Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

AVIATION INVESTIGATION REPORT
A13Q0186

BELT LOADER FIRE LEADING TO CABIN SMOKE AND EVACUATION OF PASSENGERS

BOEING 767-36N/ER, CN-RNT
OPERATED BY ROYAL AIR MAROC
AT MONTRÉAL-PIERRE ELLIOTT TRUDEAU INTERNATIONAL AIRPORT, QUEBEC
04 NOVEMBER 2013

Canada

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Belt loader fire leading to cabin smoke and evacuation of passengers

Boeing 767-36N/ER, CN-RNT operated by Royal Air Maroc at Montréal-Pierre Elliott Trudeau International Airport, Quebec 04 November 2013

Summary

On 04 November 2013, Boeing 767-36N/ER (serial number 30843/867, registration CN-RNT), operated by Royal Air Maroc as Flight RAM206, left the Casablanca Mohammed V International Airport, Morocco, for Montréal-Pierre Elliott Trudeau International Airport, Quebec, carrying 243 passengers and 8 crew members.

The flight was uneventful and, at 1634 Eastern Standard Time, the aircraft landed on Runway 06 left. The aircraft taxied towards gate 61, where it came to a stop at 1641. At 1645:20, a fire broke out under a belt loader that an employee on the ground was positioning under the left aft cargo door. The smell of the smoke from the fire penetrated the cabin, prompting the captain to order the evacuation of the aircraft. Some passengers evacuated the aircraft through the boarding bridge while others used the evacuation slides. The airport firefighting service arrived on site at 1649:50 and brought the fire under control. The aircraft sustained no damage.

Le présent rapport est également disponible en français.

Factual information

History of the flight

Flight RAM206 from Casablanca, Morocco, to Montréal, Quebec, was uneventful. Once the aircraft came to a stop at gate 61 and the engines were shut down, the automatic deployment mechanisms for the door evacuation slides were disarmed by the cabin crew. The passengers began deplaning through the boarding bridge via the left forward door (door 1L). At this point, the auxiliary power unit (APU) [1] was operational.

The fire

When the belt loader was aligned with the left aft cargo door of the aircraft, the operator raised the conveyor belt to the doorsill, applied the handbrake and stepped down from the driver's seat, as is the customary practice. That is when the operator noticed fuel leaking from the belt loader's engine compartment. He informed a fellow ground crew member of the situation, who came to investigate and in turn reported the situation to his supervisor.

The operator then climbed back into the driver's seat and lowered the conveyor belt with the intention of moving the belt loader away from the aircraft. At this point, at 1645:20,[2] the pool of fuel that had accumulated on the ground under the belt loader ignited. The operator immediately stepped down from the driver's seat to move away from the flames.

Evacuation

The passengers at the front of the cabin had started deplaning in the usual way via door 1L, the only open door at this point (Figure 1). Several passengers in the aft cabin were standing in the aisles, gathering their personal belongings and carry-on luggage or waiting for the aisle to clear to move towards the front. The cabin crew members assigned to door 1L noticed a burning smell in the cabin. At the same time, a member of the ground crew was banging on the boarding bridge door leading to the outside and shouting to warn the cabin crew about the fire.

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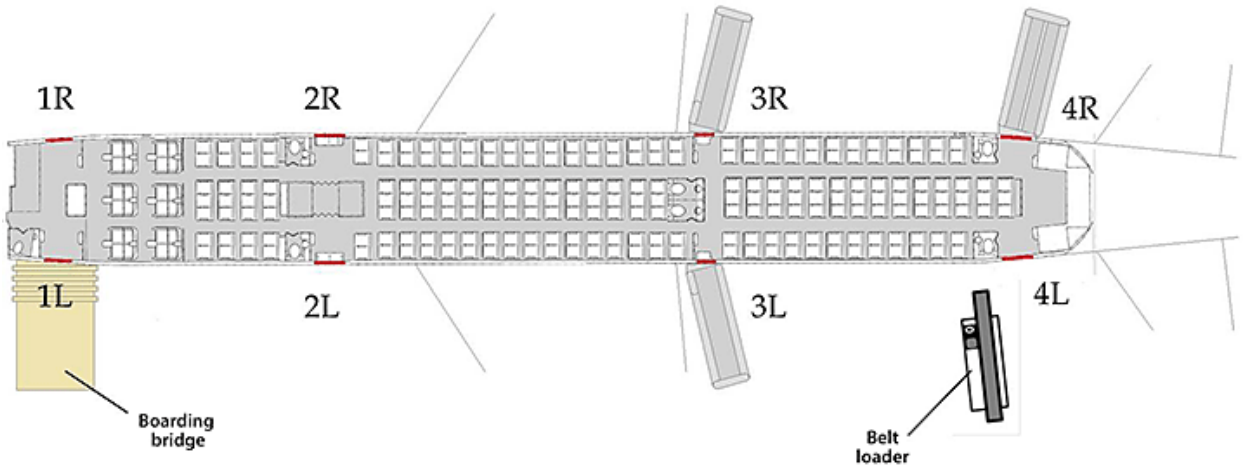
1 A self-contained power unit on an aircraft providing electrical / pneumatic power to aircraft systems during ground operations (Source: Termium).

2 All times are Eastern Standard Time (Coordinated Universal Time minus 5 hours).

Figure 1. Emergency exits



The lead cabin crew member then exited the cabin through the boarding bridge and saw through its window that there was a fire under the belt loader, which was close to door 4 left (4L). He immediately went to the cockpit to inform the captain, who went out to see for himself and then ordered the cabin crew to begin evacuating the aircraft. Using the PA system, the captain ordered the passengers to evacuate the aircraft as quickly as possible via the front exit and to leave their baggage behind. The captain then called the apron controller to alert him of the fire. The controller confirmed to the captain that firefighters had been called and were on their way. Cabin crew members helped passengers who were having trouble exiting the aircraft quickly. Some passengers tried to take their carry-on luggage with them, hampering the evacuation.

The main aft cargo door[3] was open. The smoke caused by the fire spread into the cargo compartment and moved up to the cabin through the air recirculation fans, whose air intake is between the cargo compartment wall and the outer fuselage skin.

When the smoke began to enter the cabin, there were about 106 passengers between doors 2 and 3 and 90 between doors 3 and 4. One cabin crew member was assigned to doors 2L and 2R, another one to doors 3L and 3R, and 2 to the aft doors 4L and 4R. Passengers in the aft cabin became agitated and panicked when they saw their access to the exit delayed and the smoke intensifying. Passengers began pushing and shoving, causing some passengers to fall down in

[3] This door opening is 3.4 square metres (Source: Boeing).

the aisle. The cabin crew tried to help them while having to deal with panicking passengers trying to step over the fallen passengers.

At this point, some passengers took the initiative to open doors 3L and 3R just behind the wings, triggering the automatic deployment of the evacuation slides, which are always armed on these doors. Seeing these newly created exits, several passengers chose to evacuate by sliding down the evacuation slides to the apron.

During this time, panicked passengers in the aft cabin were insisting that the cabin crew members open doors 4L and 4R. A cabin crew member blocked access to door 4L because it was directly above the fire while another cabin crew member re-armed door 4R, which had been disarmed on arrival, in accordance with procedure. Given the clear and present danger, the cabin crew member opened door 4R, which then deployed the slide.

The evacuation slide deployment sequence was as follows:

- Slide 3L deployed at 1646:56 when one or more passengers opened the door.
- Slide 3R likely deployed between 1646:45 and 1647:25 when one or more passengers opened the door, but the exact time of deployment is not known.
- Slide 4R deployed at 1647:17 when a cabin crew member opened the door.

It is estimated that 100 to 150 people evacuated through the evacuation slides and found themselves wandering on the apron in search of help. Ground crew and airport security staff led them inside the terminal where airport and airline personnel took over. Of the 7 passengers who suffered minor injuries or were overcome by smoke, 5 were transported to hospital by ambulance.

When the last passengers were evacuated, the lead cabin crew member asked the other crew members to check the cabin and washrooms to make sure no passengers were left on board. Then, on the order of the firefighters, the crew left the aircraft after shutting down the aircraft's APU and electric power supply.

The crew and maintenance staff inspected the aircraft the next day and found that it had not sustained any fire-related damage.

Response by the ground crew

When the fire broke out, an aircraft mechanic working for a third party climbed the outside stairs leading to one of the boarding bridge access doors to alert the crew. However, in his excitement, he was unable to key in the correct access code to unlock the door, so he knocked repeatedly on the window of the door and shouted to get the attention of the crew inside. He then went back down the stairs and helped the passengers coming down the evacuation slides.

Meanwhile, a co-worker went to get a wheeled dry chemical fire extinguisher under the boarding bridge. With the help of another ground crew member, he wheeled the fire extinguisher to the fire and for 1 minute, 10 seconds sprayed the flames, emptying the chemical contents of the extinguisher, but was unsuccessful in putting out the fire (Photo 1).

Photo 1. Ground crew trying to put out the fire with a wheeled dry chemical fire extinguisher (Source: Aéroports de Montréal)

While the extinguisher was being emptied, 2 other ground crew members were trying to bring a second wheeled fire extinguisher to the fire. However, after a few seconds of repeated attempts, they were unable to get the fire extinguisher to work. The flames were still raging and started to spread to the rubber conveyor belt. At this point, seeing that the airport fire trucks were approaching, other members of the ground crew gave the signal to immediately clear the area. Everyone quickly evacuated the area. The fire trucks arrived on site at 1649:50.

Response by the firefighters

As soon as the fire erupted, an unidentified caller notified the fire department rather than the emergency line of the Operational Coordination Centre. The information provided was that a vehicle at gate 61 was on fire. The exact time of the call was not recorded, but would have taken place between 1645:25 and 1646:58.

At 1646:15, the pilot of a taxiing aircraft reported to the apron control tower that a belt loader was on fire at gate 61. The apron controller confirmed that he called the fire department at 1646:58, and according to the report prepared by the airport firefighting service, the call was dispatched to the firefighting teams at 1647:39.

The fire hall at Montréal-Pierre Elliott Trudeau International Airport is located about 1200 metres north-east of the terminal, in an open area between the runways.

According to ground radar data, the fire trucks left the fire hall and headed to the location of the fire at 1648 and arrived at gate 61 at 1649:50. The 1.8 km trip took 1 minute, 50 seconds (Figure 2).

Figure 2. Path taken by the fire trucks (Source: Google Earth, with TSB annotations)

As soon as they arrived, the firefighters sprayed the base of the fire with fire suppressant foam. The fire was finally extinguished at 1650:33.

Elapsed time:

- 2 minutes, 19 seconds between eruption of the fire and call dispatch;
- 2 minutes, 11 seconds between call dispatch and arrival of fire trucks;
- 4 minutes, 30 seconds between eruption of the fire and arrival of fire trucks;
- 2 minutes, 54 seconds between call dispatch and the fire being extinguished;
- 43 seconds between arrival of trucks at gate 61 and the fire being extinguished; and
- 5 minutes, 13 seconds between eruption of the fire and the fire being extinguished.

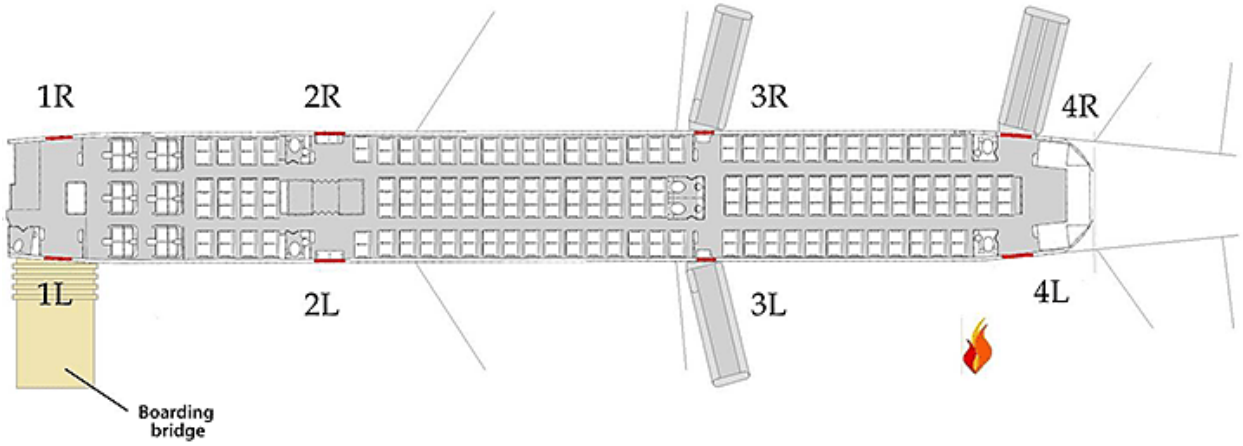
In all, 14 firefighters and 4 officers in 6 fire trucks were deployed, including the mobile command post.

Aircraft information

The Boeing 767-36N / ER involved in the occurrence has a cabin configured for 12 business class passengers in the forward cabin and 224 economy class passengers in the aft cabin. The aircraft has 8 emergency exits, 4 on each side of the cabin.

All the left and right doors are opposite each other and are identified alphanumerically (Figure 3).

Figure 3. Diagram of cabin interior



The doors, numbers 1 left (1L) and 1 right (1R), are located in the forward cabin directly behind the cockpit. Doors 2L and 2R are just in front of the wings while doors 3L and 3R are just behind the wings. Doors 4L and 4R are in the aft cabin.

Boeing offers 3 different emergency exit configurations on its 767. The aircraft involved in the occurrence had an "A" configuration. This configuration consists of 2 different types of emergency exits: type A and type 1. Doors 1L, 1R, 2L, 2R, and 4L and 4R are type A while doors 3L and 3R are type 1.

Type A doors can be opened and closed manually from the inside and the outside. They are also equipped with an electric opening and closing system. They move inward when opened and are then raised into the ceiling using a counterbalance mechanism. The door is safely kept open using a spring latch installed on the door frame. Type A doors are equipped with dual lane inflatable evacuation slides which, when the deployment mechanism is armed, deploy and inflate automatically as the door is opened. Type A doors are manually armed and disarmed from inside the cabin, and the slide can be detached to serve as a life raft.

Type 1 doors are permanently armed and equipped with single lane evacuation slides that cannot be converted into a raft and that deploy and inflate automatically when the door is opened. They swing out on lower door pivots.

Type A and type 1 doors are equipped with a mechanism to manually inflate the slide in case it fails to inflate automatically when it deploys.

The gas turbine APU is located in the aft part of the tail and its air intake is on the right side of the fuselage above the right horizontal stabilizer. It powers the aircraft's electrical systems and supplies air to the air conditioning and heating system in certain situations, such as when the

aircraft is on the ground and not connected to external sources. Outside air is drawn through the APU's intake and passes through the air conditioning and heating system into the cabin.

Crew information

The carrier's records show that the 2 flight crew and 6 cabin crew members were qualified and certified for the flight. Applicable air regulations call for 1 cabin crew member for every 50 passengers, and the flight was in compliance with this ratio.

Company information

Servisair Inc. is a third-party ground services supplier under contract with Royal Air Maroc. It provides a range of services, including baggage handling.

Such services are not regulated by Transport Canada (TC) and their oversight is the responsibility of the airport operator, which in this case is Aéroports de Montréal (ADM). Through its safety management system (SMS), which is approved by TC, ADM must ensure that service providers, such as Servisair Inc., conduct their activities in a manner that complies with ADM's quality assurance program.

At the time of the occurrence, ADM had implemented its SMS and it had been approved by TC; however, TC had not yet carried out a post-implementation assessment of ADM's system.

Additionally, some service providers, including Servisair Inc., had not yet been integrated into the SMS and consequently were not monitored by ADM's quality assurance program.

Servisair Inc. had a detailed training program. Employees assigned to the baggage room who did not work on the apron received limited training when recruited that was specific to their tasks, while employees who worked on the apron normally received 1 week of theoretical in-class training followed by practical training on the apron. However, the investigation showed that the theoretical training on the use of generic fire extinguishers did not include instruction on the extinguisher models found on the apron. As for practical training, it did not include instruction on how to use fire extinguishers nor what to do in emergency situations when passengers are evacuated onto the apron. Two employees from another major airline who were providing turn-around maintenance on the occurrence flight took part in the response. The investigation revealed that their employer had provided them adequate training on the handling of ramp fire extinguishers and basic response in emergency situations.

Belt loader information

The belt loader, model 660-42, manufactured by TUG Technologies, was purchased new by Servisair Inc. in 2005. It sustained heavy damage in the fire (Photo 2).

Photo 2. Belt loader after the fire

The loader consists of a steel frame with a Ford industrial 6-cylinder gasoline 4.2-litre fuel injection engine, model ESG-642. The engine is installed longitudinally just behind the front wheels between the side members and has no protective cover. It only has side platforms on either side of the frame and the top is exposed to the elements. The belt loader's electrical system is controlled by a rotary switch on the dash. The OFF position turns off the main electrical system, the ON position turns it on, and a momentary START position, which when held in position, starts the ignition, after which the switch springs back to the ON position.

The fuel system includes a gas tank, mounted on the left platform between the front and rear wheels and an electric pump mounted on the frame next to the gas tank that feeds a fuel filter regulator through a flexible polymer line with an inside diameter of 7.9 mm. When the electric fuel pump is operating, the pressure inside the line is 448.15 kPa (65 psi). A fibre-glass reinforced plastic push-lock connector is affixed to each end of the line with a crimped steel ring installed at the time of manufacture (Photo 3).

The fuel is then supplied to the various components of the engine's fuel injection system. The fuel filter regulator is mounted behind the intake manifold, leaving it somewhat exposed to the elements and shocks when the belt is in the raised position. High-pressure fuel from the electric pump is delivered to the central connection on the left side of the filter regulator.

The fire started in the rear part of the engine. The engine and auxiliary systems were heavily damaged, causing the fuel lines and fittings, electric harnesses, air intake system and conveyor belt to melt. An exhaust pipe runs transversally under the gear box located immediately below the filter regulator.

After the fire, the fuel line connecting the electric fuel pump to the filter regulator was found disconnected from the filter regulator. The laboratory analysis of this line showed that the end was not particularly burnt although soot was found, but there was no trace of the plastic push-lock connector which should have been on the line. However, the crimped steel ring attaching the connector to the line was still in place. The other end of the line, at the electric pump, was intact.

Photo 3. View showing crimped steel ring securing the connector of an identical, undamaged, belt loader

During the TSB laboratory examination, the connector was removed from the intact end of the line to determine whether it could be easily inserted in the defective end still fitted with the ring. It was impossible to do so without removing the ring and exerting significant pressure, suggesting that the ring was quite likely correctly crimped at the time of the occurrence.

The belt loader was not equipped with emergency stop buttons nor was it required to be. This optional device makes it possible to shut down the engine and cut all electric power to the fuel pump by pressing the buttons on the dash and / or at the rear end of the belt loader.

A portable 5-pound BC / Purple K (potassium bicarbonate) fire extinguisher was mounted on the left side platform just in front of the rear wheel; it was not used.

The belt loader was serviced according to the company's regular inspection program. The inspection program consisted of 2 parts: Part A, after every 500 hours in service or 120 calendar days, and Part B, every 2000 hours / 1 year. The involved connector was to be inspected at 500 hours / 120 days under Part A of the inspection program.

The company's records show that the last Part A inspection was conducted on 05 September 2013, or 12 hours in service before the fire. The previous Part A inspection had been conducted on 01 August 2013, or 69 hours in service / 35 days before the fire, and the inspection prior to that had been conducted on 31 October 2012, or more than 770 hours in service and more than 9 months before.

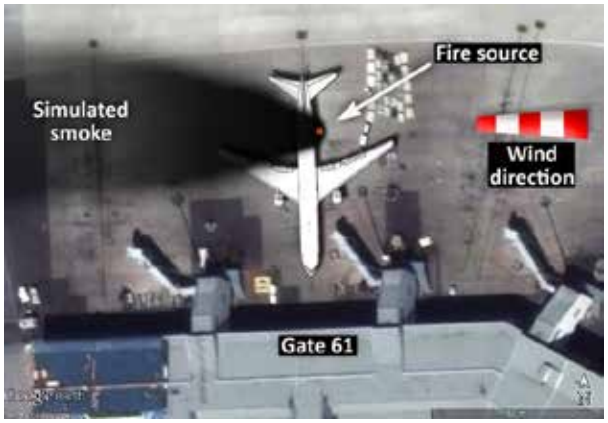
Although not clearly stated in the maintenance records for this belt loader, this type of fuel filter regulator is typically replaced annually and was replaced on this particular unit more than 1 month prior to the occurrence.

The inspection and maintenance program recommended by the manufacturer (TUG) required no special verification of the fuel system or its lines.

Weather information

At the time of the occurrence, the outside ground temperature was 1°C, the sky was clear, and visibility was good. The aircraft was parked in a north-south direction, with the nose pointing south (Figure 4). Winds were easterly at 7 km/h. As a result, the smoke from the fire moved laterally above and below the aircraft, engulfing the fuselage between the tail and the wing and dissipating to the west.

Figure 4. Position of the aircraft and wind direction (Source: Google Earth, with TSB annotations)



Wheeled fire extinguisher information

Two different types of 150-pound wheeled fire extinguishers were used during the occurrence. The first one used was manufactured in 2003. It was a BC extinguisher, used for fighting flammable liquid and gas fires (B) as well as electrical fires (C). The powder chemical agent used was sodium bicarbonate, sprayed through a pressurized nitrogen cylinder next to the main tank. The contents of this extinguisher were emptied on the flames.

Manufactured in 1995, the second fire extinguisher was an ABC extinguisher, used to fight ordinary combustible (A), flammable liquid and gas (B) and electrical (C) fires. The dry chemical agent used in this case was mono-ammonium phosphate, which is sprayed from a separate nitrogen tank. This extinguisher did not release its contents as the ground crew expected due to a kink in the hose, which no one noticed before evacuating the area of the fire in anticipation of the firefighters' arrival. After extinguishing the flames, the airport firefighters had no trouble operating the second extinguisher once they had removed the kink from the hose.

Previous Transportation Safety Board recommendation

In 2005, in its aviation investigation report of an Airbus 340 accident (A05H0002), the TSB noted that many passengers took their carry-on baggage with them despite repeated instructions shouted by the cabin crew to leave it behind. Given the need to evacuate quickly, especially when there is a fire aboard an aircraft, trying to retrieve luggage presented a significant risk to

safety. Carry-on baggage can impede an orderly evacuation, damage the evacuation slide and increase the potential for injury.

Consequently, the Board recommended that:

> The Department of Transport require that passenger safety briefings include clear direction to leave all carry-on baggage behind during an evacuation.
>
> **TSB Recommendation A07-07**

Analysis

There was no indication that an aircraft system malfunction contributed to this occurrence. Therefore, this analysis will focus on the factors associated with the fire in the belt loader, the efforts to extinguish the fire, and the evacuation process.

Belt loader fire

Based on the location of the damage and the traces of soot that were fairly centered in relation to the longitudinal centreline of the belt loader and concentrated in the area immediately behind the engine block, it is likely that the fire was caused by the fuel line becoming disconnected from the inlet of the filter regulator. If the break had occurred at the outlet of the filter regulator, signs of the fire would have been more pronounced on the right side, because the fuel flows through the filter regulator from left to right. The fuel would have gushed out of the filter regulator, which is centered on the engine, towards the right platform, which it did not in this case. If a fuel filter regulator and the lines connected to it are not properly protected, they can become damaged or weakened and eventually malfunction, causing a large amount of fuel to spill.

Also, misconnection of the fuel hose connectors during maintenance could lead to a connector disconnecting from the filter regulator unit under the effects of pressure, vibration and other environmental factors over time. However, the investigation did not reveal any evidence that such a misconnection had occurred in this case. The TSB laboratory analysis could not establish how and why the connector disconnected from the line.

The company's inspection program was stricter than the inspection and maintenance program recommended by the manufacturer (TUG), which did not require any special verification of the fuel system or its lines. The missing line connector was to be inspected at 500 hours / 120 days under Part A of the company's inspection program. The belt loader only had 12 hours of operation since its last Part A inspection. This connector had to have been in place at the time of the inspection, otherwise it would have been impossible to supply fuel to the engine. Given that during examination of the line, the steel ring had to be removed and significant pressure exerted to insert the connector from the intact end of the line into the defective end, it is quite likely that the ring was correctly crimped.

Had the connector disengaged from the filter regulator, there would likely have been some combustion residue from the connector found in the line. The absence of melted residue from the push-lock connector in the line suggests that it was separated from the line when the flames consumed and melted all the other plastic elements in the immediate area. The connector likely remained attached to the filter regulator, which was located in the area where the flames were most intense. Due to its metal construction, the filter regulator reached a very high temperature, which explains why the 3 connectors were completely destroyed by the fire, leaving virtually no trace behind.

Given the position of the fuel filter regulator on the engine, the filter regulator and the lines connected to it are somewhat exposed to any type of impact. As it is possible for objects to fall from the conveyor belt onto the side platforms, these objects can potentially come into contact

with the fuel system connectors and lines, damaging or weakening them, which could lead to their malfunction and a significant fuel spill. However, the probability of objects falling onto the side platform and bouncing inwards, towards the area where the engine and fuel system components are located, is very slim.

Since the belt loader's main switch was left in the ON position when the fire started, the electric fuel pump mounted on the frame continued to operate briefly until the engine stopped due to a lack of fuel flow and pressure, at which time the engine's electronic control module cut electrical power to the pump.

When the line initially disconnected, it caused the fuel, which at that moment was pressurized at 448.15 kPa (65 psi), to spray the rear part of the hot engine. No longer attached to the filter regulator, the line continued to spill fuel until the engine ran out of fuel and stopped. The fuel easily spilled off the top of the rounded gearbox, only to then spill onto the hot exhaust pipe a few centimetres below and ultimately puddle on the ground.

In addition, the fuel that escaped at high pressure when the line disconnected probably vaporized into fine droplets, creating a fuel vapour that was particularly susceptible to igniting on contact with the hot surface of the exhaust pipe. The flames then spread immediately to the pool of fuel that had accumulated under the vehicle and to the surrounding fuel-soaked area containing many flammable materials, such as the sheaths of electrical wires, electrical connectors and plastic parts of the engine's air intake system.

The flames continued to rage until they reached the lower surface of the rubber conveyor belt, which ignited and melted. The burning liquified rubber then dripped by gravity onto the hot engine. The fact that the conveyor was in the down position at the time made it more difficult for the crew to put out the fire because the fire extinguisher agent could not reach the source of the fire directly.

Had there been an emergency stop button within reach of the operator, the operator might have been more likely to instinctively stop the belt loader in the first few seconds after the fuel spill, which would have cut power to the fuel pump and limited the amount of fuel spilled. As well, had there been a second emergency stop button at the rear end of the conveyor belt, the ground crew could have stopped the belt loader without getting too close to the flames. If ground service equipment does not have emergency stop buttons, there is a risk of injury not only for evacuated passengers but also for the ground crew.

The fire produced thick, acrid black smoke blown towards the right side of the aircraft by the wind enveloping the aft part of the fuselage. Smoke likely entered the main aft cargo compartment since the main aft cargo door was open. The smoke spread into the cargo compartment and moved up to the cabin through the air recirculation fans, which take their air source from between the cargo compartment wall and the outer fuselage skin. At the same time, the air drawn by the auxiliary power unit's (APU) intake probably spread some of the smoke to the ventilation system. This led to the evacuation during which some passengers were injured and had to be hospitalized.

Evacuation sequence

Although the required number of cabin crew members was on board, once the smoke started entering the cabin and passengers began to panic, it became difficult for the cabin crew, well trained as they were, to contain the passengers in their respective areas.

When some passengers took the initiative to open doors 3R and 3L, it triggered an evacuation scenario that gave the cabin crew no option but to deal with the situation as best they could and to ensure the evacuation proceeded as safely as possible. The cabin crew's decision to block access to door 4L likely prevented further unfortunate consequences as the door was directly above the fire.

Some passengers tried to leave with their carry-on luggage. If passengers take their carry-on baggage with them during an emergency evacuation, this could prevent the evacuation from proceeding smoothly and quickly as well as damage the evacuation slides, thereby increasing the risk of injury.

Passengers who found themselves on the apron without designated staff to help them wandered around looking for instructions and direction. The ground crew working around the aircraft at the time of the evacuation had clearly not been trained on how to deal with such an influx of passengers from the evacuation slides. Nevertheless, some employees reacted quickly by redirecting the wandering passengers towards the door leading to the boarding gate. If ground crew on the apron are not trained to manage passengers following an evacuation, there is risk of injury both for evacuated passengers and ground crew.

Action taken to extinguish the fire

The fire extinguisher mounted on the belt loader was not used. Because this extinguisher was quite close to the flames, the ground crew opted to use the larger-capacity and more easily accessible wheeled fire extinguishers. However, although the first wheeled extinguisher operated as intended, it did not extinguish the fire. As for the second wheeled fire extinguisher, the airport firefighters found that it initially failed to work because there was a kink in its hose. However, it was not possible to determine whether this extinguisher could have put out the fire before the firefighters arrived.

Providing ground service employees with more comprehensive training on the features and use of available equipment would allow for a more effective response in the first few minutes of a fire while awaiting the arrival of airport firefighters. If ground crew have no practical training on the use of emergency equipment, there is a risk that the response will be inadequate in the first few minutes of an occurrence such as a fire.

If an airport operator's safety management system (SMS) does not include monitoring the service providers working on the apron, there is a risk that inadequate procedures or equipment will be used or that the personnel will not be sufficiently trained.

The timely and effective response of the airport firefighting service prevented more serious consequences.

Findings

Findings as to causes and contributing factors

1. The connector between the fuel line and the inlet of the filter regulator disconnected while the engine was running. Consequently, fuel sprayed onto the hot surface of the exhaust pipe, starting a fire.

2. The smoke blown by the wind entered the cabin through the air conditioning and ventilation system both via the auxiliary power unit's air intake and the intake of the air recirculation fans in the main aft cargo compartment whose door was open.

3. The presence of smoke in the cabin led to the evacuation during which some passengers were injured and had to be hospitalized.

Findings as to risk

1. If a fuel filter regulator and the lines connected to it are not properly protected, they can become damaged or weakened and eventually malfunction, causing a significant fuel spill.

2. If ground crew have no practical training on the use of emergency equipment, there is a risk that the response will be inadequate in the first few minutes of an occurrence such as a fire.

3. If ground crew on the apron are not trained to manage passengers following an evacuation, there is risk of injury both for evacuated passengers and ground crew.

4. If an airport operator's safety management system does not include monitoring the service providers working on the apron, there is a risk that inadequate procedures or equipment will be used or that personnel will not be sufficiently trained.

5. If ground service equipment does not have emergency stop buttons, there is a risk of injury not only for evacuated passengers but also for ground crew.

6. If passengers take their carry-on baggage with them during an emergency evacuation, this could prevent the evacuation from proceeding smoothly and quickly as well as damage the evacuation slides, thereby increasing the risk of injury.

Safety action

Safety action taken

Servisair Inc.

- All of the company's belt loaders in Canada had their fuel systems inspected.
- During a meeting with other service providers using the same type of equipment, the company shared its observations concerning the risks associated with the vulnerability of the fuel system on equipment with this engine model.
- The company installed an emergency switch on all belt loaders that did not already have one.
- The maintenance program checklist for this belt loader model was modified to include a specific inspection for the filter regulator and its associated lines, connectors and fixing rings.

Aéroports de Montréal

- Some service providers such as ground handlers have been incorporated into the airport operator's safety management system.
- Training is now offered by Aéroports de Montréal's firefighting service to employees working on the apron.

TUG Technologies Corporation

- Provided an Inspection Bulletin to all of its customers identifying the preventive maintenance instructions to check the fuel lines and their fittings.
- Now provides stock belt loaders with an emergency stop button positioned at each location where there are operator controls (along with the ignition switch).

This report concludes the Transportation Safety Board's investigation into this occurrence. The Board authorized the release of this report on 28 January 2015. It was officially released on 03 February 2015.

Visit the Transportation Safety Board's website (www.bst-tsb.gc.ca) for information about the Transportation Safety Board and its products and services. You will also find the Watchlist, which identifies the transportation safety issues that pose the greatest risk to Canadians. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.