Incident on Helsinki-Vantaa Airport Runway 22L on January 18, 2019

L2019-02

FOREWORD

Pursuant to section 2 of the Safety Investigation Act (525/2011), the Safety Investigation Authority of Finland (SIAF) decided to investigate an incident that occurred at Helsinki-Vantaa airport on January 18, 2019. The purpose of a safety investigation is to promote general safety, the prevention of accidents and incidents, and the prevention of losses resulting from accidents. A safety investigation is not conducted in order to allocate legal liability.

Air traffic control officer (retired) Lars Levo was appointed the investigation team leader. Team members were airline transport pilot (retired) Heikki Kasurinen and Licentiate of Philosophy Jukka Seppänen. Air traffic control officer (retired) Juha Paju was appointed a subject matter expert in air traffic controller training and site-specific training at Helsinki-Vantaa airport. The investigator-in-charge was Chief Air Safety Investigator Ismo Aaltonen. During Aaltonen's leave of absence from January 1 to March 31, 2019, the position was held by Chief Air Safety Investigator Kalle Brusi. On August 19, 2019, Chief Air Safety Investigator Janne Kotiranta assumed the duties of the investigator-in-charge.

The Accident Investigation Board Norway (AIBN), the accident investigation authority of Turkey, the Air Accident Investigation Unit (AAIU) of Ireland, and the German federal bureau of aircraft accident investigation (Bundesstelle für Flugunfalluntersuchung, BFU) appointed accredited representatives for the investigation. Pursuant to Regulation (EU) No 996/2010 on the investigation and prevention of accidents and incidents in civil aviation, the European Aviation Safety Agency (EASA) appointed a technical advisor for the investigation. The National Transportation Safety Board (NTSB) of the United States and the airplane manufacturer did not name an accredited representative or advisor but promised to help in the investigation as necessary.

The safety investigation examines the course of events, their causes and consequences, search and rescue actions, and actions taken by the authorities. The investigation specifically examines whether safety had adequately been taken into consideration in the activity leading up to the accident and in the planning, manufacture, construction and use of the equipment and structures that caused the accident or incident or at which the accident or incident was directed. The investigation also examines whether the management, supervision and inspection activity had been appropriately arranged and managed. Where necessary the investigation is also expected to examine possible shortcomings in the provisions and orders regarding safety and the authorities' activities.

The investigation report includes an account of the course of the accident, the factors leading to the accident, and the consequences of the accident as well as safety recommendations addressed to the appropriate authorities and other actors regarding measures that are necessary in order to promote general safety, prevent further accidents and incidents, prevent loss, and improve the effectiveness of search and rescue and the actions of other authorities.

An opportunity is given to those involved in the accident and to the authorities responsible for supervision in the field of the accident to comment on the draft investigation report. These comments have been taken into consideration during the preparation of the final report. A summary of the comments is at the end of the report. Pursuant to the Safety Investigation Act, no comments given by private individuals are published.

The investigation report was translated into English by TK Translations.

The investigation report and its summary were published on the SIAF's internet page at www.turvallisuustutkinta.fi on 19 Dec. 2019.

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1 EVENTS

1.1 Sequence of Events

At approximately 1715 h[1] on Friday, January 18, 2019, Turkish Airlines flight THY1XE[2] (Istanbul–Helsinki, airplane type B739) and Norwegian Air International flight IBK351 (Krakow–Helsinki, B38M) landed in succession on runway 22L at Helsinki-Vantaa airport. Separation between the airplanes was approximately 4 nm, which translated into a landing time interval of approximately one and a half minutes between the two airplanes. The traffic situation was normal for the time of the day.

The air traffic control (ATC) tower had cleared Scandinavian Airlines (SAS) flights SAS719[3] (Helsinki–Stockholm) and SAS1713[4] (Helsinki–Copenhagen) to cross active runway 22L after THY1XE had landed. The SAS airplanes had at that time been on taxiway Y and link ZD, respectively.

Once the controller had verified that SAS719 and SAS1713 had crossed the runway and THY1XE was turning off onto exit taxiway ZJ, he cleared IBK351 to land. At that time, IBK351 was at approximately 400 ft of altitude.

THY1XE had slowed down markedly during rollout and entered taxiway ZJ at approximately 9 kt. Speed subsequently reduced to approximately 4–5 kt on the taxiway. The controller told THY1XE to vacate the runway and contact ground control. By the time IBK351 was arriving over the threshold, THY1XE had vacated the 60 m wide runway and was entirely on the taxiway.[5] Tower controllers monitored the situation but due to the slow speed were unable to positively determine whether the airplane was moving or not; the controller therefore concluded that the runway was still occupied and transmitted to IBK351, “go around, I say again, go around.” The controller used the phrase go around twice in the brief message.

Owing to good visibility, the crew of IBK351 could observe both THY1XE and the SAS airplanes while the latter were crossing the runway. SAS719 completed the crossing first on taxiway Y and was followed almost simultaneously by SAS1713 crossing the runway and THY1XE turning onto the taxiway. After receiving the landing clearance, the crew of IBK351 verified visually that the runway was clear and then concentrated on landing the airplane. They did not respond to the go-around instruction, that was issued when the airplane was 50–30 ft over the threshold, while the automated callout system was outputting voice alerts of the remaining altitude in rapid succession (in ten-feet increments). The airplane landed normally. During IBK351’s final approach and landing, THY1XE was in slow and continuous motion on the taxiway. IBK351 reduced speed normally and turned off to follow THY1XE along the same taxiway.

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1 The times given in this report are Finnish standard time (UTC + 2 h).

2 This report uses aircraft type designators that appear in flight plans and consist of a three-letter airline designator issued by the International Civil Aviation Organization (ICAO) and the code of the route being operated. Information on the involved airplanes is in paragraph 2.1.2.

3 CRJ9 (Bombardier CRJ-900).

4 A20N (Airbus A320neo).

5 Surface movement radar data reveals that the perpendicular distance between THY1XE and the runway edge was about two thirds of the runway width, i.e., approximately 40 m.

On reaching the end of taxiway ZJ, THY1XE turned right onto taxiway Z and proceeded behind a follow-me car to its designated parking stand. IBK351 took a left turn and taxied autonomously to gate 19. During taxi, ATC requested IBK351 to establish contact on a separate frequency. In the ensuing discussion, the controller advised the crew that they had been told to go around and that the event would be reported. The captain of IBK351 subsequently also called ATC on the phone.

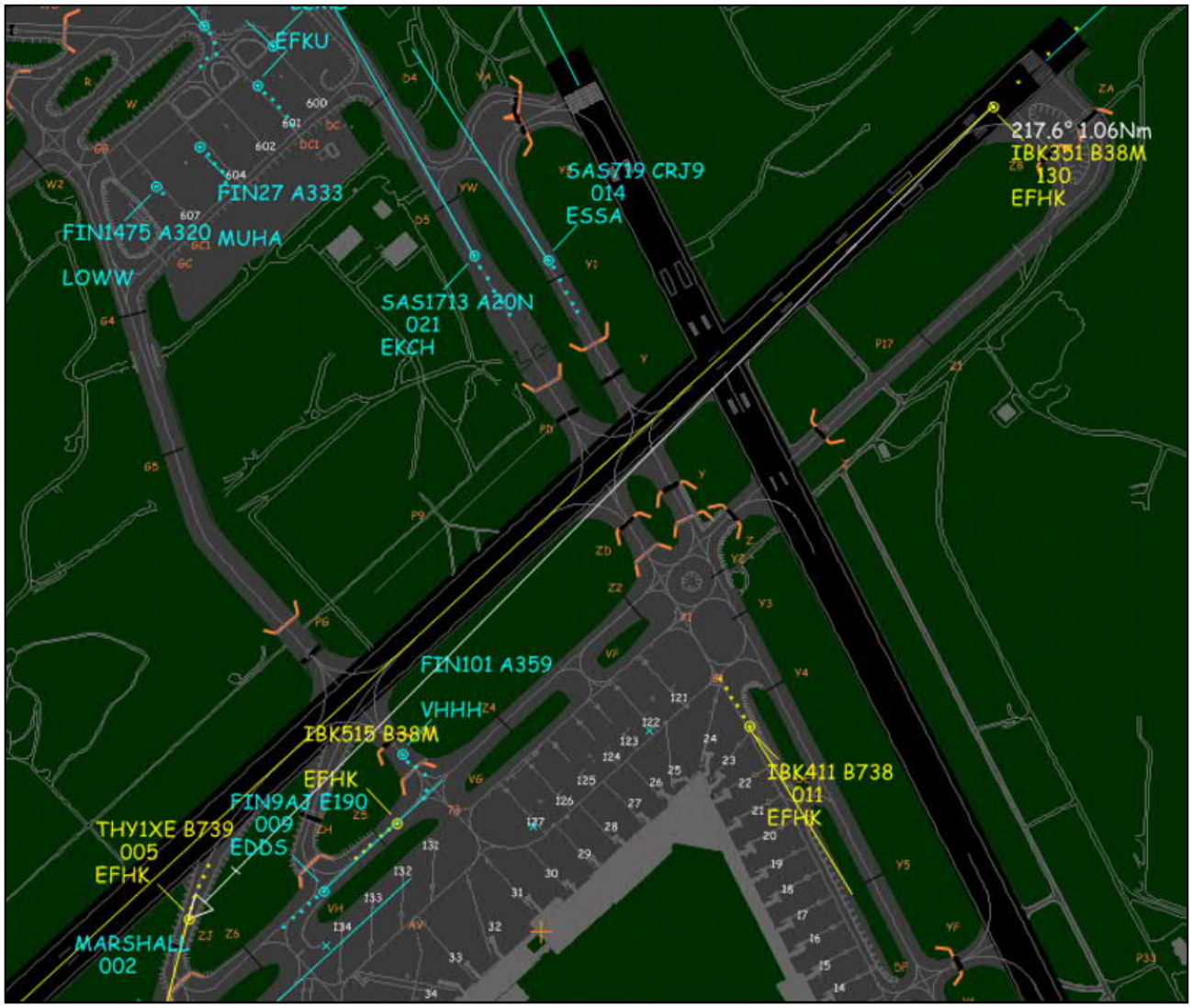

Figure 1. Rendition of the incident based on available data. In the upper right corner, IBK351 is practically above the threshold, while THY1XE is in the lower left corner, moving at a slow speed on the taxiway. The image does not represent the radar picture available to the controller at the time of the incident. (Source: ©ANS Finland)

1.2 Alerting and Rescue Operations

Since the event was not classified as an accident, no alerts were initiated and there was no need for rescue services.

1.3 Consequences

ATC classified the event as a serious incident and submitted a flight safety report to the Finnish Transport and Communications Agency (Traficom). The SIAF duty officer was also notified.

The crew of IBK351 filed an internal report in accordance with company procedures after learning about the incident.

2 BACKGROUND INFORMATION

2.1 Environment, Equipment, and Systems

2.1.1 Helsinki-Vantaa Airport

Helsinki-Vantaa airport is operated by Finavia, which is a public corporation wholly owned by the Government of Finland. In addition to Helsinki-Vantaa, it operates twenty airports across Finland.

The airport is served by three asphalt runways. Runways 04L/22R (length of paved surface 3,060 m) and 04R/22L (3,500 m) run parallel. The third runway, designated 15/33 (2,900 m), intersects runway 04R/22L. Aerodrome elevation is approximately 55 m.

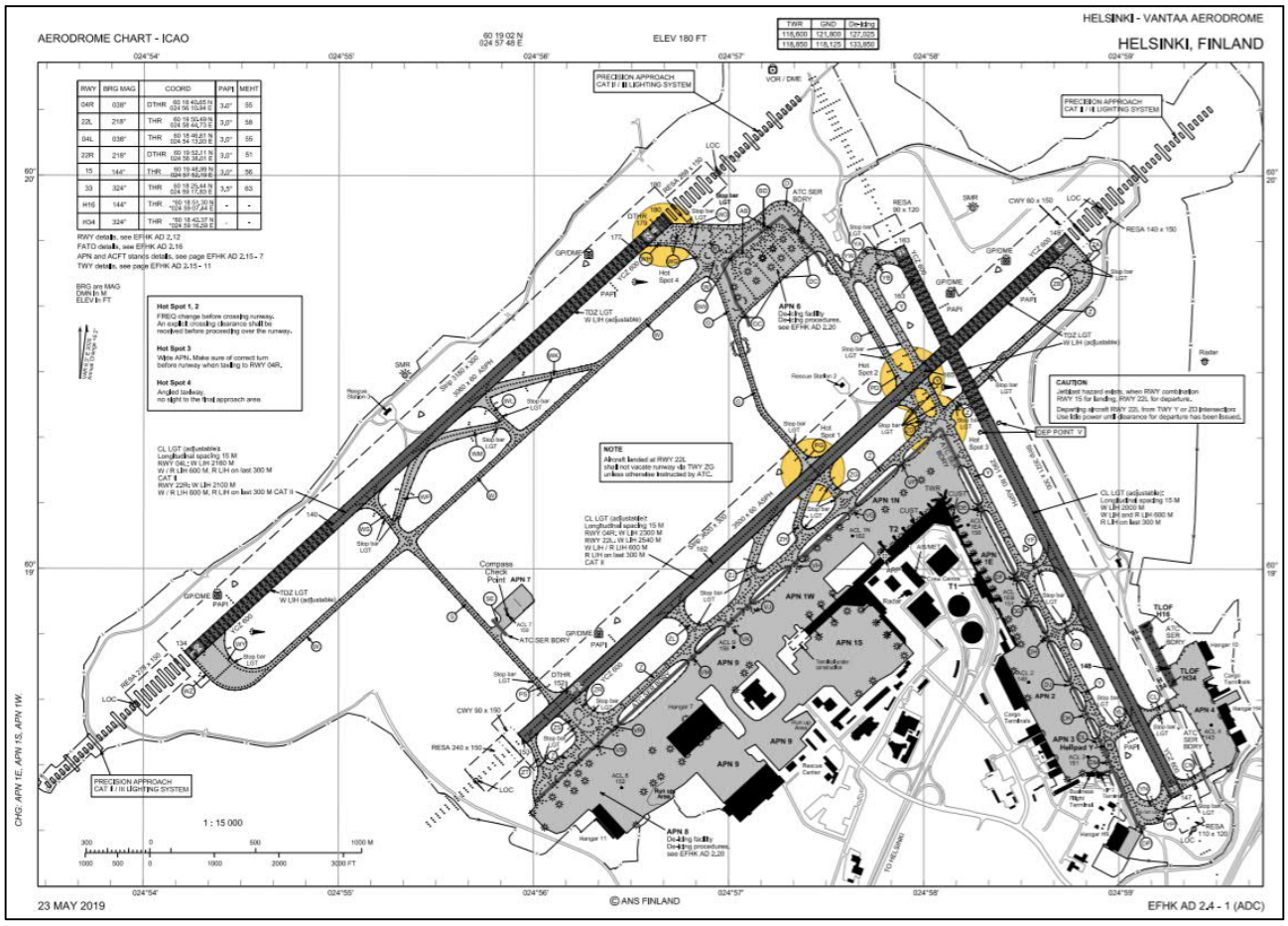

Figure 2. Helsinki-Vantaa aerodrome chart. (Source: ©ANS Finland)

2.1.2 Aircraft Information

THY1XE

Aircraft type: B739 (Boeing 737-9F2-ER)
Registration: TC-JYH
Operator: Turkish Airlines
Departure and destination aerodromes: LTFM–EFHK (Istanbul–Helsinki)

IBK351

Aircraft type: B38M (Boeing 737 Max 8)
Registration: EI-FYA
Operator: Norwegian Air International
Departure and destination aerodromes: EPKK–EFHK (Krakow–Helsinki)

2.1.2 Flight Deck Environment and Equipment in Transport Category Airplanes

Voice communications between aircraft and ATC and between aircraft – except long-distance transmissions on intercontinental flights – are accomplished using aeronautical radio communication systems on very high frequencies (VHF) from 108 to 137 MHz. VHF frequencies are also used for radio navigation and data transmission over aeronautical communication networks.

Flight crews commonly use headsets to communicate with ATC and for intra-cockpit communication during taxi, approach, and landing.

The captain and first officer of IBK351 used headsets below 10,000 ft altitude in accordance with the company flight operations manual. The Bose A20 headsets were certified for aviation use and incorporated a noise reduction feature that effectively attenuated the background noise in the flight deck.

The flight interphone (auto on) function, which enables communication between the pilots via the headsets, was permanently enabled so the pilots could communicate between each other without interruption or additional switch selections except when transmitting with the onboard radios.

In the B38M, the captain and first officer can listen to radio communications through speakers located above their seats when they are not using the headsets. An automated callout system uses both the headsets and the speakers to provide the pilots with decreasing radar altitude callouts during final approach and landing. Since the purpose of the system is to keep the pilots aware of the passing of preset altitudes and enable them to act accordingly, callouts are usually heard at a high volume.

Even though the speakers on flight IBK351 were set to mute, the altitude alerts and radar altitude callouts[6] programmed for the approach were audible at a preset volume.[7]

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6 The following alerts and callouts were heard during the approach: 2,500 feet, 1,000 feet, 500 feet, 400 feet, approaching minimums, minimums, 200 feet, 100 feet, 50 feet, and then altitudes in ten-foot increments.

7 Audio warnings for altitude alert, ground proximity warning, collision avoidance, and windshear are also heard through the speakers and headsets at preset volumes. They cannot be controlled or turned off by the crew. (Boeing 737-8 Flight Crew Operation Manual paragraph 5.20.1)

2.1.3 Air Traffic Control Facility Environment and Equipment

Tower controllers use an electronic flight strip (eStrip) system to present information on individual flights and edit strips to represent the progress of a flight. The controller arranges strips of individual flights and ground vehicles and updates them on the system's touchscreen, dragging strips and vehicle indicators between display bays, that represent the aerodrome's runways, in a manner that corresponds to the granted approvals and clearances. This ensures that each runway will be used safely and only for authorized purposes.

The tower also has a surface movement radar (SMR) that detects aircraft, vehicles, and other obstacles within the aerodrome area. The controller's SMR display combines echoes from a primary radar[8] and replies transmitted by secondary surveillance radar transponders on board aircraft and vehicles. Helsinki-Vantaa SMR uses three antennas for the surveillance of the entire aerodrome area and thereby enhances the controllers' situational awareness and flight safety under all weather conditions.

Tower controllers also use a terminal area radar (TAR) to monitor aircraft on approach. Even though they are not responsible for aircraft in the approach phase, keeping an eye on the TAR display enables them to anticipate the volume of arriving traffic over the next few minutes and obtain a picture of separation between aircraft.

Communication systems used in civil aviation do not incorporate technical solutions that would supplement voice messaging when critical instructions, such as go-around calls, are issued to arriving or landing aircraft. Neither do aeronautical communications employ the selective calling method that is used to communicate alert, urgency, or emergency messages between maritime stations nor any other audio tones that would alert a receiving station of an impending critical message.

[8] A primary radar transmits pulses on microwave frequencies and receives echoes from targets such as aircraft and vehicles.

2.2 Conditions

2.2.1 Weather Conditions

A meteorological aerodrome report (METAR) at 1647 h indicated good weather at the airport with clear skies, visibility over 10 km, and no clouds below 5,000 ft.

The cleared width of runway 22L was 54 m with 20 cm high snowbanks on either side of the cleared area. Blowing snow and a deposit of approximately 1 mm of dry snow were present on the runway. Surface friction was good (friction coefficient $\geq$ 0.43) on the runway, medium (0.32–0.36) on the taxiways, and poor ($\leq$ 0.26) on the apron.

Wind was from 320° (northwest) at 2 m/s. Temperature was -12 °C, dew point -13 °C, and air pressure 997 hPa. No significant change in the weather was expected within the next two hours.

Sunset at Helsinki was at 1557 h, and the duration of twilight[9] was 52 min. The incident occurred during the hours of darkness.

2.2.2 Flight Deck Conditions in Transport Category Airplanes

Transport category airplanes are mostly operated by two flight crewmembers. One of them is designated pilot flying (PF), who flies the airplane, and the other is called pilot not flying (PNF), who monitors the management of the flight. From this follows that instead of the airplane being flown by an individual pilot, the task is performed by two crewmembers who continuously share a common situation picture by discussing procedures and anticipating future decisions. They are positioned side by side and have generally identical controls and communication, navigation, and indication systems.

Flight IBK351's cockpit voice recorder data revealed that during the approach briefing both crewmembers stated that they felt a little bit tired after a long day. Saying this aloud showed that they recognized the associated risks and a need for heightened attention. The briefing also included a missed approach procedure.

2.2.3 Conditions at Aerodrome Control Tower

The control tower at Helsinki-Vantaa airport is in the northern corner of the terminal building complex. Its large windows offer good all-round visibility, and the environmental conditions inside the tower remain constant except for variations in lighting. External conditions, however, have an impact on the controllers' work.

The controllers' positions are on two levels so that every controller has an unrestricted field of view over his or her assigned sector. The tower control's area of responsibility is divided into three sectors designated Tower East (TWR-E), Tower West (TWR-W), and Ground (GND). The latter is sometimes divided into sub-sectors designated GND-1 and GND-2. Normally manned positions are CLD (Clearance Delivery), GND, TWR-E/W and, in wintertime, TWRSUP (Tower Supervisor). These positions can be combined, opened, and closed depending primarily on traffic intensity and also on runway combination.

Tasks can also be reallocated between the positions during a shift. The controllers' shifts consist of the time on task at the control positions and breaks so the manning of each shift always exceeds the minimum requirement for the facility. A working day is interspersed with

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[9] Twilight prevails after sunset or before sunrise when the sun is 6° below the horizon. Ambient lighting alone will be sufficient for outdoor activities in clear weather during twilight.

rest periods to maintain alertness. The longest continuous work period is two hours, which shall be followed by a break of no less than 30 minutes.

2.3 Personnel, Organizations, and Safety Management

2.3.1 Airplanes and Flight Crews

The captain and first officer of flight THY1XE held valid licenses and ratings. They were Turkish citizens.

They slowed down the airplane significantly during rollout and then proceeded along the exit taxiway at a slow speed. The captain explained in a written statement that vacating the runway at a higher speed would have been risky due to the reported taxiway friction.

The captain and first officer of flight IBK351 held valid licenses and ratings. They were Swedish citizens.

During the approach and landing, the first officer and captain exercised the duties of PF and PNF, respectively. They adhered to the sterile cockpit procedure during the approach by engaging only in conversations needed for the operation of the airplane. Their actions were also in all other respects compliant with the standard operating procedures.

During the final approach, they watched the two SAS airplanes that were crossing the runway and maintained awareness of THY1XE as it was vacating the runway. They considered the runway clear since the SAS airplanes had crossed the runway and THY1XE was on the taxiway outside the 60 m wide runway. They found these observations consistent with the landing clearance they had just received and felt they could concentrate on landing without distractions.

Up to the receipt of a landing clearance, pilots are “go-around minded,” and their mindset is tuned to the continuation of the flight; after they are cleared to land, their attention shifts to landing the airplane and they become “landing minded.” In this particular incident, the airplane had been cleared to land, and neither communications with ATC nor the pilots’ own observations gave them any reason to expect an instruction to go around.

Since a go-around call is rarely transmitted when the airplane is already over the threshold, pilots do not anticipate such an instruction unless the controller has advised them to expect a late landing clearance or the pilots themselves have recognized the possibility of a go-around based on their observations of weather or an unusual traffic situation or for some other reason. When over the threshold, the pilots concentrate on landing since the airplane is only dozens of feet above the ground and touchdown will happen in a matter of seconds.

In the flight deck of IBK351, the entire go-around instruction consisting of the flight’s call sign and the two-part message was masked by automated callouts that alerted the pilots of the passing of 50, 40, and 30 ft of altitude.

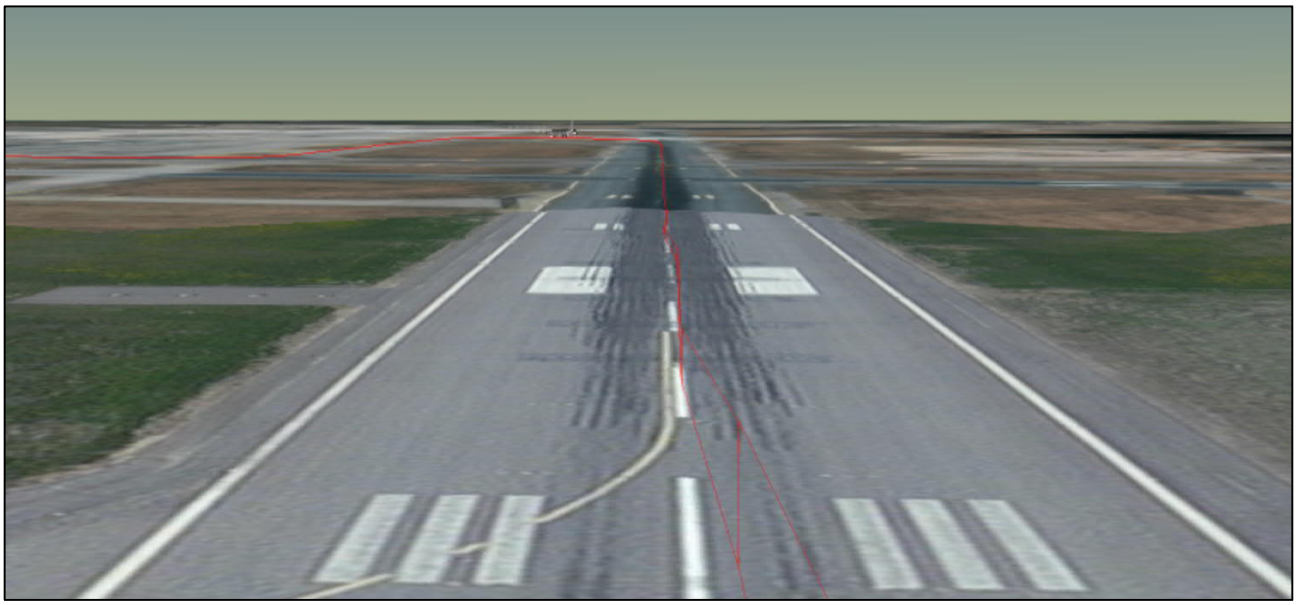

Figure 3. A reconstruction of the view from IBK351's flight deck at the moment of threshold crossing. THY1XE is in the distance off to the left side of the runway. The image does not correspond to the lighting conditions at the time of the incident due to software-related reasons. (Source: Flight IBK351 DFDR-data; Norwegian Air International)

2.3.2 Control Tower and Controllers

The controller cleared IBK351 to land on the still occupied runway 22L since it could be expected with reasonable accuracy that adequate separation[10] would exist when the airplane arrived at the threshold. The purpose of the principle of reasonable accuracy is to enable the most efficient use of runway capacity, and it involves a built-in option to cancel the landing clearance and instruct the airplane to go around if the runway remains occupied.

Another option is to first notify the crew that a landing clearance will be issued later (by transmitting "expect late landing clearance" or describing the situation by transmitting, e.g., "continue approach, another 737 vacating"); in these cases a landing clearance will be granted after the controller has determined that the runway is clear. This option also enables the crew to anticipate a go-around – which they shall execute autonomously unless they receive an explicit landing clearance.

In this particular case, the controller had cleared the SAS airplanes to cross active runway 22L after THY1XE had landed. The SAS airplanes were essential traffic from the controller's point of view because the controller had to ensure that they exited the runway.

The location of the SAS airplanes and THY1XE posed a visual observation problem due to their angular displacement of approximately 90º, and this displacement increased further as THY1XE was turning onto the taxiway. During the interview, the controller described its position by stating, "it was there... off to one side." The controllers were at the time of the incident unable to determine whether THY1XE was stationary or in motion, and they explained that several other controllers at the tower had thought it had come to a halt.

Tower controllers monitor traffic continuously and estimate runway occupancy times using the average turnoff speed of different airplanes as a yardstick. Airplanes that had landed

[10] Separation is an ATC function for maintaining a safe distance between individual aircraft.

before and after THY1XE had turned off and proceeded along the taxiway at speeds approximately twice as high as THY1XE.

From the aspect of cognitive ergonomics, an air traffic controller's job is an example of autonomously conducted safety-critical work. Even though an ATC facility is constantly manned by several persons, they are assigned different tasks, and therefore an individual controller will often need to make operational decisions quickly and assume full responsibility for his or her actions. Unlike the flight crew of a transport category airplane, who share tasks between the PF and PNF, tower controllers do not establish the roles of a 'controlling controller' and 'monitoring controller.'

This particular incident was, however, an exception as one of the two controllers involved had been recently transferred to Helsinki-Vantaa and was paired with an instructor at the TWR-E position. The controller had begun site-specific training in a simulator covering, among other topics, the airport's runway usage, low-visibility procedures, and a range of contingencies such as go-arounds and full emergency procedures. The next phase included 45 shifts of actual controlling at the tower under the supervision of an instructor controller. The first shifts during site-specific training are scheduled for periods of low traffic intensity, and the trainee then progresses to handle more intensive traffic situations. Training is based on the learning-by-doing principle, in which the instructor guides the trainee and assists him or her as required. During site-specific training, and often during any particular shift, the trainee is rotated between all control positions (TWR-E, TWR-W, GND-1, and GND-2) in order to instruct him or her in the specifics of each position in a time-efficient manner.

In this particular incident, both the trainee – who was communicating with the airplanes – and the instructor were experienced controllers. They held valid licenses and ratings, and the instructor had a valid instructor's endorsement obtained during a training instructor course at Avia College. Their previous shift had ended the night before at 0100 h and they reported again for duty at 1130 h on the day of the incident. They began the shift at the TWR-E position and then moved to the GND-2 position for a total of four hours (2 x 2 h) before relocating to TWR-E at 1700 h. The scheduling of breaks during the day had been in accordance with regulations, as the team had taken two thirty-minute breaks before the incident, and continuous time on task had not exceeded two hours.

Upon recognizing the possibility of a runway incursion, the instructor immediately prompted the trainee to transmit a go-around call, and the trainee concurred and complied. Any training situation is characteristically based on the 'play it safe principle.' In this incident, the trainee controller would in all probability have told IBK351 to go around even though the controller had been solely responsible for the control position.

The controller inserted the phrase I say again into the message, and the structure and phrasing of the message were correct in all respects. When passing the go-around instruction, the controller maintained the tone and pitch of speech that the controller had used in preceding communications.

During the interviews, the controllers mused on the reasons why the crew had disregarded the go-around call and wondered whether it had been masked by a transmission from another aircraft but rejected this theory after listening to the recordings. The conclusion of the interviews was that the controllers did not understand what had happened in IBK351's flight deck. Their view was purely technical and experience-based; it did not demonstrate an understanding of factors related to flight crew operation, human factors in play during the final approach and landing, or the impact of automated callouts in the flight deck.

The SIAF submitted to ANS Finland a query in order to find out whether controllers consider factors that would slow down the vacation of the runway, such as degrading pavement friction (this was the case in the incident under investigation; i.e., friction was good on the runway, medium on the taxiways, and poor on the apron), and their effects on taxiing speed and thence on runway usage and the separation of arriving traffic. ANS Finland responded in writing that friction coefficients are taken into account, but in this particular case runway and taxiway friction was not assumed to be a factor in the vacation of the runway.

Like all safety-critical organizations, ATC facilities report noted discrepancies. ANS Finland has an electronic occurrence reporting system (ePHI) for this purpose. In the initial step of the process, a supervisor assesses the need for further action, and significant discrepancies are addressed by the safety management organisation. Upon completion of the processing of a report, feedback is provided using the ePHI system. Corrective actions will be implemented by issuing an operational instruction or other guidance such as an air traffic procedures bulletin.

2.3.3 Definition of Runway Vacation – Interpretations

The investigation revealed that the current instructions pertaining to the vacation of the runway after landing (see paragraph 2.7.1) are interpreted inconsistently.

The instructor controller used the phrases “coming on top of row of lights” and “getting past the lights in time” during the interview and referred several times to a condition of “being on the other side of the line.” The controller apparently thought that THY1XE had not yet crossed the holding position markings, which at Helsinki-Vantaa (for CAT I–III) are 90 m from the runway centerline and 60 m from the runway edge (in accordance with aviation regulation AGA M3-5). The investigation found this notion prevalent in the controller community.[11]

On the other hand, a controllers’ representative mentioned in a media interview that THY1XE had not proceeded a sufficient distance from the runway, and said, “there is a technically defined limit of 50 meters from the runway edge.”[12]

ANS Finland’s Air Traffic Control Officer's Handbook (ATCOH) contains two definitions that are applicable to a situation where a preceding airplane is vacating the runway after landing, and one of them includes the foregoing distance of 50 m. The other option is a case where the preceding airplane has turned off and is moving away from the runway (see paragraph 2.7.1).

Due to the emergence of different interpretations, SIAF inquired ANS Finland about its views on the interpretation of the options laid down in the ATCOH. ANS Finland responded in writing that “one of the two conditions shall be met.” This means that the preceding airplane [even though stationary] shall be no closer than 50 m to the runway or it shall have turned off and be continuously in motion away from the runway.

2.3.4 Other Similar Safety Occurrences

The investigators did not receive information of any previous similar occurrence while the investigation was ongoing.

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11 This interpretation applies when the pilot reports runway vacated. The controller may request the pilot to report runway vacated when, for example, low-visibility procedures are in effect or in any situation where the controller will be unable to ascertain that the airplane is not on the runway. A report shall not be made until the airplane is beyond the relevant holding position markings (ICAO Document 9432 Manual of Radiotelephony, paragraph 4.4.2). The apparent purpose of this rule is to eliminate differences between individual pilots’ interpretations of runway vacation.

12 https://www.iltalehti.fi/kotimaa/a/ac5923d1-7839-41ba-858a-a13b519ec5aa.

However, less than two weeks after the incident, a broadly similar event was recorded at Helsinki-Vantaa when another Norwegian flight was instructed to go around due to another airplane occupying the runway in snowy conditions.

2.4 Authorities' Actions

Helsinki-Vantaa airport does not have in place any specific winter operations requirements for airlines. Finavia and Traficom (previously Finnish Transport Safety Agency Trafi) publish an annual document titled Winter Conditions at Northern Finland Airports, which only applies to operations in the North of Finland.

The ATCOH (see paragraph 2.7.1) states that an airplane may be cleared to land on an occupied runway when there is reasonable assurance that the runway is clear no later than the point in time when the airplane crosses the threshold. In the interests of safety, a go-around call will be transmitted if required. The investigation revealed that risks resulting from the issuance of a landing clearance on an occupied runway and its consequences have not been assessed by the authorities or operational-level organizations, and parameters (such as weather, friction, lighting, and other conditions) for reasonable assurance have not been established. The safe application of the principle of reasonable assurance therefore hinges on appropriate action by controllers exercising operational responsibility.

2.5 Rescue Services and Preparedness

The aircraft rescue and firefighting services at Helsinki-Vantaa airport meet the Category 9 requirements of the International Civil Aviation Organization (ICAO). The airport has, in round-the-clock readiness, an on-duty fire chief, a minimum of six firefighters and at least four rescue vehicles deployed in three rescue stations.

2.6 Recording Systems

SIAF obtained from ANS Finland SMR and TAR recordings, eStrip data, and recordings of ATC´s radio and telephone communications.

Norwegian provided flight data recorder (FDR) and cockpit voice recorder (CVR) data over the two-hour period preceding the incident. CVR data was downloaded at the BFU laboratory.

All recorders had operated normally, and the quality of the data was good.

2.7 Rules, Regulations, Procedures, and Other Documentation

2.7.1 Air Traffic Control Officer's Handbook Definitions of Runway Vacation

Paragraph 2.4 Definitions of the ATCOH defines runway as "a defined rectangular area on a land aerodrome prepared for the landing and takeoff of aircraft." This definition, which highlights the rectangular shape of the runway and thereby completely excludes exit taxiways, is in line with the definition in ICAO Document 4444 Air Traffic Management, which ATCOH lists among its source material.

ATCOH paragraph 4.4.2 Conditions of Landing Clearance states that an aircraft may be cleared to land when the separation prescribed for the relevant runway exists or there is reasonable assurance that it will exist when the aircraft crosses the threshold of the runway-in-use.

The ATCOH does not elaborate procedures for the assessment of reasonable accuracy, and in practise, this is done using previous experience. Also, like in this particular incident, the average turnoff speed may be used as a baseline value. The ATCOH does not limit the

application of the principle of reasonable assurance to good weather, friction, or lighting conditions only.

ATCO paragraphs 4.4.2 and 11.4.5 Conditions for Runway Vacated Report state that "a runway is considered vacated when the following conditions[13] are met:

> (a) Another aircraft
>
> i) is not on the runway and has passed a point at least 30 m from the runway when the runway length is less than 900 m or a point at least 50 m from the runway when the runway length is 900 m or more, or
>
> ii) has landed and vacated the runway or has crossed the runway and is in motion away from the runway [in accordance with paragraph 11.4.5, also] provided that the aircraft has unrestricted and continuous access beyond the relevant runway-holding position, or
>
> iii) is holding at a designated runway-holding position."

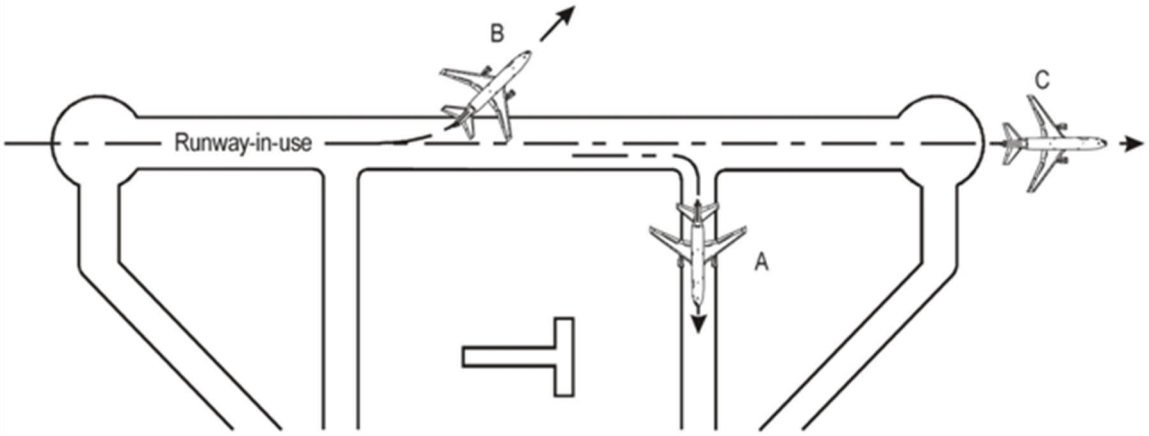
Since all Helsinki-Vantaa runways are over 900 m in length, the minimum distance meant in condition i) is 50 m. The text does not give a specific reference from which the distance is measured, but considering the context this would logically be the runway edge; i.e., the edge of the rectangular area mentioned in the definition of the runway. Condition i) does not apply only to a preceding landing aircraft but may also refer (for example in a general-aviation environment) to other aircraft parked in the vicinity of the runway.

[13] "The following conditions" refers to paragraph 4.4.2 sub-paragraphs (a)–(d). Sub-paragraph (a) applies to other aircraft; sub-paragraph (b) applies to vehicular traffic, machinery, and persons; sub-paragraph (c) applies to a displaced threshold; and sub-paragraph (d) is for a situation in which the available runway width is restricted. The text quotes only sub-paragraph (a) in its entirety. Paragraph 11.4.5 takes a somewhat different approach when it discusses aerodrome flight information services (AFIS). It replaces sub-paragraphs (c)–(d) of paragraph 4.4.2 by the following statement, "(c) net barriers and arresting cables are in their appropriate positions." Furthermore, the following addition is included in sub-paragraph (a) condition ii): "Provided that the aircraft has unrestricted and continuous access beyond the relevant runway-holding position." ICAO Document 4444 explains the matter as follows: "A landing aircraft will not normally be permitted to cross the runway threshold on its final approach until the preceding departing aircraft has crossed the end of the runway-in-use, or has started a turn, or until all preceding landing aircraft are clear of the runway-in-use."

Kun lennonjohto näkee jatkuvasti porrastettavat ilma-alukset, saa laskevan ilma-aluksen selvittää ylittämään käytössä olevan kiitotien kynnyksen, kun:

a) edellä lähtenyt on ylittänyt käytössä olevan kiitotien loppupään tai kaartanut sivuun (C ja B),

b) edellä laskenut on poistunut kiitotieltä (A).



Kiitotie vapaa –ilmoitus voidaan antaa kun:

a) edellä lähtenyt on ylittänyt käytössä olevan kiitotien loppupään tai kaartanut sivuun (A/B ja D),

b) edellä laskenut on poistunut kiitotieltä (A/C).

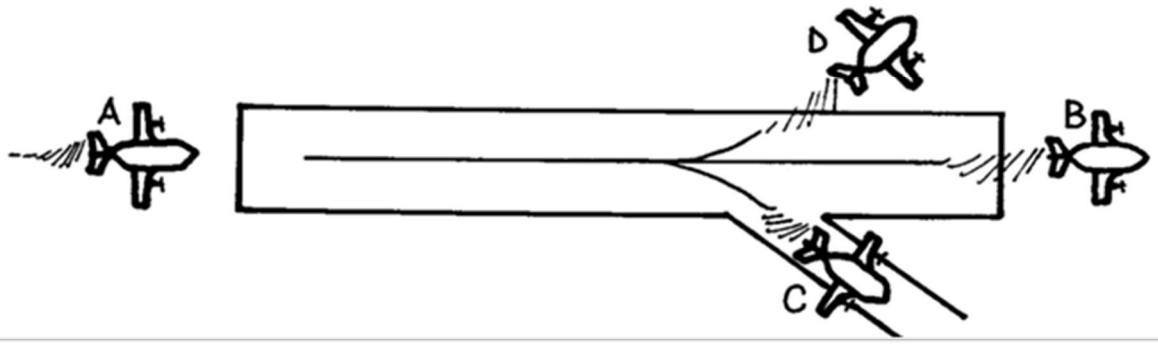


Figure 4. The ATCOH uses two figures to explain the conditions that shall exist when a runway is considered vacated. The upper figure comes from a foreign document and is found in paragraph 4.4. The lower figure, which is in paragraph 11.4.5, contains essentially the same information. The underlying notion in both figures is that the runway is vacated when the preceding landing aircraft has exited the runway. The 'wakes' in the lower figure indicate a moving airplane. (Figures: Air Traffic Control Officer's Handbook, ©ANS Finland)

Condition ii) uses two coordinating conjunctions (or and and) and discusses two aspects of runway operations: turnoff and crossing. The phrase "is in motion away from," that follows the conjunction and, can be interpreted to mean only the latter case (has crossed the runway and is in motion) or both (also: has turned off the runway after landing and is in motion). The latter interpretation is probably correct, because otherwise the text would contradict condition i), at least up to the 50-meter distance.

As apparent from the text, conditions i) and ii) are based on the definition of the runway as a rectangular area as it is written in section 2 of the ATCOH and state that an aircraft must have passed a point no less than 50 m from the runway, or an aircraft that has turned off the runway shall have unrestricted access beyond the relevant runway-holding position. Both the definition of the runway and the cognitive structure of the above-mentioned text exclude an option that the runway would extend up to the holding-position markings.

Condition iii) discusses a situation where another aircraft is stationary and waiting for an approval to enter or cross the runway and is therefore irrelevant.

Since conditions i) and ii) are separated by a comma and conjunction or, it suffices that only one of the conditions is met in cases where reference is made to a preceding landed aircraft; in other words, the runway will be considered vacated after the aircraft has turned off the runway – that is, the rectangular area mentioned in the definition – and is also in motion away from the runway. The ATCOH uses two figures (Figure 4) to visualize the foregoing scenarios.

In the investigated incident, THY1XE was entirely off, and moving away from, the runway, and had unrestricted and continuous access beyond the relevant runway-holding position.

2.7.2 Immediate Actions Instructions such as Go-around Call

The radiotelephony appendix of the ATCOH explains that the phrase I say again can be used when the speaker wishes to "repeat a message for clarity or emphasis." ICAO Document 9432 Manual of Radiotelephony also gives an option to use the word immediately, but this word was not transmitted during this particular incident.

Even though there is no specific guidance pertaining to voice modulation in transmitting immediate action instructions such as a go-around call, controllers' training stresses that messages shall be clear and easily distinguishable among other radio communications.

The ATCOH discusses technical issues[14] related to the controllability and structural integrity of the airplane that may play a role in the event of a late go-around call, but human factors in the flight deck (see paragraph 2.3.1) are not addressed. These factors are mentioned in the respective British handbook[15], which explains that the pilots should not be distracted from their tasks during the final approach, and a go-around instruction should therefore be the sole radio call issued to the aircraft.

2.7.3 Aerodrome Rules and Procedures

The Helsinki-Vantaa section of the Finnish Aeronautical Information Publication (AIP) reminds that a rapid exit from the runway is required since it will enable ATC to apply minimum spacing on aircraft on final approach, which in turn will improve runway utilization and reduce the occurrence of go-arounds.

The AIP also contains detailed runway-specific information of the exit taxiways. The remarks column in these tables contains a separate annotation if an exit taxiway is designated as a

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14 "An aborted takeoff or a go-around after threshold crossing may lead to a runway excursion. A low-level missed approach may also result in structural damage to the aircraft, and therefore the pilot-in-command (PIC) may need to use the right to assess the situation and make an appropriate decision that is vested in the PIC in the Rules of the Air." (Air Traffic Control Officer's Handbook, paragraph 4.4.11 Runway Incursion or Obstructed Runway).

15 "The final approach represents an increased period of flight deck workload. Unusual situations and emergencies during this period can be particularly demanding for the pilot. Therefore, with the exception of instructions to go-around, instructions shall not be issued to aircraft in the final stages of approaching to land that would require it to deviate from its expected flight path unless exceptional and overriding safety considerations apply." (Source: Manual of Air Traffic Services – Part 1; Civil Aviation Authority 2017; www.caa.co.uk).

rapid exit taxiway. Since no annotations of this kind are included in the tables, the airport has no rapid exit taxiways. Pilots should prepare their landings on runway 22L so that medium-category aircraft (both aircraft involved in the incident were in this category) vacate the runway via exit ZH when runway conditions permit.

An aircraft that has vacated runway 22L shall immediately contact ground for a taxi clearance.

Finavia's noise management plan for Helsinki-Vantaa airport describes approximately twenty different runway usage principles. The runways-in-use will be selected using criteria such as flight safety, wind direction and velocity, crossings of the active runway, the provisions of the airport's environmental certificate, the location of populated areas, traffic demand and direction, and the management of taxi distances and emissions.

2.7.4 Aircraft Type Specific Instructions

The maximum recommended taxiing speed of the B737NG on straight taxiways is 20 kt[16] and in no case shall the speed exceed 30 kt. When coming to a turnoff, the speed shall be reduced to suit the prevailing conditions, and on a dry surface the good turning speed [in steep turns] is 8–12 kt.

The aircraft operating manuals state that a go-around can be initiated over the threshold and even after touchdown until the thrust reversers are deployed.

2.8 Other Research

A report titled Go-Around Decision-Making and Execution Project and issued by Flight Safety Foundation in 2017 looks at go-arounds and related issues. The report found that go-arounds occur at a rate of one to three per 1,000 approaches, but there is a large variation of rates among aircraft operators and operational environments, i.e., airports. Short-haul pilots may conduct a go-around more frequently (on average once or twice a year) than their long-haul counterparts (who may conduct one every two to three years on average).

Even though the go-around is a normal phase of flight, it is the least flown phase and therefore involves a number of safety issues. One in ten go-around reports records a potentially hazardous outcome, including exceeded aircraft performance limits or fuel endurance.

The survey asked 2,035 airline transport pilots what they believed was the lowest altitude a safe go-around could be executed from. Responses were elicited to reflect various conditions (away from course, airspeed, vertical rate of descent, idle, not fully configured for landing, etc.), and the results were presented as cumulative scores. 42 % of the responders felt that during a stable and properly flown approach in good environmental conditions the lowest altitude for a safe go-around was 100 ft or higher (the options were 1,000, 500, 200, and 100 ft), while 37 % (mode for this category) opined that they would feel comfortable to initiate a go-around until the airplane crosses the threshold. 21 % regarded a go-around as a safe course of action even after threshold crossing up to reverser deployment. In every other scenario, that is, when the approach involves a deviation (examples are listed in parentheses above), the estimated minimum safe go-around altitudes were naturally higher, with the respective modes being 500 ft (except for the V_{ref} minus 0–5 kt situation).

Although the go-around is regarded as a normal flight regime, it should be noted that only one pilot in five finds the maneuver entirely safe when it is initiated after threshold crossing.

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16 20 kt equal approx. 37 km/h, 30 kt equal approx. 56 km/h, and 8–12 kt equal approx. 15–22 km/h.

The SKYbrary.aero website managed by the Flight Safety Foundation in cooperation with ICAO and Eurocontrol contains a number of articles on the operational safety of aviation and summaries of research conducted on communications. The website contains several recommendations intended for controllers and pilots with the aim of preventing low-level (i.e., below 400 ft) go-arounds. At least the following recommendations are relevant to the investigated incident:

- Pilots should advise ATC if they are unable to vacate the runway in an expeditious manner, which would allow ATC additional time for modifying its plan for the handling of arriving aircraft.

- ATC should use low-risk runway occupancy planning and avoid the creation of situations which would rely on everyone to expedite his or her actions and allow no room for unexpected factors.

- If the ATC plan relies on an aircraft vacating the runway at a particular exit, the pilots should be advised well before action is required.

- ATC should be communicating with pilots sufficiently and on a level team basis in order to enhance their situational awareness and reduce the likelihood of a go-around.

In the section that discusses verbal communications, SKYbrary.aero explains that the risk presented by ineffective verbal communication is relatively high and communication errors are often referenced as causal factors in accidents and incidents. Since the aim of communications is to elicit a desired response, the manner of speech used directly influences the meaning given to the message by the receiver.

The text lists the following among the challenges that have been found to affect verbal communications:

- poor use of volume to suit the environment

- environmental aspects such as noise, distractions, and stress

- poor use of pace or tone

- lack of emphasis of importance or urgency

- failure to listen.

3 ANALYSIS

3.1 Analysis of Occurrence

The Accimap[54] approach, further developed by Safety Investigation Authority Finland, was used in the analysis of the occurrence. The structure of the analysis text is based on the Accimap[17] presentation drawn up by the investigation. The accident is depicted at the bottom of the presentation as a chain of events. The underlying factors of the chain of events are illustrated in the presentation as separate levels of analysis.

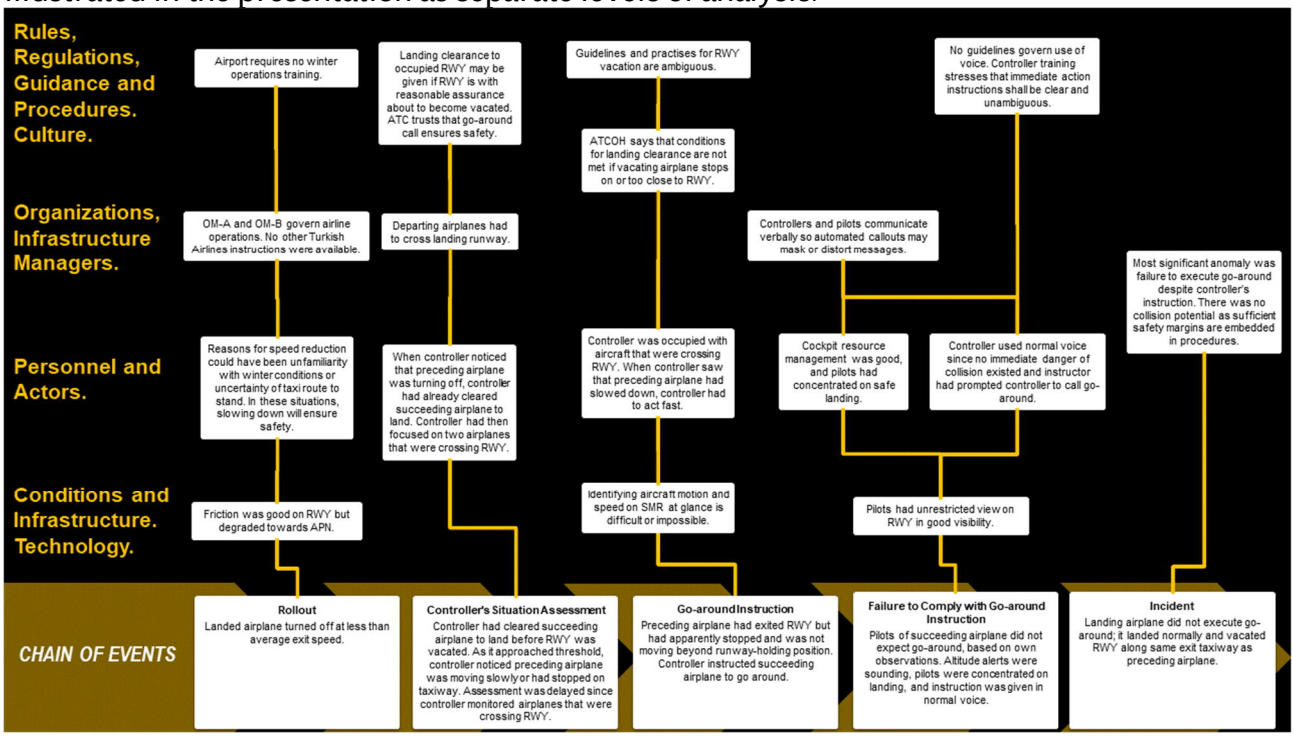

Figure 5. Accimap diagram of occurrence

3.1.1 Rollout

After landing on runway 22L, the Turkish Airlines flight vacated the runway at a slower-than normal speed. The turnoff speed of 9 kt was in accordance with the aircraft manufacturer's operating instruction. Since the instruction applies primarily to steep turns, the speed can be considered slow, considering the small angle between the taxiway and runway.

The pilots reduced speed to ensure safe taxiing in winter conditions. Friction was good on the runway but degraded progressively to medium on the taxiways and poor on the aprons. From a pilot's point of view, medium friction is worse than friction encountered on a snow-free wet runway. Proceeding with caution towards areas of degrading friction is good airmanship, and speed reduction is particularly important if pilots have little experience of winter operations.

Slowing down in order to ensure the correct taxi route to the apron was also a logical decision. In accordance with the AIP, a taxi clearance will be issued only after the aircraft has vacated the runway, and in this particular situation it made sense to slow down and wait for the clearance and a follow me car.

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17 Rasmussen, J. & Svedung, I. (2000) Proactive Risk Management in a Dynamic Society. Karlstad, Sweden: Swedish Rescue Services Agency.

Airlines lay down operational procedures for each aircraft type in the Operations Manual (OM-A) and Flight Crew Operating Manual (FCOM). The OM also includes procedures for winter operations.

Apart from the OM and FCOM, no company instructions from Turkish Airlines were available to the investigators. An example of an interface between company regulations and AIP provisions is the case where the company permits a high-speed turnoff from the runway only if the AIP has designated an exit as a rapid exit taxiway.[18]

Helsinki-Vantaa does not have in place any winter operations requirements for airlines, so no specific winter operations training is required from pilots. These requirements have been deemed unnecessary for several reasons including efficient airport maintenance.

3.1.2 Controller's Situation Assessment

The controller had observed the preceding airplane in the process of vacating the runway and cleared the succeeding airplane to land since there was reasonable assurance that prescribed separation would exist when the airplane arrived at the threshold of the runway-in-use. The principle of reasonable assurance is recognized by the ATCOH and internationally. Its purpose is to enable the most efficient use of runway capacity.

Controllers estimate runway occupancy times using their experience and maintain continuous situational awareness based on the average turnoff speed of different airplane types. Therefore, the controllers involved in this particular incident could not anticipate a situation where an airplane would turn off and continue taxi at a markedly slower-than-normal speed; neither could they foresee the airplane coming to a halt.

As the succeeding airplane was nearing the threshold, the controller noticed that the preceding airplane was either moving at a very slow speed or was even stationary on the taxiway. The controller considered the runway occupied and told the airplane to go around.

After the preceding airplane had initiated turnoff, the controller’s focus had shifted to ensuring that two other airplanes would cross the runway safely. As a result, the controller only belatedly determined that the airplane was stationary and was therefore potentially obstructing the runway, which led to a very late go-around instruction.

At the time of the occurrence, departing airplanes had to cross the landing runway. This is not entirely unavoidable at Helsinki-Vantaa due to the runway and taxiway layout. Since runway crossings compound tower controllers’ workload and may lead to hazardous situations, controllers should be aware of the associated risks and assume a proactive stance to the problem during all work shifts.

Control procedures and the established operational culture permit controllers to transmit a go-around instruction and thereby cancel the landing clearance when this is of prime importance for safety in changing circumstances. If an unexpected event occurs, the controller will be able to call a go-around in sufficient time and maintain the prescribed separation if he or she actively monitors the situation - and if the pilot complies with the instruction. A go-around is generally the last line of defense in flight safety from the controller’s point of view, and it will be effective only provided that the two foregoing conditions (two ‘ifs’) are met.

This should not be taken for granted, as demonstrated by this particular incident. In short, issuing a go-around call and complying with the instruction are two different things. From this

[18] The AIP recommends that medium-category aircraft vacate runway 22L at exit ZH. However, it became evident in the investigation that this recommendation is commonly disregarded as all aircraft were found to vacate the runway via ZJ.

follows that the only way to ensure that the pilot will execute a go-around is to transmit the call in a timely manner, which also allows time for repeating the message if necessary.

3.1.3 Go-around Instruction

The preceding airplane had exited from the rectangular runway area but had apparently come to a halt and was therefore not moving beyond the runway-holding position. In fact, it was still moving at 4 kt (approximately 7.5 km/h) minimum. Since the tower-to-airplane distance was nearly one kilometer, this slow motion was difficult to discern in darkness.

Verifying aircraft motion and speed on the SMR display at a glance is also difficult or practically impossible. The primary radar will not create a 'wake' behind a slow mover, and transponder data will not be shown on the display at all user settings – and even if this data were shown, the interpretation of a single numerical value and its trend would be a painstaking effort.

The controller was preoccupied with the two SAS airplanes taxiing out for departure from runway 22R. Sequencing these aircraft would not have been necessary, since aircraft observe established right-of-way rules, but this kind of assistance is good ATC service, and right at that moment the controller did not recognize any need to observe other traffic.

Upon subsequently observing that the preceding landed airplane had slowed down, the controller had to act fast. There was no time to estimate distances or the speed of the airplane, and the controller instructed the succeeding airplane to go around. This decision was correct as the controller had a justifiable reason to suspect that a separation infringement was impending. The ATCOH prescribes that another airplane shall not be cleared to land if the preceding airplane is stationary at a distance of less than 50 m from the runway edge, and in this particular incident, the tail-to-runway separation was approximately 40 m.

The investigation revealed ambiguity in guidelines, practises and interpretations pertaining to runway vacation. Finnish controllers commonly understand that the runway will not be vacated until the landed airplane is beyond the relevant holding position markings. However, the ATCOH states that the runway becomes vacated after the entire airplane has turned off and is moving away from the runway.

The ATCOH definition[19] is identical to the definition in ICAO Document 4444 – which is among the listed ATCOH references – and both documents refer exclusively to the continuation of movement with no regard to the possibility that a very slow post-turnoff speed would hamper, or even jeopardize, other traffic. It will, therefore, be up to the individual controller to assess any resulting risks using his or her professionalism in each situation.

The interpretation generally adopted by Helsinki-Vantaa controllers offers a wider safety margin than foreign regulations, but this cannot be known by foreign pilots. The Turkish Airlines crew very likely did not realize that the slow speed would hamper other traffic, because the airplane had turned off and was moving away from the runway. The Norwegian crew also expressed surprise when they heard that ATC had told their flight to go around.

An underlying safety management principle is that actions shall not contradict rules and regulations. Consequently, if it is found that the foregoing guidelines and definitions will need to be interpreted in a different way in Finland, the matter should be processed and

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[19] The investigation found discrepancies between ATCOH paragraphs 4.4.2 Conditions of Landing Clearance and 11.4.5 Conditions for Runway Vacated Report. For example, the statement that the airplane that is vacating the runway shall have unrestricted and continuous access beyond the relevant runway-holding position appears in the AFIS section only. For more information of these discrepancies, see footnote 13.

documented via official channels and appropriate references should be included in aerodrome-specific publications.

3.1.4 Failure to Comply with Go-around Instruction

The pilots of the landing airplane could not anticipate a go-around call since they were observing the runway, and from their point of view it was clear. They had also received a landing clearance and had therefore assumed the “landing minded” mindset. In situations where the controller advises that the crew should expect a late landing clearance or explains factors that are affecting the situation, the pilots and controller share a common situational awareness and are much more “go-around minded” and prepared to discontinue the approach. In this particular case, however, the controller’s situational awareness did not include the possibility of the runway remaining occupied.

The pilots had an unrestricted view on the runway environment in good visibility. Cockpit resource management was good, and the pilots had concentrated on landing their airplane safely.

They did not hear the go-around instruction because it was masked by automated height callouts. Since controllers and pilots communicate verbally, messages can be distorted and blanked by automated callouts. The sole way of transmitting a go-around instruction is voice communication on a radio frequency. Immediate action instructions could be made more distinguishable from other communications for example by inserting an audio tone at the beginning of the message. This would be fairly straightforward technically, but no such solutions are used in aeronautical radio communications.

When passing the go-around instruction, the controller maintained the tone used in normal communications that gave no hint of any abnormality. This is understandable given the fact that no collision potential existed; moreover, the controller was undergoing training and executing a task that had been assigned by the instructor, and it was therefore important to maintain composure. Had the controller noted a real collision hazard, the tone would very likely have been more forceful, and surprise would definitely have been reflected in the controller’s voice.

Even though the ATC facility has no written guidelines governing the use of voice, controllers’ training stresses that immediate action instructions shall be clear and unambiguous.

3.1.5 Incident

The landing airplane did not execute a go-around; it landed normally and vacated the runway along the same taxiway as the preceding landed airplane.

The most significant anomaly was the failure to execute a go-around despite the controller’s instruction. There was no collision potential due to sufficient safety margins embedded in the applicable procedures.

4 CONCLUSIONS

The observations and conclusions presented below include the causes of the incident. Cause means the underlying factors of the incident and the direct and indirect factors that had an effect on the incident.

1. ATC cleared a transport category airplane to land although the preceding transport category airplane had not vacated the runway. The controller issued the landing clearance since there was reasonable assurance that prescribed separation would exist when the airplane arrived at the threshold.

   Conclusion: The principle of reasonable assurance is recognized internationally, and its purpose is to enable the efficient use of runway capacity. If the situation changes, safety will be ensured by canceling the landing clearance. This instruction shall be transmitted in a timely manner to allow time for its execution.

2. After issuing the clearance, the controller focused on two airplanes that were crossing the runway and therefore paid little attention to the airplane that was vacating the runway.

   Conclusion: Runway crossings affect tower operations at Helsinki-Vantaa airport in several ways and may result in the breakdown of deconfliction. Controllers should be aware of the associated risks and assume a proactive stance to the problem during all work shifts.

3. The controller noted that the preceding landed airplane had slowed down significantly and could even be stationary on the taxiway.

   Conclusion: There can be a multitude of justified reasons for slower-than-normal taxi, such as procedures at an unfamiliar airport, winter conditions, or waiting for a taxi clearance or a follow me car. The traffic situation and prevailing conditions may change abruptly, in which case ATC will need to decide quickly whether the conditions of a landing clearance continue to exist, or should the succeeding airplane be directed to go around.

4. The controller delayed the go-around instruction until the airplane had crossed the threshold. The automated callout system was calling radio altimeter heights. The go-around instruction, delivered in a normal tone and comprising a single message, was masked by the 50, 40, and 30 ft callouts.

   Conclusion: Controllers shall be sufficiently conversant with flight crew activities and the sound environment in the flight deck during various phases of the flight. Sometimes the controller may need to transmit an urgent instruction (such as a go-around call) to ensure safety in an evolving situation. These calls shall be readily distinguishable among other radio communications in terms of both tone and volume.

5. The ATCOH guidelines and definitions pertaining to runway vacation after landing are interpreted inconsistently among the Finnish controller community.

   Conclusion: An underlying safety management principle is that actions shall not contradict rules and regulations. Either the actions and procedures shall be aligned with internationally recognized regulations, or the Finnish interpretation – that in this case offers a wider safety margin – shall be endorsed and incorporated in aerodrome-specific publications.

5 SAFETY RECOMMENDATIONS

5.1 Risk Analysis on Landing Clearances Issued in Accordance with Principle of Reasonable Assurance and Resulting Actions

An airplane may be cleared to land on an occupied runway when there is reasonable assurance that the runway is clear no later than the point in time when the airplane crosses the threshold. If an unexpected event occurs, the controller will be able to call a go-around in sufficient time and maintain the prescribed separation if he or she actively monitors the situation - and if the pilot complies with the instruction. The safe outcome of a landing clearance that is based on reasonable assurance can be ensured only if two conditions (two 'ifs') are met. Investigation into this particular incident revealed that the fulfilling of both conditions may not always be that straightforward.

The Safety Investigation Authority Finland recommends that

> Traficom and ANS Finland launch a joint long-term risk analysis of potential hazards associated with landing clearances that are based on reasonable assurance. The analysis would look at challenges to the controllers, the potential consequences of non-executed go-around instructions, and other contingencies. The results would be used to revamp the existing procedures by eliminating the possibilities of inconsistent interpretations resulting from the way the conditions are prescribed in the present documents. [2019-S61]

The recommended action would also offer an opportunity to provide guidance for situations and circumstances where a landing clearance could be issued on the basis of reasonable assurance, or when the controller should use another option such as a late landing clearance.

5.2 Use of Voice in Immediate Action Instructions

The crew of the landing airplane did not hear a go-around call that was masked by automated radio altimeter callouts. Controllers' immediate action instructions should be clear and readily distinguishable among other communications under all circumstances and conditions.

The Safety Investigation Authority Finland recommends that

> ANS Finland pays attention to the way controllers speak during communication and the tone and volume of speech in the delivery of critical messages. The principles shall be clearly documented and observed during site-specific and other training. [2019-S62]

5.2.1 Interpretation of Definition of Runway Vacation

The investigation revealed that the guidelines and definitions pertaining to runway vacation after landing are interpreted inconsistently among the Finnish controller community. The interpretation generally adopted by the controllers offers a wider safety margin but is not in line with the internationally-compatible instructions of the ATCOH. An underlying safety management principle is that actions shall not contradict rules and regulations.

The Safety Investigation Authority Finland recommends that

> Traficom and ANS Finland jointly see that the controllers' actions are in compliance with the existing guidelines and instructions and clarify the definition of runway vacation in the national documents if necessary. [2019-S63]

5.3 Implemented Measures

The SIAF is not aware of any measures implemented during the investigation.

REFERENCES

References

Blajev, T. & Curtis, W. (2017) Go-Around Decision-Making and Execution Project. Final Report to Flight Safety Foundation. At: https://flightsafety.org/wp-content/uploads/2017/03/Go-around-study_final.pdf. Date viewed 6.6.2019.

Rasmussen, J. & Svedung, I. (2000) Proactive Risk Management in a Dynamic Society. Karlstad, Sweden: Swedish Rescue Services Agency.

Investigation Material

1) Interviews
2) Recorder data
3) Weather and friction data
4) Occurrence reports
5) Written statements from involved airlines
6) Flight Crew Operations Manuals
7) Air Traffic Control Officer's Handbook
8) Aeronautical Information Publication (AIP), Finland
9) Bulletin about winter conditions at Northern Finland airports by Finavia and Trafi
10) Noise management plan for Helsinki-Vantaa airport
11) ICAO manuals
12) CAA UK manual of air traffic services
13) SKYbrary.aero animation on the risks associated with work on an active runway

SUMMARY OF COMMENTS TO DRAFT FINAL REPORT

The SIAF requested comments to the draft final report from the following organizations: Air Navigation Services Finland, Finavia, Traficom, Turkish Airlines, Norwegian Air International, the Air Accident Investigation Unit (AAIU) of Ireland, the Accident Investigation Board Norway (AIBN), the German federal bureau of aircraft accident investigation (Bundesstelle für Flugunfalluntersuchung, BFU), the accident investigation authority of Turkey , and the European Aviation Safety Agency (EASA). Pursuant to the Safety Investigation Act, no comments given by private individuals are published.

The SIAF received four comments to the draft final report.

Air Navigation Services Finland brings up two observations on the draft report. First, ANS Finland comments that the occurrence should not be classified as a serious incident. The second observation is related to paragraph 5.2. According to ANS Finland, controllers' radio communications and other communications-related training - including recurrent training - is fully compliant with requirements laid down in the applicable regulations, such as Commission Regulation (EU) 2015/40, and additional specifying provisions will therefore not be needed.

Finavia had no comments to the draft report.

Finnish Transport and Communications Agency's (Traficom) comments are related to the safety recommendations given in paragraphs 5.1 and 5.3. These recommendations were intended to both Traficom and air traffic service providers. Traficom holds the view that the recommendation in paragraph 5.1 should be aimed only at the air traffic service provider since its contents is related to air traffic control procedures and their implementation. As for the recommendation in paragraph 5.3, Traficom points out that it is not involved in the preparation of the service provider's operational manuals, procedures, and instructions, and updates to these documents will not need to be submitted to the competent authority for approval. Furthermore, Traficom states that it monitors the service providers' operation and compliance and addresses any deviations noted during the continuous compliance monitoring process.

Transport Safety Investigation Center, Turkey expresses its thanks to the SIAF for the professional conduct of the investigation and replies that neither it nor Turkish Airlines have comments to the draft report.