



Rail Accident Investigation Branch

Rail Accident Report



Derailment at Ropley (Mid Hants Railway) 25 July 2006

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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This report is published by the Rail Accident Investigation Branch, Department for Transport.

Derailment at Ropley (Mid Hants Railway)

25 July 2006

Contents

Introduction	5
Summary of the report	6
Key facts about the incident	6
Immediate cause, causal and contributory factors, underlying causes	6
Additional observations	7
Severity of consequences	7
Recommendations	7
The Accident	8
Location	8
Summary of the accident	8
Sequence of events	8
Consequences of the accident	10
The Investigation	11
Sources of evidence	11
Key facts	12
Infrastructure owner	12
Train/rail equipment	12
The signalman	13
Operation and signalling of trains between Medstead and Ropley	13
The points at the north end of Ropley station	16
Previous occurrences of a similar character	19
Analysis	20
Immediate cause	20
Identification of casual factors	21
Contributory factors	21

Underlying causes	23
Other factors for consideration	24
Conclusions	26
Immediate cause	26
Causal and contributory factors	26
Additional observations	26
Actions reported as already taken or in progress relevant to this report	27
Recommendations	28
Recommendations to address causal and contributory factors	28
Recommendations to address other matters observed during this investigation	28
Appendices	29
Appendix A: Glossary of abbreviations and acronyms	29
Appendix B: Glossary of terms	30

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, liability or carry out prosecutions.
- 3 This report contains the findings from an investigation into a derailment that occurred at Ropley on the Mid Hants Railway (MHR) on 25 July 2006. Access was freely given by the infrastructure owner and train operator of the MHR, Mid Hants Railway plc (MHRPLC), to its staff, data and records in connection with the investigation.
- 4 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.
- 5 Heritage railways employ a number of different arrangements for staffing their operations. Some heritage railways employ people on a full or part time basis but the sector is characterised by its reliance on volunteers to undertake the majority of tasks. The MHRPLC employs a small number of paid staff but fills other posts from a pool of volunteers. In this report, the generic term ‘staff’ is used to cover everyone working on the railway, even though in practice they may be volunteers.

Summary of the report

Key facts about the accident

- At approximately 11:15 hrs on Tuesday 25 July 2006, the leading bogie of the 10:50 hrs MHR service from Alton to Alresford derailed on No.4 points approaching Ropley station. The derailed *bogie* followed a path midway between the routes to platforms 1 and 2, while the second bogie remained on the track, but followed the route towards platform 1 (see Figure 3). An instructor who was in the cab with the driver applied the emergency brake and the train stopped within 20 metres of the point where the front bogie derailed.

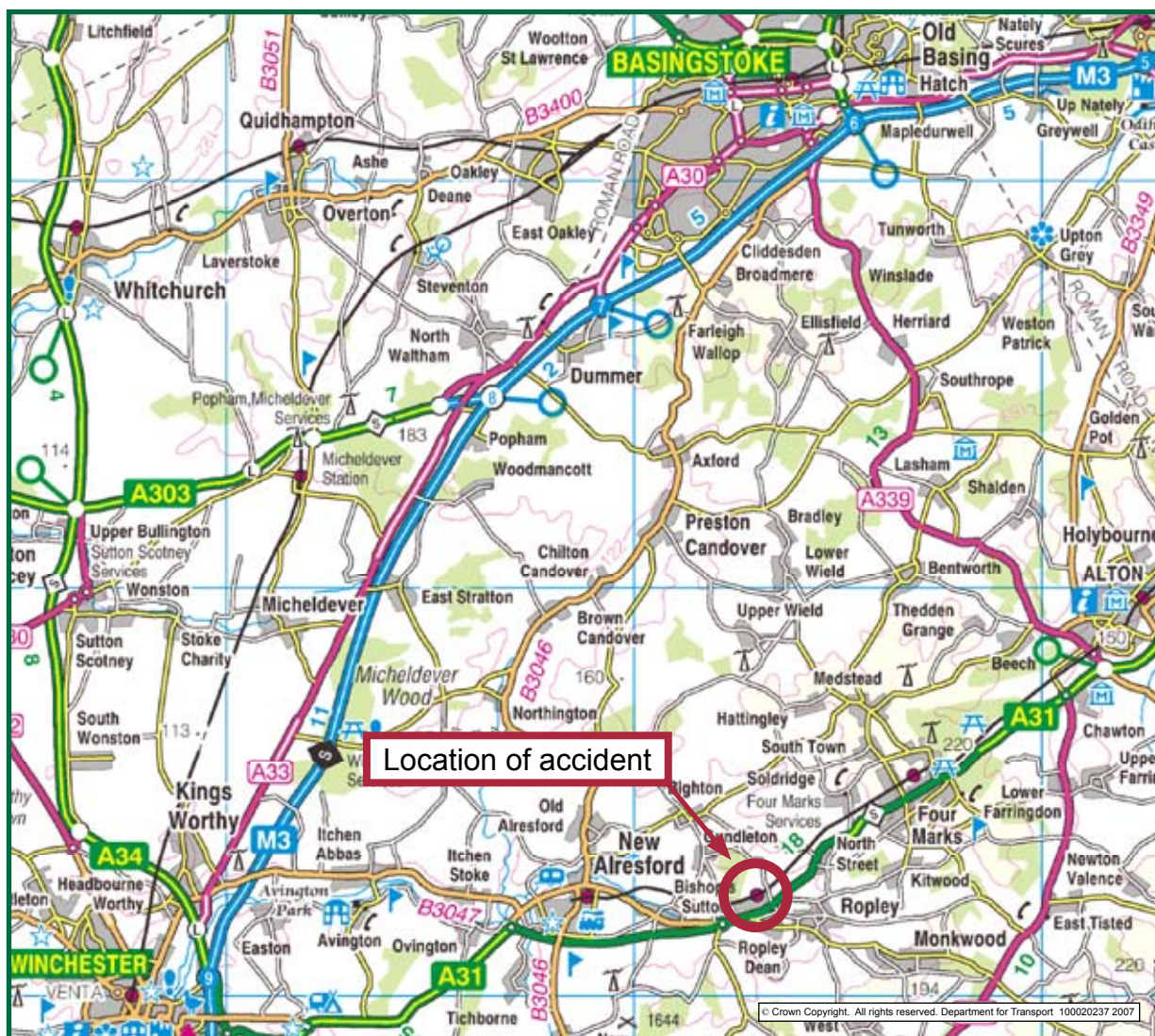


Figure 1: Extract from Ordnance Survey map showing location of accident

Immediate cause, causal and contributory factors, underlying causes

- The immediate cause of the accident was the reversal of No.4 points at Ropley by the signalman at the time that the leading wheel of the 10:50 hrs service from Alton to Alresford was passing over them.

- 8 The causal factors were:
- Momentary confusion by the signalman regarding the exact location of the 10:50 hrs service from Alton to Alresford.
 - The lack of train detection and associated interlocking on No.4 points which allowed the points to be moved under a train.
- 9 The contributory factors were:
- The intended use of a member of platform staff to receive the token from the driver of the 10:50 hrs service from Alton to Alresford which was a departure from normal practice.
 - The absence of any conditions relating to the time over which temporary signalling arrangements at Ropley could remain in force in the original approval of them by the Railway Inspectorate in 1983.
 - The delay in installing and commissioning the new signal box and signalling at Ropley.

Additional observations

- 10 The MHRPLC did not ensure that staff who were to be subject to drugs and alcohol screening remained on site until the testing was complete.
- 11 The MHRPLC is not compliant with all aspects of its safety management system.
- 12 The potential exists for a derailment to occur at Medstead under circumstances similar to those that caused the derailment at Ropley on 25 July 2006.
- 13 The advice provided to the *Heritage Railway Association* (HRA) by the Office of Rail Regulation (Her Majesty's Railway Inspectorate) (ORR (HMRI)) with regard to the competence and medical fitness of staff and volunteers aged 65 and over should be made available to all companies operating heritage railways as soon as possible to enable those operators to reflect its provisions within their safety management systems, as appropriate.

Severity of consequences

- 14 There were no injuries to passengers or staff as a result of the accident. The train and track suffered only limited damage. Train services were suspended for the remainder of the day.

Recommendations

- 15 Recommendations can be found in paragraph 119. They relate to the following areas:
- the provision of train detection on No.4 points at Ropley station and on the points at the north end of Medstead and Four Marks station.
 - the use of staff other than signalmen to perform duties associated with the operation of the *electric token block system*.
 - specific elements of the MHRPLC safety management system including drugs and alcohol testing procedures and the standard on signalling.
 - guidance to heritage railway operators on competence and medical standards for staff performing *safety critical work*.

The Accident

Location

- 16 The MHR, located in the county of Hampshire, runs between Alton and Alresford with intermediate stations at Medstead and Ropley. The train service is normally operated by steam locomotives and heritage diesel locomotives and multiple units. The railway is just over 10 miles (16 kilometres) long.
- 17 The MHR is a single track route with *passing loops* at the two intermediate stations and *run round* facilities at Alton and Alresford. See Figure 2 for a simplified layout of the railway. At Ropley station, there are two platforms; platform 1 is designated as the *up loop* and platform 2 as the *down loop*. Platform 1 is used by trains running from Alresford to Alton and platform 2 by trains running from Alton to Alresford.

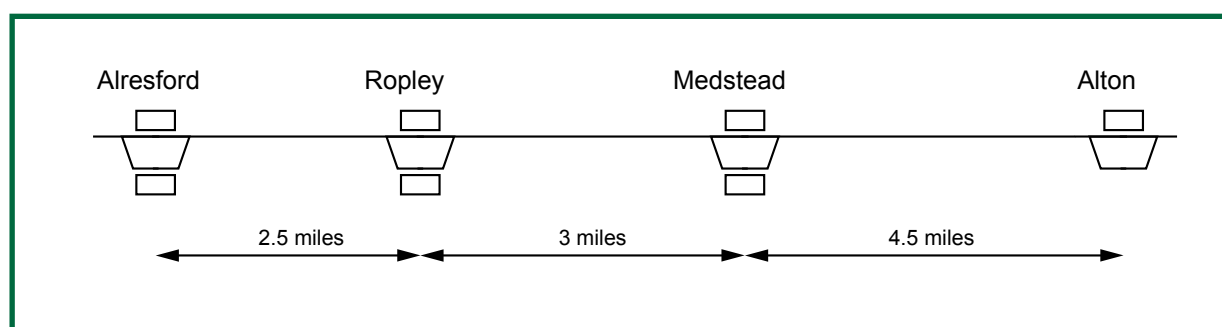


Figure 2: Simplified line diagram of Mid Hants Railway

Summary of the accident

- 18 At approximately 11:15 hrs on Tuesday 25 July 2006, the leading bogie of the 10:50 hrs MHR service from Alton to Alresford derailed on No.4 points (see Figure 3) approaching Ropley station. There were no injuries to passengers or staff as a result of the accident. The train and track suffered only limited damage. Train services were suspended for the remainder of the day.

Sequence of events

Events preceding the accident

- 19 On the morning of 25 July 2006, the MHR was operating a timetable that required two trains to be in service. One of the trains was hauled by a steam locomotive while the other was formed by a Class 117 *Diesel Mechanical Multiple Unit* (DMU). A trainee was driving the DMU and an instructor was also in the cab to monitor the trainee's performance and provide advice and guidance as necessary. The DMU was *prepared* at Alresford (where it had been stabled overnight) and taken empty to Alton in time to depart in the down direction at 10:50 hrs.
- 20 The first station stop was at Medstead. After station duties were complete, the train departed for Ropley. In the meantime, the first up passenger train of the day had departed from Alresford and arrived in platform 1 at Ropley, where it was timetabled to wait until the 10:50 hrs service from Alton had arrived and cleared the single line between Medstead and Ropley.

- 21 The *down* train had a normal journey from Medstead until the approach to Ropley station. Both the trainee driver and the instructor observed that Ropley signal No.1 (see Figure 3) was in the *clear* position, as was signal No.2. The trainee driver applied the brake to slow the train to approximately 15 mph (25 km/h) before arriving at No.4 points and then allowed the train to coast once the reduction in speed had been achieved. As the train approached No.4 points, the trainee driver and instructor observed that they were set correctly to take the train into platform 2.

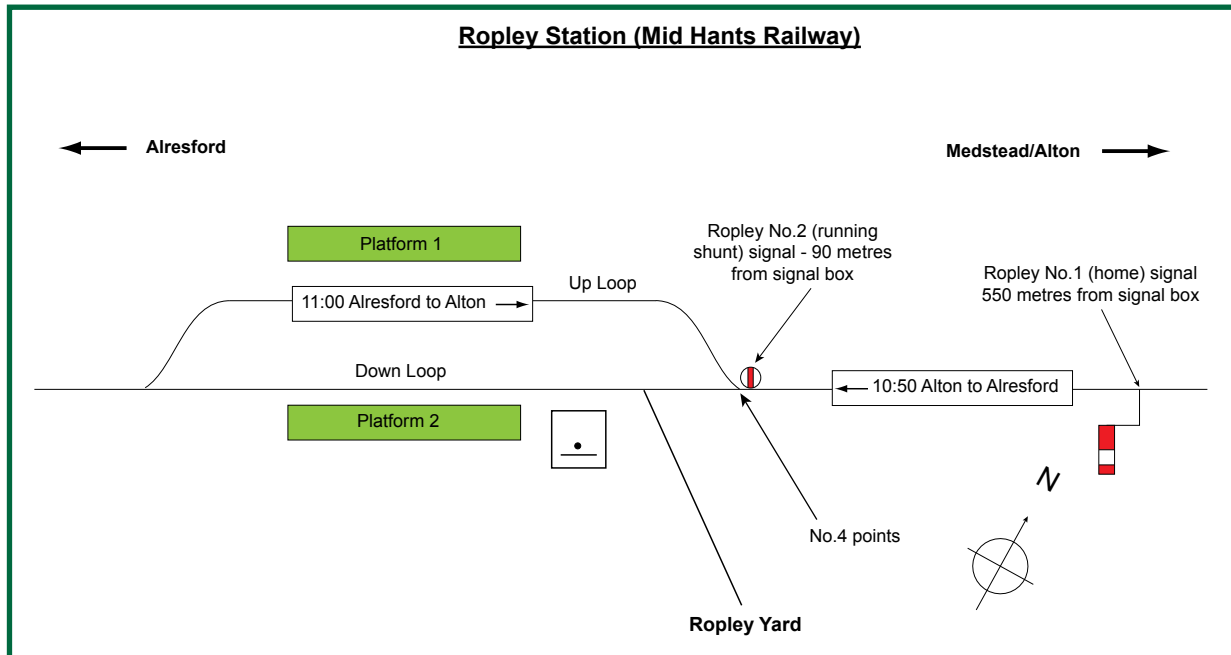


Figure 3: The track layout at Ropley

Events during the accident

- 22 Soon after the leading bogie of the train passed the *switch toes* of No.4 points, it derailed. The derailed bogie followed a path midway between the routes to platforms 1 and 2, while the second bogie remained on the track, but followed the route towards platform 1.
- 23 The derailment became apparent to the trainee driver and instructor almost immediately because of the severe jolting that occurred as the leading bogie left the rails and ran over sleepers. The instructor applied the emergency brake and the train stopped within 20 metres of the point where the front bogie derailed.

Events following the accident

- 24 Immediately following the accident, the trainee driver secured the train by applying the hand brake. It was necessary for the passengers (10-15 in number) to be assisted from the train to ground level and walk to Ropley station. This was achieved safely by the trainee driver, instructor and guard of the derailed train with the help of other MHR staff.
- 25 The MHRPLC immediately commenced its own investigation and obtained written reports from the trainee driver, the instructor and the signalman in charge of Ropley signal box. In accordance with its company procedures, the MHRPLC arranged *drugs and alcohol screening* for the trainee driver, instructor and signalman. This was undertaken for all staff approximately five hours after the incident occurred. The signalman went home before the screening took place and had to return in order to be tested. The result of the screening was negative for all three members of staff.

- 26 The derailed train was left in position until permission was granted by the RAIB for rerailing to commence at 16:00 hrs. Rerailing was completed by 19:00 hrs and damage to the track was repaired the same evening.

Consequences of the accident

- 27 No injuries were suffered by staff or passengers.
- 28 Damage occurred to approximately 25 sleepers and associated rail fastenings.
- 29 The DMU suffered damage to brake rigging and the displacement of the destination indicator. It was withdrawn from service pending repairs.
- 30 The train service on the MHR was suspended for the remainder of the day, but resumed normally on the following morning (26 July 2006).

The Investigation

Sources of evidence

31 The following sources of evidence were used during the course of the RAIB investigation:

- Physical evidence from site, including derailment marks in the vicinity of No.4 points, the condition of the switch toes of No.4 points and the profiles of the leading wheels of the derailed train.
- Review of the arrangements in Ropley signal box including method of operation of the points and signals and the *interlocking* between them.
- Statements from MHRPLC personnel directly and indirectly involved in the derailment.
- Documentation supplied by the MHRPLC relating to the approval of No.4 points for operation of trains, the maintenance of the DMU involved in the derailment and the selection, training, competence and medical fitness of key staff. The MHRPLC also supplied their *Railway Safety Case* (current at the time of the derailment) and supporting *standards*.
- Guidance from the HRA on assuring the competence and medical fitness of staff undertaking safety critical work such as drivers and signalmen.
- Advice on competence and medical fitness for staff employed in safety critical work provided by the ORR. The ORR is the safety authority for railways in this country and HMRI is part of the ORR.
- Information provided by other heritage railways relating to their practices with regard to the training, competence and medical fitness of staff in safety critical positions.

Key facts

Infrastructure Owner and Train Operator

- 32 The MHRPLC is the infrastructure owner and train operator for all timetabled services operated over the MHR.

Train/rail equipment

- 33 The train involved in the derailment was a two car Class 117 DMU, comprising vehicles 51405 (leading) and 51363 (trailing). The unit was manufactured by the Pressed Steel Company in 1960 and was withdrawn from service on the national rail network in 1999. Following withdrawal, it was purchased privately and brought to the MHR for restoration. This was completed in 2002 when the unit entered service with the MHR.
- 34 In March 2006, the DMU was taken to First Great Western's High Speed Train maintenance depot at St Philips Marsh in Bristol. *Tyre turning* was undertaken in order to restore the *wheel profile*. Measurements of flange height and flange thickness taken after the unit was returned to the MHR showed that they were comfortably within the maximum and minimum values (respectively) laid down in Appendix 3 of *Railway Group Standard GM/RT 2466, 'Railway Wheelsets'*. After returning from Bristol, the unit had only run approximately 3,000 miles in the four months leading up to the day of the derailment.
- 35 Track in the vicinity of the incident comprises *bullhead rail* laid on timber sleepers.
- 36 Trains are signalled over the MHR using the electric token block system. Signal boxes are located at Alresford, Ropley and Medstead stations.
- 37 The points and signals at Ropley are operated mechanically through rodding (for points) and wires (for signals) from a *lever frame* of 15 levers in the signal box. The signal box is at ground level and is located immediately adjacent to the Medstead end of the down platform.
- 38 The points involved in the incident (No.4 points) were installed either during the latter part of 1976 or early 1977. They were originally hand points used to allow locomotives to *run round* their train when the railway only operated between Alresford and Ropley. They were converted to signalbox operation and fitted with a *facing point lock* and associated signalling in early 1983 and brought into use in this way in May 1983 when the section from Ropley to Medstead was reopened.
- 39 Once the points have been moved to the correct position, the facing point lock lever is operated. The position of the points cannot be changed without first releasing the facing point lock (by operating the facing point lock lever). This arrangement prevented the signalman from operating the lever to change the position of the points inadvertently.
- 40 However, there was no associated means of preventing the points from being unlocked and moved while a train was passing over them. This is conventionally achieved either by means of a *locking bar* which is depressed by the flanges on the wheels of trains passing over them and forms part of the drive to the facing point lock, or by a *track circuit* which locks the facing point lock and point levers electrically.

The signalman

- 41 The signalman involved in the incident was a volunteer on the MHR. He was 81 years of age. He had first worked for the MHRPLC in 1986, following his retirement from full-time employment. In 1988, he undertook training for the role of signalman. The training comprised a mixture of classroom study and practical experience under the instruction of a qualified signalman with intermediate and final examinations before appointment. The signalman completed his training and passed all examinations successfully in 1988. In accordance with the MHRPLC standard on safety critical work and competency, he was subject to assessment of his knowledge of the rules every two years. The signalman's most recent rules assessment had been undertaken in March 2005 and he was not therefore due for another examination until March 2007.
- 42 Signalmen on the MHR are also required to attend a Personal Track Safety (PTS) course every two years and sit an assessment at the end. The signalman involved in the derailment had attended a PTS course two days before the incident and had successfully completed the assessment, achieving full marks.
- 43 In addition to formal assessments of competence, signalmen on the MHR are also seen by senior members of MHRPLC operational staff when the latter undertake signal box visits. Visits are both formal (recorded) and informal (unrecorded) in nature. On occasions, when an intensive train service is being operated, two members of staff will be in the signal box. The signalman involved in the derailment was well known to senior managers within MHRPLC and on the occasions that they had seen him in the months leading up to the derailment there had been no cause for concern. Between April and July 2006 visits had been made to signal boxes on three occasions when this signalman had been on duty. The most recent occasion before the derailment was on 14 June 2006. The records kept by the MHRPLC indicate that the signalman had not been involved in any safety-related incident during the 18 years he had worked as a signalman on the railway.
- 44 On the MHR, staff who are over the age of 65 are required to complete a medical self-certification form annually. This form seeks specific information regarding the individual's current medical condition and allows the person completing it to highlight any issues of concern. The self-assessment forms are reviewed by the individual's manager and if there are any issues of concern, advice is sought from the Company's Medical Officer. The signalman involved in the derailment at Ropley had completed an annual self-certification form in February 2006. He had identified no issues of concern.

Operation and signalling of trains between Medstead and Ropley

Sequence of events for a train running between Medstead and Ropley

- 45 The MHR comprises a single track railway with passing loops at intermediate stations. Trains operate in both directions over the single track. The safe movement of trains over the single track is controlled by the electric token block system.
- 46 The driver of a train requiring to run between a pair of adjacent stations must be in possession of the correct *token* before entering the single line section. The signalman is responsible for issuing the token to the driver. Tokens are locked in a machine in the signal box. The locking prevents the signalman from obtaining a token from the machine (or clearing the signal for the train to proceed) unless the relevant section of single line is unoccupied and the signalman at the opposite end of the section has given permission by operating a switch on his token machine. This unlocks the token in the machine at the other end of the single line, where the train is waiting to proceed.

47 The driver of a train running from Medstead to Ropley (a down train) collects a token for the single line section between the two stations from the signalman at Medstead and proceeds towards Ropley once the signal at the entrance to the single line is clear. The key features for a train approaching Ropley station in the down direction are (refer to Figure 3):

- The *distant* signal for Ropley, which is located approximately 1280 metres from Ropley signal box. The distant signal in the down direction is *fixed*, which means that it cannot show anything other than a caution indication.
- Ropley *home* signal (signal No.1), which is a stop signal located approximately 550 metres from Ropley signal box. Depending on the timetable and whether trains are running on time, the driver of a down train might be required to stop at this signal because it is not permitted for two trains to enter Ropley station from different directions at the same time (even though they use different platforms). Priority is given to *up* trains because if they are stopped between Alresford and Ropley, the driver would be required to restart the train on a steep rising gradient.
- Just before the points into platform 2 at Ropley (No.4 points) is a *running shunt signal* (signal No.2), located 91 metres from Ropley signal box. The interlocking between the signal and point levers in Ropley signal box requires No.2 signal to be cleared before No.1 signal can be operated. No.4 points must be set normal, and locked by facing point lock No.3, before signal No.2 can be cleared. This means that the only situation in which a train entering from Medstead might approach signal No.2 in the danger position when signal No.1 had been clear is if the signalman at Ropley had returned both signals No.1 and No.2 to danger after the train had passed signal No.1.
- Immediately beyond signal No.2 are No.4 points which would normally be set to take a down train into platform 2 at Ropley station.
- On the approach to Ropley signal box, the driver (or fireman on a steam locomotive) would either place the token for the Medstead-Ropley single line section onto a '*token catcher*' hook located on the approach to Ropley signal box or hand it to the signalman.
- On entering platform 2 at Ropley station, the driver of a down train would receive the token for the single line section to Alresford either in the vicinity of Ropley signal box or after stopping in the platform.

Normal actions of a signalman at Ropley

48 The signalman at Ropley, having accepted a train from Medstead, has to take the following actions to enable the down train to run into platform 2:

- ensure No.4 points are normal, which sets the route into platform 2;
- lock the points in position by operating the facing point lock (lever 3);
- clear the running shunt signal (signal No.2);
- clear the Ropley down home signal (signal No.1).

The actions need to be performed in the order described above. The signal interlocking prevents steps being taken out of sequence. Once No.4 points are locked, the signalman is unable to change their position without returning both signals to the danger position and unlocking the facing point lock.

- 49 In addition to dealing with the arrival of the down train, the signalman may also have to signal an up train to depart as soon as is practicable after the arrival of the down train. This was the case when the derailment occurred on 25 July 2006. At that time, when an up train was waiting to depart immediately following the arrival of a down train, the normal sequence of actions taken by the signalman at Ropley as the down train approaches would be:
- restore signal No.1 to the danger position when the train is seen coming through the bridge on the Medstead side of Ropley station;
 - restore signal No.2 to the danger position once the train clears No.4 points;
 - unlock the facing point lock on No.4 points;
 - move No.4 points from the normal to the reverse position;
 - retrieve the Medstead – Ropley token from the token ‘catcher’ outside of the signal box or from the driver of the down train;
 - send the ‘train out of section’ signal to Medstead signal box for the down train;
 - ask ‘is line clear’ to Medstead for the up train;
 - once ‘line clear’ has been obtained from Medstead, obtain a token for the up train;
 - clear the up starting signal (No.11);
 - hand the token for the Ropley – Medstead section to the driver or fireman of the up train.
- 50 Although signal No.11 cannot be cleared before the signalman at Ropley has received the token from the driver of the down train, placed it into the machine and obtained a new token for the up train, the first four actions could be undertaken before the token for the down train had been received or placed into the machine.
- 51 The absence of track circuits or any other train detection device on No.4 points meant that providing signal No.1 and signal No.2 had been restored to danger, it was possible for the signalman at Ropley to remove the facing point lock and move the points before the down train had passed over them or while it was doing so.

Sequence of events on the day of the derailment

- 52 The *Train Register Book* shows that the signalman at Ropley was offered the 10:50 hrs service from Alton to Alresford by the signalman at Medstead at approximately 10:52 hrs. Although at this stage the down train had only just left Alton, it was considered good practice for Medstead Signal Box to offer it forward to Ropley at the earliest possible opportunity (and before it arrived at Medstead) as this helped to ensure that no delays occurred.
- 53 As there were no movements to be made onto or over the single line between Ropley and Medstead in the up direction before the down train arrived at Ropley, the Ropley signalman was able to accept the train immediately. This provided the signalman at Medstead with the authority to give the driver of the down train the token for the single line section between Medstead and Ropley (paragraph 46). The signalman at Medstead sent the ‘train entering section’ message to the signalman at Ropley at 11:06 hrs, indicating that the down train had just left Medstead station.

- 54 At 11:10 hrs, the up train arrived in platform 1 at Ropley. Having received confirmation that the train had arrived complete, collected the single line token from the fireman and placed it into the token machine in Ropley signal box, the signalman was able to offer the down train (now running between Medstead and Ropley) to the signalman at Alresford. The down train was offered and accepted at 11:10 hrs and the signalman at Ropley was able to withdraw a token for the single line section between Ropley and Alresford in readiness for the arrival of the down train.
- 55 A member of staff was on duty on platform 2 at Ropley and offered to give the driver of the down train the token. Although this was a task normally performed by the signalman at Ropley it was occasionally (and informally) undertaken by members of platform staff to assist the signalman at busy times. The practice was condoned by MHRPLC Managers because they believed that it was a good way for staff who aspired to undertake the role of signalman to learn about certain aspects of the job. The signalman accepted the offer and gave the token for the Ropley to Alresford section to the member of staff for delivery to the driver of the down train.
- 56 With the up train now stationary in platform 1, the signalman was able to set the route for the down train to enter platform 2, following the sequence of actions described in paragraph 48. As the down train approached Ropley and an up train was waiting to depart, the signalman prepared to take the actions described in paragraph 49. The signalman on duty at Ropley on the morning of 25 July indicated that his practice was slightly different from that described in paragraph 49. He would not normally touch any of the levers in the signal box until he had received the token for the down train. Only then would he start the process of setting the route for the up train, the initial action of which is to replace signal No.1 to danger.
- 57 However, on the morning of 25 July, the signalman on duty in Ropley signal box replaced signal No.1 to danger before receiving the token from the driver of the down train, replaced signal No.2 and unlocked the facing point lock before the down train had reached No.4 points. Then, just before the leading wheels reached No.4 points, the signalman operated lever No.4 and commenced the movement of the points at precisely the moment the down train arrived at the points, causing the leading wheels to take a path between the routes to platform 1 and platform 2.

The points at the north end of Ropley station

- 58 Any attempt by a signalman on a standard gauge railway (national rail network or heritage sector) to operate points as a train approaches would normally be unsuccessful because the presence of the train in the vicinity of the points would normally be detected by an electrical or mechanical device and interlocking between this device and the levers operating the points and the facing point lock would prevent the signalman from moving either. However, No.4 points at the north end of Ropley station were not equipped with any form of train detection and the signalman was able to move the points under the train. The RAIB is aware of only one other standard gauge heritage railway where such an arrangement still exists.
- 59 The legal requirement for the interlocking of points and signals dates from the passing of the Regulation of Railways Act 1889, which gave the Board of Trade power to make orders stipulating the interlocking to be provided on existing railways. This power was later transferred to the Ministry of Transport, and an order under the Act was made in respect of British Railways.

- 60 The signalling arrangements required were defined in the ‘Requirements for passenger lines and recommendations for goods lines of the Minister of Transport in regard to railway construction and operation’ (the Requirements). The 1950 edition was still current in 1983 (when No.4 points at Ropley were brought into use) in respect of signalling. Concerning points, paragraph 21 of the Requirements stipulated that:
- ‘Facing points on passenger lines, and all points regularly used in the facing direction by passenger trains to have:
- A bolt-lock through a third *stretcher bar*, with its bolt either worked through a locking bar or controlled by track circuit. Locking bars, if used, to be longer than the greatest inter-axle dimension of vehicles likely to pass over them.
 - A *stock rail* gauge tie.
 - Apparatus to detect that each switch is in its proper position, and that the points are bolted, before the relative signals can be cleared.’
- 61 However, Appendix II gave scope for relaxation of this requirement in the case of light railways:
- ‘A locking bar will not be required when the lever working the facing points is alongside them.’
- 62 The object of the requirement is to prevent the points being moved, both as a train approaches and while it is actually passing over them. It recognises that human fallibility creates a hazard, and where possible technical solutions should be used to control the associated risk. The invention of the locking bar in the nineteenth century provided a suitable control measure. The relaxation for light railways reflects that the expense of such technology may not be justified on the basis of there being lower risk where traffic is light and speeds are low, and where the person operating the points is close to them and therefore should be aware of the position of the train.
- 63 When lines were closed by British Rail and/or transferred to other operators, the orders made under the 1889 Act ceased to apply, and other legislation was put in place to ensure that appropriate arrangements for safety were provided. During the 1970s and 1980s many sections of railway were re-opened by preservation societies, usually operating as Light Railways and therefore limited to a maximum speed of 25 mph (40 km/h).
- 64 The line from Alresford to Alton, which closed in 1973, was re-opened by the predecessor to the MHRPLC (the Winchester & Alton Railway Ltd) in stages, beginning with the Alresford to Ropley section in 1977. The authority for the operation of the main section of the re-opened MHR is the Alton and Alresford Light Railway Order 1977. This stipulates (paragraph 7(3)) that the permission of the Secretary of State for Transport is required before passengers may be conveyed on any part of the railway. At the time the MHR was being re-opened permission was given on behalf of the Secretary of State for Transport by the Railway Inspectorate (RI) following approval of the infrastructure and signalling work, the design of which had previously been discussed between the RI and the operator of the MHR.
- 65 Most preserved railways have relied on the use of second-hand equipment, which was quite plentiful in the 1960s and early 1970s when large numbers of British Railways lines were being closed, and a general reduction in facilities was taking place on the remaining routes. However, by 1977 the closure programme was largely complete.

- 66 Mechanically operated facing points on the main line network were (and are) still common. However, in most cases locking bars had been replaced by track circuits because these were easier to maintain, more suitable for high-speed running and were needed to fulfil other functions in the signalling system. The number of sets of locking bar equipment which were in suitable condition and available for re-use by preserved railways was small. The difficulty which the various preservation societies had in locating suitable equipment was well known to the RI.
- 67 Staff who were in post during the 1980s recall that the RI was prepared to accept the absence of locking bars and track circuits in circumstances where the signaller had a clear view of the points and trains passing over them.
- 68 When the first section of the MHR, from Alresford to Ropley, was re-opened there was only one platform at Ropley. The points and signals at the south (Alresford) end of the station were operated from a four-lever *ground frame*, while the points at the north (Alton) end, which were not used by passenger trains, were worked by a hand lever.
- 69 The section from Ropley to Medstead and Four Marks was re-opened in 1983. At this time, Ropley became a crossing station on the single line and signalling was introduced accordingly. The arrangements at Ropley, in common with those at a number of other locations on the MHR and elsewhere, were a compromise between the full main-line standards defined in paragraph 21 of the Requirements and the much simpler arrangements which had been deemed suitable for the Light Railways built in the early part of the twentieth century as low speed, low cost lines serving remote rural areas.
- 70 The original intention was to rebuild the former signal box from Netley on the down platform at Ropley. However, it was not possible to complete this work in time for the proposed opening of the extension, and so a temporary ground level signal box, based on a 15-lever *'knee' frame*, was erected at the foot of the ramp at the Alton end of platform 2.
- 71 The points at the Alresford end of the loop, remote from the signal box, were equipped with a locking bar. Those at the Alton end, however, were not. Instead, a running shunt signal (Ropley No.2 signal; see Figure 3) was provided on the approach to the points, and worked for each train. The home signal was positioned 459 metres on the Medstead side of the points. The signal box, at ground level as described above, was 91 metres on the Ropley side of the toe of the facing points. The signaller was thus in a position to observe the points and down trains passing over them, which then run directly in front of the signal box.
- 72 These arrangements were inspected by the RI on 12 and 27 May 1983, and permission was given for the use of the railway from Ropley to Medstead. No time limit was placed on the use of the ground level signal box, although its temporary nature was clear. The structure of the 'permanent' signal box was already in place on the down platform at Ropley. It will finally be commissioned during 2007, 24 years after the temporary arrangements were brought into use.
- 73 Since 1983 the heritage railway industry has grown substantially, both in terms of new railways opened and more extensive operations on existing lines. Signalling facilities which were planned and built on a very low budget have in many cases been upgraded to cope with the traffic levels of the twenty-first century.

74 The RI became Her Majesty's Railway Inspectorate (HMRI) in 1990. The 1889 Act was repealed by the Railway Safety (Miscellaneous Provisions) Regulations 1997 (SI 1997/553). Regulation 5 requires appropriate procedures and equipment to be provided and maintained to prevent collisions and derailments. Detailed guidance on how this should be achieved is now provided in HMRI's *Railway Safety Principles and Guidance* (RSPG), which has replaced the 1950 Requirements. The section applicable to heritage railways (part 2, section H), says at paragraph 315:

'Once the route has been set and locked, and the signals cleared, the interlocking must not permit any points on the route to be moved or conflicting signals to be cleared until the train has used it, or until it is known that the train will not use it.'

75 There are no specific relaxations for light railways. There is no requirement for retrospective fitting of such equipment, but any new schemes affecting the operation of such points would be expected to comply with current guidance.

76 During the investigation, a review of relevant parts of the MHRPLC's Railway Safety Case was undertaken. The MHRPLC has a number of standards that support the Railway Safety Case and paragraph 7.7 of the standard on signalling states:

'Once a route has been set, locked and the signals cleared it must not be possible for any points in the route to be moved or conflicting signals to be cleared until the train has used it, or until it has been proved that the train will not use it.'

77 This wording is a paraphrase of paragraph 315 in RSPG. Had the MHRPLC complied with it, the derailment that occurred on 25 July 2006 would have been avoided.

Previous occurrences of a similar character

78 There have been no occurrences of a similar nature on the MHR or on any other heritage railway as far as the RAIB has been able to establish.

Analysis

Immediate cause

- 79 The following factors were key to determining the immediate cause of the derailment:
- as the train approached No.4 points, signal No.2 was in the clear position and the route was correctly set for the train to run into platform 2;
 - on arrival at No.4 points (the toes of which are located only two metres beyond signal No.2), the leading bogie of the first coach ‘split’ the points (i.e. the right hand leading wheel, which should have been diverted towards platform 2 by following the *switch rail*, instead followed the right hand stock rail towards platform 1);
 - the left hand leading wheel followed the left hand stock rail, which was its correct route for gaining access to platform 2;
 - the trailing bogie did not derail but followed the route to platform 1.
- 80 There are three possible explanations that could account for all of these factors:
- the points moving just as the leading wheels were approaching them;
 - a fault within the pointwork that permitted the leading right wheel to run between the switch rail and the stock rail, when the switch rail should have diverted it towards platform 2;
 - a defect on the leading right wheel of the DMU that allowed the flange to run between the switch and the stock rail rather than being correctly diverted by the switch rail;
- 81 There are two reasons why the points might have started to move just as the leading wheels of the train were approaching them:
- there was a fault within the operating mechanism of the points that caused them to move as the train was passing over;
 - the signalman was able to move the points under the train and did so.
- 82 The only source of power used to move the points is human; the points therefore could not have moved as a result of spurious operation of a motor. At an early stage in the investigation, the signalman accepted that he had caused the points to move under the train. For this reason, testing of the points for faults was not undertaken. The action of the signalman is the immediate cause of the derailment.
- 83 The RAIB considered the other possible causes. There is no evidence to support any suggestion of a fault within the pointwork. There was no damage to the switch toes, which would be expected had the leading wheel forced its way between the switch and stock rails. The points were inspected after the derailment and no fault was found such as a broken or damaged switch rail. Therefore, once the facing point lock was operated, the switch rails were held securely in position.
- 84 The examination of the leading wheels of the train after the derailment found that they were in good condition and could not have caused or contributed to the accident.

Identification of causal factors

- 85 In determining the causal factors, two key questions are considered:
- Why did the signalman move the points under the train?
 - Why was it possible for the signalman to move the points under the train?
- 86 The signalman, while accepting that he had performed the actions that had resulted in the derailment of the 10:50 hrs service from Alton to Alresford, was unable to explain why he had prematurely restored signal No.1 and signal No.2 to danger, released the point lock and changed the position of the points. He had performed the actions required to cross down and up trains safely at Ropley many hundreds of times and was thoroughly acquainted with the correct procedure.
- 87 The signalman appears to have suffered momentary confusion, which resulted in the uncharacteristic behaviour of prematurely starting the process of resetting the route before the down train had arrived (paragraphs 56 and 57). The signalman's momentary confusion is a causal factor.
- 88 Paragraphs 64-72 describe the history of No.4 points at Ropley station and why they were not equipped with any form of train detection. The lack of train detection meant that there was nothing that physically prevented the signalman from moving No.4 points under a train, providing that the prerequisites of signal No.1 and signal No.2 being at danger and the point lock being released had been met. This lack of train detection and associated interlocking is a causal factor.

Contributory factors

- 89 Paragraph 87 makes reference to the signalman's momentary confusion as the down train approached Ropley. There is no evidence to indicate why the signalman lost concentration at the critical moment and any explanation offered can only be conjecture. One possibility is that his normal pattern of activity when crossing down and up trains at Ropley was broken by permitting another member of staff to hand the token for the Ropley-Alresford section to the driver of the down train. This was an informal arrangement, made on the day (paragraph 55). By so doing, it obviated the need for the signalman to be on the platform (and therefore away from the lever frame) as the down train approached. The departure from the signalman's normal pattern of behaviour is a contributory factor.
- 90 Another possible explanation is that having replaced signal No.1 and signal No.2 to danger and unlocked the facing point lock, the signalman realised that the down train had not arrived and, being concerned about the passage of the train over unlocked points, returned to the frame to lock the points again. The levers for the facing point lock and No.4 points are adjacent (see Figure 4). If the signalman accidentally pulled the lever for the points instead of that for the facing point lock, the fact that the facing point lock was already unlocked would allow No.4 points to be moved.
- 91 The signalman indicated that there were no problems with regard to his health on the morning of 25 July 2006. He had started duty approximately two hours before the derailment occurred and considered that he was adequately rested. There is no evidence to suggest that the signalman was not fit for duty.

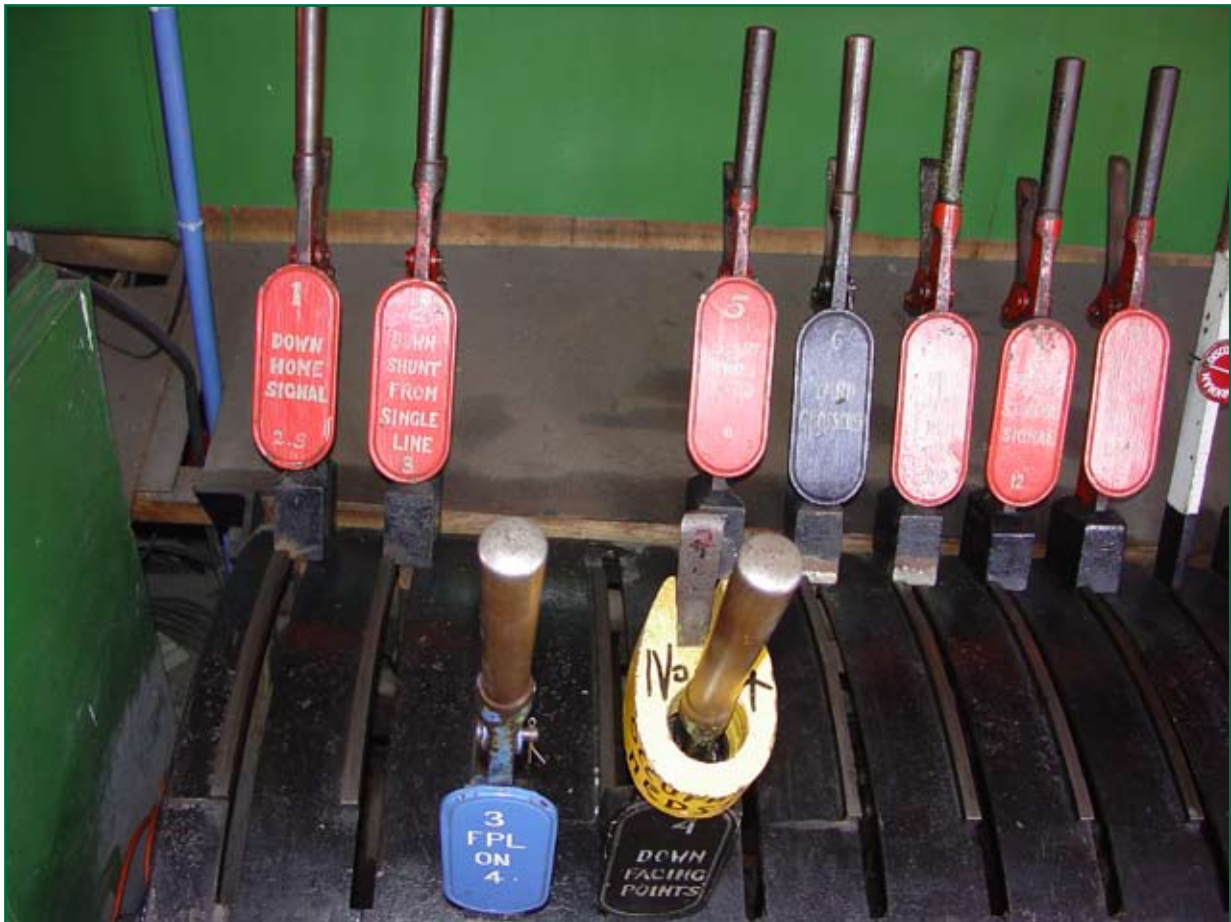


Figure 4: The lever frame in Ropley Signal Box

- 92 Paragraph 70 makes reference to the MHRPLC's intention to install and commission a new signalbox at Ropley and associated signalling in time for the reopening of the section of line to Medstead in 1983. As this was not possible, temporary arrangements were put in place in the form of the ground level signal box.
- 93 No explicit conditions had been placed on the use of the temporary arrangements with regard to the volume of traffic that passed over them. After 1983, the MHR experienced growth in passenger numbers, partly attributable to the further extension of the railway to Alton in 1985, which provided a connection with the main line rail network. In addition, the scope of the operation also increased with the running of trains in the hours of darkness (e.g. evening dining trains), special gala days with two trains per hour in each direction running between Ropley and Alton and special events at Ropley itself involving shunting of trains between platforms using the points involved in the derailment. The absence of any explicit conditions relating to the time during which the temporary arrangements could remain in force is a contributory factor.

- 94 The RAIB has considered why these ‘temporary’ arrangements remained in place for such a long time.
- Although the volume and scope of the MHR’s operation was much greater in 2006 than had been the case in 1983, the change was gradual. There was no single major change that might have led the MHRPLC to initiate a risk assessment to determine whether the commissioning of the new signal box and associated signalling at Ropley should be expedited or other mitigating measures put in place such as explicit instructions regarding when the home signal could be replaced to danger. In any case, it was not until the early 1990s that risk assessment began to be used extensively by the railway industry to assess the implications of changes in operating practice.
 - As described in paragraph 93, the RI had placed no time limits on the use of the temporary arrangements and no restrictions on the amount of traffic that could be operated over the points. The MHRPLC prioritised projects that would extend the infrastructure (extension to Alton), enhance its operating capability (restoration of locomotives and rolling stock) and improve facilities for visitors (station restoration and enhancement).
- 95 The delay in providing the new signalling installation at Ropley is a contributory factor.

Underlying causes

- 96 There is evidence to suggest that the significance of train detection on No.4 points at Ropley (and a similar situation applying to the points at the north end of Medstead; see paragraph 108) was not appreciated by the MHRPLC generally:
- the briefing of signalmen in the track layout at Ropley included no specific mention of the lack of locking on No.4 points;
 - the signalman on duty at Ropley at the time of derailment thought that Ropley was the only location where points were not locked by the presence of trains, although he also worked the signal box at Medstead where a similar arrangement existed;
 - while there is mention of the specific hazard of points being moved under trains in the risk assessment associated with train operations, the risk is assessed as low.
- 97 The MHRPLC took the view that the way to manage the risk from the lack of train detection on No.4 points at Ropley was for signalmen to comply with their training and not restore signal No.2 to danger until the whole of the train had cleared No.4 points. The points could not be moved unless signal No.2 was in the danger position. However, taking this approach meant that the hazard of points being moved under the train was only being controlled by procedural measures as opposed to the signalling system preventing such an act.

Other factors for consideration

Medical fitness of staff within the heritage sector

- 98 The heritage railway sector depends on volunteers. Many are people who have retired from full-time employment. The MHRPLC does not impose any upper age limit on its signalmen, although it does require drivers to 'retire' at 70. There is no evidence that the signalmen's age was relevant to the cause of the derailment. The RAIB has investigated a collision at Loughborough Central station (RAIB report 07/2006) which occurred on 4 February 2006 involving an individual who was 73 years of age at the time of the accident and a fatal accident on the Gwili railway on 19 July 2006 where two of the individuals associated with the accident were 66 and 69 years of age respectively.
- 99 As a general issue arising from this incident, the RAIB has considered the implications of the age profile on the medical fitness of heritage railway staff and its relevance for the safety of operations in this sector.
- 100 Ageing affects people differently and it is not possible to define an absolute cut-off point, beyond which an individual's performance will pose unacceptable risk. In a railway environment, this has particular significance for staff called upon to perform safety critical roles. The roles of train/locomotive driver and signalmen are safety critical because any lapse from the required standard might result in a hazardous situation. While the safety features that are inherent within signalling equipment might help to prevent the majority of hazardous situations that could be caused, for example, by a lapse in signalmen's concentration, there are occasions when the equipment fails and it is necessary to resort to manual methods of working requiring skill and concentration.
- 101 Guidance on competence and medical fitness is offered to the heritage railway sector by the HRA. At the time that the derailment occurred, the guidance was that staff undertaking driving duties should be medically assessed to the same standard as that applied to main line train drivers. As the standards for main line drivers only apply up to the age of 65, the HRA provides guidance on arrangements for drivers over 65, recommending annual medical examinations. For safety critical staff other than drivers, the guidance indicates that self-certification is an appropriate method for addressing the medical fitness of staff over the age of 65. The guidance includes a template for a self-certification form.
- 102 The arrangements in place at the MHR followed this guidance. The company does not impose a retirement age for posts other than that of driver (although the section on the MHR's website devoted to the MHR Preservation Society indicates that applications to volunteer for positions other than that of driver would be welcome from individuals up to the age of 85). Other heritage railways were contacted to establish whether the practice followed with regard to medical fitness of staff aged 65 or older was consistent across the sector. Even without establishing the specification for medical examinations (where employed), it was apparent from this limited review that they were not:
- one heritage operator provides annual medical examinations for its drivers, firemen and signalmen after the age of 65 and imposes a retirement age of 75 on drivers and signalmen alike;
 - another heritage operator provides annual medical examinations for its drivers, firemen and signalmen after the age of 65 and has an informal retirement age of 75 for drivers and signalmen alike, although it might allow them to continue to work after the age of 75 if they were manifestly capable of doing so;
 - a third heritage operator does not use staff over the age of 65 in the roles of signalmen and driver.

- 103 The ORR (HMRI) has a policy on the use of staff over the age of 65 in safety critical positions. It states that there should be no specified upper age limit for safety critical staff working on heritage railways, but that each individual railway must ensure that such personnel are able to carry out their duties without imposing any extra risk either to the public, fellow staff or themselves. As a member of staff progresses in years beyond 65 he or she should be examined for operational fitness on at least an annual basis
- 104 The examination should include elements related to age: i.e. possible decline in physical strength and/or mental alertness. The ORR (HMRI) provides the example of guards who might be required to climb into and out of a passenger vehicle between stations or drivers and signalmen who may be required to work long turns of duty, sometimes on hot days. The ORR (HMRI) recommends that heritage railway operators should have a process in place to assure themselves that such staff are still fully alert and cognisant of their duties, rules and regulations at the conclusion of a shift.
- 105 The ORR (HMRI) also recommends that operators of heritage railways should have a system in place to ensure that safety critical staff are medically fit to perform their duties. They advocate that the system should comprise completion of a medical questionnaire by all safety critical staff, referring to the template provided by the HRA in their guidance (paragraph 101).
- 106 For staff over the age of 65, the ORR (HMRI) advocates annual medical examinations by a suitably qualified medical practitioner for certain safety critical roles, giving the example of footplate staff (drivers and firemen) as those for whom it should apply.
- 107 The advice from ORR (HMRI) was given in a letter sent to the HRA in August 2006. The HRA is planning to reissue its guidance to the sector on competence and medical fitness using the clarification provided by ORR (HMRI) as the basis, and this will include a specification for the medical examination.

The points at the north end of Medstead station

- 108 During the course of the investigation, it was noted that the points located at the north end of Medstead station are similar to those involved in the derailment at Ropley. Neither track circuits nor locking bars are provided and it is therefore possible for a signalmen to move these points under a train. Under normal circumstances, it is unlikely that the signalmen will be in the signal box at the time that the train is travelling over the points as he needs to be on the platform to receive the token from the driver or fireman of a down train. However, there are occasions when platform staff receive the token from down trains at Medstead, which means that the potential for a derailment with similar causes to those that were relevant to the derailment at Ropley exists at Medstead.

Conclusions

Immediate cause

109 The immediate cause of the accident was the reversal of No.4 points at Ropley by the signalman at the time that the leading wheel of the 10:50 hrs service from Alton to Alresford was passing over them (paragraph 82).

Causal and contributory factors

110 Causal factors were:

- Momentary confusion by the signalman regarding the exact location of the 10:50 hrs service from Alton to Alresford (paragraph 87).
- The lack of train detection and associated interlocking on No.4 points which allowed the points to be moved under a train (paragraph 88, **Recommendation 1**).

111 In addition, the following factors were considered to be contributory:

- The informal use of a member of platform staff to hand the token for the Ropley-Alresford section to the driver of the 10:50 hrs service from Alton to Alresford which was a departure from normal practice (paragraph 89, **Recommendation 2**).
- The absence of any conditions relating to the time over which the temporary signalling arrangements at Ropley could remain in force in the original approval of them by the RI in 1983 (paragraph 93).
- The delay in installing and commissioning the new signal box and signalling at Ropley (paragraph 94, **Recommendation 1**).

Additional observations

112 The MHRPLC did not ensure that staff who were to be subject to drugs and alcohol screening remained on site until the testing was complete (paragraph 25, **Recommendation 3**).

113 The MHRPLC is not compliant with all aspects of its safety management system (paragraphs 76 and 77, **Recommendation 4**).

114 The potential exists for a derailment to occur at Medstead under circumstances similar to those that caused the derailment at Ropley on 25 July 2006 (paragraph 108, **Recommendation 5**).

115 The advice provided to the HRA by the ORR (HMRI) with regard to the competence and medical fitness of staff and volunteers aged 65 and over should be made available to all companies operating heritage railways as soon as possible to enable those operators to reflect its provisions within their safety management systems, as appropriate (paragraphs 103 to 107, **Recommendation 6**).

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

- 116 Immediately following the derailment, the MHRPLC issued an instruction to signalmen operating Ropley Box that signal No.1 should not be returned to danger until the last vehicle of a down train had passed clear of No.4 points. As one of the prerequisites for reversing No.4 points after the passage of a down train is returning signal No.1 to danger, this instruction will, if followed, prevent future derailments of the type that occurred on 25 July 2006.
- 117 It is currently planned that the new signalling at Ropley, operated from the permanent signal box, will be brought into use during late summer, 2007. It will include track circuiting through the whole length of the station, covering both sets of facing points. The track circuits will control the facing point locking bolts, and the locking bar on the Alresford end points will be removed.
- 118 The MHRPLC is developing plans to provide a track circuit on the approach to the down home signal at Medstead station. In the meantime, an instruction has been issued that the down home signal is not to be returned to danger until a down train is clear of the down loop points.

Recommendations

119 The following safety recommendations are made¹:

Recommendations to address causal and contributory factors

- 1 The MHRPLC should ensure that existing plans for the provision of train detection on No.4 points at Ropley are implemented without further delay (paragraphs 110 and 111).

Recommendations to address other matters observed during the investigation

- 2 The MHRPLC should ensure that if staff other than signalmen are to be involved in receiving tokens from or handing tokens to drivers at any station:
 - a. their use should be planned;
 - b. the specific individual undertaking the role should be identified within the relevant operating notice;
 - c. they should always work under the supervision of the signalman;
 - d. they should be competent to perform the role (paragraph 111).
- 3 The MHRPLC should make explicit in its procedures that staff who are to be subject to drugs and alcohol screening do not leave MHR premises until the screening has been undertaken (paragraph 112).
- 4 The MHRPLC should conduct a review of its safety management system to identify non-compliances and develop/implement actions plans to resolve them (paragraph 113).
- 5 The MHRPLC should provide train detection on the points at the north end of Medstead station (paragraph 114).
- 6 The HRA should:
 - a. Issue new guidance on competence and medical standards for safety-critical staff. This should be based on the advice contained within the letter from the ORR (HMRI) to the HRA of August 2006. It should include the standards to be achieved for all staff that undertake safety critical duties, denoted on a role-based model.
 - b. When the guidance has been prepared and issued, advise heritage railway operators to review their safety management systems to take account of its provisions (paragraph 115).

¹ Responsibilities in respect of these recommendations are set out in the Railways (Accident Investigation and Reporting) Regulations 2005 and the accompanying guidance notes, which can be found on RAIB's web site at www.raib.gov.uk

Appendices

Glossary of abbreviations and acronyms

DMU

HMRI

HRA

MHR

MHRPLC

ORR

PTS

RAIB

RI

RSPG

Appendix A

Diesel Multiple Unit

Her Majesty's Railway Inspectorate

Heritage Railway Association

Mid Hants Railway

Mid Hants Railway plc

Office of Rail Regulation

Personal Track Safety

Rail Accident Investigation Branch

Railway Inspectorate

Railway Safety Principles and Guidance

Glossary of terms

Appendix B

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

Bogie	A metal frame equipped with two or three wheelsets and able to rotate freely in plan, used in pairs under rail vehicles to improve ride quality and better distribute forces to the track.*
Bullhead rail	The former standard rail section in Britain, not normally laid in as new. The rail has a rail head and rail foot that are similarly shaped.*
Clear (signal)	A colour light signal displaying a green light, or a semaphore signal in the off (proceed) position.*
Diesel Mechanical Multiple Unit	A multiple unit train whose source of power is a diesel engine and whose transmission is mechanical.*
Distant (signal)	A signal only capable of displaying a proceed aspect or caution aspect.*
Down (train)	Generally, a term applied to trains running away from London. On the MHR, trains running between Alton and Alresford are referred to as down trains.
Down loop (Ropley)	A section of line provided to enable down trains to call at Ropley station while passing another train on the up line.
Drugs and alcohol screening	Testing of a blood or urine sample from an individual to determine the presence (and if relevant, concentration) of drugs and alcohol in their body.
Electric token block system	A signalling system for single lines based on the issuing of tokens to trains for each section. Only one token may be released at a time and trains may not enter the section without a valid token, ensuring that only one train may occupy each section at any one time.*
Facing point lock	A device fitted to a set of facing switches at the front stretcher bar position which positively locks the switches in one setting or the other, totally independently of any other switch operating mechanism.*
Fixed (distant signal)	A distant signal only capable of displaying a caution aspect.*
Ground frame	A small group of signals and point levers located close to some isolated and infrequently used facility such as a trailing crossover. These levers are locked by the controlling signal box, and only released when required. Alternatively, the levers may be released by means of a key attached to a train staff.*
Heritage Railway Association	Body representing the majority of heritage railways and preserved railways in the UK and Ireland.*
Home (signal)	The first signal capable of showing a stop aspect on the approach to a signal box.*

Interlocking	Controls fitted between points and signals that prevent the signaller from setting conflicting routes. In mechanical signalling this is achieved by locking slides on a locking shelf, which locked conflicting levers. More modern systems use a relay based logic, microprocessors or computers to perform the same functions.*
‘Knee’ frame	A signal frame with the base roughly at knee height as opposed to the normal position level with the floor.
Lever frame	An assembly of two or more levers and an interlocking system arranged to control the points and signals in an area.*
Locking bar	A type of depression bar fitted at facing points which locks the facing point lock when a train is present.*
Passing loop	A track onto which traffic may be diverted or held to allow other traffic to pass.*
Prepare (train)	Duties performed by driver before a train enters service, comprising internal and external examination of the train and checks to ensure that key systems such as brakes are functioning correctly.
Railway Group Standard	Mandatory technical or operational document which sets out what is required to meet system safety responsibilities on Network Rail’s infrastructure.
Railway Safety Case	A document by which a potential operator of trains demonstrates their compliance with mandatory safety standards.*
Railway Safety Principles and Guidance	The documents produced by ORR (HMRI) detailing the rules to be applied to the design and operation of light railways, railways and tramways.*
Running shunt signal	A signal provided to permit shunting movements which is also cleared for normal train movements.
Run round	The process of detaching a locomotive from one end of a train, running it to the opposite end and reattaching it.
Safety critical work	Any work on the railway that directly has the potential to jeopardise the safety of operations or the health and safety of other people travelling or working on the railway.
Standards	Documents which set out the company’s own requirements governing the design and operation of the railway.
Stock rail	The fixed rail in a half set of points.*
Stretcher bar	A bar that links the two switch rails in a set of points and maintains their correct relationship (e.g. when one is closed (against the right hand stock rail), the other is open (and not making contact with the left hand stock rail)).*
Switch rail	The thinner movable machined rail section that registers with the stock rail and forms part of a switch assembly.*

Switch toes	The end of a switch rail that is first traversed by a rail vehicle negotiating a switch in the facing direction (sometimes referred to as the switch tips).*
Token	A device (often a metal tablet) carried by a driver as authority to enter a section of line controlled by the Electric Token Block system. The system is arranged so that once a token is issued to one driver, no other token can be issued for that Section of Line.*
Token catcher	A device provided at the end of a single line section where the driver or fireman of a train can place the token for the single line section over which the train has just passed.
Track circuit	An electrical train detection system, based on the principle of proving the absence of a train. In its basic form, a source of electrical current is connected between the running rails at one end of the section to be detected. At the other end a relay coil (or equivalent) is connected between the rails. When there is no rail vehicle present, the current source energises the relay coil and the section is proved clear. When a rail vehicle enters the section, the action of wheels and axles is to short the relay out, causing it to create an open circuit.*
Train Register Book	The book in which a signaller records movements of trains, visitors and completion of other regular duties. They are also used to record details of disconnections, possessions and irregularities.*
Tyre turning	The grinding of the horizontal part of the rail wheel to remove imperfections built up through wear in service and restore the original wheel profile.
Up (train)	Generally, a term applied to trains running towards London. On the MHR, trains running between Alresford and Alton are referred to as up trains.
Up loop (Ropley)	A section of line provided to enable up trains to call at Ropley station while passing another train on the down line.
Wheel profile	The shape of a section of rail wheel taken through the axis of rotation. Typically this is a conical section with a flange on the side of the greatest diameter.*

This report is published by the Rail Accident Investigation Branch,
Department for Transport.

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