RAIB

Rail Accident Investigation Branch

Rail Accident Report

Train overspeeding through an emergency speed restriction at Ty Mawr Farm Crossing on 29 August 2007

Department for Transport

Report 22/2008
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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.

Any enquiries about this publication should be sent to:

RAIB
The Wharf
Stores Road
Derby UK
DE21 4BA

Email: enquiries@raib.gov.uk
Telephone: 01332 253300
Fax: 01332 253301
Website: www.raib.gov.uk

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Contents

Introduction

1 The sole purpose of a Rail Accident Investigation Branch (RAIB) investigation is to prevent future accidents and incidents and improve railway safety.

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

3 Access was freely given by Network Rail, Arriva Trains Wales and the Rail Safety & Standards Board to their staff, data and records in connection with the investigation.

4 All mileages in the report are measured from a datum of 31 miles 20 chains at the site of the former Buttington Junction near to Welshpool. The zero datum point for this mileage was situated at Whitchurch (Cambrian Junction) prior to line closure in the 1960s.

5 Appendices at the rear of this report contain glossaries:

- acronyms and abbreviations are explained in Appendix A; and
- technical terms (shown in *italics* the first time they appear in the report) are explained in Appendix B.

Summary of the report

Key facts about the incident

6 At around 10:50 hrs on 29 August 2007, an emergency speed restriction (ESR) of 20 mph (32 km/h) was imposed between Newtown and Caersws on the Shrewsbury to Machynlleth line close to Ty Mawr Farm *User Worked Crossing* (UWC) (see Figure 1) because of two defects in a length of rail. The signaller at Machynlleth was responsible for advising drivers of the ESR.

7 At around 12:35 hrs, the signaller contacted the driver of train 1G71, the 11:27 hrs Aberystwyth to Birmingham (New Street) operated by Arriva Trains Wales (ATW), at Talerddig and advised him of the ESR approximately 10 miles away at Ty Mawr.

8 Train 1G71 left Talerddig and, after making a scheduled station stop at Caersws, approached Ty Mawr at a speed of 75 mph (120 km/h). The driver reduced speed to 58 mph (93 km/h) as he ran through the ESR.

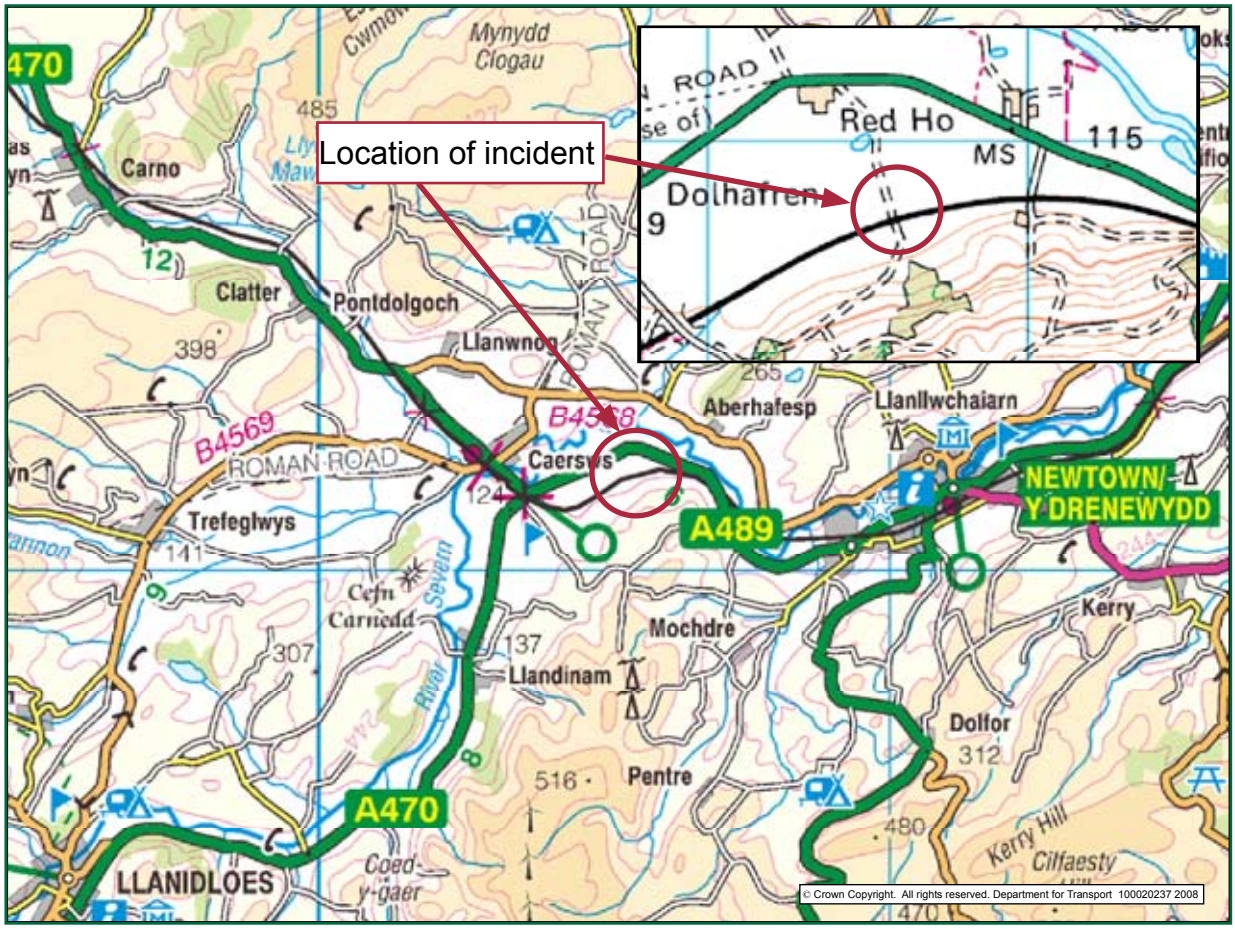

Figure 1: Extract from Ordnance Survey map showing location of incident

Immediate cause, causal and contributory factors, underlying causes

9 The immediate cause of the incident was that the driver forgot to reduce the speed of train 1G71 for the 20 mph (32 km/h) ESR at Ty Mawr.

10 Causal factors were:

a. the lack of an effective means within the cab to remind the driver of train 1G71 of the ESR ahead; and

b. the lack of warning equipment at the approach to the site of the ESR.

11 Contributory factors were:

a. the informal nature of the method for drivers to record details of the ESR;

b. the characteristics of the route between Talerddig and Caersws in terms of the numbers of level crossings and frequent changes in permanent speed restrictions together with the working timetable allowance of eight minutes for the section;

c. the unavailability of ESR warning equipment on the van used by the maintenance team or local to the incident site; and

d. the absence of verbal reminders of the ESR ahead for the driver of train 1G71 once he had left Talerddig Loop.

Severity of consequences

12 Nobody was injured during the incident. There was no damage to rolling stock or infrastructure.

Recommendations

13 Recommendations can be found in paragraph 129. They relate to the following areas:

- the method for drivers to record and remember information about ERSs;
- compliance by Network Rail with its own rules governing the maximum time that an ESR can remain in place without the installation of warning equipment and the availability of that warning equipment;
- the characteristics of the route between Talerddig and Caersws with regard to the number of permanent speed restrictions and the running time allowed for trains travelling between the two locations;
- the provision of additional verbal reminders to drivers of ESRs when the initial warning is given at a point that is a significant distance from the ESR;
- clarification of who is responsible for advising the signaller of when ESR warning equipment is to be installed; and
- consistency in the application of drugs and alcohol policy among train operating companies.

The Incident

Summary of the incident

14 At around 10:50 hrs on 29 August 2007, an *ultrasonic testing team* working between Newtown and Caersws on the Shrewsbury to Machynlleth line found two rail defects between the 50½ and 51 mile posts, close to Ty Mawr Farm UWC (see Figure 1) that required immediate attention. They contacted the signaller at Machynlleth to arrange for an ESR of 20 mph (32 km/h) to be advised to train drivers until the defective rail could be replaced.

15 The reason for imposing the speed restriction was to secure the safety of train movements until the defective rail could be replaced and to minimise the risk to rail workers in the area preparing to undertake the task. Separate arrangements applied for the period when the defective rail was replaced to ensure that no train approached the site of work. Those arrangements were implemented in accordance with the rules governing such activities and do not form part of this investigation.

16 Network Rail had a track engineering team working in the vicinity of the defects and they were sent to site to prepare for undertaking the replacement of the defective rail.

17 At around 12:35 hrs, the signaller contacted the driver of train 1G71, the 11:27 hrs Aberystwyth to Birmingham (New Street) operated by ATW, while *token exchange* was taking place at Talerddig, and advised him that an ESR of 20 mph (32 km/h) was in force between 51 miles and 50 miles and 55 chains, approximately ten miles away from Talerddig.

18 Train 1G71 left Talerddig and, after making a scheduled station stop at Caersws, approached the site of the ESR at a speed of 75 mph (120 km/h). Prompted to apply the brakes by the sight of the repair gang adjacent to the track, the driver reduced speed to 58 mph (93 km/h) as he ran through the ESR. This speed was still significantly in excess of the permitted maximum of 20 mph (32 km/h).

19 Nobody was injured during the incident. There was no damage to rolling stock or infrastructure. The repair gang reported the overspeeding incident to the Machynlleth signaller and the incident was subsequently investigated by Network Rail and ATW.

The parties involved

20 The infrastructure owner was Network Rail.

21 Train 1G71 was operated by ATW.

22 The Rail Safety & Standards Board (RSSB) issues the *rule book* (Railway Group Standard GE/RT8000) which governs operations on Network Rail infrastructure.

Location

23 Ty Mawr Farm UWC is located on the route between Shrewsbury and Machynlleth. The railway at this location comprises a single track used by trains travelling in both directions.

24 The maximum permitted speed for trains at this location is 80 mph (130 km/h).

25 There are 16 scheduled passenger train movements through the area on a weekday, comprising ATW services between Birmingham New Street or Shrewsbury and Machynlleth, Aberystwyth or Pwllheli.

Train(s)/rail equipment

26 Trains are signalled using the *Radio Electronic Token Block* (RETB) system, supervised from Machynlleth signal box.

27 Train 1G71 consisted of two class 158 *Diesel Multiple Units* (DMU), a total of four coaches. The Class 158 has a maximum permitted speed of 90 mph (145 km/h).

Events preceding the incident

28 On the morning of 29 August 2007 an ultrasonic testing team were testing rails on the single line between Newtown and Caersws stations. They identified two *class 1A defects* close together between the 50½ and 51 mile posts. Network Rail's Company Standard, NR/SP/TRK/001, 'Inspection and Maintenance of Permanent Way' mandates that when a Class 1A defect is discovered, an immediate speed restriction of 20 mph (32 km/h) shall be imposed and the defect must be repaired within 36 hours.

29 At 10:50 hrs a member of the ultrasonic team contacted Machynlleth signal box and advised the signaller that a 20 mph ESR had been imposed between 50 miles 55 chains and 51 miles 0 chains.

30 Staff from the track maintenance section at Machynlleth had been working close to the area being inspected by the ultrasonic team, in order to be swiftly available to deal with any defects that were found. They arrived on site within five minutes of being notified, and decided that a full rail change would be necessary. They expected to be able to accomplish this within two to three hours and decided not to request warning equipment for the ESR (which would have been supplied from Machynlleth).

31 The *Mobile Operations Manager* at Machynlleth was on duty in the signal box when the message from the ultrasonic team was received. He informed the *Fault and Operations Controls* at Cardiff of the restriction. The signaller at Machynlleth began cautioning drivers from the *token exchange points* (TEPs) at Newtown (47 miles 58 chains) for trains travelling towards Machynlleth and at Talerddig (61 miles 26 chains), for trains travelling towards Shrewsbury.

32 Train 1G71, the 11:27 hrs Aberystwyth to Birmingham (New Street), was formed of a two car Class 158 DMU. It left Aberystwyth three minutes late. At Machynlleth the driver had problems when attempting to couple his unit to another two car Class 158 DMU which had arrived from Pwllheli. The combined units departed Machynlleth 18 minutes late.

33 At Talerddig, the driver returned the Machynlleth – Talerddig token to, and received the Talerddig – Newtown token from, the signaller in accordance with the regulations for train signalling and general working instructions for lines controlled by the RETB system. The signaller then informed the driver about the ESR between 51 miles and 50 miles 55 chains, and advised him that emergency warning equipment was not currently in position.

34 The driver of train 1G71 repeated the message back to the signaller, and wrote the information about the ESR on a piece of paper, which he placed on the desk in front of him. The signaller confirmed with the driver that the message had been understood, and then gave the driver permission to pass the *stop board* at Talerddig and proceed to the next TEP at Newtown.

35 Train 1G71 left Talerddig at 12:40 hrs, 16 minutes late, and ran the eight miles to Caersws. The *distant signal* for Llanidloes Road level crossing was at caution as the train approached Caersws station, so the driver set the *Driver's Reminder Appliance* (DRA). The crossing keeper at Caersws came out of his cabin and engaged in conversation with the driver. On completion of station duties the driver re-set the DRA and left Caersws, now running about 18 minutes late.

Events during the incident

36 The train accelerated steadily on leaving Caersws, and reached 76 mph (122 km/h) in two miles. At approximately 12:55 hrs, train 1G71 approached the Ty Mawr area. At this point the line speed is 80 mph (130 km/h), but it reduces to 75 mph (120 km/h) at 50 miles 55 chains. The driver was preparing to reduce speed for this restriction when he saw track maintenance staff on the line ahead soon after passing Ty Mawr crossing at 51 miles 18 chains. He sounded the horn and the staff acknowledged the warning and moved clear. On seeing them, the driver realised that he had not reduced speed for the beginning of the 20 mph ESR at 51 miles 0 chains. He applied the brakes, reducing speed from 75 mph (120 km/h) at the start of the ESR to 58 mph (93 km/h) at the end of the ESR, but released them once the train had passed the end of the ESR at 50 miles 55 chains.

Consequences of the incident

37 There were no injuries or damage resulting from this incident.

Events following the incident

38 The maintenance staff reported the incident by phone to the signaller at Machynlleth at 12:57 hrs.

39 Train 1G71 continued normally to Newtown, arriving at 13:02 hrs, 22 minutes late. At Newtown the driver was advised by the Machynlleth signaller that the maintenance staff had reported that train 1G71 had passed through the ESR at line speed.

40 The driver was allowed to continue to Shrewsbury where he was relieved from duty and taken to Crewe for an interview by ATW. He was not subject to drugs and alcohol screening, although this is a requirement of ATW's company procedure on drugs and alcohol for such overspeeding incidents.

41 The ESR was removed at approximately 14:30 hrs following completion of a rail change.

The Investigation

Investigation process

42 The focus of the RAIB's investigation has been:

- the relevant modules of the rule book governing the circumstances described in paragraphs 29-30 (rule book module SP Sections 9 and 10.1);
- the requirements of relevant Network Rail company standards;
- the characteristics of the route in the area where the incident occurred and the role that they might have played in the incident; and
- the general issue of how drivers are reminded of ESRs when information about them is provided some time before they are actually encountered.

43 Emerging findings from the investigation have been shared with Network Rail and ATW.

Key Information

The requirements of the rule book

44 The ESR was imposed as soon as the defects were found by the ultrasonics team in accordance with Network Rail procedures (paragraph 28). This action is required because the defect might eventually result in a rail break.

45 The actions to be taken when an ESR is required are covered by the rule book, module SP. It places responsibilities on the signaller and the driver.

46 Section 9.1 requires the signaller to stop each driver who will travel over the restriction and advise him/her of the location where the speed restriction applies and the speed limit imposed. The signaller is required to continue with those arrangements until equipment (described in paragraphs 49 & 50) has been set up in the vicinity of the ESR to provide a local warning to drivers of the speed restriction ahead.

47 Section 9.2 requires the driver of a train passing over the restriction to control the train to a speed no higher than the maximum advised by the signaller when travelling between the limits over which the restriction applies.

48 Section 10.1 specifies that if the ESR is to last for more than a 'short time' (not quantified in the rule book, but see paragraph 53):

- Operations Control will arrange to issue a special notice to each train operator who is affected by the speed restriction; and
- additional emergency equipment should be put up as soon as possible, located in such a position to give drivers advance warning of the ESR ahead, and also at the limits of the area over which speed has been restricted.

49 The emergency equipment comprises:

- portable *Automatic Warning System* magnet;
- emergency indicator;
- warning board;
- speed indicator; and
- termination indicator.

50 For a single line, there has to be:

- four portable automatic warning system magnets (one at the emergency indicator and one at the warning boards for both directions);
- two emergency indicators (one per direction);
- two warning boards (one per direction);
- two speed indicators (one per direction);
- two termination indicators (one per direction); and
- four cancelling indicators (to inform the driver to ignore the indications received at the third and fourth magnets, which apply only to trains running in the opposite direction).

51 Section 9.1 of Module SP lists a number of items of information that a signaller will be told when an ESR is to be set up. They include the location of the ESR and the line on which it applies and when the (emergency warning) equipment will be installed.

52 There is no requirement in the rule book for any specific individual to supply the signaller with this information.

The requirements of Network Rail company standards

53 Network Rail Standard NR/SP/TRK/001 provides further guidance on how the rule book requirement for the provision of emergency equipment in circumstances where an ESR is to last more than a short time should be interpreted. It states:

> 'When a defect is found…then impose the 20 mph ESR by erection of the necessary EROS (emergency restriction of speed) and TSR (temporary speed restriction) boards (but) not later than two hours after the discovery of the defect.'

54 At the time of the incident, there was no requirement in Network Rail standards for any specific individual to supply the signaller with the information referred to in paragraph 51.

The actions of Network Rail engineering and maintenance staff

55 The ultrasonics team who discovered the defects in the rail at Ty Mawr contacted the Network Rail signaller at Machynlleth to advise him that an ESR of 20 mph was required between 50 miles 55 chains and 51 miles 00 chains.

56 The track engineering team undertaking the repair did not erect emergency equipment because they expected to be able to complete their task within two to three hours (paragraph 30). They did not tell this to the signaller at Machynlleth.

The actions of the signaller at Machynlleth

57 The signaller, upon receipt of the advice from the ultrasonics team of the two rail defects, implemented the requirements of module SP of the rule book. As this section of route is controlled by the RETB system, it was necessary for the signaller to caution drivers at TEPs (paragraph 31). The signaller implemented these arrangements correctly.

58 The signaller was not told when the emergency warning equipment was to be installed. He did not ask for the information and although section 9.1 of module SP did include it in the list of information that he would receive (paragraph 51), there was no explicit requirement for him to ask when it would be installed.

The actions of the driver of train 1G71

59 The driver of train 1G71 had signed on duty at 07:53 hrs. He was adequately rested and had worked the same turn of duty on the previous two days. His first driving task was to take a train from Shrewsbury to Aberystwyth, departing from Shrewsbury at 09:28 hrs. That train had suffered delays en route which had resulted in a 10 minute late arrival at Aberystwyth at 11:27 hrs.

60 The return working (train 1G71) was scheduled to depart at 11:27 hrs. As soon as the driver had changed ends and set up his cab, he departed for Shrewsbury three minutes late. This delay was subsequently exacerbated by the coupling problems at Machynlleth (paragraph 32).

61 On arrival at Talerddig TEP, the driver of train 1G71 was advised by the signaller of the ESR at Ty Mawr. The driver recorded the information on a piece of paper and placed it on his driving desk with the repair book. He received the token for the section to Newtown and proceeded to the next station stop at Caersws, approximately eight miles away. Throughout the journey, he made frequent use of full power (notch 7 on a class 158 DMU) and brake steps two and three (maximum) in order, so far as was possible, to align the speed of the train with the changes in permissible speed over this section of the route.

62 Once passengers had alighted and boarded at Caersws, train 1G71 departed for Newtown, with the start of the ESR approximately two and a half miles away. By the time that the driver approached the site of the ESR, he had overlooked the note that he had made regarding the ESR and was only prompted to apply the brakes by the sight of the track workers. Although the driver applied the brakes in step two (and briefly in step three), he was unable to reduce train speed to 20 mph (32 km/h) before the train reached the end of the ESR.

The route between Talerddig and Ty Mawr

63 The section of route between Talerddig loop and the ESR at Ty Mawr contained 16 changes in permanent speed restriction and 19 level crossings. There were 15 UWCs, one *automatic half barrier* crossing, one *automatic open crossing* (monitored locally by train drivers - AOCL) and two *manually controlled gated* crossings.

64 The reasons for key reductions in maximum permitted speed on this section of route are shown in Table 1:

Location	Restriction	Reason
59m 59c to 59m 17c	65	• Sarn Pile Viaduct (59m 46c) • Sighting at Sarn UWC (59m 42c) • Carno AHBC (59m 17c)
57m 52c to 57m 40c	60	• Track geometry
56m 02c to 55m 49c	65	• Sighting at Plassau Clatter No. 1 UWC (55m 78c) • Sighting at Neuadd UWC (55m 50c)
55m 21c to 54m 26c	60/30	• Sighting at Craigfryn UWC (54m 50c) • Weig Lane AOCL (54m 26c)

Table 1: Reasons for reductions in maximum permitted speed between Talerddig and Caersws

65 Of the 14 changes in maximum permitted speed before the station stop at Caersws, less than eight miles away, ten called for a specific response from the driver; the first three are of no consequence for a train starting out of the loop as they are progressive increases in speed which would be within the train's acceleration profile and the final speed restriction is so close to Caersws station as to be of no consequence for a train stopping at the station.

66 However, one specific section involves six changes in permanent speed restriction in less than two and a half miles. Table 2 shows the changes in permitted speed and the speeds achieved in the section by train 1G71 on 29 August 2007.

Location and mileage	Maximum Permissible Speed (mph)	Speed range of train 1G71 on 29/08/07 (mph)
56m 58c – 56m 20c	75	65 →74→70
56m 20c - 56m 02c	70	70→62
56m 02c - 55m 50c	65	62→58
55m 50c - 55m 21c	70	58→61→59
55m 21c - 54m 27c	60	59→27→29
54m 27c (Weig Lane AOCL)	30	29

Table 2: Changes in permissible speed between 56m 58c and 54m 27c and speed range of train 1G71

67 The working timetable allows eight minutes for a train to run from Talerddig to Caersws (start to stop). Train 1G71 exceeded the sectional running time by approximately two minutes. Figure 2 shows the location of the speed restrictions over this section of route, the locations of level crossings and signals and the speed achieved by train 1G71 through this section on 29 August 2007.

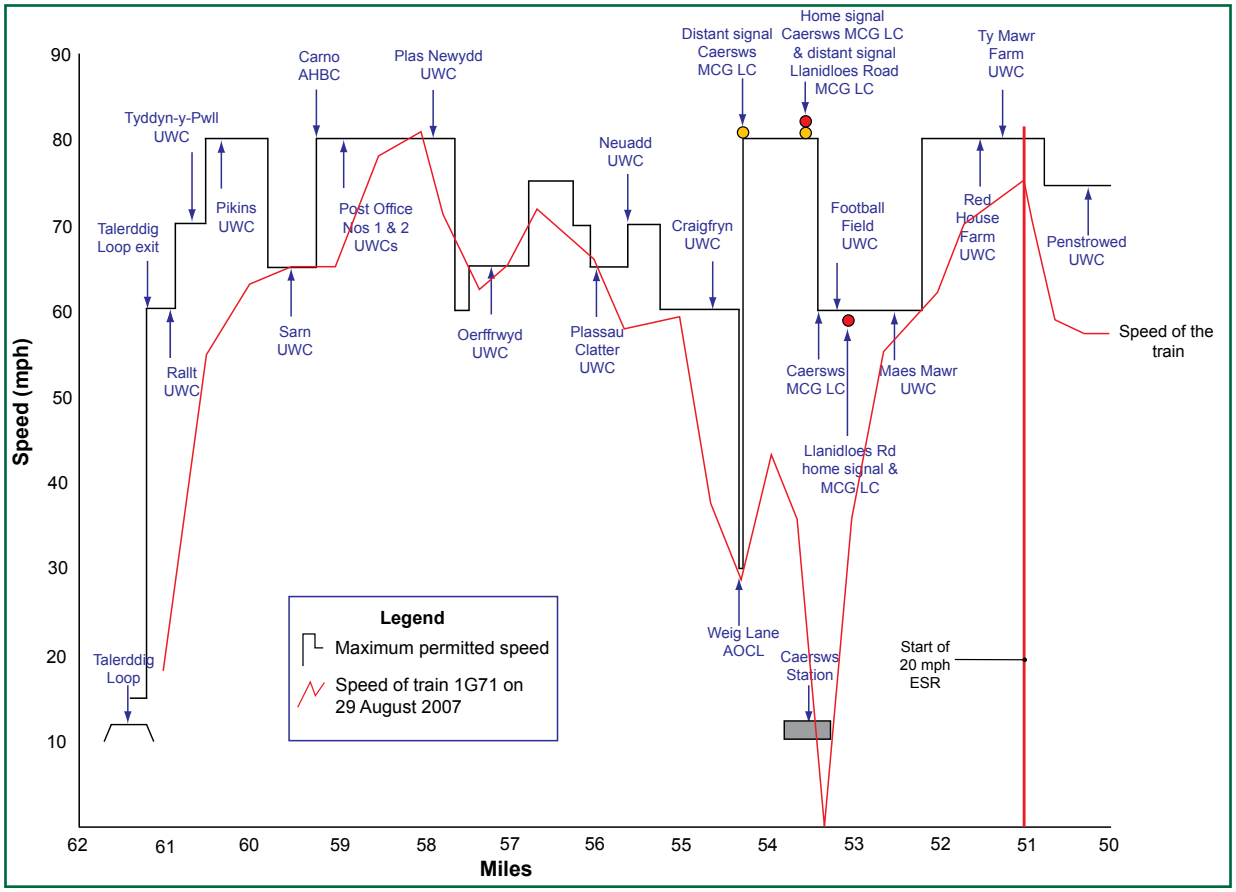

Figure 2: Variations in maximum permitted speed, location of level crossings and signals between Talerddig and Ty Mawr and speed of train 1G71 on 29 August 2007

Previous occurrences of a similar character

68 Information on previous incidents involving trains travelling at excessive speed through ESRs was obtained from the *Safety Management Information System* (SMIS) database maintained by the RSSB.

69 A total of 88 such incidents were recorded in the period February 1998 to January 2008, of which 81 contained sufficient detail to enable the RAIB to determine their similarity to the circumstances of the incident at Ty Mawr.

70 Of the 81 incidents reviewed, 90 % (73 incidents) involved trains overspeeding through ESRs where warning boards should have been present (although sometimes these were incorrectly located or missing). One further incident was the one at Ty Mawr. Of the remaining seven incidents:

- Three involved errors by the signaller in relaying information about the location of the ESR or the permitted speed through the restricted area.
- One involved a train travelling at 'excessive speed' over a 5 mph (8 km/h) ESR at Edgeley Junction in March 2000. The driver stated that although he had been warned of the presence of the ESR, he was expecting a lookout in the vicinity to warn him of its exact location.
- One involved a train travelling at 51 mph (82 km/h) over a 20 mph (32 km/h) ESR at Peterstone (between Newport and Cardiff) in February 2001. The driver had been advised of the restriction at Newport station (158m 50c) and the ESR commenced at 163 miles 09 chains.
- One involved a train travelling at 'excessive speed' over a 20 mph (32 km/h) ESR at Grantshouse in May 2001. The driver was properly advised of the speed restriction, but no further details on the incident are available.
- One involved a train travelling at 100 mph (160 km/h) over a 20 mph (32 km/h) ESR at Wingfield in December 2001. The driver made a mistake over the location of the ESR.

71 Although not recorded on SMIS, a further incident of a train overspeeding through an ESR occurred on the Shrewsbury to Machynlleth section of route on 25 October 2007. At 03:10 hrs, a broken rail was found in the vicinity of Stretton Heath, approximately nine miles (15 km) from Sutton Bridge Junction where the single line Cambrian route commences. Initially the line was blocked to traffic. By 07:00 hrs, the rail had been clamped and a 5 mph ESR imposed. The driver of train 1J03, the 06:33 hrs Birmingham to Aberystwyth, was advised by the signaller at Machynlleth of the ESR at approximately 07:45 hrs before entering the single line at Sutton Bridge Junction. He misheard the location of the ESR (by five miles) and was not corrected by the signaller when he repeated back the incorrect mileage. The driver of train 1J03 approached the area of the ESR at approximately 65 mph (105 km/h) and on seeing the track workers and a clamped rail realised that this must be the actual location of the ESR. He braked and passed over the site of the ESR at approximately 40 mph (65 km/h).

Analysis

Identification of the immediate cause

72 The immediate cause of the overspeeding incident was that the driver forgot to reduce the speed of train 1G71 for the 20 mph ESR at Ty Mawr.

Identification of causal and contributory factors

The actions of the driver of train 1G71

73 The driver of train 1G71 had suffered late running into Aberystwyth and a consequential late departure on the return journey, which was exacerbated by coupling problems at Machynlleth. By the time that the train departed from Talerddig Loop (where the driver had received information about the ESR), it was running approximately 16 minutes late.

74 Over the course of the eight mile run from Talerddig Loop to Caersws, the driver encountered 14 changes in permanent speed restriction, ten of which were material to him (paragraph 65). The evidence from the *On Train Data Recorder* (OTDR) indicates that the driver did, where possible, try to take advantage of the maximum permitted speeds over different sections of the route. Although it is difficult to be precise because of the way in which information is presented from the OTDR, it appears that the driver made approximately 20 adjustments to the power controller and 30 adjustments to the brake controller in an eight mile stretch of railway, using power notch 7 (maximum) frequently and brake step three (full service braking) occasionally. Despite this, train 1G71 still lost two minutes in running between Talerddig and Caersws. The characteristics of the route between Talerddig and Caersws are demanding of train drivers, who need to concentrate on the variations in permissible speed if they are to avoid losing too much time. There is further analysis of the characteristics of the route in the following section.

75 Given the distance between the point at which the warning of the ESR was received and where it was encountered, it was important that the driver of train 1G71 gave himself the best opportunity of remembering the ESR ahead. There is no requirement for a driver to go through a formal process of writing down the information from the signaller about the ESR on a form that is relevant to the circumstances. The same applies to other situations where drivers might be warned about hazards ahead which require reductions in speed, e.g. animals or people on the line or flooding.

76 The driver of train 1G71 wrote himself a reminder on a piece of paper that he happened to have available, which he placed on the driving desk next to the repair book (paragraph 61). The informal nature of the arrangements for recording the details of an ESR is a contributory factor for this incident. In the incident at Stretton Heath (paragraph 71), the driver wrote the details of the ESR on the back of his *weekly operating notice* book.

77 ATW's training regime for its drivers includes information on how to deal with ESRs and they are also questioned during competency reviews. There is no specific requirement as to how the driver should remind himself of the location of an ESR ahead.

78 ATW has pioneered the use of risk-triggered commentary (the first train operating company to introduce the initiative). This has been briefed to drivers on safety training days and through monthly briefs. The technique involves the driver giving a running commentary to himself (aloud) on hazards ahead and his actions to deal with them. It is based on practice employed in other countries (notably Japan) and its use is encouraged by ATW managers who consider that it can help a driver to remain alert.

79 However, the technique calls for drivers to focus on hazards in the order that they are presented. After leaving Talerddig, the driver would have been expected to focus on the fixed hazards of Weig Lane crossing with its 30 mph (48 km/h) restriction and the Caersws station stop before he turned his attention to the ESR at Ty Mawr. He would thus still need to be reminded (or remind himself) of the ESR ahead at some point between Talerddig and Ty Mawr. Ideally, this would have been at Caersws, when the ESR would have been the next significant hazard.

80 A local initiative by a former driver manager at Machynlleth involved the use of a magnetic reminder strip, approximately four inches, by one inch which could be fixed to the driver's desk until the hazard had been encountered. The driver of train 1G71 did not have one of the trial magnetic strips.

81 The driver of train 1G71 was relying on informal means to remind himself of the ESR ahead. If an alternative and more effective reminder of the ESR had been available rather than the piece of paper that he used on the day, it is likely that he would have been prompted about the need to slow down in the Ty Mawr area. The lack of an effective means to remind the driver of the ESR ahead is a causal factor for this incident.

The route between Talerddig and Ty Mawr

82 Train 1G71 was running 16 minutes late from Talerddig (paragraph 73). In order to make up time, or avoid losing any more time, a driver will try to run to the maximum permissible speed. The route between Talerddig and Caersws, with its frequent changes in maximum permissible speed, required drivers to be constantly adjusting the speed of the train with a consequential focus on lineside speed indicators.

83 Figure 2 highlights three specific features:

- The increase in permissible speed to 70 mph (112 km/h) for a distance of 29 chains commencing at 55 miles 50 chains serves no useful purpose between the 65 mph (104 km/h) and 60 mph (96 km/h) speed restrictions either side.
- The driver of train 1G71 did attempt to make use of the slight increase in permissible speed to 70 mph (112 km/h) at this location by accelerating the train (using power notch 7) for a short period of time, but there was insufficient time to enable more than a 3 mph (4 km/h) increase in speed to be achieved. Train 1G71 comprised four coaches with a total length of almost 93 metres. This meant that the driver was unable to increase speed towards 70 mph (112 km/h) until he was only 470 metres from the start of the 60 mph (96 km/h) speed restriction at 55 miles 21 chains.
- There was an over-reduction in speed for the restriction to 65 mph (104 km/h) at 56 miles 02 chains. In view of the rapid succession of changes in permanent speed restrictions, it is possible that the driver may have either suffered a momentary lapse in concentration or forgotten the detail of the actual speed permitted.

84 Paragraph 63 refers to there being 19 level crossings between Talerddig and the start of the ESR at 51 miles 00 chains. Of those 19 crossings, 13 are located in the eight miles between Talerddig and Caersws, comprising 11 UWCs, one automatic half barrier crossing and one automatic open crossing (monitored locally by train drivers).

85 Despite extensive use of maximum power and braking, the driver still lost two minutes in running between Talerddig and Caersws. With only eight minutes allowed in the working timetable for up trains to run the eight miles and many speed restrictions of 60/65 mph and one of 30 mph (48 km/h), the scheduled time is not currently achievable. Network Rail explained that some *recovery time* is included for trains between Caersws and Shrewsbury which results in a more realistic overall time allowance for the run from Machynlleth to Shrewsbury, even if some of the intermediate timings are not achievable.

86 The need to concentrate on lineside speed indicators and other key features of the route in the context of train 1G71 running late and the demanding nature of the working timetable may provide some explanation as to why the driver of train 1G71 had forgotten the ESR by the time he approached the Ty Mawr area. It is likely that he had already forgotten the ESR by the time he reached Caersws.

87 Network Rail has developed a 'route driveability tool'. Its original purpose was to support the design of new signalling schemes so that the human factors feasibility (driveability) of different signalling layouts could be evaluated early in the design lifecycle. However, it can also provide useful insight into driver workload in the existing railway environment.

88 Infrastructure features (speed restrictions, warning boards, signals, etc.) and the characteristics of a route govern the tasks that a driver performs. By considering, for a given section of route, the tasks the driver has to perform in order to control the train in accordance with the characteristics of the route and the train being driven, it is possible to identify the driver's workload. This takes into account:

- time pressures resulting from the time available to complete tasks;
- auditory, visual and cognitive demands on the driver, which may or may not have required actions associated with them; and
- conflicts which occur because of the volume of inputs experienced by and/or actions required from a driver at any given time.

89 The tool allows the identification of periods when the number of tasks the driver has to perform is high and where tasks are difficult to combine. It also identifies where activities may be physically or mentally demanding.

90 The section of route between Talerddig and Caersws was modelled using the route driveability tool. One feature that is highlighted by the tool is the number of speed changes. Although this did not necessarily create conflicts for the driver (i.e. there were few examples of overload through simultaneous driver inputs and actions), the Network Rail human factors specialist observed that it did add a level of complexity to the driving task that increases the potential for the driver to forget other items of information.

91 Taking all of the factors described in paragraphs 82-90 into account, the RAIB considers that the characteristics of the route between Talerddig and Caersws in terms of the numbers of level crossings and frequent changes in permanent speed restrictions together with the working timetable allowance of eight minutes are contributory factors to this incident.

<u>The actions of Network Rail maintenance staff</u>

92 The maintenance team's assessment that the repair would take between two and three hours (paragraph 30) should have led to a decision to erect warning equipment for the ESR without further delay (paragraph 53).

93 The ESR was removed at approximately 14:30 hrs, which means that it was in place for almost four hours. This was detrimental not only for the drivers of up trains who were required to remember the location of the ESR, but also for the signaller who was required to warn drivers of up and down trains about the presence of the ESR.

94 The erection of warning equipment within two hours in accordance with the requirements of standard NR/SP/TRK/001 would have resulted in it being in place before train 1G71 approached. The lack of warning equipment is a causal factor for this incident.

95 Warning equipment would have been sourced from Machynlleth depot (approximately 25 miles away). If the equipment had been carried on the van used by the maintenance team or available locally, they would have been able to install it before train 1G71 approached. The fact that the warning equipment was not immediately or locally available is a contributory factor for this incident.

96 In the incident at Stretton Heath (paragraph 71), the ESR boards were not put in place until almost eight hours after the broken rail that required the speed restriction was found.

The actions of the signaller at Machynlleth

97 The signaller implemented the arrangements for the ESR in a timely manner and correctly identified the details to the driver of train 1G71. There is no mandated form of words used in warning drivers of an ESR and no requirement for the signaller to dictate specific details for the driver to copy onto a form.

98 The signaller did not ask the ultrasonic team when warning equipment was going to be set up. This was information that he should have received in accordance with section 9.1 of module SP of the rule book (paragraph 51). As the person responsible for implementing the temporary arrangement of warning all drivers of the location of the ESR, it was in his interests for the equipment to be installed as quickly as possible. However, it is not certain whether the maintenance team would have supplied warning equipment had they been asked by the signaller when it was going to be provided.

The requirements of the rule book

99 Section 9 of module SP of the rule book defines the actions to be taken by train drivers and signallers when an ESR has been imposed. Initially, protection of the site is achieved by the signaller advising the driver of each train approaching the site of the exact limits of the ESR.

100 On the majority of the railway network, advice to drivers can be given in close proximity to the location of the speed restriction as signals are spaced at close intervals (typically, one to two miles apart). Train drivers encounter the ESR soon after they have been advised of its presence, which minimises the risk of them forgetting it.

101 The section of route through Ty Mawr was controlled using the RETB system. The only locations where signallers were guaranteed to be in contact with drivers were the TEPs. For trains travelling in the up direction, the signaller had to advise drivers when they were at Talerddig, ten miles (and approximately 15 minutes running time) from the location of the ESR.

102 The rule book states that emergency warning equipment should be provided if the ESR is to last more than a short period (paragraph 48). This applies to all ESRs, irrespective of their proximity to the point where the warning is to be given.

103 The RAIB has considered whether there would be a case for the rule book to require the immediate provision of this equipment if a driver had to be warned of an ESR a significant time before encountering it. However, there would be practical difficulties associated with such an approach:

- Rail defects are likely to be identified by track patrollers, their supervisors or people performing ultrasonic testing of the line. They often walk significant distances as part of their inspection activity (five miles would be normal for a track patroller) and it would be impractical for them to carry with them the equipment necessary for imposing an ESR. There must be a mechanism in place for imposing an ESR without delay, when warning equipment is not immediately available.
- If there is a requirement for staff to install ESR warning equipment before they commence repair work, this will delay the repair. The time during which the infrastructure is in defective condition will be increased as work will not be able to start until the warning equipment is in place. At Ty Mawr, the requirement to place warning equipment both sides of the site would have further delayed repair work.

104 If a repair can be completed quickly, it is better to concentrate efforts on undertaking the work that will result in the removal of the ESR rather than deploy resources to provide additional warning of the ESR and prolong the period over which it applies. Nevertheless, there is a point beyond which it is desirable to provide physical warnings to drivers of an ESR. The rule book recognises this and although it does not quantify the time, it does make it clear that it is a short time rather than an extended period. Standard NR/SP/TRK/001 defines a limit of two hours for the period when drivers might need to be cautioned (paragraph 53).

105 The RAIB has also considered whether a simpler method of physically marking the location of an ESR rather than providing the full set of warning equipment might be considered until such time as the equipment is in place (or the ESR no longer needed). An example might be the placing of detonators at braking distance from the commencement of an ESR.

106 On a single line, it is likely that at least three members of staff would be required (one at the warning point on each side of the ESR and one to mark the location of the fault/ESR) and it is also likely that the resources would have to be drawn from the team engaged in the repair of the defect. The considerations described in paragraphs 103 and 104 apply with regard to the optimum use of the limited resources available on the ground. There is also risk associated with having isolated members of staff trackside and risk from the use of detonators, which would need to be balanced against the risk arising from a train approaching the site of the ESR too quickly. Furthermore, detonators are normally placed to provide protection against hazards and a driver is instructed to stop if his or her train explodes a detonator. Using detonators as a means to warn drivers of the need to slow down ahead would be inconsistent with that philosophy.

107 It is necessary to provide some flexibility in the way that an ESR is established initially. It is also necessary to ensure that those initial arrangements are supplemented if the situation is to prevail for anything other than a short period of time. Module SP of the rule book and standard NR/SP/TRK/001 do this already.

<u>The requirements of Network Rail standards</u>

108 Standard NR/SP/TRK/001 requires provision of physical warning equipment if the ESR is to last for more than two hours.

109 Given the arguments against a requirement to apply boards immediately (paragraphs 103 and 104), the guidance given of 'not more than two hours' is appropriate. It is a maximum value; if the team undertaking the repairs estimate that their work is going to take longer than two hours to complete, they should arrange for the warning equipment to be supplied without delay. They should not wait for the two hours to elapse before they consider applying the equipment.

110 At no time after leaving Talerddig was the driver verbally reminded of the ESR ahead, despite the distance between Talerddig and Ty Mawr. There was no requirement for any reminder to be given, although the presence of a crossing keeper at Caersws station provided an ideal opportunity to do so.

111 Network Rail's *sectional appendices* contain rules that apply to specific locations, but they do not currently include any special instructions regarding additional reminders to drivers about the location of ESRs when the point at which the information is given to the driver is some distance (or time) from the point at which he will encounter it. The absence of verbal reminders for the driver of train 1G71 is considered to be a contributory factor for this incident.

Other factors for consideration

112 At the time of the incident, there was no requirement in the rule book for any specific individual to provide the signaller with the information listed in section 9.1 of module SP of the rule book (paragraph 52). This omission is now addressed by Network Rail maintenance procedure NR/PRC/MTC/MG0110, 'Imposition and removal of temporary and emergency speed restrictions'. Although it was issued in June 2007 (before the Ty Mawr incident), the preamble to the procedure states that it 'shall be complied with by 30 September 2007' (after the Ty Mawr incident).

113 Clause 4.1.2 of procedure NR/PRC/MTC/MG0110 states:

> 'The person requiring the imposition of the ESR shall inform the signaller of the requirement of the ESR giving the information detailed in the rule book GE/RT8000/SP.'

114 The procedure, as written, does not help the person taking the action to identify exactly what information they need to provide to the signaller. Module SP of the rule book contains no requirements for the person imposing the ESR. Section 9.1, which contains the relevant list of information required, is headed 'Signaller's action' (not the actions of the person imposing the ESR) and is written from the perspective of the recipient of the information.

115 The 'person requiring the imposition of the ESR' in the case of the Ty Mawr incident was a member of the ultrasonic team. Although required by procedure NR/PRC/MTC/MG0110 to advise the signaller when the emergency warning equipment was to be installed, they were not in a position to do so at the same time as they were advising him of the need for an immediate ESR of 20 mph (32 km/h). The ultrasonic team were not responsible for the repair of the defects and it was the maintenance team who made the decision about the provision of emergency warning equipment.

116 The driver involved in the overspeeding incident was not subject to drugs and alcohol screening. This was in contravention of ATW's company procedure on drugs and alcohol, clause 5.4 of which states that drugs and alcohol screening will be carried out for any speeding incident that involves excess speed of more than 11 mph (18 km/h) if there are reasonable grounds to suspect that the actions or omissions of the individual concerned contributed to the accident or incident. The same clause says that screening should be carried out 'as soon as reasonably practicable'.

117 A senior driver manager commented that he did not think that screening was necessary because Network Rail and ATW Control had permitted the driver to move into a new token section at Newtown before ATW operational managers had been made aware of the incident. This suggests that discretion was being used, although the ATW Drugs & Alcohol procedure does not permit this.

118 In the overspeeding incident at Stretton Heath (paragraph 71), the driver of the train involved was tested approximately five hours after the incident occurred, during which time he had driven to Aberystwyth and back to Shrewsbury (driving time of approximately three and a half hours). This delay was, in part, due to the fact that ATW only became aware of the incident two hours after it had happened, by which time the driver was already returning to Shrewsbury from Aberystwyth. However, he had not yet reached Machynlleth where there may have been an opportunity for him to be relieved of duty and tested.

119 For train operating companies such as ATW whose workload involves operating trains to locations remote from depots, there will always be a dilemma as to how to deal with an incident that should result in immediate drugs and alcohol screening. In the extreme, if applied to the letter, a train might have to be cancelled or held for a long period of time pending the arrival of a relief driver. There is evidence from Network Rail's daily log of incidents occurring on the network of variations in the measures applied by train operating companies when a driver has been involved in an incident where drugs and alcohol testing is required. Those variations include whether, how far and under what constraints traincrew are allowed to continue their duties after the incident has occurred.

Conclusions

Immediate cause

120 The immediate cause of the overspeeding incident was that the driver forgot to reduce the speed of train 1G71 for the 20 mph (32 km/h) ESR at Ty Mawr (paragraph 72).

Causal factors

121 Causal factors were:

a. The lack of an effective means within the cab to remind the driver of train 1G71 of the ESR ahead (paragraph 81, Recommendation 1).

b. The lack of warning equipment at the approach to the site of the ESR (paragraph 94, Recommendation 2).

Contributory factors

122 The following factors were considered to be contributory:

a. The informal nature of the method for drivers to record details of the ESR. Informal recording of information regarding hazards that require reductions in speed (not marked locally) applies to other situations on the railway (paragraph 76, Recommendation 1).

b. The characteristics of the route between Talerddig and Caersws in terms of the numbers of level crossings and frequent changes in permanent speed restrictions together with the working timetable allowance of eight minutes for the section (paragraph 91, Recommendation 3).

c. The unavailability of warning equipment on the van used by the maintenance team or local to the incident site (paragraph 95, Recommendation 4).

d. The absence of verbal reminders of the ESR ahead for the driver of train 1G71 once he had left Talerddig Loop, although there were locations where such a reminder could have been given (paragraph 111, Recommendation 5).

Additional observations

123 Network Rail procedure NR/PRC/MTC/MG0110 does not identify the information to be supplied to the signaller in accordance with the requirements of section 9.1 of module SP of the rule book (paragraph 114, Recommendation 6).

124 Notwithstanding the requirements of Network Rail procedure NR/PRC/MTC/MG0110, the person responsible for notifying the signaller of the need for an ESR may not be the person who knows when warning equipment is to be supplied (paragraph 115, Recommendation 6).

125 The driver of train 1G71 was not subject to drugs and alcohol screening, which was not in accordance with ATW's drugs and alcohol policy. Inconsistency in practice is not confined to ATW (paragraphs 116-119, Recommendation 7).

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

126 Network Rail and ATW have completed their own investigations into the incident.

127 When signalling in accordance with the *European Rail Traffic Management System* (ERTMS) is implemented on the Cambrian line (scheduled for 2009), the driver will be provided with in-cab guidance on maximum permissible speeds, including those associated with ESRs. The signaller will be responsible for applying the ESR to the ERTMS equipment as soon as he has been advised of the restriction to be applied, although there may be a short period before the system is reconfigured when drivers will need to be stopped and cautioned. If the ERTMS system has failed, the signaller will dictate a movement authority to each driver which will include details of all speed restrictions applicable at the time; the driver will record the information dictated by the signaller.

128 ATW advise that they have equipped their drivers with a magnetic strip that they can place on the driver's desk to act as a reminder of an ESR or other hazard ahead.

Recommendations

129 The following safety recommendations are made[1]:

Recommendations to address causal and contributory factors

1 The RSSB should, in consultation with Network Rail and representatives from the train operators, develop and implement a method for formally dictating and recording communication between signallers and drivers to be used when it is necessary for a signaller to warn drivers of a hazard ahead that requires reduction in speed, and no physical warning of the speed restriction is present locally. Consideration should be given as to whether the chosen means could be designed in such a way as to enable it to be used as an effective visual reminder to the driver of the location of the hazard and the speed restriction applied (paragraphs 121a and 122a).

2 Network Rail should:

a. use the circumstances of the incident at Ty Mawr to re-brief the requirements of 'Interpretation of Apply 20 mph ESR' (Appendix D, Page 79) in Standard NR/SP/TRK/001, 'Inspection and Maintenance of Permanent Way'; and

b. within one year of the briefing taking place, conduct an audit of ESRs imposed in the intervening period, to identify the number of occasions when the duration of an ESR has exceeded two hours without emergency equipment being erected, and take action, as appropriate, to address any deficiencies found (paragraph 121b).

3 Network Rail should review the range of speed restrictions and the timings for trains between Talerddig and Caersws to determine whether rationalisation of the number of such restrictions and/or relaxation of timings could enhance the driveability of the route and reduce the potential for distraction and misunderstanding by train drivers under degraded operating conditions (paragraph 122b).

Continued

[1] Duty holders, 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 ORR to enable them to carry out their 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 167 to 171) can be found on RAIB's web site at www.RAIB.gov.uk

4 Network Rail should conduct a review of the availability of warning equipment for emergency speed restrictions for the more remote areas of its network. The purpose of the review should be to identify how the requirement in NR/SP/TRK/001 to install warning equipment within two hours can be achieved. The review should include consideration of whether improvements in the speed of installation could be achieved, for example, by providing warning equipment at additional locations or on road vehicles used by staff who may have to install it as part of their duties (paragraph 122c).

5 Network Rail should:

a. review the circumstances of this incident and identify other parts of the network where the length of signal sections results in the potential for a significant period of time to elapse between a driver being informed of an ESR and the ESR being encountered; and

b. for each location identified, include within the relevant Sectional Appendix any additional locations where drivers should be reminded of the presence of an ESR ahead and how and by whom that reminder will be administered (paragraph 122d).

The purpose of this recommendation is to identify those areas of the national network where there might be significant elapsed time between a warning of an ESR being given and it being encountered and to provide further warnings to drivers, where practical.

Recommendations to address other matters observed during the investigation

6 Network Rail should modify procedure NR/PRC/MTC/MG0110 to list the information that the signaller is required to be told when an emergency speed restriction is to be imposed as defined in section 9.1 of module SP of the rule book (paragraph 123), and clearly identify who is responsible for providing each item of information (paragraph 124).

7 The Association of Train Operating Companies should develop guidance for train operating companies on 'for-cause' drugs and alcohol testing with the objective of achieving greater consistency in its application. The guidance should address the issue of who should have the authority to permit a driver to continue driving after an incident. It should also consider different scenarios where drugs and alcohol testing might be required, including how to deal with a situation where an incident requires a member of staff to be screened as soon as reasonably practicable and that member of staff is remote from a location where such testing can easily be administered (paragraph 125).

The purpose of this recommendation is not to conduct a comprehensive review of drugs and alcohol policy or practice, but rather to offer guidance on the application of existing drugs and alcohol policy in order that a more consistent approach by train operating companies can be achieved.

Appendices

Appendix A - Glossary of abbreviations and acronyms

AOCL	Automatic Open Crossing (Locally monitored)
ATW	Arriva Trains Wales
DMU	Diesel Multiple Unit
DRA	Driver Reminder Appliance
ERTMS	European Rail Traffic Management System
ESR	Emergency Speed Restriction
OTDR	On Train Data Recorder
RAIB	Rail Accident Investigation Branch
RETB	Radio Electronic Token Block
RSSB	Rail Safety and Standards Board
SMIS	Safety Management Information System
TEP	Token Exchange Point
TOC	Train Operating Company
UWC	User Worked Crossing

Appendix B - Glossary of terms

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

Automatic half-barrier crossing	An automatic level crossing fitted with half barriers, traffic lights on the highway and a telephone to the relevant signal box.*
Automatic open crossing (locally monitored)	A level crossing without barriers that is observed by the traincrew before they proceed over the crossing.*
Automatic Warning System	An arrangement of permanent magnets and electro-magnets that convey information about the associated signal to the train driver.*
Class 1A defects	A deformity, metallurgical fault or crack in a rail which requires the imposition of a 20 mph speed restriction and the removal of the defect within 36 hours.
Diesel Multiple Unit	A self-contained diesel-powered train comprising one or more vehicles that can be coupled to other compatible diesel multiple units to form longer trains.
Distant Signal	A signal only capable of displaying a proceed aspect or a caution aspect.*
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, it prevents the driver applying power and moving off.*
European Rail Traffic Management System	A standardised system of rail traffic control which supplements or replaces the existing conventional fixed signalling system.*
Fault and Operations Control (Network Rail)	An office from which control is exercised over the operation of the railway in a designated area and to which all infrastructure faults and failures in that area are reported to enable a response to be made.
Manually controlled gated crossing	A manned level crossing with gates which close across the full width of the road when a train needs to pass operated locally from a signal box level crossing box.
Mobile Operations Manager	A Network Rail operations manager who provides first line response to incidents.*
On-train data recorder	A data recorder fitted to traction units collecting information about the performance of the train. including speed, throttle and brake control positions, activations of horn, etc.*
Radio Electronic Token Block	A modern development of electric token block signalling in which the token takes the form of an encoded data message transmitted to a receiver on the train. The system ensures that only one train is in possession of any single radio token at one time.*

Recovery time	The small quantity of extra time built into a timetable that allows a late running train to get back on time.*
Rule Book	Railway Group Standard GE/RT8000, the publication detailing the general responsibilities of all staff engaged on the railway system, and the specific duties of certain types of staff such as train drivers and signallers.*
Safety Management Information System	A database of incidents occurring on the national railway network, managed on behalf of the railway industry by the RSSB.
Sectional Appendices	The publication produced by each Network Rail Route containing, amongst other things, local Instructions relevant only to specific parts of the route.
Stop board	A lineside sign instructing a driver to stop.*
Token exchange	The process by which a driver either hands or transmits a token to a signaller or vice versa.
Token exchange point	A location at which drivers relinquish and acquire electronic tokens in a RETB area.*
Ultrasonic Testing Team	A team trained in the operation of ultrasonic equipment used in the detection of rail flaws.
User Worked Crossing	A level crossing where the barriers or gates are operated by the user.*
Weekly Operating Notice	A document published by Network Rail providing information about engineering work, speed restrictions, alterations to the network and other relevant information to train drivers.

Appendix C - Key standards current at the time

GE/RT8000	Rule Book
NR/PRC/MTC/MG0110	Imposition and removal of temporary and emergency speed restrictions
NR/SP/TRK/001	Inspection and Maintenance of Permanent Way’

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Any enquiries about this publication should be sent to:

RAIB
The Wharf
Stores Road
Derby UK
DE21 4BA

Telephone: 01332 253300
Fax: 01332 253301
Email: enquiries@raib.gov.uk
Website: www.raib.gov.uk