performed "line checks", in which he normally accompanied a crew in the cockpit during a normal roster out on the line. These flights were carried out with the LCP in the third seat in the cockpit so that he could observe the work of the pilots. The LCP also performed "release flights" to qualify new first officers and captains when they were to transfer from the training department to the flight operations department after completing their training.

He was the LCP on board when one of the propeller overspeed incidents occurred, and carried out a line check on the commander. The fault occurred during the approach, at about the point where the glidepath began, and the aircraft started its final descent to the runway. The crew had identified the fault as propeller overspeed, and took out the QRH. However the checklist had not been complied with in respect of feathering and engine shut-down. The crew had assessed the situation as stable, and according to the LCP "it went against the grain" to possibly worsen the situation by shutting down a fully working engine or to break off from the approach and perform a go-around. The crew also did not consider that they had broken any limitations, since there was no "red value" on the propeller tachometer.

During the debriefing afterwards they had discussed what had happened. The LCP had agreed with the crew's reasoning and the solution to the situation that arose. He would have done the same himself. The problem was also discussed at the base, but not in operational terms, rather as a technical problem. No-one discussed the use of the emergency checklist. "The problem was more technical in nature, not that anything more serious could happen."

According to the LCP, the checklist in the QRH is not clear. Both "*Power Lever - retard toward flight idle*" and "*control propeller rpm*" are expressions that can be interpreted in different ways and thereby be misunderstood. He also thought that the checklist seemed to be written more for the case of propeller overspeed on take-off and climb-out than for this case, during the approach and landing. In the opinion of the LCP, the reason the crew did not follow the checklist was that it was so unclear that one could not understand what it meant.

The other incidents of propeller overspeed took place with instructors as commanders. These incidents were dealt with without the crews following the checklist, or without it being completely complied with. The LCP understood that there is a misguiding effect when instructors or line check pilots use other procedures that those prescribed by the checklists and manuals, and that this can have an unfortunate effect on other pilots.

1.17 Organisational and management information

1.17.1 General

The company had undergone a period of extensive restructuring with both rationalisations and efficiency measures. Organisationally the company had been split into three national units, with only the intercontinental traffic remaining in the original consortium.

Neither of the pilots on this particular flight had suffered any negative consequences from the reorganisation of the company.

Operations with the Q 400 and similar aircraft types had previously been managed by a sister company in the Group, where co-pilots from the company could apply, in order to become commanders more quickly. The sister company also recruited its own staff externally, so the pilot group within that part of the consortium consisted eventually of a mixture of internally and externally recruited pilots. A large proportion of the internally recruited pilots had no previous experience of operations with this class of large turboprop aircraft. However the sister company was closed down, and the Q 400 operations were incorporated into the present company.

The commander in the present incident had only jet experience before he started to work for the sister company. He had however flown another type of turboprop aircraft (SAAB 2000) before retraining to the Q 400. The co-pilot had experience from earlier service with several turboprop aircraft.

1.17.2 *Normal procedures – approach and landing*

The company utilised standardised procedures for approach and landing. The type of approach planned by the pilots of SK 197 was a standard ILS approach to runway 16 at Kalmar. This type of approach was normally done using the autopilot. The primary purpose of this was to minimise the workload of the pilots.

1.17.3 *Normal procedures – division of tasks in the cockpit*

For each flight the commander decides which of the pilots will perform the flying, i.e. who will be the PF (Pilot Flying). The other pilot will therefore be the PNF (Pilot Not Flying). The division of tasks is laid down in the company's OM[17], which contains a specific description of each task, methods and the actions in certain conditions. The methods are determined by whether the aircraft is to be flown manually or by the autopilot.

In this case, with manual flying from about 2000 feet height, when the autopilot was disconnected, the PF had two main tasks to perform:

- To fly the aircraft in accordance with the specified flight profile.
- To monitor the aircraft attitude, height, speed and sink rate.

The PNF must accordingly perform the other tasks in the cockpit during flight. The most important of these can be summarised as follows:

- To program in the values in various systems on receiving orders from the PF (to set the frequencies of radio beacons, other settings in the FMS[18], etc.).
- To operate the configuration controls on receiving orders from the PF (landing gear, flaps, etc.).
- To manage radio communications.
- To monitor other systems in the cockpit.

This methodology is intended to allow the PF to concentrate his/her undivided attention on the safe progress of the aircraft. The principle is that all stages of the flight that require adjustments or other kinds of manual intervention shall be carried out by the PNF, i.e. the pilot who is not flying the aircraft.

1.17.4 *Normal procedures – the use of checklists*

According to the company OM, emergency checklists shall be used in accordance with the following procedure. The principles of the routines apply in the same way regardless of whether they are memory items or not. Certain emergency situations are however always handled by the pilot in the left seat, even if at that moment he/she is the PNF.

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[17] OM = Operations Manual
[18] FMS = Flight Management System

- The pilot who is PF shall continue to concentrate on flying.
- The PF orders the relevant emergency checklist to be consulted.
- The PNF shall, as far as possible, monitor the flying.
- The PNF shall begin to comply with the emergency checklist, whereby the system or component concerned and the relevant action are to be read aloud.

When the correct action has been taken this is to be repeated verbally. For example a new position for a switch is defined. Example: "Right generator off". Actions that affect the vital systems of the aircraft, or actions which will have consequences for the continued flight of the aircraft, must always be verified by the PF before they are performed. Example: "Confirm left engine fuel off" In the case of an engine failure at an early stage of the approach, this can continue, but with increased height minima in certain cases. Memory items and checklists shall be performed/read out, but at lower than 1000 feet checklist reading shall not be carried out. If an engine fails at less than 500 feet on the approach, the aircraft must be accelerated unless a safe landing can be made.

1.17.5 Stabilised approach

The conditions that the company prescribed for an approach to be considered stabilised are described in OM B section 2.9. In this case, with an ILS approach, the conditions apply that are marked in the table in Fig. 9.

The aircraft shall be established, with only small lateral and height deviations on the ILS receiver, flaps down and landing gear shall be down. In addition the speed must be stable within a defined range, the sink rate a maximum of 1500 feet/min, and the CL at max. (1020 rpm) with only small changes in Tq.

Unless all the above conditions have been met at no lower than 500 feet AGL, the PNF, in accordance with the company's OM B must insist that a go-around is initiated, and if necessary take over control to do this.

2.9.1.2 STABILIZED APPROACH CONCEPT

The aircraft is considered to be stabilised when the following parameters are met:

<table>
<tr><td rowspan="10">Flight Path</td><td colspan="2" rowspan="2">Type of approach</td><td colspan="2">Maximum deviation</td></tr>
<tr><td>Vertical</td><td>Horizontal</td></tr>
<tr><td rowspan="2">Precision</td><td>GCA</td><td colspan="2">According to GCA controller</td></tr>
<tr><td>ILS</td><td>One dot on GP</td><td>One dot on LOC</td></tr>
<tr><td rowspan="4">Non-precision</td><td rowspan="2">CANPA</td><td>150 ft below advisory altitudes after FAF</td><td>Established on in bound course</td></tr>
<tr><td colspan="2">Wings must be level at or before 500 ft RH
MAPt must not be passed</td></tr>
<tr><td rowspan="2">Non CANPA</td><td>Above minimum altitudes after FAF</td><td>Established on in bound course</td></tr>
<tr><td colspan="2">Wings must be level at or before 500 ft RH
MAPt must not be passed</td></tr>
<tr><td colspan="2">Visual Approach</td><td colspan="2">Along the desired flight path
Wings must be level at or before 500 ft RH</td></tr>
<tr><td colspan="2">Circling</td><td colspan="2">Along the desired flight path
Wings must be level at or before 300 ft RH</td></tr>
<tr><td rowspan="5">Configuration</td><td rowspan="4">Flap Position</td><td colspan="2">Precision</td><td>15°/35°</td></tr>
<tr><td rowspan="3">Non-precision approach</td><td>Constant angle Approach</td><td rowspan="3">15°/35°</td></tr>
<tr><td>Conventional</td></tr>
<tr><td>Circling / Visual</td></tr>
<tr><td colspan="3">Landing gear</td><td>Down</td></tr>
<tr><td colspan="2">Speed</td><td colspan="3">Maximum speed 160kts.
Minimum for approach is corrected V_{REF}.</td></tr>
<tr><td colspan="2">Rate of descent</td><td colspan="3">Max. 1.500 fpm</td></tr>
<tr><td colspan="2">Power setting</td><td colspan="3">CL MAX with only small TRQ changes.</td></tr>
</table>

OM-B Q 400 2.4.1: Stabilized Approach Concept

Fig. 9. Criteria for a stabilised approach.

1.17.6 Training and recurrent training

Training on this particular type of aircraft is mainly divided into three parts: theoretical training via CBT[19], practical flight training in a simulator (including flying observed by an examiner), and line training under supervision, up to the final “release” when the candidate has been cleared for operations. The first two parts of the training are managed by the company training department. All training plans for type training are approved by the inspection authority, STK.

When the pilot has been cleared for operations on the type, he/she is transferred to the flight operations department, which apart from operational responsibility also manages recurrent training.

The company continuation training programme includes two simulator checks per year, OPC/PC, of which one takes place in the presence of a rep-

[19] CBT: Computer Based Training (self-study using a computer)

resentative who has been assigned by the company and authorised by the inspection authority. On these occasions procedures, emergencies and other situations that require special training are practised.

In the simulator checks that the pilots had undergone, propeller overspeed had been included in the training scenarios. This type of fault had however only been practised in connection with take-off. Neither of the pilots had practised with this fault in connection with approach and landing.

1.17.7 CRM

The basis for functional and safe crew co-operation is CRM (Crew Resource Management). The general definition of CRM is: *The art of using all available resources in an optimal way.*
Well-functioning CRM is documented as raising flight safety levels. History has many times shown that poor CRM can have disastrous consequences.

The cornerstones of CRM in respect of flight crews can be said to be built up from the following components:

- Professionalism
- Briefing & Communication
- Leadership & Teamwork
- Situational awareness
- Decision-making
- Own evaluation

Within commercial aviation, education and training in CRM are obligatory, and must form part of a natural strand of competence development in traffic pilots. Apart from theoretical training, CRM is included in simulator training and line training, where practice and feedback are the most important components for individuals to understand the concept. Supplementing CRM in basic training are theoretical refresher courses and CRM training in the simulator, which are obligatory elements in continuation training for pilots.

1.17.8 Administrative functions

The following is a review of some of the company's internal requirements in OM-A for the control of operations and the reporting and handling of events.

The company's control of operations

The basic requirement (OM-A 2.1.1) is that all operations are to be guided and controlled so that deficiencies are dealt with and so that the quality and safety of operations are constantly maintained and improved. In addition, among other things, it says that the standards of the staff in particular shall be in focus, and safety always has the highest priority.

Among other requirements can be mentioned that administrative pilots, instructor pilots and Line Check pilots have a special role in supervising the daily operations to ensure as a minimum that they are carried out in accordance with the company's quality and safety standards (OM-A- 2.1.2).

Reporting and handling of events

General

The company's reporting system (Common Deviation Report System, CDRS) shall be used to report all accidents, incidents, events, deficiencies, etc. (OM-A-11.1). The purpose of this reporting is to provide input for quality improvements and preventive work within the company. Reporting shall also keep the company and relevant authorities informed of events in the day-to-day business. The reporting system must also be used to present information and proposals that can improve the business of the company in general.

Reporting

Deviations must be reported as soon as possible, and no later than 72 hours from the time they occur, except for events related to flight safety, which must be reported within 24 hours. Significant flight events classed as "Urgent" must also be reported immediately to the relevant functions and authorities.

The commander must also, in many defined cases, inform the company's Operational Control function, via telephone as soon as possible after the occurrence.

CDRS is used for reporting and management of reports, statistics, analysis of individual events and trend analysis. CDRS is administered by the department of Flight Safety and Quality (Safety Office).

In accordance with OM-A 11.1.2.2 the commander is obliged to make a Safety report if a flight safety event concerns certain technical and/or operational events during flight or on board the aircraft while it is on the ground. When the commander returns to home base he/she must contact the chief pilot and be available for further investigation. If the commander assesses that the pressure on any member of the crew is such that flight safety is at risk, he/she can delay or cancel further flying (OM.A-11.1.2.3)

If an urgent message is required, it shall, in accordance with OM-A-11.1.4.2, be sent immediately. When a message is marked as urgent, the CDRS automatically sends the message. If the CDRS is not available, the message can be communicated verbally with the Operational Control function.

Notification and handling of events

A description of how the company must notify and deal with reported events is in OM.A-11.1.5. According to this, the flight operations department must, among other things, inform STK about a Safety Report within 72 hours of the time of the event.

Operational Control shall immediately inform the flight operations department Duty Manager in the case of an event classed as an accident or serious incident.

CDRS shall be monitored daily so that incoming reports shall be actioned. After screening of the reports they are to be referred to the relevant assessment office, which is then responsible for assessment and the initiation of an investigation based on the report. Safety reports must be checked within one working day. A preliminary assessment of the event must be completed within two weeks of the time of the event. When the investigation of an event is complete, a final assessment is made. Among other things, this assessment shall cover the level of the investigation and the parameters, in accordance with the company's risk assessment methods, such as cause area, seriousness and risks. The risk category and the level of seriousness respectively are assessed in accordance with the following tables, in the company OM-A section 11.1.5.9:

Risk category	If the event should recur, the probability of a major accident is
R1	high
R2	increased under any circumstances
R3	increased under any circumstances that occasionally prevail
R4	not increased or increased only under extreme circumstances
R5	not increased as the occurrence is not related to flight safety

Seriousness	For this occurrence, and under the prevailing circumstances, the probability of a major accident in (the operator) was	Explanations
A	high (or a major accident occurred)	The outcome was not controllable and could just as well have been a major accident. A major accident was avoided only by pure luck or by exceptional pilot skill beyond normal expected ability.
B	considerably increased	The outcome was controllable by use of available emergency/malfunctions procedures and emergency equipment. However, safety margins were considerably degraded and only one, or a few, safety layers remained.
C	slightly increased	Numerous safety layers were still remaining to prevent a major accident.
D	not increased, but occurrence indicative	Only under remote complications should the occurrence have developed into a major accident. However, the occurrence indicates a quality problem that could affect safety.
E	not safety related	The occurrence was not safety related.

According to the information supplied by the company to the SHK a risk assessment is made by co-operation between the Safety Office and the department affected. Simpler events are dealt with directly by the Safety Office, while more complex events are assessed by a special assessor.

The scale of the investigation into reported events can be more or less comprehensive. Investigations eventually lead to proposals for measures to be taken. Feedback is also given to those who report events.

The three earlier events concerning propeller overspeed had also been reported to the inspection authority, STK. In conversations with the official who had the Q 400 as an area of responsibility, SHK could ascertain that these events had not been followed by any proposals from the authority for measures to be taken.

<u>Additional information</u>
CDRS is one of several areas in the company's Accident Prevention and Flight Safety Programme (OM-A- 2.3.1.2) The Programme also covers, for example, Line checks. The purpose of Line checks is stated, among other things, to give the company a general picture of the company's pilot's standards and compliance with existing instructions and procedures, and to ensure a high, unified and safe operational standard.

1.17.9 Earlier incidents in the company

Within the two year period preceding this incident there were, according to the company, six cases of propeller overspeeding. The QRH emergency checklist was not followed in any of these cases, instead the crews had either carried out only part of the list, or not followed it at all. The three most recent incidents occurred within a three week period just before the present incident.

1.18 Equal opportunities aspects

This event has also been examined from the point of view of equal opportunities, i.e. against the background that there might be circumstances to indicate that the actual event or its effects were caused by or influenced by the women and men concerned not having the same possibilities, rights or obligations in various respects.

In this case the commander was an older man with great experience. The co-pilot was a younger woman with a lower level of experience.

Neither of the pilots said that they were influenced by this. Both pilots stated that their mutual relationship and co-operation in the cockpit during the flight functioned well.

1.19 Environmental aspects

No known environmental effects.

1.20 Additional information

1.20.1 Earlier problems – operational management

This incident had been preceded by three similar events with the same individual aircraft and the same engine, on 14 March, 30 March and 4 April. In every case a similar sequence of events occurred, with a PEC caution followed by a propeller overspeed. All the incidents occurred during the approach phase.

<u>14 March</u>
Flight Örnsköldsvik – Arlanda. At a late stage of the approach to runway 01R a PEC warning for the right engine appeared followed by a propeller overspeed. The crew reduced the power of the faulty engine and completed the approach and landing without further measures. The QRH checklist for propeller overspeed was not carried out.

<u>30 March</u>
Flight Växjö – Arlanda. At a late stage of the approach to runway 26 a PEC warning for the right engine appeared followed by a propeller overspeed. The approach and landing were completed without further measures. The QRH checklist for propeller overspeed was not carried out.

<u>4 April</u>
Flight Tallinn – Arlanda. At a late stage of the approach to runway 19L a PEC warning for the right engine appeared. The crew consulted the QRH and determined that the engine responded to power changes. The approach and landing were completed without further measures. The QRH checklist for propeller overspeed was only partly carried out.

All the above incidents were assessed by the company's flight operations department as belonging to the category of simple events. The incidents all received the same assessments: Seriousness level D and risk level R4. The reports did not contain any comments about not following the checklist.

1.20.2 *Earlier problems – technical management*

On 3 March 2006, about one month before the incident, the right engine had its propeller changed. During the period after this was done, the PEC memory recorded fault messages on three occasions, which resulted in the following actions.

Date	Action
060314	Actions in accordance with AMM[20] – no component change. Functional check OK.
060330	Actions in accordance with AMM – MPU replaced. Functional check OK.
060404	Actions in accordance with AMM – PECU replaced. Functional check OK.

1.20.3 *Dowty Service Bulletin (SB) D8400-61-38*

The propeller manufacturer Dowty recommended in SB D8400-61-38 that the MPU fixture should be modified (edge bevelled) to minimise the risk that contact between the fixture and the propeller hub bus bar could take place during operation. This modification was carried out on the propeller in question on 23 January 2003.

1.20.4 *Earlier accidents*

In 1994 an accident occurred to a SAAB 340 at Amsterdam airport. The aircraft performed an approach with one engine's propeller in flight idle and unfeathered. During an attempt at a go-around the aircraft became uncontrollable and crashed, with several fatalities as a result.

In 2003 an accident occurred to a Jetstream 31 on the approach to Luleå/Kallax airport. During a flight without passengers, single-engine approaches were being practised before the co-pilot's PC. The approach was made in flight idle with the propeller unfeathered. Close to touch-down control was lost, the aircraft rolled and was totally destroyed.

1.20.5 *Measures taken*

After the incident the company took the following measures:

- The checklist for propeller overspeed was altered with the intention of making it more clear.
- Information was promulgated to the pilots in respect of the handling and risks associated with unfeathered propellers in the flight idle condition.
- The company informed STK in respect of the amendment work in respect of the Q 400 checklists.
- Propeller overspeed training in association with approach and landing were inserted as a recurring theme in the OPC/PC simulator checks.
- The technical department has improved the system that warns when the same technical faults recur.

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[20] AMM – Aircraft Maintenance Manual

2 ANALYSIS

2.1 The incident

The control problem during the approach was caused by the fact that the aircraft in that particular configuration was outside the normal flight control envelope. The power from the left engine was 25% higher than its normal maximum, while the right engine was idling with its propeller unfeathered.

This configuration caused a massive increase in the drag of the aircraft, where the principal influencing factors were:

- The propeller on the right engine was unfeathered, creating a large braking "disc" in the aircraft's direction of flight.
- A powerful yaw component was applied to the aircraft, caused by the extreme asymmetric power condition.
- Reduced lift from the wing area behind the unfeathered propeller, which required increased aileron compensation and thereby increased drag due to spoiler activation.

As a consequence of the aircraft flying outside the normal flight manoeuvrability control envelope, SHK can conclude that at no stage during the approach did the aircraft meet the requirements for a stabilised approach. According to the directions in OM B a go-around must be initiated by the PNF at no later than 500 feet AGL if the aircraft is not stabilised. Since the pilots had agreed that this was not possible, the approach was continued in an unstabilised condition, however, as this was the only alternative.

SHK cannot judge how close the aircraft was to a crash in respect to height, speed and controllability, but can conclude that both pilots on separate occasions during the approach were convinced that they would not reach the runway.

Nothing has emerged to show that the crew of SK 197 handled the situation any differently than their colleagues had done in the earlier fault situations. However the conditions this time were different, with the power levers at flight idle when the technical fault occurred. In the other incidents the fault occurred when the power levers were at power levels above flight idle, which meant that the drag increase from the unfeathered propeller was never noticeable. However the crews did have in common that the emergency checklist was not followed.

2.2 Faults in the system for setting propeller pitch

The technical examination of the system for setting propeller pitch showed that mechanical contact and sparking had taken place between the fixture in which the Magnetic Pickup Unit (MPU) was mounted and the bus bar in the propeller hub. Since the sparking generated electromagnetic interference, this probably affected the signals from the MPU to the Propeller Electronic Control computer (PEC).

All the indications are therefore that the overspeeding that occurred in this flight was caused by interference to the signal from the MPU, whereby the automatic propeller speed regulation was made inoperable.

The fault messages recorded in the PEC during the period before the incident were probably caused by the same fault, that arose intermittently.

The propeller manufacturer is obviously aware of the problem, since the company issued SB-D8400-61-38 with the purpose of minimising the risk of contact between the fixture and the sensor. The fact that this could happen, despite the measures taken in accordance with this SB, show that there is still a very small gap between these units and that the problem has not been completely solved.

The additional fact that the technical department, when fault tracing after the first three messages, did not follow the fault tracing list, can indicate a deficiency in the company's quality control in respect of the technical department's methods.

2.3 Decision during the approach

2.3.1 The checklist misunderstanding

The fact that "propeller overspeed" did not result in any separate indication on the aircraft's warning panel, in this case does not matter. SHK does however consider that it is unfortunate that identification of such a serious fault is expected to take place by means of an annunciator warning concerning the PEC, followed by reading the engine instruments.

Despite this, the crew could correctly identify the fault as propeller overspeed. The commander, as PF, then himself began the memory items in accordance with the checklist, which in this case meant making sure that the two first items had been carried out. This was not in accordance with the prescribed procedures in the OM, where the PNF should manage the checklist on the orders of the PF.

According to the interviews with the commander, he interpreted the checklist item "*Power Lever.....Retard Toward Flight Idle*" as if this was completed, since both power levers were in the flight idle position when the fault occurred. The reason for the pilot misunderstanding the checklist memory item is assessed by the SHK as being because the checklist was not completely clear. There is no information in the checklist to say that a power lever should not be placed at flight idle. Nor was the company informed of the potentially dangerous situation that can arise by having an engine power lever in flight idle if the propeller is not feathered.

2.3.2 The checklist was not complied with

Thereafter, the commander had not completed the other points in the check list concerning feathering and shutting down the engine, which led to the subsequent control problems. Factors in the situation that contributed to his decision were that landing was imminent, and that he considered that the aircraft had sufficient power available. In addition he took into the account the risk of shutting down the wrong engine.

The commander did not see the connection between the pitch location of the propeller and the major control problem, which was probably due to a lack of system understanding. Contributory to this could have been the commander's earlier background, which was mainly experience in jet operations. SHK is able to say that pilots with mainly jet experience did not get any special training over and above the usual type course, when transferring to turboprop operations. This has been a shortcoming in the company's training. To this can be added that propeller overspeed had exclusively been practised in connection with take-off.

Nor had the checklist been followed, or only incompletely, by several other crews in the case of propeller overspeed in connection with landing. On these occasions, however, the power lever was not at flight idle when the overspeed occurred. Several explanations were given for not completing the checklist in these situations. One reason was said to be that the engines were completely functional and that the pilots were not willing to risk making the situation worse by shutting off an engine. A further reason was said to be that no limitations had been exceeded, since there was no "red value" on the propeller tachometer. A third reason stated was that the checklist was unclear and had been misunderstood.

The emergency checklist was thus either not used at all, or only partially, on several occasions. This was also the case when an instructor was on board to perform a line check. Against this background it was natural that the behaviour of not following the emergency checklist was perceived as acceptable. When a deviation occurs in a situation like this one, with an exacerbating factor (power lever in flight idle), this behaviour only leads to encroaching further on the safety margin.

2.3.3 *Proposal to "secure" the engine rejected*

The commander rejected the repeated proposal from the co-pilot to "secure" the engine. The reason why he did not accept the proposals was that he regarded the engine as "dead", and in addition he felt that he had been taught not to do anything else, just to descend and land. SHK has however not found any support for this assertion, neither in the company's training plan nor in interviews with those responsible for training.

After the fault arose, the co-pilot proposed on two occasions that they should secure the engine, i.e. feather the faulty propeller and shut down the engine. On both occasions she received a negative response. During the SHK interviews the co-pilot explained that she was aware that this was a potentially dangerous situation. She had however recently remembered hearing that a colleague had recently suffered a propeller overspeed in connection with landing and that the colleague had not feathered the propeller and shut down the engine. She had also the impression that the accompanying LCP did not question this action. This contributed to her not questioning the commander's decision.

During the later stage of the approach, the commander said that "he had his hands full and felt himself blocked". Taking into account the above analysis and the aircraft configuration, where it was established that the aircraft was outside its limits of normal manoeuvrability, SHK believes it probable that the entire capacity of the commander was utilised to keep the aircraft in the air, and that at this stage he did not have the capability to further evaluate the situation. It is also known that acute stress limits both attention and the capacity of the working memory.

It is also possible that a dispute in the cockpit in respect of the decision not to feather could have been disturbing, despite the relative calm existing between the pilots. During the remainder of the approach the co-pilot concerned herself instead with all her capacity in mentally supporting the commander in controlling the aircraft.

2.3.4 *Equality of opportunity aspects*

SHK has considered whether the relationship with the commander being male and the co-pilot female affected the sequence of events. It can be concluded that several other circumstances may also have influenced the relationship between the pilots: The male was the commander, older and had greater experience. The pilots themselves did not assign any importance to the difference in gender.

The investigation has not shown that any lack of equality of opportunity affected the development of events during the incident.

2.3.5 CRM

SHK can conclude that the conditions leading to whether the crew of this flight would handle the fault that occurred completely "correctly" were rather limited. With poorly written documentation, the lack of applicable training, deficient information from the company and signals that the problem could be solved without following the checklist, the conditions for making a correct decision were simply not there.

The fact that despite this the aircraft could land without any injury to anyone shows that the crew had sufficient ability to combine their resources in an effective way. The commander used all his physical capacity to control the aircraft in the final critical stage, and the first officer used her mental capacity to provide information concerning height, speed and attitude.

In the opinion of SHK the final part of the approach serves as an example of how important it is for an operator to both mentally and practically interweave CRM in all parts of the company's operations. This incident could have led to a different conclusion if the crew had not, during the final stages of the approach, made optimal use of their resources.

2.4 Understanding the consequences of a system failure

2.4.1 Manufacturer's actions

The checklist in the AFM in respect of propeller overspeed had not been altered since the aircraft was certified. The faults in the system that arose on this aircraft type cannot be said to have had an alarming extent. On the other hand, it emerged during the SHK investigation that different operators had dealt with the fault functions in different ways. Some had completely understood the emergency checklist intentions that an overspeeding propeller must be feathered and the engine shut down. Other operators, for various reasons, did not follow the list at all, or only followed part of it.

The manufacturer does not seem to have regarded this as a problem, and had not taken any action.

It is believed by SHK that doubts regarding the management and/or consequences of a technical failure should normally lead an aircraft manufacturer to review the prescribed instructions in such documentation as checklists. In this case, with a fault in the propeller pitch control system, several operators have pointed out the fault and the lack of clarity, without any result in the form of amendments.
SHK has also pointed out to the manufacturer that the checklist can be perceived as unclear and unsatisfactory, and received the following reply:

"We disagree that the procedures are not satisfactory".

After this incident, however, the manufacturer has changed the procedures in the AFM, to limit the risk of misinterpretation.
It is the opinion of SHK that the unclear checklist could have contributed to an incorrect and dangerous interpretation of how to deal with the problem, and this spread throughout the company's pilots.

The extract from the QRH that describes the procedure in the case of a propeller overspeed (see Fig. 6) is one of 17 "memory items" in the emergency checklist for this type of aircraft. Learning texts and acronyms by heart used to be a proven method of tuition. In today's society the "learning by heart" method is used only sparingly in safety-related systems. It has been replaced by methods that are based on other grounds than the ability of an individual in a perilous situation to be able to remember the right things.

SHK wonders whether it promotes flight safety to have 17 "memory items" in such a vital safety document as an emergency checklist.

2.4.2 Documentation

As mentioned earlier, the definition of a propeller overspeed is that the speed exceeds 1020 rpm, or that the CL lever position does not agree with the obtained speed according to the tachometer. In that case the pilot must immediately act in accordance with the checklist (memory items) in the QRH, feather the propeller and shut down the engine.

In addition to the emergency checklist in the QRH for propeller overspeed, there is supplementary information concerning propeller overspeed in other parts of the operational documentation:

- *Rpm greater than 1071.* (AFM)
- *Maximum allowable continuous Np overspeed is 1071 rpm* (AOM)

The manufacturer has commented on the above that there is no hurry to take any action as long as the speed does not exceed 1071 rpm.

The differing information concerning propeller speed, together with the fact that indications between 1020 and 1071 rpm are only of a "cautionary" character on the indicator in the cockpit show that the manufacturer's instructions on how to deal with the fault can be seen as conflicting. Depending on which documentation one reads, one can obtain completely different appreciations of what is permitted and what is not. The checklist in the QRH is to be learned "by heart" by the pilot. Not even the manufacturer considers, however, that there is any urgency as long as the speed does not exceed 1071 rpm.

In all, the SHK considers that the documentation created uncertainty within the operating company in respect of the content and use of the checklist. This can have contributed to the creation of a picture amongst the crew that the fault in this system could not lead to a dangerous situation.

2.4.3 Measures taken by the operating company – emergency checklist

The company's operations with the Q 400 have been plagued by frequent technical problems. Faults in the propeller pitch control system have appeared as one among many, and did not raise any alarms. Against this background, it is understandable that the earlier propeller overspeed events were not paid any particular attention. The situation became somewhat different during the period immediately preceding this incident, when three cases of propeller overspeed occurred within a short time.

SHK has however noted that the company's flight operations department, despite a relatively low failure rate in the control system, observed that the emergency checklist (QRH), was not satisfactory, and therefore entered into a dialogue with the manufacturer in respect of amendments.

As can be seen from the above, the manufacturer was not inclined to alter those particular procedures. The fact that the company pointed out the need for an amendment, in some cases together with other companies, did not therefore have any effect. The fact that changes in the QRH are not directly subject to the supervisory authority's checks can also have meant that the amendment proposals did not carry the necessary weight.

2.4.4 *The company's measures – information to the pilots*

Despite the lack of amendment to the checklist, the company was able, during training and operations, to inform its pilots about the dangerous situation that can arise if propeller overspeed is incorrectly handled. This is of increased importance since many of the Q 400 pilots had earlier flown jets. In the case of a jet engine, power levers in flight idle do not lead to increased drag.

As far as SHK knows, no special information regarding the dangers of a propeller aircraft with one engine power lever in flight idle and its propeller unfeathered has been given to this group of pilots. The lack of information about the problem of increased drag and subsequent control problems can therefore be categorised as something of a *non-sequitur* among the pilots. Information and training about the increase in drag was said to have been provided in basic training, but was not subsequently followed up.

2.4.5 *Management of deviations within the company*

The three incidents of propeller overspeed that occurred during the three week period before this incident had all resulted in the submission of Flight Safety reports. These reports were categorised by the company as simple events and had been assessed at risk level R4 and seriousness level D.

The first category, risk assessment 4, is defined as follows:

"If the event should reoccur, the probability of a major accident is not increased or increased only under extreme circumstances"

The company made the assessment that if this fault should recur, the probability of a major accident was not increased, or would only be increased in extreme circumstances.

The second category, seriousness assessment D, is defined as follows:

"For this occurrence, and under the prevailing circumstances, the probability of a major accident in (the operator) was not increased, but occurrence indicative.
Only under remote complications should the occurrence have developed into a major accident. However, the occurrence indicates a quality problem that could affect safety."

The above assessment, in which the company judges that only in the case of "remote complications" would the incident have developed into an accident, indicates that the level of seriousness was not given the correct value in the case of these incidents. SHK believes it is probable that a propeller overspeed failure was only assessed for risk in respect of the technical problem. As far as SHK can see, there was no risk assessment carried out on the fact that none of the crews followed the checklist.

SHK also notes that the three similar incidents could happen to the same individual aircraft, with incorrect handling of the fault, without any reaction from the flight operations department. It shows in these cases that the company's deviation reporting system did not work satisfactorily in respect of: reporting – investigation – action – feedback.

Inadequate checking of incoming reports, combined with an assessment that does not indicate sufficient understanding of the risks in these cases, has in the opinion of SHK contributed to the fact that correct information concerning the handling of propeller overspeed did not reach the crews.

2.5 Barrier analysis

In this context the word "barrier" refers to the technical and/or administrative functions that can interrupt a sequence of events. The following discusses both the barriers that did exist but did not suffice, and the barriers that did not exist.

- One potential barrier that has been missing is the checking by the supervisory authority of how the manufacturer and operator ensure that the QRH is so designed that the risk of misunderstanding and incorrect use is minimised.
- The checklist was insufficient as a barrier since it was unclear and could be misinterpreted. In addition, it is initially memory-based. The extra checks that the use of the written checklist contain, were thereby not used.
- The training of pilots on turboprop aircraft was insufficient to act as a barrier. The company had not taken into account the special training needs that apply to those who had previously only flown jet aircraft, in respect of managing propellers. Nor had the PC and OPC caught the need to practise propeller overspeed in connection with approach and landing.
- The routines for checking and assessing reports of events did not act as a barrier.
- The company had not noticed that the emergency checklist had either not been used, or not been completed in connection with propeller overspeed.
- Routines were lacking for quickly making the organisation aware of repeated failures, with the need for measures adapted to suit these.
- Routines were lacking for the analysis of the risks that a fault could bring with it, associated with the practice, training and checklists that were used to deal with the fault.
- The line check routine did not work satisfactorily as a barrier to catch deficiencies in compliance with existing instructions.
- One barrier that did come into operation was the EGPWS warnings. Soon after the autopilot had disconnected, the warnings caught the abnormal flight situation that was entered. The warnings made the co-pilot realise the seriousness of the situation, whereby she decided to use all her capacity in her role as PNF to support the commander in landing the aircraft. She judged that the commander had recovered the situation until the warning was sounded that the aircraft was below the glidepath.
- CRM made up the final barrier. At the beginning of the sequence of events this barrier was weakened, mainly because the prescribed procedures were not followed, that the PNF's proposal was rejected and that there was unclear communication between the crew. By means of the crew's communication and teamwork in the later part of the flight, the barrier functioned again so that they could handle the situation that had arisen.

2.6 Collective assessment

Analysis of the available facts shows that the incident was of an extremely serious character. During part of the approach the aircraft was in a configuration that was beyond the point where controllability could be maintained.

SHK considers it to be serious when a relatively simple technical fault can cause major control problems for a modern commercial aircraft. It is also alarming that many did not understand sufficiently that serious situations can arise due to incorrect handling of technical failures in this area.

The company had not made use of the possibility to make pilots aware of the risks, by means of information concerning the earlier accidents and incidents that had happened in this operational area. The level of knowledge amongst the pilots in respect of this problem was, in the opinion of SHK, insufficient.

Misunderstanding of the potential dangers of the problem also meant that the classification of the earlier events did not match the real risks. According to SHK this could lead to the company reviewing its routines in this area. SHK also noted that the supervisory authority in this case seems to have had a poor understanding of the consequences of improperly dealing with a technical fault in this area.

The safety requirements that passengers should be able to demand from a commercial operator can, according to SHK, in connection with this incident not be considered to have been met. The reason why this aircraft did not crash can to a large measure be attributed to the fact that during the final part of the approach it was kept under control by a balanced Crew Resource Management (CRM).

3 CONCLUSIONS

3.1 Findings

a) The pilots were qualified to perform the flight.
b) The aircraft had a valid Certificate of Airworthiness.
c) The technical fault could not be localised in three earlier cases of propeller overspeeding with the same propeller.
d) The technical fault tracing list was not followed during the action taken in the earlier propeller overspeeding cases.
e) During part of the approach the aircraft was in a configuration where manoeuvrability and control could not be guaranteed.
f) The pilots had not practised propeller overspeed during approach in the repeated simulator sessions.
g) The emergency checklist was not followed in any of the propeller overspeed incidents that occurred in the company earlier.
h) The design and content of the emergency checklist was not perceived by the company as satisfactory.
i) Changes to the emergency checklist take place without confirmation by the inspection authority.
j) The emergency checklist contains 17 “memory items”.
k) Propeller overspeed does not have its own warning on the aircraft warning panel.
l) The company’s system for handling deviations did not work satisfactorily in the previous incidents.
m) The commander did not succeed in sending an Urgent Flight Occurrence Report via the company’s reporting system, CDRS.

3.2 Causes of the incident

The incident was caused by the fact that the emergency checklist was not completed, and a combination of the pilots not being aware of the risks due to leaving an unfeathered propeller in flight idle, unclear operations documentation concerning the propeller overspeeding type of propeller fault, and deficient follow-up of previous similar occurrences.

4 RECOMMENDATIONS

It is recommended that EASA:

- Makes efforts to set up a working group, with representatives of the manufacturer and the airline, and possibly other operators of the Q 400. The purpose should be to improve both the content and the method of application of the emergency checklist for the Q 400 *(RL 2007:12e R1)*.

Appendix 1

Printout of the parts of the CVR and radio traffic relevant to the investigation.

Time: The starting time in minutes and seconds UTC for the message (for local time – add two hours).

From: Source of message.

VP	- Left Side Pilot
HP	- Right Side Pilot
CA	– Cabin Attendant
ARN	- Arlanda air traffic control tower
KLR	- Kalmar air traffic control tower
TK	- Technical support at Arlanda
OP	- Operations Arlanda
TEK1	- Technician at Arlanda
TEK2	- Technician at Arlanda
TEK3	- Technician at Arlanda
GA	- Gate Agent
LG	- Lifeguard 991
TU	- SE-KTU

Note: Remarks

VHF	- Airborne radio
&	- Internal to SK197
TFN	- PTT telephone for departure co-ordination
RAD	- Technicians' radio network at Arlanda
PA	- Internal public address system in SK197
PRIV	- Conversations of a private nature
(x)	- Person's name deleted

Information: Message written out in plain text.

??	- means that it was not possible to interpret the information
(Parentheses)	- used to indicate that the interpretation is uncertain
[Square brackets]	- used to denote comments

The printout consists of two parts:

Before take-off. - From the moment a technical problem was discovered in connection with the flight crew arriving at the aircraft at Arlanda up to and including when it was considered resolved and the technical personnel left the aircraft before departure.

The landing. - From normal flight before the incident up to and including the commander's announcement after parking on the apron at Kalmar. Before 14:46:16 there are only combined CVR tracks.

Before take-off

Time	*From*	**Note**	**Information**
13:30:44	***HP***	&	But, that's strange... such a high charge rate for the battery, do you see that?
13:30:49	***VP***	&	Yes, that's fishy.
13:30:52	***HP***	&	When it's not switched on.
13:31:00	***VP***	&	It's working.
13:31:01	***HP***	&	Yes.
13:31:02	***VP***	&	Hell, that was not good.
13:31:03	***HP***	&	It can't charge when it's not con-nected, can it?
13:31:06	***VP***	&	Uh... yes, it can, I suppose it can anyway. I think it can do it even if you don't have them on.
13:31:48	***HP***	&	I thought it was the cabin who came when they drove up.
13:31:50	***VP***	&	I thought that too.
13:32:02	***VP***	&	Do you want your box here (x)?
13:32:04	***HP***	&	No, thanks, no... maybe on the way home.
13:32:25	***VP***	&	You want water, yes?
13:32:29	***HP***	&	Yes, please.
13:32:54	***HP***	&	Don't you think that we should ask the tech people about that there, be-cause you never usually see that it's so high... if it's a relay?
13:33:00	***VP***	&	Because, because it's charging less now... there's no problem.
13:33:05	***HP***	&	No...
13:33:09	***VP***	&	In this plane anything can happen.
13:33:25	***HP***	&	Hello.
13:33:26	***CA***	&	Hello.
13:33:27	***VP***	&	Hello.
13:33:28	***CA***	&	I bet you wondered where we had got to.
13:33:29	***HP***	&	Yes.
13:33:30	***CA***	&	We had a changed, changed schedule both... (x) and I, so I went out with a bit of paperwork for her.
13:33:34	***HP***	&	Aha.
13:33:37	***VP***	&	Yes, yes.
13:33:38	***CA***	&	(x)
13:33:39	***HP***	&	Hello – (x).
13:33:40	***VP***	&	Hello (x).

13:33:41		&	[Private discussion concerning schedule changes].
13:34:23	***CA***	&	Is there something special?
13:34:25	***VP***	&	Er... er... I don't know, we'll see.
13:34:28	***CA***	&	Yes.
13:34:29	***VP***	&	Let's see what it says here.
13:34:31	***CA***	&	What will be the flight time?
13:34:42	***VP***	&	Yes, it's this here, you know, emergency light tracks in the floor, it says they're dirty.
13:34:46	***CA***	&	Yes, OK, yes.
13:34:47	***VP***	&	Er... and it also says here. Aft galley overhead light button ON, I mean the one where it says on, that bulb must have blown.
13:34:54	***CA***	&	Aha, OK.
13:34:55	***VP***	&	But it probably works, it's just that lamp on...
13:34:58	***CA***	&	Yes, er the bulb's broken, OK
13:35:02	***VP***	&	That's it... that was all.
13:35:04	***CA***	&	Yes, OK. Flight time?
13:35:06	***VP***	&	Yes, you come... you come in and report "cabin clear".
13:35:09	***CA***	&	Yes, yes.
13:35:11	***VP***	&	Fifty minutes there and forty-five home. And it'll be the same on the next trip then.
13:35:13	***CA***	&	Fifty first.
13:35:16	***VP***	&	And, er, (x) says welcome.
13:35:18	***CA***	&	Mmm, yes, yes we just check our stations.
13:35:21	***VP***	&	Yes, yes of course.
13:35:23	***CA***	&	Get ready as soon as you can.
13:35:24	***VP***	&	Great.
13:35:26	***HP***	&	Now they've started fuelling.
13:35:27	***VP***	&	Good.
13:35:29	***VP***	&	Now let's see... this is the VOR/(MLS) knob, that's the one that's a bit stiff, isn't it, er, on your side, that one, that's it??. It says stuck, but it isn't just a bit stiff. Does it say... a, and then there was that one there, which one was it now, it was number two, ADF number two that's a bit, er, uncertain. OK?
13:36:00	***HP***	&	Mmm.
13:36:38	***VP***	&	We said one nine seven, didn't we?
13:36:40	***HP***	&	Yes.
13:36:42	***HP***	&	Private
13:36:44	***VP***	&	Nothing, he was off duty.
13:36:45	***HP***	&	Yes, he was at the base.
13:36:47	***VP***	&	Really, did he?
13:36:49	***HP***	&	Private

13:36:51	***VP***	&	Private
13:36:56	***HP***	&	Private
13:36:57	***VP***	&	No, er, I also saw him, he's called of course...
13:37:04	***HP***	&	Private
13:37:06	***VP***	&	Private
13:37:07	***HP***	&	Private
13:37:08	***VP***	&	Private
13:37:15	***HP***	&	Private
13:37:17	***VP***	&	(Yes exactly), that's him, it's him...er, he's called... I see it was a long time since I flew with him, yes, er... no... it's so irritating when you can't remember...
13:37:55	***HP***	&	Aha.
13:37:56	***VP***	&	Yes, it'll have to drop for a while.
13:38:04	***HP***	&	It sometimes seems as if they divide the job among us first officers because there are too many... it's so unnecessary for me to have to do this on my day off.
13:38:13	***VP***	&	Yes, it certainly is, I agree on that.
13:38:16	***HP***	&	We don't need AC external.
13:38:54	***HP***	&	Private
13:38:59	***VP***	&	Private
13:39:00	***HP***	&	Private
13:39:02	***VP***	&	Private
13:39:04	***HP***	&	Private
13:39:06	***VP***	&	Private
13:39:07	***HP***	&	You see that charging is still zero thirty-six, it's completely...
13:39:11	***VP***	&	Mmm, that's a bit unusual. But it is within limits, so that…
13:39:14	***HP***	&	Yes, but I thought that if there's something to switch on, it would be a good time to do it now.
13:39:17	***VP***	&	Yes, we'll have to have a look, check on it later, if it was something temporary. Now we've stood still for several hours. And then the relays work and they go on and off. And then, then it happens and it's OK again.
13:39:29	***HP***	&	Mmm.
13:39:30	***VP***	&	We'll see, we'll see and then, I'll fly... this one and the next flight as well.
13:39:33	***HP***	&	Yes.
13:39:34	***VP***	&	So...
13:39:37	***HP***	&	I've had, I've had this sort of thing before, but then it was on the standby battery. And then two came out when I had it. Then they came out and they tapped the relay, like this...

13:39:46	***VP***	&	Yes, yes, yes.
13:39:49	***HP***	&	So I'll get a clearance.
13:39:51	***VP***	&	A small?? (So) I'll go and... pull out and see. What does it say there? It says...
13:39:59	***HP***	&	Nineteen right.
	VP	&	Nineteen right yes, and.. arrival what? Twenty-six.
13:40:12	***VP***	&	A thousand three.
13:40:19	***VP***	&	We can wait a bit, it's anyway, it's ten minutes still. It's twenty minutes still.
13:40:23	***HP***	&	Aha, you can't take a clearance sooner than ten minutes before.
13:40:25	***VP***	&	Not really. If you take a quarter of an hour they probably won't say any-thing. Twenty minutes is a bit... let's see... now I have the paper here, isn't it there somewhere? Or it was there before. It says on departure, departure clearance. Er, "request start-up clearance not earlier, not earlier than ten minutes before esti-mated start-up".
13:40:56	***HP***	&	Start-up clearance.
13:41:03	***VP***	&	Yes, or.
13:41:04	***HP***	&	Yes.
	VP	&	Departure clearance, that is.
13:41:06	***HP***	&	Yes, exactly.
13:41:07	***VP***	&	?? clearance.
13:41:08	***HP***	&	You're right.
13:41:09	***VP***	&	On the other hand, they don't usually argue here.
13:41:12	***HP***	&	But I've never thought about it, I just tried direct, me, so that you don't, don't have to think about when you are going to … brief.
13:41:17	***VP***	&	I know it was from one... maybe don't remember it, it was some time ten years ago, wasn't it. They com-plained than that we... that we
13:41:24	***CA***	&	Shall I press it, are you ready?
13:41:26	***VP***	&	We haven't finished fuelling yet.
13:41:28	***CA***	&	No, OK, we'll wait a little.
13:41:29	***VP***	&	Er, have you got a rubbish bag?
13:41:31	***CA***	&	Of course.
	HP	&	We have Power Plant.
13:41:34	***VP***	&	Oh dear, that wasn't good. Then we have to get them here anyway.
13:41:46	***HP***	VHF	SAS maintenance from R D Alfa.
13:41:49	***TK***	VHF	R D Alfa.
13:41:51	***HP***	VHF	Hi, we've got "Power Plant", showing forty-four.

13:41:56	***TK***	VHF	Power Plant, forty-four. We're coming.
13:41:58	***HP***	VHF	Thanks.
13:41:59	***VP***	&	Have we got an indication on one engine?? So that...
13:42:03	***CA***	&	OK.
	VP	&	Er, I actually think that we should wait with boarding, because we don't really know what that means.
13:42:09	***CA***	&	Yes, we'll do that. No, OK.
13:42:13	***HP***	&	We already have water.
13:42:15	***CA***	&	No, but, oh dear.
	VP	&	Yes, we have, so that...
13:42:17	***CA***	&	OK, it's enough with them?
13:42:18	***HP***	&	Yes.
13:42:19	***VP***	&	Good. And there you had it, yes, fine.
13:42:21	***HP***	TFN	Gate from flight deck.
13:42:29	***HP***	TFN	??, we have a little technical problem, the technicians are coming here for a look, so we'll wait with boarding for a few minutes until we know. Yes, thanks, full aircraft or?
13:42:45	***VP***	VHF	Operations Arlanda, one nine seven.
13:42:50	***OP***	VHF	One nine seven, OP.
13:42:52	***VP***	VHF	Er, will just let you know that we have a fault indication on the engines here, which is basically a no-go item. The technicians are on the way here. I just want to warn you, so you can have something ready in case we won't be able to fly.
13:43:07	***OP***	VHF	Good. It sounds like a Power Plant you have there. You have another aircraft, K C Golf if they don't count on this, but. It's quarter of an hour to departure so they can look a bit closer first.
13:43:17	***VP***	VHF	Yes, exactly. Aha, you knew what it was. Yes, it was, of course, it's a Q 400, so you've heard this before.
13:43:23	***OP***	VHF	Yes, we've heard it before several times.
13:43:25	***VP***	VHF	Yes, that's good. What did you say? K C Golf, did you say that?
13:43:31	***OP***	VHF	Yes, the spare plane we have now is Kilo Charlie Golf. And it's parked standing somewhere. But of course we'll take that if we don't get this one away.
13:43:39	***VP***	VHF	Yes, yes, OK. Er, we'll wait for now and see.
13:43:42	***HP***	&	Surely they can reset this, can't they?

13:43:45	***VP***	&	I think so too.
	HP	&	I've done that many times.
13:43:46	***VP***	&	Yes, yes, it's just that... some time sooner or later, it'll be serious.
13:43:54	***HP***	&	Yes.
13:44:01	***VP***	&	So they think twenty-eight tons there yes.
13:44:06	***HP***	&	Completely full and a bit more, he said. So do we want a passive crew here later?
13:44:09	***VP***	&	Yes.
13:44:11	***HP***	&	I'll say so.
13:44:13	***VP***	&	Yes, they have to decide themselves. Do what they want. Thank you.
13:44:31	***VP***	&	You have initialised, have you?
13:44:32	***HP***	&	Yes.
13:44:33	***VP***	&	Good.
13:45:19	***VP***	&	That's it, that was the fuel. And that's it, and we shall of course to NOSLI, yes.
13:45:22	***HP***	&	Good. I'll take the take-off data.
13:45:30	***VP***	&	Er, yes.
13:46:08	***VP***	&	But wait a minute. I wonder if not OP and the technicians you talk to there, if they aren't sitting together, up there. That's why he heard it. So of course he knew.
13:46:21	***HP***	&	Do you think the technicians sit up there?
13:46:24	***VP***	&	Or he, the co-ordinator sits there.
13:46:28	***HP***	&	But everybody knows about this.
13:46:29	***VP***	&	Yes. We can...
13:46:35	***HP***	&	Fuel release OK.
13:46:36	***VP***	&	Yes, that's good.
13:46:38	***HP***	&	Hello.
	VP	&	Hello.
13:46:39	***TEK 1***	&	Yes, was it like this just when you came, or?
13:46:41	***VP***	&	Yes, er, we didn't see it until...
13:46:43	***HP***	&	We didn't see it before I did (the list). But one thing I saw straight away was that the battery's main battery, it showed more than one. One point three when we switched on. Before I'd even switched on the batteries. So they charged, even though the batteries weren't switched on.
13:46:57	***VP***	&	Aha.
13:46:58	***HP***	&	As soon as I switched on external power. Then I switched on the bat-teries so they could continue charg-ing, but I don't think they can charge without.

13:47:04	***VP***	&	It's a bit unusual, but then...
13:47:07	***TEK 1***	&	Yes, I don't know, we've had, this last week, a lot of strange faults, or, yes, sometimes
13:47:13	***TEK 1***	&	Yes, I think, now it's the truck driver, before we were under tow, but now they are doing it themselves. I think they pull out the ground power connection on the aircraft with the power on, and then plug it back in. I think so, but can't be sure.
13:47:24	***HP***	&	Of course it's incorrectly connected if it can charge without the batteries switched on?
13:47:29	***TEK 1***	&	Yes, it can be a relay that doesn't operate, when you do that, among other things. Let's see, we can try it, how it switches off
13:47:34	***HP***	&	Now it's really gone well down here.
13:47:35	***TEK 1***	&	Yes, we switch off, let's see here... if the voltage disappears.
13:47:40			[Power failure. All times before this are incorrect so that a later time is stated.]
13:47:44	***VP***	&	Now you'll see that the power plant also went.
13:47:45	***HP***	&	But now we'll surely get DU fail because the displays were on.
13:47:50	***TEK 1***	&	Yes, that can happen. But… in that case one should turn on the emergency lighting. No, so that's one of the faults that is. It's a relay that has somehow burned, when they pulled that there. Like that, yes, you need to take it out. It's not good to go like that, if you need to do it without power.
13:48:08	***HP***	&	No.
	TEK 1	&	So you must make sure that...
13:48:13	***HP***	&	Yes, it was without power when we came.
13:48:15	***VP***	&	Yes, it was.
13:48:16	***HP***	&	Yes, these circuit breakers here were pulled.
13:48:17	***TTEK1***	&	It was towed. I looked at it, it had come in at... international. So it can...
13:48:20	***VP***	&	Yes, it seems like it. Exactly. It was international, yes.
13:48:30	***TEK 1***	&	Yes, it was, of course. Same codes on both sides, (do you dammit dare to)...

13:48:45	***VP***	&	Do you understand any of that?
13:48:46	***TEK 1***	&	No, really you have to look in the manual to interpret it. But are… almost the same on both sides, there is something... It can be like this ”Power Plant” if it's so that you've pulled the break... or ground power connector before you've switched off and stuff.
13:49:02	***HP***	&	Mmm, yes, because the AC was on, actually. AC external.
13:49:06	***TEK 1***	&	Yes, yes.
	HP	&	Although we didn't have any AC. So it could have been in the wrong order.
13:49:15	***TEK 1***	RAD	(x)
13:49:27	***HP***	&	It's continuing to charge less, that's good.
13:49:30	***TEK 1***	RAD	(x)
13:49:34	***TEK 2***	RAD	Yes, he's standing up in an APU of course and can't hear. Is there anything I can tell him?
13:49:41	***TEK 1***	RAD	Yes, I'd really like to help and read a few fault codes. It's an aircraft that should leave in ten minutes so... that has this ”Power Plant” warning.
13:49:53	***TEK 2***	RAD	Well, wait then, and he'll come on the radio in a little while.
13:49:58	***TEK 1***	&	Write down one??
13:50:09	***VP***	&	Er, I don't know how much we'll do here. Do you think we can go with it, or?
13:50:13	***TEK 1***	&	I probably think so. Something has happened. Triggered the same on the same side, like. When it's serious it's usually like... a code or two on one engine, (I mean). I think they've pulled this one... yes.
13:50:23	***VP***	&	Yes, yes, OK, absolutely. Er, it looks strange, yes. Er, let's see, so we can...
13:50:32	***HP***	&	Yankee Juliet is structural limit, so then we can go with those there… speeds here, aren't they?
13:50:35	***VP***	&	Yes, sure... that'll be good.
13:50:47	***VP***	&	Nineteen right we said...
13:50:54	***TEK 3***	RAD	(x),did you call me?

13:50:57	***TEK 1***	RAD	Yes, because, R D Alfa here, some ”Power Plant” when we tow... I suspect that, he pulled out the ground power connector with power on, because it was towed from international to domestic. There’s a lot of codes, but if you can sit down by a computer or look them up and see what they mean, like. There are probably similar codes for both engines so there’s definitely no danger, but you can check them (here).
13:51:24	***TEK 3***	RAD	You had nothing??
13:51:27	***TEK 1***	RAD	No, I’m standing in the cockpit. No, they came into the aircraft. When they switched the power on, it said ”Power Plant” there.
13:51:36	***TEK 3***	RAD	Yes, but wait. We’re running the APU here, I’ll just … call you later.
13:51:42	***HP***	&	Maybe it’s quicker to change aircraft. If they only had one here.
13:51:46	***VP***	&	I was thinking, if we, if we er... if it’s so that we think we can go with this one… Then maybe we should, then perhaps we should get the passengers on board anyhow. So we save a little time with that.
13:51:57	***HP***	&	Yes.
13:52:04	***VP***	&	Let’s see. I think we’ll get the passengers on board anyway.
13:52:07	***GA***	&	Aha.
13:52:08	***VP***	&	Yes, we can probably go with this. Er, so we’ll chance it. In the worst case we’ll have to get them off again, it can’t be helped. But we’ll lose so much time if, if, having them up there, I think. What do you think?
13:52:23	***HP***	&	Yes, we’ve had this before, usually you can reset.
13:52:24	***VP***	&	Yes, that’s what I mean. And (new) ??. It’s probably a computer fault. So I, we’ll chance it.
13:52:31	***GA***	&	Let’s do it.
13:52:35	***VP***	PA	(x), we’ll get the passengers on board now. We can probably go with this aircraft here. The technicians need a little more time, but it’s better to have the passengers on board in any case.
13:52:46	***CA***	&	Yes, we’ll do that. OK, we’ll do it.
13:52:50	***??***	&	Are you making all that noise?

13:52:52	***VP***	&	So we'll take these away. Er, do you need, should I move, or? Now we'll see. We can do like this, have him there.
13:53:05	***HP***	&	I can get a clearance.
13:53:06	***VP***	&	Yes, we can take it now.
13:53:10	***HP***	VHF	Delivery, Scandinavian One Niner Seven, stand four four, Dash Eight, information Hotel to Kalmar.
13:53:15	***ARN***	VHF	Scandinavian One Niner Seven information India now valid, QNH one zero zero four. Start-up is approved. Clearance to Kalmar, via Nosli Three Golf departure, squawk five seven one four.
13:53:30	***HP***	VHF	One zero zero four now. We are cleared to Kalmar, Nosli Three Golf, five seven one four, Scandinavian One Niner Seven.
13:53:37	***ARN***	VHF	Scandinavian One Niner Seven, one two one decimal seven for pushback. Bye, bye.
13:53:43	***HP***	VHF	Thanks. Bye.
13:53:46	***HP***	&	They're all talking at once here. [laughing] And then it beeps...
13:53:50	***VP***	&	Well, you can't get in when... five seven one four. It obviously didn't work. I don't know if there is something to do with... I'll have a look if it (takes it now). No, I don't think...
13:54:05	***HP***	&	Fifty-seven fourteen, Nosli Three Golf.
13:54:06	***VP***	&	Yes, but, but, you see it went off again.
13:54:10	***HP***	&	Yes, yes, we have to take it, yes, yes.
	VP	&	So we've got to, we've got to wait with it.
13:54:16	***TEK 1***	&	Did you sign this?
13:54:18	***VP***	&	No.
13:54:19	***TEK 1***	&	No, I'm going out. I think this is just nonsense. I'm going out, into the car and that. I'll wait here until you've started.
13:54:25	***VP***	&	Now it's, now it's not there.
13:54:26	***TEK 1***		No, I've taken it away so... so that they, can we find out what it can be?
13:54:28	***VP***	&	Aha, yes, you have done that... Yes, find out, yes.
13:54:32	***TEK 1***	&	Almost exactly the same on both sides, it's one of those there that they've pulled.

13:54:36	***VP***	&	Yes, OK.
	HP	&	Mmm.
13:54:37	***TEK 1***	&	I’m staying here, so.
13:54:39	***VP***	&	Good.
13:54:45	***HP***	&	See if it’s left everything here on... ??, no, it’s lost everything here.
13:54:56	***VP***	&	Aha. Yes, of course it's...
13:55:01	***HP***	&	Flight plan stayed. Fuel, then, that’s still there. Three and four. We’ve got those. Yes, but then we can just
13:55:21	***VP***	&	Now we’ll see (when).... Was that seven and four? Let’s see if it works now. Yes, it was of course when he was doing this here, I assume. Er, let’s see... [Talks to himself]
13:55:53	***VP***	&	It says here, then. Stockholm control one two four one when instructed. Two fifty below one hundred. Climb gradient we can manage. And five thousand is set, yes. Initial climb one eight six... SA Seven Zero Five, Seven Zero Six, max two twenty there. And Nosli. That’s right. Other waypoints, have you checked those?
13:56:20	***HP***	&	No.
13:56:21	***VP***	&	So it was Tonsa, Pelup, Vibar, Nesli.
13:56:24	***HP***	&	Yes.
13:56:25	***VP***	&	Good. And, in case of engine failure, first a radar heading and an altitude. Secondly, sixteen hundred, left turn Tebby. And we aim at two and five and there’ll be vectoring after that. Tebby, Arlanda and vice versa for you. Oscar Hotel Tango would be good there and Echo Alfa for landing. And if you think there, twenty-seven and eight, yes, that’s what we suspected. It won’t be full, then.
13:56:51	***HP***	&	If we shouldn’t get a load sheet it might be because the fuel release has fallen out. We could see what it looks like.
13:56:59	***VP***	&	Yes, now they’ve had it once, it’s gone in there.
13:57:04	***HP***	&	Yes, it mustn’t lie... yes, it’s in... yes, exactly.
13:57:07	***VP***	&	I mean, it’s... it’s already been sent and confirmed. So they already got it once. So it shouldn’t...
13:57:17	***HP***	&	Yes, you can’t see that here, no.
13:57:18	***VP***	&	No, you can’t see it because it was already sent.

13:57:19	***HP***	&	Yes. Mmm. No.
13:57:20	***VP***	&	So I don't actually think so. If it had stayed there, but not pressed, that's another thing.
13:57:29	***VP***	&	Now we'll see here. This, and that and that and that and then I'd have been there. And that's what they should of course have, there and yes. [Talks to himself]
13:58:01	***HP***	&	So we'll run a little list, eh?
13:58:02	***VP***	&	We can do that.
13:58:03	***HP***	&	Flow check is completed. Battery master and batteries on. Parking brakes.
13:58:06	***VP***	&	They're on and checked.
13:58:09	***HP***	&	Crew papers and aircraft log.
13:58:10	***VP***	&	Checked, it was written.
13:58:12	***HP***	&	Checked. Fuel quantity.
13:58:15	***VP***	&	Three and four. The slip is there and I've signed it.
13:58:18	***HP***	&	Locking devices.
13:58:20	***VP***	&	Removed.
13:58:22	***HP***	&	Removed. Oxygen mask and quantity.
13:58:25	***VP***	&	Er, now we'll see. Checked left.
13:58:28	***HP***	&	Checked right. Trims.
13:58:32	***VP***	&	Er, they're checked.
13:58:37	***HP***	&	Checked. APU.
13:58:38	***VP***	&	Yes, we have to wait a while.
13:58:40	***HP***	&	Mmm. Altimeters, one zero zero three. Eighty feet and seventeen hundred.
13:58:45	***VP***	&	Wasn't it one thousand four now?
13:58:46	***HP***	&	Yes, it was. Hundred feet.
13:58:48	***VP***	&	So. Er, exactly. And we'll have seventeen hundred also, yes.
13:58:57	***HP***	&	So.
13:58:58	***VP***	&	Yes.
13:58:59	***HP***	&	Take off data and bugs come next.
13:59:00	***VP***	&	Good.
13:59:13	***HP***	&	This was the aircraft I once had, it must have been a year ago, when we couldn't switch off the electrical power. We had to leave it on...
13:59:21	***VP***	&	Couldn't switch off the electrical power?
13:59:22	***HP***	&	Yes, we were going to leave it at the gate and we had no external.
13:59:25	***VP***	&	No.
13:59:26	***HP***	&	Couldn't stop the current from the batteries.
13:59:28	***VP***	&	What!

13:59:29	***HP***	&	It was R D Alfa, I remember now, it was...
13:59:32	***VP***	&	Fishy machine.
13:59:33	***HP***	&	It's incorrectly wired, must be incorrectly wired, they said then.
13:59:36	***VP***	&	Yes.
13:59:37	***HP***	&	But now it's a year later it's very strange. They should have been able to remove...
13:59:42	***VP***	&	Yes, of course.
13:59:43	***HP***	&	When you switch off the batteries you completely disconnect them.
13:59:45	***VP***	&	Yes, exactly.
13:59:46	***HP***	&	And then there shouldn't be anything there.
13:59:48	***VP***	&	No, it should, it shouldn't need to be done. No, it's not hot-wired in there.
13:59:52	***HP***	&	No.
13:59:55	***VP***	&	No, that what it's about, yes... obviously.
13:59:57	***HP***	&	Mmm.
14:01:06		&	[Private discussion concerning schedules, colleagues and crew bags].
14:03:53	***TEK 1***	&	Yes, we're just checking up a little, here, now, it... All those codes, they were the same on both engines. They say that it's both (the ejector) then, that control the propeller, FADEC, that controls the engines and ??the governors. And the probability that they would fail, when it says, both engines have exactly the same fault simultaneously, it's minimal and it had just come from Budapest and had NIL in the book and the switch was on there so that I think it was some rubbish. But I'll wait here anyway when you take off.
14:04:20	***HP***	&	Yes.
14:04:21	***VP***	&	Yes, yes, that's good.
14:04:22	***HP***	&	But so it's finished then.
14:04:23	***TEK 1***	&	Yes, as far as I'm concerned it's finished.

Landing

Time	*From*	**Note**	**Information**
14:46:54	***HP***	&	Strange that we haven't gained more than four minutes on this trip.
14:46:58	***VP***	&	No.
14:46:59	***HP***	&	… flying a direct route. But it, it's not much to gain.
14:47:02	***VP***	&	And, being so short, such a short flight, like..: You can't save much time. All you gain is that it's straight out and straight in and land, and that's just five minutes or something.
14:47:13	***HP***	&	Mmm.
14:48:37	***HP***	&	Nothing's coming loose now, its staying…
14:48:39	***VP***	&	No, it's staying in … It, it's going to melt …. before we're down, so that... not much to worry about. [Probably a discussion about light icing]
14:48:43	**HP**	&	Yes.
14:49:16	**VP**	&	So it's pre-level.
14:49:18	**HP**	&	Five thousand feet armed, one zero zero seven.
14:49:19		&	[Pre-level warning].
14:49:20	**VP**	&	Checked.
14:50:10	**VP**	&	Altitude capture.
14:50:11	**HP**	&	Checked.
14:50:38	**VP**	&	Altitude hold.
14:50:39	**HP**	&	Checked.
14:50:44	**VP**	&	Two thousand …
14:50:47	**VP**	&	… set - armed.
14:50:49	**HP**	&	Checked.
14:51:05	**VP**	&	So… and so [clicking sound in the background – seat belts on?]
14:51:17	**CA**	PA	Before landing please raise your seat back and table and place your cabin baggage under the seat in front of you. [Spoken in Swedish] Before landing please raise your seat back and table and place your cabin baggage under the seat in front of you.
14:51:26	**VP**	&	Setting heading mode.
14:51:27		&	Sound of alert. [PEC caution]
14:51:29		&	Sound of click.
14:51:30	***HP***	&	Number two PEC.
14:51:32	***VP***	&	PEC… well...
14:51:33	***HP***	&	PEC that we can… er…
14:51:35	***VP***	&	We have prop overspeed.
14:51:37	***HP***	&	Prop overspeed number two engine.

14:51:38	***VP***	&	Ah… we shall, we … never mind that now, because we, now we're going to land.
14:51:43	***HP***	&	OK, shouldn't I secure that engine?
14:51:47	***VP***	&	Yes, we can, although we have it in flight idle there…
14:51:49	***HP***	&	Yes.
14:51:51	***HP***	&	It's stable at 1060.
14:51:51	***VP***	&	And they…
14:51:52	***VP***	&	Yes, it does, so that it, it holds it there mechanically.
14:51:56	***HP***	&	OK.
14:51:57	***VP***	&	It does.
14:51:58	***HP***	&	Pattern speed is one sixty-five non-icing.
14:52:01	***HP***	&	And we have clean wings.
14:52:02	***VP***	&	That's good.
14:52:09		&	[Pre-level warning]
14:52:10	***VP***	&	Let's see here, there yes.
14:52:23	***HP***	&	And three thirty…… six, is turning radial.
14:52:27		&	"TWENTYFIVEHUNDRED" [Autocall]
14:52:28	***VP***	&	Yes.
14:52:29	***HP***	&	Ten degrees to go.
14:52:31	***VP***	&	Exactly.
14:52:35	***HP***	&	Yes, we'll see, there's no reduction in the flaps.
14:52:39	***VP***	&	No.
14:52:40	***HP***	&	There's nothing special, really.
14:52:43	***VP***	&	No, there isn't.
14:52:44	***HP***	&	Except that the engine isn't secured, though.
14:52:47	***VP***	&	No (come on) let's leave it.
14:52:50	***VP***	&	We'll carry on like this.
14:52:54	***HP***	&	Five degrees.
14:52:55	***VP***	&	Yes.
14:52:57	***VP***	&	So we'll take flaps five.
14:53:00	***LG***	VHF	Kalmar, good afternoon, Lifeguard niner niner one, flight level six zero, squawking two seven five seven to-wards Visby.
14:53:01	***HP***	&	Flaps five selected.
14:53:08	***KLR***	VHF	Lifeguard niner niner one, radar con-tact, cleared to cross Kalmar tma flight level six zero.
14:53:10	***HP***	&	Yes ??
14:53:11	***VP***	&	Arming ILS.
14:53:13	***HP***	&	OK, the ILS is armed.
14:53:14	***LG***	VHF	Cleared to cross flight level six zero.
	VP	&	Yes, that??
14:53:15	***HP***	&	Ah, yes, sorry.
14:53:16	***VP***	&	It's armed, it was armed, it was armed.

14:53:17	***HP***	&	(ILS armed).
14:53:26	***VP***	&	Er, we can take flaps five.
14:53:28	***HP***	&	We did (had).
14:53:29	***VP***	&	Yes, we did, yes – good!
14:53:30	***HP***	&	Ref speed flaps five, one three nine.
14:53:32	***VP***	&	One three nine.
14:53:38	***HP***	&	VOR radial coming.
14:53:39	***VP***	&	Yes.
14:53:40	***HP***	&	Pattern speed flaps five – one…… five three. In case we turn more there.
14:53:48	***HP***	&	Check speed.
14:53:49	***VP***	&	Yes, give it more.
14:53:55	***HP***	&	Check speed.
14:53:56		&	[Autopilot disconnect alert]
14:54:01		&	[Sound of (switch)]
14:54:02	***VP***	&	But why is it (doing) this?
14:54:06	***VP***	&	But haven't we?
	HP	&	Check speed!
14:54:07		&	High pitched sound.
14:54:08	***HP***	&	Check altitude.
14:54:10	***HP***	&	OK, we are visual, you can turn to the left.
14:54:13		&	”TERRAIN, TERRAIN, PULL UP” [GPWS Autocall].
14:54:16		&	”SINK RATE, SINK RATE” [GPWS Autocall].
	LG	VHF	Kalmar, Lifeguard niner niner one, may we descend to four thousand feet?
14:54:19	***VP***	&	To the left. Now we'll see.
14:54:22	***HP***	&	(Left engine).
14:54:23	***VP***	&	At least we have the right speed now.
14:54:24	**KLR**	VHF	Niner niner one, call you back shortly.
	HP	&	(You have left engine).
14:54:25	***VP***	&	Yes, gear down??
14:54:27	***HP***	&	Shouldn't we see the runway first?
14:54:28	***VP***	&	Yes, perhaps.
14:54:30	***HP***	&	We're continuing towards, now you're established, on the VOR.
14:54:34	***HP***	&	Turn ten degrees to the left.
14:54:36	***VP***	&	Yes, good.
14:54:40	***KLR***	VHF	Lifeguard niner niner one, you are cleared four thousand feet QNH one zero zero seven.
	HP	&	Goood.
14:54:41	***VP***	&	(Look here).
14:54:43	***HP***	&	I say – single engine and that.
14:54:46	***LG***	VHF	Cleared four thousand feet on one zero zero seven, Lifeguard niner niner one.
	VP	&	Yes, exactly, say it.
14:54:50	***HP***	&	Stay on altitude until - capture

14:54:51	***VP***	&	Yes.
14:54:54	***HP***	VHF	Scandinavian one niner seven we have ... an engine problem and ... we are gonna stay on this heading to get established on a visual approach, straight in.
14:55:06	***KLR***	VHF	Yes, you are closing with centreline seven miles from touch down.
14:55:09	***HP***	&	Turn left ten degrees.
14:55:17	***HP***	VHF	We don't need any assistance – it will be a normal landing.
14:55:20	***KLR***	VHF	Er – no alarm then?
14:55:24	***VP***	&	Flaps… Now let's see.
14:55:27	***HP***	&	Turn left to get established.
	KLR	VHF	No fire brigade you mean?
14:55:30	***HP***	VHF	Two thousand five hundred.
14:55:35	***HP***	VHF	Of fuel.
14:55:37	***KLR***	VHF	Yep.
14:55:39	***VP***	&	Say that we are…
14:55:40	***HP***	&	OK.
14:55:43	***HP***	&	Er, let's see, glideslope is coming, descend!
14:55:45	***VP***	&	Yes.
14:55:47	***VP***	&	Gear down??
14:55:49	***HP***	&	Yes, I'm arming the ILS again.
14:55:52	***VP***	&	Yes.
14:55:55	***VP***	&	Why didn't this work, then? [Talks to himself]
14:55:57	***HP***	&	Gear down and checked.
14:55:58	***VP***	&	Checked.
14:56:00	***HP***	&	Now it looks good, now it's just to fly in.
14:56:03	***VP***	&	Mm… there we have…
14:56:04	***HP***	&	Localizer, glideslope capture.
14:56:05	***VP***	&	Checked, yes.
14:56:07	***HP***	&	Well done, now you can reduce a little.
14:56:10	***VP***	&	Now we'll see here. [Talks to himself]
14:56:11	***HP***	&	Reduce a little.
14:56:12	***VP***	&	There we got it, yes. [Talks to himself]
14:56:14	***HP***	&	Speed is good – you are established.
14:56:17	***VP***	&	And so we'll take flaps fifteen.
14:56:19	***HP***	&	Yes.
14:56:20	***VP***	&	Complete checklist.
14:56:26	***HP***	&	Looks good, small corrections.
14:56:28	***VP***	&	Say that it, have you said?
14:56:29	***KLR***	VHF	And Scandinavian one niner seven, you are cleared to land.
14:56:32	***HP***	VHF	Cleared to land, Scandinavian one niner seven.
14:56:33	***KLR***	VHF	And wind one niner zero degrees at twelve knots.

14:56:37	***HP***	VHF	Thanks.
14:56:39	***HP***	&	We have flaps fifteen and you are established, runway twelve o'clock.
14:56:41		&	"ONE THOUSAND" [Autocall]
14:56:43	***VP***	&	Yes, it's checked.
14:56:44	***HP***	&	Gear.
14:56:45	***VP***	&	Down.
14:56:46	***HP***	&	Checked. Condition lever - max. Cabin warned.
14:56:50		&	[Two chimes – cabin warning]
14:56:51	***HP***	&	And bleed air min. Checklist completed.
14:56:54	***VP***	&	Very good.
	HP	&	So, take it easy, now it's very good.
14:56:56	***VP***	&	Oh, yes. Er, have you said that it's a one engine landing?
14:56:57	***HP***	&	Ref speed is one three three minimum. [at the same time as the above]
14:56:59	***HP***	&	Yes.
14:57:00	***VP***	&	Exactly.
14:57:02		&	"GLIDESLOPE, GLIDESLOPE, GLIDESLOPE, GLIDESLOPE" [GPWS Autocall, repeated four times until 14:57:09. – Warning that the aircraft is below the glideslope]
14:57:05	***HP***	&	One three three minimum.
14:57:10	***HP***	&	OK - check altitude - you have three, four red.
14:57:12	***VP***	&	Checked, (yes, I know) checked.
14:57:17	***SE***	VHF	Kalmar tower, Sigurd Erik Kalle Tore Urban requests taxi.
	HP	&	(No) pull-up.
14:57:19	***VP***	&	No. [Stressed]
14:57:22	***HP***	&	You can have more speed if you want.
14:57:25	***HP***	&	OK.
14:57:28	***HP***	&	Don't sink.
14:57:30	***HP***	&	Not so much aileron.
	VP	&	(Is it) full, oh damn.
14:57:32	***HP***	&	Not so much aileron.
	VP	&	(It was) full, even full, can't do it. [Highly stressed]
14:57:37	***VP***	&	Flaps – no, can't do it. [Extremely stressed]
14:57:39	***HP***	&	No!
14:57:40	***VP***	&	You'll see, it'll work. [Highly stressed]
14:57:41	***HP***	&	Not too much aileron, then it'll be – stall warning – so!
14:57:45	***VP***	&	Then we'll see, wait.
14:57:47	***VP***	&	That's it, I have contact, it's all right.
14:57:50	***HP***	&	Don't sink at all now.

14:57:51	***VP***	&	No.
14:57:52	***HP***	&	Don’t sink!
14:57:53	***VP***	&	No.
14:57:54	***HP***	&	Don’t sink – don’t sink!
14:57:56	***VP***	&	Why have we…
14:57:57	***SE***	VHF	Kalmar tower, SE-KTU requests taxi.
14:57:58	***HP***	&	OK.
14:58:00	***VP***	&	And we’ll see….
14:58:01	***KLR***	VHF	Yes, TU I’ll get back, I’ll get back to you.
	HP	&	We haven’t feathered – that’s why.
14:58:02		&	”FIFTY” [Autocall]
14:58:03		&	”FORTY” [Autocall]
	VP	&	No, exactly, that’s why.
	SE	VHF	Yes, understood, TU.
14:58:05	***VP***	&	I thought ….
	HP	&	Not…
14:58:07		&	”THIRTY” [Autocall]
14:58:09		&	”TWENTY” [Autocall]
14:58:10		&	”TEN” [Autocall]
14:58:11		&	Mechanical sound [Touchdown?]
14:58:12	***VP***	&	(So, hold the wheel down).
14:58:13	***HP***	&	So. I’m holding the wheel. Reduce!
14:58:19	***VP***	&	So, yes.
14:58:37	***VP***	&	Yes (damn).
14:58:38	***HP***	&	OK, breathe calmly.
14:58:40	***VP***	&	Oh, yes.
14:58:42	***VP***	&	Now we’ll see here.
14:58:45	***KLR***	VHF	Yes, one niner seven, do you want to come into the apron?
	HP	&	(Stop).

14:58:46	***CA***	PA	Welcome to Kalmar. Until the captain has switched off the seat belts sign we ask you to stay seated with your seat belt fastened, your seat back and table raised and your hand baggage still in place. Mobile telephone may be switched on when the seat belt sign has been turned off. If you do not wish to keep your newspaper, please put it in the container for newspaper recycling, which on your way to the terminal. Captain (x) and his crew thank you for being with us this time, and we hope to welcome you back to SAS and Star Alliance. I would just like to say that during our landing I heard a telephone ringing, and we must remind you that you must switch off your mobile telephones while you are flying. Thank you. [Spoken in Swedish] Welcome to Kalmar. When the captain turns off the seatbelt sign you may leave your seat. In the meantime, please remain seated with your seatbelt fastened, keep seatback and table upright and leave cabin baggage in place. Please wait to turn on mobile phones until the seatbelt sign has been switched off. The captain and his crew thank you for flying with us today and we look forward to welcome you back to Scandinavian Airlines and Star Alliance. Thank you and goodbye.
14:58:49	***HP***	VHF	We can taxi in to the apron, Scandinavian one nine seven.
14:58:52	***KLR***	VHF	Yes
14:59:02	***VP***	&	Exactly, I thought that I … exactly, I mean I…
14:59:06	***HP***	&	Secured engine.
14:59:07	***VP***	&	Yes! I thought it wasn’t necessary, that, it – since we were so close to landing.
14:59:13	***VP***	&	OK, after landing.
14:59:29	***HP***	&	Hey, shall I pull a circuit breaker for that recording there?
14:59:33	***VP***	&	I don’t know, what does it say… yes, of course, recording, yes.
14:59:37	***HP***	&	… see where it is.
14:59:38		&	Chime. [Pitot heat – off]
14:59:43	***HP***	&	I’ll take this first.
14:59:44	***VP***	&	Yes, we should do that.

14:59:45	***HP***	&	Control lock – locked. Spoilers.
14:59:47	***VP***	&	Er, taxi, yes.
14:59:48	***HP***	&	External lights.
14:59:49	***VP***	&	They are... set.
14:59:52	***HP***	&	Yaw damper – off, radar – set, flaps – up, tank aux pumps – off, main bus tie – tie, ice protection is set, check-list completed.
14:59:59	***VP***	&	Very good.
15:00:23		&	Chime. [Parking brake – set]
	VP	&	(That's it).
15:00:30	***KLR***	VHF	And one nine seven, you don't need any fire trucks nearby any longer, do you?
15:00:34	***VP***	&	No.
	HP	VHF	No, everything's under control now.
15:00:38	***KLR***	VHF	Yes, OK.
15:00:41	***HP***	VHF	We had a hard time holding course there with one engine, but then when we could slacken off a bit it went all right.
15:00:47	***KLR***	VHF	Yes, it seemed a bit tough at the end there, I thought.
15:00:49	***VP***	&	Yes.
15:00:50	***HP***	VHF	Yes, it was.
15:00:58		&	[Three chimes].
15:00:59	***VP***	&	Can we have electrical power here then?
15:01:05	***VP***	PA	Yes, sir, this is the captain, I will talk a little to you, er, in a little while. I'm not ready to let you off yet, er, re-main seated on board for a short time yet.
15:01:07		&	Chime.
15:01:14	***HP***	&	Now we have external power.
15:01:18	***VP***	&	OK, that one, yes.
15:01:20		&	Chime.
15:01:22	***VP***	&	And…
15:01:29	***HP***	&	Parking brake.
15:01:31	***VP***	&	It is – on.
15:01:33		&	Chime.
	HP	&	Fasten belt switch.
15:01:35	***VP***	&	Er... off.
15:01:36	***HP***	&	Hydraulic.
15:01:37	***VP***	&	Er... norm.
15:01:39	***HP***	&	Nose steering.
15:01:43	***VP***	&	It is off.
15:01:44	***HP***	&	Anti-collision light
15:01:44	***VP***	&	Off.
15:01:45	***HP***	&	Flight deck door.
15:01:46	***VP***	&	It is...unlocked.
15:01:48	***HP***	&	You can calm down, and I'll look at the rest here.

15:01:51	***VP***	&	You can do that.
15:01:52	***HP***	&	Important what you say.
15:01:53	***VP***	&	Mmm.
15:01:55		&	[Three chimes].
15:02:13	***HP***	&	We'll have a circuit breaker?
	KLR	VHF	Yes, TU, tower I'll get back to you soon.
15:02:16	***VP***	&	(No).
15:02:17	***SE***	VHF	Yes, understood, TU.
15:02:20	***VP***	PA	Yes, ladies and gentlemen, this is your captain again. You probably noticed that we had a very unusual landing, and this was because we had, not an stoppage in the right engine, but that ...er...er that the propeller went out of control. So it was...er a really difficult approach, and we wobbled a bit here and there, but the left engine was OK, of course, and...er...er there was no danger in that, but...er it was, now we are on the ground again. And I don't know what you felt, what you experienced everything. But, those who want more explanation of that, we can, stay behind in the hall and I'll talk to you about... that. [Spoken in Swedish] Ladies and gentlemen, your captain, now we are on ground, but we had an engine failure with the propeller on the right hand engine during the approach so this was unnormal, emergency landing. Er, so those of you. Anyhow, now we are on ground, all is safe. But those of you wanting to have more information, please remain inside the.. .er, in the terminal and I will tell you more.