Rail Accident Investigation Branch

Rail Accident Report

Safety incident between Dock Junction and Kentish Town 26 May 2011

Department for Transport

Report 07/2012
May 2012

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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Safety incident between Dock Junction and Kentish Town, 26 May 2011

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Summary

At around 18:26 hrs on Thursday 26 May 2011, a First Capital Connect service from Brighton to Bedford lost traction power and became stranded between St. Pancras and Kentish Town stations. Almost three hours elapsed before the train, with its passengers still on board, was assisted into Kentish Town station.

During the period that the train was stranded, conditions for passengers became increasingly uncomfortable because the train was heavily loaded and the air-conditioning and toilets stopped working at an early stage. Some passengers opened doors to improve ventilation and passenger alarms were repeatedly activated.

The strategy for rescuing the stranded train was to bring another train onto the front and haul it into Kentish Town station. The arrival of the assisting train was delayed and it did not couple onto the front of the failed train until around 20:20 hrs. During the next 50 minutes, the driver of the combined train tried to complete the arrangements necessary for its movement into Kentish Town. He was hampered by further operation of alarms by passengers frustrated at the continuing delay, and his uncertainty over the status of the doors (open or closed) on part of the train. A small number of passengers started to alight from the train.

Eventually, the driver over-rode a safety system in order to move the train. At the time when the train moved a short distance for the driver to test that it was properly coupled, some passengers were still alighting from the train to the track. When the train subsequently moved into Kentish Town, it did so with at least two doors open.

The investigation found that options for evacuating passengers, other than the use of an assisting train, had either been discounted or had not been briefed to those staff responsible for developing the rescue strategy on the day. There had been very little communication with passengers during the incident because the public address system on the train failed about 45 minutes after the train became stranded. Previous incidents of a similar nature had been investigated by First Capital Connect, but actions had not been taken on the findings.

The RAIB has made:

- one recommendation to First Capital Connect in relation to its management processes for emergency preparedness;
- one recommendation to Network Rail and the train operators on developing a set of principles for dealing with stranded trains; and
- one recommendation to Network Rail and the train operators to review their processes for undertaking incident reviews so that safety lessons are captured, tracked to closure and shared with other industry stakeholders.

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.

2 The RAIB does not establish blame or liability, or carry out prosecutions.

3 This RAIB investigation has resulted in recommendations being made to the railway industry. The process that applies to the management of recommendations made by the RAIB is explained on the RAIB website[1].

Key definitions

4 All dimensions and speeds in this report are given in metric units, except speed and locations which are given in imperial units, in accordance with normal railway practice. Where appropriate the equivalent metric value is also given.

5 St. Pancras International station has platforms at upper and lower levels. All references in this report to St. Pancras refer to the lower level platforms unless otherwise stated.

6 The terms 'up' and 'down' in this report are relative to the direction of travel; the direction from St. Pancras to Kentish Town is designated as 'down'.

7 The report contains abbreviations and technical terms (shown in *italics* the first time they appear in the report). These are explained in appendices A and B.

8 Trains are referred to using their train reporting numbers. The train which became stranded was train 1W95, the 16:30 hrs service from Brighton to Bedford. Train 1T55, the 18:10 hrs service from Bedford to Brighton, was terminated at Hendon and four of its coaches were used to assist train 1W95 into Kentish Town.

[1] http://www.raib.gov.uk/about_us.

The incident

Summary of the incident

9 On 26 May 2011, train 1W95, the 16:30 hrs First Capital Connect (FCC) service from Brighton to Bedford, became stranded between St. Pancras and Kentish Town (figure 1) as a result of losing traction power. When the train stopped, the front six coaches were in a narrow cutting in the vicinity of Dock Junction North and the rear two coaches were inside a tunnel (figure 2). Network Rail and FCC arranged for another train to haul the failed train into Kentish Town station. Almost three hours elapsed between train 1W95 becoming stranded and its arrival at Kentish Town station.

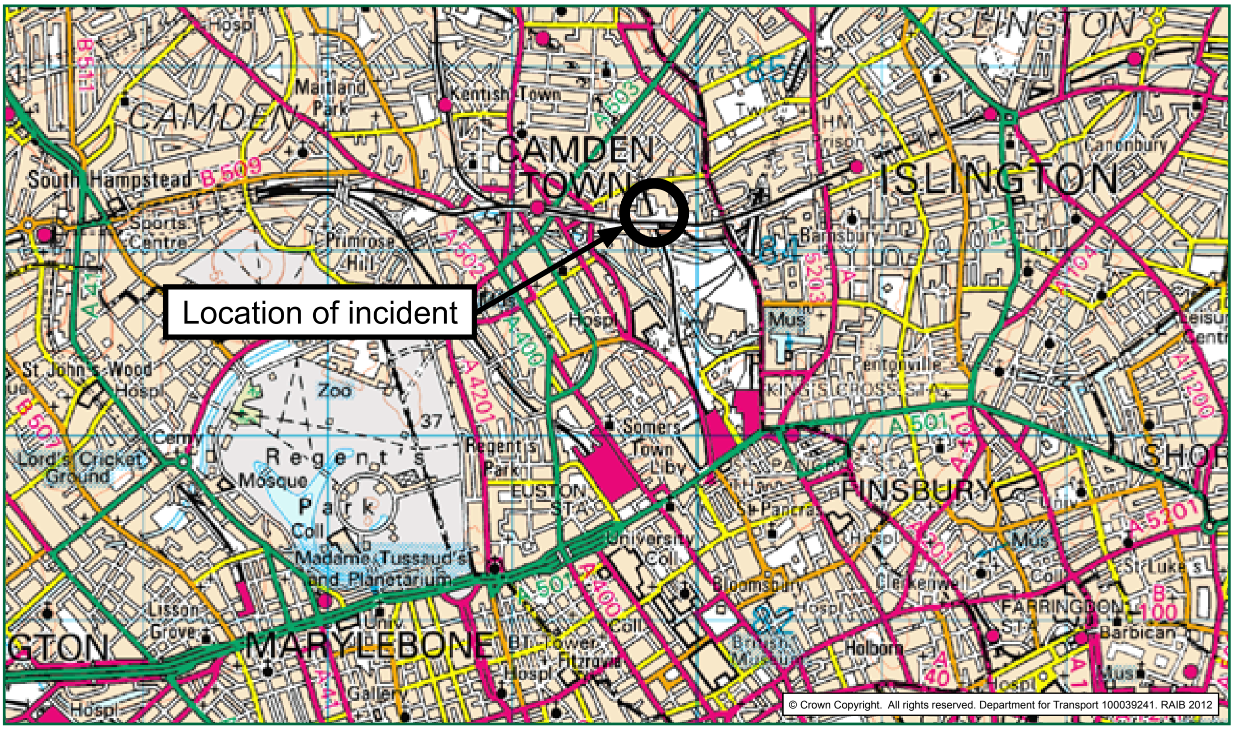

Figure 1: Extract from Ordnance Survey map showing location of incident

10 During the period that the train was stranded, the passengers became increasingly uncomfortable because the train was crowded and the air conditioning and toilets had failed at an early stage[2]. Consequently, passengers opened doors on the train using the emergency door release handles. Approximately 45 minutes after train 1W95 stopped, the train's public address system failed and the driver was unable to communicate with the passengers except by walking through the train. The driver had become aware from his in-cab display that doors had been opened and once the assisting train was attached, he sent a Network Rail mobile operations manager and fitter to close the doors. However, soon after the doors were closed passengers re-opened them. The driver was unable to move the train as a safety interlock within the train's control system required all doors to be closed before the train could be moved.

[2] The temperature on the day was below average for the time of year, with daytime temperatures recorded at around 17ºC (63ºF). At the time of the incident, the weather was reported as dry and humid. The incident occurred in daylight, with sunset at 21:01 hrs.

11 The driver of train 1W95 isolated the safety interlock and prepared to move the train a short distance to confirm that the assisting train and the failed train were properly coupled (the 'pull-test'). However, a small group of passengers had become so frustrated at the continuing delay to the train that they alighted from the train onto the lineside and were walking between the train and the tunnel / cutting wall as the pull-test was being performed. Staff had to assist these passengers back onto the train. Shortly after the passengers had re-boarded, the driver moved the train into Kentish Town station, unaware that there were still doors open towards the rear of the train, and passengers in the vicinity of the open doors.

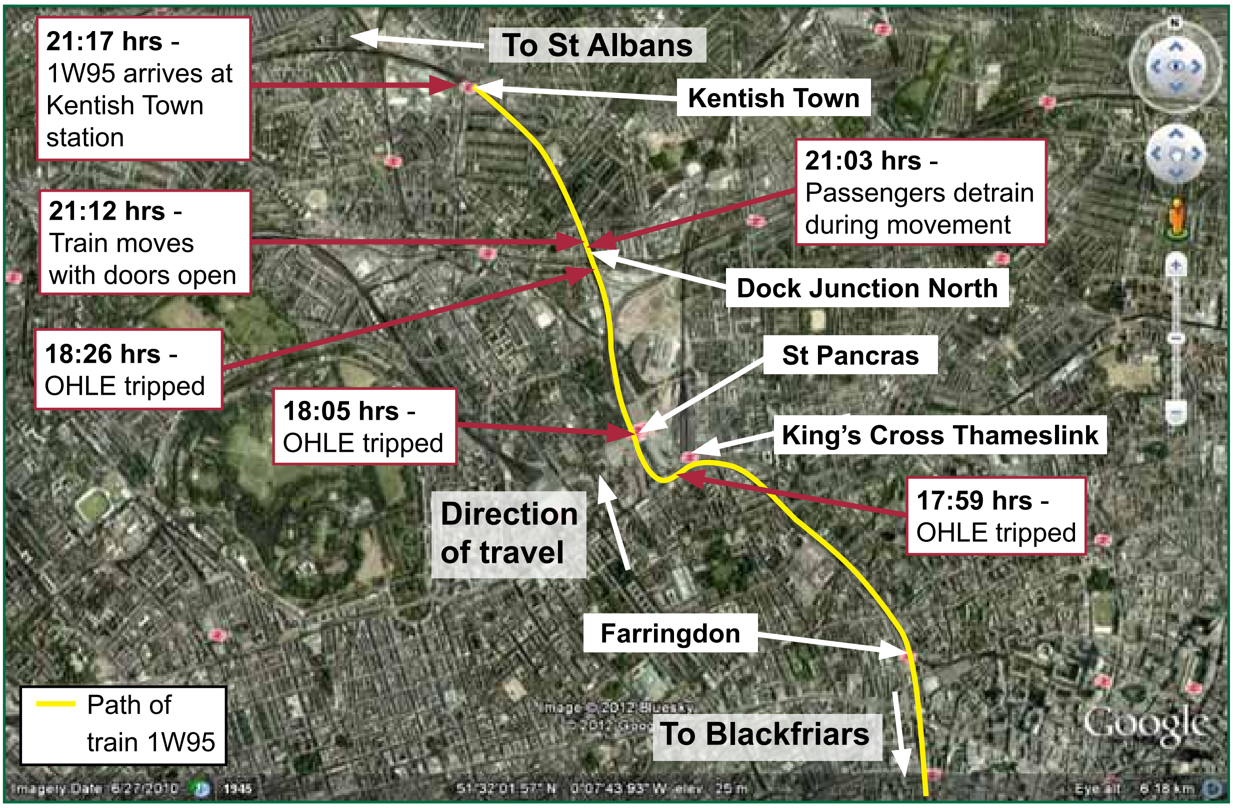

Figure 2: Overview of incident showing locations (courtesy of Google Earth)

Context

Location

12 Dock Junction North is the point at which the *Thameslink route* from south of the river Thames joins the Midland main line between St. Pancras International (high level) and Bedford. It is located approximately one and a half miles (two kilometres) north of St. Pancras station. The two-track route from St. Pancras used by Thameslink services becomes six tracks north of the junction with the main line from St. Pancras International high level.

13 The signalling is controlled by West Hampstead Power Signal Box (PSB).

14 Traction power for electric trains is supplied through a 25 kV overhead line system.

Organisations involved

15 Network Rail owns and manages the infrastructure. It also employs the signallers, mobile operations managers and overhead line engineers.

16 FCC is the train operator and employs the train driver. The company also employs engineering staff (fitters) who work from depots or strategic locations on the rail network to assist when trains have failed. FCC's control room staff are based in the Thameslink Service Delivery Centre, which is located within West Hampstead PSB (figure 3). FCC is owned by First Group.

17 FCC employs the staff who manage the Thameslink platforms at St. Pancras. FCC operates train services through the main line platforms at Kentish Town, but these platforms are not normally staffed.

Train involved

18 Train 1W95 was formed of two 4-car class 377/5 'Electrostar' *dual voltage* electric multiple units, with unit 377510 leading and unit 377518 trailing. Each coach has two sets of power operated doors on each side and a limited number of windows which can be opened manually by a member of FCC staff to allow some emergency ventilation. Train 1W95 was 'driver-only operated' and the driver was thus the only member of staff on board.

19 The class 377/5 units are sub-leased by FCC from the Southern train operating company. The fleet is being operated on Thameslink services as a short term measure pending the introduction of a complete fleet of new trains from 2015 onwards.

Staff involved

Train drivers

20 The driver of train 1W95 joined British Rail in July 1977 as a driver's assistant and progressed through various driving jobs until joining FCC in 2004. He was trained on class 377/5 units in 2009.

21 The driver of train 1T55 (used to assist train 1W95 into Kentish Town station) started work on the railway in 2000 as a member of platform staff before training as a train driver. She joined FCC in May 2010 and was trained to drive class 377/5 units later that year.

FCC duty control manager, West Hampstead

22 The duty control manager at the time of the incident started work on the railway in 2003 and joined FCC in 2009 to work at the East Croydon and West Hampstead Service Delivery Centres. He had completed relevant competence assessments (including the management of stranded trains) in 2010.

23 The role of control room staff is to manage the real time running of FCC trains and to deal with on-board equipment failures, staff incidents and accidents and resource management. On technical matters they are assisted by duty managers at Bedford (Cauldwell) depot.

FCC train services manager, West Hampstead

24 The train services manager started on the railway in 1997 as a member of station staff on the Thameslink network. In 2007 he was appointed to his current role with responsibility for monitoring train services operating over the Thameslink route north of Blackfriars. The train services manager assists the duty control manager when the latter is dealing with service disruptions.

Network Rail signalling shift manager

25 The signalling shift manager had worked on the railway since 1992 and for Network Rail since 2004. His role is to supervise the work of the three *panel signallers* and one support signaller who are on duty at any one time to manage the signalling and movement of the trains on the route. During incidents, the signalling shift manager and the signallers communicate with train operating company managers and FCC staff who work in West Hampstead PSB. For the purpose of this report, the signalling shift manager and signallers are collectively referred to as 'the signaller'. Figure 3 shows the layout of West Hampstead PSB.

Figure 3: West Hampstead PSB

The investigation

Sources of evidence

26 The following sources of evidence were used:

- witness statements and the accounts of some of the passengers involved;
- data from the train's on-train data recorder;
- Closed Circuit Television (CCTV) recordings taken from St. Pancras, Kentish Town and West Hampstead;
- site photographs;
- weather reports;
- observations at the site;
- internal CCTV recordings and social media files (You Tube / Facebook and Twitter);
- guidance to staff on handling incidents issued by Network Rail and First Capital Connect;
- guidance on incident management issued by Rail Safety and Standards Board (trading as RSSB) and Association of Train Operating Companies (ATOC);
- previous reported incidents; and
- previous RAIB investigations that are relevant to this incident.

Key facts and analysis

The sequence of events[3]

27 Train 1W95 departed from Brighton at 16:30 hrs on Thursday 26 May 2011. There were no incidents reported on its journey from Brighton to Farringdon or while the train was stationary at Farringdon station where a changeover from DC electric power (collected from a third rail) to AC electric power (collected from an overhead line) took place as normal. Following departure from Farringdon, the train was approaching St. Pancras at 17:59 hrs when the circuit breaker in the power feeder station supplying the Overhead Line Equipment (OHLE) opened automatically (referred to as 'tripping' in the remainder of this report) indicating the presence of a fault. A light (line light) on the train driver's panel went out, indicating that the train was not receiving power from the overhead line. The train was able to coast into the platform at St. Pancras station (figure 4).

Figure 4: St. Pancras lower level platforms

28 While the train was stationary in the platform with doors open, the train driver attempted to regain power, but the OHLE system continued to trip (18:05 hrs) each time he tried to take power, indicating that a fault remained. It was later found that the cause of the tripping was foliage in the train's *pantograph* (figure 5). The driver inspected the train from the platform, but did not see any damage. After returning to the driver's cab, he made an announcement to passengers using the train's public address system regarding the delay, and made passengers aware of the alternative services available at St. Pancras high level station.

29 The driver informed the signaller of the problem, and the signaller arranged for FCC's depot at Bedford to be contacted to advise on rectification of the fault. A FCC fitter who was based at Kentish Town was dispatched to St. Pancras at 18:10 hrs. He commenced his journey, travelling by public transport.

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[3] Appendix D contains a time line of key events.


Figure 5: Damaged pantograph with foliage

30 The electrical control room operator at York was aware of the trippings in the vicinity of St. Pancras and contacted the signaller who instructed the drivers of three other trains in the same overhead line section to lower their pantograph equipment, which was in contact with the overhead power lines. This would enable the electrical control room operator through a process of elimination to identify the exact location of the fault. At 18:21 hrs the signaller, in consultation with FCC control room staff, advised the driver that once the fault had been rectified, train 1W95 should be moved to Kentish Town where detrainment of passengers would take place rather than at St. Pancras.

31 Soon after, the train driver raised the pantograph on the leading unit of train 1W95 and regained power to that unit. However, he was unable to raise the rear pantograph and no power was being supplied to the rear unit. He informed the signaller that he was able to proceed with only the pantograph on the front unit raised. The fitter who had been dispatched from Kentish Town had not yet arrived. Train 1W95 left St. Pancras at 18:23 hrs, and was now heavily loaded (figure 6) because of the length of time that it had been standing in the platform. The driver then announced to passengers that the train would be terminating at Kentish Town.

32 Shortly before 18:26 hrs, the OHLE tripped again and the train stopped near to Dock Junction (figure 7). The electrical control room operator decided not to reset the OHLE again in order to prevent damage occurring. Although the driver had not reported that the train had failed, the signaller advised him that a FCC depot technician would be in contact as both the signaller and FCC controller believed that the problem was a technical fault on the train. The driver made a further announcement to the passengers to update them on the situation.

Figure 6: Image showing passengers within 1W95. The train has 482 seats available with an average evening peak train accommodating approximately 700 passengers.

Figure 7: Down Moorgate line near Dock Junction North

33 The signaller and FCC control centre staff considered the options available to them. After rejecting (or not considering) a number of possibilities (these are described later), the decision was taken to use one of the two class 377/5 units from the 18:10 hrs service from Bedford to Brighton (reporting number 1T55) to couple to the front of train 1W95 and take it into Kentish Town station. At that time, train 1T55 was approaching Hendon station and the driver was requested to detrain passengers there and take the empty train to Cricklewood depot where it would be split so that four cars could go forward to assist train 1W95.

34 Meanwhile, the driver of train 1W95 continued to attempt to identify the origin of the fault and regain traction power by following a fault finding process on his in-cab train management system, but he was unable to do so. At 18:45 hrs, the FCC fitter (paragraph 29) arrived at St. Pancras to find that train 1W95 had departed and he was redirected back to Kentish Town by the FCC controller.

35 By 18:57 hrs, the driver of train 1W95 started to receive warnings via the train management system that passenger doors had been opened and passenger communication alarms had been activated. He walked back through the train with difficulty (due to the number of standing passengers), resetting the passenger alarms manually with a key, and closing two doors which he found to be open (figures 8 and 9). Some passengers became verbally abusive and others complained of the high temperatures within the train and the lack of announcements and progress. The driver explained that a rescue train was expected in five minutes, but was only able to communicate with individual groups of passengers as the public address system was no longer operational.

Figure 8: Passenger communication alarm with alarm active (inset - alarm being manually reset using a key)

Figure 9: Door egress handle allowing partial opening of the train door after egress handle is pulled down (inset - egress alarm in its normal state)

36 Over the next two hours, passengers continued to operate communication alarms. The driver ceased resetting them due to the number being operated and his difficulty in moving around the train.

37 Meanwhile, the splitting of train 1T55 (the assisting train) at Cricklewood was being carried out. The driver had difficulty in uncoupling the two units and she sustained a hand injury. Consequently the train did not leave Cricklewood depot until 19:50 hrs, and then had to travel at caution in the 'up' direction on the down line to Kentish Town station.

38 At around the same time, the signalling shift manager decided that the train should be evacuated and authorised a Network Rail mobile operations manager, a Network Rail OHLE engineer and a FCC fitter to walk along the track from Kentish Town station to train 1W95, to supervise the evacuation of passengers from the train to the track and on foot to Kentish Town station. This decision was taken in the light of the ongoing delays to the rescue train and was not communicated to FCC control room staff.

39 As the assisting train started to travel south from Cricklewood, the signaller contacted the mobile operations manager to advise him of the imminent arrival of the assisting train. The signaller cancelled the instruction to evacuate passengers and asked that the three members of staff who were proceeding to the train returned to Kentish Town so that they could be conveyed to train 1W95 on the assisting train.

40 The assisting train arrived at Kentish Town station at approximately 20:06 hrs. Paramedics, the mobile operations manager, OHLE engineer and the fitter boarded and the train departed for Dock Junction North at 20:12 hrs, arriving at the front of train 1W95 at around 20:20 hrs. Coupling of the assisting train onto the failed train took place soon after. A number of passengers then moved from the failed train via the connecting gangway into the assisting train so that they could sit down or be in a less crowded environment. By this time some passengers had started to suffer from the effects of overheating.

41 The driver of train 1W95 made his way to the front of the combined trains, which now consisted of 12 coaches. He started the combined train's computer controlled train management system at 20:29 hrs, but the public address system on the failed 8-cars still did not work. Operation of the emergency door release handles and passenger communication alarms continued, and this meant that the driver was still unable to move the train because there was a safety interlock which prevented him from taking traction power with the alarms operated. The fitter volunteered to walk through the train to reset all of the passenger communication alarms and to close any open doors. As he walked through the train he asked passengers (some of whom had been standing for over two hours) not to activate emergency door release handles and passenger communication alarms again as this would prevent the train from moving. However, some passengers ignored this request. The driver's computer display screen continued to show door faults on the failed portion of the train, which meant that he was unable to determine whether the doors were open or closed (figure 10). It was still not possible to obtain the door interlock necessary for movement of the train.

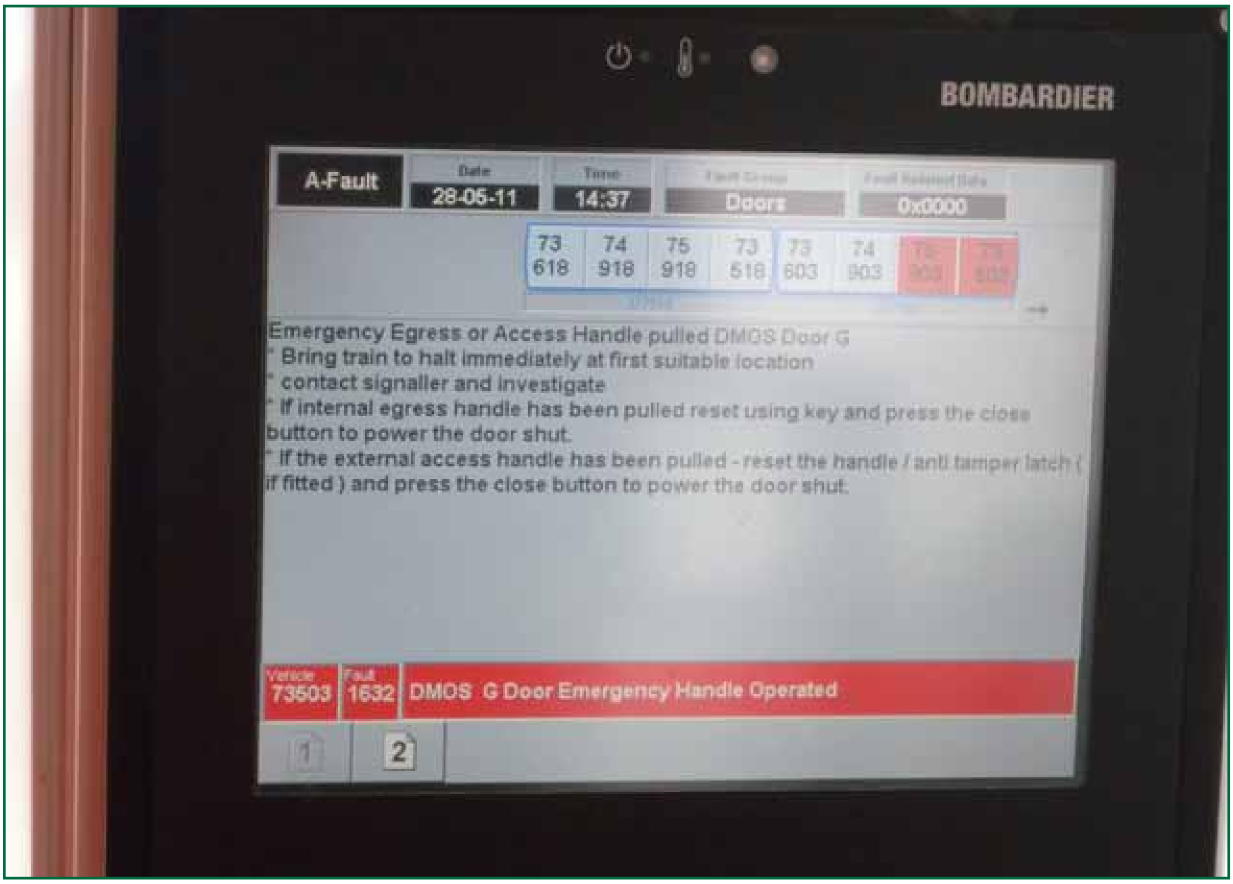

Figure 10: Door activation and instructions given to the train driver on the in-cab display

42 At 20:58 hrs the signaller (in consultation with FCC control) advised the fitter and the driver that if no solution could be found, and the driver could not obtain the door interlock, then the driver was authorised to operate the traction interlock switch. Operation of this switch would override the safety interlock and enable the driver to move the train. At approximately 21:00 hrs, the driver duly operated the traction interlock switch, and almost immediately afterwards applied traction to carry out a short 'pull test' which involved moving the train a distance of less than one metre to ensure that it was securely coupled. The train driver, who was focused on the task in hand, did not make any announcement to passengers that the pull test was to be undertaken. Had he done so, it would not have been heard in the rear eight coaches because the PA system was still not working. The driver was unaware that around 30 to 40 passengers from the two rear carriages had now decided to leave the train with some passengers getting off the train as it moved forward a short distance during the pull test. Other passengers were walking between the train and tunnel / cutting wall in the *cess* towards Kentish Town station.

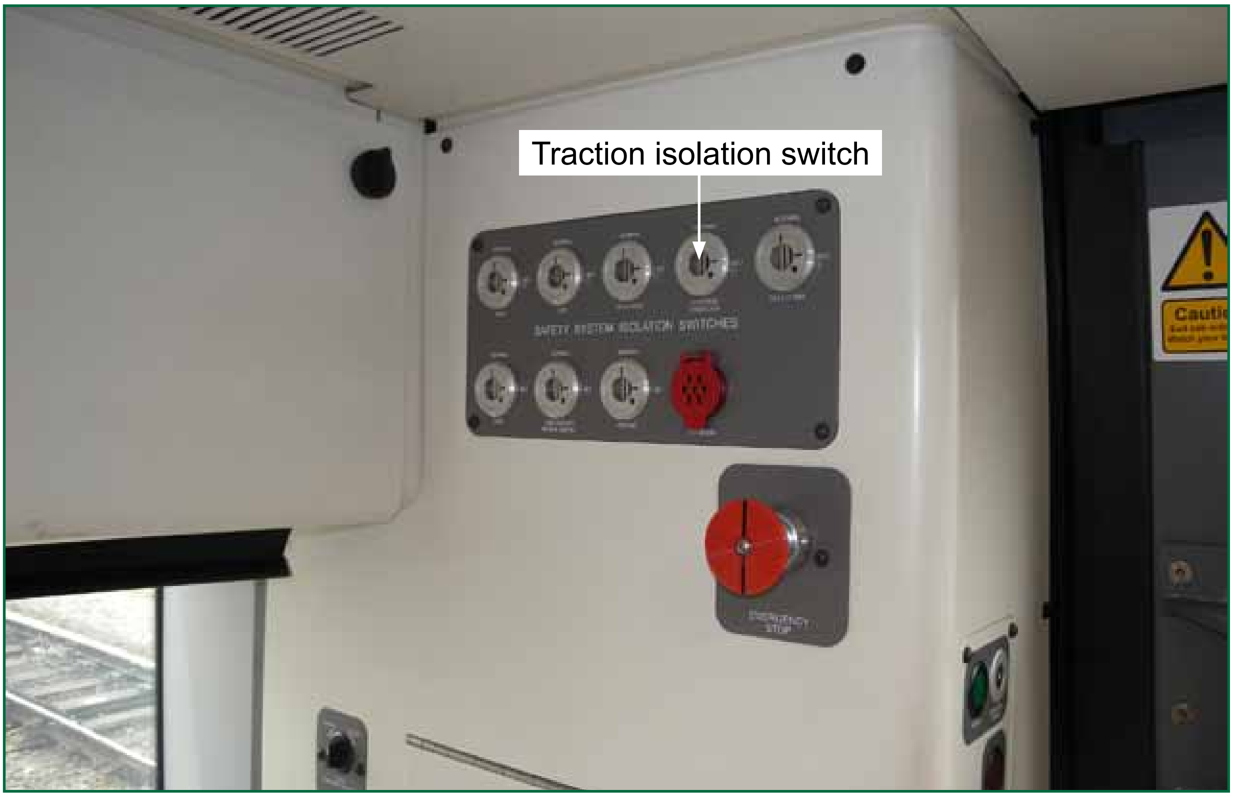

Figure 11: Traction Isolation Switch (TIS)

43 The movement of the train alarmed the passengers who had evacuated from it. Railway staff on the train became aware that there were passengers outside the train and the mobile operations manager made an emergency call to the signaller to block all lines. The driver was advised and opened the cab door so that the passengers could re-board. The passengers explained that they had not received any announcements from the driver and that the interior of the train had become unbearably hot.

44 The mobile operations manager informed the driver and signaller that both he and the fitter had checked the train and that all passengers had re-boarded and the train was safe and ready to move.

45 At 21:11 hrs the driver was granted permission to move forward to Kentish Town. No further passenger announcements were made. The driver, fitter and mobile operations manager were unaware that at least two doors remained open or had been reopened. The train started, reaching a speed of 17 mph (27 km/h), and arrived at Kentish Town at 21:17 hrs.

46 On arrival at Kentish Town, the train management system was still showing door alarm activations and door faults and this prevented the driver from opening the doors on the last eight coaches of the train, but a small number of doors were already open and additional doors were forced open. Other passengers moved down to alight through doors of what, following the coupling of the assisting train, had become the first four coaches.

47 Police and paramedics were on hand to assist passengers getting off the train, a number of whom were suffering from heat exhaustion and stress. No passengers required hospital treatment. The train departed empty to Cricklewood depot at 21:34 hrs, with four sets of doors still open. No incidents were reported between Kentish Town and Cricklewood, where the fitter and driver later discovered the open doors.

Identification of the immediate cause[4]

48 The driver moved train 1W95 when it was not safe to do so, with passengers standing in the vicinity of one or more sets of open doors.

Identification of causal factors[5]

Overview of factors

49 The rescue of train 1W95 was initially managed as a 'routine' incident with the focus of FCC staff being on service performance and recovery. In the event, the rescue became protracted and was affected by numerous delays. There were four key elements that combined to make this a serious incident, which ultimately resulted in the train moving with doors open. The four factors, considered separately in the following sections of this report, were:

a. the duration of the delay to train 1W95 (2.5 hours) (paragraphs 50 to 74);

b. the conditions on train 1W95, which were uncomfortable because of crowding, lack of airflow and the heat (paragraphs 75 to 91);

c. the limited and sometimes inaccurate information available on the progress and estimated time of the recovery of train 1W95 which caused frustration, and led to some passengers re-opening doors after they had been closed by railway staff (paragraphs 92 to 99); and

d. the movement of train 1W95 without an announcement and with some doors open (paragraphs 100 to 113).

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

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

Factors in the delay to train 1W95

Foliage in the rear pantograph

50 **Foliage had become lodged around the rear pantograph of train 1W95 at some point while the pantograph was not in use, which caused electrical tripping after the train left Farringdon with the pantograph raised and the subsequent immobilisation of the train at Dock Junction. This was a causal factor in the incident.**

51 At some stage while unit 377518 (which formed the rear unit of train 1W95) was operating south of Farringdon and drawing traction current from the third rail, a branch of a tree became lodged in the lowered pantograph and remained undetected. At Farringdon, the driver raised the pantographs in accordance with normal operating procedures, and the train continued until the first tripping of the OHLE power supply between Farringdon and St. Pancras.

52 The rear pantograph dropped due to the activation of the *Automatic Drop Device* (ADD). The train driver examined the train at St. Pancras, but he could not see the foliage from the platform. When he raised the rear pantograph, the OHLE tripped again and he was advised by platform staff that a flash and sparks of light had originated from the rear of the train. The train left St. Pancras with only the front pantograph raised. However, the OHLE tripped again (probably because the foliage in the vicinity of the rear pantograph came into contact with the OHLE) and the train stopped in the vicinity of Dock Junction North, without power.

53 Because the driver was unaware of the foliage at the rear of the train, the sequence of events caused him to believe that there was now a problem taking power through the front pantograph. As the incident started to escalate, the number of demands placed on the driver (primarily communication with the passengers, with the signaller and with the fitters at Cauldwell depot) increased. This reduced his ability to diagnose via the train management system the possible causes of the tripping that had occurred after the train left St. Pancras. The driver, having discussed the matter with the signaller, declared the train a failure and was instructed by the signaller to isolate the front pantograph leaving the train without power. The presence of the foliage was not identified until the train reached the depot later in the evening.

54 Train 1W95 was allowed to depart from St. Pancras before the arrival of a fitter who was travelling by Underground from Kentish Town to meet the train. The fitter could have inspected the train and offered support to the train driver in identifying the fault.

Train 1W95 was not detrained at St. Pancras

55 **Despite the problems experienced on train 1W95 at St. Pancras, FCC allowed it to continue to Kentish Town with passengers on board, despite the risk that the train might fail. This was a causal factor in the incident.**

56 FCC's documented policy for dealing with trains in a vulnerable condition was to avoid detraining passengers in the Thameslink *core section*. FCC controllers preferred to move the train and its passengers to Kentish Town station because they had been previously criticised by FCC management following an incident of crowding at St. Pancras when a train had been evacuated there.

57 The driver initially questioned the decision to move the train with passengers on board, but was advised by the signaller that the passengers could be transferred to other trains at Kentish Town. Train 1W95 stood in St. Pancras for 20 minutes in the evening peak, and had therefore become full with 700 to 750 passengers on board (figure 6), some of whom were standing. In accordance with FCC policy the driver had made some announcements at St. Pancras, but no reference was made to the plan to terminate the train at Kentish Town while the train was in St. Pancras station. Had this been done, it is probable that the train would have been more lightly loaded on departure.

58 There were more station staff available to assist passengers at St. Pancras than at Kentish Town. FCC did not consider asking staff at St. Pancras to join the train to assist passengers when it reached Kentish Town (where only one member of staff was on duty). Had FCC done so, staff would have been on hand to assist when the train subsequently became stranded.

The selection of the optimum strategy for dealing with the failed train

59 **FCC gave only limited consideration to a range of possible strategies for rescuing train 1W95 and its passengers and at an early stage focused solely on the use of an assisting train for moving train 1W95 and its passengers to Kentish Town. This was a causal factor in the incident.**

60 There were other options for rescuing passengers from the failed train, but these were rapidly discounted in favour of the use of an assisting train coupled to the front of train 1W95. Each of the other options is considered briefly in the following paragraphs.

Assisting train 1W95 from the rear with a class 319 unit

61 Although FCC's controllers and the signaller intended to assist train 1W95 into Kentish Town, the assisting train did not have to be coupled to the front of the failed train; another option was to couple it to the rear. The train immediately behind train 1W95 when it failed was formed of two class 319 units. FCC Control and the signaller considered using this train to assist train 1W95 from the rear. However, the coupling mechanisms on the two trains were different, which meant that an emergency coupler would be required.

62 FCC's policy for dealing with stranded trains (Safety Management System (SMS) 7.17 'Dealing with stranded trains and controlled evacuation of passengers') showed that emergency couplers were located at Kentish Town and Farringdon. FCC's controllers asked for the coupler to be found and a fitter at Farringdon located it on the station. Network Rail's mobile operations manager was requested to take the coupler to site, but the plan was overtaken by events and by the time that the coupler was ready to be transported, the decision had been taken to use another class 377/5 train coupled to the front of train 1W95. The RAIB has been unable to establish exactly why this option was not expedited, but it is likely that the necessary communications between the various parties involved in managing the incident did not take place in a timely manner. FCC's controllers had a significant workload dealing with the disruption to Thameslink services arising from the failed train and had also, by this stage, started to focus on the use of an assisting train coupled to the front of train 1W95.

Assisting train 1W95 from the rear with another class 377/5 unit

63 An 8-car southbound train formed of two class 377/5 units passed train 1W95 soon after it had failed. The passengers could have been detrained at St. Pancras and the train shunted to the northbound track and onto the rear of train 1W95, once both trains formed of class 319 units trapped immediately behind the failed train had been cleared.

64 However, exercising this alternative option required rapid decision-making. At the time the decision had to be made, Bombardier and FCC depot staff had informed the signaller and FCC controllers that the train management system software would not work properly if two 8-car class 377/5 trains were coupled together. FCC controllers did not feel competent to challenge the assertion. In fact it would have been possible to couple the two trains mechanically into a 16-car formation with normal control of traction and braking. However, the belief that a 16-car formation would not work meant that the southbound train would have to be taken to a location where the two units could be uncoupled and one of them stabled securely while the other returned northbound to assist train 1W95. This would have exacerbated the delay and disruption already being caused by the failed train. The plan to use the southbound train to assist train 1W95 was abandoned.

Use of transboardment bridges

65 *Transboardment bridges* (figure 12) could have been used to transfer passengers from the failed train to another train drawn up alongside[6]. FCC's procedure for dealing with stranded trains (paragraph 62) included this option. Although the document had been authorised as a company procedure in January 2011, it had only been loaded onto FCC's intranet system on 17 May 2011, a week before the incident. The intranet system was the source of information for control room staff on FCC's company procedures.

66 An audit undertaken after the incident confirmed that some key staff (including those in the control room) were not aware of the contents of the procedure because the briefing program had lapsed. Control room staff were therefore unaware of the existence of transboardment bridges and the option was not considered

Evacuation of passengers to the track and on foot to Kentish Town station

67 It would have been possible to take passengers off train 1W95 using emergency steps carried on board the train, and for them to walk to Kentish Town. This option was also identified in FCC's procedure for dealing with stranded trains. It was initially discounted by FCC's controllers because they believed that the number of passengers on board train 1W95 would make such a procedure protracted and difficult. It could only have been accomplished once additional staff were on hand to assist. Finding such staff in sufficient numbers may have been difficult because of the demands already being made on FCC's resources in managing the disruption arising from the failed train.

68 At around 19:45 hrs, when it became apparent that the arrival of the assisting train was being delayed, the Network Rail signaller did start to put a plan in place to evacuate passengers from train 1W95 on foot to Kentish Town station (paragraph 38). In the event, the plan was suspended as soon as it became apparent that the assisting train was on its way.

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[6] One transboardment bridge was located at Blackfriars station.

Figure 12: Transboardment bridge (image courtesy of Southeastern, the developers of the bridge)

Delays in the arrival of the assisting train

69 **The arrival of the train provided to assist train 1W95 into Kentish Town was affected by a series of delays. This was a causal factor in the incident.**

70 At around 18:55 hrs (30 minutes after train 1W95 had failed), southbound train 1T55 was identified as the train that would be used to assist the failed train from the front. At that time it was in the vicinity of Hendon, around seven miles from the failed train. Eighty minutes elapsed before the assisting train was coupled to train 1W95.

71 The initial delay in choosing train 1T55 to assist the failed train was caused partly by the workload associated with the activities described in paragraphs 59 to 68, but particularly by the ongoing debate within FCC as to whether an 8-car class 377/5 train could be coupled to another 8-car class 377/5 train (paragraph 64).

72 Train 1T55 arrived at Hendon at 19:01 hrs, and the plan adopted by FCC was for the passengers to be taken off the train and the two units taken empty to Cricklewood sidings and split, so that only one unit would go forward to Kentish Town to assist train 1W95. There was a delay of nine minutes at Hendon because the passengers who were being requested to leave the train were unwilling to alight and no platform staff were available to assist the train driver.

73 Once it had been emptied, the train ran to Cricklewood depot, stopping on the goods loop at 19:17 hrs. The loop was not part of FCC's sidings at Cricklewood. The member of staff responsible for the control of the adjacent FCC sidings was not advised by the signaller or FCC controllers of the arrival of the empty train or the plan to split the units on the goods loop until approximately 19:30 hrs. He was initially unwilling to assist in splitting the two units as he was not trained or competent to do so. He did eventually go to assist the driver when directed to do so by FCC control. The driver of the empty train had not had any experience of uncoupling class 377/5 units since her initial training and had to refer to the traction manual for guidance. She suffered a hand injury while uncoupling the units.

74 The empty train was in Cricklewood sidings for 33 minutes, eventually departing at 19:50 hrs. It then took a further 30 minutes to reach train 1W95, mainly due to running in the 'wrong direction' at low speed towards the front of the failed train and the need to stop at Kentish Town to allow emergency services personnel to board.

The conditions on train 1W95

The on-board environment

75 **The conditions for passengers within train 1W95 became increasingly uncomfortable as time wore on. In an attempt to make conditions more tolerable, some passengers opened doors and, later, some alighted from the train. This was a causal factor in the incident.**

76 Although the class 377/5 is equipped with batteries to keep essential services running for a limited period when traction power is lost, it is necessary for the electrical load on the batteries to be reduced in order to preserve battery life (a process known as 'load-shedding') and to provide basic facilities such as limited lighting. The as-designed time limits for services once the train has entered load-shed mode are:

• emergency lighting	90 minutes
• driver to passenger communications (public address)	90 minutes
• passenger to driver communication (pass comm)	90 minutes
• toilets (electrical flush, etc.)	0 minutes
• driver-operated door-release	90 minutes
• cab secure radio (CSR)	90 minutes
• air conditioning	0 minutes
• internal CCTV system	90 minutes

77 Train 1W95 was heavily loaded, having already stood at St. Pancras station for 20 minutes while the driver attempted to remedy the problem. For part of that time, the train was without power, so the batteries were already starting to be depleted. The train systems restarted for 13 minutes when the train gained power from the front pantograph, prior to its departure from St. Pancras. Once the train had stopped again between St. Pancras and Kentish Town with no power, it automatically started to shed electrical load again. The air conditioning and the electrical operation of the flushing system in the toilets stopped functioning almost immediately. At around 19:10 hrs, the internal CCTV system and the public address system ceased to function, which meant that the driver could no longer speak to all passengers from the cab. The passenger communication system continued to function intermittently, which enabled the driver to speak to the passenger who had made the call and identify the area from which the call had been made on his in-cab display.

78 The toilet facilities quickly became unhygienic due to the number of passengers on board. Within 40 minutes of the air conditioning stopping, the driver had, in accordance with FCC procedure SMS 7.17 (paragraph 62), walked through the train to open the small emergency ventilation windows.

79 Witness evidence indicates that within 20 minutes of the air conditioning stopping the passengers were feeling ill effects as conditions within the train deteriorated. Passengers subsequently opened the first doors at around 18:57 hrs (31 minutes after the train stopped) to gain fresh air. These doors were closed by the driver when he walked through the train. The driver had advised passengers that the arrival of the rescue train was imminent (paragraph 38). As time progressed, the rescue train still did not arrive and there were no further announcements from the driver because the public address system had failed at 19:10 hrs. This increased the frustration of some passengers over the next hour and led to them re-opening doors to reduce the temperature and operating the passenger alarm buttons (around 90% of the alarm buttons were operated during the incident) in an attempt to gain information and understand what was causing the further delay.

80 Following an incident near Huntingdon in June 2005 when a train became stranded for two hours and on-board conditions became uncomfortable, RSSB commissioned research which considered the on-board environment on a stalled and heavily loaded class 377 train (T 626 – 'research into the management of passengers on trains stranded in high ambient temperatures').

81 The research concluded that in a stalled train in still air, without air conditioning, but with a limited number of open emergency windows, conditions become:

- uncomfortable within 40 to 50 minutes (ie any time from 19:05 hrs onwards in the incident on 26 May 2011); and
- intolerable within 70 to 90 minutes (ie any time from 19:35 hrs onwards in the incident on 26 May 2011).

82 The research predicted temperature ranges between 30ºC and 46ºC, dependent on variables such as time, ambient conditions and the number of passengers on the train. It also predicted that conditions for passengers would improve significantly if doors were opened, lowering temperatures and providing a tolerable environment for up to five hours. The same research predicted that opening the emergency windows would have an almost negligible effect.

83 The research and conclusions provided the basis for the Association of Train Operating Companies (ATOC) to produce guidance for train operators on the subject. FCC's policy for stranded trains (paragraph 62) incorporated the lessons learnt from the research and required drivers of stranded class 377/5 trains to:

- continually assess the conditions on board and prepare for immediate evacuation if it seems unlikely that alternative propulsion or power will be available within 30 minutes;
- open the front door to allow better air circulation;
- walk through the train and open ventilation windows;
- attempt to distribute passengers evenly throughout the coaches; and
- request that drinking water is supplied on any assisting train.

84 The driver had been told that an assisting train was on its way and he did not therefore prepare for the train to be evacuated. He did open the cab door and windows at the front of the train, but had to close them whenever he left the cab. He was unable to redistribute passengers because the train was heavily loaded throughout. Drinking water was provided on the assisting train.

The absence of door screens on class 377 units

85 **Unlike class 319 units which are used on the majority of Thameslink services, the class 377/5 units were not equipped with screens to allow doors to be opened without compromising passenger safety. This was a possible casual factor in the incident.**

86 In the light of operating experience on the Thameslink route, changes have been made to the class 319 units to improve facilities for passengers during incidents when trains have lost power. One specific incident occurred on 10 January 2002, also in the vicinity of Dock Junction. The driver of a northbound train lost power because of problems with the overhead power supply, and stopped. The driver issued snap lights (disposable tubes that glow when snapped) to the passengers, and looked after their welfare to the best of his abilities. About three hours after the train had stopped, the evacuation commenced, with passengers being escorted in groups of ten to Kings Cross Thameslink station (now closed). The evacuation was completed within four hours with no injuries being reported.

87 Following this incident, a formal investigation was completed by Railtrack and a number of recommendations were made including the provision of door screens (figure 13) to enable some doors to be opened without compromising passenger safety.

Figure 13: Emergency door screen equipment (images courtesy of FCC and Southern Railways)

88 In 2002, there was a proposal to introduce dual-voltage class 377/2 units into operation on Thameslink services. At that stage, a route compatibility assessment was completed by the Southern train operating company, the purpose of which was to ensure that the class 377/2 was suitable for use on the new route over which it was to operate. It was identified that, as with the class 319 units, the class 377/2 units would need to be equipped with door screens.

89 The plan to introduce the class 377/2 units onto Thameslink services did not come to fruition. When the proposal to introduce class 377 units to Thameslink services was resurrected in 2007, it was considered by FCC and Network Rail that there was no requirement for route compatibility to be addressed again because the class 377/5 units that would now be used were, to all intents and purposes, the same as the class 377/2 units. When planning the introduction of the class 377/5 units, there was no review of the lessons learnt during planning for the use of class 377/2 units in 2002, and the requirement for door screens was therefore overlooked.

90 Another opportunity to supply door screens was missed at a later date. In preparation for the introduction of class 377/5 units to Thameslink services, FCC's driver assessors and training staff had completed their training on the units at Southern Railway where the use of door screens was briefed by the Southern training staff. Southern had also produced a class 377/5 hot weather contingency training manual which deals with these issues. FCC subsequently completed a risk assessment for the process of conversion training for its drivers on class 377/5 units, using the Southern training manuals as a template to produce an FCC manual. Although both the training and documentation referred to the use of door screens, FCC did not provide them on the new trains.

91 Had door screens been available it would have made it less likely that passengers would have resorted to opening doors or evacuating from the train.

Communication with passengers

92 Only limited information was provided to the passengers on train 1W95 during the first 45 minutes of the incident, and no information was provided after that time. This was a causal factor in the incident.

93 When train 1W95 failed in the vicinity of Dock Junction and the driver decided that he would not be able to rectify the fault alone, he immediately advised passengers that he had requested assistance and he would update them when further information was available. Shortly before 19:00 hrs he advised passengers that a rescue train was now on its way. No other general announcements were made to all passengers after 19:10 hrs because of the non-availability of the public address system. When the driver had walked down the train opening windows, he had been subject to comments from angry passengers who had become frustrated by the length of the delay. This led to the driver feeling increasingly beleaguered, so he remained in his cab (from where he was unable to speak to passengers) after the first hour had elapsed.

94 The class 319 units that had operated most services on Thameslink routes before the introduction of the class 377/5 units were equipped with an auxiliary battery button which allowed drivers to continue to use the public address system when power had been lost. The class 377/5 units were not equipped with such a button, but it was established after the incident on 26 May 2011 that drivers can obtain power for the public address system for up to five discrete periods of around seven minutes each by re-setting the auxiliaries. However, FCC was unaware of this (the seven minute cycle is mentioned in FCC training material but does not specifically mention that it will enable the public address system to be used) and its use had not therefore been briefed to drivers.

Figure 14: Auxiliary battery button on the class 319 train

95 However, even if the driver had been able to communicate with passengers, he would have had only limited information for them. The signaller and FCC controllers did not initially know why the assisting train was being delayed and the driver of train 1W95 could only have indicated to passengers that there was a delay without being able to explain why or its likely duration.

96 FCC's customer services staff had been receiving messages from passengers stranded on train 1W95 via its social media site (Twitter) and by telephone and were responding to passengers on the train. However, information supplied by passengers relating to the conditions on the train was not properly evaluated and brought to the attention of those making decisions (signaller and FCC controller) and therefore this information was not acted upon (paragraph 183).

97 When the assisting train was coupled at 20:20 hrs, the driver of the combined train was unable to speak to all passengers as the public address system (and the air conditioning) was still not working on the failed portion of the train. This was a critical factor in passengers continuing to open doors and, eventually, some of them getting out of the train. Once the assisting train had coupled to train 1W95 at 20:20 hrs, a further 50 minutes elapsed before the train moved into Kentish Town station. Passengers had been led to believe that they would move into Kentish Town soon after the assisting train arrived. The fact that it did not happen quickly led to a further loss of confidence among passengers.

98 By the time that the driver of train 1W95 had completed the coupling of the assisting train, he was being assisted by a mobile operations manager and an OHLE engineer from Network Rail and a fitter from FCC. They had specific tasks to undertake in relation to resolving problems with open doors (described in more detail in the following section) and the nature of their communication with passengers was largely in connection with the need to close doors.

99 Such was the mood among passengers that doors were being re-opened as soon as the staff had returned to the front of the train. In turn, this resulted in further warning messages on the train management system display screen in the driving cab. This further delayed the movement of the train and increased the frustration of passengers, resulting in some of them leaving the train. Notices above the doors advise passengers to stay calm and not to leave the train unless instructed to do so, but there is also text and pictograms showing them how to evacuate themselves to track level (figure 15).

Figure 15: Guidance and passenger evacuation notices and pictograms above the train door

Movement of train 1W95 with doors open

100 **The driver of train 1W95 moved the train with some doors open because he had been informed that train doors were closed and his in-cab display could not be relied upon to establish the exact status of doors because it had been affected by the loss of power. This was a causal factor in the incident.**

101 Once the assisting train had coupled to train 1W95, the computer systems on both trains needed to be reconfigured to recognise the modified formation and to ensure that other systems on the train were properly connected in a way that enabled it to be operated safely from the leading cab.

102 After the coupling, the train management system recognised that the train was now configured in a 12-car formation, but as the passenger alarm activations had been present and not reset on the failed portion when the train lost power, the data from the rear eight coaches of the train (the failed part) did not correctly update the system on the assisting train. This is an inherent feature of the class 377/5 unit, which was subsequently reproduced in simulations by the RAIB, Bombardier and FCC.

103 The driver's train management screen shows the status of doors on a pictogram (figure 16) of the coaches, which is coloured:

- blue when the doors are closed;
- red when the doors are open; and
- yellow when the door is showing a fault, with warning symbols provided in the event of an alarm.

Figure 16: Image showing (yellow) door fault indication on the driver's in-cab display

104 The driver's display screen showed the status of all doors on the rear eight coaches as 'door fault' (yellow). This meant that the status of the doors was unknown; it did not necessarily mean that they were open.

105 The door fault indication is interlocked with the train's traction power system, which meant that the driver would not be able to take power (to move the train) unless the fault could either be resolved or overridden. As the status of the doors on the failed portion of the train was unknown the mobile operations manager, OHLE engineer and the fitter were dispatched to check the doors and close them as necessary (paragraph 98), but the fault indication persisted.

106 The mobile operations manager and fitter returned to the leading cab and informed the driver that all of the doors were closed but alarms had been reactivated. The driver advised them that he had also seen the reactivations take place on his in-cab display. He therefore considered that the only way he could overcome the problem was to bypass the door interlock that was preventing him from taking traction power. This could be achieved by operation of the traction isolation switch in the driving cab.

107 The driver consulted with the signaller, FCC controller and the fitter regarding the proposal to operate the traction isolation switch. As the procedure entails overriding one of the train's safety systems, its use is strictly governed by rules, in this case described in the railway rule book, module TW5 (Sections 2.10 and 33.3), 'Preparation and movement of trains, defective or isolated vehicles and on-train equipment'.

108 Sections 4 and 5 of rule book module TW2, 'Preparation and movement of multiple-unit passenger trains' also contain procedures to be followed when the driver cannot obtain the door interlock light, with a cross reference to section 2.10 in module TW5.

109 Module TW5 states that, when a defect has occurred on a train, the driver must advise the signaller and the train operator of the situation. The train operator will decide upon the course of action in line with its contingency plans, and advise the signaller of the action to be taken by the driver on the defective train. The driver will carry out the instructions given by the signaller to rectify the situation. The driver is required to comply with the relevant section pertaining to the defective equipment. Section 33.3 of module TW5 describes the circumstances under which the traction isolation switch can be operated:

- when the driver cannot obtain traction power;
- when the driver has carried out the laid down fault-finding procedures; and
- when the driver has completed all necessary door checks as described in module TW2.

110 The same section of the rule book module describes the isolation procedure. The driver is required to:

- tell the signaller;
- not move the train until instructed to do so;
- make an appropriate entry in the train repair book;
- tell the guard (not applicable to driver-only operated trains); and
- carry out the instructions given.

111 The driver considered that these conditions had been met and requested authority to isolate the traction switch. The FCC controllers who had been managing and monitoring the situation were aware of the circumstances on board train 1W95 and agreed with the driver's decision to operate the traction isolation switch.

112 The driver was required by the rule book (section 33.5 of module TW5) to check that all train doors were securely closed before moving the train. As the OHLE engineer and fitter had reported that they had checked (and closed, as necessary) all the doors on the failed portion of the train, the driver had some assurance that this had been done. Given the repeated re-opening of doors that had been occurring in the previous two hours, the driver could not be absolutely certain that all doors were closed. His options for confirming the status of the doors were to:

- physically check the doors himself (this would lead to further delay and would provide no guarantee that they would remain closed once he returned to the driving cab);

- request police or other staff to assist (resulting in further delay until they arrived); or
- allocate competent persons to ensure the doors were not re-opened (there were not enough people to enable each coach to be staffed, let alone each door).

113 None of these actions were taken before the train moved into Kentish Town. The driver, who had himself been affected by the experiences of the previous three hours, considered that he had done everything possible to resolve the problem. He did not want to create further delay and unnecessary risk for passengers by requesting assistance at this late stage.

Incident management

114 **FCC's policy for handling incidents involving stranded trains was not applied. This was a causal factor.**

FCC's policy

115 FCC's policy for dealing with stranded trains (paragraph 62) outlines key milestones to assist staff involved in managing incidents. The policy requires that 30 to 60 minutes after an incident occurs, the driver, signaller and duty control manager need to be in regular contact to share the following information:

- ongoing assessment of the situation and the conditions on board the train;
- the planned evacuation method and the projected timescales (accelerated in the presence of extreme hot or cold temperatures);
- the status of additional support en-route to the train;
- the appointment of a *Train Operators Liaison Officer* where the delay is likely to exceed one hour;
- the plan for onward arrangements for passengers especially if evacuation is to the track;
- the need to deploy customer response teams to greet passengers at the place of safety; and
- the presence of other rail industry personnel or suitable personnel to assist.

116 FCC's policy identifies that prolonging a decision to evacuate a train could result in worsening environmental conditions and serious medical problems. It also states that where passengers resort to 'uncontrolled' evacuation, there is a risk of serious and even fatal injury. The policy stipulates that as an absolute minimum, actions to detrain passengers by the best and safest method must be considered and must have commenced within 90 minutes of a train being stranded, although an earlier evacuation may be necessary, depending on conditions on the train.

The decisions taken

117 FCC operates a three-line on-call response system with first and second on-call staff being junior to the manager who is at third line on-call. The managers rostered as first and second line on-call were not contacted when the incident commenced, as the third line on-call manager was contacted at Kings Cross signal box when train 1W95 initially experienced problems on the approach to St. Pancras. He considered the incident to be a 'routine' performance issue and left with the incident apparently resolved and the train about to depart from St. Pancras to Kentish Town where it would be terminated. Following his departure, no senior managers were available to manage the incident (paragraphs 131 to 141) from a position where they could monitor developments. Decision-making was undertaken in a fragmented manner and at a relatively junior level.

118 Although it became apparent that the rescue of train 1W95 was going to take some time, nobody within the FCC control room proposed deploying the on-call staff to the train to assist the driver in managing the passengers. FCC mistakenly thought that Network Rail had sent a mobile operations manager to the train at an early stage in the incident, but even if one had been present, liaison with passengers would not have been his or her primary duty. FCC had not identified the need to deploy another manager to support the train driver and assist in passenger welfare. This was due to the 'vacuum' that had been created by the third line on-call manager's belief that the matter had been resolved, the first and second line on-call managers not being contacted and the FCC controllers' perception that the arrival of the assisting train was always 'imminent'.

Communications between Network Rail and FCC

119 The management of the incident was impeded by limited lines of communication. From the outset, Network Rail's route control in Derby had no involvement in handling the incident; this role was taken by the signaller who had the advantage of being co-located with FCC's controllers at West Hampstead. The primary line of communication for the driver of train 1W95 was to the signaller. There was no clear focus for the driver's communication with his own company. There were three different departments within FCC that might have provided useful lines of communication to the driver:

- the controllers at West Hampstead, for train operation matters;
- train crew supervisors, for matters relating to driving duties and changes that might result from the incident; and
- fleet technicians at Cauldwell depot, for technical matters in relation to the train.

120 Although the FCC controllers wanted to contact the driver at various times during the incident, they had no means of doing so as they did not have the driver's mobile telephone details. Even if the controllers had wanted to assume strategic control of the incident, they would have had difficulty doing so because of their inability to talk directly to the driver of the train (figure 17).

121 When the signaller took the decision to evacuate train 1W95 at 19:47 hrs (paragraph 38), nobody in FCC was aware that he had taken such a decision, even though FCC would have had a key role in managing such an evacuation.

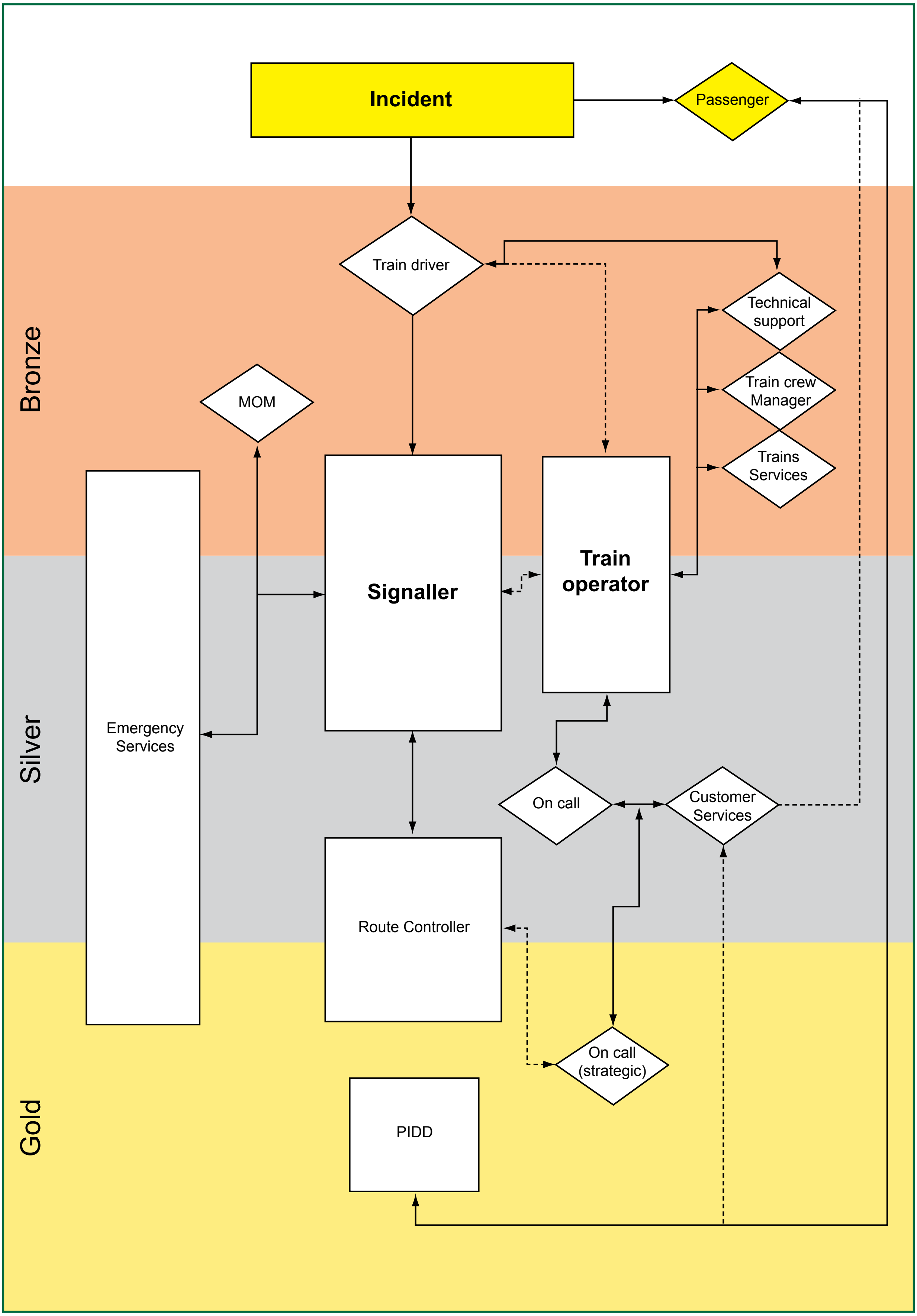

Figure 17: Stakeholders involved in the incident and operational (Bronze), tactical (Silver) and strategic (Gold) roles

122 The process applied following the driver's request to operate the traction isolation switch (paragraphs 107 and 111) was in accordance with the rule book. However, the FCC controllers had not been assessed with regard to their competence in that part of the rule book and they, together with the signaller, were unsure as to who could authorise the operation of the traction isolation switch. FCC's controllers saw their role to be one of supporting the signaller, rather than working in partnership to develop strategy and set milestones. This resulted in information not being shared or communicated effectively (paragraph 121) and different strategies being formulated.

Emergency preparedness

123 Joint tabletop exercises involving FCC (or the previous train operator), Network Rail and the British Transport Police had not taken place focused on an incident within the Thameslink 'core' section since 1999. Had such an exercise taken place, it may have resulted in a better mutual understanding of the policies of the different organisations and highlighted deficiencies and contradictions relevant to the circumstances of the incident on 26 May 2011, such as:

- no support in the form of a train manager or mobile operations manager being sent to the train;
- the driver of train 1W95 and the signaller not coming to a clear understanding about conditions on the train and nobody monitoring those conditions as the incident developed;
- the driver and signaller not arranging for the tunnel lights to be switched on, and the potential effect of this on passengers;
- non-communication to FCC of the signaller's decision to evacuate the train;
- communication between all parties in relation to the delays that were incurring at Cricklewood depot while the assisting train was split;
- non-communication to FCC controllers of information received by FCC customer services from passengers on the train; and
- non-provision of site support information to British Transport Police and London Ambulance Service as the incident developed.

124 Joint protocols on managing incidents had been discussed but no document had been issued prior to the incident taking place. This is discussed further at paragraph 152.

Good practice from elsewhere

125 During the course of the investigation, the RAIB met with London Underground and with train operators and Network Rail route controllers covering the Wessex, Sussex and East Coast routes in order to understand how previous incidents were managed and to identify good practice. The exercise showed that:

- There is no consistent approach across the national rail network to the management of incidents involving trains becoming stranded for long periods. Although good practice has been identified in some routes, it has not been adopted elsewhere or even shared widely.

- There is an increasing recognition in the main-line railway industry of the importance of identifying key milestones for defined actions and sticking rigorously to them. Milestones should not be ignored or deferred just because a preferred solution is believed to be 'just around the corner'.
- Early and effective communication with passengers on stranded trains is imperative if there is to be any chance of managing passengers' behaviour. This means that drivers need to be aware of planned actions. London Underground's train operators inform passengers of the reason for short delays to trains (eg waiting at a red signal or regulating the train service) and provide assurance that the train will move shortly.
- London Underground has identified and implemented an approach to managing stalled trains that is predicated on the need for rapid decision-making and effective action during the early stages of an incident. With trains operating on two-minute headways, a number of heavily-loaded trains can rapidly become affected by the immobilisation of a single train and there needs to be a clear strategy for taking control of such a situation.

Identification of underlying factors[7]

Lack of assistance to the driver on site

126 **The driver of train 1W95 was not given adequate support during the incident which affected his ability to manage the conditions on board the train. This was an underlying factor in the incident.**

127 Until the arrival of the assisting train almost two hours after train 1W95 stopped, FCC provided no practical support on site to the driver (such as a Train Operator's Liaison Officer or customer services staff). Evidence shows that this was largely due to FCC not contacting its first and second line on-call managers because its third line on-call manager was already aware of the situation (paragraph 117).

128 The driver of train 1W95 was left on his own to deal with a multitude of tasks including:

- opening the windows on the train to maintain limited ventilation and to try to improve conditions for the passengers;
- dealing with passenger alarm and door alarm activations and resetting the alarms; and
- liaising with the signaller to understand what steps were being taken to rescue his train.

129 Even when the assisting train arrived, the driver of train 1W95 was still required to take responsibility for coupling the two trains and preparing them for movement into Kentish Town station, because the driver of the assisting train was incapacitated as a result of a hand injury (paragraph 73).

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

130 Lack of communication was one of the fundamental reasons why some passengers continued to operate alarms, open doors and leave the train (paragraphs 92 to 99). Evidence shows that the driver became overwhelmed as the incident progressed, and this almost certainly affected the nature and extent of his communications with FCC depot staff and the signaller on the origin of the fault, and with passengers on board the train about the steps being taken to rescue them. Had the driver been provided with assistance on site, it is likely that communications, particularly with passengers, would have been significantly improved. There would also have been more people to monitor the status of doors in the period immediately before the train moved into Kentish Town.

Briefing of safety related policy

131 **FCC had not briefed its policy on stranded trains to all key staff prior to the incident. This was an underlying factor.**

132 FCC's controllers on duty at the time of the incident were not aware of FCC's policy on stranded trains (SMS 7.17) and were managing the incident using their experience. Witness evidence shows that members of control room and on-call staff were expected to view new documents on the company intranet, but this had resulted in staff not being aware that SMS 7.17 had only recently been made available. Furthermore, as controllers had not been briefed in the provisions of SMS 7.17 they were not aware of the 'milestones' that FCC had defined as part of the process of managing an incident.

133 FCC had not identified that training programmes had not been completed and policies had not been effectively briefed to key staff. FCC did not have a process in place to audit the effectiveness of arrangements for briefing of key staff on the documents relevant to their role. Had the method used to brief staff been effective it should have prompted FCC's controllers to develop a strategy for managing the incident and to take decisive action when it became apparent that the arrival of the assisting train was being delayed. The briefing of the policy would have also provided the controllers with an awareness of the locations of key equipment (emergency couplers and transboardment bridges) and its proximity to the incident so that other options for rescuing passengers could have been pursued.

Competence and assessment of staff

134 **FCC's competence management regime did not equip staff involved in the incident with the skills to perform some of the necessary key tasks. This was an underlying factor in the incident.**

Train drivers

135 The first class 377/5 units were delivered to Cauldwell depot in February 2009. Only three units were delivered initially; delivery of the remaining 20 units was staggered and this affected FCC's training programme prior to all class 377/5 trains being delivered in February 2010.

136 Although the driver of train 1W95 had completed his conversion training in 2010 and was deemed competent to operate class 377/5 trains, a driver manager had not reassessed him since November 2009. FCC policy requires reassessment every six months. The staggered introduction of the class 377/5 trains had affected the initial conversion training and drivers had received little or no training in fault-finding and resolution. The RAIB considers that this left them ill-prepared in the use of the train management system for fault-finding. The driver of train 1W95 was unable to identify the fault on his train using the train management system, and when the train stopped at Dock Junction, he isolated the front pantograph when the rear pantograph was actually the origin of the fault.

137 In addition, the driver of train 1W95 was unaware of a technique that he could have used to gain power for the use of the public address system while the train was stalled without power (paragraph 94).

138 The driver of the assisting train had also completed a conversion course for class 377/5 trains, but she did not have regular opportunities to practise coupling and uncoupling the units. This resulted in the driver's lack of confidence in performing the uncoupling task under pressure at Cricklewood depot and may also have been a factor in the injury she sustained (paragraph 73).

139 An audit undertaken by FCC following the incident found that the company had been unable to keep to its programme for driver reassessment following completion of class 377/5 conversion courses. This was because only a small number of the driver managers themselves had the required competence to undertake such assessments and a number of managers had either resigned or moved to another post. This factor, in addition to a concern regarding the management of training records, had been identified during an inspection of FCC's driver management arrangements by the Office of Rail Regulation (ORR) in September 2010. FCC undertook to ensure that there were sufficient resources available for the driver's competence to be reassessed, but the circumstances of this incident suggest that little improvement had been made by May 2011.

On-call managers

140 FCC's policy on stranded trains (paragraph 62) outlines the competence requirements for on-call staff. The policy states that:

- periodic briefings and attendance at table top exercises will be utilised to update staff on the latest procedures and good practice for dealing with train evacuations; and
- incidents involving passenger action, evacuation time scales, National Control and Train Operators Control logs, Train Operators Liaison Officer's Logs and Significant Performance Incident Reviews (SPIR) should be used to identify good practice for on-call managers.

141 Although no on-call staff were mobilised during the incident the investigation identified that on-call staff had little or no mentoring to prepare them for on-call duties, and managers had received little ongoing development in incident management and personal development. The third line manager was relatively inexperienced in his on-call duties. He was unaware that FCC's policy on stranded trains had been issued a week before the incident.

FCC Controllers

142 FCC's controllers were unaware of the company's stranded trains policy (paragraph 132), and training sessions which included this policy had not been completed. The controllers' understanding was that evacuating trains was a last resort and they did not consider this as a viable option. FCC's policy on stranded trains actually states that train evacuation should be considered after 60 minutes and must be commenced after 90 minutes.

143 FCC's train service manager was aware that the stranded trains policy had been published, but had not had time to read the document before the incident and was not in a position to provide advice and support to the FCC controllers. The lack of any briefing had affected the controllers' ability to competently manage the incident in accordance with FCC's own policy which outlined the actions to be taken and milestones to be used when an incident involving a stranded train occurred (paragraph 65). Had all key staff been made aware of the policy for dealing with stranded trains, it is likely that the lines of communication and the management and recovery of the train would have been more effective.

FCC depot

144 As a result of the staggered implementation of the class 377/5 trains, FCC depot staff had not had the opportunity to resolve the issue relating to the software compatibility of coupling two 8-car class 377 trains (the potential problem had initially been identified by another train operator in 2005). Software upgrades and lessons learnt from previous incidents had afforded FCC and depot staff the opportunity to resolve the issue, but no action had been taken. This meant that FCC depot staff did not give the correct advice to FCC controllers when required to do so during the incident.

145 The shunter employed at Cricklewood depot was not competent in coupling / uncoupling class 377/5 trains as this was normally undertaken by train drivers. As the assisting train was being left outside his area of responsibility (on the goods line rather than in the depot), he did not feel he was competent or in a position to assist the train driver until he was instructed to do so (paragraph 73).

Lessons from previous incidents

Previous relevant incidents

146 **Between 2009 and 2011, FCC had investigated a number of incidents involving trains becoming stranded for extended periods of time, but had not implemented measures to improve its handling of such incidents. This was an underlying factor.**

147 Thameslink services have experienced a number of incidents involving trains becoming stranded over extended periods. The incident in Kings Cross tunnel on 10 January 2002 is referred to in paragraphs 86 and 87 of this report. The key features of some of the incidents occurring from 2009 onwards and the recommendations made are described in the following paragraphs.

148 In April 2009, an engine in the rear power car of a train travelling between Nottingham and London (not operated by FCC) caught fire at Leagrave. The fire caused the failure of the OHLE system and significant disruption to FCC's services which were dependent on it. FCC undertook a review of the incident, with the following lessons identified:

- FCC to adopt a 60 minute 'code red' practice for evacuating stranded trains. *This was later included within FCC procedures, but not implemented during the Kentish Town incident.*
- FCC to look at the ability to cool down class 377/5 trains when stranded. *No further action was taken due to the designated manager leaving the company.*

149 In October 2010, a Kings Cross to Cambridge train operated by FCC suffered a fault in its power collection equipment and stopped between Foxton and Shepreth at 16:44 hrs. The train was unable to collect power from the OHLE system and conditions on the train deteriorated rapidly when load-shedding occurred.

150 There were 375 passengers on the stranded train. After it had been stationary for 60 minutes, some passengers self-evacuated from the train. The first train sent to rescue the passengers still had its passengers on board and could only take around 100 people from the stranded train. Three disabled passengers and a heavily pregnant lady remained on the stranded train along with the other passengers until another empty train could be provided (equipped with a ramp). All passengers were detrained by 20:20 hrs.

151 Lessons from FCC's review included:

- FCC on-call staff to be invited to join Network Rail conferences to ensure all parties are aware of the latest situation and recovery;
- FCC should adopt an 'evacuation from train' plan which sets out milestones to detrain a stranded train within an hour, and this should contain guidelines on numbers of personnel required to safely detrain 4-, 8- and 12-car trains; and
- the process for activating the FCC Customer Action Team requires review to ensure that it is in place and can be called upon reliably if required.

152 An internal debrief was organised and chaired by the Route Operations Manager in November 2010. Representatives from FCC customer service, fleet, operations standards and driver management departments and the British Transport Police (BTP) attended. The meeting discussed the issues arising from the train evacuation including those relating to customer service. FCC began to formulate its stranded train policy which was agreed in January 2011 and also discussed a joint protocol with Network Rail (East Midlands route). However there is no evidence that the issues raised during this review had been dealt with by FCC by the time of the incident at Kentish Town.

153 In November 2010, a FCC train travelling from Bedford to Brighton stopped while climbing the steep gradient at Farringdon as a result of the driver not cancelling a warning from the *Automatic Warning System*. The driver was then unable to move the train for 51 minutes.

154 FCC and Network Rail undertook a review of the incident. Lessons learnt related to:

- The competence of FCC drivers in managing faults on class 377/5 units. *This was still an issue at the time of the Kentish Town incident.*
- Addressing problems in software compatibility of class 377/5 trains when resetting the pantograph, and its potential effect on the 12-car formations that were to be introduced in December 2011. *There was still uncertainty in this area at the time of the Kentish Town incident (paragraph 64).*
- A review and updating of the train drivers' fault finding guide for class 377/5 units. *This had not been completed by FCC at the time of the Kentish Town incident.*

155 In January 2011, the driver of a Brighton to Bedford train formed of two class 377/5 units reported that while in the Mill Hill area he was unable to take power. The initial plan was to attempt to take the train to Elstree station and commence fault-finding, but the unit then failed, causing a two hour delay.

156 The relevant lessons that were learnt from the review conducted by FCC were:

- snap lights were not provided on class 377/5 units;
- the driver's public address announcements varied in quality and quantity;
- revenue staff removed themselves from public view due to the amount of verbal abuse and the number of complaints they received;
- not all levels of on-call managers (operations and customer services) were notified about the incident; and
- there was currently no defined process within FCC to escalate incidents sufficiently to achieve the correct level of response.

157 The relevant recommendations were;

- to fit class 377/5 units with emergency light sticks;
- to review the quantity / quality of driver public address announcements;
- on-call requirements within FCC to be made clearer when requests for action are made;
- methodology to be devised to provide a facility to escalate incidents;
- a discussion to be held with Bombardier (the manufacturers of the class 377) to establish whether the class 377/5 units behaved as expected when in degraded mode;
- a conference call facility to be developed to facilitate communication between train drivers, FCC Control, Cauldwell depot and Network Rail;
- assistance to be provided to drivers of trapped trains; a process needs to be developed and include how to alert staff and then get them to site; and
- an overview of major events should be carried out by third line on-call managers, including the initiation and chairing of conference calls.

158 At the time of the incident on 26 May 2011, FCC's stranded trains policy had just been published, but few actions had been taken in response to the lessons learnt. If appropriate action had been taken, it might have helped in the management of the incident and expedited its resolution. The report into this incident also noted that a number of outstanding actions from other investigations into incidents involving faults with class 377/5 units had still not been closed out.

159 In March 2011 an 8-car class 377/5 train with approximately 500 passengers on board struck an object on the overhead line in Elstree tunnel, which disabled the train at 00:23 hrs. Passengers were assisted from the failed train to the adjacent line and walked to a rescue train where a ladder was used to help them board. The evacuation took approximately 80 minutes with some delay incurred assisting a small number of mobility-impaired passengers. All passengers were evacuated by 03:38 hrs.

160 The relevant lessons that were learnt from the review into this incident were:

- there were no announcements made by the driver to try to enlist help; drivers' training needs to be reviewed;
- an evacuation transboardment bridge to move the passengers from one train to the other would have been a better means of evacuation;
- Network Rail to train mobile operations managers to deploy evacuation ramps and carry ramps on their vehicles;
- FCC had no clear process to deal with evacuation; an evacuation checklist was to be drawn up for FCC Control staff;
- first line on-call staff were not advised - FCC controllers should be briefed that for any major incident, first line on-call staff should be called; and
- FCC controllers were not clear on what was happening during the incident - FCC should brief all drivers on the importance of contacting controllers to advise them of developments.

161 By the time of the Kentish Town incident, there was little evidence that action was being taken by FCC to address the majority of the recommendations made.

162 Two principal reasons were identified for a number of actions and recommendations not being reviewed, audited, implemented, closed out and / or briefed to other staff by the time of the incident at Kentish Town:

- FCC's database for tracking actions and recommendations arising from investigations was not used by all FCC departments; and
- there was inadequate handover when employees to whom actions had been assigned either left the company or changed roles within the company.

Safety learning from incidents

163 **Although safety lessons are sometimes identified from the industry's review of incidents which are deemed to be only relevant to performance, there is no process in place to convert those lessons into actions and track them through to conclusion. Relevant safety lessons had been identified in performance-focused reviews on a number of occasions before the incident at Kentish Town on 26 May 2011, but no action had been taken. This was an underlying factor.**

164 The railway industry's national database for the recording of safety related events that occur on the main line rail network, the Safety Management Information System (SMIS), was developed in 1997. It is managed by RSSB and its use is mandatory for Network Rail and train operators.

165 Network Rail's company standards NR/L3/RMVP/047 'Train Operations Manual', and NR/L3/OCS/041 'Operations Manual' outline responsibilities for the reporting of defects and safety related matters.

166 The type of industry investigation carried out into an event will depend on the nature and severity of the incident. The options are:

- a formal investigation led by Network Rail with participation from other involved parties; or
- a local investigation led by Network Rail or the train operator;

167 The findings of such investigations are required to be logged onto SMIS. SMIS also contains details of safety-related incidents that are not investigated. The collection of safety related data and sharing of intelligence assists the industry in analysing risk, predicting trends and generating specific projects and research with the aim of improving safety.

168 In addition to formal and local investigations, Network Rail and / or train operators conduct Significant Performance Incident Reviews (SPIR) for incidents where the total consequential delay to trains passes a threshold of 1000 minutes or where performance lessons can be learnt. Although SPIR reviews are intended to focus on performance issues and possible financial implications arising from incidents, they also seek to identify root causes and all factors contributing to incidents and consider measures to prevent a recurrence (figure 18).

169 The nature of the incident will determine whether the SPIR process is led by Network Rail or the train operator who will then manage the process and record, on its bespoke database, actions that have been generated and implemented.

170 The members of staff who attend SPIR meetings are drawn from a variety of roles and skill levels and evidence shows that valuable safety learning does result from such meetings, but the information which is generated is not shared across the rail industry. The process requires SPIR groups to report their findings to the Area or Route Managers and to update:

- the route database for discussion at a safety recommendations review panel; and / or
- Network Rail's national database of all SPIR reports, where they are reviewed by a national performance process specialist who can track actions.

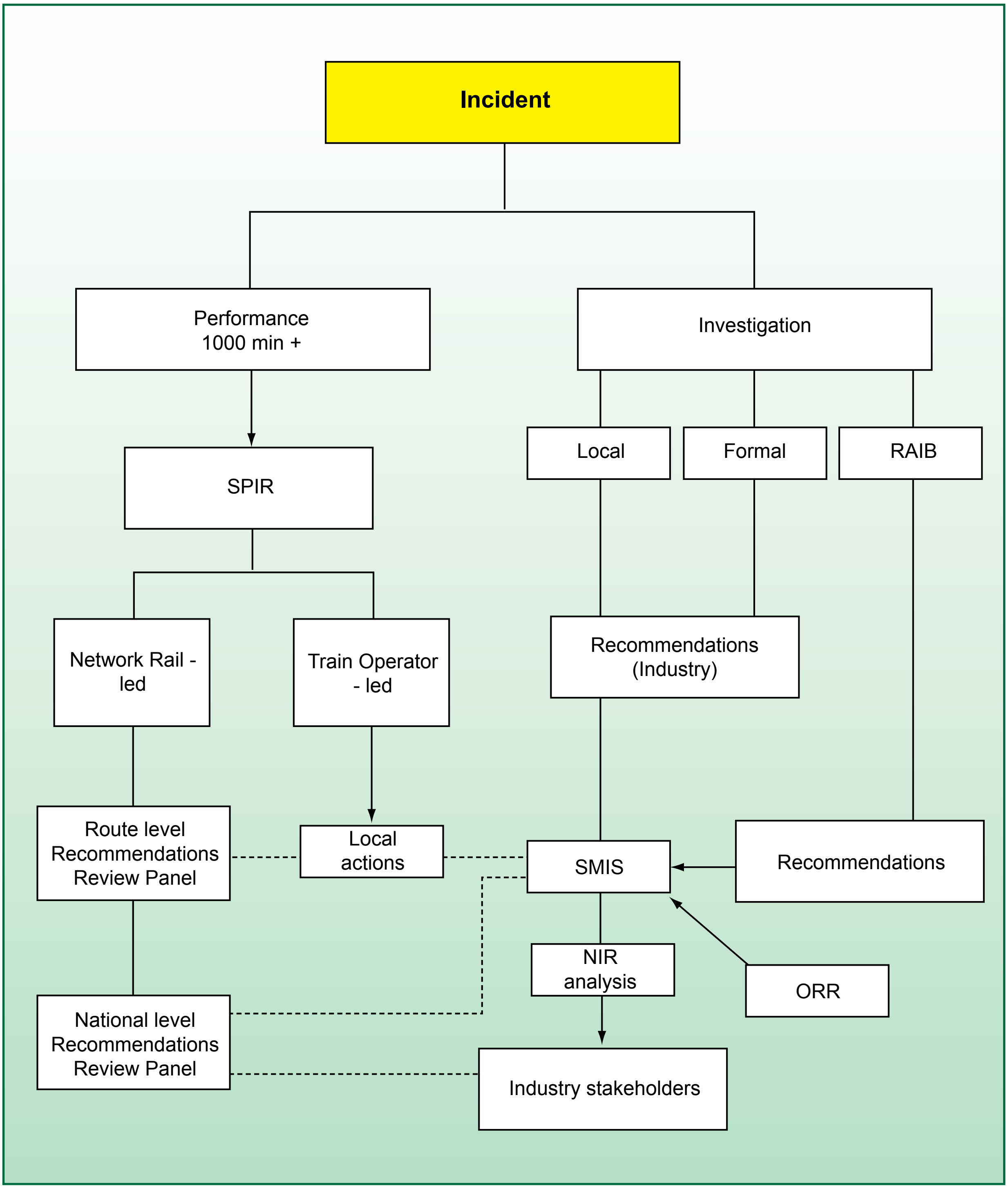

Figure 18: SPIR and SMIS process diagram

171 Although it is not prohibited, there is currently no requirement for SPIR reports to be input to SMIS. It is up to the individual route where the SPIR report was produced to decide whether a safety lesson has been identified and how to share the safety lesson with the railway industry or if the safety lesson is to be changed into a safety recommendation. The RAIB reviewed the SMIS and SPIR data relating to the incidents at Foxton, Leagrave, and Elstree where train evacuations had taken place and safety lessons had been identified. SMIS contained a summary of each incident, but no details of lessons learnt or recommendations made from such lessons. The Farringdon incident (2010) was not recorded on SMIS. There was no local investigation into the incidents and therefore no visible safety learning.

172 Network Rail had led the SPIR processes for Leagrave and Foxton (paragraphs 148 to 152) in partnership with the train operators. Actions arising from the lessons learnt were recorded by the local performance improvement team. Information given by the train operators provided evidence to Network Rail that the actions were completed and could be shown as closed. However, the incident at Kentish Town showed that some of the actions had not been fully implemented by FCC and actions shown on the Network Rail database were not identical to those shown on the SPIR reports.

173 Network Rail's local performance improvement team were not involved in the Farringdon or first Elstree incidents (paragraphs 153 to 158) as the SPIRs were led by FCC. The second Elstree incident (paragraphs 159 and 160) had involved the Network Rail Local Operations Manager but the incident was not recorded on Network Rail's database even though an action for a joint protocol (Network Rail and FCC) for dealing with stranded trains had been generated. Evidence shows that all of the incidents had safety lessons for other train operators and Network Rail.

174 Network Rail is not routinely invited to TOC-led SPIR meetings. While it is Network Rail's policy to engage with the relevant train operator whenever Network Rail leads a SPIR, evidence shows very little engagement actually occurs between the two parties.

175 The SPIR reports into recent incidents involving trains being delayed for significant periods referred to in paragraphs 148 to 160 show that valuable lessons were identified. Progress with implementing changes arising from the lessons identified might have been more effective if a process had existed for clearly identifying the action required and then monitoring that action through to completion.

176 Following an incident involving two trains being in the same section of railway at Aylesbury in August 2007[8], the RAIB recommended that RSSB should devise a means of disseminating to the industry safety lessons from incidents which are not so urgent as to require immediate notification.

177 In 2008 RSSB considered the recommendation within its 'Learning from Accidents' programme. Part of the programme involved the establishment of a rail industry internet-based web portal as a means of disseminating safety lessons.

[8] RAIB report 13/2008, available at www.raib.gov.uk.

178 RSSB later produced a proposal to create a magazine in which non-urgent safety notices would be published. A draft pilot issue was produced, which was assessed by the Learning from Operational Experience (LOE) cross-industry steering group. The group considered the proposed document and decided that there were already sufficient safety communications channels available from RSSB or external publishers (eg Red Alert, produced by Halcrow for the railway industry). The ORR and RSSB considered that these publications, together with an expanded online system to cover operational issues and non-urgent safety reports, were sufficient for the recommendation to be deemed implemented.

FCC's review of its management processes

179 **FCC's management processes had not identified weaknesses in its emergency preparedness. This was an underlying factor in the incident.**

180 Paragraphs 114 to 125 and 131 to 162 describe a number of deficiencies in relation to FCC's processes for managing incidents, briefing staff, managing competence and learning lessons from previous incidents. FCC had not identified the relevant deficiencies before the incident.

181 FCC did not have a systematic process in place to monitor and review the effectiveness of its policies in these key areas. The oversight was not identified by any of FCC's management processes.

Factors affecting the consequences of the incident

Social media networks

182 Effective, accurate and frequent communication is necessary to minimise the risk of passengers detraining when it is not safe to do so. A number of train companies have now established dedicated social media sites to assist passengers during times of disruption. However, the use of sites such as Twitter and Facebook for intelligence gathering, monitoring messages and as a means of communicating to passengers during these types of events has not been widely recognised by the rail industry. Evidence from different incidents involving severe delay in 2010 and 2011 shows that information from social media networks:

- was available to the train operators;
- provided useful intelligence which could have been acted upon or used to influence decision making during the incident (see appendix E); and
- had been communicated via social media sites between passengers and had influenced behaviour. In one incident this led directly to passengers leaving the train and putting themselves at risk from moving trains or electrocution (see appendix E).

183 During the incident on 26 May 2011 FCC was advised by telephone and via the Twitter / Facebook web sites that:

- passengers on train 1W95 had operated the passenger communication alarms;
- doors had been opened with passengers 'spilling out onto the track';
- information was not being received via the public address system;
- water was required on the train but none had been delivered;
- passengers could not communicate with the driver as he was now staying in his cab, and
- passengers were requesting assistance.

184 The use of social media by train operators may assist them in communicating with customers during times of severe service disruption, and contribute to a two-way exchange of information; thus reducing speculation. Train operators can consider the intelligence in the context of other known information to ensure a proper risk assessment and evaluation of the information takes place and suitable action is taken.

Factors associated with the response from the emergency services

185 British Transport Police and the London Ambulance Service attended Kentish Town station from 19:10 hrs onwards as a result of calls originating from passengers on the train and issues of crowding at Kentish Town. Both organisations requested information from FCC control and the signaller on:

- the number of passengers on board train 1W95;
- how long the train had been in the tunnel; and
- the train's estimated time of arrival at the station.

186 The signaller and FCC controllers could not provide information relating to passenger numbers as they had not requested the information from the train driver. They advised the police that the arrival of the assisting train was imminent at 19:20 hrs but it did not arrive at Kentish Town for another 45 minutes (paragraph 40). The absence of intelligence from the train meant that FCC controllers did not consider sending ambulance personnel to train 1W95 at an early stage as a precautionary measure. As time went on, senior managers from the police and ambulance service made requests for a senior manager from FCC to attend Kentish Town station, but this did not happen and the lack of updates was not challenged by any party.

Previous occurrences of a similar character

187 Over the course of a year, there are many incidents that involve significant delays to trains. Some events have circumstances that are similar to the incident at Kentish Town and lessons have been identified that are relevant to the incident at Kentish Town. Those involving Thameslink or FCC services are referred to in paragraphs 86 to 87 and 148 to 160 of this report.

188 Recent events involving long delays for passengers on stranded trains in other parts of the country are described in appendix E. These events have given rise to concern within the industry, and among passenger organisations, at the industry's ability to manage the potential consequences of stranded trains effectively. These concerns, in conjunction with the RAIB discussing the emerging lessons from this investigation with the industry, led to the setting up of a working party by ATOC, including representatives of Network Rail and the statutory passenger group London TravelWatch, to draft guidance for the industry (paragraph 199).

Summary of conclusions

Immediate cause

189 The driver moved train 1W95 when it was not safe to do so, with passengers standing in the vicinity of one or more sets of open doors (**paragraph 48**).

Causal factors

190 The causal factors were:

a. Despite the problems experienced on train 1W95 at St. Pancras, FCC allowed it to continue to Kentish Town with passengers on board, despite the risk that the train might fail (**paragraph 55, see paragraphs 196a and 201i, no recommendation**).

b. Foliage had become lodged around the rear pantograph of train 1W95 while the pantograph was not in use, which caused electrical tripping after the train left Farringdon with the pantograph raised and the subsequent immobilisation of the train at Dock Junction (**paragraph 50, no recommendation**).

c. FCC gave only limited consideration to a range of possible strategies for rescuing train 1W95 and its passengers and at an early stage focused solely on the use of an assisting train for moving train 1W95 and its passengers to Kentish Town (**paragraph 59, see paragraphs 196c, 196d, 198a and Recommendation 1**).

d. The arrival of the train provided to assist train 1W95 into Kentish Town was affected by a series of delays (**paragraph 69, Recommendation 1**).

e. The conditions for passengers within train 1W95 became increasingly uncomfortable as time wore on. In an attempt to make conditions more tolerable, some passengers opened doors and, later, some alighted from the train (**paragraph 75, see paragraphs 196d, 201b, 198i and Recommendation 2**).

f. Only limited information was provided to the passengers on train 1W95 during the first 45 minutes of the incident and no information was provided after that time (**paragraph 92, see paragraphs 196d, 201b 201h, 202 and Recommendation 1**).

g. The driver of train 1W95 moved the train with some doors open because he had been informed that train doors were closed and his in-cab display could not be relied upon to establish the exact status of doors because it had been affected by the loss of power (**paragraph 100, see paragraph 201a, no recommendation**).

h. FCC's policy for handling incidents involving stranded trains was not applied (**paragraph 114, see paragraphs 196, 201 202 and Recommendations 1 and 2**).

191 The following factor was possibly causal:

a. The class 377/5 units were not equipped with screens to allow doors to be opened without compromising passenger safety (**paragraph 85, see paragraph 201b, no recommendation**).

Underlying factors

192 The underlying factors were:

a. The driver of train 1W95 was not given adequate support during the incident, which affected his ability to manage the conditions on board the train (**paragraph 126, see paragraphs 196b, 198b, 201a, 201e, 201g and 202, no recommendation**).

b. FCC had not briefed its policy on stranded trains to all key staff prior to the incident (**paragraph 131, and see paragraphs 196d, 201d and Recommendation 2**).

c. FCC's competence management regime did not equip staff involved in the incident with the skills to perform some of the necessary key tasks (**paragraph 134, see paragraphs 196d, 197, 201a and Recommendation 2**).

d. Between 2009 and 2011, FCC had investigated a number of incidents involving trains becoming stranded for extended periods of time, but had not implemented measures to improve its handling of such incidents (**paragraphs 146, 179, see paragraphs 196e and 201f, no recommendation**).

e. Relevant safety lessons had been identified in performance-focused reviews on a number of occasions before the incident at Kentish Town on 26 May 2011, but no action had been taken (**paragraph 163, Recommendation 3**).

f. FCC's management had not identified or addressed deficiencies in the processes for emergency preparedness prior to the incident (**paragraph 179, see paragraphs 196f and 202 and Recommendation 2**).

Factors affecting the consequences of the incident

193 A factor that possibly affected the consequences of this incident was the availability and use of information from social networking sites by passengers as an input to their decisions to self-evacuate from the train (**paragraphs 182 to 184, see paragraph 201h and Recommendation 1**).

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

194 The ORR is currently undertaking an audit of train operators' emergency planning processes to identify good practice. The findings will be published in 2012.

195 In March 2011 ORR consulted the railway industry on a proposal to introduce new obligations into passenger and station licences and into Network Rail's network licence. The new obligations have been agreed and require the train operators and Network Rail to provide effective information to passengers to help them plan their journeys, particularly in times of disruption.

196 FCC has:

a. Reviewed its disruption management policy and emergency response procedures for trains that may be at risk of failure in the Thameslink core section (paragraph 190a).

b. Provided the driver of train 1W95 with a programme to assist him back to full driving duties (paragraph 192a).

c. Re-briefed staff on the availability and location of emergency couplers and the use and location of transboardment bridges (paragraph 190c).

d. Provided all train drivers and FCC controllers with a briefing on SMS 7.17 (paragraphs 190c, 190e, 190f, 192b and 192c).

e. Reviewed actions arising from previous SPIR reviews into the incidents at Foxton and Elstree Tunnel and identified outstanding issues (paragraph 192d).

f. Commenced a programme (the briefing of the revised standard and table top exercise by June 2012) to develop an overarching company standard policy statement that will ensure all FCC standards relating to emergency preparedness are reviewed and cross mapped with other standards. This will ensure that any amendment to a standard is reviewed against other standards to ensure its effect is known. The review process will include consultation with the end user to ensure the standard is not only adequate for controlling the risk, but that the control measures and training can be implemented in a practical and efficient manner (paragraph 192f).

197 FCC and Network Rail have organised annual desk top exercises to take place in order to share best practice (February 2012) (paragraphs 192c and 192e).

198 Network Rail has:

a. re-briefed its response staff who cover the Thameslink core section on the locations of key equipment such as emergency couplers and on emergency evacuation strategies (paragraph 190c); and

b. briefed Route control managers to consider the appointment of a Rail Incident Officer in all cases where they are requested to attend a train failure in the Thameslink core section (paragraph 192a).

199 Network Rail and the Association of Train Operating Companies have reviewed the lessons learnt from recent incidents involving stranded trains and jointly published a new guidance document, 'Meeting the needs of passengers when trains are stranded'. Amongst other things, the guidance suggests that train operators and Network Rail should develop joint protocols for handling stranded train incidents.

200 British Transport Police has set up a new department whose objective is to review current processes and where necessary revise or create procedures to enhance the police response which may minimise the delays incurred as a result of an incident and subsequent railway disruption.

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

201 FCC has:

a. Reviewed its competence assessment, training and briefing regime in the light of this incident and made changes to its processes to equip drivers with the necessary skills to deal with foreseeable failure modes, and for them to have the opportunity to practise all foreseeable operational duties such as coupling and uncoupling trains (paragraphs 190g, 188a and 188c).

b. Equipped its class 377/5 units with emergency door screens and light sticks, acquired additional transboardment bridges and briefed its drivers on a technique to obtain additional power for the passenger communication system on a temporary basis (paragraphs 190c, 190e and 191a).

c. Changed its on-call instructions so that an on-call manager is contacted for all incidents that may become protracted (paragraph 190h).

d. Reviewed its document control and briefing procedure to ensure all briefing documents / traction notices / updated procedures have an audit trail allowing managers to incorporate the items within their briefing and all staff to be aware of current procedures (paragraph 190h).

e. Produced, with Network Rail, a specific Thameslink 'core' route response and communication document to assist signallers, controllers, train drivers, response staff and station staff in the management of rolling stock incidents through the 'core' section (paragraphs 190h and 188a).

f. Reviewed and amended its procedures for SPIR exercises so that when necessary all parties are invited to participate in the review. The outcomes from SPIR exercises are now included on a bespoke tracker database to ensure all safety lessons are identified, captured, reviewed, monitored and completed (paragraph 192d).

g. Introduced enhancements and additional resources that provide technical support to drivers of stranded trains, with a particular focus on the means of communicating and the need to coordinate the technical and operational response to such incidents (paragraph 190h and 188a).

h. Introduced enhancements and additional resources to provide customer service support to FCC controllers dealing with incidents involving stranded trains, with a particular focus on the means of communicating information to passengers and the need to coordinate and evaluate social media information, and its importance in developing the operational response to such incidents (paragraphs 190f and 193).

i. Reviewed its disruption management policy and emergency response procedures and instructed all FCC controllers and train drivers that trains are not permitted to enter the core in a vulnerable condition. If a train fails or is vulnerable to failure within the core the train is terminated at the next station where passengers will be asked to alight. The train will then go forward empty (paragraph 190a).

202 FCC has also redrafted policy SMS 7.17, 'Dealing with stranded trains and controlled evacuation of passengers', with the following changes:

- the driver must request via the signaller that emergency lights in tunnels, where provided, be switched on should any part of the stranded train be in that environment;
- the driver will request assistance from railway staff on the train;
- staff are sent to assist train drivers and passengers during incidents involving stranded trains;
- the driver will monitor the conditions on the train and must request the assistance of the emergency services should conditions inside the stranded train become uncomfortable and the possibility of dehydration exists, or the passengers are showing signs of agitation or unrest with the possibility of open door emergency egress; and
- the driver must request via the public address system that any disabled passengers make their presence and location known to the driver so that emergency services can assist them should the need arise for a controlled evacuation (paragraphs 190f, 192a and 192e).

Recommendations

203 The following recommendations are made:[9]

1. *The intent of this recommendation is to improve the way in which incidents involving stranded trains are currently handled across the network with a view to implementing good practice and with the objective of train operators reviewing existing protocols, or jointly developing and agreeing with Network Rail new protocols, that can be applied to the management of all such events.*

   Train operating companies and Network Rail routes over which they operate, should review existing protocols, or jointly develop a new protocol, for stranded trains in accordance with the contents of ATOC / Network Rail Good Practice Guide GPD SP01 'Meeting the needs of passengers when trains are stranded'. The protocols should also consider:

   - the key findings from this investigation;
   - the different arrangements in place for the interface between Network Rail and train operators' control functions;
   - the different approaches to managing incidents and good practice applied in different parts of the main-line and other railway networks;
   - the need to identify who will take the lead role in managing the incident and how key decisions will be recorded and shared between the affected organisations;
   - the need to provide on site support to the traincrew of such trains in managing passengers' needs;
   - the need to provide technical support to the train crew of stranded trains, with a particular focus on means of communicating and the need for coordinating the technical and operational response to such incidents;

continued

[9] 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 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 RAIB's website www.raib.gov.uk.

- the need to recognise when minor operational occurrences have the potential to develop into major incidents unless decisions are taken in a timely and decisive manner;
- the views of passenger interest groups and emergency services: and
- the positive and negative role that can be played by social networking sites in the management of such incidents

(paragraphs 190c, 190d, 190e, 190f, 190h, 193 and 199).

2. *The intent of this recommendation is to ensure that First Capital Connect safety related processes in relation to emergency preparedness are managed effectively.*

   First Capital Connect should carry out a review of its management processes referred to in this report to examine why it did not identify and address deficiencies in emergency preparedness prior to the incident. The lessons learnt from this review should lead to changes in management systems to provide confidence that all such deficiencies will be identified in the future (paragraphs 190h, 192a, 192c, 192f and 196f).

3. *The intent of this recommendation is for safety related lessons learnt during Significant Performance Incident Reviews and other incident review processes to be effectively tracked, implemented and shared with other railway operators, as appropriate*.

   Network Rail and the train operators should amend their processes so that safety lessons identified during Significant Performance Incident Reviews and other incident review processes can be effectively monitored through to closure, and actions taken as appropriate. The process should also include a mechanism for advising other railway operators of safety lessons that may be relevant to them (paragraph 192e).

Appendices

Appendix A - Glossary of abbreviations and acronyms

ADD	Automatic Drop Device
ATOC	Association of Train Operating Companies
BTP	British Transport Police
CCTV	Closed Circuit Television
FCC	First Capital Connect
OHLE	Overhead Line Equipment
ORR	Office of Rail Regulation
RSSB	Rail Safety & Standards Board
SMIS	Safety Management Information System
SMS	Safety Management System
SPIR	Significant Performance Incident Reviews

Appendix B - Glossary of terms

Automatic Warning System	A fail-safe system of permanent magnets and electromagnets found within in the four-foot that relays information about the signal aspect to the train driver.
Automatic Drop Device	A device that lowers the pantograph if it exceeds its minimum or maximum height limits which will prevent damage occurring to the overhead line equipment.
Cess	A safe space running alongside the line.
(Thameslink) core section	The two-track section between Blackfriars Junction in the south and Kentish Town in the north. The stations within the core section are Blackfriars, City Thameslink, Farringdon and St. Pancras.
Dual voltage train	Trains which are able to take AC power from overhead line equipment using pantographs, or DC power from a ‘third rail’ at track level using collection equipment mounted on some of the train’s bogies.
Pantograph	Equipment fitted to the roof an Electric Locomotive or Electric Multiple Unit (EMU) that contacts the wire of the Overhead Line Equipment (OHLE), allowing the train to draw current.
Signaller (panel signaller)	A person employed to supervise and operate a panel within a Power Signal Box (PSB) containing push buttons, selectors and switches in order to operate the Signalling System in a particular area.
Thameslink route	The network of routes over which services (collectively referred to as ‘Thameslink services’) with origins / destinations in Bedfordshire, Hertfordshire, Kent, Sussex, and south London operate, the common feature being that they all operate through the Thameslink core section (see separate definition).
Transboardment bridge	Bridge that can be used to transfer passengers from one train to another adjacent train.

Appendix C - Key standards current at the time

Rule book module GE/RT 8000 Module M1	Train stopped by a train accident, fire or accidental division
Rule book module GE/RT 8000 Module M2	Train stopped by train failure
Rule book module GE/RT 8000 Module M5	Managing accidents
Rule book module GE/RT 8000 TW1	Preparation and movement of trains
Rule book module GE/RT 8000 TW2	Preparation and movement of multiple-unit passenger trains
Rule book module GE/RT 8000 TW5	Preparation and movement of trains-defective or isolated vehicles and on train equipment
Railway Group Standard GO/RT3437	Defective on train equipment
Railway Group Standard GM/RC2534	Recommendations for Rail Vehicle Emergency Evacuation
Railway Group Standard GO/RT3118	Incident Response Planning & Management
Railway Group Standard GO/GN3518	Guidance on Incident Response Planning & Management
Railway Group Standard GO/GN3519	Guidance on accident and incident Investigation.
Railway Group Standard GM/RT/2130	Vehicle, Fire and safety evacuation.
Railway Group Standard GM/RT 2473	Power operated external door on passenger carrying rail vehicles

Network Rail - company standards

NR/L3/OCS/041	Operations manual
NR/L2/OCS/250	National Emergency Plan
NR/L3/OCS/043.4.6.	Codes Of Practise for train evacuation

Association of Train Operating Companies (ATOC) - Guidance documents

ATOCGPG004 Issue 2	ATOC Good Practice Guide - Responding to the Failure or Non-Availability of On-Train Air-Conditioning
ATOCGPG017 Issue 1	ATOC Good Practice Guide - Responding to Stranded Trains
ATOCGN003 Issue 4	Guidance Note - The Training of On-Train Staff in On-Train Emergency Procedures

Appendix D - Time line of key events

16:30	First Capital Connect (FCC) service 1W95 departs from Brighton.
17:57	1W95 departs from Farringdon having changed from DC to AC power.
17:59	As the train approaches St. Pancras the circuit breaker in the power feeder station supplying the Overhead Line Equipment (OHLE) 'trips'.
18:03	OHLE reset by Electrical Control Room Operator.
18:05	OHLE system trips for a second time.
18:10	FCC fitter dispatched from Kentish Town to St. Pancras.
18:13	OHLE reset by Electrical Control Room Operator.
18:21	The signaller advises the driver of 1W95 that once the fault had been rectified, train 1W95 should be moved to Kentish Town for detrainment of passengers.
18:23	1W95 departs from St. Pancras with its rear pantograph lowered.
18:26	OLE trips for a third time. 1W95 stranded in the tunnel at Dock Junction North.
1830 to 18:45	Driver of 1W95 contacts the signaller and depot in an attempt to resolve the technical problems.
18:35 to 18:50	FCC enquiries undertaken to use a southbound train to assist or using an emergency coupler to assist 1W95 from the rear using a class 319 train.
18:42	Signaller reports the emergency coupler to attach a class 319 unit to 1W95 cannot be located.
18:45	FCC fitter arrives at St. Pancras to find that train 1W95 had departed and he is redirected back to Kentish Town by the FCC controller.
18:45 to 18:55	FCC instructs the driver of train 1T55 to terminate at Hendon station.
18:57	The driver of train 1W95 starts to receive warnings via the train management system that passenger doors have been opened and passenger communication alarms have been activated.
19:01	OHLE reset allowing other trains to move forward.
19:01 to 19:05	OHLE Engineer and MOM arrive at Kentish Town.
19:01	Train 1T55 arrives at Hendon station. The driver reports a delay due to passenger who have refused to leave the train.
19:05	The driver of 1W95 explains to passengers as he walks through the train opening windows that a rescue train is expected in five minutes (19:10 hrs).
19:10	Train 1T55 departs from Hendon station.

19:10	Internal CCTV and public address system fails on 1W95.
19:10 to 20:20	Further passenger communication alarm activations occur without reset.
19:16	The driver of 1W95 reports the train is totally disabled and all communications now being undertaken via the train driver's mobile telephone.
19:17	Train 1T55 arrives at Cricklewood depot to be split and reformed into a 4-car train.
19:30 to 19:40	Signaller contacts the Shunter at Cricklewood depot as a result of the delay and requests him to attend train 1T55 to assist the train driver.
19:47	Signaller requests MOM / OHLE Engineer and FCC fitter go to train 1W95 to start an evacuation of passengers to Kentish Town Station.
19:47 to 19:50	Signaller cancels evacuation and requests all parties return to the station. The assisting train leaves Cricklewood depot.
20:06	The assisting train arrives at Kentish Town station. Paramedics, the mobile operations manager, OHLE engineer and the fitter board and the train departs for Dock Junction North.
20:12	The assisting train arrives at the front of train 1W95.
20:20	Assisting train couples to train 1W95.
20:29	Train driver starts the combined train's computer controlled train management system, but the public address system on the failed 8-cars still does not work.
20:30 to 20:58	FCC Fitter attempts to reset passenger communication alarms but further activations take place. The signaller (in consultation with FCC control) advises the fitter and the driver that if no solution can be found, the driver is authorised to operate the traction interlock switch.
20:58 to 21:01	Passengers start to evacuate from the rear of train.
21:00	The driver operates the traction interlock switch and almost immediately applies traction to carry out a pull test.
21:03	MOM makes an emergency call to report passengers are trackside. All lines blocked.
21:11	MOM reports all passengers back on board train after train had been checked.
21:11	The driver is granted permission by the signaller to move forward to Kentish Town. Train moves with at least two doors still open.
21:17	Train 1W95 arrives at Kentish Town.
21:34	Train 1W95 departs empty to Cricklewood depot with four sets of doors still open.

Appendix E - Sample of recent incidents involving significant delays to trains

1 The RAIB investigation into the incident at Kentish Town on 26 May 2011 included a review of a number of other recent incidents involving stranded trains, the causes of which ranged from signalling failure and technical failures of the train to theft and passenger-related incidents.

Stewarts Lane viaduct (July 2003)

2 The driver of the 17:15 hrs Waterloo International to Paris Gare du Nord service stopped his train on Stewarts Lane Viaduct following an alert from the on-board train management system. A flexible hose pipe had become detached from its coupler causing a loss of power and prevented further movement of the train.

3 Power was lost within 80 minutes of the incident commencing causing significant discomfort to passengers on the heavily-loaded train, with no lighting, ventilation, toilet facilities or secure door locking available. Passengers opened exterior doors for air, and allegedly attempted to break windows.

4 The disabled train was eventually towed back to Waterloo International, arriving 5 hours later at 22:46 hrs.

5 Recommendations arising from the investigation included:

- a technical review of the train to establish the feasibility of providing extended battery life for auxiliary systems in failure situations; and
- a review of emergency and contingency plans in both Eurostar and Network Rail to ensure procedures and arrangements remain robust and ensure that lessons learned are incorporated in future staff training / briefing and competence assessment.

Huntingdon (June 2005)

6 A Newcastle to London Kings Cross service came to a stand near Peterborough due to overhead line damage. The temperature in the train rose to 37ºC and passengers broke windows to escape after being trapped in carriages for two hours. Relevant lessons learnt from the multi-agency debrief were:

- ensure proper command and control structure is in place;
- ensure Network Rail telephone conferences consider the welfare of passengers;
- ensure everyone understands the effects of hot / cold weather conditions on emergency response;
- have a ‘hot weather’ guide for stranded electric trains (RSSB research was later commissioned (T626)); and
- recognise the possibility of a major incident developing more quickly.

Woking (June 2011 - after the incident at Kentish Town)

7 At approximately 18:46 hrs, the signalling centres at Woking, Ash Vale, Aldershot and Guildford reported a loss of signalling, and the electrical control room at Eastleigh reported an initial loss of supply (which was later restored). Track circuits and points indicators could not be relied upon between Pirbright Junction and Farnborough (Main) stations.

8 The signalling failure resulted in trains being halted east of Pirbright Junction and approximately 60 trains were delayed by up to four hours (70,000 to 80,000 passengers). Some passengers experienced total delays of over six hours.

9 The incident was caused by criminal action and was not investigated by the RAIB, but the industry did conduct its own review to identify lessons, which included:

- incident assessment should prioritise planning, train service impact and information dissemination to make it expressly clear the timescales in which each stage is to be achieved;
- communications infrastructure within and around the control room must be upgraded to allow those accountable for the management of the incident to manipulate the communications network and prioritise links to the key individuals responding to any given incident;
- when disruption leads to significant delays or trapped trains control rooms need to monitor how long trains have been stationary;
- control rooms need to have a structured process to mobilise on-call resources;
- the role of managers needs to be clearly defined including the circumstances in which attendance at site is mandatory;
- consideration should be given to establishing a level 3 operations on-call either within each company or on an integrated basis involving individuals with the knowledge, experience and seniority to provide guidance to the control room on the management of major incidents and if necessary to modify the strategy during the incident; and
- consideration should be given to enhancing the capability within the control room to disseminate information via social media (Twitter / Facebook) and to monitor real time customer messages.

South Croydon (June 2011 – after the incident at Kentish Town)

10 On 4 June 2011 (Epsom Derby day) a Tattenham Corner to Victoria train formed of eight coaches was stopped by an emergency brake application following the operation of the passenger communication alarm by a passenger. The train was approximately 400 metres south of South Croydon station.

11 As the driver attempted to reset the passenger communication equipment he noticed (approximately 30 minutes after the train had stopped) passengers on the track and carried out emergency arrangements to stop all trains and isolate the electrical current. During this time a female passenger in company with others had got off the train and was severely burned after coming into contact with the live electrical conductor rail.

12 The industry conducted its own investigation to identify lessons, which included:

- once trains have been at a stand for five minutes, suitably worded announcements should made to request customers to be patient and not to attempt to interfere with any doors and to advise them of the dangers of electrified lines; and
- a review of communications between BTP, Network Rail and the train operator's control room to be undertaken to ensure that all relevant information is passed as necessary in a timely manner.

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