



Rail Accident Investigation Branch

# Rail Accident Report



## Unauthorised train movement and subsequent derailment at Haymarket, Edinburgh 14 January 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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# **Unauthorised train movement and subsequent derailment at Haymarket, Edinburgh**

## **14 January 2006**

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## 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 Access was freely given by Network Rail and EWS to their staff, data, investigation reports and records for the purpose of this investigation.
- 4 Appendices at the rear of this report contain glossaries explaining the following:
  - acronyms and abbreviations are explained in Appendix A; and
  - certain technical terms (shown in *italics* within the body of this report) are explained in Appendix B.

## Summary of the report

### Key facts about the incident

- 5 During engineering work on the railway between Haymarket East Junction and Curriehill on 14 January 2006, a train loaded with *spent ballast* left the section of line that was under *engineers' possession* without authority and ran onto a line open to other traffic. On reaching Haymarket East Junction it was diverted onto a line on which a passenger train was approaching in the opposite direction. The ballast train stopped in Haymarket station when the driver realised that he was travelling on the wrong line. The passenger train was stopped by the action of the signaller.
- 6 Subsequently, during tests on the brakes of the ballast train, one wagon became derailed by one set of wheels. There were no injuries, and minor damage to a set of *points*.

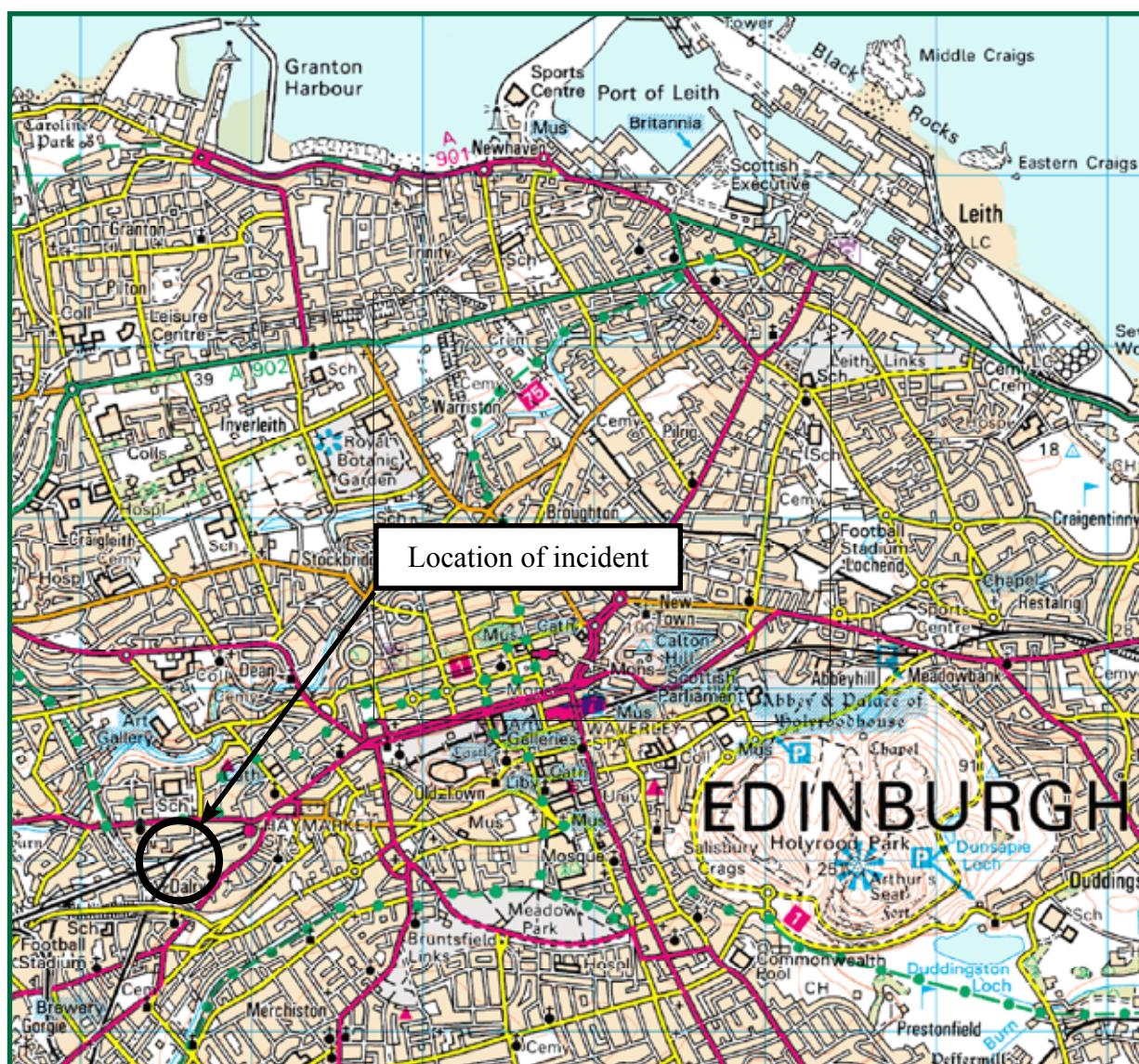


Figure 1: Extract from Ordnance Survey map showing location of incident.

## **Immediate cause, contributory factors, underlying causes**

- 7 The immediate cause of the first incident was that the driver of the ballast train left the possession without obtaining authority from the signaller.
- 8 The derailment occurred because a fitter carried out a brake test while the train was standing over points which had been damaged during the first incident.

## **Causal and contributory factors**

- 9 Causal factors were:
  - the standard of communication between the signaller, the driver, the *Person in charge of possession* (PICOP) and the '*PICOP's assistant*';
  - the rules in module T3 of the *Rule Book* that govern the protection of possessions when the end of the possession is located between the last signal and a junction are complex and not easy to understand;
  - the staff involved did not understand, or correctly apply the requirements of module T3 of the *Rule Book* governing the provision of a handsignaller and the limits of a possession;
  - late change to the possession limits at the request of a contractor;
  - the driver did not correctly apply the requirements of module T11 of the *Rule Book* concerning authority for movements out of a possession;
  - trains were not stopped on the line that was open to traffic prior to the move towards the protection being authorised;
  - confusion over the role and authority of the '*PICOP's assistant*'; and
  - there were issues associated with the quality of the training and competence assessment of these individuals which contributed to the incident.
- 10 In addition, the following factors were considered to be contributory:
  - staff considered the placing of protection at a location in close proximity to points on a line that was still open to traffic to be unexceptional; and
  - the planning process did not identify the need for the special working arrangements associated with protection that is positioned between the last signal and a junction.
- 11 A causal factor in the derailment was that the fitter did not consider the risks of carrying out the brake test with the train in the position he found it.

## **Recommendations**

- 12 Recommendations can be found in paragraph 105. They relate to the following areas:
  - changes to the rules relating to the movement of trains within and out of engineering possessions, and to the rules governing the protection of engineering possessions; and
  - compliance with the existing rules for possessions pending any such changes.



## The Incident

### Summary of the incident

- 13 At 15:00 hrs on Saturday 14 January 2006, a train consisting of a class 66 locomotive and 35 loaded ballast wagons left an engineering possession on the Midcalder lines west of Haymarket without the signaller's permission, and ran towards the junction at Haymarket.
- 14 The train ran through a set of *switch diamond* points which were not correctly set for the move, and was diverted on to the *down* south Edinburgh & Glasgow line. It travelled along this line for approximately 400 metres, running in the wrong direction, until it reached Haymarket station. The driver stopped at the platform and advised the signaller of his location. A passenger train approaching Haymarket from Edinburgh Waverley on the same line was stopped by the action of the signaller.
- 15 Some time later, while a brake test was being carried out as part of the preparation to remove the train from the site, one of the wagons in the train rolled back when the brakes were released and became derailed on the switch diamond points. Re-railing of the train took place by 21:00 hrs and repairs to minor damage to the points were completed at 02:00 hrs the following morning. There were no injuries to people and no damage to the train.

### The parties involved

- 16 The infrastructure is owned and managed by Network Rail.
- 17 The train was operated and crewed by English Welsh & Scottish Railway (EWS).
- 18 The works were being carried out as part of Network Rail's West Coast Route Modernisation project (WCRM).
- 19 The possession management was contracted by WCRM to Scotweld Employment Services Ltd, who provided the staff who undertook the roles of PICOP and PICOP's assistant.



## Location and infrastructure

- 20 The two principal rail routes from Edinburgh to Glasgow diverge at Haymarket East Junction, which is about 300 m west of Haymarket station. The line from Haymarket East Junction to Midcalder Junction is double track, electrified at 25 kV on the overhead line system, and is used by, among others, West Coast Main Line services between London Euston and Edinburgh. Signalling is by the track circuit block system using three and four aspect colour light signals, controlled from Edinburgh Signalling Centre. A diagram of the railway routes in this area is to be found at Figure 2.

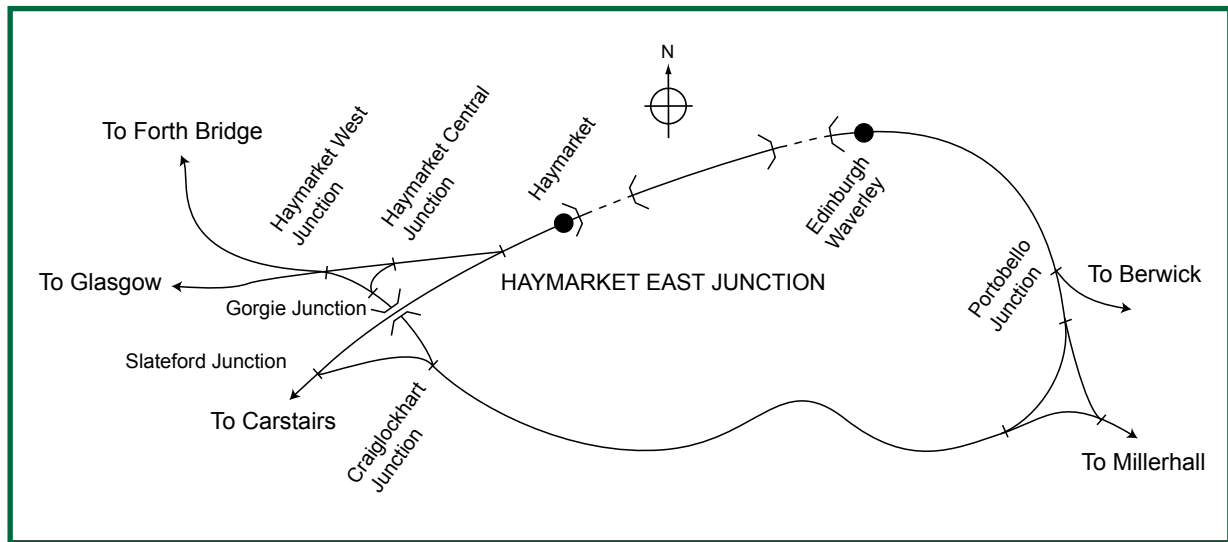


Figure 2: Diagram of the area.

- 21 The Midcalder route was closed for engineering work over the weekend of 14/15 January 2006. The engineering possession included both lines from Curriehill to just west of Haymarket East Junction, and covered the period between 05:00 hrs on Saturday 14 January and 00:30 hrs on Monday 16 January. The work to be carried out during the possession included re-ballasting and re-sleepering, maintenance patrolling, tree cutting, ultrasonic rail testing, and maintenance of the overhead electrified lines.

- 22 The possession was included in the *Weekly Operating Notice* (WON) for week 42, as item 36. Although it was described as extending from Midcalder Junction to Haymarket East Junction (10½ miles), the possession limits were shown as from signal ES697 to clear of 173B points (down line) and clear of 172 points to signal ES696 (*up* line). Signals ES696 and ES697 are on the Midcalder lines at Curriehill, some 4½ miles short of Midcalder Junction, while 172 and 173B points are at Haymarket East Junction, making the total length of the possession some 6 miles. Figure 3 shows the layout and signalling details at the Haymarket end of the possession.

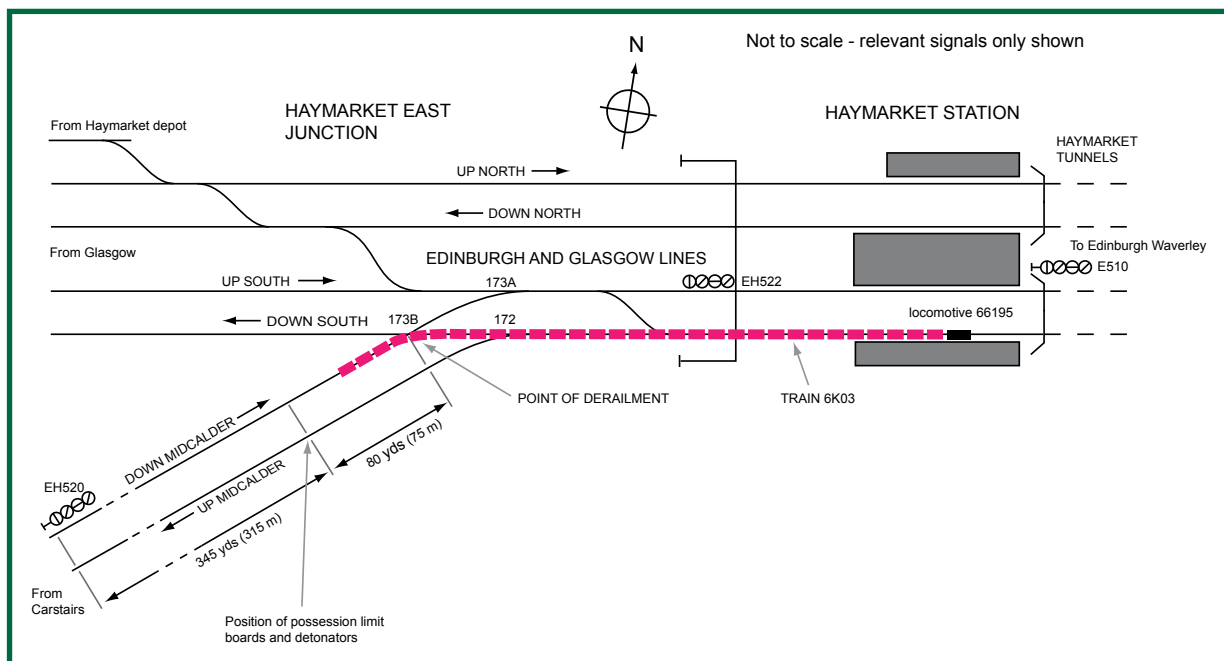


Figure 3: Track layout and possession limits.

- 23 The last signal on the down Midcalder line protecting Haymarket East Junction, EH520, is located at the 100¼ milepost, 390 m (425 yards) on the approach to the junction. At Haymarket East Junction the designation of the eastbound direction of travel changes from ‘down’ to ‘up’. The next signal for a train travelling in this direction is EH522, which is between the junction and Haymarket station, followed by EH510 at the east end of Haymarket station.

## The train

- 24 The train involved was 6K03, the 15:00 hrs Haymarket East Junction to Millerhill Yard. It consisted of a locomotive (number 66195) and 35 vehicles of type ZCA (four wheeled open ballast wagons). It was owned and operated by English Welsh and Scottish Railway (EWS).

## Events preceding the incident

- 25 The possession was managed by the WCRM project, who subcontracted the actual management to staff supplied by Scotweld Employment Services Ltd. The PICOPs were Scotweld employees. Two people filled this role on 14 January 2006, the first (PICOP 1) from the start of work to 14:40 hrs, and the second (PICOP 2) from 14:40 hrs until 20:30 hrs. They were responsible for the item 36 possession, and also for a possession (item 351) on the Slateford Junction – Craiglockhart Junction line which abutted the item 36 possession at Slateford Junction. Each PICOP was based (in turn) at Motherwell signalling centre, where WCRM has established facilities for PICOPs controlling possessions throughout the project area in Scotland.
- 26 PICOP 1 was responsible for setting up the possession on the morning of 14 January 2006. He had attended meetings on the preceding Wednesday, Thursday and Friday in connection with the work to be done and the arrangements for the organisation of the possession and the work sites within it. After the meeting on the Thursday (which had been chaired by the Network Rail Possession Assurance Manager), PICOP 1 was approached by a member of contractor's staff with a request for the possession limits to be moved closer to the junction at Haymarket to enable access to overhead line switching equipment near the junction. He agreed to the change, although it had not been discussed at the meeting and no record of it was published, contrary to section 11.5 of module T3 of the Rule Book. The revised possession limits were 75 m (80 yards) from the junction, and thus 315 m (345 yards) ahead of signal EH520. A diagram of the area showing the possession limits is at Figure 3.
- 27 At 04:55 hrs on the Saturday morning PICOP 1 was given permission to lay the *protection* for the possession. Shortly after this PICOP 1 advised the signaller that there was '*substandard*' *protection* on the down Midcalder line. This information was not passed on to the signaller on the next shift when the signalling centre shifts changed over at 06:00 hrs.
- 28 A PICOP's assistant was stationed at the *possession limit boards* (PLB) at the Haymarket end of the possession throughout the period of the possession; part of his duties was to remove and replace the protection for trains entering and leaving the possession.

## Events during the incident

- 29 The driver of train 6K03 at the time of the incident booked on duty at 12:20 hrs and relieved the previous driver at Slateford at 13:20 hrs. He then performed a number of shunting movements in connection with reballasting work near Slateford to enable the wagons to be filled with spoil.
- 30 PICOP 2 relieved PICOP 1 and took over responsibility for the possession in a handover which took the two PICOPs from 14:30 hrs to about 14:40 hrs. At 14:40 hrs PICOP 2 authorised train 6K03 to leave the work site and proceed towards the *detonator* protection at Haymarket East.

- 31 When train 6K03 reached the possession limits, the PICOP's assistant informed PICOP 2 that it had arrived. At 14:54 hrs PICOP 2 contacted the signaller and advised him that the train was now standing at the detonators. The signaller asked if the train was at EH520 signal, and PICOP 2 informed him, incorrectly, that it was. The signaller told PICOP 2 that there was an Edinburgh – Glasgow train approaching Haymarket, and that train 6K03 would be signalled away in four to five minutes. The signaller then asked PICOP 2 to lift the detonator protection and let him know when this had been done, following which he would signal the train away when he had a path available for it. He intended to allow the 15:00 hrs Edinburgh to Glasgow passenger train (1R25) to pass over the junction first, and had set a route for it accordingly.
- 32 Three minutes later, at 14:57 hrs, the driver of train 6K03 contacted the signaller. There was then a three-way conversation involving the driver, the PICOP's assistant and the signaller, which concluded with the signaller saying to the PICOP's assistant that the driver had permission to move as soon as the protection was lifted and that the train would then be signalled out.
- 33 During this conversation, none of the three participants took the lead in establishing who was giving permission to whom for *lifting the protection* and moving the train, with the result that they did not reach a clear understanding about where the train was, where it could move to, and when. Each person was left with a different impression of what had been decided. The driver had passed the phone to the PICOP's assistant to reach an understanding with the signaller. The signaller thought that the PICOP would be contacting him when the detonators had been lifted, and the PICOP's assistant thought that the signaller had given permission for the train to move.
- 34 At 15:00 hrs PICOP 2 contacted the signaller again and informed him that he had given incorrect information about the position of the train and the PLB. This conversation was terminated by the signaller when he received an audible alarm that points 173B had lost *detection*, and observed from the indications on his *control panel* that the train was moving onto the down Edinburgh & Glasgow line. The signaller replaced signals to danger in front of train 1R25, which was stopped shortly after leaving Edinburgh Waverley station.
- 35 Meanwhile, the PICOP's assistant had lifted the protection, and had given a wave to the driver of train 6K03 to indicate that he could now move forward. At about 15:00 hrs the train left the possession and moved towards Haymarket East Junction. The driver saw that the signal beyond the junction (EH522) was clear (it was working automatically at the time), and took this to be applicable to his train.
- 36 The train passed over the junction and ran through 173B switch diamonds, which diverted it onto the down south line. The driver realised that his train was heading in the up direction on the down line and stopped the train in platform 4 of Haymarket station, after the locomotive had travelled about 400 m past the junction; he immediately contacted the signaller. The rear of the train was still on the down Midcalder line.
- 37 In order to ensure that it had not been damaged as it went through the switch diamond points, arrangements were then made to examine the train before it was moved onto the correct line. At 16:14 hrs a member of EWS engineering staff asked the driver to release the train brakes so that he could carry out a functional brake test. The wagons of the train rolled back a short distance and the wagon that was standing on the switch diamond points (173B), the fifth from last in the train, became derailed by one pair of wheels (see paragraph 44).

## **Consequences of the incident**

- 38 The action of the signaller in stopping train 1R25 prevented a potential collision.
- 39 There was minor damage to the switch diamonds.

## **Events following the incident**

- 40 Recovery arrangements were put in place and the train was eventually drawn forward and removed at 22:24 hrs. Repairs to 173 switch diamonds were completed by 02:00 hrs on 15 January 2006.

## **Previous occurrences of a similar character**

- 41 During 2005 there were many instances of irregular working in connection with engineering possessions on Network Rail. On 18 August 2006 the RAIB published its report on an incident at Thirsk on 11 January 2006, in which a rail was removed from a section of line on which a passenger train was approaching, by staff who were under the impression that the line was under possession. The RAIB report on the Thirsk incident gives some indication of the numbers of such irregularities.

## Analysis

### The immediate cause of the incident

- 42 The incident occurred when train 6K03 left the possession without the authority of the signaller, because of a lack of a clear understanding between the staff concerned about the position of the train and the responsibility for authorising movements.
- 43 Following this incident, one wagon of the train became derailed. The EWS fitter who attended the train at Haymarket was not aware that the train was still standing with its rear end over 173B switch diamonds and therefore did not consider the risks of doing a functional brake test at that location. When the brakes were released, the rear of the train rolled a short distance back, and one pair of wheels which were standing on the switch diamonds were derailed towards the *six-foot*. The movement was probably caused by the release of the compressed buffers of the wagons, since the Edinburgh and Glasgow lines are level at this point.
- 44 The movement of the train was extremely limited, and there was no risk to any person or other train from this derailment.

### Requirements of the Rule Book

- 45 The requirements for the protection of engineering possessions are laid down in the Rule Book (GE/RT8000) module T3, and the movement of engineering trains within possessions is covered by module T11. Detonators and PLBs are used to mark the possession limits; within these limits, marker boards are used at the boundaries of each *work site*. The PICOP is responsible for authorising train movements out of and between work sites; within each work site, the Engineering Supervisor for that work site controls train movements.
- 46 Arrangements for detonator protection at the end of the possession are dealt with in module T3 clause 5.5. A *handsignaller* is required if there is no signal between the possession limit and a line that is open to traffic, as was the case at Haymarket East Junction. The relevant extracts from the Rule Book, including diagrams T3.2 and T3.3, are to be found at Appendix C.
- 47 The duties of the handsignaller at the detonator protection are listed in module T8 section 5. The handsignaller is required to carry out the instructions of the PICOP. In addition, they must place and keep three detonators on the line, and show a red hand signal to trains approaching from either direction. They must remove and replace the detonators and the PLB when the train is to pass, but must not allow the train to pass without the PICOP's permission.
- 48 Train movements leaving work sites and moving toward the end of the possession are covered by module T11 section 3. The situation where there is a handsignaller at the detonator protection is specifically dealt with in clause 3.6b. The PICOP is required to get the signaller's permission before any movement is authorised from a work site towards the detonator protection. The signaller must only give this permission when any 'previous movement for which he has cleared the signals has passed clear'. The role of the handsignaller in this situation, as explained in module T8 section 5, is to stop such movements from leaving the possession without the permission of the PICOP. The handsignaller should only communicate with the PICOP, and not with the signaller.

- 49 Train movements leaving the possession are dealt with in module T11 section 4. The PICOP is required to tell the signaller when the train is ready to leave. The detonators must not be removed until the train has stopped at them. The signaller must personally authorise the driver to pass beyond the detonators, and must work the signal beyond the detonators normally if it is possible to do so. The rule book does not make clear what the handsignaller's role in this process is, but it is generally understood to imply that having obtained the signaller's permission, the PICOP will instruct the handsignaller to remove the detonators to allow the train to pass.
- 50 The driver's duties are defined in module T11 section 8. The driver is required to move out of the possession past the protecting detonators only on the personal authority of the signaller. The driver is required to reach a clear understanding with 'the person authorising the movement' (module T11 clause 8.2) as to what is to be done and how far the movement is to proceed. In this case the 'person authorising the movement' must be the signaller (module T11 8.1).
- 51 The role of a PICOP's assistant does not appear anywhere in the Rule Book. Staff involved in the incident were confused about the status of the PICOP's assistant, referring to him sometimes as a 'handsignaller' and sometimes as a '*block road man*'.
- 52 The rules that should be applied when there is no signal between the end of a possession and a line that is open to traffic are covered in the following clauses of the Rule Book:
- clauses 5.5 (a) and (b) of module T3;
  - clause 5 of module T8; and
  - clause 3.6 of module T11.
- 53 These rules are complex and not easy to understand (paragraph 95).

## Identification of causal factors

### Communications

- 54 When PICOP 2 contacted the signaller to request permission for the train to leave the possession, he gave the signaller wrong information about the position of the train, and this was not corrected during any of the conversations between the driver, the PICOP's assistant and the signaller. The result of this was that the signaller believed that the train was standing at signal EH520, when it had actually passed the signal by some 300 m and was standing at the PLBs. The signaller continued to believe that the train was standing at signal EH520 despite the control panel indicating that the train was standing between signal EH520 and Haymarket East Junction.
- 55 Analysis of the recorded conversations shows that the general standard of communication between the train driver, the signaller, PICOP 2 and the PICOP's assistant was poor. The manner of their communications was informal, lacking in detail and far from the standard required by the Rule Book module G1 section 11 'Giving and receiving safety messages'. In most instances there was no attempt to confirm the proper understanding of the message nor was it clear who was leading in each exchange.



- 56 The signaller gave permission to the PICOP's assistant to remove the detonator protection, under the impression that the driver would obey the aspect of EH520 signal. He should not have planned to signal the train in this way, as the signal was within the possession and according to modules T3 and T11 of the Rule Book should not have been used to control the movement of trains; in addition the train had already passed this signal. The driver, on the basis of a previous conversation with the signaller, then accepted a wave from the PICOP's assistant as his authority to leave the possession. This is contrary to the Rule Book, module T11, clause 4.2 that states that the signaller 'must personally authorise the driver to pass beyond the protecting detonators out of the possession'. This instruction is repeated to drivers in module T11, clause 8.1.
- 57 The standard of communication between the signaller, the driver, the PICOP and the PICOP's assistant was a causal factor in the incident (paragraph 102).

#### The role of the handsignaller

- 58 The use of a handsignaller, in situations where there are points or crossings (which are to be used for traffic) located between the protection and the first signal in advance of the possession, dates back to the BR Rule Book revisions of 1970, and has remained in subsequent Rule Books since then. However, since that time the railway as a whole and the way in which possessions are organised have changed considerably. Most possessions now involve staff from more than one company. There is a far greater element of pre-planning involved, and the equipment used for protection has also changed, with electrically lit PLBs replacing banners, flags and lamps. Some of these changes have been reflected in the rules, but others, particularly the modernisation of communication methods, have not.
- 59 In this specific case the presence of the PICOP's assistant, and the train driver's and signaller's perception of his role, was a significant factor in why the incident occurred.
- 60 At present, the signaller is required to personally authorise the driver to proceed past the protecting detonators when leaving the possession (module T11 clauses 4.2, 8.1). For T3 possessions where no handsignaller is required, responsibility for lifting the detonators is not defined, although it is the PICOP's duty to ensure that they are replaced after the train has left the possession (module T11 clause 4.1). When a handsignaller is mandated then he is required to carry out the instructions of the PICOP and to remove the PLB and detonators when a train is to pass and replace them afterwards (module T8 section 5).
- 61 The movements of engineering trains should be planned by the PICOP and communicated to all those concerned (driver, signaller and engineering supervisor (ES)) in a way that will avoid the possibility of misunderstanding. The presence of the handsignaller with, according to the Rule Book, an extremely limited role to play may give rise to confusion and misunderstanding, particularly as in all other circumstances the handsignaller can instruct a driver to proceed, if necessary past a signal at danger. It is possible that drivers who see someone who is in fact a 'PICOP's assistant' or a 'block road man' think that he has the authority of a handsignaller.
- 62 The role of the handsignaller will be removed from the possession arrangements in module T3 by amendments to the Rule Book due to come into effect in June 2007 (paragraph 104).
- 63 Confusion over the role and authority of the 'PICOP's assistant', and his relationship to the duties of a handsignaller, was a causal factor in the incident.

### Train movements within possessions

- 64 In those cases where the protection at the end of a possession is between the last signal and a running line that is open to traffic the permission of the signaller is required before any movement is made within the possession towards these points (module T11 clause 3.6 (b)), even if the protection is a long distance from the start of the movement (and even if there are other work sites in between, according to a literal interpretation of the clause).
- 65 It seems unlikely that this interpretation of this rule can be what was intended when it was written, because this would imply that the signaller's permission is required before every move that takes place in a possession in the direction of protection where a handsignaller is present; module T11, clause 3.6(b) of the Rule Book should be clarified. This will be done in amendments due to come into effect in June 2007 (paragraph 104).
- 66 During the incident at Haymarket the signaller had not taken any steps to stop trains on the line that was still open to traffic until he realised that train 6K03 had run through 173 points. This was because he had misunderstood the location of the train rather than due to any confusion about how the rules should be applied.

### Planning of possessions

- 67 Late changes to the plan for the works and a lack of understanding of the rules contributed to poor planning decisions in days prior to the incident (paragraphs 26 and 74).
- 68 The failure of the planning process to identify the correct arrangements for protecting the limits of the possession and to properly assess the risks was a contributory factor in this incident (**Recommendation 3**).

### Possession arrangements

- 69 The planning of the possession took place as part of the WCRM project, although some of the work to be done in it was routine maintenance. However, the arrangements for the work were made through what was then Network Rail's normal planning process, which has since changed. At the time, this involved meetings nine, six and three weeks before the weekend of the possession, a planning meeting ten days before and a meeting between the actual participants (PICOPs and Engineering Supervisors) on the Wednesday before.
- 70 The possession limits were defined at the specific request of Network Rail's maintenance organisation, to enable track patrolling and lineside maintenance work to take place right up to Haymarket East Junction. However, there was no requirement for engineering trains to work in the area between signal EH520 and the junction.
- 71 The WON entry for these works showed the possession limit as being 'clear of 173B points'. This limit was considered the norm for works taking place on this section of line and had been the same for all possessions during the previous six months.
- 72 The use of these limits was convenient for the planning staff and simplified the organisation of the engineering works, but it is apparent that the actual limits used varied according to the work being done; what was specified as 'clear of the points' could mean 400 m from the junction (placing the limits on the approach to signal EH520) or as close as 75 m, as on this occasion. The Rule Book (module T3 clause 1.3) requires that the possession is kept as short as possible and also requires the placing of protecting detonators and PLBs, 400 m on the approach side of signals, points and crossings, or as close to that distance as possible (module T3 clause 5.5).

- 73 At Haymarket on 14 January 2006, the rules required a handsignaller to be positioned at the detonators at the possession limit on the down Midcalder line, because the junction points were between the detonators and the next signal (EH522). A handsignaller should also have been positioned at the detonators protecting the entry to the possession on the up Midcalder line, because these were less than 400 m from the junction points. The PICOP's assistant, who was employed to lay and lift the detonators, was not filling the role of handsignaller, even though he was in the vicinity of the possession limits throughout the duration of the possession (paragraph 59).
- 74 When the possession was taken early on the 14 January, the detonators were laid closer to the junction than had originally been planned; this was because of a request from the overhead line contractors to enable them to have access to switching equipment close to Haymarket East Junction. This need had not been identified in the planning process and the request was only made to PICOP 1 shortly before the possession took place. He agreed to the change, but did not seek to arrange handsignallers for either the up or the down Midcalder lines, as required by the Rule Book, because he was unaware of the need to do so. This was a causal factor in the incident.
- 75 Because of the new position of the detonators PICOP1 advised the signaller that the protection on the Midcalder lines was 'substandard'. Neither the signaller nor PICOP 1 took any steps to clarify what was meant by this term.
- 76 The signaller did not pass on any information about the position of the detonators to his replacement when the shifts changed at 06:00 hrs. As a result of this, the signaller who was on duty when the incident occurred was unaware of the position of the detonators relative to the junction and EH520 signal.
- 77 When train 6K03 left the site where it had been working (at 14:40 hrs), and moved towards the possession limit, PICOP 2 had not obtained the authority of the signaller for this move, and had not given the driver authority to pass signal EH520 at danger within the possession.
- 78 The Rule Book requirement for a handsignaller if the possession limits and protection were beyond EH520 signal was neither understood nor implemented.
- 79 The lack of understanding of the need for a handsignaller at Haymarket East Junction, and the lack of knowledge of the signallers of the exact position of the protection, were contributing factors to the incident.

#### Competence and fitness of the staff involved

- 80 The competence of all the staff concerned was examined as part of the investigation. All were found to have had the specified training and were qualified for the jobs they were doing. The driver, PICOP 2 and the PICOP's assistant were tested for drugs and alcohol with negative results.
- 81 There were issues associated with the quality of the training and competence assessment of these individuals which contributed to the incident. These have been addressed as part of the industry's own investigation. The areas for improvement included each of the following:
- application of the Safety Critical Communications Protocol;
  - use of correct terminology associated with engineering possessions;
  - understanding and application of the Rule Book modules T3 and T11 in the planning and implementation of engineering works; and
  - application of post-incident procedures.

- 82 The medical fitness of the staff is not considered to have contributed to the causes of the incidents.
- 83 RAIB's causal analysis shows a number of areas of concern relative to the competency of staff. These areas are indicated on the causal analysis diagram at Appendix D.
- 84 Given the issues arising from the incident at Haymarket it is important that Network Rail assess the extent of understanding of the rules related to the protection of engineer's possession across its network and implement steps to address any deficiencies that are found (**Recommendation 2**).

#### Clarity of the rules

- 85 Module T3 clause 5.5 sets out the requirements for positioning the protection at the end of a possession (for the relevant extract see Appendix C). Two situations are covered:
- clause 5.5(a) covers those 'normal' situations where it is possible to place protection on the approach to a signal; and
  - clause 5.5(b) covers those situations where trailing points or crossings exist between the end of the possession and the signal beyond it (ie there is no signal between the end of the possession and the trailing points or crossings).
- 86 Both sections state that protection should be placed 400 m on the approach side of the signal, points or crossings beyond the end of the possession, or 'as close to this distance as possible'. There is no explanation of why the 400 m distance is considered necessary, nor are there any additional precautions specified if it is not achievable (**Recommendation 1**).
- 87 This lack of explanation, and of clarity about the extra precautions, may lead staff to disregard the 400 m distance, as at Haymarket where the protection was placed only 75 m from the junction points.
- 88 The Rule Book extract at Appendix C shows that staff are given little guidance on how to choose the method of protection. The way the information is presented suggests to planners and engineers that they are free to choose whether to place the protection on the approach to the signal (as per clause 5.5(a)) or clear of the trailing points or crossing (as per clause 5.5(b)). Diagrams T3.2 and T3.3 are likely to add to the confusion since neither shows the 'normal' method of protection. This is likely to suggest to the reader that the preferred location for protection is clear of points rather than clear of a signal, as the Rule Book implies.
- 89 The lack of clarity about where to place protection at the end of a possession has resulted in the Rule T3, clause 5.5(b) mode of protection being widely adopted for the protection of engineering works. However, the absence of a signal between the end of the possession and the trailing points or crossing increases the risk of an unauthorised movement from the possession onto a running line that is open to traffic (**Recommendation 1**).
- 90 The reasoning behind any decision as to when to use clauses 5.5 (a) or 5.5 (b) is unclear, and this lack of clarity is reflected in the confused and inconsistent application of the protection arrangements. Whether the risk associated with movements towards the possession limits (where there is no signal between those limits and a section of railway on which trains are running) is being adequately controlled is also unclear.
- 91 A review of all the WONs for Network Rail for week 42 of 2005/06 demonstrated that 31 per cent of all possession limits were shown as 'clear of points' rather than on the approach to specified signals. In none of the published entries was the need for a handsignaller posted.

- 92 Situations where the possession limits have to be placed so close to a junction as to be beyond the signal protecting that junction should be avoided whenever practicable, so that any train leaving the possession can be clearly under the control of fixed signals when it approaches the junction.
- 93 There is a need to clarify the presentation of the Rule Book module T3 to make clear that the placing of the protection between the last signal on the approach to a junction and the junction itself should only be permitted where it essential to the task that is being undertaken and where no alternative arrangement is reasonably practicable (**Recommendation 1**). This has been partly addressed by the changes to the Rule Book due to come into effect in June 2007 (paragraph 104).
- 94 Not following the requirements of the Rule Book module T3 over where protection could be placed on the approach to a junction was a contributory factor to the incident (**Recommendation 2**).
- 95 The confusing wording of the Rule Book, module T3 is also considered to be a contributory factor to the incident (**Recommendation 1**).

## Overview of causal factors

- 96 There are a number of causal and contributory factors involved in this incident. For this reason a diagram has been prepared showing the relationship between the factors identified in this report. This diagram is to be found at Appendix D.

## Conclusions

### Immediate cause

- 97 The immediate cause of the first incident was that the driver of train 6K03 left the possession without obtaining authority from the signaller.
- 98 The derailment occurred because the EWS fitter carried out a brake test while the train was standing over points which had been damaged during the first incident.

### Causal and contributory factors (see also Appendix D)

99 Causal factors were:

- the standard of communication between the signaller, the driver, the PICOP and the 'PICOP's assistant' (paragraphs 54 to 57);
- the rules in module T3 of the Rule Book that govern the protection of possessions when the end of the possession is located between the last signal and a junction are complex and not easy to understand (paragraphs 85 to 95);
- the staff involved did not understand, or correctly apply the requirements of module T3 of the Rule Book governing the provision of a handsignaller and the limits of a possession (paragraphs 80 to 83);
- late change to the possession limits at the request of a contractor;
- the driver did not correctly apply the requirements of module T11 of the Rule Book concerning authority for movements out of a possession (paragraph 56);
- trains were not stopped on the line that was open to traffic prior to the move towards the protection being authorised (paragraph 64 to 66);
- confusion over the role and authority of the 'PICOP's assistant' (paragraphs 58 to 63); and
- there were issues associated with the quality of the training and competence assessment of these individuals which contributed to the incident (paragraphs 80 to 83).

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

- staff considered the placing of protection at a location in close proximity to points on a line that was still open to traffic to be unexceptional (paragraphs 69 to 79); and
- the planning process did not identify the need for the special working arrangements associated with protection that is positioned between the last signal and a junction (paragraphs 67 to 68).

101 The subsequent derailment was caused by the release of the brakes when the train was still standing over the switch diamond points that had been damaged by the train running through them (paragraph 43).

## **Actions reported as already taken or in progress as a result of this investigation**

- 102 Network Rail has undertaken a major education programme for its own staff and employees of train operating companies and contractors, to improve communication standards throughout the industry.
- 103 Network Rail has already commenced an extensive review of the rules relating to the protection of engineering works. This review is intended to identify ways in which the rules can be made more robust and comprehensible to staff. Best practice on railways in other parts of the world is to be identified and evaluated.
- 104 RSSB has deleted references to handsignallers from section T3 of the Rule Book, in the amendments due to come into effect in June 2007. Sections T3 and T11 have also been revised, as part of the same amendment, to clarify that where any protection is less than 400 m from points or crossings, the PICOP must always get the signaller's permission before authorising a movement to approach the detonator protection.



## Recommendations

105 The following safety recommendations are made:<sup>1</sup>

### Recommendations to address causal and contributory factors

- 1 **The Rail Safety and Standards Board (RSSB)**, in conjunction with *Railway Group* members, should undertake an urgent revision of Rule Book modules T3 and T11 to provide clarity in the requirements for the protection of possessions. This should include:
  - clearer definition of the responsibilities of persons authorised to lift protection at possession limits (paragraphs 58 to 63);
  - emphasising the preference for placing protection on the approach to the last signal rather than clear of the points at the junction (paragraphs 85 to 95); and
  - stressing the importance of a minimum separation distance between protection and an open line when protection is placed clear of points (paragraph 86).
- 2 **Network Rail** should review appropriate components of their competence management system, with the aim of ensuring that PICOPs and signallers fully understand modules T3 and T11 of the Rule Book (paragraph 84 and Appendix D).
- 3 **Network Rail** should review the possession planning arrangements to ensure that there is a process in place for checking that the location and type of protection is compliant with the requirements of the Rule Book, and that wherever possible the extent of the possession will permit the placing of detonator protection on the approach to the signal protecting any points, or through crossings, beyond the possession (paragraph 74).

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<sup>1</sup> 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](http://www.raib.gov.uk)

## Appendices

### Glossary of abbreviations and acronyms

BR

CCTV

ES

EWS

HMRI

PICOP

PLB

RAIB

RSSB

WCRM

WON

ZCA

### Appendix A

British Rail

Closed circuit television

Engineering supervisor

English, Welsh & Scottish Railway

Her Majesty's Railway Inspectorate

Person in charge of possession

Possession limit board

Rail Accident Investigation Branch

Rail Safety & Standards Board

West Coast Route Modernisation

Weekly operating notice

A four-wheel ballast wagon

Block road man	A term used informally to describe a person who lifts and replaces the protection at the end of a possession on the instruction of the PICOP or the signaller as appropriate. The role is neither defined nor referred to in the Rule Book.
Control panel	A panel containing a diagram showing the position of all trains relative to the track in an area of the railway, along with the necessary switches to allow the signaller to operate the signals and points in that area.
Detection	A failsafe arrangement that proves a set of switches within points are correctly set in the required direction.
Detonator	A small explosive device clipped to the rail head which explodes when a train passes over it and gives an audible warning to the driver.
Down (line)	Line normally used by trains moving in the direction of Haymarket.
Engineer's possession	A section of the line which is under exclusive occupation of an engineer for maintenance or repairs.
Handsignaller	A competent person authorised to control the passage of trains by coloured flags and detonators in the absence of normal signalling.
Lifting the protection	The act of removing detonators and the PLB in order for a train to exit or enter an engineer's possession.
Person in charge of possession	<p>A competent person nominated to, inter alia:</p> <ul style="list-style-type: none"><li>● manage the safe and correct establishment of the protection for the possession;</li><li>● liaise with the signaller about the passage of trains in and out of the possession.</li></ul>
PICOP's assistant	A term used informally to describe a person who undertakes unspecified duties at the instruction of the PICOP – in this case the placing and removal of the protection for the possession. The role is neither defined nor referred to in the Rule Book.
Points	The items of permanent way which may be aligned to one of two positions, normal or reverse, according to the direction of train movement required.
Possession limit boards	A miniature version of the stop sign used on roads, denoting the end of a possession.
Protection	The measures taken to mark the limits of a possession. Consists of a lit board and the placing of three detonators on the rail.
Railway Group	Companies who hold a Railway Safety Case accepted by Network Rail.

Rule Book	RSSB publication documenting the rules by which all personnel working on railway property must abide, also incorporating those for the safe operation of the network.
Six-foot	A colloquial term for the space between two adjacent tracks, irrespective of the actual distance involved.
Spent ballast	Graded stone sub-base used for drainage and support of the track, which has become degraded and dirty over time and is to be removed and disposed of.
Substandard protection	An unofficial term used by railway staff relating to those situations where it is not possible to place the protection at 400 m or more from the designated points or signal.
Switch diamond	A type of points mechanism used where two lines cross one another.
Up (line)	Line normally used by trains moving in the direction of Carstairs.
Weekly Operating Notice	A weekly notice issued by Network Rail. Section B contains details of planned engineering work.
Work site	The area within a possession that is managed by an Engineering Supervisor.

Providing Detonator Protection

Arrangements for detonator protection at the end of the possession are dealt with in T3 clause 5.5. Diagrams T3.2 and T3.3 show the Handsignaller that is required if there are points ahead of the protecting signal at the end of the possession and trains are to be worked over the points. Note that the reference to T8 section 8 is incorrect and should read T8 section 5. This has been issued as an amendment to the Rule Book.

## **5.5 Detonator protection at the end of the possession**

### **a) Normal protection**

#### **PICOP**

You must make sure that detonator protection is placed 400 metres (440 yards) on the approach to the signal beyond the possession, or as close to this distance as possible, **in the normal direction of travel**.

See detonator protection 400 metres (440 yards) on the approach side of signal KS101 in diagram T3.1 on page 19, and detonator protection as close to 400 metres (440 yards) as possible on the approach side of signal KS190 in diagram T3.3 on page 21 as an example.

### **b) If points or crossings are involved**

If there are trailing points or through-crossings between the possession and the signal beyond the possession, you must make sure the detonators are placed:

- 400 metres (440 yards) on the approach side of these points or crossings, or
- as close to this distance as possible.

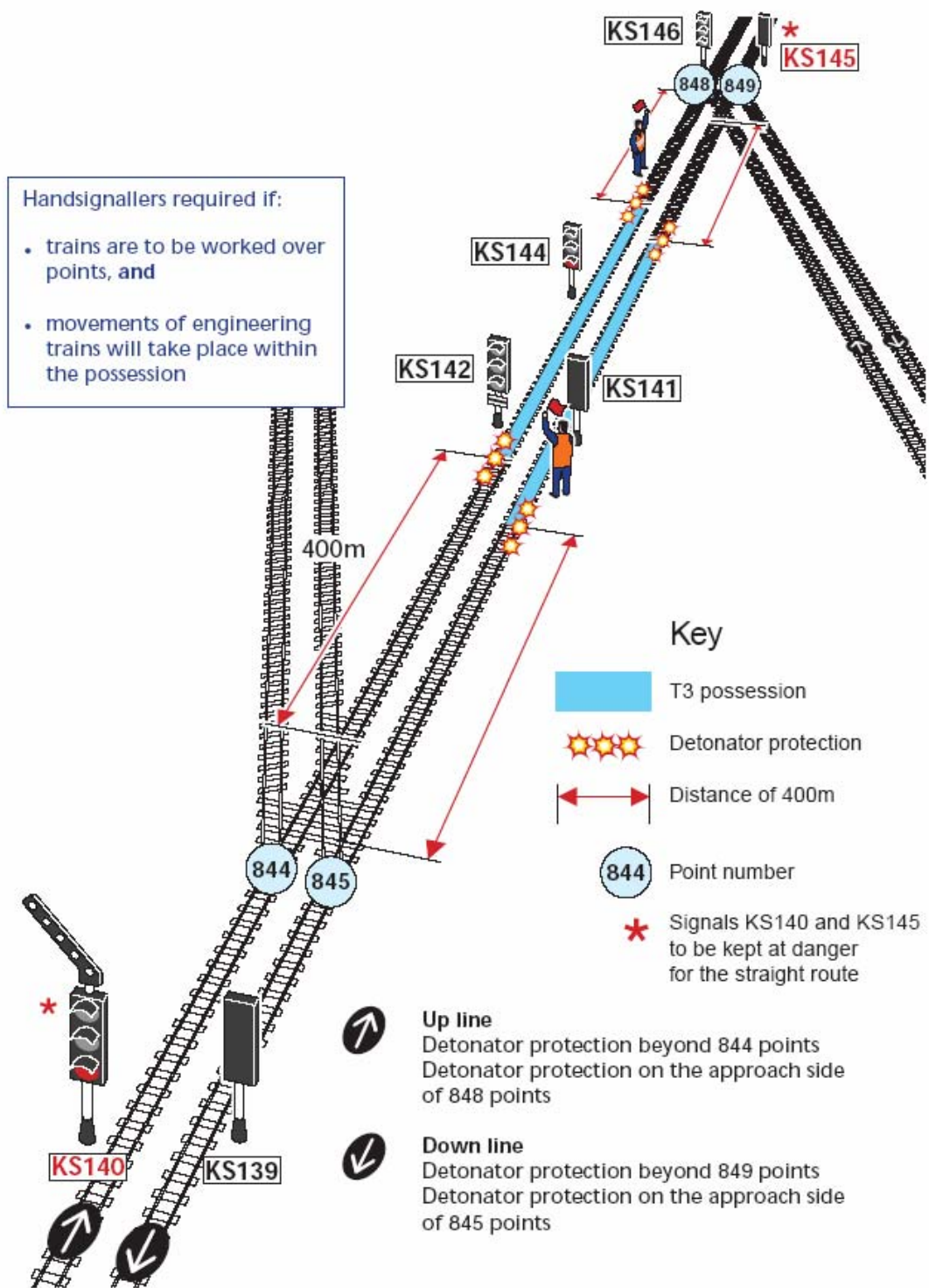
See detonator protection 400 metres (440 yards) on the approach side of 845 and 848 points in diagram T3.2 on page 20 as an example.

If trains are to be worked over those points or crossings, you must appoint a handsignaller at the detonators to carry out the requirements of section 8 of module T8 *Handsignalling duties*.

See handsignallers in diagram T3.2 on page 20 as an example.

You do not need to appoint a handsignaller if there will be no movement of engineering trains within the possession.

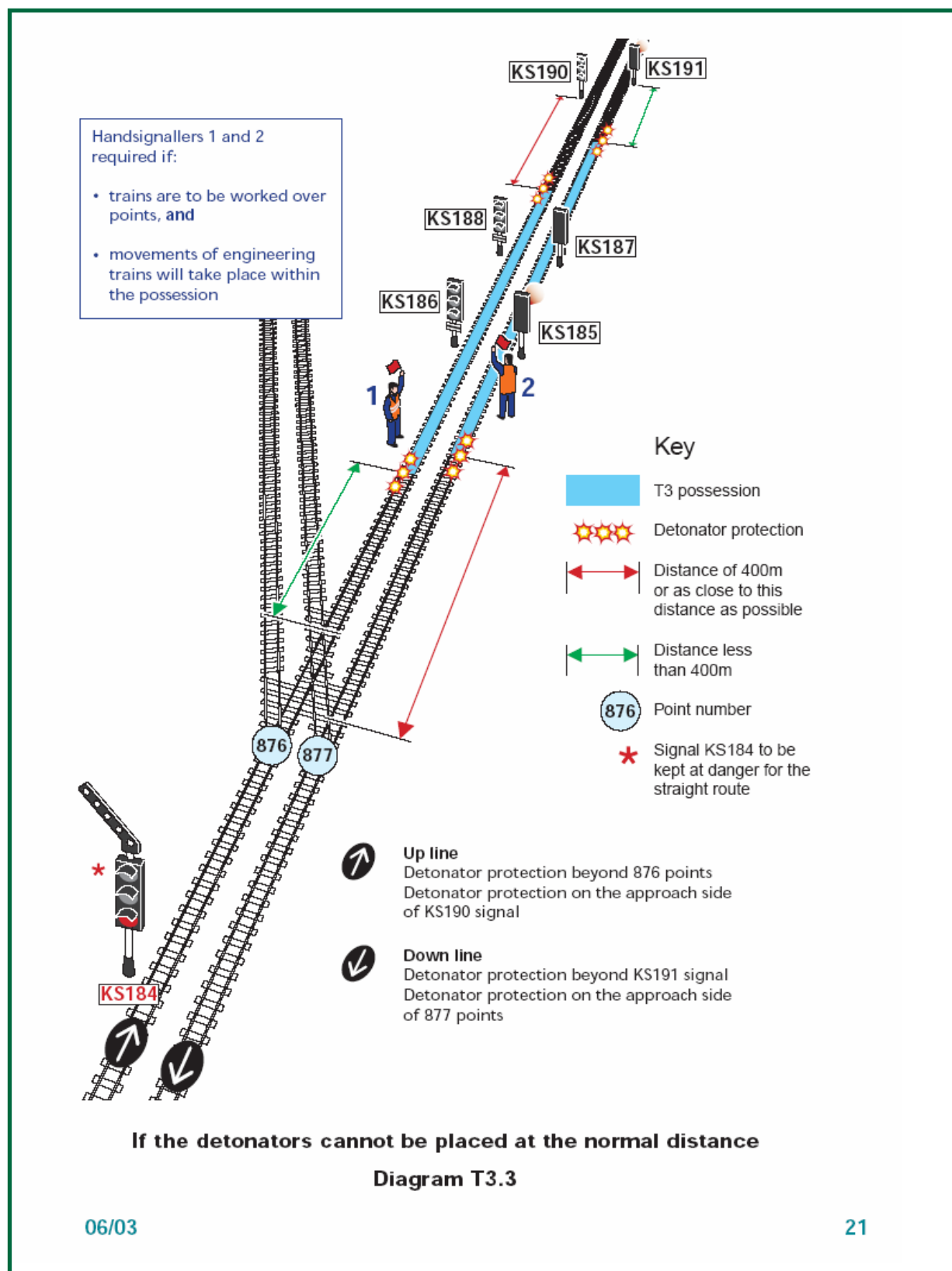
<sup>2</sup> This will be superseded by the revised version described in paragraph 104 in June 2007



**Detonator protection if points or crossings are involved**

**Diagram T3.2**

The arrangements shown above will be superseded by the revised version described in paragraph 104 in June 2007.



Extracts from the Rule Book reproduced with kind permission of the RSSB.

The arrangements shown above will be superseded by the revised version described in paragraph 104 in June 2007.



(relevant paragraphs in the report are referenced in the top right hand corner of each block)



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