



Rail Accident Investigation Branch

Rail Accident Report



**Near-miss at Llandovery level crossing,
Carmarthenshire
6 June 2013**

Report 11/2014
May 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 05:56 hrs on Thursday 6 June 2013, train 2M43, the 04:34 hrs passenger service from Swansea to Shrewsbury, was driven over Llandovery level crossing in the town of Llandovery in Carmarthenshire, Wales, while the crossing was open to road traffic. As the train approached the level crossing, a van drove over immediately in front of it. A witness working in a garage next to the level crossing saw what had happened and reported the incident to the police.

The level crossing is operated by the train's conductor using a control panel located on the station platform. The level crossing was still open to road traffic because the conductor of train 2M43 had not operated the level crossing controls. The conductor did not operate the level crossing because he may have had a lapse in concentration, and may have become distracted by other events at Llandovery station.

The train driver did not notice that the level crossing had not been operated because he may have been distracted by events before and during the train's stop at Llandovery, and the positioning of equipment provided at Llandovery station relating to the operation of trains over the level crossing was sub-optimal.

The RAIB identified that an opportunity to integrate the operation of Llandovery level crossing into the signalling arrangements (which would have prevented this incident) was missed when signalling works were planned and commissioned at Llandovery between 2007 and 2010. The RAIB also identified that there was no formalised method of work for train operations at Llandovery.

The RAIB has made six recommendations. Four are to the train operator, Arriva Trains Wales, and focus on improving the position of platform equipment, identifying locations where traincrew carry out operational tasks and issuing methods of work for those locations, improvements to its operational risk management arrangements and improving the guidance given to its duty control managers on handling serious operational irregularities such as the one that occurred at Llandovery.

Two recommendations are made to Network Rail. These relate to improvements to its processes for signalling projects, to require the wider consideration of reasonable opportunities to make improvements when defining the scope of these projects, and consideration of the practicability of providing a clear indication to train crew when Llandovery level crossing, and other crossings of a similar design, are still open to road traffic.

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 term 'up direction' refers to trains travelling towards Craven Arms, and the term 'down direction' refers to trains travelling towards Llanelli.
- 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 05:56 hrs on Thursday 6 June 2013, train 2M43, the 04:34 hrs passenger service from Swansea to Shrewsbury, was involved in a near-miss with a van at a level crossing in the town of Llandovery in Carmarthenshire, Wales (figure 1). This occurred because 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, the condition which the crossing should be in when there are no trains approaching.

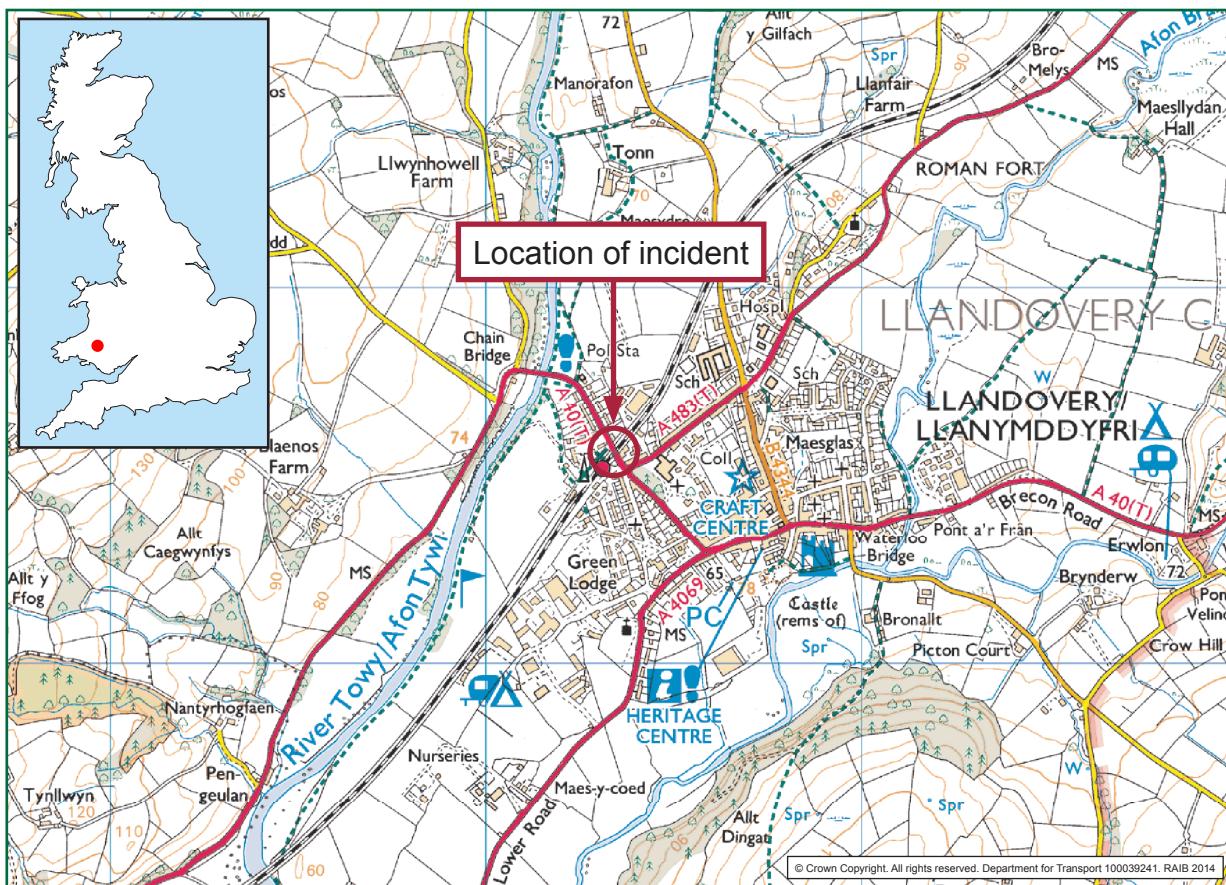


Figure 1: Extract from Ordnance Survey map showing location of incident

Context

Location

- 7 Llandovery is located on the Central Wales line (also known as the Heart of Wales line), which runs from Llanelli in the south to Craven Arms in the north, where it joins the railway from Hereford to Shrewsbury. The Central Wales line is mainly a single track railway with *passing loops* at Pantyffynnon, Llandeilo, Llandovery, Llanwrtyd Wells, Llandrindod and Knighton (figure 2). By rail, Llandovery is located approximately 31 miles from Llanelli and 60 miles from Craven Arms. At the level crossing, the railway intersects Tywi Avenue, the A40 road from London to West Wales, which carries heavy vehicle and pedestrian traffic.

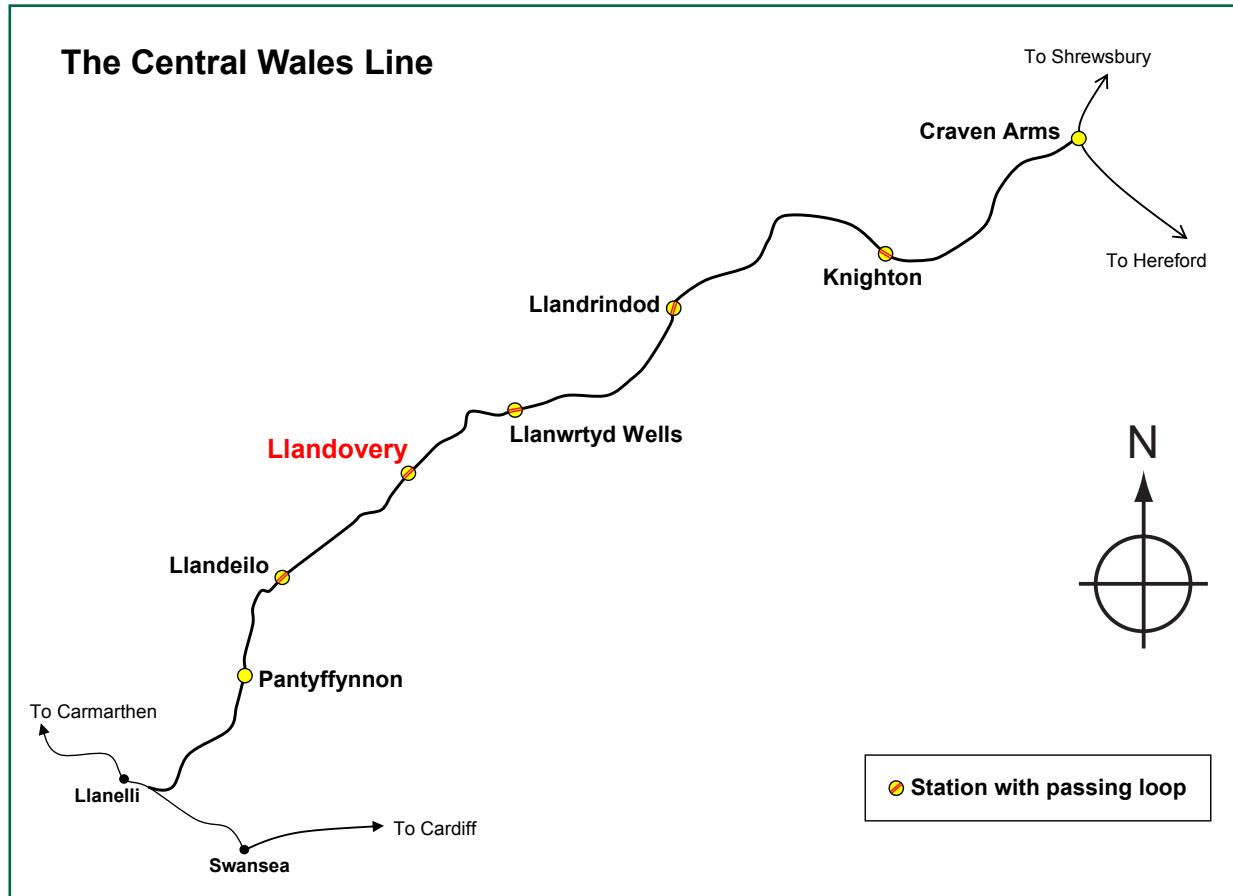


Figure 2: The Central Wales line (not to scale and not all features shown)

Organisations involved

- 8 Network Rail is the owner, maintainer and manager of the infrastructure. This includes Llandovery level crossing, and the equipment associated with its operation at Llandovery station.
- 9 Arriva Trains Wales (ATW) is the operator of the passenger service over the Central Wales line. It employed the driver and conductor of train 2M43 and was responsible for the provision of customer services to passengers using the station, including passenger information systems.

Train involved

- 10 Train 2M43 was formed by a class 150 'Sprinter' diesel train. The train comprised two vehicles and was 40 metres long with a maximum speed of 75 mph (121 km/h). The train was fitted with an on-train data recorder (OTDR) and forward-facing and internal closed circuit television equipment (FFCCTV and internal CCTV).

Rail equipment/systems involved

- 11 There are two platforms at Llandovery station. Normally, trains travelling towards Craven Arms use the up platform, and those to Llanelli use the down platform. The level crossing is located at the north end of the station (figure 3). The crossing has four barriers, two on each side of the level crossing, which together cover the whole width of the road. The crossing is provided with road traffic signals which, when the crossing is required to close for the approach of a train, initially display an amber warning light to drivers and then change to alternate flashing red lights which warn road users that the barriers are about to descend.
- 12 For trains travelling towards Craven Arms, the crossing is operated by the train conductor (also known as a guard) using a control panel situated in a locked cupboard on the platform¹. After operating the level crossing controls, the conductor should check that the crossing has operated correctly by observing that the barriers have lowered, and that no vehicles or pedestrians are trapped within the crossing. This type of crossing is known as a traincrew operated barrier crossing.
- 13 A *stop board* is located on the up platform at Llandovery, around seven metres from the north end, with the wording, '**Stop. Operate barriers. Obtain white light before proceeding**' (figure 4). The stop board is carried on the same post as the cupboard containing the level crossing controls. When the level crossing barriers have commenced lowering, and the road traffic signals are showing red stop lights, a white light on the stop board will illuminate and flash (the light is not illuminated at any other time). The flashing white light indicates to the train driver and conductor that the level crossing is operating correctly and that the train may pass the level crossing stop board.

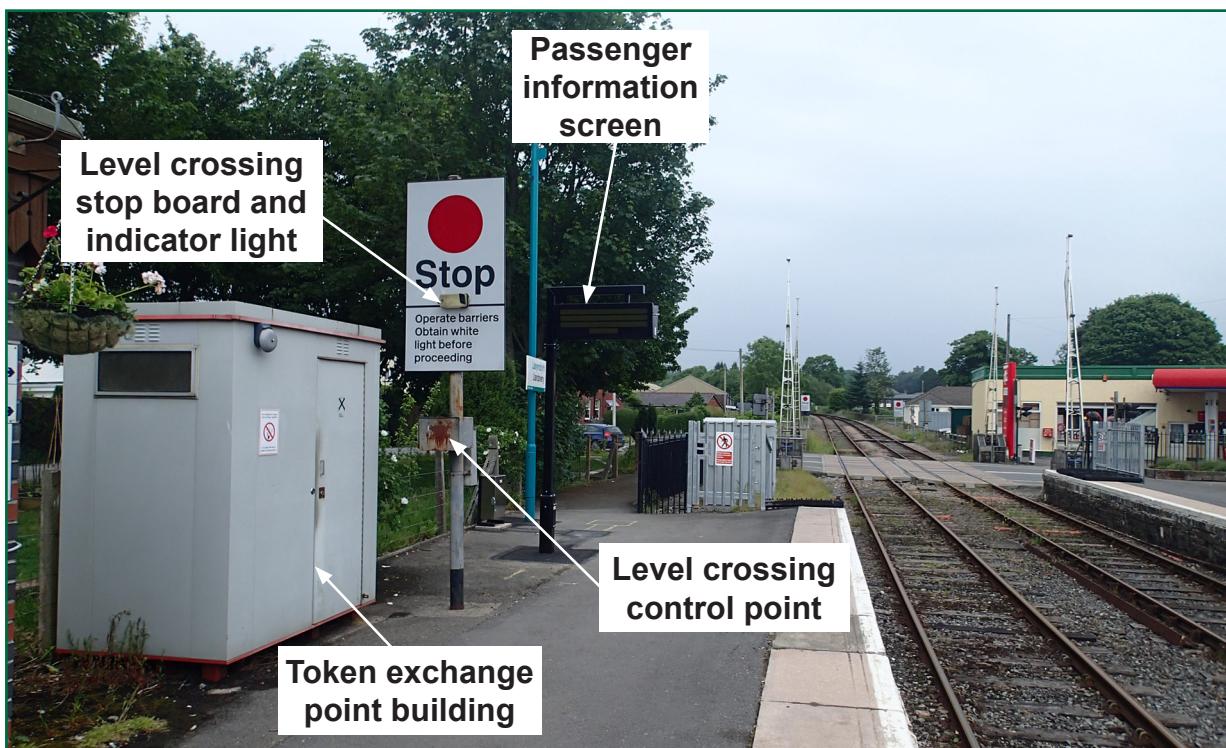


Figure 3: Llandovery up platform and level crossing

¹ To operate the level crossing a 'lower' push-button must be kept depressed until the barriers have fully lowered. If the push-button is released the lowering sequence will stop.



Figure 4: The up platform level crossing stop board

- 14 The single-line sections on the Central Wales line are operated in accordance with the 'No signaller token with remote crossing loops' (NSTR) regulations issued by Network Rail. These regulations permit a train driver (or other authorised person) to operate a *token instrument* with permission from the signaller at Pantyffynnon. Once a token is withdrawn from a token instrument, electrical interlocking prevents a token being withdrawn from any other token instrument relating to the same section of single line. Drivers are required to be in possession of the token before entering the single line section, and carry the token with them during the journey over the single line, thus ensuring that only one train can traverse a single line section at any one time. The token instruments are located in a locked hut on the platform, close to the cupboard containing the controls for the level crossing (figure 3).
- 15 On arrival at Llandovery², the driver of a train travelling towards Craven Arms puts the *token* for the section of line over which the train has just travelled into the instrument for that section, and retrieves a token from the other instrument in the hut for the section of line onwards to Llanwrtyd Wells. The driver must also get verbal permission from the signaller at Pantyffynnon to pass the stop board at the entrance to the single line section (this is referred to in the next paragraph). This often happens at the same time that the conductor is operating the level crossing (paragraph 12). Both the conductor and the driver must check that the white light (paragraph 13) is flashing before the train can continue.

² The working of trains at Llandovery is based on documents and information provided by Network Rail and Arriva Trains Wales.

- 16 A second stop board, associated with the beginning of the single line section north of Llandovery, is located around 90 metres beyond the level crossing. The wording on this stop board reads '**Stop. Start of section. Obtain token to Llanwrtyd and permission to proceed**'. A red light normally flashes on the stop board to indicate that the motorised *points* at the entrance to the single line have not been set for the passage of a northbound train. In this condition, the *train protection and warning system* (TPWS) equipment is active and will apply a train's brakes to prevent it from entering the single line. Under normal circumstances when the driver withdraws the token for the section to Llanwrtyd Wells (paragraph 15), the points will be driven to the correct position, the TPWS equipment will be suppressed (ie it will not intervene to stop a train which passes over it), and a flashing blue light will replace the flashing red light on the stop board. The TPWS equipment is suppressed for a period of seven minutes. After this period, if no train has passed, the TPWS will become active and two minutes later, the points will be driven to the opposite position (ie to allow a train to approach Llandovery from the Llanwrtyd direction). In this condition, the flashing blue light will be replaced by a flashing red light on the stop board.
- 17 Providing the train driver and conductor have correctly performed the actions described above, the train can proceed past the level crossing stop board displaying a flashing white light, over Llandovery level crossing (with its barriers lowered), and then past the single line stop board displaying a flashing blue light onto the single line towards Llanwrtyd Wells. Once on the single line the train than passes a 'barriers up' indicator (located around 400 metres beyond the level crossing). The 'barriers up' indicator informs the driver whether the level crossing barriers have risen, and thus the level crossing is open to road traffic. If the 'barriers up' indicator remains unlit at the point the train is about to pass it, the driver must stop the train. The conductor (or driver where no conductor is provided as would be the case for freight trains) is then required to walk back to the crossing, and establish if the barriers have correctly risen. If they have not, the conductor is required to try to raise them using the level crossing controls or by manual operation if necessary. This ensures that the road over the crossing does not remain closed to road vehicles and pedestrians for long periods of time.

Staff involved

- 18 The driver of train 2M43 had eight years of train driving experience. He was based at ATW's Carmarthen depot. On average, he drove trains over the Central Wales route three or four times a month. He had previously been a conductor for three years during which time he had operated Llandovery level crossing on many occasions.
- 19 The conductor of train 2M43 had five years' experience in that role, and had worked trains over the Central Wales line throughout that period. He was also based at ATW's Carmarthen depot. On average, he worked trains over the Central Wales line two to three times a month, and was experienced at operating Llandovery level crossing.

External circumstances

- 20 It was a clear, bright morning with clear visibility.

Events preceding the incident

- 21 Train 2M43 departed from Swansea on time at 04:34 hrs. At Llanelli, the driver and conductor involved in the incident took over operation of the train from another traincrew.
- 22 The train left Llanelli at around 04:55 hrs. The conductor travelled with the driver in the driving cab³ between stations as the train progressed towards Llandovery, where it arrived, on time, at 05:53 hrs. When the train stopped, the conductor left the driving cab, opened the train's doors, alighted and stood on the platform next to the train. The driver also alighted to carry out the token exchange (paragraph 15).
- 23 CCTV images from the train showed that the conductor stayed close to the leading set of train doors. He did not walk over to the level crossing controls and operate them. Around 70 seconds after he first alighted, the driver, having completed the token exchange, returned and entered the driving cab.

Events during the incident

- 24 Around 13 seconds after the driver had re-joined the train, the conductor closed the train's doors, and signalled to the driver that the train was ready to depart. Neither the driver nor conductor checked to see if the white light on the level crossing stop board was flashing, and the driver did not notice that the barriers were still raised.
- 25 The driver applied power, and the train departed from the platform. CCTV images from a garage located close to Llandovery level crossing, and from the train's FFCCTV, showed that as the train reached the level crossing, a white van passed over the crossing immediately in front of the train (figure 5). The near-miss was seen by an ATW employee travelling on the train, and a worker at the garage. There were no other road vehicles in the vicinity at the time.

Events following the incident

- 26 Train 2M43 continued northwards and onto the single line. CCTV images from the train showed that shortly after departing from Llandovery, the conductor entered the driving cab where he remained until a short while after the train had passed the 'barriers up' indicator (paragraph 17). Because the level crossing had not been operated, the 'barriers up' indicator would have remained unlit.

³ Rules permit conductors to be in the leading driving cab while the train is being driven only under defined circumstances, normally in connection with certain train defects. It requires the explicit permission of an authorised person as defined by a train operator's procedures.



Car approaching level crossing

Car has passed over the level crossing as a train is passing over it

Figure 5: CCTV from the nearby garage showing the near-miss (note: the time stamp on the CCTV images reflect GMT and did not represent the actual time of the incident) (images supplied courtesy of McCanns Group and Morris Isaacs Garage, Llandovery)

- 27 The train's next station stop was at Llanwrtyd Wells, about 11 miles beyond Llandovery (there are two intermediate stations at Cyngordy and Sugar Loaf, but the train was only required to stop at them if requested by a passenger). After witnessing the incident, the garage employee rang Dyfed Powys police to report the near-miss, who in turn reported the incident to Network Rail's control room. ATW's control is located jointly with Network Rail's control, and so ATW's Duty Control Manager was aware of the incident soon after. He spoke with the conductor by phone while the train was stationary at Llanwrtyd Wells, and permitted the driver and conductor to continue to Llandrindod station (about 16 miles (26 km) beyond Llanwrtyd Wells), where they were scheduled to be relieved by another crew who would take the train forward. Both the driver and conductor were removed from duty at Llandrindod and were subsequently tested for the presence of drugs and alcohol in accordance with ATW's routine procedures for staff involved in safety incidents. The tests did not detect the presence of drugs and alcohol in either member of staff.

The investigation

Sources of evidence

28 The following sources of evidence were used:

- witness statements;
- data from the train's OTDR;
- CCTV recordings taken from the train involved, and a garage located adjacent to Llandovery level crossing;
- site photographs and measurements;
- information held by Network Rail about Llandovery level crossing;
- Network Rail documents relating to upgrade work that had taken place at Llandovery in 2007 to 2010;
- ATW safety management system documents;
- Railway Group Standards, and Network Rail company standards, relating to level crossing design, management and risk assessment; and
- a review of previous RAIB investigations that had relevance to this incident.

Key facts and analysis

Identification of the immediate cause⁴

29 The train passed over the level crossing while the barriers were raised and the crossing was open to road traffic.

Identification of causal factors⁵

- 30 The reason why the train passed over the level crossing while the barriers were raised was a combination of the following factors:
- the conductor of train 2M43 did not operate the level crossing controls while at Llandovery station;
 - the driver of train 2M43 did not check that the white flashing light was illuminated on the level crossing stop board, or notice that the level crossing barriers were still raised, before departing from Llandovery station; and
 - an opportunity to integrate the operation of Llandovery level crossing into the signalling arrangements for the single line section ahead, which would have prevented this incident, was missed when improvement works were undertaken at Llandovery in 2007.

Each of these factors is now considered in turn.

The actions of the conductor

- 31 The conductor of train 2M43 did not operate the level crossing controls at Llandovery station. This was a causal factor.
- 32 The conductor was experienced in operating the level crossing at Llandovery. However, he did not operate the crossing before the train passed over it on the morning of 6 June 2013. The RAIB considers that either, or both, of the following factors may have contributed to this omission:
- the conductor may have had a lapse in concentration; and
 - the conductor may have become distracted by other events at Llandovery station.

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.

The conductor's concentration and awareness

- 33 The conductor may have had a lapse in concentration which resulted in him overlooking the need to operate the crossing at Llandovery.

Fatigue

- 34 The conductor stated that he had only slept for around three and a half hours before leaving home for work on the day of the incident, and had only slept for four hours the night before that. On both occasions the conductor left home for work early in the morning as he was scheduled to commence duty at 04:03 hrs on the day of the incident, and at 04:41 hrs the previous day. The conductor said that although he felt tired, he did not consider not going to work on the morning of the incident. He was aware of ATW's policy about not reporting for duty if unfit, but he considered himself fit to work.
- 35 The conductor reported that factors external to his work may have had a direct bearing on both the quantity and quality of his sleep in the previous 36 hours, and the RAIB considers that tiredness may have affected his concentration while working train 2M43.
- 36 Arriva Trains Wales, like other train operators, has a policy that staff should not book-on for duty when they are fatigued, or when they feel that they are unfit to work. However, RAIB has noticed in the course of its investigations⁶ occasions when staff have booked on duty when they have not had sufficient length or quality of sleep. The reasons staff may not apply company policies about reporting 'unfit' for duty include the general stigma associated with reporting unfit because of tiredness, fear of triggering company attendance procedures, or the effect their absence will have on their work colleagues or train services, particularly on early shifts where it is often difficult to provide last-minute cover for their absence. It is also sometimes the case that although staff may know that they have not had sufficient sleep, they do not feel tired at the start of their shift, but do start to suffer from tiredness later. The Office of Rail Regulation (ORR) reports that it has suggested to RSSB⁷, that further work is desirable on the development of booking-on aids to help companies (and individual members of staff) make an informed 'on-the-spot' decision about whether staff who are about to book-on are likely to be able to safely work their whole shift in terms of fatigue. At present RAIB understands that neither ORR, nor RSSB, has any firm plans for research into methods for detecting and managing actual or potential fatigue at the start of, or during shifts. RAIB intends to undertake work itself to better understand this issue, including considering good practice from other industries.

⁶ Brentingby Junction (report 01/2007), Basford Hall (report 06/2007) and Purley Station (report 27/2007) are examples where staff have booked on duty following poor-quality, or insufficient sleep prior to a shift. RAIB reports are available at www.raib.gov.uk.

⁷ 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'.

Other factors

- 37 The conductor had travelled in the driving cab during the journey (this was against the rules). Llandovery is the only station between Llanelli and Llandrindod at which both the conductor and the driver have duties to perform outside the train at the same time. There are two stations between Llanelli and Llandovery where the driver leaves the train to operate the token equipment (with no action by the conductor to operate a crossing at either location), and three stations where the conductor operates a level crossing (and the driver remains in the cab). It is possible that the conductor, seeing the driver leave the train at Llandovery to operate the token equipment, indirectly associated this with a station where he was not required to perform any action, other than open and close the train doors and indicate to the driver when the train could depart.
- 38 While the driver was carrying out the token exchange, the level crossing control unit was out of the conductor's sight because when fully open, the token hut door can partially obscure the level crossing control panel (figure 6). Had the level crossing controls been fully visible, the conductor might have noticed them and realised he had not yet operated the crossing. However, the fact that the conductor did not observe that the white light on the crossing stop board was not illuminated, and did not notice that the level crossing barriers were in the raised position, indicate the extent to which he was not alert to the task, as these were key elements of his duties at this location.



Figure 6: The level crossing control panel partially obscured by the open token hut door

Distractions at Llandovery station

- 39 **The conductor may have become distracted by other events at Llandovery station.**
- 40 The conductor may have become distracted on arriving at Llandovery by two other factors. He stated he had observed a member of the public with a dog walking along the platform, but not boarding the train, and was concerned that he might trespass on the railway by walking off the far end of the platform (gates were provided, but had not yet been fitted with padlocks). The conductor stated that he decided to monitor the situation until it became apparent that the member of the public was not going to trespass. He also noticed that the passenger information screen was not working (unknown to the conductor, it had not yet been commissioned, and he had not noticed it on previous days).

The actions of the train driver

- 41 **The driver of train 2M43 did not check that the white flashing light was illuminated on the level crossing stop board, or notice that the level crossing barriers were still raised, before departing from Llandovery station.**
- 42 Although the driver had significant experience of operating trains through Llandovery station, he did not notice that the white flashing light, which indicates that the crossing barriers have closed, was not working. He also did not notice that all four level crossing barriers were in the raised position. RAIB considers that the following factors may have contributed to this omission:
- the driver may have been distracted by events before and during the train's stop at Llandovery; and
 - the white light on the level crossing stop board was not in the driver's direct line of sight, and the driver was less likely to see whether the light was illuminated and flashing from where the train had stopped.

Possible distractions

- 43 **The train driver may have been distracted by events before and during the train's stop at Llandovery.**
- 44 The driver stated that he was well rested in the days leading up to the incident and had slept well. Fatigue is not considered to have been a factor affecting the actions of the driver. RAIB considers that there were three possible sources of distraction for the driver as the train approached Llandovery station, and just before it departed:
- the presence of the conductor in the cab;
 - activity on the platform as the train arrived; and
 - the driver's focus on the flashing blue TPWS light (paragraph 16).

Each is discussed in turn.

- 45 **The driver may have been distracted by the presence of the conductor in the cab.**
- 46 The conductor travelled with the driver for most of the journey between Llanelli and Llandovery (paragraph 37). Although the driver and conductor were unable to recall the detail of their conversation, it is possible that it may have affected the driver's focus on the activities to be carried out when the train arrived at Llandovery station, and in the first few minutes after departing from the station.
- 47 There is evidence to suggest that the driver may have been distracted as train 2M43 arrived at Llandovery. He did not set the *driver's reminder appliance* (DRA) on arriving at the station⁸ (the rules require the DRA to be set when a train stops at a level crossing stop board). If he had operated the DRA, it is possible that he would have been reminded to check if the white light on the level crossing stop board was illuminated and flashing (discussed further at paragraphs 54 to 56), and he might have noticed that the barriers were still raised before releasing the DRA, although the driver stated that he relied on the conductor operating the level crossing and would not normally check the light on the level crossing stop board himself. Further evidence that the presence of the conductor may have distracted the driver was that the driver did not notice that the 'barriers up' indicator was unlit as the train passed it (paragraphs 17 and 26).
- 48 **The driver may have been distracted by activity on the platform as the train arrived at Llandovery.**
- 49 As the train was arriving at Llandovery, the driver also saw the member of public walking his dog along the platform (paragraph 40), which he stated had acted as an unwelcome reminder of a non-work-related recent event. The effect of this may have been that the driver became preoccupied as he operated the token equipment, and did not notice that the conductor had not walked over to the level crossing control unit to operate the controls (normally the conductor is still at the level crossing control unit after the driver has completed his duties).
- 50 **The driver was focused on the flashing blue TPWS light beyond the level crossing, which may have distracted him from noticing that the crossing barriers were still raised.**
- 51 The driver did not notice that the level crossing barriers were raised as he drove towards, and onto the crossing. The driver stated that he was looking at the flashing blue light TPWS/Points indicator displayed at the 'start of token section' stop board located beyond the level crossing (paragraph 16). The driver was conscious of the possibility that the TPWS equipment might 'time out' before he reached the stop board, which would automatically apply the train's brakes. This would result in a delay to the service because the driver would have to return to Llandovery station and carry out the token procedure again.

⁸ An analysis of OTDR data from a train working the previous day's journey over the Central Wales route, worked by the driver involved in the incident, recorded that the DRA was operated on arriving at Llandovery station.

- 52 The driver was trained on the changes to the NSTR regulations following the installation of power operated points on the Central Wales line in 2009. The training material used indicated that TPWS would be suppressed for only three minutes, starting from when the forward section token was taken out of the instrument. The assessment to prove a driver's competence in respect of the new arrangements also referred to a three minute suppression time. This information was not correct. The TPWS suppression timer fitted at the 'start of section' stop board on the up line at Llandovery had actually been set to seven minutes. Believing that he had only three minutes to reach the stop board after withdrawing the token, the driver may have been focused on the need to depart from Llandovery promptly, rather than on the condition of the crossing.

The train's stopping position in the platform

- 53 **The white light on the level crossing stop board was not in the driver's normal line of sight, and the driver was therefore less likely to see whether the light was illuminated and flashing from where the train had stopped.**
- 54 The white indicator light on the level crossing board is designed to operate when the crossing barriers are down, and the road traffic stop signals are illuminated, providing a positive indication to the driver that the crossing has operated correctly. On this occasion, the flashing white light did not operate before the departure of train 2M43 because the crossing had not been operated. However, this did not prevent the conductor from signalling (using the buzzer provided for the purpose) to the driver that the train was ready to start, or the driver from driving onto, and over, the level crossing with the barriers raised.
- 55 The stop board and associated flashing light were not positioned as well as they could have been at Llandovery. The requirements for positioning of stop boards are described in Railway Group Standard GK/RT0192 'Level crossing interface requirements'. This standard says that stop boards should be positioned 50 metres before level crossings, or 25 metres where a level crossing is located immediately beyond a station platform. The stop board at Llandovery was positioned around 27 metres from the level crossing, meaning that the usable length of the platform was 48 metres (since trains could not pass the stop board until the level crossing had been operated). The length of a two-car class 150 train is around 40 metres, so drivers had limited flexibility in deciding where to stop their train as they needed to ensure that the whole train was on the platform. No sign had been provided to tell drivers where to stop their trains, and they were therefore in the habit of stopping with the front of the trains close to the level crossing stop board, because it was positioned close to the token exchange hut on the platform (and close to the platform shelter where passengers waited for trains) (figure 7).



Figure 7: A train stopped in the up platform at Llandovery adjacent to the level crossing stop board (not the train involved in the incident)

- 56 When a train was stopped with the driver's cab opposite the token exchange hut, the level crossing stop board was not in the driver's direct line of sight, although it was visible out of the driving cab side window if looked for. Had a *car stop marker* been provided before the stop board⁹, or the stop board located to a position closer to the crossing¹⁰, it would have been more easily seen by drivers as it would be in their field of view when looking forward.
- 57 The driver stated that he would not normally look at the light on the level crossing stop board before departure. He assumed the conductor would not indicate to him that the train was ready to depart, unless the level crossing had been correctly operated and the white light was flashing, even though he knew that he was also responsible for checking for the white flashing light. He based this reliance on the conductor on his previous experience of being a conductor on the Central Wales route, when he had operated the level crossing at Llandovery on many occasions. However, had the stop board been directly within his line of sight, it is possible that he might have noticed that the flashing white light was not illuminated and flashing, without consciously deciding to look for it.

⁹ An assessment undertaken by Network Rail and ATW following the incident identified that to provide the optimum view of the white light on the level crossing stop board through the train windscreens, a car stop marker would need to be positioned around 10 metres on the approach to the level crossing stop board. Trains stopping at that point would not be fully accommodated in the platform. However, it was also found that the positioning of the car stop marker 8 metres on the approach to the level crossing stop board would significantly improve the visibility of the white flashing light, whilst still allowing the train to be fully accommodated within the platform (see paragraph 111).

¹⁰ Moving the level crossing stop board 10 metres closer to the level crossing from its current position would have required derogation from standard GK/RT0192 that states that stop boards should be positioned 25 metres from a level crossing where one is located immediately beyond a station platform (see paragraph 55).

The driver's crossing indicator

- 58 The indication to the train crew that the crossing had not been operated was the absence of the white flashing light; this was more likely to be overlooked than a positive indication of the crossing's status.
- 59 The indication to traincrew that the crossing has not been operated, or not operated correctly, is the absence of a flashing white light. Other types of level crossing display a positive indication in the form of a red flashing light to indicate that the crossing has not operated correctly (or has not yet been operated). A positive indication that the crossing had not been operated might have been observed by the conductor of train 2M43 because it would have been easier to notice than the absence of a white flashing light, particularly as the conductor was looking in that area when he noticed that the passenger information screen was not working (paragraph 40 and figure 3).
- 60 At the time of the incident no formalised process for the working of trains at Llandovery had been produced. This is discussed further at paragraphs 77 to 88.

Integrating the level crossing into the signalling arrangements

- 61 An opportunity to integrate the operation of Llandovery level crossing into the signalling arrangements for the single line section ahead, which would have prevented this incident, was missed when improvement works were planned and commissioned at Llandovery between 2007 and 2010.
- 62 In 1986 British Rail upgraded the Central Wales line by installing equipment to enable the introduction of NSTR working. With the closure of many of the signal boxes on the route, one of the main features of the NSTR system was remote passing loops equipped with *train operated points* at either end. Trains leaving the passing loops pushed the points over, and hydraulic pressure stored in the points system pushed the points back to their normal position once the train had passed through them.
- 63 Around 2007, Network Rail identified the need to replace the train operated hydro-pneumatic points on its Western route because they were becoming unreliable. With no identical point mechanisms available, and the high cost of engineering a new design of train operated points, Network Rail decided to replace the hydro-pneumatic point machines at the loop ends with widely available electric point machines. This project was called the Western Route Train Operated Points Scheme (WTOPS). It originally included five passing loops on the Central Wales line at Llandeilo, Llandovery, Llanwrtyd Wells, Llandrindod and Knighton with a further two locations elsewhere in Wales at Ystrad Rhondda and Tenby.
- 64 TPWS had already been installed at the 'start of section' stop boards and integrated with the token instruments on the Central Wales line in 2002/2003 as part of a national project to provide a train protection system on Britain's railway system, although the start of section stop boards were not fitted with any indicator lights at that time.

- 65 The WTOPS project was intended to be implemented with minimal change to the operation of the line, with its main focus being the renewal of the points systems to improve the reliability of the passing loops. Although integrating Llandovery level crossing into the signalling arrangements for entry onto the single line did not fit within the remit of the WTOPS project, there was early dialogue within Network Rail about incorporating the level crossing into the improvement works. However, it was decided by the WTOPS scheme that it was out of scope for the project (paragraph 67).
- 66 As the WTOPS project progressed, regular meetings and design risk assessment workshops took place involving Network Rail and its scheme contractor, and the train operators involved, principally ATW. ATW did not ask Network Rail to consider integrating the level crossing within the WTOPS scheme, because it had not identified any associated risk at Llandovery level crossing itself.
- 67 Railway Group Standard GK/RT0045 ‘Lineside Signals, Indicators and Layout of Signals’ permits the combining of the indications for a level crossing and TPWS/points indicator, which would have been one option for integrating the crossing with the signalling arrangements. The project team had considered this issue but did not propose combining the indications because:
- the level crossing stop board was located outside the token section (figure 8);
 - it was considered that combining the two stop boards would reduce the usable length of the loop line at Llandovery from about 400 metres long to around 300 metres, and this would have an operationally restrictive effect when long freight trains used the route¹¹;
 - it was believed that drivers would find the arrangement of lights confusing (white level crossing lights and blue TPWS/points lights would both be on the same board); and
 - the project team had not fully considered how the traincrew would be affected by the provision of the new equipment, and in particular that a train could depart from the platform without the level crossing having been operated.
- 68 For the reasons described in paragraphs 66 and 67, the scheme designers did not consider ways in which the safety of train movements into, and out of, Llandovery over the level crossing, could be enhanced by adapting the signalling equipment that was to be provided under WTOPS.
- 69 The project team had engaged Network Rail’s human factors team to review the layout of new and existing equipment provided in the token exchange/points huts. Although the human factors team undertook visits to Knighton (on the Central Wales line) and Ystrad Rhondda (on the line between Cardiff and Treherbert), they were not asked to review the arrangements at Llandovery. Furthermore, the human factors team was not made aware of the possibility of combining the indications for the level crossing and TPWS/points indicators at Llandovery because the project team had already decided not to progress the idea (paragraphs 65 to 67). No assessment was undertaken to establish if combining the indications would be better than keeping them separate.

¹¹ Although nearly all trains on the route were passenger trains formed of two vehicles (40 metres), there had recently been several long freight trains diverted over the route. Network Rail stated that it was mindful that altering the length of the loop may have to led to challenge from the freight operating companies concerned about possible difficulties using the Central Wales line as a diversionary route.

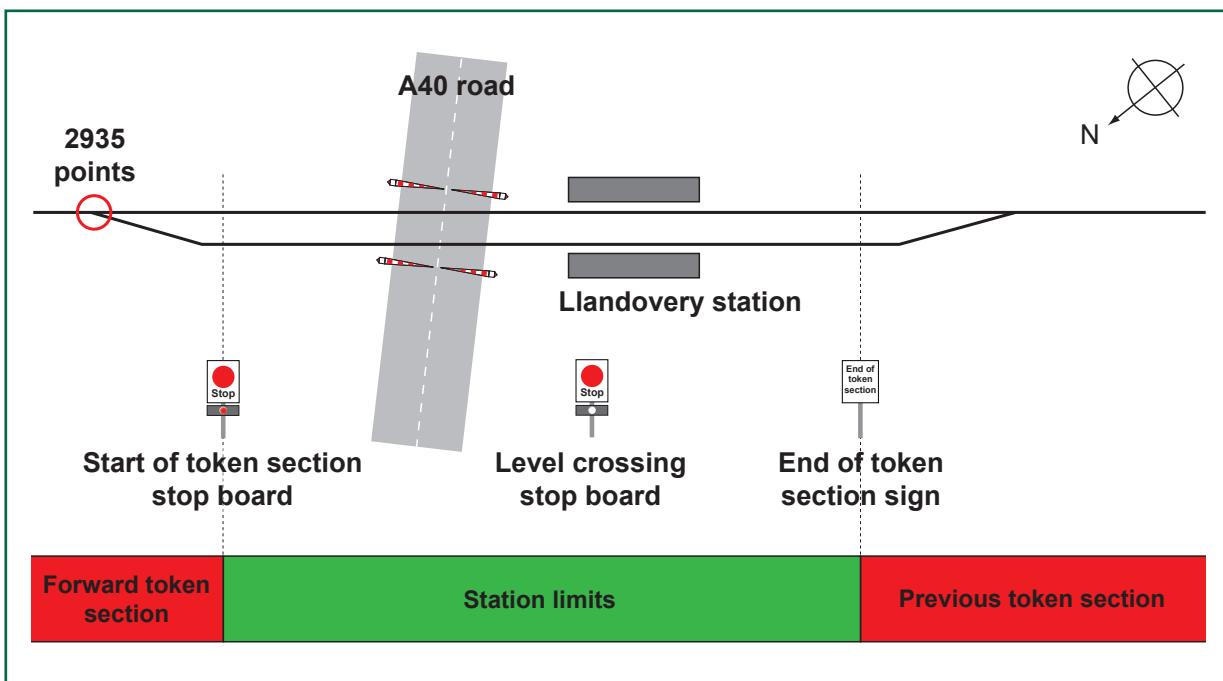


Figure 8: The station limits and single line sections at Llandovery (not to scale)

- 70 In May 2013, after the completion of the WTOPS project, Network Rail's professional head of signalling and telecommunications issued a notice (NB 123) to engineers and asset managers reminding them of their obligation to exploit reasonable opportunities to make improvements to the control of risk in line with the Construction (Design and Management) regulations 2007¹², and Network Rail's own policies. It stated:
- 'It is no longer acceptable to perpetuate situations where known weaknesses rely on procedural mitigations rather than engineered solutions. Signalling assets last for many years but society's expectations of safety has moved on. Procedural mitigations rely on human beings to provide mitigation, the general public and our stakeholders no longer find this acceptable.'*
- 71 In January 2014, Network Rail issued a 'Sponsors' Handbook'. The handbook was intended to be a 'how to' guide, primarily for renewals and enhancements projects. Section 12 of the handbook includes 'key themes' to be considered when developing project requirements, and identifies that '*opportunities to improve safety through construction, operation, maintenance and decommissioning should be considered*'. However, the handbook does not explicitly require sponsors to consider options to make safety improvements beyond the immediate scope of the proposed project.

¹² Available at www.hse.gov.uk.

Providing TPWS at the level crossing stop board

- 72 Another option for integrating the operation of the crossing with the signalling arrangements would have been to provide TPWS at the level crossing stop board. The requirements to fit TPWS to the railway infrastructure are described within Railway Group Standard GE/RT8030 ‘Requirements for the Train Protection and Warning System (TPWS)’. This standard states that the infrastructure manager (Network Rail at Llandovery) shall ensure that TPWS is provided on passenger lines to mitigate the risks associated with trains passing signals displaying a red ‘stop’ aspect without authority. Under normal circumstances, TPWS is fitted:
- at all main-line signals capable of showing a red ‘stop’ aspect (including stop boards) that protect crossings or converging movements with any running line or siding (normally junctions and station areas);
 - on the approach to buffer stops in terminal platforms; and
 - on the approach to certain speed restrictions where there is a risk of derailment from a train travelling over the speed restriction too fast (normally on curves).
- 73 The level crossing stop board did not meet any of the above criteria and so TPWS was not fitted at it (TPWS is not required at signals or stop boards that protect level crossings). However, TPWS equipment was correctly fitted at the ‘start of section’ stop board in accordance with the requirements of GE/RT8030.
- 74 Given the proximity of the ‘level crossing’ and ‘start of section’ stop boards, consideration might have been given to locating additional TPWS equipment at the level crossing stop board such that it would be suppressed only when the level crossing was proved to have been correctly operated, and the route was set onto the single line.
- 75 Since the incident at Llandovery, Network Rail has taken some steps to highlight measures (such as those described in paragraph 74) that could be used to mitigate overrun risk at such crossings. In March 2014, Network Rail issued notice NB 130. The intention of the notice was to promote good practice when designing measures for signals close to level crossings to mitigate the risk from trains passing signals at stop, and proceeding onto level crossings that may still be open to road and pedestrian users. However, the scope of the notice only covered those persons specifying level crossing renewals, and designing level crossing risk mitigation measures, which was outside the scope of the WTOPS scheme (paragraph 63). Control measures for consideration identified in the notice included:
- use of special controls to operate the road approach lights at the level crossing in circumstances where the equipment judges a train is unlikely to stop at the signal on the approach to the level crossing;
 - fitment of TPWS equipment to the signal on the approach to the level crossing; and
 - fitment of TPWS equipment at train stopping indicators (car stop markers).

Identification of underlying factors¹³

Information available to traincrew about the operation of the level crossing

- 76 There was no clear, formalised process for traincrew working trains at Llandovery.

Route information

- 77 Information about the national rail network is provided to the railway industry in a document called the Sectional Appendix. This includes a list of all running lines (usually the main lines of the rail network, not normally including sidings and railway yards) and local instructions. The Sectional Appendix includes local instructions about Llandovery, and its level crossing. The relevant text for Llandovery level crossing states (note that the term guard includes conductor):
- 'On arrival of a train at the stop board, the guard must unlock the cupboard and press the 'lower' button... The Guard must observe the crossing whilst the barriers are lowering to ensure that nothing is trapped under or between the barriers... When the barriers are correctly lowered, a white light on the 'Stop' board will flash. The Guard MUST THEN RELOCK THE CUPBOARD and re-join the train. As the barriers are designed to rise automatically following the passage of the train, the train may proceed on its journey'.*
- 78 These instructions are specific as to how the level crossing controls at Llandovery are to be used. The instructions do not describe all of the operational activities that take place at Llandovery such as the exchange of tokens, or the interaction between driver and conductor.
- 79 Traincrew learned about the operational arrangements at Llandovery through a combination of riding on trains over the route, talking with drivers and conductors who knew the arrangements and referring to reference documentation provided in the Sectional Appendix and by their employer. ATW provides its traincrew with information about the routes they work over. The information is provided in route packs. Each route pack is based on the output of a route risk assessment. The route packs for the Central Wales route did not include any information about operating the level crossing at Llandovery. In fact, none of the level crossings on the Central Wales route were mentioned at all. Despite the lack of a formalised method of work, the driver and conductor involved in the incident at Llandovery knew how to carry out the token exchange and operate the level crossing, but if they had applied a formalised process that involved a cross-check of each other's actions, it is less likely the incident would have occurred.

Train dispatch risk assessment at Llandovery

- 80 Railway Group Standard GO/RT3475 'Operational requirements for the dispatching of trains from platforms', was withdrawn from December 1999. The purpose of the standard had been to enable trains to be dispatched safely from platforms. It mandated a risk management methodology to contribute to a safe and consistent system of train dispatch. The standard applied to all platforms, irrespective of whether there were staff provided at the station to assist with train dispatch, and when it was withdrawn there was an expectation that train operators would apply the requirements of GO/RT3475 in their own company procedures.

¹³ Any factors associated with the overall management systems, organisational arrangements or the regulatory structure.

- 81 Standard GO/RT3475 required risk assessments for each platform to be undertaken to ‘ensure compatibility between trains, platform, process and infrastructure’. When carrying out risk assessments, the standard identified key factors in relation to each platform, including:
- position of signals;
 - location of level crossings;
 - platform length and indication of stopping points;
 - length and type of train using the platform; and
 - human factors, including distraction and operational procedures.
- 82 With standard GO/RT3475 no longer in force, ATW had a company procedure for the risk assessment of train dispatch. However, this procedure only applied to those stations where platform staff assisted with train dispatch. As a result, the two platforms at Llandovery were not subject to dispatch risk assessment. ATW relied on its traincrew applying the requirements of the railway rulebook (GE/RT8000) when dispatching trains from unstaffed platforms.
- 83 Had the platforms at Llandovery been subject to a dispatch risk assessment, it is likely that the sub-optimal stopping position of trains would have been identified and the order of operational tasks would have been defined in a formal, written procedure.

Briefing of traincrew about the Central Wales route upgrade work

- 84 Before the implementation of the WTOPS project, train drivers and conductors were trained on the new arrangements. The training included a presentation about the scheme, and a DVD produced jointly between Network Rail and ATW. The DVD contained information about the new power operated points and associated Points/TPWS indicator units, and included a specific section about Llandovery.
- 85 The Llandovery section was included because of the perceived risk of a token being withdrawn before the level crossing had been correctly operated. In this situation, any significant delay in the departure of the train could result in the TPWS system timing out. The token would need to be replaced in the token instrument and again withdrawn before the train could proceed. To address this situation, a document was produced by the project team (including input from ATW) that described a set of steps that should be taken by the traincrew on arriving at the up platform at Llandovery. These steps were reflected in the WTOPS training DVD:
- while the driver replaces the token for the single-line section the train has just travelled over, the conductor operates the level crossing controls;
 - before the driver removes the forward section token and asks the signaller for permission to pass the start-of-section stop board, the conductor and driver must confirm with each other that the level crossing barriers have correctly lowered; and
 - the forward section token can then be withdrawn.

- 86 Following the WTOPS upgrade, all traincrew had to pass a written assessment before being allowed to operate trains over the Central Wales route. The written assessment did not include any questions about the operational arrangements at the level crossing at Llandovery as indicated in the WTOPS DVD, in particular the important step in the process that required the driver and conductor to confirm with each other that the level crossing had operated correctly. One of the questions relating to TPWS indicated that the TPWS would time out after three minutes. The timer was actually set to suppress TPWS for seven minutes (paragraph 52).
- 87 The document produced by the project team detailing the steps to be taken at Llandovery was not converted into any formalised process, including ATW's traincrew training and route information, or included in the Sectional Appendix.

Safety management

- 88 **Some of Arriva Trains Wales' safety management processes were not effectively managing operational risk.**

Risk assessments

Train dispatch risk assessment

- 89 While the method of dispatch for unstaffed stations can be identified and assessed against the requirements of the railway rule book (GE/RT8000 module SS1 'station duties and train dispatch'), compatibility between trains and the infrastructure, such as stop boards, stopping position of trains, signalling equipment, and local features such as traincrew operated level crossings are only effectively assessed by a site visit and review by competent people. From these compatibility assessments, risk-based methods of work can be produced, and the information included in route briefings and route and competence assessments. As discussed at paragraph 82, ATW had not risk assessed the dispatch arrangements at unmanned stations.

Route risk assessments

- 90 Each route is given a risk ranking based on the output of a route risk assessment. The Central Wales route was assessed as a medium-risk route for train driving and a low risk route for conductors.
- 91 The route risk assessments were used to generate route briefing material and route assessment written questions against which traincrew were assessed. However, the route risk assessment template questions were focused on the actual infrastructure and not on location specific operational activities. For example, the route risk assessments did not include hazards identified with methods of work, or locations where there was a risk of an incident arising from traincrew errors (such as errors in the operation of level crossing equipment). Because those hazards had not been identified, they were not included in route briefing material or route assessments for drivers or conductors.

Monitoring safety critical workers

- 92 ORR published guidance¹⁴ about managing fatigue to the railway industry in 2012. Section 5.64 on page 26 of the guidance states that:
- 'Companies should have fitness for duty checking arrangements to ensure that staff reporting for safety critical work are not suffering, or likely to suffer during their shift, from fatigue. Such arrangements seek to identify any issues which may reduce the individual's ability to work safely including not only fatigue but any drug and alcohol use, illness or its after-effects, potential distraction or other psychological effects from any recent incident, work related or domestic problems. The system should seek to establish whether the individual has had sufficient sleep in the hours before starting work, such that they should be able to carry out their work safely for the whole of their shift. The system should identify not just whether the individual is fit at the start of the shift, but is likely to remain fit until the end of their shift – being awake too long before work greatly increases the risk of fatigue later in the work period. If remote booking-on procedures are used, random face-to-face checks should be carried out sufficiently frequently to provide an effective deterrent against the system being abused.'*
- 93 RSSB also published guidance¹⁵ to the railway industry in 2012. Section 7.4.3 discusses additional control measures that companies could put in place to manage staff fatigue, and includes a 'sign-on sleep risk assessment' that is undertaken by staff when booking-on duty. The output of the 'sign-on sleep risk assessment' includes identifying whether the member of staff is not fit to undertake safety critical duties; or that they are fit but additional risk mitigations need to be applied (such as additional breaks); or that they are fit to undertake safety critical duties without additional risk mitigation. The guidance acknowledges that the success of fatigue management processes rely on a company's safety culture, and the trust and involvement of its staff in the process.
- 94 The traincrew at Carmarthen depot book-on remotely via telephone to ATW's control centre in Cardiff. ATW's processes for managing its safety critical workers include carrying out 'out of hours' checks, 'performance and fitness' spot-checks, and unannounced monitoring. 'Out of hours' checks are traditionally undertaken outside normal office hours¹⁶ and at weekends. These checks tend to be done at locations where traincrew book on and off duty remotely. The static nature of these 'out of hours' checks means that safety critical non-compliances, such as unauthorised cab access, would not be identified, but this type of check was considered to address the greater risk, which was perceived to be traincrew booking on for duty while under the influence of drugs or alcohol. The guidance issued by ORR (paragraph 92) includes remote booking-on procedures. ATW was carrying these out at Carmarthen depot, but they could have been more effective if more were carried when staff were booking-on for early shifts, and on a more frequent basis. ATW's procedures for managing safety critical workers did not include a requirement to undertake a 'sign-on sleep risk assessment' (paragraph 93).

¹⁴ 'Managing rail staff fatigue' available at www.orr.gov.uk.

¹⁵ 'Managing fatigue- a good practice guide' available at http://www.rgsonline.co.uk/Railway_Group_Standards/Traffic%20Operation%20and%20Management/RSSB%20Good%20Practice%20Guides/RS504%20Iss%201.pdf.

¹⁶ Typically 'out of hours' is between 18:00 hrs and 07:00 hrs, and weekends.

- 95 The ‘performance and fitness’ spot-checks can be undertaken anywhere (ie on a train or on a platform) and are used to monitor staff performance and fitness for duty. Information about the spot-check is captured on a checklist to record observations ranging from the correct uniform being worn, to train dispatch being correctly carried out and that the person seems fit for duty (in the context of not being under the influence of drugs and alcohol). The RAIB reviewed spot-checks undertaken on the conductor of train 2M43 and observed that all were carried out at stations on the busier routes and during ‘office hours’. None were on the Central Wales route. A sample of spot-checks carried out on other conductors confirmed these findings.

Unauthorised cab access

- 96 When monitoring for unauthorised cab access, the driver team managers at Carmarthen occasionally used covert tactics, such as observing trains arriving at platforms. However, the most frequently used method was during practical assessments where approaching train driving cabs can be observed (clearly, this is not effective on single track routes such as the Central Wales line). It is difficult for driver team managers and conductor managers to join trains during a journey and remain covert as they are well known to traincrew.
- 97 Another tool used to check for unauthorised cab access is on-train CCTV images that have been downloaded following an incident. CCTV images are also available at many stations. Currently, ATW does not use CCTV images to covertly monitor safety critical performance. Before the Llandovery incident there were only a few cases of conductors having been found entering driving cabs without authority.
- 98 Following the incident at Llandovery, ATW identified that another conductor had been riding in the cab of train 2M43 on the day before the incident (the same driver was involved). On this occasion the driver correctly applied the DRA when the train stopped at Llandovery (footnote 5) and the conductor correctly operated the level crossing. This suggests that although on the day of the incident, and the previous day, conductors rode in the driving cab without authority, the operational performance of the staff only seemed to be affected on the day of the incident, and was most probably affected by other factors (as described in paragraphs 31 to 52).

OTDR assessments

- 99 ATW used OTDR data to identify that the DRA was being used as part of its driver monitoring process. DRA operation was linked to the reason for its use (eg the train had been stopped at a red signal). Providing the DRA had been used correctly, the box for DRA use could be ticked on the OTDR assessment form. While this approach confirmed DRA operation, it was not effective at identifying if the DRA had not been used in situations where it should have been (ie at level crossing stop boards) or confirming that on a particular route the DRA was being used consistently on every occasion that it should have been.

100 An OTDR assessment undertaken by ATW on 18 May 2011 on the driver involved in the incident at Llandovery mentioned use of the DRA at all ‘start of token section’ stop boards. No mention was made about its use at level crossing stop boards. The driver team managers advised drivers to use the DRA at stop boards associated with level crossings, but left it to the discretion of individual drivers as to whether they used it or not. The railway rule book GM/RT8000 module TW1 ‘Preparation and movement of trains- general’ includes instructions about the use of the DRA. Section 10.3 states that the DRA must be applied when stopped at a signal at danger (this includes stop boards) and must only be reset when the signal has cleared (ie is no longer displaying a red aspect) or when the driver has been given authority to pass the signal at danger (for a level crossing stop board, successful operation of the crossing and complying with the wording on the stop board would constitute being given authority).

Training material

101 The RAIB noted that ATW’s training material for conductors, and for drivers, tended to focus on the detail of the rules and the consequences of non-compliance, rather than on the rationale behind the rules and the reasons for the required compliance. Guidance¹⁷ and practice¹⁸ in other industries supports RAIB’s belief that it is beneficial if staff have an understanding of why rules and procedures are in place.

Observation¹⁹

ATW’s management of the incident

102 After being notified about the incident, the traincrew were initially permitted to continue working, and were asked to submit written reports before they booked off duty. This was because the seriousness of the incident was not fully understood by the ATW duty control manager who initially dealt with the incident. When train 2M43 was identified as the train involved, the duty control manager decided to first call the conductor on the conductor’s mobile phone to speak with him to better understand what had happened at Llandovery. Train 2M43 was at Llanwrtyd Wells at this time. During this call, the conductor admitted that he had not operated the barriers at Llandovery, but the ATW duty control manager did not realise the serious nature of the incident at that stage.

103 The duty control manager’s shift ended soon after his conversation with the conductor and another person took over the role. The incoming duty control manager better appreciated the seriousness of the incident, and began to make arrangements for the traincrew to be relieved of duty on arrival at the train’s next stop (Llandrindod), and for the traincrew to be taken into the care of an on-call manager for post-incident interview, drugs and alcohol screening and welfare and support.

¹⁷ ‘Behaviour is strongly influenced by a person’s awareness of hazards in the workplace. With little or no awareness people will more readily deviate from the rules and procedures of the workplace. Indeed, these rules are likely to be seen more as simple restrictions on actions rather than good and safe working practices.’ Improving Compliance with Safety Procedures, Reducing Industrial Violations, paragraph 128, HSE, 1995.

¹⁸ ‘Where appropriate, explain the reasons for the procedure’, Civil Aviation Authority, CAP 716 Aviation Maintenance Human Factors, Section 3.1, Table 1, CAA 2003.

¹⁹ 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.

104 There was no guidance immediately available to the duty control manager that might have helped him better appreciate the seriousness of the incident. Since he had not previously experienced an incident of this nature, he relied on his own judgement of the best action to take.

Summary of conclusions

Immediate cause

105 The train passed over the level crossing while the barriers were raised and the crossing was open to road traffic (**paragraph 29**).

Causal factors

106 The causal factors were:

- a. The conductor of train 2M43 did not operate the level crossing controls while at Llandovery station (**paragraph 31**). There are two possible reasons why this happened:
 - the conductor may have had a lapse in concentration which resulted in him overlooking the need to operate the crossing at Llandovery (**paragraph 33**); and
 - the conductor may have become distracted at Llandovery by the actions of a member of the public and an item of railway equipment that he thought was defective (**paragraph 39, Recommendations 1, 2, 4 and 5**).
- b. The driver of train 2M43 did not check that the white flashing light was illuminated on the level crossing stop board, or notice that the level crossing barriers were still raised, before departing from Llandovery station (**paragraph 41**). There are two possible reasons why this happened:
 - the train driver may have been distracted by events before the train arrived at Llandovery and while it was in the station (**paragraph 43**):
 - the presence of the conductor in the cab (**paragraph 45**);
 - activity on the platform (**paragraph 48**); and
 - the flashing blue TPWS light beyond the level crossing (**paragraph 50**).
 - the white light on the level crossing stop board was not in the driver's normal line of sight, and the driver was therefore less likely to see whether the light was illuminated and flashing from where the train had stopped (**paragraph 53, Recommendations 1, 2, 4 and 5**).
- c. An opportunity to integrate the operation of Llandovery level crossing into the signalling arrangements for the single line section ahead, which would have prevented this incident, was missed when improvement works were undertaken at Llandovery between 2007 and 2010 (**paragraph 61, Recommendation 3**).

107 It is possible that the following factor was causal:

- a. The indication to the train crew that the crossing had not been operated was the absence of the white flashing light; this was more likely to be overlooked than a positive indication of the crossing's status (**paragraph 58, Recommendation 5**).

Underlying factors

108 The underlying factors were:

- a. There was no clear, formalised process for traincrew working trains at Llandovery (**paragraphs 76 to 87, Recommendations 1 and 4**).
- b. Some of Arriva Trains Wales' safety management processes were not effectively managing operational risks (**paragraphs 88 to 101, Recommendation 4**).

Additional observation

109 Although not linked to the incident on 6 June 2013, RAIB observes that despite having been involved in a serious operational incident, the traincrew were allowed to continue working the train (**paragraphs 102 to 104, Recommendation 6**).

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

110 A car stop marker has been positioned 8 metres on the approach to the level crossing stop board at Llandovery station to improve the visibility of the white flashing light associated with the level crossing stop board.

Recommendations

111 The following recommendations are made²⁰:

- 1 *The intent of this recommendation is to reduce the risk created by having no formal method of work where traincrew have duties to perform, such as token exchange, level crossing operation and train dispatch at unstaffed stations.*

Arriva Trains Wales should identify all locations where traincrew carry out operational activities such as token exchange and level crossing operation in addition to train dispatch, and develop risk assessed methods of work for each location. The methods of work should be briefed, and trained to all traincrew, incorporated in the performance monitoring systems and be subject to periodic review (paragraphs 106a, 106b and 108a).

- 2 *The intent of this recommendation is to improve the arrangements at stations in respect of the positioning of equipment and signage used by traincrew.*

Arriva Trains Wales should lead a review of the positioning of platform equipment and signage used by traincrew at unmanned stations and, where practicable, arrange with Network Rail for improvements to be made. This should include (paragraphs 106a and 106b):

- a. identification of the optimum stopping position for trains to enable the best achievable view of signals, stop boards and indicators; and
- b. an assessment of the positioning of control equipment operated by traincrew (such as level crossing controls).

continued

²⁰ 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 infrastructure upgrade and improvement projects to include explicit consideration of all reasonable opportunities to improve safety at those locations where work is taking place.*

Network Rail should make improvements to its processes for the design of new and altered signalling, to require the active consideration of reasonable opportunities to make improvements (for example, the types of measures indicated in NB 130 (paragraph 75)) to the control of risk beyond the immediate scope of the proposed works, including identifying where operator errors, individual or collective, could lead to unsafe conditions (paragraph 106c).

- 4 *The intent of this recommendation is for ATW to review and improve its operational risk management arrangements.*

Arriva Trains Wales should conduct a review of its operational risk management arrangements in the light of the findings from this investigation, and make improvements in accordance with the findings of the review (paragraphs 106a, 106b, 108a and 108b). The scope of the review should include:

- a. the process for assessing risk associated with station duties on all lines over which its traincrews operate (eg the application of route risk assessments);
- b. a prioritised plan for the assessment of dispatch risk at unmanned platforms;
- c. a prioritised plan to formulate, brief and train dispatch plans to traincrew;
- d. the effectiveness of its methods for checking compliance with its policies and procedures (eg the application of remote booking-on spot checks, out-of-hours checks, and remote monitoring of the use of safety-critical equipment (including the use of OTDR data));
- e. the guidance issued by ORR and RSSB about fatigue management, in particular sleep risk assessments when booking-on duty, and a culture of trust and openness in fatigue management; and
- f. the need for a revision of its training practices and materials for drivers, conductors and controllers to explain the rationale that underpins the rules and to emphasise the benefits of compliance (as well as describing the rules and the consequences of non-compliance).

- 5 *The intent of this recommendation is to reduce the risk of error at traincrew operated level crossings by providing positive indications of the status of those crossings.*

Network Rail should review the current arrangements for providing an indication to the train driver of the status of the crossing at Llandovery. This should include consideration of the practicability of providing an active indication when the crossing is still open to road traffic (eg a flashing red light). This review should then be extended to other traincrew operated level crossings of a similar design (paragraphs 106a, 106b and 107).

- 6 *The intent of this recommendation is to control the risk created by traincrew continuing to operate trains in service where there is evidence that their actions contributed to a serious operational incident.*

Arriva Trains Wales should review and improve the training and guidance given to its duty control managers on the steps to be taken when traincrew are involved in a serious operating incident where their actions directly contributed to it (paragraph 109).

Appendices

Appendix A - Glossary of abbreviations and acronyms

ATW	Arriva Trains Wales
CCTV	Closed Circuit Television
DRA	Drivers Reminder Appliance
FFCCTV	Forward-Facing Closed Circuit Television
NSTR	No signaller token with remote crossing loops'
ORR	Office of Rail Regulation
OTDR	On-Train Data Recorder
RAIB	Rail Accident Investigation Branch
RSSB	Rail Safety and Standards Board
TPWS	Train Protection and Warning System
WTOPS	Western Train Operated Points Scheme

Appendix B - Glossary of terms

All definitions marked with an asterisk, thus (*), have been taken from Ellis's British Railway Engineering Encyclopaedia © Iain Ellis. www.iainellis.com.

Car stop marker	Where provided, a sign indicating to train drivers the stopping point for the train. Where trains of different lengths stop at a particular location, several car stop markers may be provided.
Driver's reminder appliance	A device in the driving cab of a train that allows the driver to set a reminder when brought to a stand at a signal showing a stop aspect. When set, the driver's reminder appliance prevents the driver applying power and moving off.*
Passing loops	A track onto which trains may be diverted or held to allow other trains to pass.
Points	Moveable rails that permit trains to take alternative routes.
Stop board	A sign instructing a train driver, or train movement, to stop. The sign often carries additional instructions.
Token instrument	The self-contained apparatus designed and used to control the correct issue and return of tokens.
Train operated points	Train operated points feature a self-restoring mechanism using a gas-filled accumulator connected to a hydraulic actuator. Energy stored in the accumulator allow the points to return to their normal position following the passage of a train leaving a loop.
Train protection and warning system	The primary purpose of the Train Protection and Warning System 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.

Appendix C - Key standards current at the time

GE/RT8030	Requirements for the Train Protection and Warning System (TPWS)
GK/RT0045	Lineside Signals, Indicators and Layout of Signals
GK/RT0192	Level crossing Interface requirements
GI/RT7006	Prevention and mitigation of overruns – Risk Assessment
GO/RT3475	Operational requirements for the dispatching of trains from platforms

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