



Rail Accident Investigation Branch

Rail Accident Report



Collision between a passenger train and two rail-mounted grinding machines at Acton West 24 June 2008

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.

Collision between a passenger train and two rail-mounted grinding machines at Acton West

24 June 2008

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Preface

- 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.

Key definitions

- 3 This accident occurred near Acton West Junction, which is situated on the Great Western Main Line from Paddington to Bristol. All mileages are measured from a datum at Paddington. Up lines are used by trains travelling towards Paddington and down lines by trains travelling away from Paddington.
- 4 Four appendices are provided at the rear of this report:
 - abbreviations are explained in Appendix A;
 - technical terms (shown in *italics* the first time they appear in the report) are explained in Appendix B;
 - key standards current at the time are shown in Appendix C; and
 - an extract from the record of site safety arrangements and briefing form is shown in Appendix D.

Summary of the report

Key facts about the accident

- 5 At around 01:00 hrs on the morning of 24 June 2008, three members of a *rail grinding* team were standing with two rail-mounted grinding machines on the up relief line east of the *crossovers* at Acton West Junction waiting for permission to push the machines towards Ealing Broadway station.
- 6 Train 2P01, the 00:15 hrs service from Reading to London Paddington, ran from the up main line through the crossovers at Acton West onto the up relief line and struck the machines. The three members of the grinding team scattered as the train approached.
- 7 Nobody was injured in the accident, but the train suffered damage to braking equipment and a punctured fuel tank on the leading coach. The 25 passengers on the train were evacuated safely.

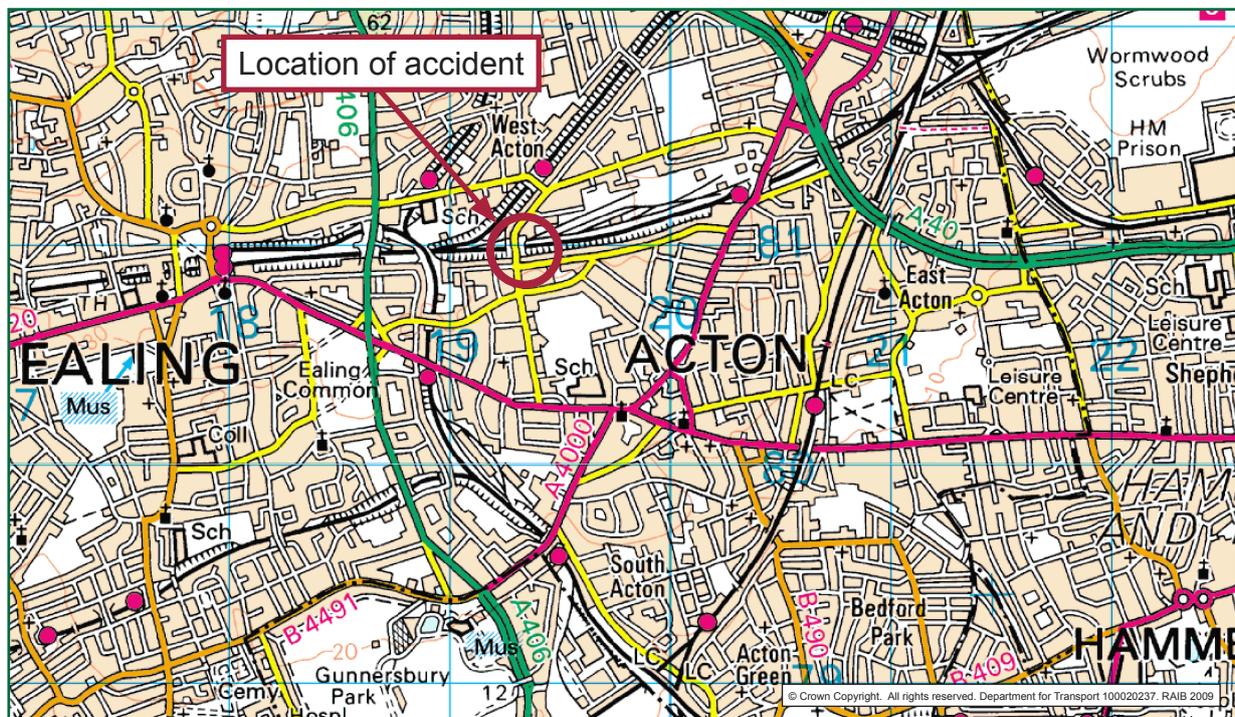


Figure 1: Extract from Ordnance Survey map showing location of accident

Immediate cause, causal and contributory factors, underlying causes

- 8 The immediate cause of the accident was that the rail-mounted grinding machines were placed on the up relief line at Acton West on a section of railway that was open to train operations.
- 9 Causal factors were:
 - a. the *Controller of Site Safety's* (COSS) lack of knowledge of the Acton West area; and
 - b. the lack of knowledge of the Acton West area of the person preparing the COSS pack.

- 10 Contributory factors were:
- a. the format of the COSS pack, including the RT9909 form;
 - b. the COSS's belief that the contents of the RT9909 form did not need to be subject to a detailed check on site;
 - c. the absence of a track layout diagram at the access point used by the grinding team;
 - d. Reading Area Services Department's management arrangements did not ensure that the COSS had adequate knowledge of the areas he was to be working in;
 - e. Reading Area Services Department did not have arrangements in place for checking the grinding team's COSS packs by somebody who had knowledge of the Acton area;
 - f. the way in which the *PICOP's briefing meeting* was run at Paddington; and
 - g. the workload of the *Engineering Supervisor*, arising from the use of a single work site with five areas of work within the possession, reduced the time available for him to focus on the actions of each COSS in his work site.
- 11 The underlying causes were:
- a. the general arrangements within Network Rail for the preparation of COSS packs, which led to a lack of involvement by the COSS in the definition of safety arrangements for his work group;
 - b. overall management arrangements within Reading Area Services Department; and
 - c. the non-compliance of the Thames Valley's London area PICOP briefing meeting with standard NR/PRC/MTC/PL0056, 'Work and possession planning for the railway infrastructure (meetings management pack)' was not identified by Network Rail's audit arrangements.

Recommendations

- 12 Recommendations can be found in paragraph 179. They relate to the following areas:
- the need for those individuals involved in preparing and implementing engineering work on site to have adequate geographical knowledge of the location where work is to take place;
 - improvements in the arrangements for preparing material used to promote the safety of staff working on the line, and in the content of that material;
 - expediting the provision of track layout information at access points;
 - improving the effectiveness of the PICOP's briefing meeting;
 - improving the effectiveness of Network Rail's processes for auditing compliance with their own possession planning standards;
 - achieving an equitable balance in the workload of safety-critical staff involved in possessions and work sites; and
 - a review of Network Rail's assessment in the line process in Western route.

The Accident

The location of the accident

- 13 This accident occurred near Acton West Junction, which is situated on the Great Western Main Line from Paddington to Bristol. Paddington station is five miles to the east and Ealing Broadway station less than a mile to the west.
- 14 The layout of the lines at this location is shown in Figure 2. There are four lines used by main line passenger trains at this location, designated down main, up main, down relief and up relief. The main lines are generally used by faster trains and the relief lines are generally used by slower trains calling at Ealing Broadway station. A series of crossovers at Acton West allows trains to cross from the up main line to the up relief line and from the down relief line to the down main line.

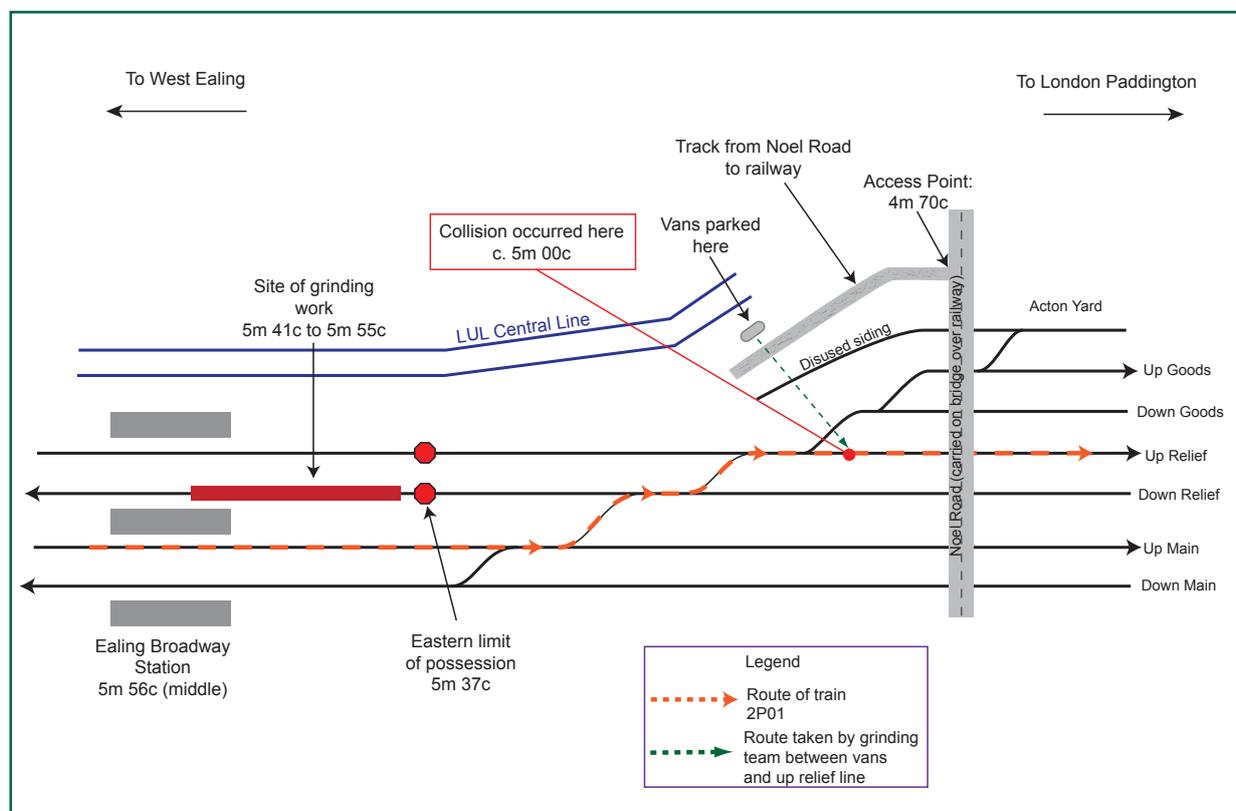


Figure 2: Track diagram of the area in which the accident occurred

- 15 The maximum permitted speed for trains is 80 mph (128 km/h) on the up relief line and 90 mph (144 km/h) on the down relief line. Trains running through the crossovers at Acton West are limited to 70 mph (112 km/h).
- 16 In addition to the four lines used by main line passenger trains, there is also a goods line which allows trains to enter and leave the west end of Acton yard. The goods line is connected to the up relief line approximately 60 metres to the east of the crossover at Acton West Junction.
- 17 London Underground's Central Line converges with the main line to the east of Ealing Broadway station.

Summary of the accident

- 18 Network Rail's Thames Valley area had planned a *T3 possession* of the up and down relief lines between Acton West and Southall West (a distance of approximately four miles) from 00:10 hrs to 05:15 hrs on Tuesday 24 June 2008 in order to carry out maintenance work on the track and overhead line equipment.
- 19 One of the planned tasks was manual rail grinding of the down relief line over a length of approximately 280 metres in the vicinity of Ealing Broadway station.
- 20 At around 01:00 hrs on the morning of 24 June 2008, three members of a grinding team had placed two rail-mounted grinding machines on the up relief line east of the crossovers at Acton West Junction (see Figure 2), and were waiting for permission from the COSS to push the machines towards Ealing Broadway station.
- 21 While they were waiting, train 2P01, the 00:15 hrs service from Reading to London Paddington departed from Ealing Broadway station on the up main line and ran through the crossovers at Acton West onto the up relief line. The three members of the grinding team scattered before the train struck the machines.
- 22 Nobody was injured in the accident, but the train suffered damage to braking equipment and a punctured fuel tank on the leading coach. The up relief line was closed until 06:41 hrs for recovery of the damaged train and repairs to the infrastructure. The 25 passengers on the train were evacuated safely.

The parties involved

- 23 The infrastructure owner at Acton West was Network Rail. Network Rail's delivery unit at West Ealing was responsible for maintenance of the track and other infrastructure at that location.
- 24 The Grinding Supervisor Manager of the grinding team was employed by McGinleys, a contractor to Network Rail.
- 25 Train 2P01 was operated by First Greater Western (trading as First Great Western).
- 26 The *rule book* which governs operations on Network Rail infrastructure is part of the suite of *Railway Group Standards* which are managed on behalf of the railway industry by the Rail Safety & Standards Board (RSSB).
- 27 Network Rail, First Great Western, the RSSB and McGinleys freely cooperated with the investigation.

External circumstances

- 28 The weather was fine and dry. There was little ambient light in the vicinity of Acton West Junction.

Train(s)/rail equipment

- 29 Signalling at Acton West is in accordance with the *Track Circuit Block regulations*, and is controlled from Slough New Signalling Centre.
- 30 Train 2P01 comprised a single three-car class 165 *Diesel Multiple Unit*. The Class 165 has a maximum permitted speed of 90 mph (145 km/h).
- 31 The rail-mounted equipment comprised two NV3 track grinding machines (see Figure 3). This type of machine weighs 117 kg and incorporates a generator to drive the grinding equipment. It is equipped with a carrying handle at each corner, which enables four people to carry it over short distances. It is insulated to prevent it operating track circuits when placed on the track. This allows rail grinding to be undertaken without the machine interfering with any testing of signalling equipment that might be taking place at the same time.



Figure 3: NV3 track grinding machine

Events preceding the accident

- 32 Routine ultrasonic inspection of the down relief line had identified *rolling contact fatigue* in a length of approximately 280 metres in the vicinity of Ealing Broadway station. The local Track Maintenance Engineer decided that grinding of the rails would be necessary to eliminate or reduce the length/depth of the cracks.

- 33 The West Ealing delivery unit did not have permanent staff who could undertake rail grinding. Instead, there was a rail grinding team based in Network Rail's Area Services Department at Reading. The Area Services Department was part of the maintenance organisation managed by the *Infrastructure Maintenance Manager* for the Thames Valley, as was the West Ealing delivery unit and two other delivery units at Reading and Didcot.
- 34 A technical officer within the West Ealing Track Maintenance Engineer's team identified a suitable T3 possession in which the work could be started. The technical officer arranged for grinding of the first 80 metres (5 miles 41 chains to 5 miles 45 chains) to be included in the overall plan for the possession on 7 May 2008, with the work scheduled to be undertaken on 24 June 2008.
- 35 The technical officer requested the services of the Area Services Department grinding team for the work at Ealing Broadway during late May or early June 2008. The grinding team comprised six permanent members who worked for Network Rail and a Grinding Supervisor Manager from McGinleys (paragraph 24) who worked on site with the team and was their technical specialist on grinding matters. The team also had its own Network Rail supervisor (referred to as the grinding team's manager in the remainder of this report), who did not normally work on site with them. He was on sick leave at the time the technical officer requested the grinding team's services and preliminary planning of the work was undertaken by another supervisor from Reading Area Services Department.
- 36 In week commencing 16 June 2008, the grinding team's manager returned to work and took responsibility for detailed planning of their activities for week commencing 23 June 2008. A key task was preparation of the 'record of site safety arrangements and briefing form' (the RT9909 form, included within a pack of information provided to the COSS, referred to as the COSS pack), which provided information to the COSS and the grinding team on:
- the possession they would be working in;
 - the hazards at that location;
 - the place where they would gain access to the railway;
 - the place where they would be working; and
 - the system of work to be used to secure the safety of the team while on the track or in its vicinity.
- 37 The manager based the contents of the RT9909 form on the preliminary information provided by the supervisor (paragraph 35). The supervisor had identified Noel Road as the place at which the team would gain access to the railway, located at 4 miles 70 chains and thus outside the possession which ran from 5 miles 37 chains to 9 miles 30 chains.
- 38 The RT9909 form was left for the grinding team to collect at Reading during the day on Friday 20 June 2008. The team had worked overnight on Thursday/Friday 19/20 June 2008, but did not work over the weekend. Four of the six permanent members of the team were rostered for the grinding work on 24 June. One of them lived in the Reading area and he collected the COSS pack during the evening of 23 June 2008 and took it up to London for the start of work in the early hours of 24 June 2008.

- 39 He met with the three other members of the team (including the COSS) at West Ealing depot. They all lived in the London area, and had gone straight to West Ealing in preparation for the start of work.
- 40 The COSS was not familiar with the access point and, when booking in with the Engineering Supervisor, asked for directions to Noel Road, which were given. The four members of the grinding team then drove to Noel Road, where they met the Grinding Supervisor Manager.
- 41 The group of five then drove down the access road to the railway, parked their vans at around 5 miles 00 chains and unloaded their equipment. The COSS realised that the site of work was some distance from the location where they had parked their vans, but the rough condition of the roadway meant that it was not possible to take the vans any closer to the site. He therefore decided that the best method of reaching their site of work was to place the grinding machines on the up relief line and push them towards Ealing Broadway station until they arrived adjacent to the site of work on the down relief line.
- 42 Without detailed knowledge of the area, but with the general knowledge that the Great Western Main Line at the London end comprised up and down main lines and up and down relief lines, the COSS had assumed that there would be four lines at this location, but his inspection of the site revealed that there were six. The line closest to where he was standing was overgrown and was a disused siding. The second line was the short section of bidirectional goods line at the west end of Acton Yard (see Figure 2). At some stage before work started the COSS and the Engineering Supervisor had a brief conversation on whether the goods line was within the possession. This is discussed further in paragraph 81.
- 43 The Engineering Supervisor telephoned the COSS at approximately 00:37 hrs to give him permission to start work. The COSS briefed the team in accordance with the contents of the COSS pack and the method for gaining access to their site of work.
- 44 The COSS then instructed the team to start assembling the two grinding machines and other kit such as lighting equipment on the up relief line. All the additional kit was carried on the grinding machines. The Grinding Supervisor Manager started walking towards Ealing Broadway station in order to mark-up their work. As he approached the area between 01:00 hrs and 01:05 hrs, he encountered the *possession limit board* at 5 miles 37 chains. He telephoned the COSS and asked him to check the RT9909 form as he thought that something was wrong. The COSS asked the three members of the team to remain with the grinding machines and returned to his van to find the relevant paperwork.
- 45 In the meantime, train 2P01 had departed from Reading on time and had run as scheduled to Ealing Broadway station, where it stopped at the up main platform. On departure from Ealing Broadway at 01:05 hrs, the driver accelerated the train towards Acton West Junction, where it was routed onto the up relief line. As the train entered the crossover, it was travelling at approximately 52 mph (83 km/h).

Events during the accident

- 46 As the train was crossing onto the up relief line the driver saw the reflective strips of the grinding team's personal protective equipment. He sounded the horn and saw three men move away. The train ran along the up relief line and the driver saw the grinding machines and equipment on the track when the train was approximately 25 metres from them. He placed the brake into the emergency position at about the time that the collision occurred (approximately 01:07 hrs).
- 47 The three members of the grinding team had been waiting by the grinding machines and looking towards Ealing Broadway when one of their number noticed train 2P01 running through the crossovers and onto the up relief line. He called a warning to the other members of the team and they scattered towards the goods line before the train struck the grinding machines.

Consequences of the accident

- 48 Nobody suffered any physical injuries in the accident.
- 49 The grinding machines and equipment became wedged under the train and were carried to the point at which the train stopped, rupturing a fuel tank and causing damage to braking equipment on the leading vehicle. The grinding machines were destroyed.
- 50 A track-mounted *train protection and warning system* (TPWS) module was destroyed by the grinding equipment being carried underneath the train.

Events following the accident

- 51 The train stopped approximately 250 metres from the point of impact (see Figure 4) and the driver made an emergency call to the signaller at Slough using the *Cab Secure Radio*. The signaller stopped traffic on all lines in the vicinity until the circumstances could be established. The driver checked that the 25 passengers on board the train were uninjured. Arrangements were made for them to be conveyed by road to their destinations. The passengers remained on the train until approximately 03:00 hrs before being evacuated by ladder to the track and up to Noel Road. The reason for the delay was confusion over the availability of a coach to take all the passengers. In the event, taxis were provided.
- 52 Meanwhile, the *Person In Charge Of Possession* (PICOP) arranged for all activity to be stopped within the possession until the immediate cause of the accident could be established. The Engineering Supervisor and all members of the grinding team were screened for drugs and alcohol in accordance with Network Rail's procedures following an incident. The results were negative (clear) in all cases.



Figure 4: The train with the grinding equipment underneath (photograph courtesy of Network Rail)

- 53 The train remained on site while preparations were made to move it to Old Oak Common depot. The train could not be driven from the leading cab because of the damage to the braking equipment on that vehicle, so two drivers were provided; one to travel in the front and one to drive the train from the rear, where the braking system was still functioning. The unit was made safe for movement by 05:55 hrs and departed at 5 mph (8 km/h) to Old Oak Common depot, clearing the up relief line by 06:25 hrs.
- 54 Network Rail replaced the damaged TPWS module. The rail head on the up relief line had been contaminated by fuel from the ruptured tank and this was treated. Network Rail and First Great Western arranged for a train to make a controlled stop in the area. Once it had been confirmed that this had been successfully achieved, the up relief line was opened for normal working at 06:41 hrs.

The Investigation

Sources of evidence

- 55 The sources of evidence used in the investigation have been:
- statements from witnesses including those in their line of management;
 - information obtained from the *on-train data recorder* on the train involved in the accident;
 - documents associated with the planning and undertaking of the possession, including the rule book and Network Rail's own standards; and
 - documents associated with the planning and undertaking of the grinding task.

Key Information

The possession between Acton West and Southall West

- 56 The grinding work was one of five tasks being undertaken within the possession. The limits of the possession (see paragraph 37) were identified on the ground by possession limit boards.
- 57 The possession was treated as a single work site. Normally, the limits of a work site would be identified on the ground by the presence of *work site marker boards*. However, Clause 10.1 of module T3 of the rule book states that work site marker boards need not be provided if there is only one work site within the possession and the only movements that will take place are those of *on-track plant* or *on-track machines*. These conditions were met for the possession in which the grinding was to take place and no work site marker boards were provided.
- 58 See Figure 5 for details of the five tasks being carried out. Each of the tasks had a COSS allocated, whose principal job was to ensure the safety of the team working at that location.

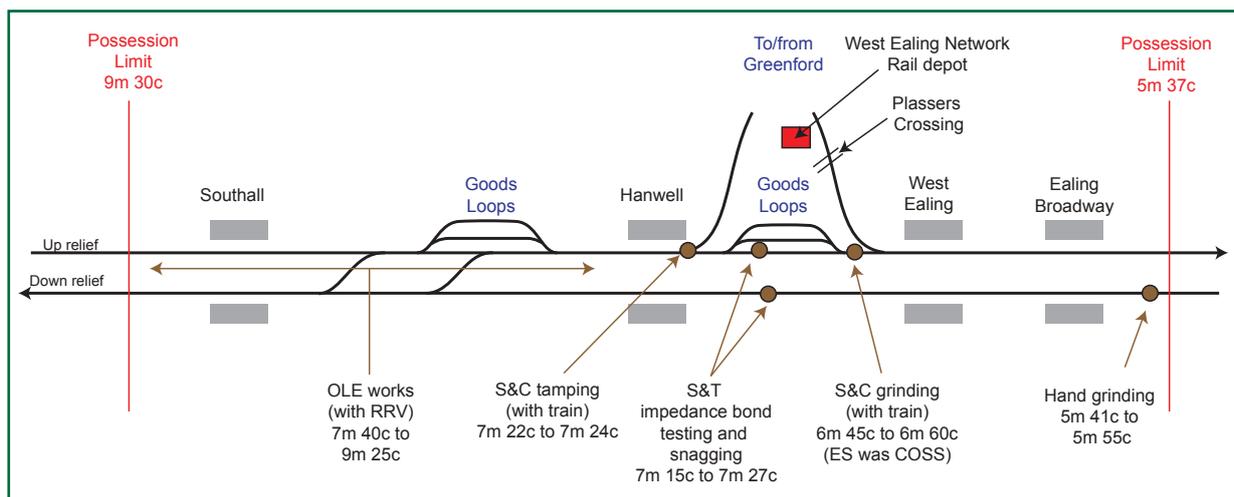


Figure 5: The possession and the tasks being carried out

- 59 An Engineering Supervisor was in charge of all work within the work site. He was also responsible for the movement of on-track machines into and through his work site. The Engineering Supervisor based himself at Network Rail's West Ealing depot initially, from where he arranged for two on-track machines (a *tamper*, and a rail grinding vehicle) and one item of on-track plant (a rail-mounted overhead line inspection platform) to enter his work site. He was then to become COSS for the staff working with the rail grinding vehicle at West Ealing (see Figure 5).
- 60 The PICOP dealt with the overall arrangements for the possession. His tasks included:
- liaising with the signaller at Slough over the time at which the possession could be taken;
 - instructing staff to set up possession limit boards;
 - arranging for trains to enter the possession; and
 - giving the Engineering Supervisor authority to start work.

- 61 The PICOP was located at Paddington. He had no direct responsibility for activities within the work site once he had given authority to the Engineering Supervisor to start work.

The COSS pack and RT9909 form

- 62 The COSS is responsible for establishing and maintaining a safe system of work for a team of workers while on or in the vicinity of the track. In discharging that duty, the COSS uses information contained within a COSS pack, which includes the RT9909 form (paragraph 36). Appendix D contains the RT9909 form from the pack prepared for the COSS who was in charge of the grinding work on the morning of 24 June 2008.
- 63 The RT9909 form for the grinding work on 24 June 2008 included information on the work and its location, the location where the team would gain access to the railway, hazards in the vicinity and the safe system of work to be employed. Safe systems of work were defined both for walking to the area of work and for carrying out the work (see paragraphs 87 and 88).
- 64 The location of the work was defined in miles and chains. The limits of the possession were recorded, but in this case by reference to signal and points numbers (in accordance with the way that the information was presented in the *Weekly Operating Notice*), rather than by miles and chains. The mileage of the access point was not recorded.
- 65 The pack contained an extract from the *sectional appendix* which showed the crossovers at Acton West Junction, but did not mark the site of work, the limits of the possession or the access location.
- 66 Further information on the preparation of the COSS pack is contained in the section of this report on the planning of the grinding work at Reading Area Services Department (see paragraphs 83 to 92).

The COSS of the grinding team and his actions

- 67 The COSS had been working in the railway industry for approximately eight and a half years at the time of the accident. Initially he worked for contractors on track maintenance tasks and then in 2001, he was appointed leader of a rail grinding team. In April 2007 he joined Network Rail, becoming the team leader for the grinding team at Reading Area Services Department. In September 2007 he trained for COSS duties and passed his assessment, subsequently entering a period of mentoring from an experienced COSS. From January 2008, he started to act as COSS for the grinding team. As he was the only qualified COSS within the team, he had frequently undertaken COSS duties (the team normally worked four or five shifts per week).

- 68 The grinding team could be called upon to work anywhere within the Thames Valley area. At the time of the accident, the Thames Valley area was bounded by Paddington and:
- Box tunnel on the route to Bristol (99 route miles);
 - Northolt on the line to High Wycombe (3.5 route miles from the junction with the Paddington-Bristol route at West Ealing);
 - Somerton on the Reading to Taunton line (83 route miles from the junction with the Paddington-Bristol route at Reading);
 - a point between Tackley and Heyford on the route to Banbury (22 route miles from the junction with the Paddington-Bristol route at Didcot);
 - Kemble on the Swindon to Gloucester line (15 route miles from the junction with the Paddington-Bristol route at Swindon); and
 - all branches within those boundaries (including Windsor, Marlow, Henley, and Bicester).
- 69 Network Rail Standard NR/SP/OHS/019, 'Safety of people working on or near the line', mandates that it is necessary for a COSS to be familiar with the location at which he is working.
- 70 The COSS had only worked at a limited number of locations within the Thames Valley area in the 15 months he had been employed by Network Rail. He had never undertaken a site familiarisation visit since commencing COSS duties for the grinding team in January 2008. Generally, detailed information (including the COSS pack) for the following week's work was only made available on the Thursday or Friday beforehand, because the arrangements for the possession could be changed until that time. With the grinding team either working at the weekend or taking rest days, there was no opportunity to conduct site visits before the day of the work.
- 71 The COSS had not been to the access point at Noel Road. His prior knowledge of the work was restricted to a telephone conversation with his manager towards the end of the previous week. He did not see the COSS pack until it was handed to him shortly before midnight on 23 June 2008. He had little opportunity to familiarise himself with the detail of the pack, and no opportunity to familiarise himself with the location.
- 72 He asked the Engineering Supervisor for details of how to get to Noel Road, but did not ask for any information about the area where the work was to take place. Once on site, he spoke to the Engineering Supervisor to clarify the track layout (paragraph 42). This conversation led him to believe that he was within the possession (see paragraph 81). The COSS also believed that the access point would be inside the possession and so he felt able to instruct the other members of the team to place the grinding machines on the up relief line.
- 73 The COSS did not see the COSS pack until it was handed to him at West Ealing depot. However, he considered that he still had sufficient time to review its contents and implement its provisions, and would not have looked at it until arriving on site, even if he had received it earlier.

- 74 He did not consider that his unfamiliarity with the area was a safety hazard. He was confident that the COSS pack provided him with a safe system of work and he had never previously been given an access point that was outside the possession limits. Although he had copies of the relevant track diagrams with him, he did not check his location against those diagrams. Standard NR/SP/OHS/019 requires the COSS to check that the proposed safe system of work is adequate and can be implemented as planned.
- 75 When the Grinding Supervisor Manager phoned him after encountering the possession limit boards (paragraph 44), it did not immediately occur to the COSS that the grinding equipment might have been placed on the track outside of the possession. He was checking his paperwork when the accident happened.

The Engineering Supervisor and his actions

- 76 The Engineering Supervisor had been employed by Network Rail for four and a half years. He had qualified as an Engineering Supervisor approximately 11 months before the accident and had since worked extensively in that role. He was also a qualified COSS.
- 77 The Engineering Supervisor's normal practice was to review the detail of what was to take place within his work site on the night of the activity itself. He started work one hour early in order to do so. On the night in question, he received a pack of information which included minutes of the PICOP's briefing meeting (containing details of key personnel involved in the possession) and the Weekly Operating Notice (containing details of each task and associated train movements).
- 78 On the evening of 23 June 2008, the Engineering Supervisor arrived at Network Rail's West Ealing depot at approximately 22:00 hrs and reviewed the pack of information. He then moved to Plassers Crossing, a point close to West Ealing depot and the location from which the tamping machine and road-rail vehicle were to enter his work site (see Figure 5).
- 79 The Engineering Supervisor was provided with a RT3199 form, the Engineering Supervisor's Certificate. This form included details of the possession and work site limits. Each COSS working within the work site was required to sign the Engineering Supervisor's Certificate before work could start on site. When the COSS met the Engineering Supervisor to sign the certificate, the Engineering Supervisor checked that the COSS had been correctly identified in the PICOP's briefing minutes and that they were intending to work at the correct location. The process included a reminder of the work site limits, an indication of when work might start and details of any train movements taking place in or through the work site.

- 80 When the COSS and the Engineering Supervisor went through the process described in paragraph 79 between 23:30 hrs and midnight on 23 June 2008, the COSS asked the Engineering Supervisor for directions to Noel Road, which the Engineering Supervisor gave. The Engineering Supervisor was local to the area and was therefore aware that Noel Road was outside the possession. He assumed that the grinding team would drive their vans as far as they could and then carry their equipment the remainder of the distance into the possession. The Engineering Supervisor did not see any of the COSS's paperwork and because the COSS did not ask for any further clarification regarding the location of the work or the limits of the possession, the Engineering Supervisor did not show him any maps or diagrams.
- 81 At some stage in the evening, the COSS asked the Engineering Supervisor whether the goods line was within the possession. There is disagreement as to whether this conversation took place when the COSS was signing the Engineering Supervisor's certificate or later, when the Engineering Supervisor gave the COSS permission to start work. Irrespective of when it took place, the Engineering Supervisor assumed that the COSS was referring to the goods lines at West Ealing or Hanwell, and, without referring to them by name, confirmed that these goods lines were in the possession.
- 82 The PICOP granted the Engineering Supervisor permission to start work at 00:34 hrs. The Engineering Supervisor spoke to the grinding team's COSS at approximately 00:37 hrs to authorise work to start. He then spoke to the other COSSs to authorise them to start work and made arrangements for the tamper, road-rail vehicle and rail grinder to enter his work site. The next time the Engineering Supervisor spoke to the COSS of the grinding team was when the latter called to say that the grinding machines had been struck by the train.

The planning of the grinding work at Reading Area Services Department

- 83 The RT9909 form was prepared by the grinding team's manager at Reading Area Services Department. He had returned to work after a period of sick leave on Monday 16 June 2008, taking over from a supervisor who had been covering his job (paragraphs 35 and 36). The supervisor relinquishing the work provided minimal briefing to his colleague, other than to explain which tasks were outstanding.
- 84 The grinding team's manager maintained a computerised diary of forthcoming work for the team. As soon as a request for grinding was received from any of the three delivery units, he placed summary information about the job in the diary. The information recorded at that stage included details of date, time, location of work and the access point to be used by the team when going to site.

- 85 While the grinding team's manager was on sick leave, the task of placing information in the diary fell to the covering supervisor. He had received notification of the requirement for the grinding team to work at Ealing Broadway on 24 June 2008 during the period when the team's manager was on sick leave. He identified Noel Road as the access point for the work. His practice when making entries in the diary was to record the closest feasible access point to the work, without referring to the limits of the possession. His rationale was that possession limits could change before the day of the possession. When preparing the RT9909 form nearer the time, he changed the access point if he found that it was outside the possession limits.
- 86 The manager of the grinding team took the information directly from the diary when compiling the RT9909 form for the work to take place on the morning of 24 June 2008. He was aware that the entrance to the access point at 4 miles 70 chains was outside the possession. He was also aware that the team might not be able to drive to a point that was adjacent to their site of work.
- 87 There are two sections of the RT9909 form (Appendix D) that deal with arrangements for gaining access to the working area. The first section requires details to be entered for the 'planned safe system for access and egress arrangements to/from the working area'. The grinding team's manager had completed this section with '*separated green zone*' and 'Noel Road'. He intended that the team would drive as close to the eastern limit of the possession as possible using the wide gap between the up relief line and the Central Line (see Figure 2). No safe system of work needed to be defined for driving to the point at which the vans would be parked. The reference to a separated green zone related to the safe system for the distance that the grinding team would have to walk between the point at which they parked their vans and the eastern limit of the possession.
- 88 The second section of the form that deals with gaining access to the working area is in the section headed 'safe system of work'. This section of the RT9909 form is specifically concerned with staff walking to or from the working area when they are '*on or near the line*'. This phrase has a specific meaning within the rule book and refers to a person being in any position within 3 metres of the nearest rail (although you are not defined as being on or near the line if you are within 3 metres of the nearest rail, but separated from the railway by a permanent fence or structure). The grinding team's manager had defined separated green zone as being the safe system of work for walking on or near the line to/from the working area. The choice of a separated green zone indicated that the team were to walk adjacent to a line that was outside the possession.
- 89 The grinding team's manager thought that the team could drive their vans from Noel Road to a point that was close to the eastern limit of the possession at 5 miles 37 chains. In practice, the road ran out at around 5 miles 02 chains and the grinding team would have needed to carry their equipment the rest of the way into the possession, which, given its weight, was not feasible.
- 90 NR/SP/OHS/019 states that it is a requirement for those preparing the COSS pack to have good local knowledge of the area where the work is being undertaken.

- 91 In order to prepare COSS packs, Network Rail requires that practitioners pass an assessment as a 'Core Planner'. The grinding team's manager had taken the assessment on 2 October 2006, but had not reached the required standard. He should have undertaken a period of mentoring before taking his assessment again. This did not happen. The RAIB has been unable to establish whether this was because the paperwork that should have gone to the line manager following the assessment was not sent or because its contents were not acted upon. The grinding team's manager was not qualified as a Core Planner at the time of the accident.
- 92 It is a further requirement that COSS packs should be checked by the supervisor or manager of the team that is actually undertaking the work. The fact that the COSS pack was prepared by that manager meant that there was no check of its contents. COSS packs would normally be prepared by a Works Planner or Scheduler. This was not happening at Reading Area Services Department because the Works Planner had also suffered a period of sickness and had a backlog of work in other areas.

Possession and work planning

- 93 Network Rail's process for possession planning is laid down in standard NR/SP/MTC/0086, 'Work & possession planning for the railway infrastructure: change control'. It defines activities to be undertaken starting from 84 weeks before the possession occurs and running through to the day after the possession when a review should take place.
- 94 On the *Western route* out of Paddington, there are four passenger lines as far as Foxhall Junction, a mile west of Didcot. A standard programme of overnight possessions applied during the week, allowing maintenance work to be undertaken on an alternating weekly basis on main and relief lines. This facilitated the undertaking of routine maintenance activities.
- 95 Once the need for the grinding work at Ealing Broadway had been recognised by the Track Maintenance Engineer at West Ealing, Network Rail's procedures required that it be communicated to:
- the Thames Valley area possession planning team (the computerised planning system shows that the work was first registered on the system on 7 May 2008);
 - the Reading Area Services Department grinding team (this had happened by week commencing 9 June at the latest as it was already in the diary when the manager of the grinding team returned from sick leave on 16 June 2008); and
 - the delivery unit planning team, for inclusion on their planning sheets.

- 96 Because of an oversight by the person responsible for communicating details of the work within the delivery unit, grinding work was not registered on the delivery unit planning sheets until two weeks before it was due to take place. The only reason that the delivery unit planning team realised that the work was to take place at all was because they were involved in the generation of paperwork to accommodate a change to the planned grinding activity. In week commencing 9 June 2008, the Track Maintenance Engineer decided to extend the western limit of the grinding site from 5 miles 45 chains to 5 miles 55 chains. He had a contract team of grinders available to him and his intention was that they would work alongside the Reading Area Services Department team to complete more work on the night.
- 97 In accordance with the requirements of NR/SP/MTC/0086, this extension of the site of work would not normally have required special authorisation. However, because the West Ealing delivery unit planning team had no knowledge of the original request for work between 5 miles 41 chains and 5 miles 45 chains, the change to the grinding work went through a late change process and a *possession change control form* was raised and approved. The revised limits of the area of work duly appeared in the *supplementary operating notice*. In the event, the need for the contracting gang to work at Ealing Broadway on the morning of 24 June 2008 was not communicated to them and they did not appear on site.
- 98 Within the delivery unit, a weekly planning meeting was held to discuss the details of all work being undertaken within possessions covering their area. The absence of the grinding job from the planning sheets meant that until the week before it was due to take place it was not discussed in these meetings. No representative from the Reading Area Services Department team attended West Ealing delivery unit planning meetings, although they should have been present in accordance with the requirements of Network Rail standard NR/PRC/MTC/PL0056.
- 99 In the week before the work was due to take place, a PICOP's briefing meeting was held to discuss the following week's possessions. NR/PRC/MTC/PL0056 describes the purpose of this meeting, who should attend and the agenda items for discussion. The main text of the document provides a summary of the arrangements and an appendix includes the detailed arrangements.
- 100 There is inconsistency between the main text and the appendix. The main text states that the meeting should be chaired by the Possession Delivery Manager or his/her team, but the appendix states that the PICOP should chair the meeting. However, there is agreement over the objective of the meeting, which is to brief the Engineering Supervisor(s) regarding arrangements for the following week's possessions. Supervisors of works included in the following week's possessions are also supposed to attend the meeting.

- 101 Neither the PICOP nor the Engineering Supervisor attended PICOP's briefing meetings in the London area of the Western route. The meetings were chaired by a representative from the possession planning team. The primary purpose of the London meeting was to confirm that the items of work identified for the following week's possessions would go ahead. The name and contact details of the Engineering Supervisor for each work site and COSS for each area of work were recorded, as were the limits of each area of work. These details then appeared in tabular form as the minutes of the PICOP's briefing meeting. Access arrangements were not discussed, although access was a defined agenda item in NR/PRC/MTC/PL0056.
- 102 No representative from Reading Area Services Department attended the PICOP's briefing meeting. The grinding work was represented by the Assistant Track Section Manager at West Ealing. Before attending the meeting, he confirmed with the delivery unit welding manager that all grinding and welding work was going ahead in the following week. At the PICOP's briefing meeting, he provided that confirmation. He did not know who the COSS was going to be (this information was supplied directly from Reading Area Services Department to the possession planning team). After the meeting, he had no contact with Reading Area Services Department.

Previous occurrences of a similar character

- 103 The RSSB maintains a database of railway incidents and accidents. There are 27 instances of trains striking track-mounted equipment recorded in the period from February 1999 to August 2008. Most of those occurred in circumstances that were not analogous to the event at Acton West for a variety of different reasons, for example:
- the signaller had granted possession of the line before the last train had cleared the section;
 - there was confusion over the line on which the possession was to be taken;
 - the equipment had been left behind after overnight engineering work;
 - the equipment had been clipped to the line by staff working between trains and they had been unable to unclip it when a train approached;
 - the equipment had been placed on the line by vandals; or
 - the equipment had been left foul of the line rather than on it.
- 104 One incident with features similar to those at Acton West occurred on 1 February 1999. Train 2F56, the 00:47 hrs service from Liverpool Street to Chelmsford struck an engineers' trolley on the up main line at Shenfield. The trolley had been placed outside the possession on a crossover being used by passenger trains. Nobody was injured and the train suffered only minor damage. The Works Planner had not visited the site. The method statement had not identified a specific access point, and did not contain any diagrams of the work site, limits of the work site or other significant points including protecting signals. The method statement had been prepared by a subcontractor to Railtrack and the recommendations arising from the incident focused on the interface between the two organisations.

- 105 The RAIB has conducted a number of investigations which had features in common with the circumstances of the accident at Acton West.
- 106 On 11 January 2006, a section of rail was removed from a line that was open to traffic at Thirsk in Yorkshire (RAIB report 15/2006¹). In this case, the area of work was outside the limits of the possession, a discrepancy that had not been identified during the planning process. The PICOP's briefing meeting did not take place in accordance with the requirements of NR/PRC/MTC/PL0056, as a result of which the discrepancy was not identified by the participants at the meeting. Furthermore, the PICOP and Engineering Supervisor did not have clear and accurate information to help them identify the limits of the possession and work sites, with the possession being referenced from points and signals and the work site from mileages.
- 107 On 19 March 2006, a train struck two wheelbarrows that had been placed on a line that was open to traffic at Manor Park in East London (RAIB report 26/2007). The RAIB's investigation identified four factors that were also relevant in the Acton West accident:
- there was a lack of understanding between the Engineering Supervisor and the COSS at the start of the work as to where the work group was located;
 - the COSS received his COSS pack 30-45 minutes before the commencement of work, leaving him little time to assimilate its contents;
 - the complex format of the information in the COSS pack; and
 - the length of the work site (eight miles) and the number of work activities (twelve) taking place within it.
- 108 On 31 October 2006, a collision occurred between two track maintenance machines at Badminton in Gloucestershire (RAIB report 30/2007). The work site was 17.5 miles long with three locations where work was being undertaken. The investigation concluded that the length of the work site created additional risk for those working within it (in this case, from train movement) and that the length of the work site made it difficult for the Engineering Supervisor to comply with all of the relevant provisions in the rule book.
- 109 On 17 March 2007, a track worker narrowly avoided being struck by a train at Tinsley Green in Sussex (RAIB report 43/2007). The information on the RT9909 form contained a number of factual errors, which were not identified through any process of checking. In this case, the Works Planner had prepared the RT9909 form, and the errors were not detected by the manager who had originally requested its preparation.
- 110 The investigations referred to in paragraphs 106 - 109 have resulted in recommendations to Network Rail to address the matters identified. The progress made by Network Rail in implementing those recommendations is described in paragraphs 173 - 176.

¹ RAIB reports are available at www.raib.gov.uk.

Analysis

Identification of the immediate cause²

- 111 The immediate cause of the accident was that the rail-mounted grinding machines were placed on the up relief line at Acton West on a section of railway that was open to train operations.

Identification of causal³ and contributory⁴ factors

The COSS pack and RT9909 form

- 112 The presentation of information within the COSS pack generally and on the RT9909 form specifically makes it difficult for the relative positions of access points and possession limits to be readily identified. The RT9909 form in Appendix D shows that:
- the site of work was identified in miles and chains;
 - the limits of the possession were identified by signal/points numbers; and
 - the access point was named, but no other information was given on its location.
- 113 It was a requirement for the COSS and the person preparing the COSS pack (including the RT9909 form) to have adequate geographical knowledge of the area of work and this is discussed in paragraphs 120 and 137. Despite his limited geographical knowledge, the presentation of information in a consistent manner would, in all probability, have immediately drawn the COSS's attention to the fact that the access point was outside the possession limits.
- 114 Paragraph 106 refers to the incident at Thirsk involving a rail being removed from a line that was open to traffic. The RAIB's investigation report (published on 18 August, 2006) recommended that all relevant staff involved in possessions had easy access to accurate mileage information for all published possession limits. In response to this recommendation, Network Rail changed the RT3199 form (paragraph 79) used by the Engineering Supervisor to define work site and possession limits by mileages, and the RT3198 form (Record of Possession Arrangements) used by the PICOP. However, information on the RT9909 form remained in a mixed format.
- 115 There are two sections on the RT9909 form that refer to safe systems for gaining access to the area of work (paragraphs 87 and 88). This leads to confusion over the scope of each section. Under some circumstances, it is possible to drive or walk to an area of work along a roadway or walkway that is *lineside* rather than 'on or near the line'. This is the safest method for gaining access to the area of work, but is not included explicitly in the RT9909 form.

² The condition, event or behaviour that directly resulted in the occurrence.

³ Any condition, event or behaviour that was necessary for the occurrence. Avoiding or eliminating any one of these factors would have prevented it happening.

⁴ Any condition, event or behaviour that affected or sustained the occurrence, or exacerbated the outcome. Eliminating one or more of these factors would not have prevented the occurrence but their presence made it more likely, or changed the outcome.

- 116 The RT9909 form is presented in densely packed script (see Appendix D). The absence of a track layout diagram showing all the key features of the possession and the relevant site of work prevents the COSS from assimilating that information quickly. A complete picture of the arrangements could only be gained by reference to the *five-mile line diagrams* (for access locations), the Weekly Operating Notice (for detailed possession arrangements) and the Sectional Appendix (for mileages of other key locations in the vicinity).
- 117 The format of the COSS pack (including the RT9909 form) is a contributory factor to this accident.

The actions of the COSS

- 118 The COSS had no knowledge of the track layout at Acton West Junction. He had to ask for directions to Noel Road (paragraph 40) and sought further clarification on the layout at Acton West when he arrived on site (paragraph 81).
- 119 NR/SP/OHS/019 states that a COSS must be familiar with locations at which he is to work. The safety of the team working with him is dependent on the COSS's knowledge of the layout and operation of trains in and around the work location. The COSS's lack of knowledge of the Acton West area is a causal factor in this accident.
- 120 Given the geographical boundaries of the area covered by Reading Area Services Department (paragraph 68), it was unlikely that a COSS would be familiar with every access point. The COSS had never asked to make a site visit before working at an unfamiliar location and neither had it been suggested that he should do so by managers at Reading Area Services Department (see paragraph 134).
- 121 The COSS did not receive the COSS pack until he arrived at West Ealing depot to book in with the Engineering Supervisor (paragraph 39). However, even if he had received it earlier, he would not have looked at it until he was on site (paragraph 73).
- 122 Although the COSS had access to track layout diagrams, he did not feel it necessary to check the information on his RT9909 form against the diagrams. It did not occur to him that the access location might be outside the possession limits (paragraph 73). He believed that the safe system of work shown on the form had already considered such factors and that his role as COSS was to implement its provisions, rather than critically check the contents, as was required by NR/SP/OHS/019. The COSS's belief that the contents of the RT9909 form did not need to be subject to a detailed check on site is a contributory factor in this accident.
- 123 Paragraph 42 refers to the COSS finding more lines at the access point at Acton West than he was expecting. Paragraph 81 explains the circumstances which resulted in the COSS believing that the access point was within the possession.
- 124 It would have been easier for the COSS to identify the location of the access point in relation to other railway features if there had been a track layout diagram provided at the access point. Such diagrams already exist at some locations on the railway (see Figure 6). The absence of a track layout diagram at the access point is a contributory factor to this accident.

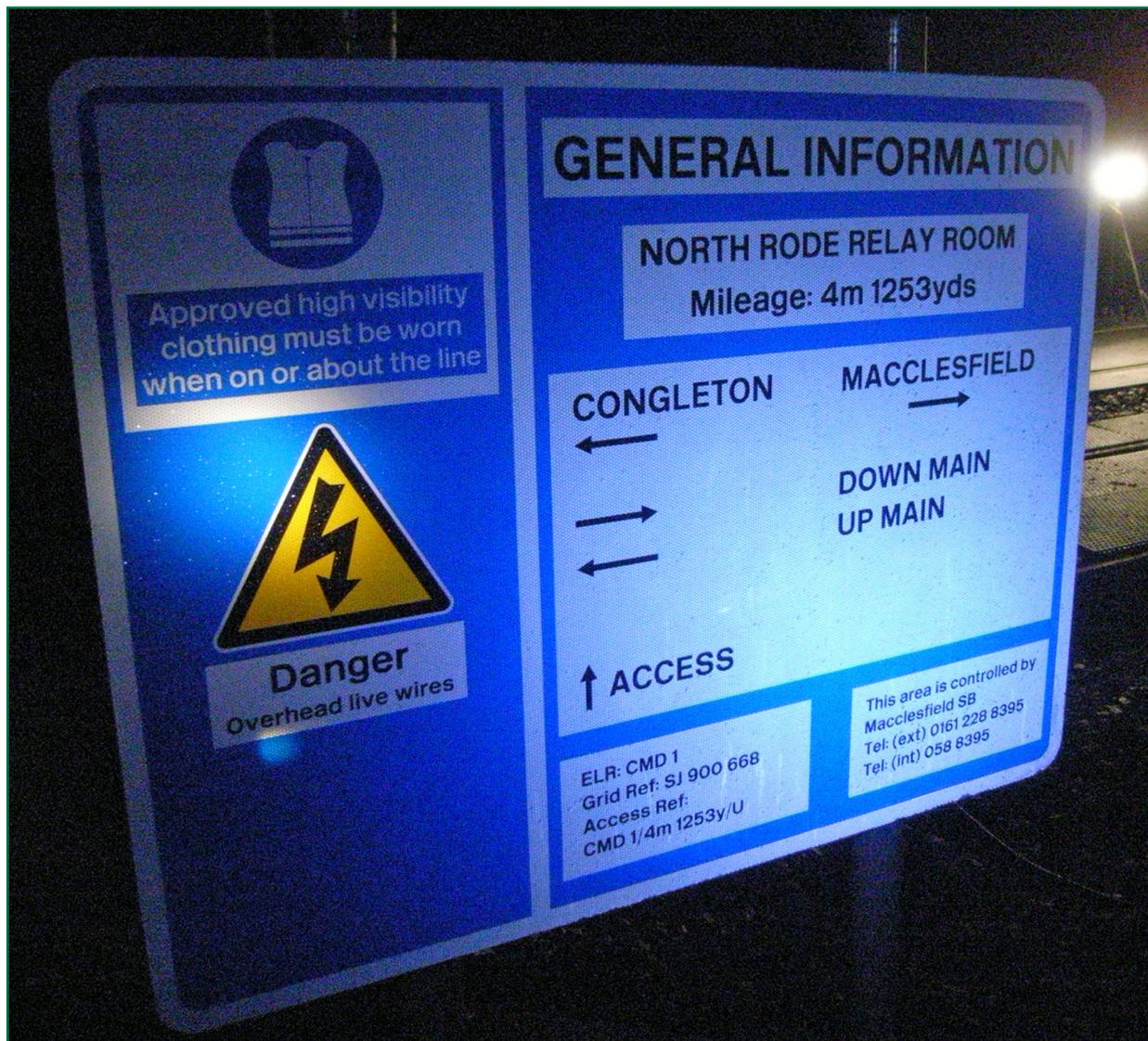


Figure 6: Lineside signage at North Rode access point

125 Practices within Reading Area Services Department on facilitating a COSS's knowledge of the area in which he was to work, and the preparation of the COSS pack, are discussed in paragraphs 134 to 138. Network Rail's processes for compilation of COSS packs are discussed in paragraph 150.

The actions of the Engineering Supervisor

126 The Engineering Supervisor provided the COSS with directions to the Noel Road access point. He was therefore aware that the COSS did not know the area and that the grinding team were gaining access to the railway at a point that was outside the possession. He assumed that they would carry their equipment from their vans along the wide space between the up relief line and the converging London Underground Central Line and into the possession. He had no knowledge of the equipment carried by the grinding team and the impracticality of carrying it any great distance (paragraph 31).

- 127 There is a difference in the recollections of witnesses as to when the Engineering Supervisor and the COSS discussed whether the goods line was in the possession (paragraph 81). The RAIB considers that the conversation is likely to have taken place when the Engineering Supervisor was giving the COSS permission to start work (the alternative suggested was when the Engineering Supervisor and COSS met at the beginning of the evening, but it is unlikely that the conversation took place then because the COSS had not seen the layout on the ground or in any diagram at that stage). The Engineering Supervisor knew that there were no goods lines in the immediate vicinity of the grinding team's site of work and could have asked why, if they were walking to site between the up relief line and the Central Line, they needed to know about any goods line.
- 128 Around the time that the Engineering Supervisor phoned the COSS at Acton, he needed to make similar calls to the COSSs involved in three of the other four sites of work. He also had to arrange for the movement of three trains (paragraph 59) into his work site in conjunction with the PICOP who was responsible for moving them into the possession. With limited time available during the possession, the timely movement of trains to the locations where they were to work was critical to getting the work completed on time.
- 129 The Engineering Supervisor was to act as COSS for the grinding train once he had arranged for the movement of the three trains into the work site. Module 14 of Network Rail Company Standard NR/L3/MTC/PL0175, 'Maintenance Planning Handbook' offers guidance on the circumstances under which it is permissible for an Engineering Supervisor also to act as COSS. The key determining factors are the number of trains (including on-track machines and on-track plant) and the number of work groups within the work site.
- 130 On 24 June 2008, there were three items of on-track machinery within the work site. NR/L3/MTC/PL0175 indicates that under these circumstances, the Engineering Supervisor should only act as COSS if there are no more than three work groups present in the work site, inclusive of those working with the three items of on-track machinery. There were five work groups in the work site.
- 131 The workload of the Engineering Supervisor is a contributory factor in this accident, and is discussed further in paragraphs 146-149. Non-compliance with the provisions of NR/L3/MTC/PL0175 is discussed in paragraphs 163 and 164.

The actions of the PICOP

- 132 The PICOP only communicated with the Engineering Supervisor during activities on the night in relation to preparing for and commencing the possession. His actions were neither causal nor contributory to the accident.
- 133 The division of work between the PICOP and the Engineering Supervisor is discussed in paragraphs 146-149.

The planning of the grinding work at Reading Area Services Department

- 134 The COSS had not undertaken a site familiarisation visit before the day of the work (paragraph 70). The two supervisors involved in managing the grinding team's work at Reading Area Services Department during the first half of 2008 assumed that the COSS would make it known if he was not familiar with a specific location. They did not ask the COSS whether he was familiar with the locations where work was planned. For the most part, this would have been feasible as requests from the delivery units for grinding work were normally received at least three weeks before the work was to take place.
- 135 Furthermore, the way in which the Area Services Department worked did not facilitate early involvement of the COSS in the grinding team's work. The normal arrangement was for the COSS to find out towards the end of one week where the team was to be working during the following week (paragraph 71). The absence of management arrangements within Reading Area Services Department to ensure that COSSs had adequate knowledge of areas where they were working is a contributory factor to this accident.
- 136 Paragraphs 84 and 85 describe the circumstances under which the COSS pack was prepared and the involvement of two individuals in the planning of the work. The practice employed by the supervisor of nominating an access point without reference to the possession limits was the reason why Noel Road was selected in the first place. It was slightly closer to the grinding site than Longfield Avenue (6 miles 15 chains), the alternative access point that was within the possession.
- 137 The manager who prepared the grinding team's COSS pack recognised that the access point was outside the possession limits, but thought that the team would be able to drive close enough to their site of work to enable them to walk into the possession with their equipment. The lack of geographical knowledge of the person preparing the COSS pack is a causal factor in this accident.
- 138 The involvement of the grinding team's manager in preparing COSS packs was not normal practice within Network Rail. Usually the task would have fallen to the Works Planner and the grinding team's manager would have checked the document. For the reasons described in paragraph 92, this did not happen and the grinding team's COSS packs were not checked at all. The lack of arrangements at Reading Area Services Department for the checking of the grinding team's COSS pack by somebody who knew the layout at the location where the work was to take place is a contributory factor to this accident.

Possession and work planning

- 139 The grinding work was planned within adequate timescales and registered on the Thames Valley area possession planning system on 7 May 2008, over six weeks before it was to take place. The extension of the western limit of the grinding work from 5 miles 45 chains to 5 miles 55 chains did not require formal possession change process to be invoked because:
- it was a *non-disruptive change* to a site of work;
 - it did not change the limits of the possession;
 - it did not change the limits of the work site; and
 - there was no change to the type of work being undertaken.

- 140 The fact that a possession change control form was generated arose from a breakdown in communications within West Ealing delivery unit (paragraph 95). This created the impression locally that the grinding work was an additional item to be undertaken within the work site, for which a possession change control form was needed.
- 141 The absence of the work on the depot planning sheets until approximately a week before it was due to take place meant that it was not discussed at depot planning meetings. However, even if it had been on the depot planning sheets, any discussion would not have identified the discrepancy between access points and possession limits because no representative from Reading Area Services Department (the only department that knew which access point the grinding team were intending to use) attended delivery unit planning meetings.
- 142 No representative from Reading Area Services Department attended the PICOP's briefing meeting either. It was held in the week before the grinding work was due to take place. The grinding work for 24 June 2008 was represented at the PICOP's planning meeting by an individual from West Ealing delivery unit, who did not communicate with Reading Area Services Department about the work before or after the meeting. He had no knowledge of the team's proposed arrangements for gaining access to the railway.
- 143 The purpose of the PICOP's briefing meeting is described in paragraphs 99 to 101. The PICOP's briefing meetings held at Paddington departed from the templated arrangements in several key respects:
- the PICOP did not chair the meeting, neither did he attend it;
 - the Engineering Supervisors did not attend the meeting;
 - not all the relevant Works Supervisors were present; and
 - access arrangements were not discussed.
- 144 The overall purpose of the PICOP's briefing meeting is for key people involved in the following week's possessions to discuss the arrangements. Had that been achieved, and the templated agenda followed, it is likely that the discrepancy between the grinding team's access point and the limits of the possession would have been identified. The way in which the PICOP's briefing meeting was run at Paddington is a contributory factor to this accident.
- 145 One key reason why the PICOP's briefing meeting was conducted in this way at Paddington was because it was normally held in the middle of the day. The PICOP(s) and Engineering Supervisor(s) involved in the following week's work were generally also involved in the current week's night work. Possession planning staff worked during the days and there was therefore an incompatibility in the availability of these two groups. As the meeting was chaired by a member of the possession planning team, it was held at a time that was compatible with their commitments. No thought had apparently been given to reconciling the mismatch in availability of the two groups by holding the meeting during the late evening or early morning, immediately before or after one of the current week's possessions had taken place.

- 146 The possession itself was almost four miles long with a single work site, the limits of which were virtually identical to the limits of the possession. The use of a single work site in a long possession was standard practice in the Thames Valley area. The advantages to Network Rail of a single work site were:
- only one Engineering Supervisor was needed for all of the work to be undertaken;
 - it simplified the PICOP's work as he only had to deal with one Engineering Supervisor and did not have to take responsibility for train movements within the possession limits (had the possession been divided into five work sites, the PICOP would have taken responsibility for moving trains anywhere within the possession limits apart from within the five work sites); and
 - it eliminated the need for work site marker boards (paragraph 57).
- 147 With the work site limits and possession limits being at virtually the same location, the Engineering Supervisor was effectively responsible for all train movements within the possession. He was also responsible for the five items of work taking place within the work site and had been given the role of COSS for one of those items of work
- 148 This distribution of the workload between PICOP and Engineering Supervisor was uneven. The former had little to do once the signaller had granted the possession and trains had been brought up to the possession limits (paragraphs 60 and 61), while the latter had full responsibility for getting the trains to their appropriate locations within the possession, for all the five items of work and for the safety of the team working on one of the items of work.
- 149 Inevitably, this meant that in the period after the possession was granted, the Engineering Supervisor was focused on expediting the movement of trains in order that he could maximise the time available for them to work on site. It was at this time that the COSS asked the question about the goods line at Acton West (paragraphs 127-129), the significance of which may have occurred to the Engineering Supervisor had his attention not been elsewhere. The workload of the Engineering Supervisor arising from the use of a single work site with five areas of work is a contributory factor in this accident because it reduced the time available for him to focus on the actions of each COSS within his work site.

Identification of underlying factors⁵

The COSS pack

- 150 The current arrangements for preparation of COSS packs in Network Rail are for the information to be prepared by a desk-based Work Planner or manager and passed to a COSS for use on site. This means that the COSS has no involvement in the planning of the safe system of work. Greater involvement of the COSS would lead to a better understanding of the arrangements for the safety of his or her team on site.

⁵ Any factors associated with the overall management systems, organisational arrangements or the regulatory structure.

151 The general arrangements within Network Rail for the preparation of COSS packs are an underlying factor in this accident.

Management arrangements at Reading Area Services Department

152 The Reading Area Services Department organisation was disbanded in September 2008 as part of the changes arising from the nationwide reorganisation of Network Rail maintenance activities. Throughout the first half of 2008, the impending reorganisation had an impact on Reading Area Services Department. The Area Services Department Manager was seconded away to another task within the Thames Valley area and his post was filled by an individual from within the department who had hitherto been the overall manager of four teams, including the grinding team. His post was not filled because of the imminent reorganisation.

153 The grinding team's manager was also on sick leave for part of this time (paragraph 83), and the period leading up to the accident was therefore characterised by a shortage of managerial/supervisory staff at Reading Area Services Department, resulting in the need for others to take on additional responsibilities and act out of their normal positions. While no causal link can be established to the accident, the disrupted managerial arrangements were the context in which the preparations for the grinding work of 24 June 2008 took place. In the investigation that the RAIB undertook into a derailment of a freight train that occurred at Santon on 25 January 2008⁶, an underlying cause of the accident was identified as frequent changes in local management (there had been six changes in management of the local track maintenance team in 18 months).

154 Overall monitoring of the performance of the Area Services Department was the responsibility of the Infrastructure Maintenance Manager, to whom the Area Services Department Manager reported. During the first half of 2008, the performance of Reading Area Services Department, as measured by their work output, gave the Infrastructure Maintenance Manager no cause for concern.

155 A number of issues have been identified during this investigation in relation to management arrangements at Reading Area Services Department. They include:

- no arrangements in place to allow COSSs to make site familiarisation visits before working at locations with which they were not familiar (paragraph 70);
- weak briefing arrangements between a person returning from a long period of sick leave and the person who had been covering his duties (paragraph 83);
- the use of an individual to prepare COSS packs who had not achieved the necessary formal competence to do so (paragraph 91);
- the absence of any arrangements for checking COSS packs (paragraph 92);
- no involvement in delivery unit and possession planning meetings by the grinding team (paragraphs 98 and 102); and
- the absence of annual checks of the competence of those charged with preparing COSS packs (see paragraph 159).

156 The management arrangements within Reading Area Services Department are an underlying factor in this accident.

⁶ Derailment at Santon near Foreign Ore Branch Junction, Scunthorpe, 25 January 2008, RAIB report 10/2009, available at www.raib.gov.uk.

Compliance with NR/PRC/MTC/PL0056

157 Paragraphs 101 and 102 identify that the PICOP's briefing meeting was not operating in accordance with the requirements of NR/PRC/MTC/PL0056. This had been the case for a number of years. The RAIB has not been able to find any evidence of the planning arrangements in the Thames Valley area being subject to audit, which might have identified this issue. The fact that auditing arrangements had not identified this non-compliance is an underlying factor in this accident.

Other factors for consideration

Assessment in the line

- 158 Network Rail's Competence and Training Management function issued a document titled, 'Training and Assessment Arrangements for Network Rail Employees' Core Planner Skills' (no reference) in January 2006. It sets out the requirements for those employees who are to undertake preparation of COSS packs. It defines the skills required, the standard to be achieved, how to deal with staff who do not meet the required standard and arrangements for ongoing assessment of those who do meet the required standard. Those who are qualified as Core Planners should be subject to an annual review of their competence.
- 159 The arrangements at Reading Area Services Department did not meet these requirements:
- the grinding team's manager had not passed his assessment, but still continued to produce COSS packs unsupervised and with no mentoring (paragraph 91); and
 - two supervisors who had passed their Core Planner assessments had not received annual re-assessments.
- 160 The COSS packs prepared by the grinding team's manager were considered by those who used them to be of a generally high standard. However, the definition of a separated green zone as the 'safe system of work' for the team to drive along the gap between the up relief line and the Central Line (paragraph 87) and his lack of geographical knowledge of the Acton West area (paragraph 89) indicated that there were gaps in his competence to undertake the Core Planner's task.
- 161 The supervisor who prepared the grinding team's COSS packs in the absence of their manager had passed his assessment in October 2006. This supervisor was one of the two referred to in paragraph 159 who had not been subject to annual assessment of his competence in Core Planner skills.
- 162 Assessment in the line is a key element in Network Rail's competence management system. Since its introduction, Network Rail has abandoned the use of external service providers for competence assessment in a number of key skills and substituted local testing. The robustness of this arrangement is dependent on Network Rail's compliance with its own procedures for assessment in the line. This was not happening at Reading Area Services Department and did not happen after the staff referred to in paragraph 159 transferred to other departments in September 2008.

Compliance with Standard NR/L3/MTC/PL0175

- 163 Paragraphs 129 and 130 describe the workload of the Engineering Supervisor and the fact that he was also allocated the role of COSS for one of the tasks. This was a non-compliance with NR/L3/MTC/PL0175 (module 14).
- 164 Responsibility for allocating the Engineering Supervisor to perform the role of COSS additionally lies with the delivery unit and was discharged at West Ealing by the Assistant Track Section Manager. He had not been briefed on the contents of NR/L3/MTC/PL0175 (module 14).

Conclusions

Immediate cause

165 The immediate cause of the accident was that the rail-mounted grinding machines were placed on the up relief line at Acton West on a section of railway that was open to train operations (paragraph 111).

Causal factors

166 Causal factors were:

- a. the COSS's lack of knowledge of the Acton West area (paragraph 119, Recommendation 1); and
- b. the lack of knowledge of the Acton West area of the person preparing the COSS pack (paragraph 137, Recommendation 1).

Contributory factors

167 Contributory factors were:

- a. the format of the COSS pack, including the RT9909 form (paragraph 117, Recommendation 2);
- b. the COSS's belief that the contents of the RT9909 form did not need to be subject to a detailed check on site (paragraph 122, Recommendation 2);
- c. the absence of a track layout diagram at the Noel Road access point (paragraph 124, Recommendation 3);
- d. Reading Area Services Department's management arrangements did not ensure that the COSS had adequate knowledge of the areas he was to be working in (paragraph 135, no recommendation is made - see paragraph 177);
- e. Reading Area Services Department did not have arrangements in place for the checking of the grinding team's COSS packs by somebody who had knowledge of the Acton area (paragraph 138, no recommendation is made - see paragraph 177);
- f. the way in which the PICOP's briefing meeting was run at Paddington (paragraph 144, Recommendations 4 and 5); and
- g. the workload of the Engineering Supervisor, arising from the use of a single work site with five areas of work within the possession reduced the time available for him to focus on the actions of each COSS in his work site (paragraph 149, Recommendation 7).

Underlying causes

168 The underlying causes were:

- a. the general arrangements within Network Rail for the preparation of COSS packs, which led to a lack of involvement by the COSS in the definition of safety arrangements for his work group (paragraph 151, Recommendation 2);
- b. overall management arrangements within Reading Area Services Department, which resulted in a number of non-compliances with Network Rail procedures (paragraphs 155 and 156; no recommendation is made - see paragraph 177); and
- c. the non-compliance of the Thames Valley's London area PICOP briefing meeting with standard NR/PRC/MTC/PL0056 was not identified by Network Rail's audit arrangements (paragraph 157, Recommendation 6).

Additional observations⁷

169 Delivery unit staff responsible for the allocation of work within possessions and work sites had not been briefed on the contents of NR/L3/MTC/PL0175 regarding the circumstances under which an Engineering Supervisor can also act as a COSS. NR/L3/MTC/PL0175 addresses some elements of the distribution of work between PICOP, Engineering Supervisor and COSS, but there is a need for an overall review of the workload of safety critical staff within possessions (paragraph 164, Recommendation 7).

170 The assessment in the line process for Core Planner skills was not being applied correctly for some staff in Reading Area Services Department at the time of the accident or when they transferred to other departments in Western route in September 2008 (paragraph 161, Recommendation 8).

⁷ An element discovered as part of the investigation that did not have a direct or indirect effect on the outcome of the accident but does deserve scrutiny.

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

- 171 Access arrangements are now discussed at London area PICOP's briefing meetings (paragraph 143).
- 172 Network Rail is currently conducting a review of the RIMINI planning process (encompassing preparation of COSS packs). It is being conducted by a cross-functional team on track worker safety. Their remit also includes the planning process, reducing interfaces, reducing exposure, and simplification of the rules and regulations structure (paragraphs 112 to 115).
- 173 Paragraph 108 refers to the collision between two on-track machines near Badminton. The RAIB recommended that the length of work sites should be kept as short as possible. Wording to this effect was included within the December 2008 revision to the rule book.
- 174 Paragraph 107 refers to the collision at Manor Park between a train and wheelbarrows that had been placed on an open railway. The RAIB recommended that Network Rail should review their possession planning principles with a view to reducing the complexity of work sites in a possession and consider the risk and benefits of a number of short work sites with single jobs in comparison with a longer work site and multiple jobs. Network Rail's response was to undertake a review and issue new guidance in the Maintenance Planning Handbook, NR/L3/MTC/PL0175 at the end of September 2007 (paragraphs 129, 130 and 164).
- 175 Network Rail intends to publish a company standard which defines the limits of safety critical roles which can be performed by an individual, based upon the workload associated with discharging those duties, under a range of different possession/work site arrangements and work site lengths. This work was ongoing at the time of publishing this report.
- 176 Paragraph 109 refers to factual errors in, and lack of checking of, the RT9909 form which were factors in the near-miss that occurred at Tinsley Green. The RAIB recommended that a process of checking the accuracy of data contained should be implemented. Network Rail has commenced a review of NR/SP/OHS/019 and NR/PRC/MTC/PL0094 (paragraph 172).

Completed actions which address factors in the report so avoiding the need for the RAIB to issue a recommendation

- 177 Paragraph 155 makes reference to issues identified in relation to management arrangements at Reading Area Services Department. Those issues that the RAIB considers may have systemic implications for Network Rail have been the subject of recommendations in this investigation report. No recommendations have been made with regard to issues that the RAIB considers specific to Reading Area Services Department because the department was disbanded as part of the reorganisation of Network Rail's maintenance arrangements that took place in the Thames Valley area in September 2008.
- 178 The individuals at Reading Area Services Department referred to in paragraph 159 who were either not qualified as a Core Planner or who had not been subject to annual assessments have had their Core Planner accreditation removed pending assessment.

Recommendations

179 The following safety recommendations are made⁸:

Recommendations to address causal and contributory factors

- 1 The intention of this recommendation is to reinforce existing arrangements within Network Rail for COSS packs to be prepared and implemented by staff with adequate geographical knowledge of the locality.

Network Rail should:

- a. re-brief the requirements (now in standard NR/L2/OHS/019) for the COSS pack to be prepared and checked by individuals who have geographical knowledge of the relevant area and for COSSs to have geographical knowledge of the area in which they are to work;
- b. take steps to achieve compliance with the requirements defined in 1a; and
- c. conduct a compliance audit after a suitable period of time to confirm that these requirements defined in 1a are being implemented satisfactorily (paragraphs 166a and 166b).

- 2 The intention of this recommendation is to:

- promote the involvement of the 'end-user' in designing the paperwork that they use on site;
- secure the COSS's involvement in the planning of the safe system of work that they will implement on site; and
- achieve a consistent and user-friendly appearance for the COSS pack (including the RT9909 form).

Network Rail should, in its current project to overhaul the RIMINI planning process:

- a. involve those who will use the information on site in developing a revised format for the COSS pack (and the RT9909 form);

continued

⁸ Those identified in the recommendations, have a general and ongoing obligation to comply with health and safety legislation and need to take these recommendations into account in ensuring the safety of their employees and others.

Additionally, for the purposes of regulation 12(1) of the Railways (Accident Investigation and Reporting) Regulations 2005, these recommendations are addressed to the Office of Rail Regulation to enable it to carry out its duties under regulation 12(2) to:

- (a) ensure that recommendations are duly considered and where appropriate acted upon; and
- (b) report back to RAIB details of any implementation measures, or the reasons why no implementation measures are being taken.

Copies of both the regulations and the accompanying guidance notes (paragraphs 167 to 171) can be found on RAIB's web site at www.RAIB.gov.uk.

- b. include a role for the COSS in the planning of their safe system of work; and
 - c. improve the format of the COSS pack (and the RT9909 form), with particular emphasis on the clarity and consistency of information presented, including, but not limited to:
 - o consistency in the method for identifying key locations such as the site of work, limits of possession and access points;
 - o clarity over the information that is required in each section of the new forms;
 - o the option of identifying in the COSS pack where access to site can be achieved by walking lineside as opposed to on or near the line; and
 - o the use of diagrams and maps to show key locations and their relationship with each other (paragraphs 167a, 167b and 168a).
- 3 The intention of this recommendation is to encourage Network Rail to expedite the provision of track layout signage at access points.
- Network Rail should develop and implement a programme for the provision of track layout information signage at all railway access points, showing mileages, line names and directions and other key items of local railway information, as appropriate (paragraph 167c).
- 4 The intention of this recommendation is to reinforce existing requirements on the content of PICOP's briefing meetings within the London delivery unit of Network Rail's Western route.
- Network Rail should modify the format and content of the PICOP's briefing meeting held in the London delivery unit of Western route to conform with the requirements of NR/L2/MTC/PL0056 and in particular, arrange for the PICOP, Engineering Supervisor and direct representatives of those who are to be involved in the following week's possessions to be present (paragraph 167f).
- 5 The intention of this recommendation is for Network Rail to review the extent to which existing requirements on the contents of PICOP's briefing meetings are being respected nationally and take action to promote compliance with the contents of standard NR/L2/MTC/PL0056.
- Network Rail should:
- a. investigate the extent to which PICOP's briefing meetings comply with the requirements of NR/L2/MTC/PL0056 nationally, taking steps to achieve wider compliance, as necessary; and
 - b. consider the development of standard forms to assist those leading meetings referred to in NR/L2/MTC/PL0056 to cover all of the items on the agenda (paragraphs 106 and 167f).

continued

- 6 The intention of this recommendation is for Network Rail to review the adequacy of its audit arrangements in view of the longstanding non-compliance of the London area of Western territory with NR/PRC/MTC/PL0056, and make improvements as necessary.

Network Rail should conduct a review of its audit arrangements as applied to possession planning to establish how it was possible for the PICOP's briefing meeting at Paddington to have been non-compliant with the requirements of NR/PRC/MTC/PL0056 for an extended period of time, making changes, as necessary, for adequate scrutiny of possession planning arrangements nationally (paragraph 168c).

- 7 The intention of this recommendation is for Network Rail to promote an equitable balance of work between safety-critical staff in work sites and possessions including development of specific guidance on how to keep work sites as short as possible.

Network Rail should issue guidance to routes on how to achieve an equitable balance of work between safety-critical staff within possessions and how to avoid the workload of any individual being excessive (including, but not limited to, complying with the rule book requirement to keep work sites as short as possible and briefing the guidance in Module 14 of standard NR/L3/MTC/PL0175) (paragraphs 167g and 169).

Recommendations to address other matters observed during the investigation

- 8 The intention of this recommendation is for Network Rail to consider whether its current arrangements for assessment in the line are being properly implemented in Western route.

Network Rail should conduct a review of arrangements within Western route for assuring that those employees undertaking assessments in the line are being monitored in accordance with the requirements identified in Network Rail's own procedures and take steps to rectify any deficiencies found (paragraph 170).

Appendices

Appendix A - Glossary of abbreviations and acronyms

COSS	Controller of Site Safety
PICOP	Person In Charge Of Possession
RAIB	Rail Accident Investigation Branch
RSSB	Rail Safety & Standards Board
TPWS	Train Protection and Warning System

Appendix B - Glossary of terms

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

Cab Secure Radio	A radio system provided to allow signaller and train driver to communicate safety critical information as securely as if they were speaking on a land line such as a signal post telephone.*
Controller of Site Safety	A safety critical qualification demonstrating the holder's competency to arrange a safe system of work, i.e. protecting staff working on the line from approaching trains.*
COSS pack	The documentation supplied to a COSS which includes the RT9909 form and other details as appropriate which may include the method statement for the work, extracts from the hazard directory and sectional appendix and relevant track diagrams.
Crossover	Two turnouts connected to permit movements between parallel tracks.*
	
Diesel Multiple Unit	A self-contained diesel-powered train comprising one or more vehicles that can be coupled to other compatible diesel multiple units to form longer trains.
Engineering Supervisor	The person nominated to manage the safe execution of works within an engineering work site. This includes authorising movements of trains in and out of the work site and managing access to the site by Controllers of Site Safety.*
Five-mile line diagram	A diagram that shows key features of Network Rail's infrastructure including access points, locations of signals, gradients, bridges, etc.
Infrastructure Maintenance Manager	At the time of the accident, this was the Network Rail senior manager responsible for the delivery of infrastructure maintenance within the Thames Valley area, including line management of the three maintenance delivery units and the Area Services Department at Reading.
Insulated	Not capable of conducting an electrical charge.
Lineside	Within the railway boundary, but at least three metres from the nearest rail.
Non-disruptive change	A change (to planned engineering work) that will not affect either the running of train services or other planned work.
On or near the line	A position within 3 metres of the nearest rail, or on the line itself. Excludes areas that are on the other side of a permanent fence or structure, even if it is less than 3 metres from the nearest rail.
On-track machine	Any piece of specialist railway plant which moves only on the rails and is normally self-propelled, e.g. ballast cleaners, rail cranes and tamping and lining machines (tamperers).*

On-track plant	Engineering plant with rail wheels, including road-rail vehicles.*
On-train data recorder	Equipment fitted on-board the train which records the train's speed and the status of various controls and systems relating to its operation. This data is recorded to a crash-proof memory and is used to analyse driver performance and train behaviour during normal operations or following an incident or accident. This equipment may also be known as an OTMR, Black Box or Incident Recorder.
Person In Charge Of Possession	A certificated member of railway staff responsible for implementing and then managing a possession of the line.
PICOP's Briefing Meeting	The final planning meeting which confirms the working arrangements which will apply within an engineering possession.*
Possession Change Control Form	A form that is completed by engineering planning staff in order to request additional or amended work in a possession at late-notice.
Possession Limit Board	A miniature version of the stop sign used on the roads, denoting the ends of a possession.*
Railway Group Standards	A document mandating the technical or operating standards required standard of a particular system, process or procedure to ensure that it interfaces correctly with other systems, process and procedures.*
Rail grinding	The grinding of a rail head to return it to its original profile and to remove minor surface cracks.*
Rolling contact fatigue	Collective term for all rail defects directly attributable to the rolling action of a rail wheel on the rail.*
Rule Book	The publication detailing the general responsibilities of all staff engaged on the railway and the specific duties of certain types of staff such as train drivers and signallers.*
Sectional Appendix	The publication produced by each Network Rail route containing, among other things, local instructions relevant only to specific parts of the route.
Separated green zone	A green zone where a distance of at least 3 metres is maintained between the site of work and the nearest rail of the closest line outside the site of work, whether the line is open to movements or not.
Supplementary Operating Notice	A document containing amendments to work published in the Weekly Operating Notice.
Tamper	An on-track machine that can lift and slew the track and simultaneously compact the ballast under the sleepers.*

T3 possession	An arrangement whereby a section of a route is closed to normal train operations to enable engineers to replace, repair or maintain the infrastructure.
Track circuit	An electrical or electronic device used to detect the absence of a train on a defined section of track using the running rails in an electric circuit.*
Track Circuit Block Regulations	The set of regulations applying to those sections of the railway where the safe operation of trains is achieved by proving the status of the line as far as the overlap beyond the next signal using track circuits or axle counters.
Train Protection & Warning System	A system fitted to certain signals which will automatically apply a train's brakes if it approaches the signal at too high a speed, or fails to stop at it, when it is set at danger. It will also automatically apply a train's brakes if it is travelling too fast on the approach to certain speed restrictions and buffer stops.
Weekly Operating Notice	A document published by Network Rail providing information about engineering work, speed restrictions, alterations to the network and other relevant information to train drivers.*
(Western) route	Network Rail's network is divided into eight routes, with each route managing operations and maintenance of the infrastructure within a defined geographical area.
Work site marker boards	A device used to delimit the ends of an engineering work site. They are made of yellow plastic and are fitted with two highway-style flashing road lamps. These show yellow on the work side and red on the possession side.*

Appendix C - Key standards current at the time

GE/RT8000, Issue 11	Rule Book
NR/L2/MTC/PL0056, Issue 2	Work and possession planning for the railway infrastructure (meetings management pack) ⁹
NR/PRC/MTC/PL0056, Issue E1	Work and possession planning for the railway infrastructure (meetings management pack) ¹⁰
NR/SP/OHS/019, Issue 6	Safety of people working on or near the line
NR/SP/MTC/0086, Issue E1	Work & possession planning for the railway infrastructure: change control
NR/L3/MTC/PL0175, Issue 1	Maintenance Planning Handbook

⁹ Valid from 21 June and thus current on the day of the incident.

¹⁰ Valid until 20 June and thus current for all planning meetings.

Appendix D - Extract from the record of site safety arrangements and briefing form

RT9909 RECORD OF SITE SAFETY ARRANGEMENTS AND BRIEFING FORM							
FOR SSOWPS REF No. 1809112		Status autoaccepted			GZAC Ref		
GENERAL INFORMATION							
Name of COSS/				Sentinel Card No			
Start Date	24/06/2008 00:00:00	End Date	24/06/2008 05:15:00	Week Number 13			
Business Function	P Way		MDUM	Reading			
Nature of Work	Plainline grinding to remove GCC						
Location	EALING BROADWAY						
Start Mileage	5 m	38 ch	End Mileage	5 m	50 ch		
How to contact the signaller in an emergency							
Slough IECC				Tel			
Line	Direction	Opn/Blk	Speed	From	To	Protecting	
UP RELIEF	UNI	Blocked	80	PTS SN258*	SIG SN202	SN258*	
DN RELEIF	UNI	Blocked	90	SIG (SN) 8135Bpts	SIG SN265	(SN)8135Bpts	
UP MAIN	UNI	Open	125	SIG	SIG		
DN MAIN	UNI	Open	125	SIG	SIG		
Planned safe system for access and egress arrangements to/from working area	Separated Green Zone Noel Rd						
Hazards associated with access/egress (conductor rails, tripping, vegetation, overhead cables or OLE)	<i>SLIPS TRIPS</i>						
Hazards associated with the site (conductor rails, tripping, vegetation, overhead cables or OLE, buried services, etc.)	Red Zone Working Prohibited <i>SLIPS TRIPS</i>						
Limits of the working area and how these are defined	<i>BY COSS</i>						
Permit to work arrangements (AC or DC lines) if appropriate. If no permit to work is held electrified line are live	<i>LIVE</i>						
You MUST sign in with the ES/PC BEFORE you start work							
WON Item	item 18						
There are Engineers Trains within the Possession	Yes						
There are OTP/RRV/RMMM within the Possession	Yes						

SAFE SYSTEM OF WORK				
Tick the relevant box. Only tick the "Planned" column if you have been provided with planned safe system of work.	Walking on or near the line to/from the working area		Whilst carrying out the work	
	Planned	Actual	Planned	Actual
Safeguarded Green Zone All Blocked	No		No	
Fenced or Separated Green Zone with one or more lines blocked	No		Yes	
Fenced Green Zone	No		No	
Separated Green Zone	Yes		No	
Red Zone blocking one or more lines for a position of safety	No		No	
Red Zone with ATWS	No		No	
Red Zone with TOWS	No		No	
Red Zone with LOWS	No		No	
Red Zone with PeeWee	No		No	
Red Zone with Lookout(s) only or IWA	No		No	
Reason and authority for change from planned safe system of work, if appropriate				

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Department for Transport.

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