Investigation report

C7/2005 L

Falling of passenger stairs at Rovaniemi airport on 14 December 2005

Translation of the Finnish original report

G-OOAH

AIRBUS A321

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SUMMARY

On Wednesday 14 December 2005 at 10.17 UTC, an Airbus A321 airliner registered G-OOAH landed at Rovaniemi airport, Finland. The aircraft was operated by First Choice Airways on a charter flight from Bristol, Great Britain, with the call sign FCA536C. The aircraft was taxied to stand number nine guided by Rovaniemi airport staff. At 10.32.40, about eight minutes after the aircraft was parked, it began to move backwards. The open aircraft door caused the passenger stairs to fall, and four persons were slightly injured.

On 15 December 2005, the Finnish Accident Investigation Board decided to set up an investigation commission to investigate the incident (decision No. C 7/2005L). Jussi Haila was appointed as investigator-in-charge and Kari Siitonen as a member of the commission. The British accident investigation authority was also informed of the investigation.

After the aircraft was stopped, the ground handling staff had placed wheel chocks in front of and behind the left wheel of the nose landing gear and the left main landing gear, and pushed the passenger stairs to the front passenger door L1. The passengers started to disembark using the stairs. The co-pilot came out of the aircraft and showed a sign to the captain on the flight deck as agreed, after he had checked that the wheel chocks were in place. The captain had risen from his seat and released the parking brake. On the right side of the aircraft there was a refuelling truck, the driver of which had attached the refuelling hose to the coupling on the right wing. The co-pilot entered the necessary figures on the aircraft refuelling panel and gave the truck driver a permission to start refuelling. A forklift truck stood in front of the forward cargo door, and a baggage conveyor belt had been placed at the aft cargo door. The ground staff had started to unload the baggage. A water truck had been driven at the left side of the aircraft, under the aft fuselage. Its driver had attached the water hose into the coupling on the aircraft.

At 10.32.40, the ground staff noticed that the aircraft was moving backwards. The driver of the refuelling truck noticed that the refuelling hose was tightening and released the safety switch in his hand, which stopped the fuel flow. However, the hose was torn off from the wing, breaking the attachment. The loading supervisor and the co-pilot tried to show to the captain on the flight deck that he should engage the parking brake, but the captain was not on his seat. He was standing in the rear of the flight deck with his face towards the cabin. After hearing some noise from the passenger door he turned towards the flight deck and engaged the parking brake. At the same time, air traffic control announced by radio that the aircraft was moving. The driver of the refuelling truck and one loader had gone to the left side, crossing below the aircraft while it was moving, and tried to push wheel chocks behind the left main landing gear wheels, but the chocks slid on the icy surface and did not stop the aircraft from moving. It only came to a stop when the captain engaged the parking brake. As the aircraft was moving backwards, the door opening moved behind the passenger stairs and the handrail of the stairs got stuck to the passenger door, which caused the stairs to fall down. The other handrail slammed the passenger door and damaged it. There were 7–10 persons on the stairs when they began to fall. The others managed to get away from the stairs, but a family with two children under 10 years of age, which were at the upper end of the stairs, fell down with them and sustained minor injuries.

The aircraft started to move because the surface at the stand was sloping. The angle of slope exceeded the maximum allowed in the standards for construction of aircraft stands. The wheel chocks could not keep the aircraft in place, but slid in front of the turning wheels due to the slip-

pery surface and the structure and material of the chocks. The captain used the parking brake in accordance with the cockpit procedure intended for freezing conditions. However, the aircraft manufacturer has also published a standard procedure which allows the parking brake to be engaged on a slippery stand. After the incident and during the investigation, the airline has already changed the instructions given to its pilots.
Some deficiencies were found in the supervision of ground handling operations. Rovaniemi airport had not concluded the agreements required by aviation regulations with the ground handling agents working at the airport, and did not monitor their operations. The Finnish aviation authority had not inspected the ground handling operations either. The airline had recently started operating to Rovaniemi. It had not controlled the operations of the ground handling agent it was using in Rovaniemi, nor had it provided the agent with all manuals listed in the agreement between the airline and the ground handling company.

The incident occurred when a parked aircraft began to move backwards. Passengers were disembarking the aircraft using stairs placed at passenger door L1. Refuelling and baggage unloading had already been started.
The aircraft began to move because the surface of the stand was sloping, and the wheel chocks slid on the slippery surface when the captain released the parking brake. The moving aircraft caused the passenger stairs to fall, and four passengers fell down with the stairs. The refuelling hose was torn off, breaking the attachment part on the wing.
Contributing factors were:

1. The angle of slope at the aircraft stand exceeded the construction standards.
2. The stand was covered with ice and slush.
3. The wheel chocks, which were made of rubber and shaped like an equilateral triangle in cross-section, did not prevent the aircraft from moving.

The investigation commission issued eight safety recommendations:

1. Finavia (the airport operator) should bring stand number 9 at Rovaniemi airport into conformity with applicable standards with regard to the angle of slope, or obtain the Finnish aviation authority's approval for using the stand and inform airport users of the non-conformity.
2. Rovaniemi airport should develop an operational procedure for systematic maintenance of the apron also at daytime, to ensure that the friction coefficient of 0.30 as presented by the airport maintenance instructions is achieved at the apron. Airport maintenance services should have enough staff resources to ensure that all assigned duties can be appropriately carried out.
3. Finavia should remove any de-icing fluid after treatment or build a separate area with appropriate draining facilities for aircraft de-icing before take-off.
4. Rovaniemi airport should, in co-operation with the emergency dispatch centre and rescue services, plan the driving routes for emergency vehicles also for other situations than aircraft accidents. It should also revise the alerting instructions provided to the staff and ensure that the whole personnel is trained for the procedures. Airport staff should practise using Virve* telephones (* Virve = a network for communications between authorities in Finland).
5. The Finnish Civil Aviation Authority should ensure that Rovaniemi airport complies with aviation regulations in its co-operation with ground handling agents working at the airport.
6. The Finnish Civil Aviation Authority should improve the oversight of ground handling operations and make sure that the airports conduct the supervision referred to in aviation regulation GEN M1-3 within their own areas.

7. Airpro Oy should acquire such wheel chocks that, as to their material and other properties, could prevent the movement of aircraft in the conditions prevailing at the airports where the company operates. Airpro Oy should also develop the protection of its ground handling equipment so that it is sufficient to prevent damage to aircraft.
8. The airline, First Choice Airways Ltd, should inspect the operations of its ground handling agents, and ensure that the flight crews comply with appropriate regulations when refuelling the aircraft with passengers on board.

The final draft of the investigation report was sent for comments on 06.09.2006. All responses were received within the time limit. The comments received have been taken into account in the final report as appropriate.

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ABBREVIATIONS

CAT II	Category two
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
LVP	Low visibility procedures
METAR	Aviation routine weather report
QNH	Altimeter setting to obtain elevation
SOP	Standard Operating Procedures
TWR	Aerodrome control
UTC	Co-ordinated Universal Time

SYNOPSIS

All times used in this report are UTC times (winter time in Finland -2h).

On 14 December 2005, an aircraft incident occurred at Rovaniemi airport, when a parked Airbus A321 airliner, registered G-OOAH and operated by the British company First Choice Airways Ltd, began to move backwards and caused the passenger stairs to fall while passengers were disembarking. The aircraft was also being refuelled. Four passengers fell down with the stairs and sustained minor injuries.

The Finnish Accident Investigation Board (AIB) was immediately informed of the incident, and started investigations at the site assisted by Rovaniemi police. An AIB investigator arrived about four hours after the incident. On 15 December 2005, AIB set up an investigation commission to examine the causes of the incident (decision No. C 7/2005 L). Jussi Haila was appointed as investigator-in-charge and Kari Siitonen as a member of the commission. The British accident investigation authorities and the airline were also informed that an investigation had been commenced.

At AIB's request, the police conducted an on-site investigation at the aircraft stand, measured its slope, photographed the wheel chocks and aircraft damage, interviewed the flight crew and made an alcometer test to the crew. An AIB investigator arrived at the site at 14.45. The investigation focused on the conditions at the aircraft stand, wheel chocks, use of the parking brake by the flight crew, and ground handling operations.

The investigation was completed on 27 November 2006.

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1 FACTUAL INFORMATION

1.1 Sequence of events

The airliner landed at Rovaniemi at 10.17 UTC. The airport *Follow me* car guided it to stand number nine, which has no passenger bridge. When the aircraft had been taxied to the intended stand at 10.25, the driver of the *Follow me* car showed an international stop sign to the flight crew. The pilot-in-command engaged the parking brake after the aircraft had stopped. The apron staff of Airpro Oy, which provided ground handling services for the flight, placed wheel chocks in front of and behind the left wheel of the nose landing gear. After the aircraft anti collision lights had been switched off, the ground handling staff also placed wheel chocks in front of and behind the left wheel of the left-side main landing gear and pushed the passenger stairs to the forward passenger door. The ground handling supervisor climbed up the stairs to the aircraft door and signalled by knocking on the door that it could now be opened. The supervisor then descended the stairs and started to guide arriving passengers to the terminal building.

At the right side of the aircraft, Airpro loading staff drove a forklift truck to the front of the forward cargo door and a conveyor belt to the aft cargo door. The loader went from the truck platform to the forward cargo compartment and started to move baggage to the cargo door. The loading supervisor came to the site and went to the forward cargo compartment to unload the baggage. The loader then stood at the truck platform to receive the baggage. Two loaders went to the aft cargo compartment, opened the safety nets and started to move baggage to the conveyor belt.

A driver employed by R&P Aviation had driven a refuelling truck to the right side of the aircraft and attached the refuelling hose into a coupling on the right wing. At the same time, another driver of the ground handling company drove a water truck to the left side of the aft fuselage and attached the water hose into a coupling on the aircraft.

The co-pilot came out of the cockpit and checked that the wheel chocks were in place. He gave an agreed signal to the captain, indicating that they were in place. The co-pilot then went to the refuelling panel, located on the right side of the fuselage near the wing, entered the necessary figures and gave the refuelling truck driver a verbal permission to start refuelling. The driver began to transfer fuel from the truck to the aircraft.

In the cockpit, the pilot-in-command had risen from his seat. He released the parking brake in a standing position after receiving the signal from the co-pilot that the wheel chocks were in place. After this he turned towards the cabin. In the aircraft type in question, the parking brake can be used independently of toe brakes.

The ground handling supervisor climbed back to the aeroplane and discussed with cabin crew at the front door.

At 10.32.40, about eight minutes after the aircraft had been stopped, the fireman sitting in the fire truck on the left side noticed that the aircraft was moving backwards. He asked the fire truck driver to contact the air traffic control by radio and ask them to alert

the crew that the aircraft was moving. At the same time, the loaders and the refuelling truck driver also noticed that the aircraft was moving backwards. The loading supervisor used hand signals to show that the parking brake should be engaged, but he did not see anyone on the flight deck seats. He stated that there was someone standing at the door between flight deck and cabin, with his back towards the flight deck. The co-pilot also noticed that the aircraft was moving and tried to alert the captain with hand signals, but did not succeed as he did not see the captain on the flight deck.

The passenger door, which opened forwards and had been locked in the open position, and the door opening were between the handrails of the passenger stairs. As the aircraft was sliding backwards, the door opening moved behind the stairs and the hinge side of the door stuck into the right handrail (as seen from the foot of the stairs), starting to tilt the stairs. One loader and an airport official tried to prevent the stairs from falling by holding them at the lower end. However, the aircraft moving backwards caused the stairs to fall down. As the stairs fell, their left handrail hit the outer edge of the passenger door and banged the door shut, since the lock holding it open failed.

According to eye-witness reports, there were 7–10 persons at the stairs when they started to fall. The others managed to jump off the stairs in time, but one family at the top of the stairs (two children under 10 years of age and their parents) held to the stairs and fell down with them. No one was left under the stairs. The father and the children got up to their feet after falling, but the mother stayed lying on the ground. Airpro Oy staff helped the passengers who had fallen. They had no serious injuries. The fire truck crew contacted air traffic control by radio and asked them to call ambulances to the site. The parents were able to walk to the terminal building to wait for the ambulance, assisted by the airport official. Airport staff carried the frightened children to the terminal.

The refuelling truck driver, who was on the right side of the aircraft, noticed that the aircraft was moving and released the safety switch from his hand. This caused the fuel feed to stop and the shut-off valve in the refuelling truck to close. The driver went under the aircraft, next to the left main landing gear, and tried to push the gliding wheel chocks behind the landing gear wheels, together with one loader. However, the chocks slid because the apron was covered by ice, snow and slush, and could not stop the aircraft from moving.

The captain, who was standing at the rear of the flight deck, heard some noise from the passenger door and noticed that the aircraft was moving. He engaged the parking brake while still standing. At the same time, air traffic control reported by radio that the aircraft was moving. After the parking brake was engaged the aircraft stopped, but it had already moved 4.8 m backwards. The ground handling supervisor was standing at the front door inside the aircraft. He looked back and saw the door bang shut in front of his face. However, the door did not hit him.

Picture 1. Track marks of the aircraft

As the aircraft was moving, the refuelling hose attached to the right wing tightened and tore off a coupling on the wing. The pressured fuel in the hose, about 40 litres, flowed out to the apron. The refuelling hose did not hit anyone working in the area, but one loader got fuel spray on him. The valve on the aircraft wing prevented fuel from running out of the tank. About 500 kg of fuel had been transferred from the refuelling truck to the aircraft before the fuel hose was torn off. The conveyor belt in front of the aft cargo door turned in a slant position as the aircraft moved, and its unpadded corner dented and scratched the aircraft skin plates. The hose of the water truck, situated on the rear left side of the aircraft, also tightened when the aircraft was moving, but the rest of the hose wound open from the reel and caused no damage. As the aircraft stopped, the left engine was about three meters from the water truck.

1.2 Injuries to persons

Injuries	Crew	Passengers	Others
Fatal	0	0	0
Serious	0	0	0
Minor/no injuries	0	4	0

1.3 Damage to aircraft

The falling passenger stairs caused the front passenger door of the aircraft to shut down violently, damaging the mechanism at the lower part of the door. The door and door frame were visually inspected, and the door was closed for the following flight. The fuel hose attached to the aircraft caused a refuelling coupling to break. The unpadded right baulk of the conveyor belt, located at the aft cargo door, made a scratch on the aircraft skin plate below longeron RH 34. The scratch was 2.5 mm deep and about 1500 x 6 mm in area. The damaged area was visually inspected at both sides by the mechanic of the airline.

1.4 Other damage

Some profiles and form parts of the passenger stairs were slightly damaged. The conveyor belt that scratched the aircraft skin plate was not damaged because of its strong construction. The water hose attached to the aircraft was not damaged either.

1.5 Personnel information

FCA536C captain:	49 years
Licence:	Airline transport pilot, valid until 2 August 2009
Medical certificate:	JAR-FCL Class 1, valid until 1 June 2006
Ratings:	All required ratings were valid.
FCA536C co-pilot:	44 years
Licence:	Airline transport pilot, valid until 28 July 2008
Medical certificate:	JAR-FCL Class 1, valid until 30 December 2005
Ratings:	All required ratings were valid.

1.6 Aircraft information

The aircraft was an Airbus A321 narrow-body airliner manufactured by Airbus Industrie with two CFM56 turbojet engines and 220 passenger seats. The length of the aircraft is 44.5 m, wingspan 34.1 m and vertical stabiliser height 11.8 m. The main landing gear is 7.59 m wide, and the distance between main and nose landing gear is 16.9 m. In standard operations, the lower edge of the front passenger door is at a height of 3.4 m. The maximum certificated take-off mass is 89000 kg and the maximum amount of fuel 18960 kg. At the time of the incident, the aircraft had 6100 kg of JET-A1 fuel. There were 141 passengers, one of them in a wheel chair. Three of the passengers were children. The crew consisted of two pilots and six flight attendants. Of the baggage, 650 kg had been loaded in the forward cargo compartment and 936 kg in the aft cargo compartment. About ten suitcases had been unloaded before the aircraft began to move backwards.

1.7 Meteorological information

On 14 December 2005, Northern Finland was under a large low-pressure area. A snowfall front was approaching Lapland from west. Snowfall began in Rovaniemi at about 10 UTC and was quite heavy by the afternoon.

Aviation routine weather report (METAR) for Rovaniemi airport at 10.20:

Wind 120 degrees three knots, visibility 1000 m, runway visual range RWY 21 1500 m, trend: improving, runway visual range RWY 03 varying 740–1100 m; no change, snowfall, freezing fog, vertical visibility 200 feet, temperature -15 °C, dew point -16 °C, atmospheric pressure QNH 998, ice on runway 21, covering 51–100 % of the surface, depth 2 mm, braking action 29.

1.8 Aids to navigation

The equipment had no significance for the investigation.

1.9 Communications

Radio communications were listened to from Rovaniemi airport recordings, which were good in quality and readability.

When the crew of a fire truck, which was on standby at the apron because of low visibility, noticed that the aircraft was moving backwards, the driver called the aerodrome control tower (TWR) and asked them to alert the pilots that the aircraft was moving. TWR reported this to the aircraft by radio. After the passenger stairs had fallen, the fire truck crew requested air traffic control to call two ambulances to the site. A little later the air traffic control contacted the fire truck crew to check the number of patients, as requested by the emergency control centre.

The radio communications after the event stated that the airport personnel did not know to which entry gate of the airport the ambulances would drive.

There were no other radio communications relating to the incident.

1.10 Aerodrome information

Rovaniemi airport is used for both civil and military operations. It has one runway (03/21), which is 3002 m long and 60 m wide. Aerodrome reference point coordinates are 66° 33’ 42” N and 025° 49’ 51” E. The aerodrome is located 197 m (645 feet) above mean sea level. Instrument approach procedures have been published for the runways from both directions. Runway 21 has CAT II approach facilities.

There are two passenger bridges at the apron. Stand number 9, where the incident aircraft was parked, has no passenger bridge.

Rovaniemi airport had not applied to the Finnish Civil Aviation Authority for any exemptions from published standards.

1.11 Flight recorders

Flight recorders were not used for the investigation.

1.12 Wreckage and impact information

Inspectors from Rovaniemi police measured the slide marks and angle of slope at the aircraft stand. They also photographed the marks, wheel chocks and damage to the aircraft.

An inspector from the Accident Investigation Board arrived to the site at 14.45. At his request, the police took more photographs of the incident site.

The police inspectors measured the angle of slope at the stand again after the incident. The results showed that at the stop line, where the nose landing gear normally is when the aircraft is parked, the slope was 1.0 % and at the main landing gear area 1.4–1.5 %. At the site where FCA536C was parked, the slope was 1.042–1.667 %.

1.13 Medical and pathological information

The police made an alcometer (breath analyzer) test to the pilots. The test showed zero for both of them.

1.14 Fire

There was no fire.

1.15 Survival aspects

After the passenger stairs fell down, the ground handling staff and refuelling truck driver immediately started to help the passengers who had fallen with the stairs. When it became clear that no one had been severely injured, the chief airport official assisted the injured persons to the terminal building to wait for the ambulance. The fire truck also had first-aid equipment and its crew was trained to give first aid. However, the injuries were minor and the patients only needed to be transported for a doctor's examination.

The call for ambulance was transmitted by radio from the fire truck to the tower controller and further to the ATC shift supervisor, who telephoned Rovaniemi emergency control centre. Airport rescue vehicles are also equipped with "Virve" telephones for communications between authorities, but they were not used. The emergency control centre asked someone on the incident site to call directly to the centre to provide further information.

According to the radio communications it was unclear to the airport staff where the ambulances should be driven at the airport. Appropriate driving routes and places had been arranged for aircraft accident situations, but there were no agreed procedures for other incidents.

About ten persons were working around the aircraft while it was moving. After the aircraft began to move backwards, the refuelling truck driver and one loader went under it to the left main landing gear and tried to put wheel chocks behind the wheels to stop the aircraft. The refuelling hose, which was torn off, did not hit the persons working in the vicinity, but one loader got some JET-A1 fuel on him from the hose and got thoroughly wet. No one working around the aircraft was injured.

1.16 Test and research

1.16.1 Structure and properties of the wheel chocks

The handling agent Airpro Oy used wheel chocks manufactured of rubber by Teknikum Oy. The orderer had given the manufacturer a model from which the form and dimensions of the chock had been taken. Based on the model, the manufacturer had made a metal mould in which the wheel chocks were manufactured. The raw material of the chocks was waste rubber, and no requirements had been set for the quality and properties of the material. The only requirements imposed by the customer to the manufacturer were the weight and reasonable price of the chocks. The wheel chocks were 38 cm long, and 17 cm wide on each side.

Picture 2. Wheel chock

When the loading staff tried to push the chocks behind the wheels while the aircraft was moving, the chocks did not become wedged under the main landing gear wheel because of their form and the slippery surface. At the handling agent's initiative, the wheel chocks

had been equipped with studs intended for car tyres in winter, to keep the chocks better in place in winter conditions. Only a small area of the upper part of the chock was in contact with the tyre.

1.16.2 Maintenance of the aircraft stand

Apron maintenance instructions were contained in the airport's internal instructions folder (KPTO-RO) e.g. in paragraph 11, *Priority of maintenance actions*. According to the instructions, the apron was to be kept in usable condition throughout the day and night. Cleaning the apron came second in priority order together with taxiway B, right after runway 03/21.

There were usually three persons working in airport maintenance in each shift. The maintenance staff stated that, in practice, the apron could only be cleaned during the night shift. This was partly due to aircraft standing and operating at the apron, but also the several other duties assigned to airport maintenance staff. In addition to maintaining the airport movement area, their tasks included braking action measurement, providing rescue services, marshalling aircraft to stands and keeping the car test track located in the airport area in condition. In snowy weather, as at the time of the incident, the workload was high and all paper work in the office could not always be done in time because of other, more urgent tasks. Braking action was only reported to the air traffic control by radio. The staff did not always have time to write movement area inspection reports right after each inspection either. On the day of the incident, low visibility procedures (LVP) were in use several times. This means that two airport maintenance staff members were required to wear fire suits and be on standby at the apron in a fire truck.

In winter, the apron was allowed to be covered with a surface of packed snow and ice. The aim was to keep the thickness of ice layer at 1–2 cm. According to airport maintenance instructions of the Finnish Civil Aviation Administration (CAA Finland; later named Finavia, the friction coefficient on this kind of surface is usually better than 0.30 at temperatures below -3 °C. At the time of the incident, the temperature was -15 °C. Measurements made after the incident showed an average friction coefficient of 0.21, varying between 0.10–0.25, except for the heated stands next to passenger bridges.

Due to the usual clearing procedure used at the apron, there was a small amount of loose snow on top of the layer of packed snow. In the morning, the passenger bridge stand next to stand number 9 had been cleared with a blower-sweeper, and some slush had been blown on stand 9. This stand had not been cleared after that.

Aircraft de-icing was carried out at the stands at the apron. Rovaniemi airport had no procedures or equipment for collecting de-icing fluid from the ground. As the fluid mixes with snow, it forms slush which makes aircraft stands slippery also at colder temperatures. The apron had been ploughed the night before, but in a movement area inspection made in the morning, the braking action at the apron was estimated as poor (2). However, reliable braking action measurement at the apron is difficult because of parked aircraft, since it would require the measurement vehicle to be driven at a speed of 60 km/h.

Airport maintenance staff was working in three shifts. Usually there were three men working in each shift, but during the peak traffic period the day shift consisted of 4–5 men. At the time of the incident there were five men at work. The additional staff usually consisted of persons working at the airport vehicle repair shop, or students from the local adult education centre who were practising at the airport.

1.16.3 Ground handling regulations

Ground handling operations are regulated by aviation regulation GEN M1-3, which requires that from 1 April 1999, the ground handling agent and the airport must have a specific agreement on the provision of ground handling services. According to paragraph 3.1 of the regulation, the agreement must determine the ground handling agent's current organisation, responsible persons and their duties for each airport separately. However, this kind of agreement had not been made between Rovaniemi airport and Airpro Oy. The ground handling agent stated that the operations were based on verbal agreements, and the written agreement required by the aviation regulation was only a formality which had remained uncompleted. Airpro Oy saw that Rovaniemi airport, as the airport administrator, should have been more active with regard to the agreement. Rovaniemi airport reported that the agreement was at draft stage in December 2005.

The agreement was made on 20 October 2006 when comments to this report were already requested.

Paragraph 4.1.3 of aviation regulation GEN M1-3 requires the ground handling agent to ensure that passengers can safely move at the apron, and that passenger stairs equipped with wheels are safely locked in place or otherwise prevented from moving before they are used. The same paragraph advises on safety precautions for passenger movement when the aircraft is being refuelled. This paragraph also refers to aviation regulation AIR M1-12 on aircraft refuelling.

According to paragraph 3.4 of aviation regulation GEN M1-3, the Flight Safety Authority (Finnish Civil Aviation Authority as of 1 January 2006), airport operator or aircraft operator may inspect ground handling services. However, such inspections had not been made at Rovaniemi airport.

1.16.4 Instructions to ground staff

Ground handling instructions

The British airline First Choice Airways Ltd was a new customer to Airpro Oy. The companies had signed an agreement of Rovaniemi flights defining the services provided by Airpro to FCA on 29 November 2005. The agreement was in the English language and followed the model of standard ground handling agreement given in IATA Ground Handling Manual, Annex B. Paragraph 3.1 of the agreement determined that one set of passenger stairs was to be supplied for each aircraft turn-around. Paragraph 6.1 listed the FCA handbooks to be complied with by Airpro Oy in ground handling operations: Operations Notices Manual, Passenger Handling Manual, Ramp Handling Manual and Secu-

rity Manual. Of these manuals, only the Ramp Handling Manual had been delivered to Rovaniemi by 14 December 2005 (received on 28 November 2005).

The airline had not given ground handling training to Airpro staff, nor had it inspected the ground handling agent's operations before opening its air services on 3 December 2005. The ground handling agent also had agreements with other airlines using the same aircraft type. They had provided all necessary manuals according to the contract before commencing their operations.

The Ramp Handling Manual sent by the airline contained instructions for ground handling services to be provided at the apron. The agent had provided the aircraft with the services listed in the ground handling agreement. The instructions were in the English language, for which reason the responsibility for conveying information to the workers rested with loading supervisors. According to the ground handling agent's training and operating procedures, the supervisors should have given the necessary information to the loaders at the beginning of each shift. However, the interviews revealed that this procedure was not always followed. The loading supervisors were also required to enter the familiarization with the manuals in the training records. As to the familiarization with First Choice Airways' procedures, Airpro Oy training records were incomplete.

Refuelling instructions

Refuelling services at the airport were provided by R&P Aviation, which is a private company. The company had a fuel distribution agreement with Shell and was using Shell's equipment, instructions and procedures. R&P Aviation had been subjected to a quality inspection five times during the past year. The need for aircraft refuelling was usually reported through the despatch officer, after which the refuelling truck was driven to stand-by next to the aircraft to be refuelled. The refuelling company had the Finnish aviation regulations AIR M1-12 on aircraft refuelling and GEN M1-3 on ground handling operations. However, Rovaniemi airport had not made an agreement with the refuelling company as required by GEN M1-3. The airline had not made any separate agreement on refuelling services either. The procedures for providing the services were determined in the refuelling company's distribution agreement. The refuelling company had instructions related to the distribution equipment and fuel, whereas the airline was responsible for ensuring that the aircraft was ready to be refuelled. Overall responsibility for monitoring the refuelling and ensuring that it was carried out in accordance with relevant regulations and instructions rested with the aircraft operator.

Finnish aviation regulation AIR M1-12 requires all normal passenger exits to be equipped with stairs when an aircraft is refuelled with passengers on board, embarking or disembarking, and no passenger bridge is available. In this case, the ground handling agent had only provided stairs to the front passenger door in accordance with its agreement. The aft cabin door was closed during refuelling. The amount of fuel needed had been reported to the fuel company before refuelling, and the co-pilot gave a verbal permission to the refuelling truck driver to start refuelling. Monitoring of refuelling operations also requires communications between the aircraft and refueller. In this case, no communications procedure had been agreed and was not available during refuelling.

Ground staff training

Airpro Oy staff had been trained in accordance with the company's own training manuals. The manuals had been last updated on 1 December 2004. The training had covered the general instructions and procedures for ground handling operations. Instructions given by different airlines for the same aircraft type are usually similar in content. Training records had been kept, but the records had not always been completed exactly as instructed. The airline, First Choice Airways, had not provided training for ground handling operations, but it had made its ramp handling manual available to the handling agent. The ground handling agent's staff had not been inspected by the airline, and it had no ground handling and monitoring agreement with Rovaniemi airport as required by aviation regulation GEN M1-3.

1.16.5 Instructions to flight crew

The aircraft manufacturer Airbus has published two procedures for the use of the parking brake in its Standard Operating Procedures (SOP):

Parking Procedures (3.03.25 P3)

PARKING BRAKE……..AS RQRD

- *The parking brake should be released after chocks are in place, if the "BRAKES HOT" ECAM caution is displayed (or if one brake temperature is above 150 °C with brake fans ON)*

  Releasing the parking brake prevents the critical structures from being exposed to high temperature levels for an extended time. However, if conditions dictate (ie slippery tarmac), the parking brake may remain applied.

Cold Soak

The standard operating procedure for aircraft expecting a Cold Soak are defined on page 3.04.91 Page 9 of FCOM 3. The Cold Soak procedure is as follows:

SECURING THE AIRCRAFT FOR COLD SOAK

- *After switching off all bleeds and before switching off AC power:*

  DITCHING pushbutton……..ON

  This closes the outflow valve, the pack valves, the avionic ventilation inlet and extract valves

  PARKING BRAKE……...OFF
  Check chocks in place and release the parking brake to prevent brakes from freezing.

The term *"cold soak"* is somewhat unclear, but in the manufacturer's instructions it is used with reference to the *"effect of low temperature at night"*.

The captain used the parking brake in accordance with the latter instruction. The aircraft was intended to depart for a flight back to Britain after a parking time of approximately one hour. After the incident now under investigation, the airline has issued new instructions to its flight crew, according to which the parking brake is kept on when the aircraft is parked for less than 12 hours. If the aircraft is parked for a longer time, the parking brake may be released after making sure that wheel chocks are in place and hydraulic pressure is available to the parking brake and toe brakes. In addition, the pilot must sit on the cockpit seat with his feet on brake pedals when releasing the parking brake.

1.16.6 Aircraft stand

Airport ground staff marshalled the aircraft to stand number 9, which is not equipped with passenger bridge. In winter time, the stand is constantly covered with a layer of packed snow to save expenses. Snow ploughs, bucket loaders and road scrapers are used for snow removal. Blower-sweeper is not normally used. The aim is to keep the layer of snow and ice on the asphalt at about 1–2 cm. Airport maintenance staff cleans the stands during night shift. At daytime, the apron cannot usually be cleaned because of parked aircraft and the scarce personnel resources at airport maintenance. In an inspection made in the morning before the incident, braking action at the apron was estimated as 20. Measurement after the incident showed that the average friction coefficient at the apron was 0.21, varying between 0.10–0.25. After ploughing and because of the snowfall that began just before the aircraft arrived, there was about one centimetre of snow on top of the ice layer at the stand. Moreover, the aircraft previously using the stand had been de-iced, and the mixture of snow and de-icing fluid had formed slush which made the surface slippery. Friction conditions on the surface covered with slush were similar to those normally found at temperatures near the freezing point, although the actual temperature was -15 °C.

A special feature for the traffic at Rovaniemi airport is a short high season in December, when the number of transport aircraft using the airport during each day may be four times higher than during normal operations. The flight crews of these operators are usually accustomed to using airports in summer conditions. Winter conditions, snow and ice are not very familiar to them, and they are not used to slippery movement areas and aircraft stands.

The guidance and stop lines painted on the asphalt at the stand were not visible through the layer of ice and snow. The aircraft was taxied to the stand guided by the signals of the *"Follow me"* car driver. It stopped about 15 m before the stop line, at an angle of 10–15° to the alignment bar of the stand. The marshaller accepted this parking position. Measurements made by the police showed that the slope was 1.4–1.5 % in the area where the main landing gear of an A321 aircraft is located when it is correctly parked on stand number 9. In the area where FCA536C moved 4.8 m backwards, the slope was 1.042 % at the nose gear, 1.396 % at the left main landing gear and 1.667 % at the right main landing gear. According to the Finnish aviation regulation AGA M3-5, paragraph 13.5 the slope of an aircraft stand shall not, and ICAO Annex 14, paragraph 3.13.5 should not exceed 1 %. Charts of the stand measurements made by police are shown in Appendices 1-3.

According to Rovaniemi airport, aircraft stands at the apron had been designed by the Airports Department of CAA Finland in the years 1996 and 2000.

The airport operator certificate holder for Rovaniemi airport is CAA Finland. An internal service unit for CAA Finland, Airport Engineering, is in charge of planning and implementing all airport construction investments of CAA Finland. The Airport Engineering unit carries through the investment projects at its own discretion and concludes the agreements with contractors. However, the orderer of the work is CAA Finland. Airport Engineering appoints the persons supervising the work, and its project manager reviews and accepts the contracts assigned to him in the investment decision. An acceptance inspection is made to ensure that the work result meets the quality requirements set in the contract and corresponds with the construction plan. According to CAA Finland, this procedure was also followed when constructing stand no. 9 at Rovaniemi airport. Design drawing for the stand is shown in Appendix 3. According to the information, which Airport Engineering delivered to the investigation commission, they use the aviation regulation AGA M3-5 and ICAO Annex 14 as directions when planning airport stands.

According to CAA Finland, the project manager together with the airport is responsible for providing the necessary information to the Aeronautical Information Service (AIS) to be published in the Aeronautical Information Publication (AIP), where the information is transferred to the Operation Manuals (OM) used by the pilots. In the case under investigation, however, the slope at the stand exceeded the standard but was not mentioned in the AIP. The fact that the angle of slope at the stand exceeded the international requirements was not reported to operators through the AIP or OM. The crews of many operators using Rovaniemi airport during high season are not necessarily familiar with winter conditions and are not prepared to cope with slippery aprons.

The airport had not applied for a specific approval for using the apron from the Authority.

The Airports Department of CAA Finland stated to the investigators that in their opinion, the incident could not be caused by the sloping stand and insufficient friction.

1.17 Organizational and management information

First Choice Airways Ltd

First Choice Airways Ltd is a British airline, which had been operating under its current name for about one year. It functions as the air operator for First Choice Holidays and Flights Ltd, a subsidiary of the leisure travel company First Choice Holidays PLC. The company uses about 30 transport aeroplanes of Airbus A320 series as well as Boeing B757 and B767 types. The airline operated charter services to most holiday destinations that were popular among the British. The former name of the operator was AIR2000, under which name it had been flying to Rovaniemi during the Christmas season for several years. This airline had used services of another handling agent in Rovaniemi.

Airpro Oy

Airpro Oy was established in 1994 as a 100% owned subsidiary of the Finnish Civil Aviation Administration (Finavia). It provides airport ground handling services, but also offers e.g. security checking, airport staff leasing, aviation consulting, hotel reservations and travel ticket services.

At Rovaniemi airport, Airpro Oy was providing ground handling services for one airline with scheduled services and for some charter operators according to separate agreements. The number of permanent staff in the company is small. During charter seasons, it uses temporary staff such as students from Rovaniemi University and Polytechnic for passenger check-in duties and ramp workers for various temporary posts in different companies. At the time of the incident, most of the Airpro staff working at Rovaniemi airport, including supervisors, had short-term temporary employment contracts. Some of the staff changed during the Christmas season.

Rovaniemi airport

Rovaniemi airport is an independent profit unit of CAA Finland (Finavia). It operates the airport and its infrastructure, providing e.g. air traffic control, flight information, briefing and alerting services. It also maintains the airport facilities, manoeuvring areas and aprons. The airport rents its buildings and territories to outside organisations. The airport maintenance staff is also in charge of maintaining the car test track located within the airport area. The basic duties of the airport maintenance unit consist of keeping the manoeuvring areas and apron in condition, carrying out inspections and braking action measurements, and marshalling aircraft to stands. The airport maintenance staff is also required to be on standby in rescue vehicles where needed, for example during low visibility procedures.

Outside the tourist season, Rovaniemi airport is used daily by 6–7 aircraft on scheduled flights and a military flying squadron. Tourist traffic is busiest in December, when the airport may be visited by about 20 passenger aeroplanes during one day.

Aviation regulation GEN M1-3 contains the minimum requirements for airport operators and ground handling agents, as explained above in item 1.16.3. The regulation entitles airports to inspect ground handling operations. If the airport operator finds out that the ground handling agent is not in compliance with aviation regulations, it should inform the Finnish Civil Aviation Authority and take actions to correct the situation. No such inspections had been made at Rovaniemi airport, and the airport operator had not paid enough attention to compliance with aviation regulation AIR M1-12 during aircraft refuelling.

2 ANALYSIS

2.1 Factors that led to the falling of passenger stairs

The passenger stairs fell as the aircraft began moving backwards after it was parked on the stand, and the front passenger door hit the right handrail of the stairs (as seen from the foot) causing them to fall down. When the stairs were falling, their left handrail hit the outer edge of the passenger door, banged it shut and caused some damage.

The aircraft had been marshalled by airport staff to stand number 9. It had been stopped about 15 m before the stop line. The angle of slope at the stand was 1.042% at the nose wheels, 1.396% at the left main landing gear and 1.667% at the right main landing gear. The left main landing gear was 11.8 cm lower and the right 21.0 cm lower than the nose wheels.

The whole stand was covered by a layer of packed snow and ice on the asphalt. In addition, on top of the hard layer there was about 1 cm of slush formed of snow and aircraft de-icing fluid. Because of the ice and slush, the stand was slippery although the temperature was -15 °C.

After the aircraft had stopped, ground handling staff placed wheel chocks in front of and behind the left wheel of the nose landing gear and the left main landing gear. As the captain released the parking brake after the co-pilot signalled that the wheel chocks were in place, the aircraft mass of about 68 t started to load the chocks behind the wheels because the stand was sloping. The chocks were shaped like an equilateral triangle in cross-section, each side was 17 cm long. Due to the shape of the chocks, their upper edge only touched the tyre on a small area and there was not enough friction between the chock and the tyre. The shape of the chocks was also such that the aircraft tyre did not press them against the ground and did not create sufficient friction. The nine car tyre studs attached to the bottom of the chock did not touch the ground and had no effect on the friction between the chock and the surface. Therefore the chocks began to slide when pushed by the aircraft tyres and could not prevent the aircraft from moving backwards. When the ground staff noticed the situation, they took chocks from the front and tried to put them behind the wheels, but these chocks also slid and did not stop the aircraft. The aircraft only stopped when the pilot-in-command applied the parking brake again.

When the aircraft stopped again, it was still on a backwards sloping area. Its left main landing gear was 13.5 cm lower and the right 24 cm lower than the nose landing gear.

After parking the aircraft, the captain believed that the wheel chocks would keep it in place, and released the parking brake.

2.2 Flight crew actions

The captain told that he had used the aircraft manufacturer's operating procedure for parking in freezing conditions *(Cold Soak)*. According to this procedure, the parking

brake is released after making sure that the wheel chocks are in place. At the time of the incident the temperature in Rovaniemi was -15 °C and it was snowing, but freezing during a short parking time was not probable, since the brakes were warm due to braking after landing.

The aircraft manufacturer had also determined an operating procedure for normal conditions, in which parking brake is used as necessary when the brakes are not hot. In this case the brake temperature was normal. According to this procedure, the parking brake could be left on in slippery conditions. The captain either had insufficient knowledge of the Airbus A321 operating manual, or was not able to use it as the conditions required. He only believed that the aircraft would be kept in place by the wheel chocks and released the parking brake after making sure that the chocks were on.

After the incident, the airline has instructed its flight crews to keep the parking brake applied when the aircraft is parked for less than 12 hours.

The co-pilot checked that the wheel chocks were in place, and signalled this to the captain who was in the cockpit. The captain released the parking brake while standing. The co-pilot entered the necessary figures in the refuelling panel and gave a permission to start refuelling. According to the Finnish aviation regulation AIR M1-12 as well as Appendix 1 to JAR-OPS 1.305 and the instructions provided by the airline to the crew, there must be a person supervising the refuelling in the cockpit and a procedure must be agreed for communications between him and the refuelling staff. However, the captain had left his seat and no procedure for communications between refuelling staff and the cockpit had been agreed. Air traffic control and rescue services had not been informed of refuelling when passengers were disembarking, as required by the regulations and company instructions. Moreover, passenger stairs had not been provided to the aft door in accordance with the Finnish aviation regulation. The fire truck on the apron was on standby as required by low visibility procedures (LVP), and its crew did not know that the aircraft was refuelled with passengers disembarking.

The flight crew actions indicate that they were working in a routine manner, with an aim to get the aircraft ready for the next flight as soon as possible. The required precautions were overlooked, since performing the ground handling actions as quickly as possible seemed to be the first priority. The incident suggests a risk-prone operational approach, in which passenger safety is not adequately valued when economic considerations require rapidity. The airline should make sure that its flight crews comply with regulations issued on refuelling.

2.3 Refuelling

Instructions relevant to the incident flight on aircraft refuelling with passengers on board, embarking or disembarking are contained in the following documents: Appendix 1 to JAR-OPS 1.305, Finnish aviation regulation AIR M1-12 and First Choice Airways Ltd Operations Manual 8.2.1.4, Refuelling with Passengers on Board.

Complying with refuelling regulations is the responsibility of the aircraft operator, in this case First Choice Airways Ltd. The airport is also responsible for monitoring compliance with ground handling regulations in its area.

The aircraft was intended to depart for a return flight about one hour after arriving at Rovaniemi. Refuelling had been ordered through the handling agent. A refuelling truck was driven next to the aircraft after it had stopped, and the driver attached the refuelling hose to the coupling on the right wing at his own initiative. When the co-pilot had entered the necessary figures on the refuelling panel and given permission to the fuel truck driver to start refuelling, the driver switched the fuel pump on. After a while the aircraft began to move backwards. As a result, the fuel hose tightened and was finally torn off from the attachment, breaking the coupling on the aircraft wing. The refuelling truck driver noticed the situation and released the safety switch he was holding in his hand, which caused the fuel pump to stop.

The passengers had started disembarking a little earlier, but there were still about 120 passengers inside the aircraft at the time of the incident.

The following instructions given in the Finnish aviation regulation AIR M1-12, the airline Operations Manual and Appendix 1 to JAR-OPS 1.305 were not followed during refuelling:

- Air traffic control and rescue services were not informed of refuelling with passengers disembarking.
- There were no stairs by the aft passenger door of the aircraft (however, according to the operator's instructions and Appendix 1 to JAR-OPS 1.305, one set of stairs was sufficient).
- There was no one in the cockpit to handle communications with refuelling staff, and ready to initiate and direct an emergency evacuation if needed.
- No communications procedure for use between the flight crew in the cockpit and refuelling staff had been agreed.

Because of the two last mentioned deficiencies, the co-pilot and loading supervisor could not alert the captain that the aircraft was moving. The lack of communications made it impossible to prevent the incident.

The investigation commission could not obtain information on whether the aircraft was prepared for evacuation as required by the above mentioned regulations.

The different instructions on the use of passenger stairs are somewhat contradictory. The Finnish aviation regulation AIR M1-12 requires passenger stairs to be placed at all exits normally used by passengers, where a passenger bridge is not available. The airline instructions only require one set of stairs. According to paragraph 8 of Appendix 1 to JAR-OPS 1.305, *Refuelling/defuelling with passengers embarking, on board of disembarking,* "the ground area beneath the exits intended for emergency evacuation and slide deployment areas must be kept clear". The requirement does not mention the use of passenger bridge or passenger stairs.

2.4 Actions by the ground handling agent

Airpro Oy is a limited liability company entirely owned by the Finnish Civil Aviation Administration (Finavia). Rovaniemi airport is an independent profit unit of Finavia. Aviation regulation GEN M1-3 requires an agreement to be made between these operators since 1 April 1999, but no such agreement had been concluded. Airpro Oy reported that the services were based on verbal agreements, and regarded a written agreement only as a formality. Moreover, Airpro Oy had not determined who was responsible for concluding such an agreement in their organisation and who had the authority to sign it. Aviation regulation GEN M1-3 defines the responsibilities and organisations of different parties in ground handling and gives instructions on safe operations. The regulation also enables the airport to supervise and inspect ground handling operations. Since Airpro staff at Rovaniemi airport changed very often, a written agreement would have provided a good basis for familiarising new staff with their duties.

Airpro Oy and Rovaniemi airport made the agreement on 20 October 2006, when comments of this investigation report had been already requested.

In this case the ground handling staff worked in accordance with their instructions. However, First Choice Airways Ltd had not provided the ground handling agent with all manuals mentioned in the agreement between the companies, nor had the ground handling staff been familiarized with their contents. At Airpro Oy, the loading supervisors usually explained the customers' procedures to other staff members with less knowledge of English during the morning briefing, but the distribution of ground handling information to workers was not consistent. For this reason, according to the statements of personnel, all individual instructions were not conveyed clearly enough. The investigation also revealed some deficiencies in the company's training records. Short employment relationships particularly emphasize the need for systematic training, since an appropriate operations and safety culture for an aviation company is not easily created when staff changes quickly. In addition, quick turnover of staff is a risk for aviation safety and security, since internal safety control is weaker in a constantly changing work environment.

The ground handling agreement of the Rovaniemi flights between Airpro Oy and First Choice Airways Ltd had been signed on 29 November 2005. The flights started on 3 December 2005. As a result, there was not enough time for thorough ground handling staff training before the operations commenced. Most of the staff was even employed by Airpro Oy after the agreement was signed, although some of them had been working in ground handling duties for short times before.

The actions of Airpro Oy indicate that under the pressures of profit and expenses, the significance of safety-critical duties, procedures and equipment had not been fully assessed, and the specific safety features of seasonal traffic were not adequately considered.

2.5 Airport and aircraft stand

The Airport Engineering Unit of CAA Finland (Finavia) plans and implements all construction projects at CAA airports. The project manager at Airport Engineering reviews and accepts the work under his responsibility. The Airports Department of CAA Finland reported that, also in this case, an acceptance inspection was made to ensure that the work result meets the quality requirements defined in the contract. However, according to ICAO Annex 14 paragraph 3.13.5 recommendation and the Finnish aviation regulation AGA M3-5 requirement, the angle of slope at an aircraft stand should not exceed 1 %. The slope measured at stand number 9 at Rovaniemi airport was 1.042–1.667 %.

The Airports Department of CAA reported in its comments to this investigation report that it does not follow the regulations of the Finnish aviation regulation AGA M3-5.

According to the Airports Department, the project manager together with the airport is in charge of reporting the necessary information to the AIP. In this case, CAA Finland's quality system failed, since the stand is not in compliance with applicable regulations and the non-compliance was not reported.

In winter time, the stands at Rovaniemi airport are intentionally kept covered with a layer of packed snow and ice to save expenses. The layer of snow and ice on the asphalt is 1–2 cm thick. Blower-sweepers are not usually used to clear the stands, but they are maintained with bucket loaders, road scrapers and trucks with a special blade attached under them. When cleared in this way, some snow always remains on the stand. Due to the staff resources at Rovaniemi airport maintenance as well as the busy traffic at daytime, snow removal from the apron is carried out during the night shift. Any snow fallen during the day is not usually removed.

According to the airport maintenance instructions compiled by the Airports Department of CAA Finland, the friction coefficient on the layer of snow and ice is usually better than 0.30 when the temperature is below -3 °C. At the time of the incident the temperature was -15 °C, and the friction coefficient should have been better than the average. When measured after the incident, the average friction coefficient was 0.21, varying between 0.10–0.25 except for the heated stands next to passenger bridges. The required coefficient of friction was thus not achieved although the temperature was low. Rovaniemi airport should develop an operational procedure to ensure that the intended friction value is obtained. Moreover, the peak season for both air traffic and the car test track often occurs at the same time. The primary task of airport maintenance personnel still is to keep the airport manoeuvring area and apron in operable condition.

Besides the snow over the ice, friction coefficient at the stand is also affected by de-icing fluid that runs to the ground when aircraft are de-iced. De-icing treatment had also been made to an earlier aircraft at stand number 9. De-icing fluid had mixed with snow, forming a layer of slush which together with the fluid over the hard surface made the stand considerably slippery. To prevent the stands from becoming slippery, any de-icing fluid should be removed immediately after the treatment, or de-icing should be carried out at a separate location just before take-off. Rovaniemi airport has no equipment for collect-

ing de-icing fluid. In a separate de-icing area, the fluid could be collected from the ground, which would also be necessary for environmental reasons. Consequently, Finavia should construct a separate location for aircraft de-icing treatment at Rovaniemi airport, as has already been done at several other Nordic airports.

Slipperiness at the apron significantly affects the safety of the operations. For example, passengers may slip and fall over, and the airport would be liable for any injuries caused. During turnaround there are also several vehicles near the aircraft, which may hit the aircraft or each other causing damage. This risk can be reduced by keeping the friction coefficient good. Moreover, the companies operating to Rovaniemi in winter and their passengers are not necessarily used to winter conditions, which increases the risk for incidents.

2.6 Structure of the wheel chocks

The wheel chocks were made of rubber, left over from the manufacture of other rubber articles. This material was used because of lower production costs and because it responded well to the needs of the customer, Airpro Oy. No quality requirements have been defined for wheel chock materials. For this reason, they can be made of such rubber types that do not, according to the manufacturer's report, have the properties intended for winter conditions. Winter conditions make different requirements for the quality and composition of the rubber. If the material hardens, it becomes more slippery. If the shape of the object is changed as a result of wear, or if it is incorrectly shaped from the beginning, it glides easily away from its place behind the tyre. In addition, residue of de-icing fluid often found at the stands at Rovaniemi airport in winter reduces the grip of the chocks. The shape and dimensions of the chocks had been taken from a model. Due to the structure and shape of the chocks, the forces affecting them did not act in the correct direction, pushing them under the wheel to prevent the aircraft from moving backwards. If the wheel chocks were better shaped, they would be more effectively wedged and pressed between the tyre and the ground. Moreover, if appropriate requirements were defined for the rubber material to be used, it would be possible to develop a material which would more effectively prevent sliding on winter surfaces.

The ground handling agent had fitted studs to the wheel chocks so that they would better keep in place in winter conditions. However, due to the shape of the chock, its upper edge only touches the tyre on a small area. The slush at the stand also prevented the studs from gripping the ice when the chock stood freely on the ground. Therefore the studs used did not significantly improve the friction between wheel chocks and the ice layer in the conditions normally prevailing at Rovaniemi airport stands, since they did not reach to the hard ice surface through snow and slush. Because of the form of the chock aircraft wheel does not weight the chock dawn against the surface.

Wheel chocks are intended to make sure that the aircraft is kept in place also when the brakes cannot be used for some reason. In this case, the captain believed that because the chocks were in place, they would be sufficient to prevent the aircraft from moving. Under this impression he released the parking brake. However, due to the shape and properties of the wheel chocks, they did not function as intended.

Winter operations set specific requirements for the properties of wheel chocks. The material and shape of the chocks should be such that they are kept in place also on a slippery surface. At Rovaniemi airport, winter conditions prevail longer than at more southern Finnish airports. Therefore special attention should be paid to the operating conditions when choosing wheel chocks, to ensure that the chocks function as intended and are able to keep the aircraft in place also in winter conditions. Aviation supervisory bodies should seek to ensure that wheel chocks suitable for winter operations are developed to meet the requirements of specific operating conditions at different airports.

2.7 Rescue operations

Rescue operations were started immediately when the staff noticed that the stairs had fallen and four passengers had fallen to the ground with them. The staff knew the actions to be taken and handled the situation in accordance with their training.

The airport maintenance supervisor asked the fireman to request ambulances to the site by radio through the air traffic control. Because of the situation at the aerodrome control tower (TWR), the tower controller transferred the task of calling ambulances to the ATC shift supervisor. The supervisor, in turn, had to check the situation at the apron from the tower before the emergency control centre received the alert. These actions caused a delay of about two minutes in relaying the message to the emergency control centre. The centre then asked someone on the scene of the incident to call them directly to provide more information. The alert would have been transmitted to the emergency control centre more quickly and the information relayed more reliably, if someone on the scene had called the centre directly. CAA Finland's vehicles were also equipped with "Virve" telephones (a network for communications between authorities), which would have enabled direct contacts to the emergency control centre and rescue vehicles, but they were not used. Disadvantages of "Virve" telephones are that they are rather difficult to use, and the staff lacks routine in using them.

According to the radio communications the airport staff did not know where ambulances should be driven at the airport in other cases than aircraft accidents. Rovaniemi airport should, together with the emergency control centre and rescue services, design appropriate driving routes for emergency vehicles also for other situations than aircraft accidents or incidents. Alerting instructions to the crew should also be updated to include a wider range of situations.

The fuel truck driver and loader, who went to the left main landing gear under the moving aircraft and tried to stop it with wheel chocks, acted in a risk-prone manner and were in danger of being injured. They might have been crushed by the aircraft wheels on the slippery apron.

There were several loaders working in the vicinity of the refuelling coupling on the right wing, unloading baggage from the aft cargo compartment. The separated fuel hose could have caused serious injury if it had hit them.

All vehicles around the aircraft were placed as required by the relevant instructions.

2.8 Supervision and compliance with regulations

The Finnish aviation regulation AGA M3-5 prescribes a maximum value of 1% for the angle of slope at aircraft stands, in accordance with the recommendation in ICAO Annex 14. However, the Airports Engineering unit of CAA Finland had not succeeded in designing stand number 9 at Rovaniemi airport as required by this standard. The statement issued by the Airports Department of CAA Finland to the investigation commission indicates that the significance of the standard is underestimated, and the Department seems reluctant to understand that an aircraft may move on a sloping, slippery surface.

According to the comments of Airports Department of CAA Finland they consider that the Finnish aviation regulation AGA M3-5 is not a norm which they shall follow.

Aviation regulation GEN M1-3, *Ground Handling at Airports*, had become effective on 1 April 1999 with regard to the agreement between the ground handling agent and airport operator. The regulation is consistent with European Union (EU) Council Directive 96/67/EC. It is applied to ground handling services provided to aircraft with a maximum certificated take-off mass of at least 10 000 kg, or a passenger seating configuration of 20 or more. Chapter 1 of the regulation prescribes that: *The provisions given in this regulation with regard to the managing body of the airport and the supplier of ground handling services shall be the minimum requirements applicable to ground handling operations.* According to paragraph 3.1 of the regulation, *there must be an agreement on the provision of ground handling services between the managing body of the airport and the supplier of ground handling services. The agreement must state any special conditions applied at each particular airport. The agreement shall present the current organisation of the supplier of ground handling services, the responsible persons and their duties for each airport separately.*

Rovaniemi airport reported that such an agreement was under preparation. Airpro Oy regards the conclusion of an agreement that meets the minimum requirements for ground handling operations as a formality, and reports that a draft agreement in standard format was sent to the airport on 21 March 2006. The agreement was made on 20 October 2006.

Several new ground handling service providers have entered the market in recent years. Price competition is hard, and ground handling companies seek to minimize costs e.g. by using temporary staff. Nevertheless, for flight safety reasons, the aviation authority should make sure that the number and competence of personnel is adequate, the quality of services provided meets relevant requirements, and aviation regulations are complied with in ground handling operations.

Aircraft refuelling is regulated by aviation regulation AIR M1-12, which entered into force on 1 January 2002. The regulation defines the responsibilities of each party and gives instructions on refuelling procedures. Paragraph 4.7 contains separate requirements for refuelling with passengers on board, embarking or disembarking. Only JET-A1 or equivalent fuel may be replenished with passengers on board.

According to the regulation, the fuel company is responsible for the refuelling equipment, quality of fuel, and correct refuelling procedures. The aircraft operator is responsible for *ensuring that the aircraft to be refuelled, including its equipment and all vehicles in the refuelling area are appropriate, and that the refuelling crew assigned by the operator and the passengers comply with current instructions and regulations on the subject. The operator shall appoint a person to monitor refuelling on the ground.*

As stated in item 2.3 above, the flight crew did not comply with the refuelling regulations given in AIR M1-12, paragraph 4.7. The aviation regulation contains the same requirements as Appendix 1 to JAR-OPS 1.305.

AIR M1-12, paragraph *4.9*, *Interruption of refuelling:*
Refuelling must immediately be interrupted where anyone observes that the above mentioned refuelling regulations are infringed or any other hazard arises.
In this case the refuelling was interrupted when the aircraft began moving backwards, but the fuel hose was torn off from the attachment on the aircraft wing. The fuel truck driver started refuelling after having received permission from the co-pilot, although the requirements of the aviation regulation were not met. The flight crew did not comply with applicable regulations, and no one else interfered in the situation.

The investigation commission got the impression that compliance with refuelling regulations at Rovaniemi airport varies from one airline to another. However, requirements to ensure passenger safety are comprehensive and harmonised at European level. Compliance with these regulations should be monitored more effectively.

3 CONCLUSIONS

3.1 Findings

1. The flight crew had the required licences and ratings.

2. The aircraft was parked on stand number 9, which is not equipped with a passenger bridge.

3. The passengers disembarked using stairs placed at the front cabin door.

4. The co-pilot checked that wheel chocks had been placed in front of and behind the left wheel of the nose landing gear and left main landing gear, and showed a hand signal to the captain in the cockpit indicating that the chocks were in place.

5. The captain released the parking brake while standing in the cockpit, and turned then towards the cabin.

6. The co-pilot entered the necessary figures on the refuelling panel and gave the fuel truck driver permission to start refuelling.

7. The flight crew had not reported to air traffic control and rescue services that the aircraft was refuelled while passengers were disembarking.

8. There was no one in the cockpit to handle communications with refuelling staff and ready to initiate and direct an evacuation if necessary. No procedure for communications between the cockpit and refuelling staff had been agreed.

9. The Finnish aviation regulation AIR M1-12, Appendix 1 to JAR-OPS 1.305 and the airline instructions on refuelling with passengers on board are in contradiction with each other as to the number of passenger stairs required.

10. About eight minutes after the aircraft was parked, a fireman who was on standby in a fire truck at the apron as required by low visibility procedures (LVP) noticed that the aircraft was moving backwards. The other fireman contacted air traffic control by radio and asked them to alert the crew that the aircraft was moving.

11. The co-pilot and loading supervisor used hand signals to alert the captain that the aircraft was moving, but he was not at his seat in the cockpit.

12. The fuel truck driver and one loader went under the moving aircraft to the left main landing gear and tried to push wheel chocks behind the turning wheel to stop the aircraft. However, the chocks slid in front of the wheel and did not prevent the aircraft from moving.

13. The captain heard some noise from the cabin door and noticed then that the aircraft was moving. He engaged the parking brake while still standing in the cockpit. The

aircraft stopped after the parking brake was applied. At the same time, air traffic control reported by radio that the aircraft was moving.

14. The captain had used the aircraft manufacturer's operating procedure for freezing conditions *(Cold Soak)*, according to which parking brake is released after wheel chocks are in place to prevent the brakes from freezing. However, the manufacturer had also published a procedure to be used in normal conditions, which states that the parking brake can be engaged where necessary, e.g. on a slippery apron.

15. After the incident, the airline has introduced an operating procedure according to which the parking brake is normally kept on when the aircraft is parked for less than 12 hours.

16. As the aircraft moved backwards, its front door overturned the passenger stairs, which in turn broke the lock holding the door open and slammed it shut.

17. There were 7–10 persons on the stairs when they began to fall. Others managed to get away from the stairs, but a family with two children under 10 years of age fell down with the stairs.

18. No one was left under the stairs when they fell.

19. The fuel truck driver on the right side noticed that the aircraft was moving. He released the safety switch from his hand, which caused the fuel pump to shut down. The fuel hose had tightened and tore off the refuelling coupling from the aircraft wing, and the hose was thrown on the ground. The hose did not hit anyone, but one loader got fuel spray on him.

20. A baggage conveyor belt at the aft cargo compartment door made a dent and scratch of about 1,5 m on the side of the aircraft in front of the cargo door.

21. The ground handling staff gave first aid to the family that fell with the stairs. The airport staff contacted air traffic control by radio and requested them to call two ambulances to the site. Due to the situation in the control tower, the controller transferred the task to the shift supervisor, which caused a slight delay in alerting.

22. According to the radio communications the airport staff did not know where the ambulances should be driven at the airport.

23. First Choice Airways Ltd was a new customer to Airpro Oy. The ground handling agreement of Rovaniemi flights between the companies had been signed on 29 November 2005. The first flight was operated on 3 December 2005. The airline had not provided all manuals listed in the agreement to the ground handling agent, nor had it inspected the ground handling operations by 14 December 2005.

24. The usual procedure at Airpro Oy was that the loading supervisor relayed information on the customers' procedures to other workers during morning briefing. However, according to the statements of personnel, the distribution of information was

not complete, and there was some unclarity as to the transmission of individual instructions.

25. The training records of Airpro Oy were partly incomplete as concerns First Choice Airways Ltd.

26. Airpro Oy used wheel chocks made of rubber, which for their material and properties were poorly suited for winter operations. The chocks did not function as intended and could not keep the aircraft in place.

27. The slope at stand number 9 at Rovaniemi airport was 1.042–1.667%, although the applicable aviation regulation on airport construction specifies a maximum slope of 1%.

28. According to the Airports Department of CAA Finland (Finavia), the project manager together with the airport is responsible for providing the necessary information to Aeronautical Information Services and to the AIP. In this case, CAA Finland's quality system failed, since the stand constructed does not meet the applicable requirements, but the non-compliance was not reported.

29. When the aircraft stopped after moving backwards, its left main landing gear was 13.5 cm lower and the right main landing gear 24.0 cm lower than the nose landing gear.

30. At winter time, the stands at Rovaniemi airport are kept covered with a layer of packed snow and ice which is about 1–2 cm thick, except for the stands with passenger bridges. The stands can only be cleared during night shift because of other airport maintenance duties. Some snow usually remains over the ice even after clearance.

31. According to CAA Finland's airport maintenance instructions, friction coefficient on the layer of ice is usually better than 0.30 when the temperature is below -3 °C. At the time of the incident the temperature was -15 °C. Friction measurement after the incident showed that the average coefficient of friction was 0.21, varying between 0.10–0.25.

32. Aircraft de-icing at Rovaniemi airport is carried out on the stands. De-icing fluid that runs on the ground makes the icy surface slippery. Moreover, it mixes with snow forming a slush which decreases friction even further and is also harmful to the environment.

33. Rovaniemi airport and Airpro Oy had not concluded an agreement on ground handling services as required by aviation regulations. Rovaniemi airport had not been monitoring ground handling operations in its area either.

34. Rovaniemi airport and the refuelling company, R&P Aviation, had not made a ground handling agreement as required by aviation regulations.

3.2 Probable cause

The incident occurred because the parked aircraft began moving backwards while passengers were disembarking using stairs placed at the front cabin door. The aircraft was also being refuelled, and the fuel hose was attached in a coupling on the right wing. The ground handling agent's staff had started unloading baggage from the forward and aft cargo compartment.

The aircraft started moving because the aircraft stand was sloping and the wheel chocks slid on the slippery surface after the captain released the parking brake. The moving aircraft caused the passenger stairs to fall, and four passengers fell to the ground with the stairs. The movement of the aircraft also tore the fuel hose off from the wing, breaking the attachment.

Contributing factors:

1. The angle of slope at the stand exceeded airport construction standards. The excessive slope had not been reported to aeronautical information services.

2. The aircraft stand was covered with packed snow and ice. Over the ice, there was a layer of about 1 cm of snow and slush. The snow that remained on the surface after clearing, and the new snow fallen during the day, had mixed with de-icing fluid after an earlier treatment carried out at the stand. The slush formed of snow and de-icing fluid over the ice made the stand considerably slippery with regard to the ambient temperature.

3. The wheel chocks, which were made of rubber and shaped like an equilateral triangle in cross-section, only contacted the aircraft tyres on a small area, for which reason the tyres did not push the chocks towards the ground. As the aircraft began to move, the chocks slid in front of the tyres, failing to prevent the aircraft from moving. The friction characteristics of chocks are poor for winter conditions because of their material. Moreover, residue of de-icing fluid at the stand further decreased the friction.

4 RECOMMENDATIONS

1. The Airports Department of CAA Finland (Finavia) is responsible for ensuring that the areas used for aircraft operations are in appropriate condition as required by international standards and Finnish aviation regulations. Any variations must be approved by the aviation authority and reported through the aeronautical information system to everyone concerned. The slope at the stand used by the aircraft exceeded the applicable construction standards.

Finavia should alter stand number 9 at Rovaniemi airport so that it complies with the standard for maximum slope, or apply for the aviation authority's approval to use the stand as it is and inform airport users about the non-compliance.

2. Except for two stands equipped with passenger bridges, aircraft stands at Rovaniemi airport are kept covered by a layer of packed snow and ice at winter time to save expenses. According to airport maintenance instructions issued by the Airports Department of CAA Finland (Finavia), the friction coefficient on this kind of surface is usually at least 0.30 when air temperature is less than -3 °C. Due to the snow removal procedure used at Rovaniemi, some snow always remains on the ice. In this case the measured coefficient of friction was 0.10–0.25, although the air temperature was -15 °C. Because of other duties, Rovaniemi airport maintenance staff only has time to clear the stands during night shift. The size of the airport manoeuvring areas has grown in recent years, besides which the airport also carries on other business not related to air traffic. For this reason the airport maintenance staff duties include ploughing a car test track located within the airport area. Despite the growing workload, personnel resources at airport maintenance have not been increased. At present the maintenance staff does not always have sufficient time to write appropriate reports on movement area inspections and friction measurements. Moreover, the peak season for both air traffic and the car test track often occurs at the same time. The primary duty of airport maintenance, however, is to make sure that the airport manoeuvring area and apron are in operable condition.

Rovaniemi airport should develop an operational procedure to ensure that the apron is systematically maintained also at daytime, so that the friction coefficient mentioned in the airport maintenance instructions is achieved. Staff resources at airport maintenance should be increased so that all assigned duties can be properly performed.

3. At Rovaniemi airport, aircraft de-icing is carried out on the stands. Before the incident aircraft arrived, de-icing treatment had been made to another aircraft on stand number 9. De-icing fluid had run on the ground and mixed with snow on top of the ice, making the stand very slippery with regard to the ambient temperature. Due to the operating conditions at Rovaniemi, aircraft de-icing is a common procedure and a lot of de-icing fluid is used. The fluid is also harmful to the environment, for which reason it should be collected and treated appropriately.

Finavia should remove any de-icing fluid immediately after the treatment or construct a separate area for aircraft de-icing at Rovaniemi airport, where the treatment could be

made immediately before take-off. This area should be equipped with appropriate systems for collecting the fluid.

4. Calling ambulances to the site was delayed, since a person in the fire truck contacted aerodrome control tower by radio and asked the controller to call for two ambulances. Due to the situation at the control tower, the controller transferred the task to the ATC shift supervisor, who was then requested by the emergency control centre to ask for more information. Only after this the ambulances were called. However, there were several persons at the incident site carrying mobile telephones, and airport rescue vehicles are also equipped with ”Virve” telephones for communications between authorities. According to the radio communications the airport staff did not know where the ambulances should be driven after arriving at the airport.

Rovaniemi airport should, in co-operation with the emergency control centre and rescue services, plan the driving routes for emergency vehicles also for other situations than aircraft accidents. It should also revise alerting instructions given to the airport staff, and provide training on required actions to the whole personnel. The staff should practise using “Virve” telephones.

5. Rovaniemi airport had not concluded an agreement with the ground handling agent Airpro Oy and refuelling company R&P Aviation as required by Finnish aviation regulation GEN M1-3.

The Finnish Civil Aviation Authority should ensure that Rovaniemi airport complies with applicable aviation regulations in its co-operation with companies working at the airport.

6. Aviation regulation GEN M1-3 enables the Finnish Civil Aviation Authority and airports to monitor ground handling operations. In this case the operators had not concluded an agreement as required, and the regulation AIR M1-12 on aircraft refuelling was not fully complied with. The Finnish Civil Aviation Authority and Rovaniemi airport had not inspected the ground handling operations at the airport. In general, ground handling is a rapidly changing sector, as airlines are outsourcing these operations. The new companies established seek to minimize costs by using temporary staff with short employment contracts. Therefore, the quality of services provided and compliance with safe procedures required for aviation should be ensured by sufficient monitoring. This is particularly important now that outsourcing becomes more and more common and the competition is hard.

The Finnish Civil Aviation Authority should improve the oversight of ground handling operations and ensure that the airports carry out the inspections referred to in aviation regulation GEN M1-3 within their own area.

7. The shape of the wheel chocks was such that the aircraft tyres did not push them towards the ground. The chocks were equipped with nine studs normally intended for car tyres. However, the studs did not increase friction, since the studs did not reach the hard ice through the layer of snow on the stand. The baggage conveyor belt used by Airpro Oy was only padded at the end that normally contacts the side of

the aircraft. When the aircraft moved, the belt was turned in a slant position and the unpadded corner damaged the aircraft skin.

Airpro Oy should acquire such wheel chocks that, for their material and properties, are sufficient to keep the aircraft in place in the conditions prevailing at the airports where the company operates. Airpro Oy should also develop its ground handling equipment so that it is adequately protected to prevent damage to aircraft.

8. The aircraft operator is responsible for ensuring that applicable regulations are followed in ground handling operations. The operator is also instructed to inspect the ground handling agent's work, but no inspection had been made in this case. Instructions given in First Choice Airways' operations manual on aircraft refuelling are appropriate. The refuelling was started immediately after the co-pilot had entered the necessary settings in the refuelling panel, although the passengers had only started disembarking. Air traffic control and airport rescue services were not informed of refuelling with passengers disembarking. Moreover, no procedure for communications between refuelling staff and cockpit had been agreed, and there was no one in the cockpit to initiate and direct an evacuation if needed.

The airline, First Choice Airways Ltd, should inspect the operations of its ground handling agents before the first flight. It should also emphasize to its flight crews that the regulations on aircraft refuelling with passengers on board must be complied with.

Helsinki, 30th November 2006

Jussi Haila

Kari Siitonen

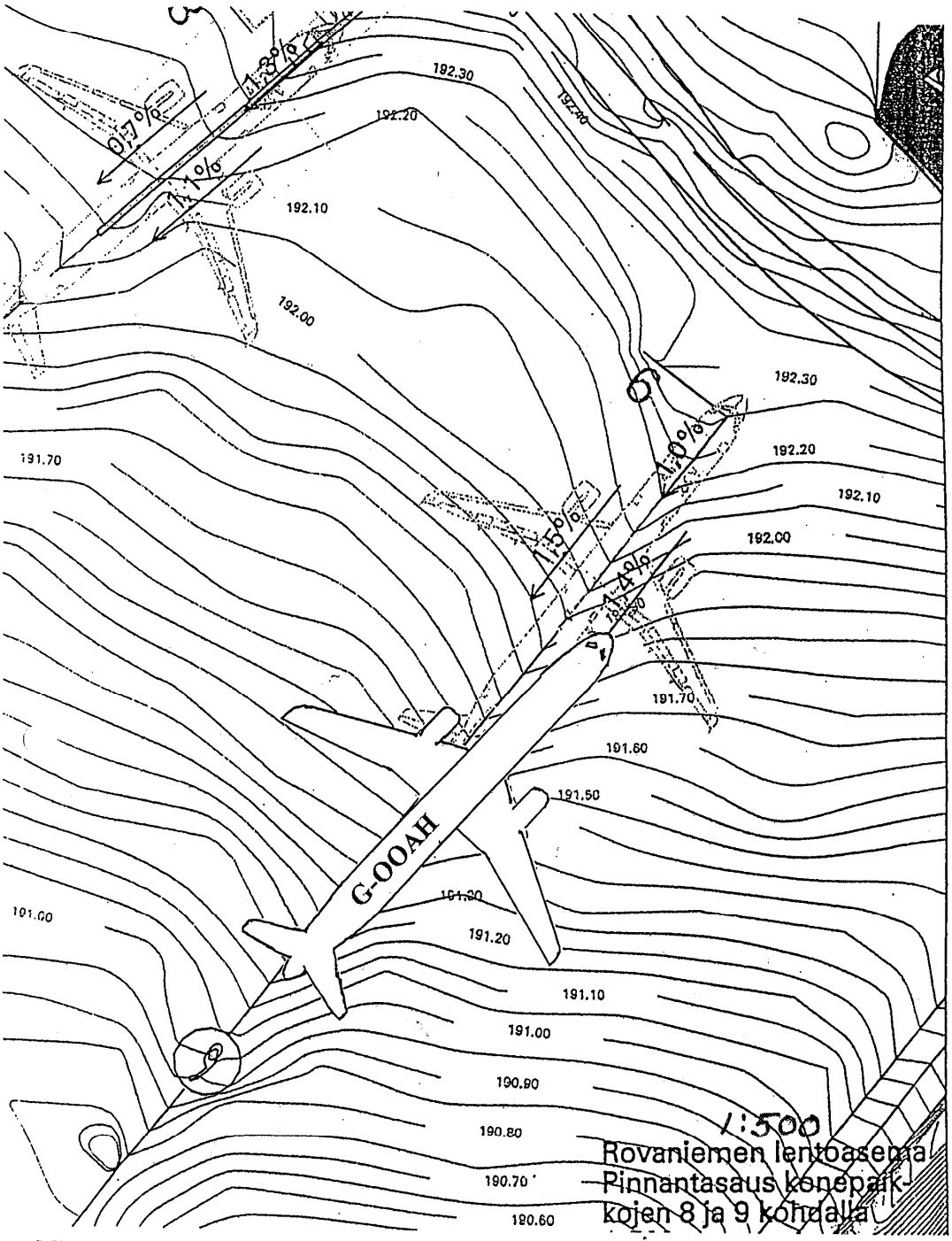
LIST OF SOURCES

The following reference material is stored at the Accident Investigation Board, Finland:

1. The incident reports
2. Finnish AIB decision No C 7/2005 L
3. Flight FCA536C information
4. Airline information
5. Handling agent information
6. Airport information
7. Weather information
8. Recordings
9. Personnel statements
10. Police documentation
11. Comments

PIIRROSLIITE III

Liittyy Rovaniemen kihlakunnan poliisilaitoksen ilmoitukseen 6670/S/33049/05, onnettomuustutkinta Rovaniemen lentokentällä.
Koneen sijainti tapahtuman jälkeen pysäköintipaikassa 9.



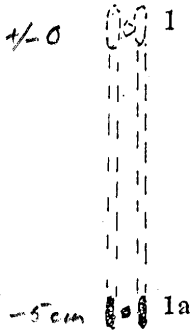
Mittaukset ja laadinta; Rovaniemi 7.2.2006

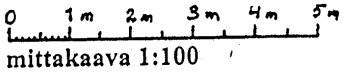
Rikosylikonst. Martti Kaihua

PIIRROSLIITE II

Liittyy Rovaniemen kihlakunnan poliisilaitoksen ilmoitukseen 6670/S/33049/05, onnettomuustutkinta Rovaniemen lentokentällä.

Lentokentän terminaalin konepaikoitusalueen pinnan kaltevuus tapahtumapaikalla (paikka 9 kohdalla).





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Numeroselvitykset;

1 nokkapyörän sijainti pysäköitäessä
1a nokkapyörän sijainti onnettomuuden jälkeen
2 vasemman päälaskutelineen sijainti pysäköitäessä
2a vasemman päälaskutelineen sijainti onnettomuuden jälkeen
3 oikean päälaskutelineen sijainti pysäköitäessä
3a oikean päälaskutelineen sijainti onnettomuuden jälkeen

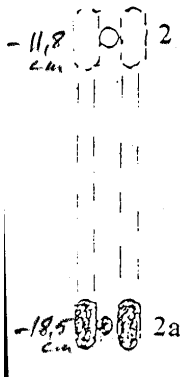
Kentän pinnan korkeuserot;

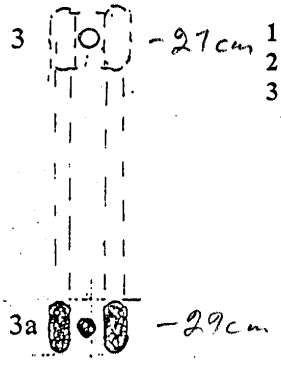
1 +/- 0
1a - 5,0 cm
2 - 11,8 cm
2a - 18,5 cm
3 - 21,0 cm
3a - 29,0 cm

Koneen vierintämatka 4,80 cm

Pyörien vierintämatkojen korkeuserot / kaltevuus prosentteina;

1 - 1a	**5,0 cm / 1,042 %**
2 - 2a	**6,7 cm / 1,396 %**
3 – 3a	**8,0 cm / 1,667 %**

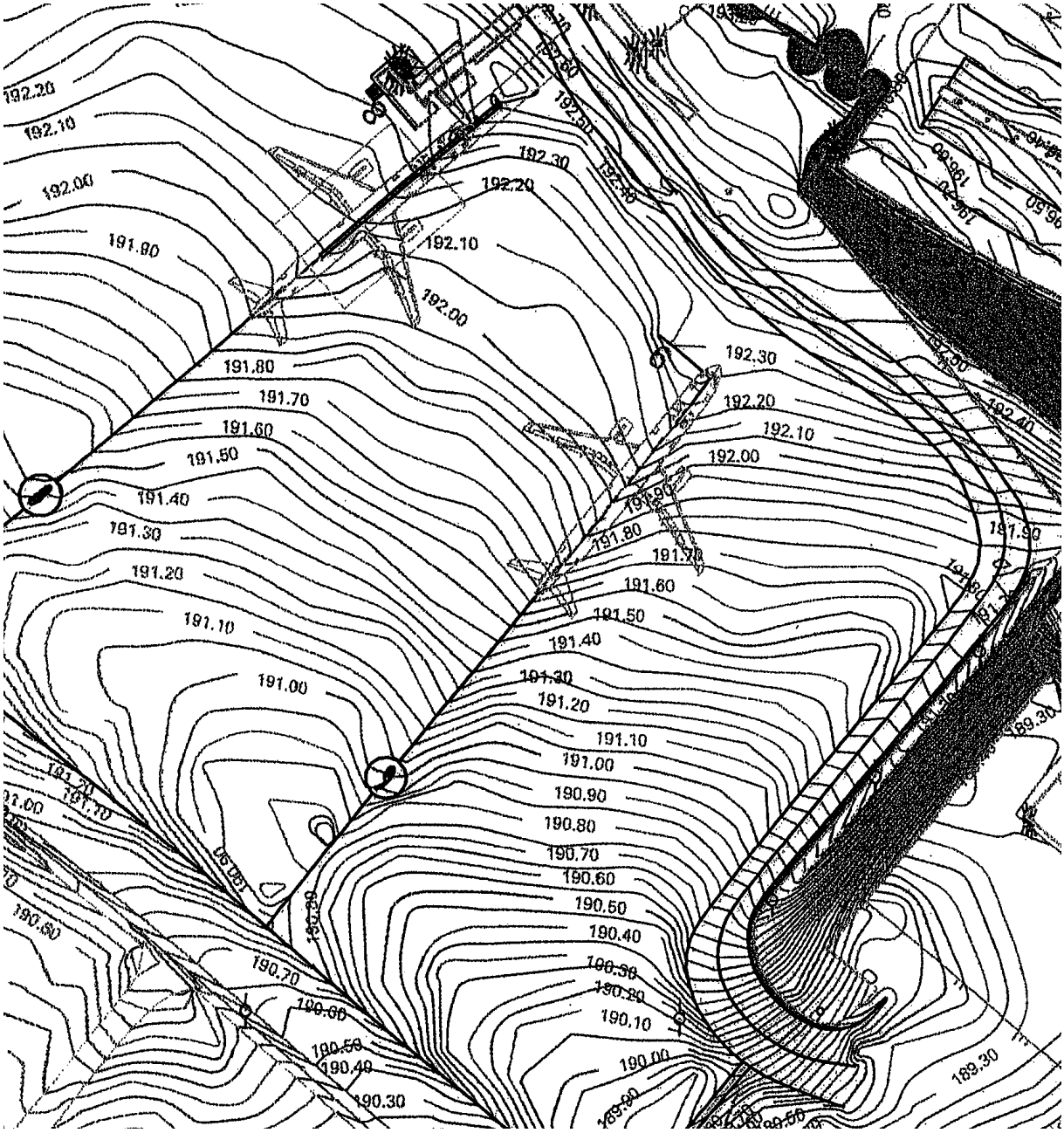




Mittaukset ja laadinta;
Rovaniemi 3.2.2006

Rikosylikonst. Martti Kaihua

Appendix 3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