RAIB

Rail Accident Investigation Branch

Rail Accident Report

Uncontrolled evacuation of a London Underground train at Holland Park station 25 August 2013

Report 16/2014
July 2014

This investigation was carried out in accordance with:

- the Railway Safety Directive 2004/49/EC;
- the Railways and Transport Safety Act 2003; and
- the Railways (Accident Investigation and Reporting) Regulations 2005.

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Uncontrolled evacuation of a London Underground train at Holland Park station, 25 August 2013

Contents

Summary

At around 18:35 hrs on Sunday 25 August 2013, a London Underground train departing Holland Park station was brought to a halt by the first of many passenger emergency alarm activations, after smoke and a smell of burning entered the train. During the following four minutes, until the train doors still in the platform were opened by the train operator (driver), around 13 passengers, including some children, climbed out of the train via the doors at the ends of carriages.

The investigation found that rising fear spread through the train when passengers perceived little or no response from the train operator to the activation of the passenger emergency alarms, the train side-doors remained locked and they were unable to open them, and they could not see any staff on the platform to deal with the situation. Believing they were in danger, a number of people in different parts of the train identified that they could climb over the top of safety barriers in the gaps between carriages to reach the platform.

A burning smell from the train had been reported when the train was at the previous station, Notting Hill Gate, and although a request had been made for staff at Holland Park station to investigate the report, the train was not held in the platform for staff to respond. A traction motor on the train was later found to have suffered an electrical fault, known as a 'flash-over', which was the main cause of the smoke and smell.

A factor underlying the passengers' response was the train operator's lack of training and experience to deal with incidents involving the activation of multiple passenger emergency alarms.

The report observes that London Underground Limited (LUL) commenced an internal investigation of the incident after details appeared in the media.

The RAIB has made six recommendations to LUL. These seek to achieve a better ergonomic design of the interface between the train operator and passenger emergency alarm equipment, to improve the ability of train operators to respond appropriately to incidents of this type, and to ensure that train operators carry radios when leaving the cab to go back into the train so that they can maintain communications with line controllers. LUL is also recommended to review the procedures for line controllers to enable a timely response to safety critical conditions on trains and to ensure continuity at shift changeover when dealing with incidents. In addition, LUL is recommended to review the training and competencies of its staff to provide a joined-up response to incidents involving trains in platforms and to reinforce its procedures on the prompt and accurate reporting of incidents so that they may be properly investigated.

Introduction

Preface

1 The purpose of a Rail Accident Investigation Branch (RAIB) investigation is to improve railway safety by preventing future railway accidents or by mitigating their consequences. It is not the purpose of such an investigation to establish blame or liability.

2 Accordingly, it is inappropriate that the RAIB's reports should be used to assign fault or blame, or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

3 The RAIB's investigation (including its scope, methods, conclusions and recommendations) is independent of all other investigations, including those carried out by the safety authority, police or railway industry.

Key definitions

4 The report contains abbreviations which are explained in appendix A.

The incident

Summary of the incident

5 On Sunday 25 August 2013, at around 18:35 hrs, a westbound Central Line train departing from Holland Park station (figure 1) was halted by the operation of a passenger emergency alarm when passengers became aware of smoke and a burning smell within the train. The train was busy because it was the weekend of the August Bank Holiday and the nearby Notting Hill Carnival.

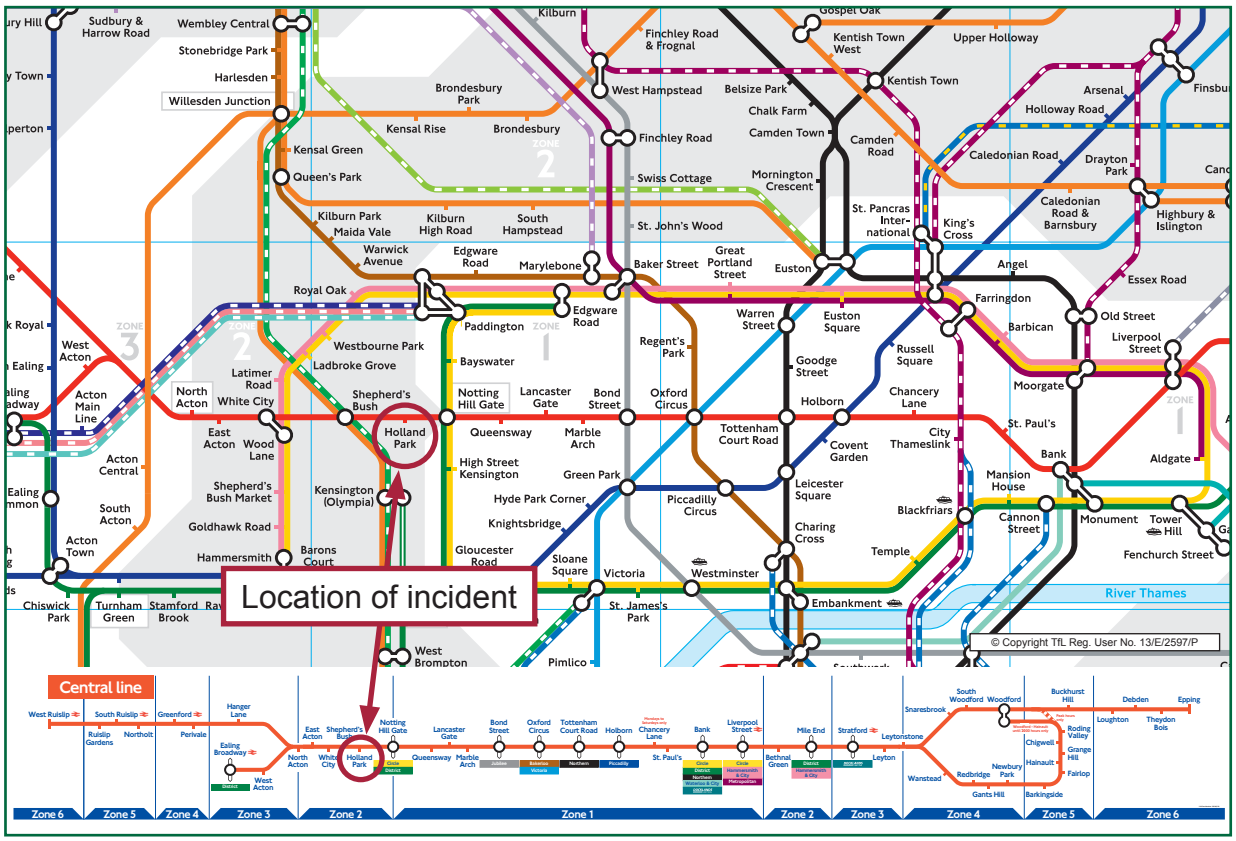

Figure 1: Extract from TfL map showing location of incident

6 The train came to a stand with part of the leading car in the running tunnel and with the remainder of the train in the platform. The doors remained locked. Very quickly, fear spread through the train and people, both on the train and on the platform, tried unsuccessfully to force open the doors.

7 After less than two minutes passengers began to get out of the train using the interconnecting doors between cars. Over a two minute period approximately 13 people, including some children, climbed over barriers in the gaps between cars to reach the platform (figures 2 and 3).

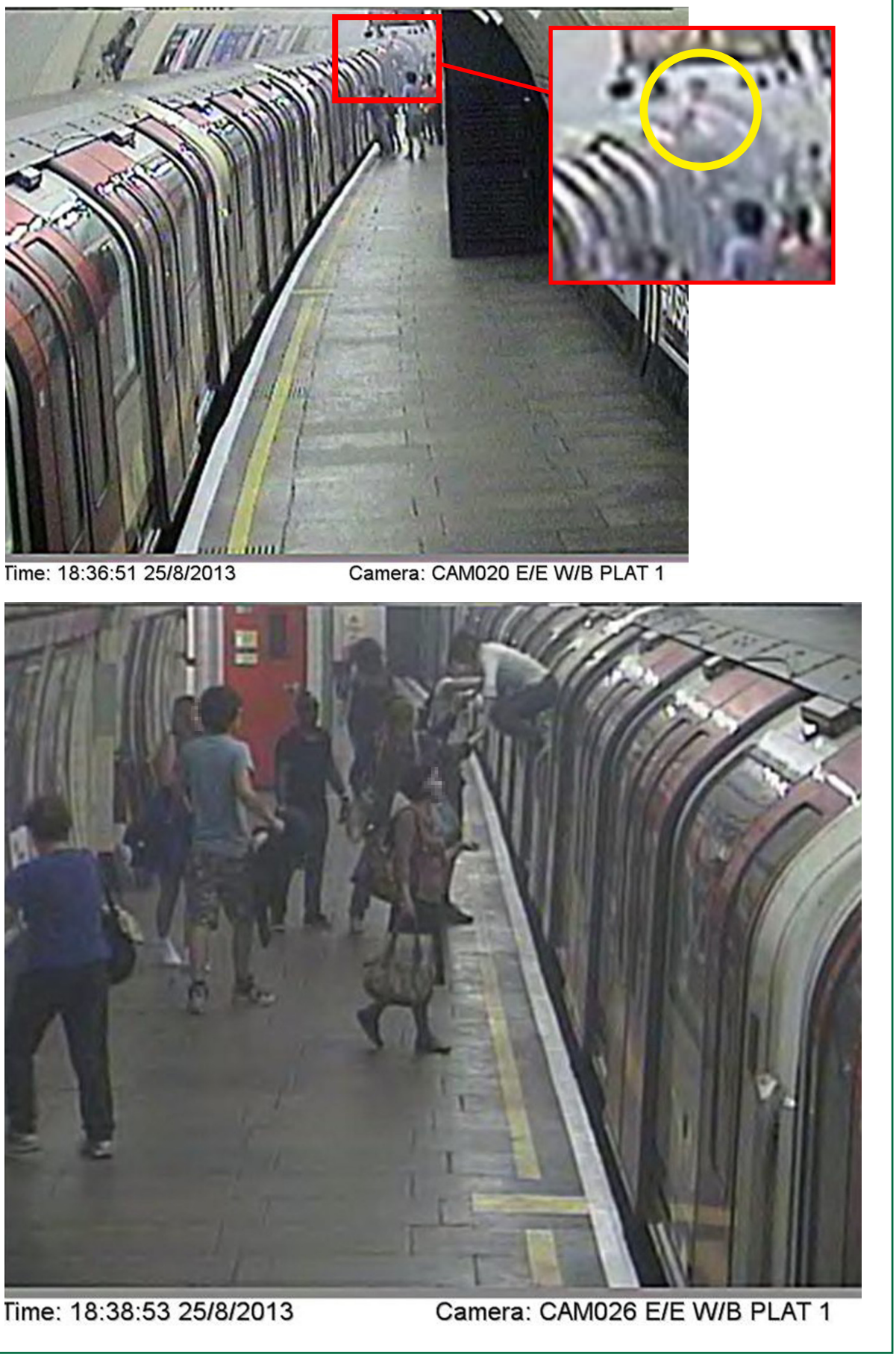

Figure 2: CCTV images of persons self-evacuating the train

Figure 3: Passenger climbing out between cars 3 and 4 (image courtesy of newsflare.com)

8 Around three minutes after the train came to a halt a single set of doors was opened by a member of station staff and about a minute later, the train operator (driver) opened all the doors on the part of the train that was in the platform.

9 An estimated 800 people, including a number with pushchairs and luggage, and some elderly passengers, were evacuated from Holland Park station via a long spiral staircase. The station evacuation was complete by 18:52 hrs.

10 The London Fire Brigade attended the incident and confirmed that the train was not on fire. The train then proceeded out of service to the depot at Ruislip.

11 The westbound Central Line service was suspended for 19 minutes during which time another train was stalled in a tunnel behind the incident train. Once the service was resumed, trains ran through the station without stopping, until the station was reopened to the public at 19:19 hrs.

12 There were no reported injuries. However, a number of passengers, including children, who had been on the train and on the platform reported being extremely distressed and in fear for their safety.

Context

Location

13 Holland Park station is on the Central Line which runs from Epping in Essex, north-east of London, across the city to Ealing Broadway and West Ruislip in the west. For all of the route through central London the Central Line is a 'deep-tube' line, constructed from twin single circular bored tunnels which run deep underground.

14 Holland Park station dates from 1900. It has two platforms, one for the westbound line and one of the eastbound line (figure 4). The platforms are accessed from street level by two lifts or by a spiral staircase. There is a small booking hall at street level, with a ticket office and station control room.

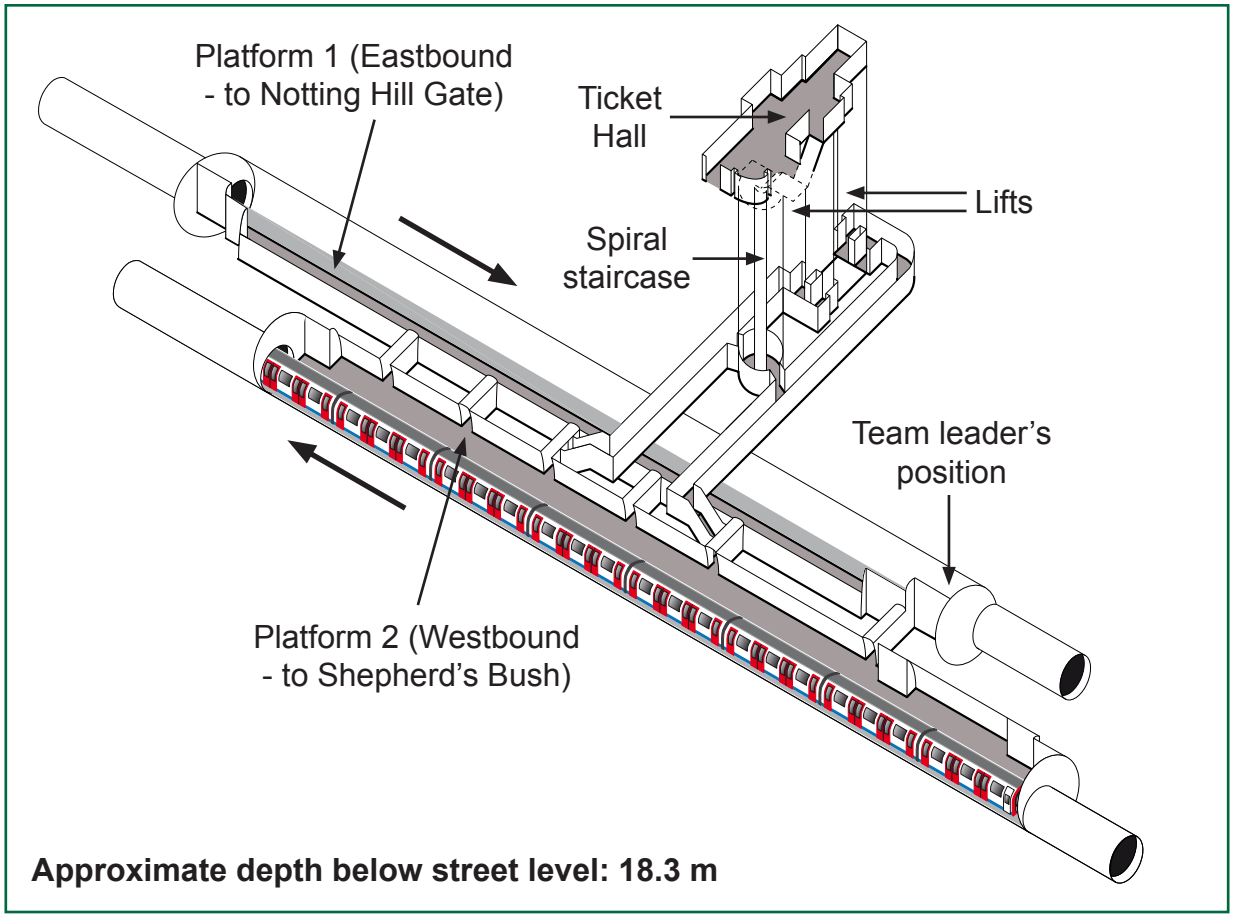

Figure 4: 3D representation of the Holland Park lower station area (adapted from diagram supplied courtesy of LUL)

Organisations involved

15 LUL owns and maintains the infrastructure, the station and the train. It employs the train operator, the station staff, the line controllers and duty staff who attended the incident.

16 LUL freely co-operated with the investigation.

Train involved

17 The Central Line train was of the type known as 1992 tube stock. It was built by British Rail Engineering (1988) Limited and entered service in 1993.

18 Central Line trains are made up of 8 cars (carriages) with a driving cab at each end of the train (figure 5).

19 The train normally operates automatically. However, the train operator is responsible for opening and closing the doors at station stops and for checking that the train is safe to depart using a closed circuit television (CCTV) display in the cab. At Holland Park station the CCTV display screen is split into four images, covering the whole of the train/platform interface (figure 6).

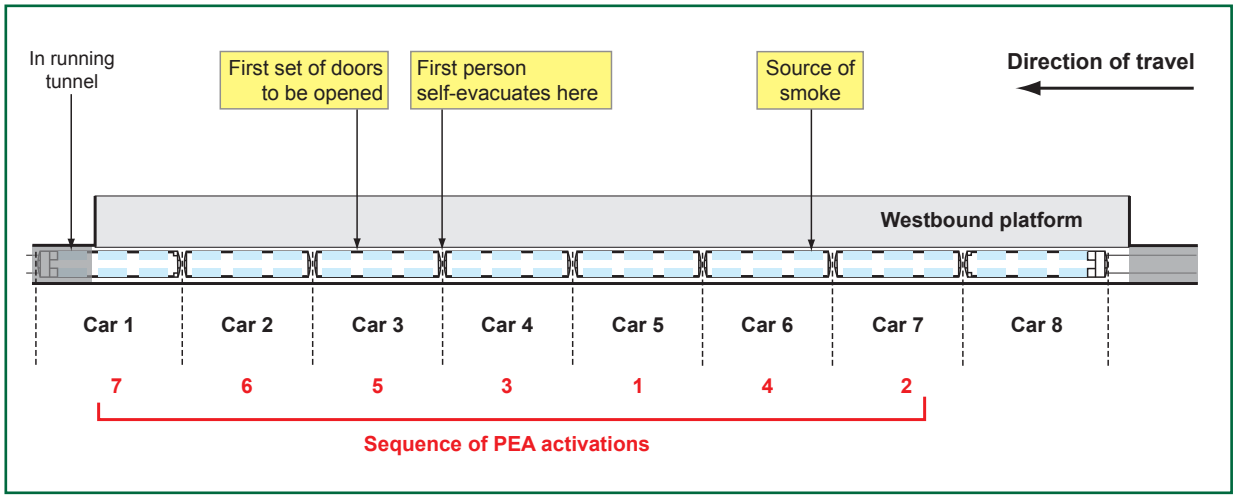

Figure 5: Diagram of train showing incident position in the platform and the sequence of passenger emergency alarm activations

Figure 6: An example of CCTV images of the platform-train interface displayed in the cab of a Central Line train at Holland Park station

20 Trains are equipped with a passenger emergency alarm system (figure 7). The operation of a passenger emergency alarm handle when at least part of the train is within a platform will apply the train's emergency brake, otherwise the train will automatically continue to the next station. This is because the principle underpinning the passenger emergency alarm system is that an emergency on a train is best dealt with in a station. The passenger emergency alarm system has a talkback facility for two-way communications between the train operator and passengers in the car in which the handle has been activated.

Figure 7: Passenger emergency alarm (PEA) equipment

21 Central Line trains have a public address system which allows the train operator to make announcements to the whole train. Trains also have a radio system for two-way communications between the train operator and the Central Line controller, who manages the service (paragraph 23).

Rail equipment/systems involved

22 In common with all of the London Underground system, Central Line trains operate on a four rail system, consisting of two running rails and two electrified conductor rails. The positive conductor rail is located on the outside of the running rails, generally on the opposite side from the platform in stations; the negative conductor rail is located centrally between the running rails. The conductor rails provide 630 volts direct current to power the train.

23 The Central Line service is controlled from a service centre in which line controllers, line information specialists and signallers are based. The role of the line controller includes keeping trains running to the timetable and to restore service following any service disruptions. Line information specialists provide service information and updates to stations and to other parts of the network and monitor the performance of the line. Signallers work with line controllers to regulate and route trains.

Staff involved

24 The train operator had 20 years' driving experience on the Central Line. He was subject to a standard continuing development plan as part of LUL's competence management system in which his knowledge of LUL's Rule Book and procedures was refreshed and tested over a two-year cycle. His refresher training included practical scenarios in a simulator to assess his handling of passenger emergency alarms in accordance with LUL's rules and procedures.

25 Various aspects of the train operator's driving competence, including making appropriate and timely public address announcements, had been assessed five times in the previous year, the most recent being on 3 August 2013. He was assessed as fully competent.

26 The train operator's personal records indicated that he had dealt with five passenger emergency alarm activations since April 2009, the most recent being in May 2013. All of these reportedly involved the activation of a single alarm handle. There is no evidence of any deficiency in the train operator's handling of these alarms.

27 There were two line controllers involved in dealing with the incident on 25 August 2013. Line controller 1 had 15 years' experience as a line controller on the Central Line. His competence was assessed and managed as part of LUL's standard two-year continuing development plan and he was assessed as fully competent.

28 On 25 August he booked on duty at 07:00 hrs and was nearing the end of shift when the incident occurred.

29 Line controller 2 had three years' experience as a line controller, 18 months of which had been gained on the Central Line. He was assessed as fully competent by LUL.

30 Line controller 2 booked on duty at 18:30 hrs on the day of the incident and was due to relieve line controller 1.

31 For managing the safety of large events, such as the Notting Hill Carnival, LUL implements a formal response plan which allocates responsibility for dealing with local incidents to an incident officer or 'silver controller'. In accordance with this plan, a duty station manager (DSM) was allocated to Holland Park station during the Carnival to be the designated silver controller. The DSM did not normally work at Holland Park station but had been a silver controller at the station during the previous year's Carnival. Although the DSM was senior to the station supervisor who normally managed Holland Park station, the station supervisor remained in charge of the station.

32 The DSM had two and a half years' experience in that role. Her competence was managed as part of LUL's competence management system and had been tested and assessed to a higher standard than a station supervisor. The DSM booked on duty at 15:00 hrs.

33 On the day of the incident the DSM was being 'shadowed' by a duty train staff manager (DTSM), who had been assigned to Holland Park station for training in the role of silver controller and to relieve the DSM during meal breaks.

34 The DTSM had nine years' experience in operational management, mainly managing train staff and, prior to that, had been a train operator for two years. He had no training or previous experience in station management. He arrived at Holland Park station shortly after 14:00 hrs.

35 On the day of the incident, a part-time station assistant was designated as a team leader for the lower station area, including the platforms, the lift lower concourse and the corridor leading from the platforms to the lifts and spiral staircase. The station assistant had worked for LUL for 19 years, the last two years of which were at Holland Park. He was trained and assessed as competent in a multi-functional role, which included platform duties, and carrying out station evacuations.

The investigation

Sources of evidence

36 The following sources of evidence were used:

- witness evidence;
- the LUL system for monitoring train movements;
- staff and training records;
- station CCTV recordings;
- recordings of voice communications;
- the fire alarm control panel at Holland Park station;
- the on-train data recording system;
- LUL documentation associated with the fitting of inner inter-car barriers, including the design risk assessment and change assurance plan;
- train maintenance records;
- LUL maintenance standards;
- the RAIB examination and testing of the passenger emergency alarm system;
- LUL planning documents for the Notting Hill Carnival;
- Emergency plans for Holland Park station;
- the LUL Rule Book (issue 2); and
- records of previous smoke incidents on LUL trains.

Acknowledgement

37 The RAIB would like to thank all members of the public who responded to our appeal for witnesses to the events at Holland Park station. Their help was invaluable to the investigation.

Key facts and analysis

Sequence of events

Events preceding the incident

38 The train operator booked on duty at White City around 16:00 hrs and relieved the train operator of train 003 on an eastbound journey. During the handover the previous train operator told him that, when driving from the west cab, he had experienced shuddering of the leading car.

39 The train operator drove the train eastwards to Epping without incident. He then changed ends and when driving from the west cab he noted an unusual, strong vibration when accelerating and braking. He felt it was similar to, but worse than, the juddering sensation from a dragging brake. A brake is described as dragging when it fails to release properly and the brake blocks remain in contact with the wheel. The train operator contacted line controller 1 and arrangements were made for a fitter to meet the train at Leytonstone (figure 1). The fitter then travelled on the train for two stops.

40 At 18:09 hrs the fitter reported to line controller 1 that he was unable to confirm the cause of vibration. He deemed the train fit to proceed but asked for it to be taken out of service when it arrived at West Ruislip for further investigation at the depot there. Line controller 1 put the necessary arrangements in place while the train continued its westbound journey, with the vibration occurring as before.

41 Just over 20 minutes later, when the train was at Notting Hill Gate station (the station before Holland Park), platform staff reported to the station controller that there was a burning smell coming from the train. There is a voice recording of the station controller passing on this report to line controller 2 as train 003 departed for Holland Park station. Figure 8 shows the timeline of the incident from this point onwards.

42 By the time train 003 arrived at Holland Park station there was smoke coming from the trailing end of car 6 (figure 9). While it was standing in the platform a line information specialist (paragraph 23) telephoned the DSM at Holland Park station to request that a member of station staff be sent urgently to investigate the burning smell that had been reported from Notting Hill Gate station. The content of the call was recorded but the DSM has no recollection of receiving a call at this time and there is no evidence that this request was acted upon.

43 At Holland Park station passengers got on and off the train as normal but CCTV footage shows some alighting passengers turning to look in the direction of car 6. The train operator was unaware of the burning smell and could not see the smoke on his in-cab CCTV. After all waiting passengers had boarded the train, and in the few seconds before the train operator closed and locked the train doors for departure, passengers were observed on CCTV footage to begin getting out of car 6.

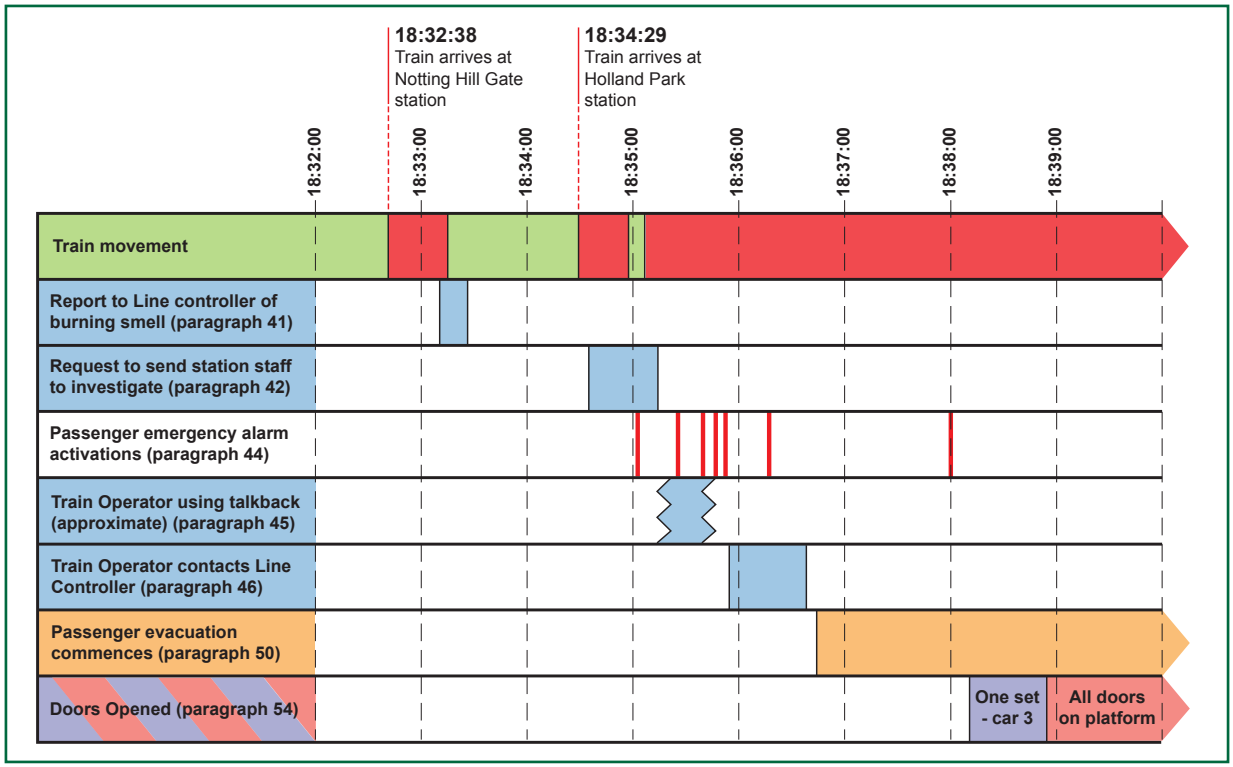

Figure 8: Timeline of key events

Figure 9: Smoke emitting from trailing end of car 6 as train 003 was coming to a stand at Holland Park station

44 Around 18:35 hrs, train 003 moved off from the platform at Holland Park station but within seconds was brought to a stand by the activation of a passenger emergency alarm (figure 6) in car 5. The train had travelled about five metres, putting the leading car partly in the running tunnel. Twenty-two seconds later a passenger emergency alarm activation was made in car 7, followed at short intervals by activations from cars 3, 6, and 4. Over a period of almost three minutes there were seven passenger emergency alarm activations in total (figures 5 and 8). The train doors remained locked.

45 The train operator made contact with a car in which a passenger emergency alarm had been activated, most likely car 5, using the passenger emergency alarm talkback facility and asked passengers to tell him what the problem was. Passengers reportedly shouted, "there's a fire, there's a fire". The train operator stated that he could not understand from the shouting what he was being told, but believed he had heard, "there's a fight, there's a fight". Meanwhile, passengers on the train had already begun trying to force open the doors and were aided by people on the platform. The train operator had a view of the platform on his in-cab CCTV and saw a person around car 2 pulling forcefully on the doors.

46 On completing his talkback communication, and about 47 seconds after the train had stopped, the train operator initiated a call to Central Line control. The train operator advised the line controller that he had a problem on car 5, that he did not know what it was and he was going to investigate. The line controller responded that he would ask station staff to assist. The RAIB has no record of the line controller contacting Holland Park station to pass on a request for assistance or of a member of station staff being despatched to assist the train operator.

47 When the call to the line controller was terminated, the train operator immediately removed his keys from the operator's desk to disable the cab and secure the train. He then left the cab to walk back into the passenger saloon through the interconnecting door.

48 Around this time, a fire call point on the platform was operated by a member of the public. This sent an alarm to the fire alarm control panel in the station control room and broadcast a coded message. The DSM and DTSM, who were in the control room, reported that they could see from CCTV images that there was smoke on the platform. The DSM decided to evacuate the station and instructed staff to close the entrance to incoming passenger traffic. She also contacted the line controller to request fire brigade attendance and to arrange for eastbound trains to run non-stop through the station.

49 In the meantime, the DTSM stated that he heard a radio message mentioning a fire on the train and, on his own initiative, left the control room to go to the train.

Events during the incident

50 The first person climbed out of the train via the interconnecting doors between cars 3 and 4 about 100 seconds after the train stopped (figures 2 and 3).

51 Over the next two minutes approximately 12 other passengers, including children, self-evacuated, mostly at the same point but also between cars 5 and 6, 2 and 3, and 1 and 2. One person managed to force a pair of doors apart sufficiently to get out of the train.

52 The team leader, who was at the east end of the eastbound platform, was told about the smoke by members of the public. After reporting this to the station supervisor, he made his way to the westbound platform, arriving about two and a half minutes after the train had stopped. He reported he was alarmed by the general chaos and people trying to squeeze out of the doors. The team leader ran to the leading end of the train to speak to the train operator about what was going on but was unable to do so because the driving cab was in the running tunnel.

53 It was at this point that the fire alarm system commenced automatic announcements of a station emergency, asking people to leave the station. This was initiated by the activation of a second fire call point on the platform by a member of the public. Some witnesses on the train stated that they could hear the announcements.

54 The DTSM arrived on the platform shortly after the team leader. He reported that he saw people climbing out of the train at the car ends and others who appeared stuck in the doors, including a man with his head and shoulder through a set of doors. The DTSM operated an external valve on car 3 which opened a single set of double doors on that car (figures 5 and 8). Approximately three minutes after the train stopped, passengers began evacuating through this set of open doors. The DTSM reported that he then opened a second set of doors at the trailing end of car 1.

55 Just under four minutes after the train had been stopped by the activation of the passenger emergency alarm the train operator returned to the cab and, after isolating the leading set of doors that was in the running tunnel (paragraph 88), opened all the doors remaining in the platform.

Events following the incident

56 Passengers evacuating the train made their way to the relatively narrow spiral staircase and queued to climb about 100 stairs to the surface. The lifts had been taken out of service at booking hall level by the lift operators after the station evacuation announcements began. Station CCTV recorded evacuating passengers assisting others to carry pushchairs and to help elderly passengers up the stairs.

57 The DTSM inspected the train and reported to the DSM that the train was not on fire. The evacuation proceeded, however, because the fire alarm was still sounding and procedure required that the London Fire Brigade must give the ‘all clear’ before reopening the station. It took approximately 13 minutes after the train operator opened the train doors for the station to be fully evacuated.

58 At 18:50 hrs the London Fire Brigade arrived on the platform via the spiral stairs. They confirmed that the train was not on fire and agreed that it could be driven forward with staff members on board ready to stop it in an emergency. After a brief test to confirm that the train was fit to proceed, it left Holland Park station at 18:54 hrs and ran without incident to the Ruislip depot.

59 When service was resumed, Central Line trains ran through Holland Park in both directions without stopping because the station fire alarm continued to sound. Once the fire call points were reset the station was reopened at 19:20 hrs.

Identification of the immediate cause[1]

60 Passengers, believing that they were in danger by remaining on the train, self-evacuated by climbing through the gaps between cars or by forcing open a door.

61 CCTV footage from Holland Park station showed that smoke from the underside of car 6 (figure 9) spread quickly towards the west end of the platform. This was probably due to the piston effect[2] created by trains behind and in front of train 003. Witness accounts described smoke entering the train through open windows in the car-end doors and through ventilation grilles in car sides. The smoke was described as thin and did not impair visibility.

62 Some witnesses also reported a strong burning smell which some associated with train brakes and others with electrical burning. One witness referred to a smell of burning glass fibre.

63 Various accounts from passengers described rising levels of panic from being trapped in a train that they mistakenly believed to be on fire. Their belief was supported by hearing screams and commotion from other parts of the train. A witness referred to hearing the shouts of, “there’s are fire, there’s a fire”, made in response to the train operator’s talkback communication, which suggested to him that people in another car could see a fire. Other witnesses on the train who could hear the evacuation announcements stated that these caused further alarm because they reinforced a notion that something serious had occurred and that they were trapped. Several stated that they felt frightened but tried to remain calm, while others attempted to kick out windows and throw themselves against the doors in an effort to open them. In a heightened state of fear, some passengers in different parts of the train identified that they could get out of the train by climbing over the top of safety barriers between cars.

64 There are two types of barriers at the car ends; an inner and an outer inter-car barrier (figure 10). The inner inter-car barrier is made up of offset blocks (shaped like large ‘teeth’) fitted either side of the door openings on the outside of each car. (Paragraph 98 gives further information on the purpose of these barriers.) The outer inter-car barrier, which is made from a rigid fabric, mitigates the risk of persons on a platform falling into the gap between cars.

65 Witnesses reported seeing people go through the doors at car-ends and get into the gaps between cars. They then either climbed the inner inter-car barriers or pulled themselves up on car-end components, and jumped from roof level over the outer inter-car barrier to the platform. Some were helped by people supporting them from behind, some by people sitting on the train roof, and some were assisted by people on the platform (figures 2 and 3). Over a period of about two minutes approximately 13 people, including at least two children, were recorded on CCTV leaving the train in this way. Others stated that they were preparing to do the same by the time the side doors opened allowing them out on to the platform.

[1] The condition, event or behaviour that directly resulted in the occurrence.

[2] Piston effect refers to the forced air flow inside a tunnel caused by moving trains. On the Central Line which has single bore tunnels the effect is particularly strong because the train almost fills the tunnel cross section.

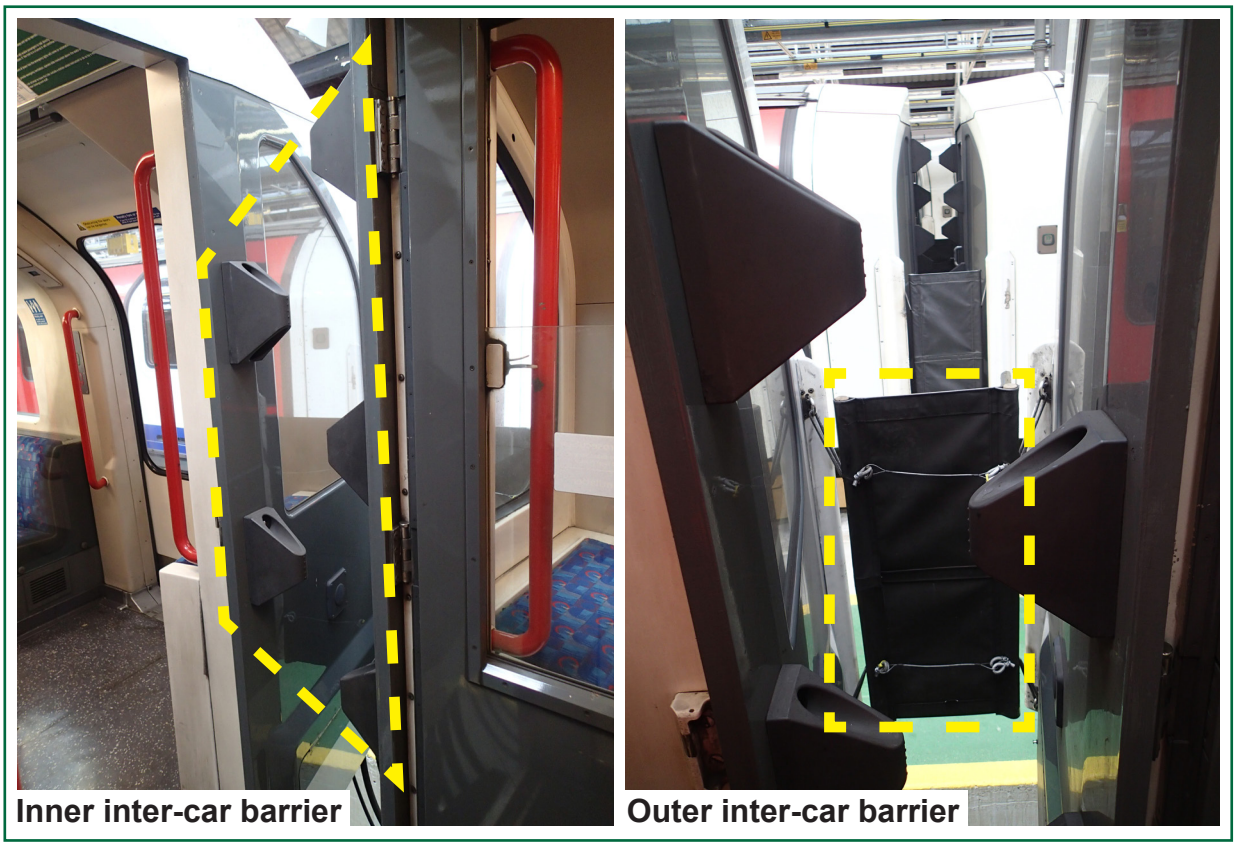

Figure 10: Inner and outer inter-car barriers fitted to Central Line trains

Identification of causal factors[3]

66 **Once the departing train was stopped by a passenger emergency alarm the situation was not sufficiently quickly controlled by LUL staff and passengers formed the perception that they were in danger for the following reasons:**

- **smoke and a burning smell entered the train;**
- **passengers became increasingly alarmed when they perceived little or no response from the train operator to the activation of passenger emergency alarms and no information announcements were made;**
- **the doors did not open and passengers, both on the train and on the platform, were unable to open them; and**
- **they could not see any staff on the platform responding to the situation.**

Each of these is now considered in turn.

Sources of smoke and burning smell

67 At the time of the incident, the train operator and the DTSM attributed the smoke and the pungent smell to dragging brakes. This was because they had both experienced dragging brakes before and believed they recognised the smell. However, there is no direct evidence to substantiate a dragging brake as the source of the smoke and smell. The train's data transmission system, which displays diagnostic information to the train operator, did not record a dragging brake fault on the journey either to or from Holland Park. The train was also found to be rolling freely when it was tested before taking it forward from Holland Park. The vibration problem, which the train operator had associated with a possible dragging brake, was later found to have been caused by wheels on car 1 that had worn out-of-round.

68 However, it is possible that train 003 had an undetected dragging brake fault. When vehicles in the train were later uncoupled, maintenance records reportedly showed that a brake cylinder on car 6 was found to contain two bar of air pressure when it should have been empty (a brake cylinder is pressurised when there is a demand for braking, and emptied to release the brakes). If air pressure in a brake cylinder is not fully released it could cause a brake block to be partially applied and to drag on a wheel. It is not possible to say whether this condition was present at the time of the incident because a computer log, which would have recorded this information, was erased when the train was split. The maintenance work to correct the cause of the fault was not recorded in enough detail to make it clear whether the fault would be undetected by the train's data transmission system. However, maintenance records do not show that the wheels or brake blocks on car 6 required any remedial action for the sort of damage that would be caused by a dragging brake.

[3] Any condition, event or behaviour that was necessary for the occurrence. Avoiding or eliminating any one of these factors would have prevented it happening.

69 A smell from the brakes could also be explained by two heavy braking events in the minutes before the train arrived at Holland Park station. At 18:31 hrs, when the train was travelling between Queensway and Notting Hill Gate stations the emergency brakes were applied by the train's automatic protection system because of an error detected in the speed monitoring system[4]. The train was brought to a stand from 28.5 km/h in 14 seconds. At 18:33 hrs when the train was being driven manually between Notting Hill Gate and Holland Park stations, the emergency brakes were again applied, this time for only a few seconds, to correct a train overspeed[5].

70 Although there may have been some smell from the brakes, the primary cause of the smoke and burning smell was almost certainly a faulty traction motor. When the train was examined at the depot it was found that one of the traction motors at the trailing end of car 6 had suffered 'flashover' damage. This type of damage occurs when a motor suffers from an insulation breakdown and there is a subsequent electrical short circuit, known as a flashover[6]. It is often accompanied by arcing and smoke from the breakdown and burning of insulation. The train is fitted with safety systems to ensure that the safety of passengers is not at risk from a motor flashover.

71 The electrical burning smell reported by a number of witnesses, and the smell from burning glass fibre (a material used in motor insulation), are consistent with a breakdown of insulation, arcing and burning within the motor.

72 The motors on 1992 tube stock have a history of a high rate of flashover. LUL has found that some motors are more susceptible to flashover than others for reasons that are not fully understood. However, it has identified certain wear characteristics on motor components which, its experience suggests, are precursor indicators that a motor is more likely to flash over. Each motor on 1992 tube stock is examined every 28 days to measure the wear on these components. This data, together with data from the motor's maintenance and overhaul history, is used to calculate its risk of flashover and frequency of preventative maintenance. LUL has reported that this inspection and monitoring regime has reduced the incidence of flashover from around 20 per week to an average of four a week.

73 Some motors, however, do not display signs that they are at risk of flashover and their failure is therefore unpredicted by LUL. Prior to the incident at Holland Park station the motor on car 6 was rated as having a low risk of flashover and was within specification when last examined on its 28-day cycle, 22 days earlier on 3 August.

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[4] The signalling system on the Central Line calculates the maximum permitted speed of a train and communicates it to the train by means of an electrical code transmitted from the track. It is these codes that cause the train to accelerate and decelerate automatically. If the train is unable to detect a code its automatic protection system applies the emergency brakes.

[5] At this time the train was being operated in a semi-automatic mode, known as 'coded manual'.

[6] 1992 tube stock was the last built LUL stock to be fitted with direct current traction motors. All subsequent rolling stock was fitted with alternating current motors which are not subject to this type of flashover.

74 In 2007 LUL modified the traction propulsion software on Central Line trains to detect a flashover condition at a lower threshold and to isolate motors when they fail. The intention was to minimise damage to motors due to flashover and to reduce the number of reports of smells and smoke from under cars. In this instance, the traction propulsion software on train 003 was not sensitive enough to detect the level of traction fault on car 6 before the incident. However, a traction fault associated with a motor flashover was detected on car 6 after the incident when the train was being taken forward to Ruislip depot.

75 LUL staff consulted during the investigation, including fleet engineering and safety staff, reported that incidents involving smoke from trains do occasionally occur but rarely give rise to an adverse response from passengers. By way of comparison, there was an incident in November 2013 at South Kensington station in which heavy smoke was produced by an earth fault on a train. The station fire alarm was activated and the station was evacuated. Photographs show the smoke to be heavier than at Holland Park but passengers reportedly remained calm.

76 LUL has also stated that reports of smells from Central Line trains are not unusual. Several witnesses involved in the incident at Holland Park station, who were familiar with travelling on London's underground system and had experienced dragging brake smells before, reported that they were not unduly alarmed by the smell. However, other circumstances came into play which spread fear and anxiety, and caused passengers to try to escape from the train. These are described below.

The perception of the train operator's response

77 The train operator stated that once the train had been brought to rest by the passenger emergency alarm activation, he acknowledged the emergency alarm and selected the talkback facility (figure 6). Talkback is a two-way communication system connecting the train operator with the car in which a passenger emergency alarm has been activated. When the train operator presses the talkback button in the cab all loudspeakers and microphones in the car concerned are switched on so the train operator can be heard throughout the car and anyone in the car can respond. Talkback communications are not recorded and there is no record of which car is contacted.

78 The train operator recollected that he contacted car 2. However, the passenger emergency alarm activation from car 2 occurred while the train operator was reporting the passenger emergency alarm activation to the line controller, and the data transmission system indicates that he shut down the cab on finishing the call. It is more likely that the train operator contacted car 5 because he was recorded telling the line controller that the problem had occurred in car 5. This is supported by a witness who is believed to have been in car 5. The witness told the RAIB that someone in their car pulled a passenger emergency alarm handle, and the train operator came on 'the tannoy' straight away after the train stopped. The witness confirmed the train operator's account that he announced he was the driver, that someone had pulled an emergency alarm, and asked passengers to tell him what the problem was. The train operator reported that he heard shouting which made it difficult to understand what he was being told. He also stated he told passengers in the car he could not understand what was being said, and he was coming down to the car to assess the situation. However, the evidence of the witness conflicted with this part of the train operator's account, instead indicating that the driver said nothing about coming to investigate and, after the initial exchange, no further communication was heard.

79 Witnesses in other parts of the train described an initial lull while passengers waited for an announcement from the train operator to advise them about the situation. One witness stated that the train operator had previously been making regular announcements on the westbound journey, and there is some evidence that he made an announcement before closing the doors at Holland Park. There was therefore an expectation that the train operator would make an announcement to tell them about what was happening. The lack of any communication from the train operator led one witness to fear that the train operator had been incapacitated by an event on the train.

80 The LUL Rule Book requires train operators to tell passengers about what is happening when a passenger emergency alarm has been operated. The RAIB found that this was generally understood to mean that the train operator should make an announcement to the train. Train operators are trained to do this and assessed as part of their annual continuing development programme.

81 LUL recognises the importance of announcements for calming anxiety in passengers. In the case of stalled trains, for example, the Rule Book advises train operators that the longer passengers are kept on a train without information the more likely they will become anxious.

82 In the absence of information from the train operator about what was happening, or confirmation that the train operator was dealing with the situation, passengers made their own decisions about remaining in the train.

The train doors remained closed

83 Passengers were unable to open the doors to the platform because on 1992 tube stock, once the doors have been locked for departure, the mechanical locking is designed to prevent them being opened beyond a pushback facility, limited to 115 mm. This would normally be used to free obstacles in the doors. Passengers should therefore be unable to force the doors wider than this distance although it is likely that the person who escaped from the train by squeezing through the doors did manage to do so (paragraph 51).

84 The train operator did not open the doors because, in the situation at Holland Park where a passenger emergency alarm activation brings a train to a stand partly within a station, LUL rules only permit the doors to be opened once certain procedures have been carried out. The train operator is first required to investigate the problem, assess whether opening the doors is the right response to the situation and, if so, to implement the appropriate door opening procedure. There are different procedures depending on how many doors are in the running tunnel. These include reversing the train back into the platform, or driving it back into the platform from the cab at the other end of the train. The procedures are designed to ensure that train doors are not opened in a tunnel environment because of the risk of passengers exiting into the gap between the train and the tunnel wall and coming into contact with the live conductor rail. (LUL trains, unlike mainline trains and trams, are not fitted with an emergency door release for the same reason. There are emergency doors at either end of the train to facilitate controlled detrainments of passengers on to the track.)

85 The train operator reported that when he left the cab to investigate the reason for the passenger emergency alarm activation he initially believed that there was a fight on the train and that the person on the platform, whom he had seen aggressively pulling the doors (paragraph 45), was trying to get into the train to join the fight. He considered that, in these circumstances, opening the doors would not have been the correct response. During his recorded conversation with the line controller to report the passenger emergency alarm activation the train operator was not told about the reported burning smell from the train. Line controller 1 stated that he was not aware of a report from Notting Hill Gate station and line controller 2 stated that he did not initially associate the passenger emergency alarm activation with the report of the smell of smoke.

86 The train operator stated that he walked through car 1 to car 2 and observed that people were generally calm but less so at the interconnecting doors between cars 2 and 3. He reported that he saw smoke in car 2 and thicker smoke in car 3 with a horrible smell, which experience told him was from dragging brakes. He stated that he reassured passengers that the smoke was brake dust, that there was no danger, and that he was going to open the doors. He recalled a conversation with a passenger about making an announcement, but believed that he had already made an announcement to the entire train over the talkback system. He reported that he was unaware that passengers in the rest of the train were also experiencing the smoke and a strong smell and he did not know that passengers were self-evacuating.

87 Two witnesses, who believed they were in car 1, stated that the train operator went about halfway down the car shouting “it’s only the brakes”. However, one of the witnesses reported that people at the trailing end of the car were already panicking and kicking the doors, and the train operator was unable to make himself heard.

88 Once he had decided to open the doors the train operator stated that he returned to the cab and followed the designated procedure to identify how many doors were beyond the platform. The train operator stated that he opened his cab door to look back along the side of the train and ascertained that only the leading set of double doors was in the tunnel. He was, therefore, able to use the facility on Central Line trains to isolate the leading doors and to open the doors remaining on the platform. This was in accordance with the rules.

89 It is possible that the four minute delay in opening the doors could have been shortened if the line controller had been able to make contact with the train operator during the two minutes he was out of the cab. Line controllers 1 and 2 had accessed live CCTV images from the platform and were aware that people were self-evacuating the train. Both line controllers reported trying repeatedly to contact the train operator to tell him what was happening on his train but the train operator did not have his handheld radio with him. Although the carrying of handheld radios when investigating a passenger emergency alarm activation is advised in training material for train operators, LUL does not currently require train operators to carry their radios with them when leaving the cab in these circumstances.

Station staff response

90 There were no members of station staff visible on the platform for about two and a half minutes after the train had been brought to a stop, by which time self-evacuation of the train was already well underway. Several witnesses reported that the delay before the first member of staff arrived seemed like a long time and their alarm was increased by not knowing if station staff were even aware of what was happening.

91 The team leader, who was the first to arrive, had been standing at the east end of the eastbound platform, apparently unaware of the smoke on the adjacent platform or of unfolding events until advised by members of the public. He stated that he could hear shouting and other noises from the westbound platform but did not consider this unusual at Carnival time. After contacting the station supervisor to pass on the report of smoke, the team leader made his way to the westbound platform. There he witnessed what he described as ‘mayhem’ with people on the train trying to force open the doors. He ran to the leading end of the train to find out from the train operator what was going on but found the cab was in the running tunnel and he could not locate the train operator.

92 The DTSM stated that it took him an estimated two minutes to walk down the spiral stairs, which he described as very crowded, from the control room to the platform (paragraph 49). Analysis of CCTV indicates that the message he heard on the radio mentioning a fire on a train may have come from a lift operator who was recorded using a radio after speaking to passengers arriving from the westbound platform.

93 When the DTSM arrived on the westbound platform he saw people climbing out of the train and decided to open a set of doors on car 3 to allow a safe detrainment to begin. He stated that he then located the train operator who he recalled to be around the trailing end of car 1. The DTSM stated that he opened a set of doors on car 1 and spoke to the train operator, reportedly telling the train operator to go back to the cab while he dealt with getting passengers off the train. However, this was not substantiated by the train operator's account.

94 The LUL Carnival Contingency plan for Holland Park station provided for eight members of staff (excluding the DTSM) to be on duty at the time of the incident. (Holland Park station would normally be staffed by a supervisor and an assistant.) The extra staff were mainly provided to manage congestion by controlling the flow of passengers in and out of the station. This meant that most of the staff were needed in the upper station area and in the lifts, leaving only one member of staff (the team leader) available to patrol the lower station area. Both the DSM and the station supervisor stated that they regarded the number of staff provided to be insufficient to deal with the amount of customer traffic and to cover meal breaks. They had previously raised concerns about the staff plan for the day of the incident but it appears that there were no more staff available. The RAIB was told that if staff were not rostered to work during the Carnival weekend, they were often unwilling to volunteer to do so.

95 It is possible that, had there been a member of staff located on the westbound platform at Holland Park station, action could have been taken to alert the train operator to the smoke during the time (about 30 seconds) the train was stopped normally in the platform.

96 **Passengers were able to climb over the inner inter-car barriers.**

97 Passengers on the train who witnessed people self-evacuating, and one witness who climbed out of the train, described either using the inner inter-car barriers (figure 10) as footholds to climb out, or pulling themselves up between the barriers using components at the ends of the cars.

98 Inner inter-car barriers were retrofitted to Central Line stock during the early part of 2013. They were fitted to deter a passenger from attempting to get out of a train via the car end-doors after failing to leave the train at the final station stop and being over-carried into sidings where the train operator changes ends. Once the barriers had been fitted, LUL removed the previous requirement for station staff at the final station stop to check that all passengers had got off the train before it moved off to the sidings.

99 LUL's design risk assessment for the fitting of the barriers recognised that they could be used as footholds to climb out of the train in the circumstances described in paragraph 98. However, LUL assessed that this risk was minimised by the sloping design, the height of the barriers (extending to 1.685 metres above train floor level), the restricted gap between the cars (nominally 330 mm) and the vigilance of train operators who would be walking along the train when changing ends. The risk assessment concluded that, taking account of the design mitigations, the risk of someone climbing out using the barriers was the same or lower than the risk of someone climbing out using car-end components.

100 Before the inner inter-car barriers were fitted, LUL had experienced a number of incidents, including some fatalities, in which persons using the interconnecting doors while the train was moving had fallen between cars. The inner inter-car barriers also served to reduce these risks.

101 In October 2012 there was an incident in which a 12-year-old boy, who had been carried into sidings, climbed out of a Bakerloo Line train at Queens Park (he was uninjured). Bakerloo Line trains were fitted with a different design of inner inter-car barriers but had a similar open top. In response to this incident the LUL Directors' Risk Assurance and Change Control Team decided to fit canopies over the top of all such barriers to eliminate the risk of persons climbing out. In the interim, the fitting of inner inter-car barriers without canopies to Central Line stock went ahead pending design and financial approval for canopies on the basis that the interim risk was acceptable. Financial approval for fitting canopies on Central Line trains was not in place at the time of the incident at Holland Park station.

102 The fitting of canopies is consistent with LUL's safety philosophy which seeks to retain passengers on trains because they are almost always safer there.

103 Although some passengers used the inner inter-car barriers as footholds, the RAIB considers that the risk of climbing out would have existed without the barriers because parts of the train such as the grab rail, 'perch' seats and the window reveal in the interconnecting doors, could have been used to access the roof of the train and slide to the platform.

104 Canopies would probably have prevented self-evacuation by people climbing over the top of the inner inter-car barriers.

105 **The train was not held in the platform at Holland Park station to allow the requested investigation of the burning smell to be carried out.**

106 The train was allowed to depart from Holland Park station while the line information specialist was speaking to the DSM to request that station staff be sent urgently to investigate the report of the burning smell. If the train had been held in the station platform to allow this requested investigation to be carried out it is unlikely that the self-evacuations would have occurred. This is because the train doors would have remained open or, if they had been closed, the train operator would have been able to open them sooner. When a train is fully in a platform when a passenger emergency alarm activation is made, the rules require the train operator to open the doors before investigating the cause.

107 The request from the line information specialist to the DSM could only have been made under instructions from, or with the knowledge of, line controller 2 who received the initial report from Notting Hill Gate station (paragraph 41). Line controller 2 stated that he intended to advise the train operator to empty (or detrain) the train of passengers at Holland Park station but had not done so before the train started to depart.

108 Between the end of the call from Notting Hill Gate station and the train departing Holland Park station there was a period of 73 seconds in which line controllers could have contacted the train operator by radio to prevent the train from departing the platform. Although the procedure to hold a train in a platform in such circumstances is not mandated, LUL has advised that line controllers routinely use the radio to ask train operators to hold a train in a station, for example, when managing service congestion.

109 The investigation has been unable to ascertain why this action was not taken. However, the timing coincided with a shift changeover between line controllers. Line controller 2 reported that he answered the call from Notting Hill Gate station as his first action on entering the control room, while line controller 1 was still in control of the line. Line controller 2's arrival also occurred at a time when the control centre was reportedly busier than normal with calls from stations.

Identification of underlying factors[7]

110 **Train operators are not equipped to deal with multiple passenger emergency alarms.**

111 The train operator had not experienced multiple passenger emergency alarm activations before and did not understand how the passenger emergency alarm system operated in such circumstances. His training and experience had prepared him to deal with passenger emergency alarm activations from a single car only. The refresher training given to train operators as part of LUL's continuous development programme and the training scenarios used for assessing their competence only deal with single passenger emergency alarm activations[8].

112 When a single passenger emergency alarm is activated a loud alarm is sounded in the cab, which the train operator is trained to acknowledge by pressing a button on the communications panel (figure 7). This panel is on the left-hand wall of the cab (facing the direction of travel). Acknowledging the alarm mutes it to about half volume and displays the message, 'driver aware', below the passenger emergency alarm handle in the activating passenger car. The number of the car in which the alarm has been activated is displayed on the data transmission system (figure 7), which is on the right-hand side of the cab. To speak to the car concerned, the train operator should then operate the talkback button on the communications panel and lift the handset (figure 7). This automatically connects the train operator with the relevant car and switches on all the loudspeakers and microphones in that car. The message, 'speak to driver', is displayed below the passenger emergency alarm handle. The design is such that operating other passenger emergency alarm handles in the same car has no effect and the train operator will not know that other handles have been operated until going to the passenger car to investigate.

[7] Any factors associated with the overall management systems, organisational arrangements or the regulatory structure.

[8] LUL advised that passenger alarm activations are typically made, for example, when a person becomes ill on a train, or a parent and child are separated when the train doors close. These usually involve a single car and this is reflected accordingly in the training provided to train operators.

113 The alarm remains muted unless a passenger emergency alarm is activated in a different car, which re-sounds the alarm at full volume in the cab. The procedure is the same as for a single passenger emergency alarm activation, except pressing the talkback button disconnects any on-going communication and connects the train operator with the most recent activating car. The numbers of cars making subsequent passenger emergency alarm activations are displayed on the data transmission system (figure 7). However, there is no information displayed to the train operator to indicate which car is now connected to the talkback. This information can only be accessed by the train operator leaving the driving seat and interrogating the data transmission system computer. This is not a routine operation and a LUL trainer advised the RAIB that, apart from being covered in initial training, train operators are not provided with any further training in accessing this information. An experienced train operator would not necessarily remember how to do it and in any event, it would be unrealistic to expect the train operator to do this while handling multiple passenger emergency alarm activations.

114 Regardless of how many passenger emergency alarms are activated, the train operator can only speak to one car at a time using the talkback. To speak to the whole train, the train operator has to use the public address system.

115 The train operator was unable to accurately interpret the repeated sounding of alarms and associated messages on the data transmission system to understand the scale of the incident. He reported that he acknowledged a number of new alarms but mistakenly believed that the same alarm was timing out and resounding at full volume. He stated that he did not look again at the data transmission system where the other alarms were listed. He believed, therefore, that there was only one passenger emergency alarm activation before he left his cab.

116 The RAIB reconstructed the sequence and timing of the passenger emergency alarm activations. The reconstruction indicated that the train operator would have experienced a heavy demand on his concentration over a short, very stressful period. During the time he was using the talkback to communicate with passengers and speaking to the line controller the train operator would have been interrupted by five further alarms, each of which would need to be acknowledged. The train operator stated that he was also viewing the in-cab platform CCTV (figure 6) to try to understand what was happening. It is therefore possible that he was unable to give attention to the data transmission system or if he looked at the data transmission system, to assimilate the list of alarms displayed to help him understand the unusual nature of what was going on.

117 The train operator's limited appreciation of the functioning of the talkback facility could also explain the different accounts of the talkback communication. It is possible that, unknown to the train operator, the second part of his communication was heard in another car. This could explain why the witness did not hear the train operator stating that he was coming to investigate (paragraph 78).

118 The train operator was also confused about who could hear his talkback communication, stating that he mistakenly believed he had spoken to the whole train. Other train operators told the RAIB that they did not know if pressing the talkback button connected the operator with all of the cars in which a passenger emergency alarm handle had been operated.

Factors affecting the severity of consequences

119 Passengers were at virtually no risk from a fire on the train. The design and materials of construction are such that the propagation of a fire, from whatever cause, was highly unlikely (the last fatality in a train fire on London's underground system was in 1958). A study of CCTV footage from the platform shows that the emission of smoke appeared to cease when the train came to a stand, as would be expected when there was no demand on the faulty motor.

120 Passengers self-evacuating were at risk of injury from falling in the confined space between the cars, on to the track. Although the risk of coming into contact with the positive rail, which runs adjacent to the wall furthest from the platform was low, the consequences of doing so would be very serious.

Observations[9]

Internal reporting of the incident

121 The seriousness of the event was not immediately recognised by the senior staff involved who were responsible for applying LUL's investigation procedures when an incident of this nature has occurred. The incident did not come to the attention of senior management at LUL until an article appeared in a London newspaper and footage recorded by someone on the platform was shown on local television news. Only then was an internal formal investigation commenced.

122 Neither the train operator nor staff who were aware of the self-evacuations, including the line controllers who had watched the event unfolding on CCTV, were debriefed after the incident to capture information while it remained fresh in their memories. The train was not quarantined for investigation when it returned to the depot which inevitably resulted in a loss of evidence (paragraph 68). The staff involved in the evacuation of Holland Park station were not debriefed to check their actions against those specified in LUL's congestion control and emergency plan for the station, as required by procedure when an evacuation has taken place.

123 The incident report form completed by the DSM on 27 August makes no mention of the self-evacuations. Other staff spoken to during the investigation who were directly involved stated that they were unaware that people had climbed out of the train. However, another report completed by a member of staff who attended after the incident, did include a reference to passengers exiting the train between carriages.

124 It is possible that the incident was not appropriately reported and escalated because it was not regarded as a serious event. There was a perception among some LUL witnesses that the incident had involved an overreaction by passengers to a situation in which they were not in any danger.

[9] An element discovered as part of the investigation that did not have a direct or indirect effect on the outcome of the incident but does deserve scrutiny.

Summary of conclusions

Immediate cause

125 The immediate cause of the incident was that passengers, believing that they were in danger by remaining on the train, self-evacuated by climbing through the gaps between cars or by forcing open a door (**paragraph 60**).

Causal factors

126 Once the departing train was stopped by a passenger emergency alarm the situation was not sufficiently quickly controlled by LUL staff and passengers formed the perception that they were in danger for the following reasons:

a. smoke and a burning smell from a faulty motor and possibly a seized-on (dragging) brake entered the train (**paragraph 67, no recommendation – see paragraph 131**);

b. passengers became increasingly alarmed when there was little or no perceived response from the train operator to the activation of passenger emergency alarms and no passenger information announcements were made (**paragraph 77, Recommendation 2**);

c. the doors to the platform did not open and passengers, both on the train and on the platform, were unable to open them (**paragraph 83, Recommendations 2, 3 and 5**); and

d. passengers could not see any staff on the platform responding to the situation (**paragraph 90, Recommendation 5 – see paragraph 132**).

127 Passengers were able to climb over the inner inter-car barriers to self-evacuate the train (**paragraph 96, no recommendation – see paragraph 133**).

128 The train was not held in the platform at Holland Park station to allow the requested investigation of the burning smell to be carried out (**paragraph 105, Recommendation 4**).

Underlying factors

129 Train operators are not equipped to deal with multiple passenger emergency alarm activations (**paragraph 110, Recommendations 1, 2, 3 and 5**).

Additional observations

130 Although not part of the cause of the incident the RAIB observes that the seriousness of the incident was not immediately appreciated by some senior staff involved which resulted in a loss of some evidence and a delay in initiating an internal formal investigation (**paragraph 121, Recommendation 6**).

Actions reported as already taken or in progress relevant to this report

Actions reported that address factors which otherwise would have resulted in a RAIB recommendation

131 LUL has reported that, in the short term, the algorithm used to calculate the risk of motor flashover will be changed to increase the weighting given to a motor once it has been in service for 1.6 years after overhaul. This will allow motors to be more accurately targeted for preventative maintenance. Efforts are also ongoing to prevent motors becoming susceptible to flashover; there is an ongoing trial of a modification to the motor which is due to be completed in 2015 and a proposal to develop another modification to reduce wear on motor components associated with flashover (paragraph 72). In the longer term, LUL is seeking to introduce changes to the train and motor control systems to reduce stresses on the motor which appear to be a factor in the process leading to a motor flashing over.

132 LUL has also reported that it intends to review the special events planning and staff allocation for Holland Park, in consultation with local representatives, as part of the planning cycle for the 2014 Carnival.

Other reported actions

133 LUL is undertaking a review of the risk assessment for inner inter-car barriers, taking account of emergency situations.

Recommendations

134 The following recommendations are made[10]:

1 *The purpose of this recommendation is to promote a design review of the passenger emergency alarm system on 1992 tube stock and the adoption of ergonomics best practice in an improved design.*

London Underground Limited should carry out an ergonomics assessment of the driver interface with the passenger emergency alarm system on 1992 tube stock. This assessment should include the functioning of the talkback system and the compatibility between the controls and the display. Taking account of guidelines on alarm handling and prioritisation (such as the, 'Good Practice Guide for the design of alarms and alerts' (T326), RSSB, 2008), London Underground Limited should then take appropriate action to present critical information to the train operator in a way that supports decisions and actions so that they can deal appropriately with the emergency situation (paragraph 129).

Relevant outcomes of this ergonomic assessment should also be applied to other stock as appropriate.

continued

[10] Those identified in the recommendations, have a general and ongoing obligation to comply with health and safety legislation and need to take these recommendations into account in ensuring the safety of their employees and others.

Additionally, for the purposes of regulation 12(1) of the Railways (Accident Investigation and Reporting) Regulations 2005, these recommendations are addressed to the Office of Rail Regulation to enable it to carry out its duties under regulation 12(2) to:

(a) ensure that recommendations are duly considered and where appropriate acted upon; and

(b) report back to the RAIB details of any implementation measures, or the reasons why no implementation measures are being taken.

Copies of both the regulations and the accompanying guidance notes (paragraphs 200 to 203) can be found on the RAIB's website www.raib.gov.uk.

2 *The purpose of this recommendation is to improve the ability of train operators to handle multiple passenger emergency alarms and other 'out of course' events on 1992 tube stock*.

London Underground Limited should review the rules, procedures and training applying to the handling of emergency situations on 1992 tube stock where multiple passenger emergency alarms have been activated and/or where only part of the train is stopped in a station. This review should include an assessment of the ways in which train operators can best manage a situation and adequacy of existing training arrangements. Particular attention should be paid to helping operators make appropriate and timely announcements and the safe management of doors in such circumstances. Any necessary changes to existing arrangements should then be implemented and staff briefed and trained as appropriate (paragraph 126b).

Relevant outcomes of this review should also be applied to other stock as appropriate.

3 *The purpose of this recommendation is to ensure that train operators remain in communication with line controllers when they are required to leave the cab to go back into the train*.

London Underground Limited should put procedures in place to require train operators to carry their hand-held radio when going back into the train, for example, to investigate the activation of a passenger emergency alarm, so that they can communicate with the line controller in a timely manner (paragraph 126c).

4 *The purpose of this recommendation is to make sure that line controllers are enabled to take appropriate and timely action when dealing with potential safety critical faults and conditions on trains*.

London Underground Limited should:

a. review the procedure applying to line controllers for dealing with reports of faults on trains, particularly reports relating to smoke or burning, and improve as necessary, in order that line controllers are provided with a clear process to assist timely decision-making and response; and

b. establish a protocol to manage the shift changeover between controllers, so that there is no loss of time or continuity in dealing with an incident (paragraph 128).

continued

5 *The purpose of this recommendation is to ensure that London Underground Limited's staff are able to respond appropriately to incidents on trains in platforms*.

London Underground Limited should review the required competencies and training for dealing with out-of-course events on trains in platforms. This should include consideration of how best to prepare station staff, train operators and line controllers to respond to such events in a rapid, coordinated and coherent manner, to protect the safety of passengers and station users (paragraphs 126b, 126c, 126d and 128).

6 *The purpose of this recommendation is to draw attention to the need for the prompt and accurate reporting of incidents*.

London Underground Limited should devise a time bound programme to reinforce, by briefing and further training if necessary, its procedures on the reporting and investigation of incidents in which there are no reported injuries but which could have led to more serious consequences. This should include the need for the early debriefing of staff involved and, where appropriate, the withdrawal of any trains from service for inspection and testing, to permit such incidents to be properly investigated (paragraph 130).

Appendices

Appendix A - Glossary of abbreviations and acronyms

CCTV	Closed circuit television
DSM	Duty station manager
DTSM	Duty trains staff manager
LUL	London Underground Limited
RAIB	Rail Accident Investigation Branch

Appendix B - Key standards current at the time

Rule Book 4 ‘Moving a stalled train and authorised detrainments’, issue 2	London Underground Limited
Rule Book 7 ‘Train incidents and safety equipment’, issue 2	London Underground Limited

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