



Rail Accident Investigation Branch

Rail Accident Report



**Near-miss at Butterswood level crossing,
North Lincolnshire
25 June 2013**

Report 12/2014
June 2014

This investigation was carried out in accordance with:

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

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Summary

At around 07:35 hrs on Tuesday 25 June 2013 a passenger train was involved in a near-miss with a car on a level crossing near Butterswood in North Lincolnshire. The train passed over the level crossing with the barriers in the raised position and the road traffic signals extinguished. No injuries or damage were caused as a result of the incident.

Normally, the approach of the train would have automatically initiated the closure of the crossing. However, the crossing was not working normally because the power supply to the crossing equipment had been interrupted. The crossing was of a type where train drivers are required to check that it is not obstructed as they approach and that it has operated correctly. A flashing light is provided for this purpose, just before the crossing, with a flashing white light displayed if the crossing has correctly closed against road users, and a flashing red light displayed at all other times (including those occasions when the crossing has failed to close on the approach of a train). The driver of the train involved in the near-miss did not notice until it was too late to stop that the flashing light was indicating that the crossing was not working normally, and was still open for road traffic.

The RAIB's investigation found that the train driver had the expectation that the crossing would operate normally as the train approached and that he had not focused his attention on the flashing light at the point where he needed to confirm that the crossing had operated correctly for the passage of his train. Although the level crossing had probably failed around nine hours before the incident, the fact of its failure was not known to any railway staff.

The investigation also found that the crossing was not protected with automatic warning system equipment and that the maintenance arrangements at the crossing were not effective in ensuring reliable performance of the equipment. In addition, the train operator's briefing material did not clearly explain to drivers their role in respect of failures at this type of level crossing.

The RAIB has identified four key learning points relating to non-provision of the automatic warning system at locations where it is mandated by standards, recording of the condition of assets during inspection, storage of batteries, and involving people with relevant technical expertise in industry investigations into incidents and accidents.

The RAIB has made four recommendations. Three recommendations have been made to Network Rail addressing the indications given to train drivers approaching crossings where they are required to monitor the crossing's status, improvements to the reliability of power supplies to crossings such as Butterswood and considering remote monitoring of the power supply at similar crossings. One recommendation has been made to First TransPennine Express regarding the briefing that it gives its drivers on this type of level crossing.

Introduction

Preface

- 1 The purpose of a Rail Accident Investigation Branch (RAIB) investigation is to improve railway safety by preventing future railway accidents or by mitigating their consequences. It is not the purpose of such an investigation to establish blame or liability.
- 2 Accordingly, it is inappropriate that RAIB reports should be used to assign fault or blame, or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.
- 3 The RAIB's investigation (including its scope, methods, conclusions and recommendations) is independent of all other investigations, including those carried out by the safety authority, police or railway industry.

Key definitions

- 4 All dimensions 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. The 'down' direction refers to trains travelling towards Barton-on-Humber. The 'up' direction refers to trains travelling towards Cleethorpes.
- 5 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.

The incident

Summary of the incident

- 6 At around 07:35 hrs on Tuesday 25 June 2013, train 2F83, the 07:00 hrs passenger service from Cleethorpes to Barton-on-Humber was involved in a near-miss with a car on a level crossing near Butterswood in North Lincolnshire (figure 1). The train passed over the level crossing with the barriers in the raised position and the road traffic signals, commonly known as wig-wags, inactive (in other words, open for road traffic). No injuries or damage were caused as a result of the incident.



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

Context

Location

- 7 Butterswood level crossing is located on the line that runs from Ulceby Junction to Barton-on-Humber in North Lincolnshire. The railway comprises two tracks with the down line used by trains running towards Barton-on-Humber. The up line through the area where the incident occurred can also be used by freight trains running in the down direction which require access to the New Holland freight terminal, which is not accessible from the down line. However, freight traffic has not operated to the freight terminal for several years.

- 8 By rail, Butterswood level crossing is around 3 miles (4.8 km) from Ulceby and around 6.5 miles (10.5 km) from Barton-on-Humber. At the time of the incident there were normally nine return train services between Cleethorpes and Barton-on-Humber on Mondays to Saturdays, departing from Cleethorpes around every two hours between 06:00 hrs and 21:03 hrs. No passenger trains were scheduled to operate on Sundays.

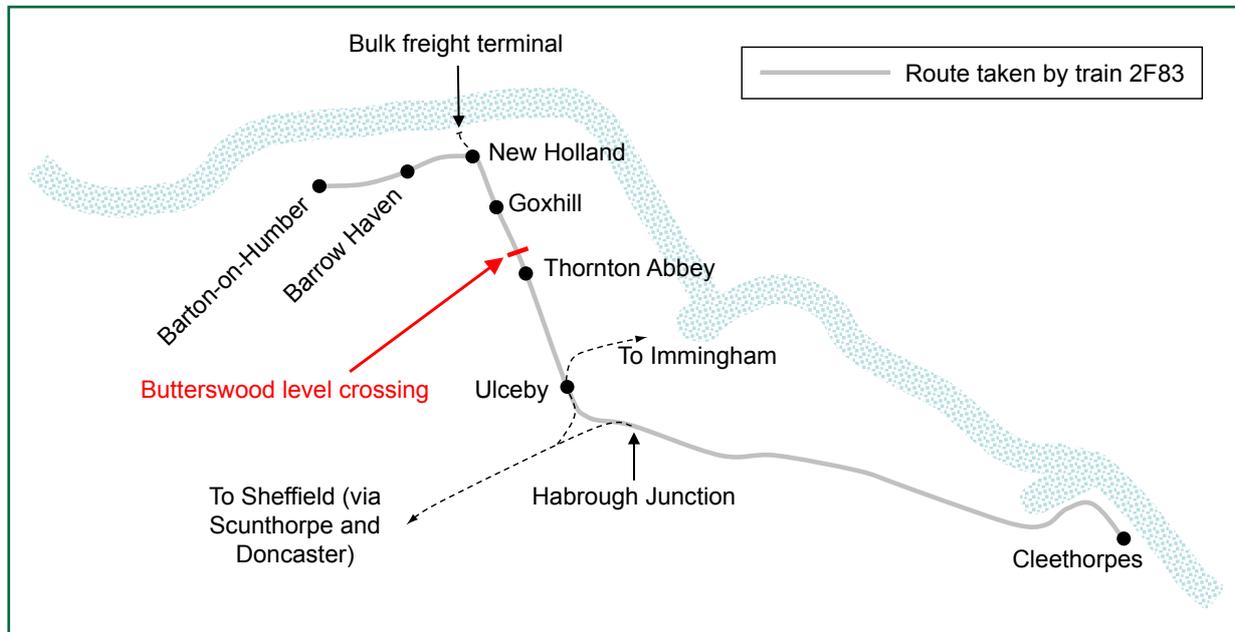


Figure 2: The Barton-on-Humber route (not to scale and not all features shown)

Organisations involved

- 9 Network Rail is the owner, maintainer and manager of the infrastructure. This includes Butterswood level crossing, and the equipment associated with its operation.
- 10 Northern Rail is the operator of the passenger service over the Barton-on-Humber line. However, the driver and conductor of train 2F83 were employed by First TransPennine Express (FTPE) through a train crew hire agreement¹ with Northern Rail.
- 11 Northern Powergrid operated the power distribution network² that supplied electricity from the national grid to Butterswood level crossing.

Train involved

- 12 Train 2F83 was formed by a single-vehicle class 153 'Sprinter' diesel train with a driving cab located at each end. These vehicles are 23 metres long and have a maximum speed of 75 mph (121 km/h). The train was fitted with various safety systems, of which the *automatic warning system* and the *driver's vigilance device* are relevant to this incident. The train was not equipped with any closed-circuit television (CCTV) equipment.

¹ A contractual arrangement where one train operating company hires the services of staff from another train operating company (such as train drivers and conductors) to operate some of its own train services.

² At the time of the incident there were nine distribution network operators that held distribution licenses for fourteen areas in the UK. Northern Powergrid held the licenses for North East England (including North Lincolnshire) and Yorkshire.

The level crossing

- 13 Butterswood level crossing was originally a gated crossing, operated by a railway crossing keeper. It was converted to automatic operation in the early 1990s, and records indicate that lifting barriers were installed around 1993 as part of a national programme of level crossing improvements following a multiple fatality accident at Lockington level crossing between Bridlington and Hull on 26 July 1986³.
- 14 Butterswood level crossing is of a type known as an automatic barrier crossing, locally monitored (ABCL). ABCLs are normally operated automatically by an approaching train, rather than by the actions of a signaller or crossing keeper. They have lifting barriers pivoted at the near-side of the road that, when lowered, extend to the road centre-line (ie they are 'half barriers'). Each road approach is provided with road traffic signals on the nearside and offside of the road to warn road users and pedestrians that a train is approaching. Figure 3 shows the road approach to the level crossing.



Figure 3: Butterswood ABCL level crossing - road approach

³ The accident at Lockington occurred on an automatic crossing with lights but without barriers, when a train derailed after striking a van which had been driven on to the crossing just as the train arrived. The investigation report, which can be found at: http://www.railwaysarchive.co.uk/documents/DoT_Lockington1986.pdf, concluded that the driver of the van, who had just turned out of a nearby driveway, was probably distracted and did not observe the flashing lights at the crossing indicating the imminent arrival of a train.

- 15 In their 'normal' state, the barriers are raised and the road traffic signals are extinguished. The crossing is open to road traffic. On the railway approach, an indicator known as the driver's crossing indicator (DCI) is located close to the crossing. When this shows a flashing red light, it indicates to the driver of an approaching train that the crossing is open to road traffic. The crossing closure sequence is initiated by the train, which depresses a treadle and operates a track circuit located around 720 metres from the crossing for trains approaching from Cleethorpes; this is around 35 seconds before the train reaches the crossing when travelling at the maximum permitted line speed of 45 mph (72 km/h). When the train initiates the crossing sequence the road traffic signals are activated and the half barriers then lower across the carriageway. Once the barriers have begun to lower, the flashing red light at the DCI is replaced by a flashing white light. This flashing white light informs the train driver that the crossing is functioning correctly (hence the term 'locally monitored'). Figure 4 shows the rail approach to the level crossing.

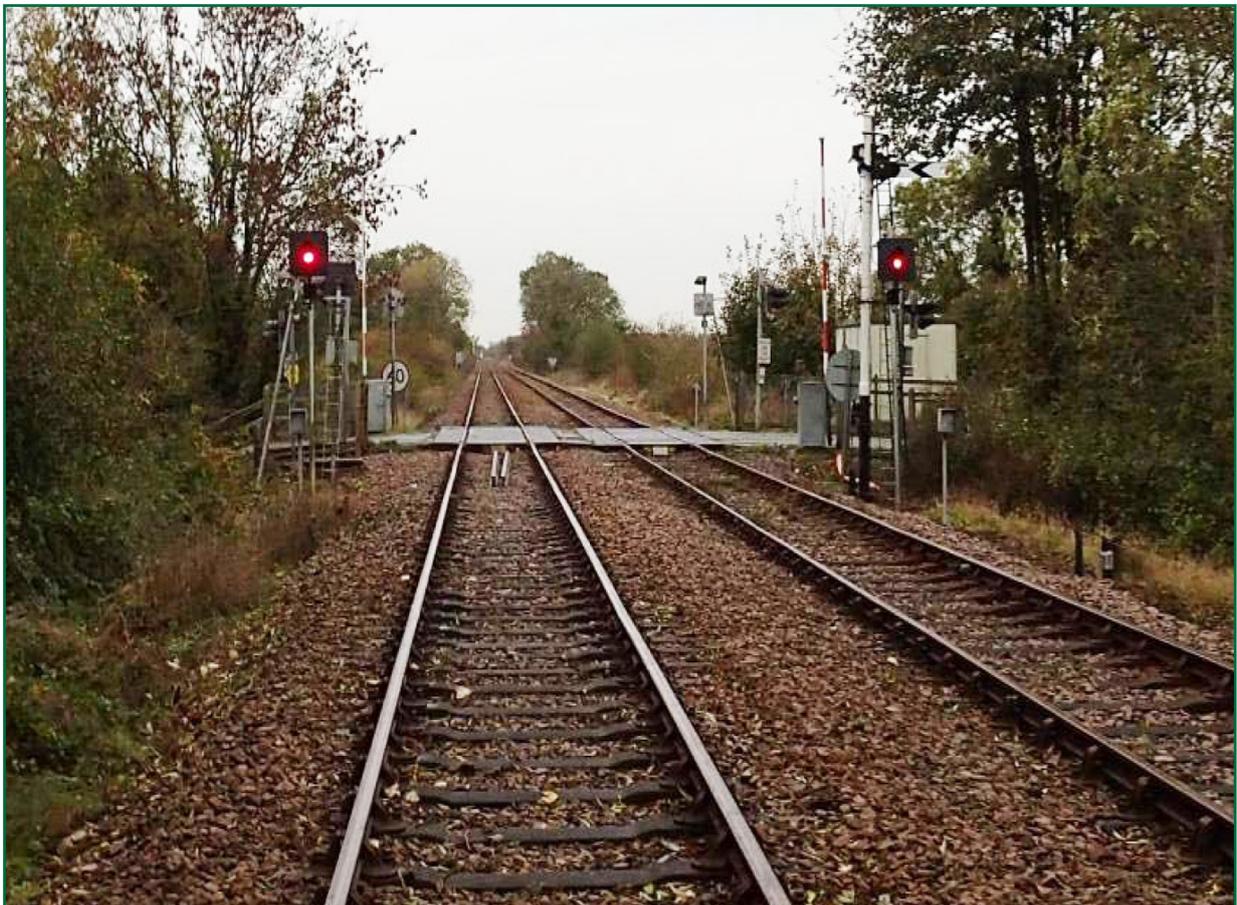


Figure 4: Butterswood ABCL level crossing - rail approach

- 16 There are two DCIs in the vicinity of Butterswood level crossing applicable to trains running in the down direction (the direction in which the train involved in the incident was travelling). One is adjacent to the down line applying to trains travelling towards Barton-on-Humber, and one is adjacent to the up line for trains travelling in the down direction towards the New Holland freight terminal (paragraph 7).

- 17 When a down train approaches Butterswood crossing, the train driver first encounters an advance warning board (AWB), located 404 metres from the crossing, intended to inform the train driver that the train is approaching the level crossing and that the speed of the train must be controlled to comply with the speed indicated on a special speed restriction board (SSRB) that is located ahead. SSRBs are required to be positioned so that a train travelling at the indicated speed can stop before reaching the crossing if the DCI has not changed from a flashing red light to a flashing white light by the time the train reaches the SSRB.
- 18 The SSRB for trains travelling in the down direction was located 303 metres from Butterswood level crossing, and indicated a maximum speed of 45 mph (72 km/h). This is the same as the maximum permitted line speed (paragraph 15). The arrangements for trains approaching Butterswood ABCL crossing are shown at figure 5.

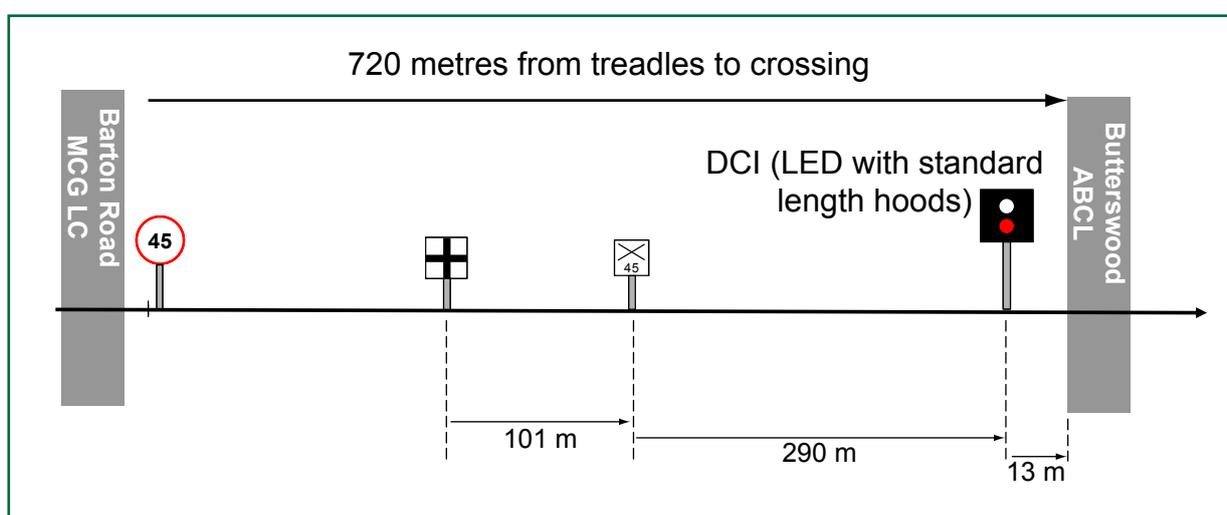


Figure 5: The arrangements for trains approaching Butterswood ABCL (not to scale)

- 19 Power to operate the level crossing is provided by Northern Powergrid (paragraph 11). However, because the crossing was required⁴ to have two independent power supplies the feed from the network operator was supplemented with an uninterruptible power supply (UPS) system that comprised a bank of batteries located in a building at the crossing.
- 20 The UPS did not provide power for every aspect of crossing operation, and in the event of a power supply failure, the arrangements for the safe operation of the crossing changed. The activation of the road traffic signals and lowering of the barriers were no longer initiated automatically by the approaching train. Consequently, the red flashing signal displayed to the train driver by the DCI did not change to a white flashing signal as the train approached. Drivers are required to stop their train before it reaches the crossing if the DCI does not display a white flashing light by the time the train passes the SSRB (paragraph 17). An emergency plunger was provided near to the crossing, which the driver could use to initiate the closing closure sequence manually.

⁴ All automatic type level crossings that cross public roads are required to have a Level Crossing Order. These orders are a statutory instrument made under the Level Crossings Act 1983 describing in detail the method of operation and control to be employed at a particular level crossing. The requirement for two independent power supplies was included within the Level Crossing Order for Butterswood level crossing.

- 21 A bank of 24 V batteries (separate from the main and UPS power supplies) allowed the road traffic signals and barriers to be operated by the train driver manually. A low-voltage detection circuit prevented the barriers from lowering if it detected insufficient power to raise them again. This prevented long delays to road users that might arise if the barriers were to fail in the lowered position⁵.
- 22 A residual current device (RCD) was provided on the incoming mains power supply to Butterswood crossing. If the RCD had operated (ie 'tripped'), the level crossing would function as described in paragraph 20, even if the main incoming power supply was available. The level crossing was also fitted with a data logger to record aspects of its operation.

Staff involved

- 23 The driver of train 2F83 had been driving trains for 20 years, and had driven over the route between Cleethorpes and Barton-on-Humber for around 19 years. He was based at FTPE's Cleethorpes depot.
- 24 The conductor of train 2F83 had around eight years' experience in that role and had operated trains over the Barton-on-Humber route throughout that time. He was also based at FTPE's Cleethorpes depot.

External circumstances

- 25 Following the incident the driver of the train said that sunlight and foliage may have affected his ability to see the DCI. At the time of the incident the sun was not shining directly onto the DCI, or directly into the driver's line of sight. The effects of sunlight were ruled out as a causal factor by Network Rail staff who undertook post-incident assessment of the DCI under similar conditions, and considered that it was visible from the driving cab from around 800 metres away and unaffected by sunlight. The assessment also ruled out obscuration due to vegetation, and although some vegetation had been trimmed back as a precaution before the assessment was undertaken, no drivers over the route in the previous days had reported vegetation obscuring the DCI. The train operator did not challenge Network Rail's findings, and used them in its own investigation report.

Events preceding the incident

- 26 Information has been obtained from the train's on-train data recorder (OTDR), the data logger fitted at the level crossing, and measurements taken by the RAIB.
- 27 Around 22:00 hrs on the night of Monday 24 June 2013 (the night before the incident), the incoming power supply to Butterswood level crossing equipment room was lost. The data logger fitted at the level crossing failed around this time because its internal battery was dead. The level crossing barriers remained raised and the road traffic signals remained extinguished. The DCI displayed a flashing red light to warn any trains approaching the crossing that it had not operated.

⁵ In these circumstances, the train can still proceed over the crossing providing that the train driver checks it is safe to do so, even though the DCI will not display a flashing white light. If this occurs, the train driver is required to report the level crossing failure to the controlling signaller.

- 28 On the morning of Tuesday 25 June 2013 the driver and conductor booked on duty at Cleethorpes depot to work the 07:00 hrs service to Barton-on-Humber. Due to a landslide affecting the Doncaster and Scunthorpe lines at Hatfield colliery, the first train to Barton-on-Humber from Cleethorpes at 06:00 hrs had been cancelled.
- 29 The journey from Cleethorpes to Thornton Abbey (around ½ mile (0.8 km) from Butterswood crossing) was reported as uneventful by the train crew. On departure from Thornton Abbey, the crossing keeper authorised the driver to pass a defective signal at danger (this was unrelated to the power failure at the crossing). Having passed the defective signal, the driver accelerated the train using full power.

Events during the incident

- 30 The crossing closure sequence was not initiated by the train because of the power supply failure, and the DCI continued to display a flashing red light. Around 200 metres before reaching Butterswood level crossing the driver realised the DCI was still showing a flashing red light. At this point the train was travelling at 40 mph (64 km/h). The driver immediately applied the train's emergency brake but was unable to stop before the train ran onto the level crossing.
- 31 As the train ran onto the level crossing, a car driver approaching from the east had to brake sharply to stop before reaching the crossing. The train came to a stand with the rear of it on the level crossing and partially obstructing the road approach.

Events following the incident

- 32 The train driver stated that he looked out of the left-hand side driving cab window to look for any road vehicles or persons close to the train, and, seeing nothing, decided it was best to move off the level crossing and proceed to Goxhill to report the incident. The train's OTDR recorded that the train was stationary for around six seconds (the car driver also stated the train only stopped for a short while). The train driver said that he did not report the incident immediately using the train's radio system as he believed it would not work properly because of poor signal reception in the area.
- 33 When the train arrived at Goxhill the driver spoke face-to-face with the signaller. Following this conversation the train proceeded on its journey. The signaller reported to Network Rail's control office that the level crossing had not operated for the passage of the train. In turn, Network Rail control reported a technical fault at the crossing to Network Rail's signalling technicians. At that stage, it was not apparent to Network Rail's controller that an operating irregularity had also occurred.

- 34 Meanwhile, the car driver reported his near-miss with the train to Network Rail's helpline. This information was passed on to Network Rail control. It was then realised that a serious operating irregularity had occurred. By this time the train involved had completed its journey to Barton-on-Humber and the return journey to Cleethorpes, and had just departed for Barton-on-Humber again. The train returned to Cleethorpes where the driver was tested for the presence of drugs and alcohol, the results of which were clear.
- 35 The signalling technicians were able to return the level crossing to normal operation by re-setting the RCD (paragraph 22), which immediately restored power to the crossing.

The investigation

Sources of evidence

36 The following sources of evidence were used:

- witnesses;
- the train's OTDR data;
- site photographs and measurements;
- weather reports and sun position data;
- FTPE, Northern Rail and Network Rail safety management system documents and information;
- information held by Network Rail on Butterswood level crossing, including periodic safety and maintenance assessments;
- a review of previous reported occurrences at the crossing; and
- a review of previous RAIB investigations that had relevance to this incident.

Key facts and analysis

Identification of the immediate cause⁶

- 37 **The train passed onto the level crossing while the barriers were raised and the crossing was open to road traffic.**

Identification of causal factors⁷

- 38 The incident occurred due to a combination of the following factors:
- the train driver did not notice that the DCI had not changed to display a flashing white light until it was too late to stop before reaching the level crossing;
 - the level crossing did not automatically operate for the approaching train; and
 - although the level crossing had probably failed around nine hours before the incident, this failure was not known to the driver, signaller or signalling technicians.

Each of these factors is now considered in turn.

The actions of the driver

- 39 **The train driver did not notice that the DCI had not changed to display a flashing white light until it was too late to stop before reaching the level crossing.**

- 40 Although it has not been possible to identify the exact reasons why the train driver did not notice the DCI was not displaying a flashing white light until the train was too close to the crossing to stop, the RAIB considers that a combination of the following factors may have contributed to this omission:
- the driver expected that the level crossing would operate normally as the train approached;
 - the driver initially interpreted the flashing red light displayed at the DCI as an indication that the crossing had not yet activated rather than that it had failed; and
 - the driver did not focus his attention on the DCI at the time that his train passed the SSRB, which was the point at which he needed to confirm that the crossing had operated correctly for the passage of his train.

Each of these factors is now considered in turn.

⁶ The condition, event or behaviour that directly resulted in the occurrence.

⁷ Any condition, event or behaviour that was necessary for the occurrence. Avoiding or eliminating any one of these factors would have prevented it happening.

The driver's experience of ABCL level crossings

- 41 **The driver expected that the level crossing would operate normally as the train approached.**
- 42 The driver had driven trains over the Barton-on-Humber route for around 19 years. He stated that on a small number of occasions in that time he had been told by the signaller that either Butterswood or Pasture Road (around 6 miles further on) ABCL had failed, and to stop and operate the emergency plunger if required. He stated that he had never experienced an occasion when he had been required to stop on the approach to either of the two ABCL crossings due to a failure of the crossing that had not been previously notified by the signaller. This meant that he had never experienced the red light continuing to flash without first being alerted to the reason.
- 43 The driver also drove trains between Cleethorpes and Sheffield. On this route there are many types of level crossing, but no ABCLs. For all these other types of crossing the driver has no role in monitoring the condition of the crossing and is therefore provided with no special indication as to its status.
- 44 The indications that can be displayed by the DCI are:
- flashing red light, meaning that the level crossing has not yet activated or has failed (and is thus open to road traffic);
 - flashing white light, meaning that the level crossing has operated correctly (and is thus closed to road traffic so that a train can pass safely over the crossing); and
 - no light, which may mean that there is no power being supplied to the DCI and it must be assumed that the level crossing has failed.
- 45 The DCI at Butterswood level crossing is visible to train drivers when they are at Thornton Abbey station some 800 metres away. This means that a train driver is able to see the DCI for just under two minutes before passing it. It only changes from a flashing red light to a flashing white light around 24 seconds before the train reaches the crossing (under normal conditions). Drivers are therefore used to seeing a flashing red light for a considerable time when approaching the level crossing. Until they have passed the point at which it should change to a flashing white light, there is nothing to indicate that the crossing has actually failed.
- 46 The DCI indications do not therefore clearly identify when an ABCL crossing has failed. The flashing red light is the same for a crossing that is in its 'normal' state (open to road traffic) as for a crossing that has failed (and is probably still open to road traffic).

The driver's lack of focus on the DCI

- 47 **The train driver did not focus his attention on the DCI at the time that his train passed the SSRB, which was the point at which he needed to confirm that the crossing had operated correctly for the passage of his train.**
- 48 The RAIB undertook cab rides over the route to video and time the operation of the DCI at Butterswood level crossing. The DCI normally changes from a flashing red light to a flashing white light around the time the front of the train is close to the AWB (around 404 metres from the level crossing – see paragraph 17). Around 7 seconds later the train passes the SSRB, which is the point where train drivers need to confirm that the DCI is showing a flashing white light and that the crossing is clear (because the train can still be stopped before it reaches the crossing if the light has not changed).



Figure 6: The special speed restriction board, around 303 metres from the level crossing

- 49 Data from the incident train's OTDR indicated that the driver only applied the emergency brake when the train was around 110 metres beyond the SSRB (approximately six seconds after passing it). If at any point before reaching the SSRB the driver had noticed that the DCI was showing a red light, he could still have stopped the train safely before the crossing.

- 50 As discussed at paragraph 42, the driver was expecting the level crossing to operate (the driver was aware that the white light normally started to flash on passing the AWB). The RAIB has considered other possible reasons why the driver did not observe that the flashing red light had not changed to a flashing white light:
- the RAIB reviewed the driver's shift patterns, and information on how he spent his time out of work, and concluded there was no evidence that his attention may have been affected by fatigue;
 - there was no evidence that the driver was affected by any personal issues, or that any other person was in the driving cab with him, which may have constituted a distraction;
 - although vegetation may have caused intermittent obscuration of the DCI during the train's approach (paragraph 25), this had not been reported by any other train drivers before the day of the incident and the driver should, in any case, have been looking for the DCI and controlling the train's speed such that he could stop before the crossing if the DCI could not be seen.
- 51 It cannot be determined, with certainty, why the driver did not observe that the flashing red light had not changed to a flashing white light. However, in the absence of other possible explanations, the RAIB considers it most likely that the driver suffered a lapse of attention as the train approached Butterswood crossing.
- 52 The train was fitted with driver's vigilance device (DVD) equipment. This equipment sounds a warning, nominally at around 60 second intervals, unless the driver has undertaken certain actions such as acknowledging automatic warning systems (AWS) warnings, or operating the power or brake controls (in which case the 60 second timer is reset). If the driver does not acknowledge a DVD system warning within around five to seven seconds, the train's brakes are automatically applied. The OTDR fitted to train 2F83 recorded that the driver acknowledged a DVD system warning around four seconds before he applied the train's emergency brake. It is possible that the DVD system warning re-focused the driver's attention, and it was at this point he noticed that the DCI was still showing a flashing red indication and so he applied the train's emergency brake.
- 53 Another form of stimulus to the driver could have been provided by a warning horn from AWS equipment, had it been provided at the crossing. Normally AWS equipment is provided on the approach to the AWBs at ABCs. Its purpose is to provide an audible warning to the train driver to focus attention on the SSRB and level crossing beyond. No AWS equipment was provided approaching the warning sign at Butterswood level crossing. The lack of AWS equipment approaching the level crossing is discussed at paragraphs 66 to 73.

The loss of electrical power at the level crossing

54 The level crossing did not automatically operate for the approaching train because the power supply to the crossing equipment had been interrupted.

- 55 At around 22:00 hrs on the night of 24 June 2013, the data logger at Butterswood level crossing stopped recording data. It did this because both the main power supply and its own internal battery had failed (the battery issue is discussed further at paragraphs 82 and 83). The loss of power supply meant that automatic operation of the level crossing was not possible.

- 56 Following the incident on the morning of 25 June 2013, Network Rail's signalling technicians attended Butterswood level crossing to investigate the cause of the crossing's failure to operate for the passage of trains. It was discovered that the RCD on the incoming power supply had tripped. It is not known whether the tripping occurred as a consequence of an interruption to the incoming power supply from the national network, or because of some other transient electrical discontinuity. The RCD was reset by the technicians, and the main power supply became available. The technicians had to re-set the control circuits to allow the level crossing to operate normally.
- 57 Fault records about power supply issues at Butterswood level crossing indicated that the RCD had tripped on two previous occasions: 10 May 2011 and 17 June 2013. The RCD trip on 10 May 2011 was associated with an air conditioning fault in the crossing equipment room. Network Rail's signalling technicians recorded that the RCD trip on 17 June 2013 was due to a transient power spike, but the records obtained by the RAIB from the network supplier did not indicate there had been any issues with the power supply to Butterswood level crossing on that day. No other fault with the level crossing system was found following the RCD trip on 17 June 2013.
- 58 Network Rail considered that the tripping of the RCD may have been caused by it reacting to the restoration of power from the national network, following a temporary interruption. The network supplier provided the RAIB with records of known power issues. These were cross-referenced against reported failures at Butterswood level crossing (when train drivers had reported no driver's flashing white light). Between 2008 and 2013 there were 11 reports from drivers of 'no white light'. There were only four corresponding network records of a power supply issue. The remaining seven events had no correlating network power issue recorded. It has not been possible to establish whether there was no network supply failure, or whether the failure occurred, but was unrecorded.
- 59 Following the incident, Network Rail identified that the RCD on the incoming power supply was not required at Butterswood level crossing. This was because the system was provided with multiple earthing as an integral part of the power supply arrangements, thereby negating the requirement for a RCD. Although this anomaly with the unnecessary provision of an RCD on the incoming power supply at Butterswood level crossing could potentially have been detected earlier by Network Rail's electrification and plant technicians during their maintenance visits, it was not, probably because they were focused on individual items of equipment rather than on the design of the overall installation.

Network Rail's knowledge of the status of power supplies at the level crossing

- 60 **Although the level crossing had probably failed around nine hours before the incident, this failure was not known to the driver, signaller or signalling technicians.**
- 61 When the level crossing failed as a result of the loss of power supply, its condition was not known to the signaller or Network Rail's signalling technicians until after the incident had occurred, despite the level crossing having failed around nine hours earlier. There was no remote monitoring of the condition of the level crossing power supplies to Butterswood level crossing (and there is no current requirement for such a system to be fitted).

- 62 Because the signaller was unaware, the train driver was not told about the failure. Had the driver been told about the failure when the train was at Ulceby earlier in the journey, it is almost certain that the incident would not have occurred. If an ABCL is known to be not working correctly, the signaller tells the train driver to stop before the crossing and make sure that it is safe to proceed. If an emergency plunger is provided, train drivers are told they must use this to operate the level crossing controls when the level crossing equipment has failed.
- 63 The normal process for reporting an ABCL failure is that a train driver encounters the crossing in a failed state, and reports it to the controlling signal box. This is the essence of a 'locally' monitored crossing (ie the correct operation of the crossing is monitored locally by an approaching train driver). The railway rule book⁸ module GE/RT8000/TW8 'Level crossings - drivers' instructions' states that train drivers must report to the signaller, in the quickest way possible, any defect or irregularity with level crossing equipment.
- 64 It is less likely that road users would notice a failure of the crossing unless it failed with the barriers down. Between 2008 and the day of the incident, Network Rail had logged two such reports from members of the public about Butterswood level crossing. On 24 March 2011 and 10 May 2011, it was reported that the barriers had failed in the down position, thus preventing road users from crossing over the railway.

Identification of underlying factors⁹

Infrastructure arrangements at the level crossing

AWS provision

65 There was no AWS equipment provided on the approach to the AWBs for Butterswood level crossing.

- 66 *Railway Group Standard* GK/RT0016 'Automatic Warning System of Train Control (AWS)' issued in May 1997 required that AWS equipment be fitted on the approach to an AWB that applies to locally monitored automatic crossings (this includes ABCLs) where the line is also fitted with AWS equipment. This standard also indicated that all lines shall usually be fitted with AWS equipment, but that existing lines not so equipped shall be fitted retrospectively at the discretion of the infrastructure manager in consultation with train operators. Butterswood level crossing was already established as an ABCL when standard GK/RT0016 came into force, and there is no recorded evidence that consultation took place between Network Rail and train operators about the fitment of AWS approaching Butterswood level crossing.

⁸ The railway rule book is available at www.rgsonline.co.uk.

⁹ Any factors associated with the overall management systems, organisational arrangements or the regulatory structure.

- 67 GK/RT0016 was replaced by another Railway Group Standard, GE/RT8035 'Automatic Warning System (AWS)', in October 2001. This new standard required that where an existing route had not yet been fitted with AWS, a plan for fitment should be produced by 1 June 2002, and implementation should be completed by 31 December 2003. Any proposal not to fit a route (eg low usage freight lines) should be supported by an *authorised derogation* in accordance with Railway Group Standard GA/RT6006 'Derogations from Railway Group Standards'.
- 68 In response to the requirements of standard GE/RT8035, Network Rail established a project in 2004 to identify and assess unfitted routes with the aim of fitting AWS at signals and warning boards on those routes, or applying to RSSB¹⁰ for derogation from Standard GE/RT8035. A Network Rail document titled 'Line-side renewals programme: LNET (London North East Territory) AWS assessment of unfitted routes' prepared in July 2004, indicated that two companies had been contracted by Network Rail to complete desk-top studies of several routes that had not been fitted with AWS. RAIB has seen documentation associated with the studies which includes the statement that consideration of the Ulceby to Barton-on-Humber route (for retrospective fitting of AWS) was to be stopped 'under instruction from Network Rail HQ'. Network Rail was unable to provide the RAIB with any information about the decision to stop an assessment of AWS fitment on the Barton-on-Humber route.
- 69 A derogations register is maintained by RSSB¹¹. It shows that no derogation against the requirements to fit AWS at signals on the Barton-on-Humber route in accordance with Standard GE/RT8035 had been sought by Network Rail, which itself was unable to locate any documents outlining a derogation against the requirements of that standard.
- 70 In contrast, AWS equipment was provided at some permanent speed restrictions on the Barton-on-Humber route. This was because Railway Group Standard GK/RT0038 'Speed Restrictions' required AWS to be fitted approaching certain speed restrictions (using a table of information within the standard) where there is a significant risk of derailment should a train driver not observe the speed restriction warning sign and reduce the train's speed to comply with the restriction. Two such speed reductions existed on the Barton-on-Humber route, and AWS equipment was provided for both.
- 71 Network Rail's standard NR/L2/SIG/11201 'Signalling Design: Module X11 - Level Crossings: Automatic Barrier Crossing Locally Monitored' requires that AWS is provided at ABCLs in accordance with the requirements of Railway Group Standard GE/RT8035. Butterswood level crossing existed before the requirements of the Network Rail standard were mandated and was exempt from its requirements because the standard is not retrospective.
- 72 Following an earlier near-miss incident at Butterswood ABCL level crossing in August 2005, a recommendation was made by FTPE to Network Rail to fit AWS approaching Butterswood level crossing. However, Network Rail took no action to do this because it stated it that it was not aware of the recommendation (paragraphs 93 and 99).

¹⁰ A not-for-profit company owned and funded by major stakeholders in the railway industry, and which provides support and facilitation for a wide range of cross-industry activities. The company is registered as 'Rail Safety and Standards Board', but trades as 'RSSB'.

¹¹ Derogations register available at: <http://www.rssb.co.uk/RGS/Documents/Deviations%20Register.pdf>.

- 73 It is probable that the lack of AWS equipment at Butterswood ABCL is an underlying factor because, as explained at paragraph 53, an AWS warning on the approach to the crossing's AWB might have provided a prompt to the driver to check the DCI (in the same way that the DVD activation (paragraph 52) may have done a few seconds later). Had the driver been prompted to check the DCI on the approach to the AWB, he could have stopped the train before reaching the crossing.

Maintenance and inspection of Butterswood level crossing

- 74 The maintenance arrangements in place at the crossing did not identify that the RCD was not required, that the UPS could not perform reliably, and that the data logger system's batteries were defective.**

The RCD

- 75 Records show that the RCD at Butterswood level crossing had been tested in accordance with Network Rail's requirements, and that it had proved to be working correctly. Following the incident on 25 June 2013, the technician responding to the crossing failure (paragraph 35) found that the RCD had tripped. The reason for the tripping is not known (paragraph 56). Once it had tripped, the level crossing was not able to return to automatic operation until it had been reset.
- 76 On previous occasions, when the RCD was found to have tripped during visits by the signalling technicians, it was not raised as a fault in its own right in Network Rail's fault management system because the RCD itself was not considered to be faulty (although the RCD trip was entered into the narrative on the fault paperwork). This meant that the maintenance department responsible for RCDs (the electrification and plant department) was not aware of each event and was therefore not investigating the reason for the RCD trippings. The signalling technicians responding to faults at the crossing did not consider that the RCD itself might have been the cause of the loss of the power at the crossing.
- 77 After the incident, Network Rail identified that the RCD was not required at Butterswood level crossing (paragraph 59).

The UPS system

- 78 Network Rail required that the performance of the UPS system and its batteries was tested annually, with additional checks that the indications of its status were working correctly, undertaken at quarterly intervals. For convenience, the local signalling technicians tested the UPS system's performance, and that of its batteries, during the level crossing's annual test. The annual level crossing test involved many separate tests aimed at confirming the level crossing was functioning correctly. Several of the tests required the level crossing to be disconnected from the main incoming power supply. Testing of the UPS system was normally undertaken at this time, and consisted of measuring the voltage of the UPS system's batteries, and observing indications on the front of the UPS system that showed if it was operating correctly. Witness evidence indicates that when testing the UPS system at Butterswood level crossing, technicians were only turning the main power off for around 25 minutes as this coincided conveniently with other non-powered tests they were undertaking. Although the technicians said they were testing the UPS system batteries during the annual level crossing test, they were not recording the results (they should have recorded them on either a hand-held computer device, or the forms provided for the test by Network Rail.)

- 79 A signalling technician completed an annual level crossing test at Butterswood on 26 August 2012 (this was the last time the UPS had its performance tested before the incident). He recorded data from the annual level crossing test on a hand-held computer device. During this test, the technician stated that he switched off the power to the level crossing and observed that the UPS indicated it had failed before it should have done¹². He did not record this as a 'fail' on the hand-held computer and neither did he record the measurements he took in relation to the UPS batteries: he should have done both these things. Because he had not recorded that the UPS system had failed the test, the defect was not identified as work arising, and thus was not entered into Network Rail's fault management system for future attention. Instead, the technician said that he had told his manager about the UPS's poor performance, although the manager said he could not recall for certain that the signalling technician had told him this. In any case, he had not taken any action in relation to the UPS system prior to the incident at Butterswood level crossing.
- 80 Network Rail issues guidance about UPS systems. The guidance acknowledges that the batteries of a UPS system 'are the most critical component' and are 'perishable' in that their performance will degrade over time. The guidance also states that 'manufacturers will provide batteries with a design life which will often not be achieved. For example an 8-10 year battery will probably need replacing after 7 years provided that maintenance and good temperature control has been maintained'. The batteries of the UPS system in use at Butterswood level crossing had not been replaced since the system was installed around 20 years before the incident.
- 81 The signalling department whose responsibilities included Butterswood level crossing had no plans to replace the UPS system batteries during the life of the system. In fact, Network Rail's knowledge about the condition of the UPS system at Butterswood, including the age of its batteries, was incomplete until after the incident on 25 June 2013.

The data logger

- 82 The data logger fitted at Butterswood level crossing had its own internal UPS system, separate from the level crossing's main UPS system. Normally the data logger is powered from the main incoming network power supply and uses its own internal batteries to provide back-up power in the event of a main power failure for a maximum of 6 hours. The data logger is tested annually by signalling technicians. The test involves pulling the main network power lead out of the unit, and checking that the indications are still showing that the data logger is operating correctly. Network Rail requires that the batteries in the UPS systems of its data loggers are renewed at no more than 10 yearly intervals.

¹² For level crossing UPS systems, Network Rail required them to operate for 20% of their expected performance. The UPS system at Butterswood level crossing was believed to be capable to operate for up to 12 hours, therefore the permitted performance time was 2.4 hours.

- 83 Records indicate that the batteries were replaced in 2012. This means the batteries only lasted around a year before they failed. Information from the data logger manufacturer suggested that the batteries may only last 5 years, depending on how many channels the data logger is monitoring. It was the belief of the local signalling and electrification and plant teams, that it was often the case that new batteries can spend significant periods of time 'on the shelf' in store rooms, and could thus be several years old before they are used, sometimes leading to premature failure.

The train operator's understanding of ABCL level crossings

84 First TransPennine Express's training and briefing material did not clearly explain to drivers their role in respect of failures at ABCLs.

- 85 A number of train drivers and managers told the RAIB that they were not aware that signallers may not know that ABCL crossings had failed. They believed that the signaller would receive an indication in the signal box when such a failure had occurred. The driver involved in the incident at Butterswood on 25 June 2013 expected to be told of all such failures before approaching the level crossing, unless the crossing failed during the train's approach. Most train drivers will never approach an ABCL that has failed without having first been told of the circumstances by the signaller.

- 86 The driver of the train involved in the incident stated that he had never encountered a failed ABCL without having first been told by the signaller. His previous experience led to his expectation that Butterswood level crossing would operate normally on the morning of 25 June 2013. The driver was last re-briefed on FTPE's *professional driving policy* in May 2012. This was a one-off briefing intended to give train drivers an appreciation of the policy which had been recently reissued. One slide covered information about ABCL type level crossings. This told drivers:

- 'You must check that the white light at the crossing is working. Never assume that the white light will start to work, whatever your previous experience – the crossing may have failed.'
- You must comply with the speed restriction board. If the white light does not flash or the associated crossing 'red light' continues to flash – you must stop before the crossing.'

- 87 The professional driving policy brief gave drivers no information about where on the approach to an ABCL level crossing to look for the white light, although the professional driving policy itself stated that:

- 'The braking point relies on you reacting and applying the brakes at the speed restriction board. Remember, every second you wait after passing the speed restriction board is valuable braking distance lost.'

- 88 The professional driving policy brief did not make it clear to drivers that it is their responsibility to detect if a crossing has operated correctly (hence the title 'locally monitored' crossing), and it did not inform drivers that signallers are often unaware that this type of crossing has failed, and therefore drivers may not be told beforehand that an ABCL crossing had failed.

- 89 The driver was aware of the railway rule book provisions for ABCLs that are not working correctly¹³, which included the requirement to stop the train if the red light is flashing, but had never had to put the rules into practice. It is not unusual for drivers to have little or no practical experience of certain situations such as equipment failures requiring a procedural response.
- 90 Train driving simulators can be used to help drivers practise situations they may rarely, if ever, encounter in real life. Before the incident on 25 June 2013, FTPE had not considered using its train driving simulator to let its drivers practise a scenario where an ABCL had failed, and so an opportunity for drivers to practise this was not available.

Observations¹⁴

Incident investigation

- 91 Railway Group Standard GO/RT3119 'Accident and Incident Investigation'¹⁵ mandates the requirements for the investigation of accidents and incidents involving infrastructure managers and train operators. The standard defines the roles in the investigation process of the railway industry parties.
- 92 An investigation into the incident on 25 June 2013 was completed by FTPE with Network Rail's involvement. The lead investigator from FTPE used information following an early review into the incident that had also involved Network Rail, including input from a local manager regarding aspects of the level crossing's operation. However, important information about the level crossing's design had not been considered because neither the lead investigator, nor the local manager from Network Rail, had the necessary specialist technical competence.
- 93 Following a previous near-miss at Butterswood level crossing in August 2005 (paragraph 99), Network Rail stated that it was not involved in the investigation of the incident. Network Rail also stated that it was not aware of the resulting recommendation to fit AWS approaching Butterswood level crossing until after the incident on 25 June 2013 (paragraph 72).

¹³ GE/RT8000/TW8, Module TW8, Section 4.4. The railway rule book can be found at http://www.rgsonline.co.uk/Rule_Book/Forms/Live_Documents.aspx.

¹⁴ An element discovered as part of the investigation that did not have a direct or indirect effect on the outcome of the accident but does deserve scrutiny.

¹⁵ Railway Group Standards are available at www.rgsonline.co.uk.

Driver briefing on actions at SSRBs

- 94 Briefing material for train drivers provided by FTPE about its professional driving policy was substantial and very detailed. While this was a ‘one-off’ brief intended to refresh drivers’ knowledge, the volume of information being presented meant that there was a risk that important information could be overlooked or forgotten.
- 95 The information in FTPE’s professional driving briefing about ABCLs does not make it explicit that drivers should start to brake to stop before reaching the crossing if they observe the red light is flashing at the DCI on passing the SSRB. The SSRB is often positioned at no more than braking distance from the level crossing. Applying the brakes beyond the SSRB may mean a train cannot stop before the crossing. The requirements for ABCLs within the rule book (GR/RT8000 module TW8) do not state that the train’s brakes should be applied when passing the SSRB if the DCI is displaying a red aspect.
- 96 The RAIB made a recommendation to RSSB about this following an RAIB investigation into a near-miss at Llanbadarn ABCL on 21 October 2008¹⁶. A train passed over the crossing with the barriers raised, narrowly avoiding a collision with a lorry carrying liquefied petroleum gas. Causes of the incident included the train driver anticipating the level crossing would operate, and then applying the train’s brakes too late to stop before the crossing. The recommendation was;

Recommendation 3

‘The Rail Safety and Standards Board (RSSB) should make a proposal, in accordance with the Railway Group Standards code, to amend paragraph 4.2 of module TW8 of the Rule Book so as to make explicit that a driver should start to control his speed at once if he observes a flashing red aspect when passing the special speed restriction board of a locally monitored automatic crossing’.

- 97 In response to this recommendation, the RSSB said that, after consideration, it had *‘concluded that it was not appropriate to introduce a rule that prescribed so specifically how a driver should control his/her train. This was not normal practice within the rules, the actual braking point required is not fixed, but will vary according to actual approach speed, the braking capability of the train concerned and the adhesion conditions’.*

Monitoring driver performance

- 98 Northern Rail was the operator of the passenger service on the Barton-on-Humber line and used hired-in traincrew through a contractual agreement with FTPE (paragraph 10). This agreement included a requirement for those traincrew to be managed in accordance with the requirements of FTPE’s safety management system. The RAIB observed that FTPE was not able to comply with its own requirement to unobtrusively monitor the performance of traincrew on the Barton-on-Humber line through the use of OTDR data, because its competence managers were not trained on downloading and analysing the OTDR software used on the Northern Rail class 153 trains. This had been recognised by FTPE and Northern Rail before the incident, but although discussions had been held to identify a way forward, no action had been taken to address the deficiency by 25 June 2013.

¹⁶ Report 20/2009 available at www.RAIB.gov.uk.

Previous occurrences of a similar character

- 99 In the near-miss that occurred between a car and train on Butterswood level crossing on 31 August 2005 the industry investigation stated that the cause of the incident was due to the train driver becoming distracted by a fault with the train. This led to him failing to notice that the DCI was still indicating a flashing red light until it was too late to stop the train before the crossing.

Summary of conclusions

Immediate cause

100 The train passed over the level crossing while the barriers were raised and the crossing was open to road traffic (**paragraph 37**).

Causal factors

101 The causal factors were:

- a. the train driver did not notice that the DCI had not changed to display a flashing white light, until it was too late to stop before reaching the level crossing (**paragraph 39, Recommendation 1**) because of a combination of the following factors:
 - he expected that the level crossing would operate normally as the train approached (**paragraph 41**); and
 - the driver did not focus his attention on the DCI at the time that his train passed the speed restriction board, which was the point at which he needed to confirm that the crossing had operated correctly for the passage of his train (**paragraph 47**);
- b. the level crossing did not automatically operate for the approaching train because the power supply to the crossing equipment had been interrupted (**paragraph 54, Recommendation 2**); and
- c. although the level crossing had probably failed around nine hours before the incident, this failure was not known to the driver, signaller or signalling technicians (**paragraph 60, Recommendation 3**).

Underlying factors

102 The underlying factors were:

- a. there was no AWS equipment provided on the approach to the AWBs for Butterswood level crossing (**paragraph 65, see paragraph 106 and Learning point 1**);
- b. the maintenance arrangements in place at the crossing did not identify that the RCD was not required, that the UPS could not perform reliably, and that the data logger system's batteries were defective (**paragraph 74, Learning points 2 and 3, Recommendation 2**); and
- c. First TransPennine Express's briefing material did not clearly explain to drivers their role in respect of failures at ABCLs (**paragraph 84, Recommendation 4**).

Additional observations

103 Although not linked to the accident on 25 June 2013, the RAIB observes that:

- a. the industry investigation into the incident lacked technical expertise (**paragraphs 92 and 93, Learning point 4**).
- b. First TransPennine Express's guidance and briefing material did not clearly explain that drivers should start to control the speed of the train at once if they observe that a flashing red light is still visible on the DCI when passing the SSRB of a locally monitored automatic level crossing (**paragraphs 94 and 95, Recommendation 4**).
- c. First TransPennine Express was not compliant with its own corporate requirement to monitor traincrew performance using OTDR data (**paragraph 98, see paragraph 104**).

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

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

- 104 The driver managers at First TransPennine Express's Cleethorpes depot now analyse the OTDR equipment fitted to Northern Rail's class 153 trains following training in downloading and analysing the data (paragraph 103c).

Other reported actions

- 105 The UPS system at Butterswood level crossing has been replaced with a new system.
- 106 Network Rail is installing AWS equipment approaching Butterswood level crossing as part of its upgrade of the North Lincolnshire routes (paragraph 102a).

Learning points

107 The RAIB has identified the following learning points¹⁷ for the railway industry:

- 1 Railway Group Standard GE/RT8075 'AWS and TPWS Interface Requirements' states that AWS shall be fitted on all signalled lines, except where a train protection system provides a level of protection equal to, or better than, that provided by AWS and TPWS. This investigation identified that AWS equipment had not been provided at the level crossing warning board as required by Railway Group Standards (paragraphs 66 to 70) and that no derogation had been granted. The railway industry is reminded of the need for compliance with the above standard and to risk assess any proposals for non-fitment of AWS on any line of route (paragraph 102a).
- 2 The records associated with the testing of the UPS at Butterswood level crossing were not completed in accordance with the required process. This meant the asset's poor condition was not formally recorded and an opportunity to identify repeat failures was lost. Where an asset fails to meet the required test or inspection criteria, it is important that the matter is recorded in accordance with company procedures (paragraph 102b).
- 3 When storing replacement batteries for safety related equipment their age should be recorded and their condition monitored to ensure that they are in adequate condition when they are eventually brought into use (paragraph 102b).
- 4 When carrying out investigations into accidents and incidents, it is important that those investigations involve people with the required technical expertise so that safety lessons can be effectively identified, and recommendations addressed appropriately (paragraph 103a).

¹⁷ Learning points' are intended to disseminate safety learning that is not covered by a recommendation. They are included in a report when the RAIB wishes to reinforce the importance of compliance with existing safety arrangements (where the RAIB has not identified management issues that justify a recommendation) and the consequences of failing to do so. They also record good practice and actions already taken by industry bodies that may have a wider application.

Recommendations

108 The following recommendations are made¹⁸:

- 1 *The intent of this recommendation is to provide a positive indication to train drivers when automatic locally monitored level crossings have failed to operate for the approaching train.*

Network Rail, in consultation with RSSB, should conduct a human factors and technical review of the indications displayed at driver's crossing indicators provided on the approach to automatic locally monitored level crossings, and evaluate alternative means (eg audible and visual) of indicating to train drivers that the level crossing has not operated as intended. A time-bound plan for improvements arising from the review should be developed using a risk-based approach (paragraph 101a).

- 2 *The intent of this recommendation is to improve the reliability of all power supplies (including battery back-up arrangements) at automatic locally monitored level crossings.*

Network Rail should review the arrangements in place at all types of automatic locally monitored level crossings, and make improvements to the reliability of those crossings. The review, and associated improvements, should include (but not be limited to):

- a. locations where parallel protective systems exist (such as multiple earthing systems combined with RCD protection) where their presence can lead to unnecessary loss of the main network power supply to the level crossing;
- b. the plans in place to ensure that UPS systems maintain adequate performance throughout their life (including plans to replace UPS battery systems during the life of the UPS system); and
- c. understanding the age of UPS systems in use, and the manufacturer's life expectancy of those assets (paragraphs 101b and 102b).

continued

¹⁸ 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.

- 3 *The intent of this recommendation is for Network Rail to be able to identify level crossings that have suffered a power supply failure so that prompt action can be taken to manage the consequences of the failure including consideration of the benefits of recent technological developments that allow remote condition monitoring at reasonable cost.*

Network Rail should evaluate the practicality of remote condition monitoring of the power supply system, and key sub-systems whose failure can have the same effect as loss of power supply, at all locally monitored level crossings, so that prompt action can be taken to manage the failure (such as telling train drivers that the crossing has failed and arranging for technical staff to attend the level crossing to investigate the failure) (paragraph 101c).

- 4 *The intent of this recommendation is for First TransPennine Express to identify and implement changes where necessary to its briefing methods in order to reduce the risk of drivers making errors at key locations such as locally monitored crossings.*

First TransPennine Express should review and enhance its briefing techniques and guidance material for train drivers (paragraph 102c):

- a. to explain the role of the driver at locally monitored crossings;
- b. to ensure that it properly reflects the operation of key infrastructure assets such as level crossings (including revisions to its description of the arrangements at automatic locally monitored level crossings, beyond the level of detail described in the railway rule book);
- c. to allow its train drivers to practise dealing with unannounced level crossing failures, including, for example, the use of its train driving simulator or *video-based hazard perception* exercises;
- d. by using focused, risk-based, presentation material for briefing operational staff (paragraph 103b); and
- e. by stating clearly the action drivers should take when passing the special speed restriction board of any locally monitored automatic level crossing, when a flashing red light is visible at the drivers crossing indicator (paragraph 103b).

Note: Recommendation 4 may also apply to other train operators.

Appendices

Appendix A - Glossary of abbreviations and acronyms

ABCL	Automatic barrier crossing, locally monitored
AWB	Advance warning board
AWS	Automatic warning system
CCTV	Closed-circuit television
DCI	Driver's crossing indicator
DSD	Driver's safety device
DVD	Driver's vigilance device
FFCCTV	Forward-facing closed circuit television
FTPE	First TransPennine Express
OTDR	On-train data recorder
RAIB	Rail Accident Investigation Branch
RCD	Residual current device
RSSB	Rail Safety and Standards Board
SSRB	Special speed restriction board
TPWS	Train protection and warning system
UPS	Uninterruptible power supply

Appendix B - Glossary of terms

Authorised derogation	The procedure by which permanent non-compliance with a requirement of a Railway Group Standard is authorised by the RSSB.
Automatic warning system (AWS)	A safety system for alerting train drivers about the signal aspect or speed restriction ahead. A horn sounds in the driving cab for a red, single or double yellow signal aspect, or a warning sign for a speed restriction. A bell sounds to indicate a green signal.
Driver's safety device	A system, normally incorporating a foot pedal that must be kept depressed. If pressure on the foot pedal is released, the train's brakes are applied after a delay of around five to seven seconds.
Driver's vigilance device	A system, often incorporated into the DSD system that sounds an alert at regular intervals (normally around 60 seconds). If the driver does not acknowledge the alert the train's brakes are automatically applied through the driver's safety device system.
Professional driving policy	A company policy that provides information and guidance to train drivers about personal attitudes, behaviours and train driving techniques, including the control of risks caused by behaviour and other factors arising within and outside the work environment.
Railway Group Standard	A document mandating the technical or operating standards required of a particular system, process or procedure to ensure that it interfaces correctly with other systems, process and procedures. Railway Group Standards are maintained by RSSB on behalf of the railway industry.
Residual current device	A type of automatic circuit breaker designed to prevent potentially fatal electrical shocks should a person come into contact with any exposed elements of an energised electrical circuit. When a RCD detects that the electric current is not balanced between the energised conductor and the return neutral conductor, it operates to disconnect the electrical supply.
Track circuit	A device to detect trains which involves passing an electrical current through the rails.
Train Protection and Warning System	<p>The primary purpose of the Train Protection and Warning System (TPWS) is to minimise the consequence of a train passing a TPWS fitted signal at danger, or a train over-speeding at certain other locations on Network Rail controlled infrastructure.</p> <p>The Train Protection and Warning System (TPWS) is designed to be compliant with the train protection requirements of the Railway Safety Regulations 1999.</p>

Uninterruptible
power supply

A near-instant back-up electrical power supply system using energy stored in batteries.

Video-based
hazard perception

The use of video equipment to simulate hazards to test the user's response.

Appendix C - Key standards current at the time

GK/RT0016 (issue 1, May 1997)	Automatic Warning System of Train Control (AWS)
GE/RT8035 (issue 1, October 2001)	Automatic Warning System (AWS)
GE/RT8075 (issue 1, September 2013)	AWS and TPWS Interface Requirements
GA/RT6006 (issue 1, August 1998)	Derogations from Railway Group Standards
GK/RT0038 (issue 1, May 1996)	Speed Restrictions
GO/RT3119 (issue 3, December 2012)	Accident and Incident Investigation

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