



Rail Accident Investigation Branch

Rail Accident Report



Class investigation into accidents and near misses involving trains and track workers outside possessions

Report 07/2017
April 2017

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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Preface

The purpose of a Rail Accident Investigation Branch (RAIB) investigation is to improve railway safety by preventing future railway accidents or by mitigating their consequences. It is not the purpose of such an investigation to establish blame or liability. Accordingly, it is inappropriate that RAIB reports should be used to assign fault or blame, or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The RAIB's findings are based on its own evaluation of the evidence that was available at the time of the investigation and are intended to explain what happened, and why, in a fair and unbiased manner.

Where the RAIB has described a factor as being linked to cause and the term is unqualified, this means that the RAIB has satisfied itself that the evidence supports both the presence of the factor and its direct relevance to the causation of the accident. However, where the RAIB is less confident about the existence of a factor, or its role in the causation of the accident, the RAIB will qualify its findings by use of the words 'probable' or 'possible', as appropriate. Where there is more than one potential explanation the RAIB may describe one factor as being 'more' or 'less' likely than the other.

In some cases factors are described as 'underlying'. Such factors are also relevant to the causation of the accident but are associated with the underlying management arrangements or organisational issues (such as working culture). Where necessary, the words 'probable' or 'possible' can also be used to qualify 'underlying factor'.

Use of the word 'probable' means that, although it is considered highly likely that the factor applied, some small element of uncertainty remains. Use of the word 'possible' means that, although there is some evidence that supports this factor, there remains a more significant degree of uncertainty.

An 'observation' is a safety issue discovered as part of the investigation that is not considered to be causal or underlying to the event being investigated, but does deserve scrutiny because of a perceived potential for safety learning.

The above terms are intended to assist readers' interpretation of the report, and to provide suitable explanations where uncertainty remains. The report should therefore be interpreted as the view of the RAIB, expressed with the sole purpose of improving railway safety.

The RAIB's investigation (including its scope, methods, conclusions and recommendations) is independent of any inquest or fatal accident inquiry, and all other investigations, including those carried out by the safety authority, police or railway industry.

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Summary

The Rail Accident Investigation Branch (RAIB) has investigated a number of accidents involving track workers on Network Rail's infrastructure and has identified track worker safety as an area of particular concern in recent annual reports¹. This report describes the RAIB's investigation into the safety of track workers working outside possessions of the line (ie those cases in which the normal running of trains has not been blocked to allow engineering work to be carried out). It follows the publication in 2015 of the RAIB's report into irregularities with protection arrangements during infrastructure engineering work.

Five recommendations have been made to Network Rail. These cover

- improvements in procedures and/or training for those in leadership roles to be able to adapt to changes in circumstances;
- improvements to the training of track workers in non-technical skills;
- changes in the competence requirements for people who lead track work in higher-risk situations;
- making location-specific photographic and video information more easily available to staff involved in planning and leading work on the track; and
- improvements in the collection, analysis and reporting of information on incidents involving track workers.

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

Introduction

Key definitions

- 1 Metric units are used in this report, except when it is normal railway practice to give speeds and locations in imperial units. Where appropriate the equivalent metric value is also given.
- 2 The report contains abbreviations and technical terms (shown in *italics* the first time they appear in the report). These are explained in appendices A and B. Sources of evidence used in the investigation are listed in appendix C.

Background

Class investigation into protection irregularities

- 3 In August 2015, the RAIB published the report of its class investigation into irregularities with protection arrangements during infrastructure engineering work ([RAIB report 14/2015](#)). This was carried out as the result of the RAIB's general concern about track worker safety and because of the number of operating irregularities that were associated with the protection of those carrying out engineering work, particularly where protection was planned to block the line to traffic.
- 4 The report was based on analysis of operating irregularities included in the daily incident reports produced by Network Rail's national operations centre (NOC) over a two-year period (April 2011 to April 2013), and the RAIB's investigation of the safety issues that this identified. The data analysis showed that most of the reported operating irregularities were potentially harmful and that their occurrence was neither infrequent nor reducing. A systematic review of these was undertaken to identify the various safety issues that would need to be addressed to prevent them occurring and leading to harm.
- 5 At the time that the report was published, Network Rail was implementing a major track safety initiative known as 'Planning and Delivering Safe Work' (PDSW). Network Rail intended that PDSW would address a number of the safety issues identified. However, the RAIB observed in the report that the initiative was in the early stages of implementation and that the envisaged benefits had not yet been demonstrated. It also observed that PDSW was focused on the roles of those working on the track, and therefore would not have significant benefits in areas where risks may be created by people in other safety-related roles.
- 6 The investigation identified a variety of likely safety issues associated with these events, including miscommunication, violations, lapses, and incorrect understanding of protection limits.

Decision to carry out a further class investigation

- 7 The RAIB continued to gather data from the daily incident reports produced by Network Rail's NOC. These reports include incidents that are deemed significant at the time; however, in some cases near miss incidents are reported by the staff involved some time after they occur and therefore may not be included in the NOC log (which deals with the 24 hour period prior to 06:00 hrs on the day of issue). Therefore Network Rail's periodic safety, health and environment performance reports were also reviewed for details of potentially severe *operational close call* (OCC) incidents.
- 8 The RAIB identified 71 incidents that occurred during 2015 in which track workers working outside a possession on Network Rail infrastructure were at risk of being struck by a moving train, appendix F. Further information on the incidents was obtained from data on OCC incidents provided by Network Rail.

- 9 In view of the numbers of incidents that were continuing to occur, some of which included the potential for multi-fatality accidents, and of reported delays to the implementation of PDSW, the RAIB decided to undertake a further class investigation. This was focused on the safety of track workers who were not protected by possessions of the line; the remit for the investigation is summarised at appendix C.

Industry track safety initiatives and committees

- 10 Track worker safety is the focus of much work being carried out throughout the GB rail industry. A brief summary of some of the most relevant initiatives and working groups is included for reference at appendix D. In particular, these include revisions to Network Rail's standard 'Safety of People Working On or Near the Line', NR/L2/OHS/019 (paragraph D9, appendix D)². Except as cross-referenced from elsewhere in this report, the RAIB has not specifically sought to evaluate the effectiveness of these initiatives in improving the safety of track workers.

² The new version of NR/L2/OHS/019, Issue 9, was published at a late stage of the investigation. References to NR/L2/OHS/019 in this report are to the previous version, Issue 8, unless stated otherwise.

Near miss statistics

General

- 11 In order to provide some context for the investigation, the RAIB considered the incidence of fatalities and near misses with moving trains involving track workers. The numbers of fatalities has been generally declining over a twenty year period to 2016 (figure 1), although it should be noted that the numbers are very low so the trend may not be a reliable indicator of the risk. Details of the incidents are provided at appendix E.

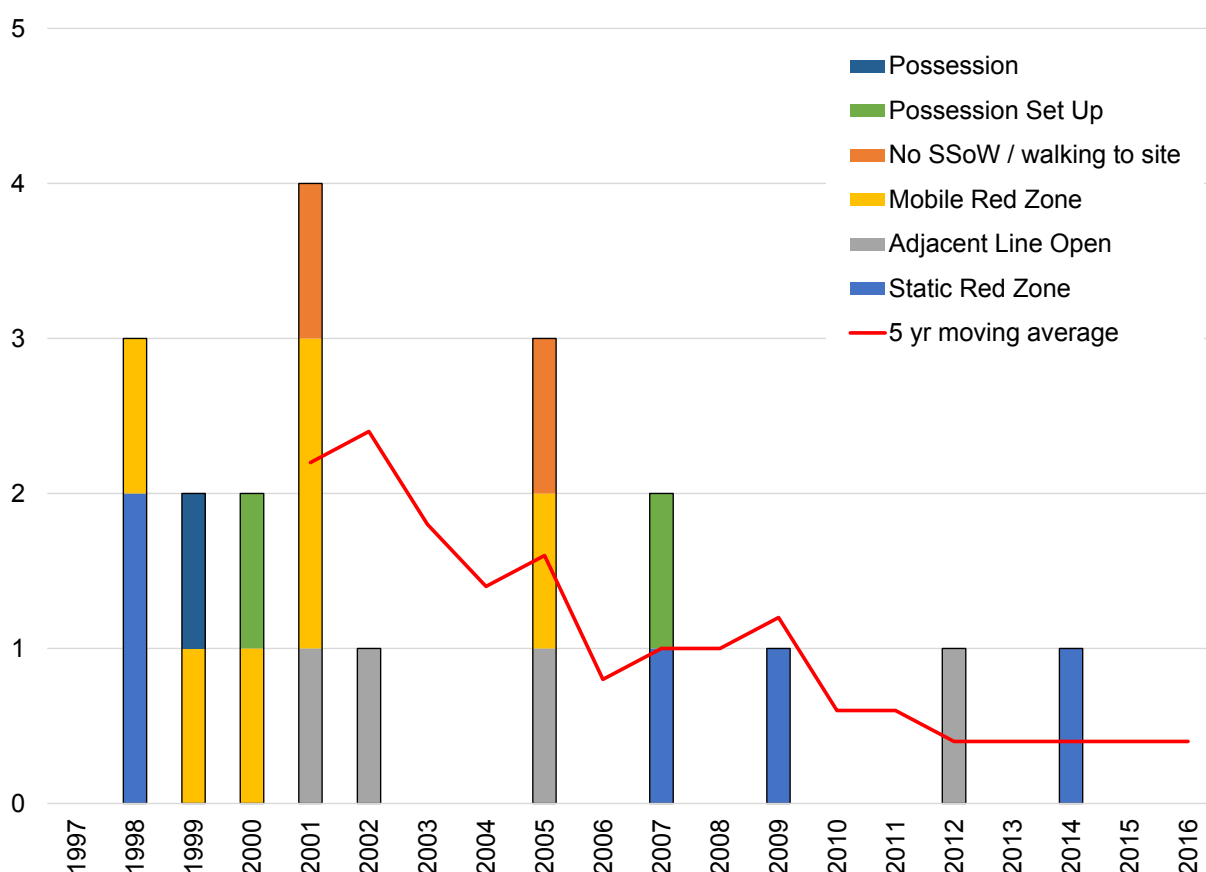


Figure 1: Track worker fatalities as a result of being struck by trains; twenty years 1997 to 2016

- 12 Data for incidents recorded as 'near miss - train with person (not at level crossing)' from the industry's safety management information system (SMIS) over a ten year period to 2015/16 is shown at figure 2. The data has been plotted alongside Network Rail's data for 'potentially significant' and 'potentially severe' OCC incidents³. Both sets of data indicate that there has been a reduction in the number of incidents over the period.

³ These incidents were previously referred to as irregular working incidents introducing significant risk to the railway.

- 13 The number of incidents captured in the OCC data is approximately five times higher than those recorded by SMIS. The OCC data includes incidents other than workforce near miss incidents with trains, for which Network Rail does not publish data. Furthermore, witnesses have reported that, although Network Rail has key performance indicators covering OCC incidents, it does not have one that specifically reflects near misses with trains. It should be noted that data on near miss incidents is dependent on reporting of the incidents, usually by the staff involved; it is not possible to quantify the extent of under-reporting (see paragraph 83c).

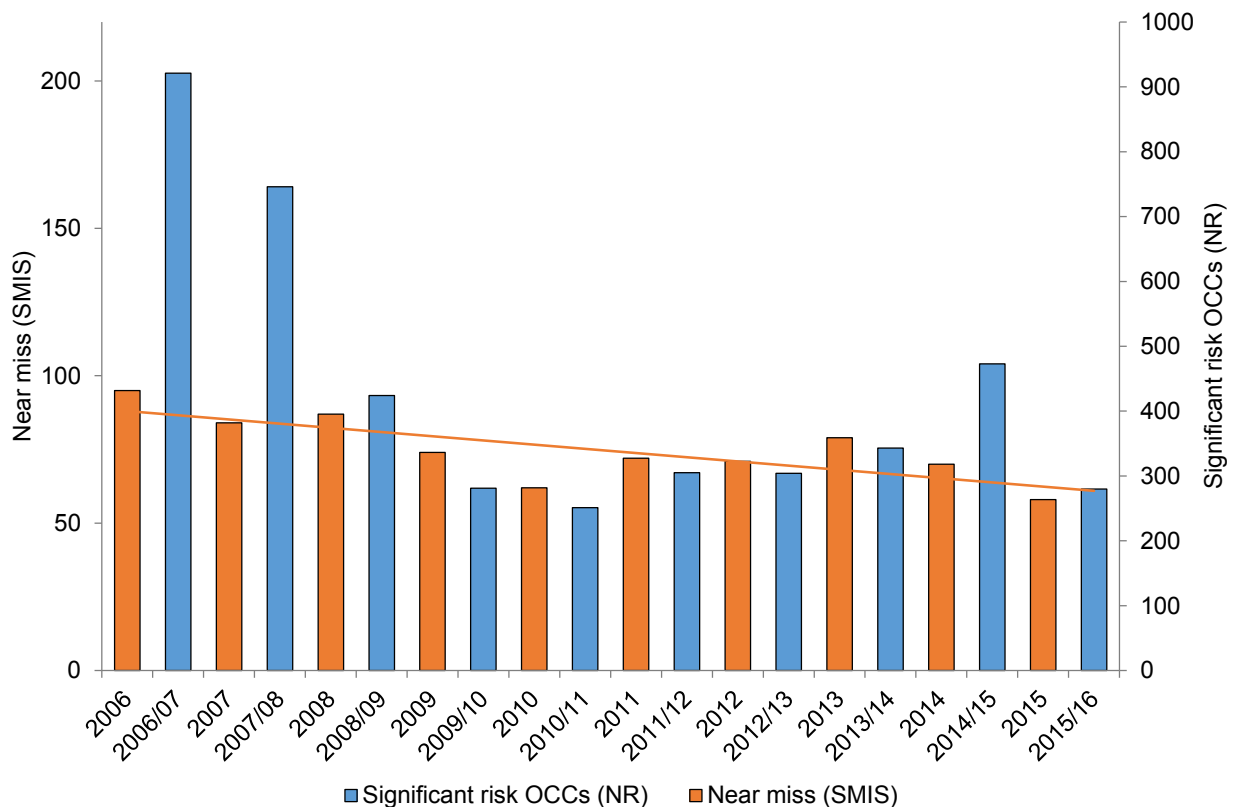


Figure 2: Comparison of SMIS data for workforce near miss incidents with Network Rail data for OCCs with significant risk; ten years 2006-2015⁴ (source: RSSB)

Network Rail statistics

- 14 NR/L2/OHS/019 requires that work carried out *on or near the line* must be carried out using an appropriate *safe system of work* (SSOW). The terms *green zone* and *red zone* were used in NR/L2/OHS/019 Issue 8 to refer to SSOWs in which trains have and have not been stopped from running on the tracks on which work is being carried out⁵. These SSOWs are explained in more detail at appendix H.

⁴ SMIS data provided by RSSB. Data on 'potentially significant' and 'potentially severe' OCC incidents from Network Rail's Annual Returns, by which it reports on its progress in delivering outputs established by the Office of Rail and Road (ORR); these are available at www.networkrail.co.uk.

⁵ The terms green zone and red zone are used in this report although they have since been superseded by 'warning arrangements' and 'protection arrangements' in NR/L2/OHS/019 Issue 9.

- 15 Network Rail provided the RAIB with data covering ten periods (P1 to P10 2015/16) indicating that an average of 25% of hours were worked nationally using red zone SSOWs, and 75% using green zone SSOWs. However, Network Rail advised that this data was not reliable because the hours recorded may have been based on standard task durations, the actual time taken for the task or the time estimated by the planner; also they may or may not have included the time spent travelling to and from site. Furthermore, some track visits, for example inspection of *switches and crossings* (S&C), involve multiple tasks. As a result, the hours recorded for red zone tasks are not comparable with the hours worked under green zone conditions.
- 16 Network Rail has identified that the highest number of near misses occur with red zone SSOWs using unassisted *lookouts* (RZUL)⁶ (figure 3). It has advised that, in order to reduce the volume of work being carried out using RZUL, the response of its regional management was to invest in *lookout operated warning systems* (LOWS)⁷. Such systems provide an extra degree of assurance through the incorporation of a vigilance device, requiring a regular response from the lookout. However, the RAIB's investigation into the near miss at Hest Bank in September 2014 ([RAIB report 08/2015](#)) found that LOWS is still vulnerable to a single point failure by one person. Since the data shown at figure 3 has not been normalised by the volume of work planned, it is not possible to determine whether the use of LOWS achieves a significant reduction in risk compared with RZUL (Recommendation 2 of [RAIB report 08/2015](#) refers).

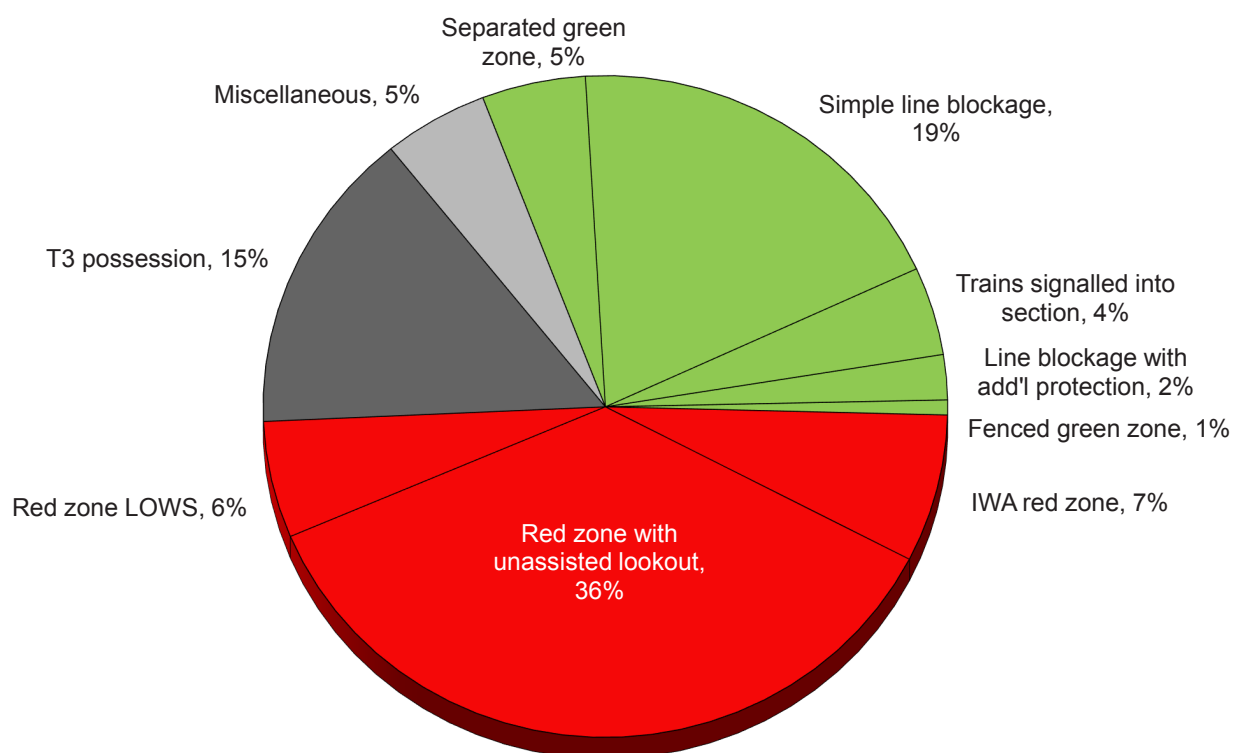


Figure 3: Near misses recorded for work planned using different types of SSOW; two years 2014/15-2015/16 (source: Network Rail)

⁶ An unassisted lookout provides a warning of an approaching train using the traditional means of a flag, horn or whistle; this method of working is also referred to as 'lookout warning' (see appendix H).

⁷ Network Rail's Infrastructure Projects organisation has also issued instructions requiring director level approval for work using lookouts.

Analysis of representative incidents occurring during 2015

General

- 17 As mentioned at paragraphs 7 and 8, the RAIB identified 71 incidents that occurred during 2015 in which track workers working outside a possession on Network Rail infrastructure were at risk of being struck by a moving train. These were initially identified from Network Rail's daily incident reports and periodic safety, health & environment performance reports; further information on the incidents was obtained from data on operational close call incidents.
- 18 The RAIB selected ten incidents that were representative of those occurring during 2015; the industry's investigation reports were then analysed to identify causal factors. It should be noted that the RAIB has not carried out independent investigations of these incidents. A breakdown of the incidents is shown at figure 4, showing the person most involved in the immediate cause of the incident⁸, with a comparison between the 71 incidents that were identified initially and the 10 that were selected for analysis. The figure includes incidents occurring under both red zone and green zone conditions (see appendix H).
- 19 Although the incidents have been selected for analysis on the basis that they are reasonably representative, it should be noted that it is not possible, with a limited sample, to represent all combinations of the circumstances in which people access the track. As well as the division between SSOWs under red zone and green zone conditions, these include:
- access by both full-time and agency staff working for Network Rail or its contractors;
 - work being carried out on behalf of Network Rail's Network Operations (maintenance) and *Infrastructure Projects* organisations;
 - pre-planned access, either cyclical (for routine maintenance including *patrolling*) or non-cyclical; and
 - emergency access using safe systems of work prepared at the lineside.

⁸ Examples of the categorisation used in figure 4:

- COSS (Controller Of Site Safety) / PC (protection controller) / IWA (individual working alone)
 - working outside limits of line blockage
 - not working in accordance with SSOW
 - inadequate SSOW
- Signaller
 - signalling train into line blockage
 - granting line blockage while train within limits
 - clear understanding not reached
- Lookout
 - not seeing train
 - not providing warning
- Workgroup
 - working without COSS present
 - not observing warnings
 - not moving to place of safety

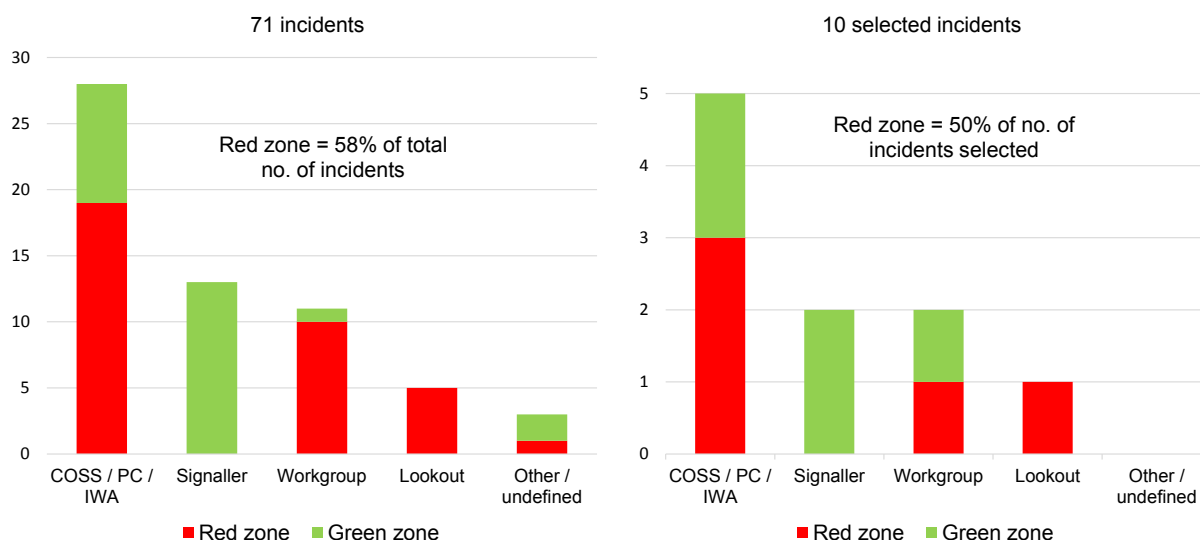


Figure 4: Categorisation of incidents occurring in 2015

Near miss close to Evanton, Easter Ross, 2 February 2015

20 Two track workers climbed over a fence near Evanton and accessed the line in order to rectify a track fault. They had not received a COSS briefing and had not taken a *line blockage*, as required by their documented SSOW. A passenger train subsequently approached their location at 75 mph (120 km/h). The train driver made a full service brake application and sounded the horn to warn the track workers. The train driver reported the incident as a near miss, stating that he had been within a few seconds of striking the track workers.

21 Network Rail's investigation found that:

- The track workers had departed from their documented SSOW due to 'self-imposed pressure to complete the work as quickly as possible'.
- Management within the maintenance delivery unit was aware that there were insufficient authorised access points on the line; this had led to routine use of unauthorised access points in order to complete the required volume of work.
- Although great importance was attached to safety within the delivery unit, managers also gave potentially contradictory messages about the importance of delivery.
- Managers stated that their workload was preventing them from spending as much time as they would like carrying out site assurance.

Line blockage irregularity near Morecambe South Junction, Lancaster, 19 February 2015

- 22 A signaller set a route for a passenger train from Lancaster to Morecambe and immediately afterwards telephoned a COSS to grant her a line blockage for the same piece of track. The workgroup needed the line blockage to cross over an underbridge and was walking on the track when the COSS saw the train approaching. The workgroup then moved off the track to a *position of safety*; there was no report of a resulting near miss.
- 23 Findings of Network Rail's investigation included that:
- The signaller did not check that all trains were clear of the proposed line blockage before granting the line blockage to the COSS. He also did not verify the location of the workgroup.
 - The signaller was covering 'meal relief' duties, had just taken over the signalling panel and was concentrating on trains on the northern end of the panel as well as completing paperwork. He stated that the handover arrangements mean that a meal relief signaller has less sense of the 'rhythm' of a panel; in particular the status of line blockages.
 - The signaller and COSS discussed the planning of the line blockage and agreed that it was confusing as it covered a large area. However the investigation concluded that the arrangements were appropriate, as they reduced the amount of paperwork to be completed by the signaller and COSS.

Near miss at Great Chesterford, Essex, 15 April 2015

- 24 A COSS and an ultrasonics tester went onto the track prior to carrying out an inspection for rolling contact fatigue, without having set up a SSOW. A passenger train approached the workgroup at close to 90 mph (145 km/h); the driver made an emergency brake application and sounded the horn.
- 25 Network Rail's investigation established that:
- The SSOW covered a large area. Although a localised plan would have added to the planner's workload, it would also have provided a better account of the working areas and allowed safer working, particularly for a team that was not familiar with the area.
 - The event occurred as a result of a lapse in concentration by the COSS and tester, however the evidence pointed to underlying distractions as contributing factors. The sighting distance was insufficient, requiring a distant lookout (not present), and the COSS was trying to identify the points numbers to determine which set of points needed to be examined.
 - The other members of the workgroup did not challenge the COSS on why a SSOW was not set up and tested.
 - The delivery unit had insufficient ultrasonics staff to carry out its work without relying on contractors who might not have local knowledge.

Near miss at Courthill Loop Junction, Lewisham, 19 April 2015

- 26 A signal faulting response team from London Bridge (an adjacent area) took a line blockage to conduct faulting activities on a failed track circuit at Lewisham, using an emergency SSOW. The line blockage was on a diverging route that was crossed by the Up Courthill Loop line. The team leader subsequently reported a near miss with a freight train that had been signalled along the Up Courthill Loop.
- 27 Network Rail's investigation found that:
- The COSS and signaller did not reach a clear understanding of which up line was to be blocked. No-one took the lead role and there was no repeating back of the *blocking points* (paragraph 55). The signaller advised the COSS that only the Down Mid Kent line was blocked to traffic.

The industry's control centre incident log records that:

- A review of the voice recordings revealed that the signaller told the COSS that he would continue to signal trains on the Up Courthill Loop, and the COSS had agreed to this.

The investigation report does not discuss whether:

- The COSS may have become preoccupied with the task to the exclusion of maintaining the SSOW.
- The COSS may have been unfamiliar with the location and/or whether the requirements for familiarising staff with 'cross boundary' locations had been followed⁹.

Near miss close to Penstrowed, Powys, 21 April 2015

- 28 Members of a large workgroup (11 people), consisting of Babcock staff and sub-contractors, were standing on the track on an underbridge when a passenger train rounded a curve approximately 250 metres away from the bridge. There is no record of the speed at which the train was travelling; the maximum permissible speed at the location is 80 mph (130 km/h). The driver sounded the horn and applied the emergency brake to try and avert an accident. The last member of the group reached a position of safety approximately two seconds before the train passed them.
- 29 The incident was investigated by Babcock Network Engineering. The investigation's findings included:
- The group had departed from the planned SSOW and adopted an unofficial method of working (the planned COSS had split a group of 17 people into two groups, and had nominated an additional unofficial COSS for the second group; the planned COSS was acting as an intermediary with the *protection controller*). The nominated COSS's competence had expired.
 - The nominated COSS had not signed in with the protection controller appointed by Network Rail, who was unaware of the second group.

⁹ These are set out in 'Infrastructure Maintenance Restructure – Cross Boundary Working for S&T Response', NR/L3/MTC/MG0229.

- The planned line blockage had been given up by the planned COSS while the nominated COSS's workgroup was still on or near the line.
- The SSOW had been downgraded without authorisation. The actual SSOW in force at the time of the near miss was unclear and had not been briefed to the workgroup; it was a hybrid between lookout warning and site warden warning (described in NR/L2/OHS/019 as 'separated green zone').
- The nominated COSS had become distracted by the survey work.
- No-one challenged the arrangements, although some members of the group subsequently expressed misgivings about them.

Near miss adjacent to Canton Sidings, Cardiff, 29 April 2015

30 A workgroup was engaged in surveying track, working under red zone conditions, and was unaware of an approaching train despite an apparent warning from the lookout. The COSS, who had been looking through a surveying instrument, became aware of the train immediately before it passed and pulled the surveyor out of its path.

31 Network Rail's investigation concluded:

- The members of the workgroup who were involved in the surveying activity did not acknowledge the lookout's warning or move to a position of safety.
- The survey equipment was closer than permitted to the open line and no-one challenged this.
- The COSS had become engrossed in the surveying task and was not monitoring the SSOW. The pressure to complete the survey may have influenced the COSS's behaviour.

Although not explicitly mentioned in the investigation report, other evidence shows that:

- The line on which the train approached the workgroup had recently become bi-directional and the train approached from the opposite direction to normal.
- The SSOW site plan did not show the sidings adjacent to the site of work.
- The SSOW covered work at nine different locations over a twelve hour period.

Near miss close to Bessacarr, Doncaster, 14 May 2015

32 Three members of a workgroup were walking in the *four foot* when a passenger train rounded a curve ahead of them at approximately 50 mph (80 km/h). They moved clear of the line about three seconds before the train passed them. The workgroup was involved in renewing degraded signal wiring, and was returning to the site of work after a lunch break without having taken the planned line blockage for this activity.

- 33 The causes of the incident identified by the Network Rail investigation included:
- The team leader (who was also the COSS) did not request the planned line blockage as he felt he had ‘pestered’ the signaller with the number of calls he had made for testing purposes during the morning, and did not want to bother the signaller again. He downgraded the SSOW without seeking authorisation.
 - The other two members of the team did not know what safe system was in force at the time of the incident, but had not challenged the team leader / COSS.
 - The team leader stated that he put pressure on himself to deliver a large output of work and that is the reason he acted as COSS and carried out all duties, including testing; this gave him full control to deliver the work.
 - All of the team agreed that complacency¹⁰ was a factor in the incident. They had earlier walked back from the site of work without a line blockage and without incident, so they assumed there would be no problem in walking back after lunch without taking a line blockage.

Line blockage irregularity close to Norton level crossing, Runcorn, 6 August 2015

- 34 Three members of a permanent way technical team were involved in a near miss with a passenger train. The incident occurred on a curved section of the West Coast Main Line between Warrington Bank Quay and Acton Bridge stations. There is an enhanced permissible speed of 125 mph (201 km/h) at this location; the workgroup reached a position of safety approximately five seconds before the train passed them. Incorrect blocking points were listed in the SSOW documentation; these had not been identified by the authorising manager, the COSS or the signaller.
- 35 The Network Rail investigation found that:
- The SSOW was for *cyclical access*; it had been annotated as being non-cyclical although it had not been verified by the COSS as required by NR/L2/OHS/019. The work being carried out was the examination of a suspected track defect following an ultrasonic track assessment.
 - The SSOW listed incorrect blocking points for the line blockage; these were on the down main line but the line required to be blocked was the up main. The blocking points had been identified as being incorrect one month previously by a signaller and a COSS using the cyclical SSOW, but this had not been reported back to the planner.
 - The planner had prepared the cyclical SSOW plan in an open plan office and entered the details straight into the planning system. The plan was then submitted to a green zone access coordinator (GZAC) to be entered to the green zone access management system (GZAM)¹¹. Checking of the SSOW by an authorising manager was also carried out in an open office and was therefore liable to distraction.

¹⁰ See discussion at paragraph 58.

¹¹ Although there was an opportunity for the incorrect blocking points to have been identified at this stage, there is no requirement for a GZAC to check blocking points (the GZAC role is not regarded as safety-critical).

- The COSS did not have in-depth knowledge of the location.
- The standard of communication between the COSS and signaller was poor and the blocking points were not cross-checked against the signaller's diagram.

Near miss close to Hitchin North Junction, Hertfordshire, 22 September 2015

36 A workgroup of nine track maintenance staff¹² was working on a curved section of the up fast line¹³, close to Hitchin North Junction, when a passenger train approached on the up slow line (maximum permissible speed 80 mph (129 km/h)). The SSOW was lookout warning with distant lookouts for trains approaching from both up and down directions. The workgroup did not receive a warning of the approaching train and had to run across the up slow line in front of the train to reach their position of safety.

37 The Network Rail investigation identified:

- The SSOW 'was a generic patrolling pack.'
- The gang had been working for approximately 2¾ hours without a break. The lookouts had a high workload due to the busy train service at the location.
- The distant lookout stated he signalled a warning of the approaching train to the site lookout, using his flag, until he believed the site lookout had seen him. The site lookout stated he did not see the distant lookout's flag, although he was looking out without distraction.
- The lookouts had adopted a system of signalling to each other to provide an 'all clear' indication after the passage of each train. This had broken down when a train had taken the route over the Cambridge flyover without passing the distant lookout positioned to the north of the workgroup.

Factors which were implied in the investigation report, but which were not explored in detail, include:

- The cyclical SSOW covered 5½ miles and did not refer to the actual work being carried out (digging wet beds). It also did not include distant lookouts in the section covering resource requirements and incorrectly listed the maximum speed of trains on the up and down slow lines (although this was not relevant to the incident).
- The use of an 'all clear' flag was an informal practice. Although this is not necessarily a problem, the report notes that the distant lookout was an agency employee and was a different person from the previous day; he may therefore have been unused to this method of working. He may also have been inexperienced (evidence indicates he had been in post for four months).
- It is possible that the distant lookout may have been waiting for trains to get close to him before signalling to the site lookout¹⁴.

¹² There was also a site lookout and two distant lookouts; one for trains approaching from each direction.

¹³ The fast lines are in the centre of the formation, with the slow lines to the outside.

¹⁴ The issue of extended warning times was considered as part of the RAIB's investigation into the accident at Cheshunt Junction in March 2010, and was discussed in the report into the near miss at Hest Bank in September 2014 ([RAIB report 06/2011](#) and [RAIB report 08/2015](#)).

Line blockage irregularity at Chathill, Northumberland, 3 November 2015

- 38 An on-track machine (rail grinder) that had been used in an overnight possession struck a tripod supporting a surveying instrument at about 40 mph (64 km/h). The tripod was standing in the four foot of the down line at Chathill and was being used in a line blockage; the surveying team had moved clear as the rail grinder approached and there were no injuries.
- 39 As well as the possession in which the rail grinder had been operating, there were line blockages on the down main line south of Alnmouth and on both lines between Little Mill and Chathill. The signaller arranged with the relevant COSS to lift the line blockage south of Alnmouth to allow the rail grinder to cross over from the up main to the down line and return to its depot. He then inadvertently removed the reminder appliances for both line blockages, not just the one south of Alnmouth. He subsequently set the route for the rail grinder to run all the way to the end of the Alnmouth control area, through the northern line blockage where the survey team was working.
- 40 Findings of the Network Rail investigation included:
- The COSS advised the signaller that the surveying did not affect the safety of the line and therefore there was no need to use the detonator protection that had been identified when the work had been planned. Furthermore, there was no resource booked to lay the protection. If detonators had been placed on the line, it is probable that the rail grinder would have stopped before reaching the survey team and their equipment.
 - No red light had been placed on the approach to the site of work¹⁵. Although this might have prevented the rail grinder from striking the surveying equipment, it would not have prevented it from entering the line blockage. The report observes that it may be common for COSSs not to place a red flag or light on the approach to a line blockage.
 - The standard of communication was good. The signaller demonstrated a professional attitude throughout, but was 'let down by a lapse in concentration.'
 - The shift pattern at Alnmouth signal box may have led to the signaller being fatigued.

¹⁵ This is a requirement of Handbook 8 of the Rule Book.

Discussion

Identification of common causal factors

- 41 Based on the analysis of the ten incidents examined from 2015, the RAIB has considered the existence of common factors in incidents involving track workers working outside possessions, listed below¹⁶. The common factors have been defined based on a subjective assessment of the incidents examined; alternative classifications are possible, such as the RSSB's Incident Factor Classification System¹⁷.
- a. COSS distraction (paragraph 43).
 - b. The SSOW covered multiple locations / moving worksite (paragraph 48).
 - c. Lack of challenge / cultural issues (paragraph 51).
 - d. Poor communication (paragraph 54).
 - e. Complacency / Over-familiarity (paragraph 57).
 - f. Unfamiliarity / inexperience (paragraph 60).
 - g. Circumstances changed from planned SSOW (paragraph 63).
 - h. Unauthorised downgrading of SSOW / protection (paragraph 66).
 - i. Use of unofficial / informal method of working (paragraph 69).
 - j. Resource issues (paragraph 72).
 - k. Unclear SSOW (paragraph 74).
 - l. Other staff distraction (paragraph 77).
- 42 A matrix showing the RAIB's assessment of the applicability of these common factors to the incidents occurring in 2015 is included at table G1 appendix G; figure 5 provides an overview. Each of these factors is now considered in turn.

COSS distraction

43 The COSS became preoccupied with the task and was no longer effectively maintaining the safe system of work.

44 Handbook 7 of the *Rule Book* states that a COSS must stay with the group in order 'to personally observe and advise everyone.' In addition, NR/L2/OHS/019 states that a COSS must not under any circumstances permit work to continue where an adequate SSOW cannot be maintained. These requirements imply that a COSS should be continuously maintaining the SSOW, even if they are participating in the work itself.

¹⁶ It is possible that fatigue was a factor in sub-optimal decision making by COSSs and/or other staff involved in the incidents considered. However, without having investigated these incidents in detail itself, the RAIB has evidence that fatigue was a significant factor in only one of the 2015 incidents. It is therefore not included in the list of common factors.

¹⁷ See www.rssb.co.uk/improving-industry-performance/human-factors/human-factors-case-studies/developing-the-incident-factor-classification-system.

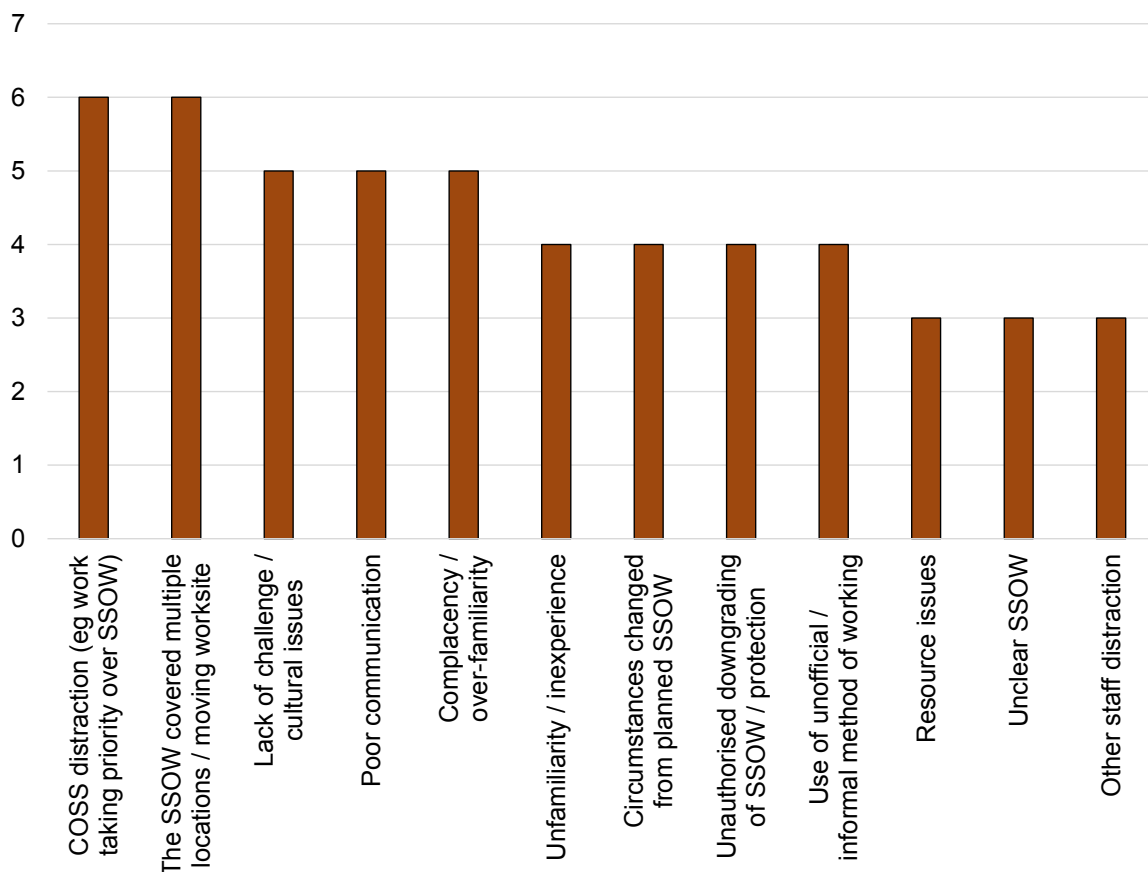


Figure 5: Occurrence of common factors in selected incidents occurring during 2015

- 45 The incidents occurring during 2015 include examples of COSSs disregarding the SSOW because it was impractical and there was an imperative to complete the work, trying to scope the work on site before setting up the planned SSOW and becoming so engaged in the work that they lost their awareness of the risk from moving trains.
- 46 Network Rail's Anglia Route has been encouraging the use of risk based commentary by its track workers. This builds on work previously carried out by RSSB ('Good Practice Guide on Cognitive and Individual Risk Factors', Ref. RS/232 Issue 1, August 2008), in which risk triggered commentary was proposed to help train drivers increase their awareness of risk, improve concentration levels and manage potential distractions. Similar issues may be relevant to a COSS, when the need to carry out a number of different tasks can result in a COSS losing focus on maintaining a SSOW.
- 47 The role of COSS was introduced during 2002 in order to clarify the arrangements to ensure that a workgroup is not endangered by train movements (paragraph D8, appendix D). This enabled management of the work to be separated from management of the risk from trains¹⁸. The latest revision of NR/L2/OHS/019, Issue 9, introduces the role of the 'person in charge'. When this person is also acting as COSS, the RAIB notes that there are similarities with the role of the person in charge of work (PICOW) that preceded the introduction of the role of COSS.

¹⁸ Although the revised arrangements gave the opportunity to separate the COSS and work manager roles, they did not mandate it.

The SSOW covered multiple locations and/or a moving worksite

48 A single safe system of work covered work at multiple locations, each with potentially different risks, or a mobile work activity.

- 49 NR/L2/OHS/019 provides for SSOWs to be prepared by planners for non-cyclical maintenance tasks as well as for cyclical maintenance tasks (also referred to as *maintenance scheduled tasks*)¹⁹. Patrolling is an activity that is typically carried out using a cyclical SSOW providing for a moving worksite. Cyclical SSOWs may be authorised by a responsible manager (the person responsible for the management of staff who will work on or near the line) in consultation with a COSS, for repeated implementation over a period of up to 12 months without further verification by any COSS who would be using it.
- 50 Incidents occurring during 2015 include examples of cyclical SSOWs being used for non-cyclical work such as reactive maintenance and SSOWs provided for use at a number of discrete locations or over a large area in which the worksite moved along the line²⁰. This suggests that the pre-planned SSOW may not have been directly relevant to the task and/or the location, and that it may therefore not have provided appropriate risk mitigation. More recent examples include the near miss at Maesyfelin bridge on 8 April 2016 ([RAIB safety digest 04/2016](#)) and the near miss involving a track worker at Shawford on 24 June 2016 ([RAIB report 05/2017](#)).

Lack of challenge and/or cultural issues

51 Members of the workgroup did not challenge the COSS or stop work despite being aware of deviations from the safe system of work.

- 52 Network Rail's standard '*Worksafe Procedure*', NR/L2/OHS/00112, states that the company does not expect staff to work in an unsafe manner to achieve results; it states 'If you can't do it safely – don't do it'. The procedure gives rail staff with concerns about the safety of an activity the right to stop work and have the situation assessed in a fair way; the absence of a SSOW is quoted as a specific example of when the procedure should be invoked.
- 53 Within the incidents examined by the RAIB from 2015, there are examples of work being carried out without a SSOW having been set up, and others where some of the workgroup were unclear about what SSOW was in place. Subsequent interviews reveal that in some cases staff were aware that the planned SSOW had not been set up, and/or they had acquiesced in a non-compliant but customary method of working, without challenging the arrangements. The RAIB has not explored whether this lack of challenge arose from ignorance of Network Rail's Worksafe Procedure, an unwillingness to confront authority, a desire to complete the work quickly or some other cause.

¹⁹ SSOWs may also be prepared by a COSS in exceptional circumstances, including emergency situations.

²⁰ SSOW packs created using Network Rail's Safe System of Work Planning System (SSOWPS 2) may contain up to six individual safe systems of work; this should provide for situations in which a workgroup carries out activities that vary in terms of location and/or task content.

Poor communication

54 The standard of communication was such that either a clear understanding was not reached between the COSS and a signaller, or members of the workgroup were left unclear about matters concerning the safety of the group.

55 Handbook 1 of the Rule Book states that track workers must make sure they properly understand the meaning of all messages whether they are communicated by phone, radio or face-to-face. It further states that the person receiving a message must repeat it back so that the other person knows it has been correctly understood. Module G1 of the Rule Book states that the signaller must always take lead responsibility for communications with anyone except an electrical control operator. The importance of effective communications is indicated by the inclusion of communications as one of the core modules of the *non-technical skills* (NTS) training that Network Rail was providing to COSSs (paragraph D22, appendix D).

56 As well as instances of poor communications between signallers and COSSs (eg not repeating messages back), the incidents occurring during 2015 included examples of poor communications between the COSS and the workgroup. At Hitchin on 22 September 2015 (paragraph 36), there was a breakdown in the communication between a distant lookout and the site lookout (Handbook 7 of the Rule Book requires the COSS to make sure that the distant lookout communicates correctly with the site lookout).

Complacency and/or over-familiarity

57 The COSS and/or signaller may have been over-familiar with the location, possibly leading to an inappropriate perception of the risks, or they may have been over-tolerant towards risk, leading to mistakes in setting up and/or maintaining the SSOW.

58 Although the term ‘complacency’ is commonly used, research suggests an individual’s behaviour may be better understood in terms of their perception of risk and their tolerance towards it²¹. Risk perception is influenced by the individual’s experience and familiarity with the hazards, as well as their perceived ability to deal with the hazards and perception of the consequences. Their behaviour is then influenced by risk tolerance, which is a characteristic willingness to accept the perceived risks.

59 Five of the incidents from 2015 that were examined as part of this investigation might have been prevented by a more appropriate perception of the risks on the part of the COSS or the signallers involved.

²¹ Innes-Jones, G. (2012). ‘Complacency as a causal factor in accidents – fact or fallacy?’

Unfamiliarity and/or inexperience

60 The COSS may have been unfamiliar with the location or inexperienced, leading either to inappropriate decisions or to a misunderstanding of the risks.

61 NR/L2/OHS/019 requires the responsible manager to check that the COSS is familiar with the location where work is to be carried out. If they are not, familiarisation is required before the work is started. The standard states that this can be achieved by provision of documents relevant to the site of work or by conducting a site visit. The official documents listed represent the track using straight lines and do not show possible obstructions to the sighting of trains such as overbridges. Although photographs are also mentioned by the standard, witness evidence indicates that planners do not currently receive training in the use of Network Rail's route visualisation tools²² and are unlikely to include photographs in a SSOW pack. It is therefore unclear how the requirement for a COSS to be familiar with the location is met in practice, in particular where a COSS is provided by an agency.

62 Lack of familiarity of the COSS with the location was identified as a factor in two of the 2015 incidents and may have been a factor in at least two others, although the investigations did not explicitly recognise it as such.

Circumstances changed from planned SSOW

63 The COSS had not implemented the SSOW as planned because circumstances on site were different from those envisaged by the plan.

64 NR/L2/OHS/019 requires the COSS to check that the planned SSOW is appropriate for the conditions once on site. It does not provide explicit guidance on what authority a COSS has to vary the SSOW in the light of changed circumstances (paragraph 66); it also states that a COSS must not permit work to start or to continue where an adequate SSOW cannot be established or maintained.

65 The RAIB's examination of representative incidents from 2015 revealed situations in which changes arose on site as the result of:

- difficulties in using the nominated access point;
- a lack of clarity about the exact site of work prior to setting up the SSOW;
- a workgroup which was larger than expected; and
- a COSS who decided not to take a planned line blockage because he did not want to bother the signaller, following numerous earlier phone calls associated with signal testing.

²² Network Rail is developing new tools such as the RINM (Rail Infrastructure Network Model) as part of its ORBIS (Offering Rail Better Information Services) programme.

Unauthorised downgrading of SSOW or protection

66 The COSS downgraded the SSOW or the planned protection without seeking authorisation from a responsible manager.

- 67 NR/L2/OHS/019 emphasises that the COSS is ultimately responsible for safety on site and has the final decision as to whether a planned SSOW is acceptable. If it is necessary to vary the SSOW on site, the COSS should:
- move the workgroup to a position of safety;
 - obtain authority from a responsible manager if the SSOW is being ‘downgraded’ (ie the revised SSOW is lower down the hierarchy)²³;
 - record the revised SSOW on the ‘Record of Arrangements and Briefing Form’, RT9909; and
 - brief the revised SSOW to the workgroup before allowing work to restart.
- 68 At Great Chesterford on 15 April 2015 (paragraph 24), the COSS had started work before implementing the planned SSOW. In two other incidents, the COSSs had downgraded the SSOWs by not taking planned line blockages. At Chathill on 3 November 2015 (paragraph 38), the COSS decided not to place detonator protection on the basis that the surveying work did not affect the safety of the line. In none of these cases did the COSS seek authorisation from a responsible manager; as noted above, the RAIB has not investigated these incidents independently to understand the various reasons for this.

Use of unofficial or informal method of working

69 An unofficial method of working was agreed on site, creating the potential for confusion about the arrangements for maintaining safety.

- 70 The COSSs involved in three of the 2015 incidents considered by the RAIB had either not set up or had made unofficial variations to the planned SSOW for the sake of expediency. At Hitchin (paragraph 36), a site lookout and a distant lookout had adopted a communication system that went beyond the Rule Book requirements. This broke down when the staff involved made different assumptions about the meaning of an ‘all clear’ signal that was not given.
- 71 An unofficial method of working was also involved in the near miss at Maesyfelin bridge on 8 April 2016 ([RAIB safety digest 04/2016](#)).

Resource issues

72 Resource constraints potentially affected the way the SSOW was implemented.

- 73 A lack of resource was identified as an underlying factor in three of the incidents occurring in 2015. Although there is a requirement in NR/L2/OHS/019 for the responsible manager to make the necessary resources available to the COSS to allow them to implement the SSOW as planned, resource constraints also affected the way the work was planned. Issues included:
- insufficient provision of access points, with the effect that the use of unofficial access points had become routine in order to maintain the required volume of work;

²³ This implies that a COSS can decide on site to ‘upgrade’ a SSOW from lookout warning to site warden warning, without authorisation, even though this may be unsuitable for a moving workgroup.

- a reliance on contractors to carry out ultrasonics testing work, with reduced control over staff competence and local knowledge; and
- the planning of survey work with a small team, such that the COSS would have to participate in the work rather than prioritising the monitoring and maintenance of the SSOW while moving along the track.

Unclear SSOW

74 Members of the workgroup were unclear about the SSOW in place.

- 75 Handbook 7 of the Rule Book requires a COSS to brief the workgroup before it goes on or near the line. Members of the workgroup must then sign a safe-work briefing form to confirm that they understand the SSOW.
- 76 The COSSs involved in three of the 2015 incidents considered by the RAIB had not briefed the workgroup about the arrangements that were in place at the time of the incident, creating a lack of certainty about the SSOW that was in place. Two of these included on-site 'upgrading' of the SSOW for moving workgroups from lookout warning to site warden warning (paragraph 67).

Other staff becoming distracted

77 Distraction of members of staff other than the COSS led to mistakes in planning or implementing the SSOW.

- 78 The near miss near Runcorn on 6 August 2015 (paragraph 34) involved blocking points that had been recorded incorrectly in the SSOW pack. Although the opportunity was missed for the COSS and signaller to have identified this error when the line blockage was being set up, other opportunities to have identified and/or corrected the mistake had also been missed by:
- the responsible manager and the COSS who were responsible for verifying the accuracy and appropriateness of the SSOW plan²⁴; and
 - a COSS who had previously used the SSOW and identified the incorrect blocking points but had not reported the mistake back to the SSOW planner.
- Network Rail's investigation report observed that the planner and responsible manager were both working in an open plan office environment with the potential for distractions and interruption.
- 79 Signaller distraction was associated with the line blockage irregularity near Lancaster on 19 February 2015 (paragraph 22). Network Rail signal boxes have locally imposed limits on the numbers of line blockages that a signaller is able to manage during a shift; these are derived from risk assessments of signaller workload.
- 80 The near miss at Hitchin on 22 September 2015 (paragraph 36) involved the possible distraction of a distant lookout.

²⁴ The SSOW was for cyclical work, even though it was being used for a non-cyclical activity.

Other issues identified during the investigation

Provision of additional protection for line blockages

- 81 Most line blockages are taken without using any protection other than the signaller placing the protecting signal to danger (figure 6). Handbook 8 of the Rule Book states that *additional protection* such as the disconnection of signalling equipment or the use of a track circuit operating device must be arranged if the work will affect the safety of the line²⁵. Additional protection could be arranged for any line blockage, although the time taken to set up the arrangements may be disproportionate. NR/L2/OHS/019 states that such protection need not be used if it would increase the time taken to complete the work by more than 25%.
- 82 Network Rail Infrastructure Projects wrote to its principal contractors in December 2014 to advise them that it expected additional protection to be used for line blockages wherever it was reasonably practicable to do so. The company has been unable to provide the RAIB with information on the extent to which this instruction has led to an increase in the use of additional protection.

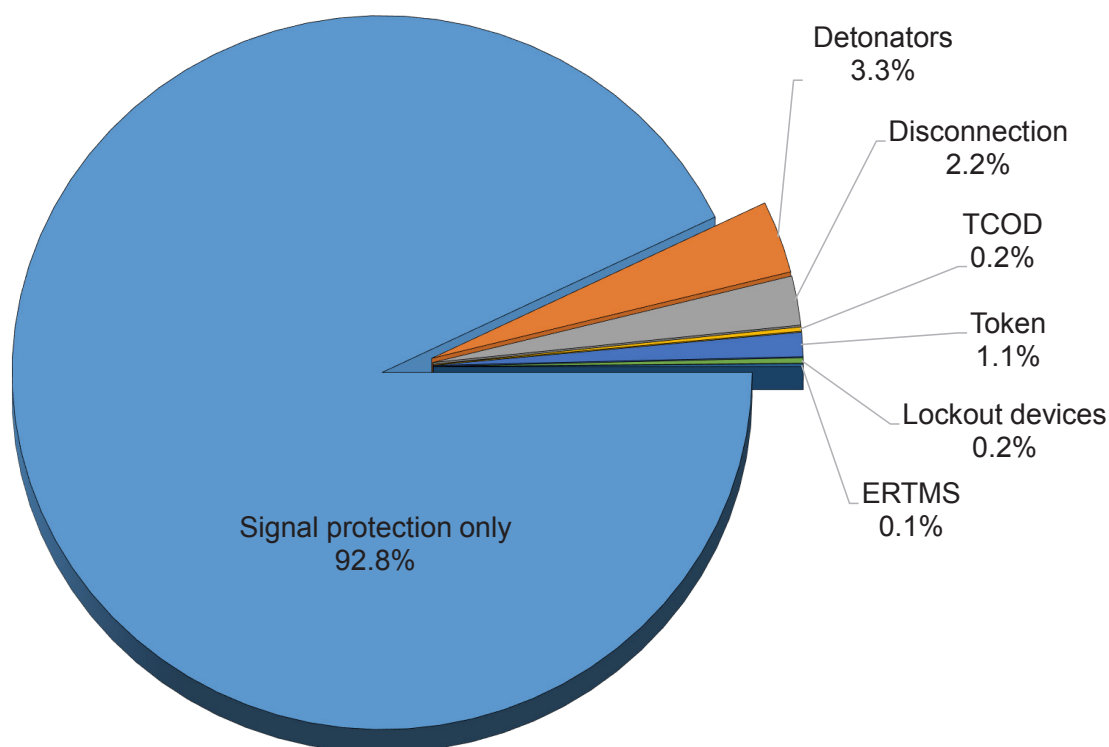


Figure 6: Protection arrangements for pre-planned line blockages²⁶; twelve months, 18/11/14-17/11/15 (source: Network Rail)

²⁵ Both of these forms of additional protection would prevent a signaller from accidentally clearing the protecting signal.

²⁶ Data from Safe System of Work Planning System (SSOWPS) – used by Network Rail only.

Other findings

- 83 During this investigation, the RAIB has also identified the following issues:
- Witness evidence indicates that, in some maintenance teams, the safe system of work hierarchy (appendix H) is typically inverted, such that the default SSOW chosen uses lookout warning unless that is not feasible (eg if the area is 'red zone prohibited')²⁷.
 - The RAIB observes that site warden warning, particularly for a moving workgroup or when this SSOW is used without an associated line blockage or possession, has similarities with lookout warning, in that trains continue to run and the safety of the workgroup depends on a human warning²⁸.
 - In at least three of the ten incidents examined from 2015 there was an attempt to cover up or not report the incident by some of the staff involved. This suggests that more incidents are occurring than get reported.
 - Witnesses report that planners often find themselves so busy that they do not have time to familiarise themselves with the infrastructure or to obtain first-hand experience of working on or about the line. Despite this high workload, the RAIB has been advised that a significant proportion of planned line blockages (possibly as high as 50%) are not actually implemented; data for Kent and Sussex is shown at figure 7.

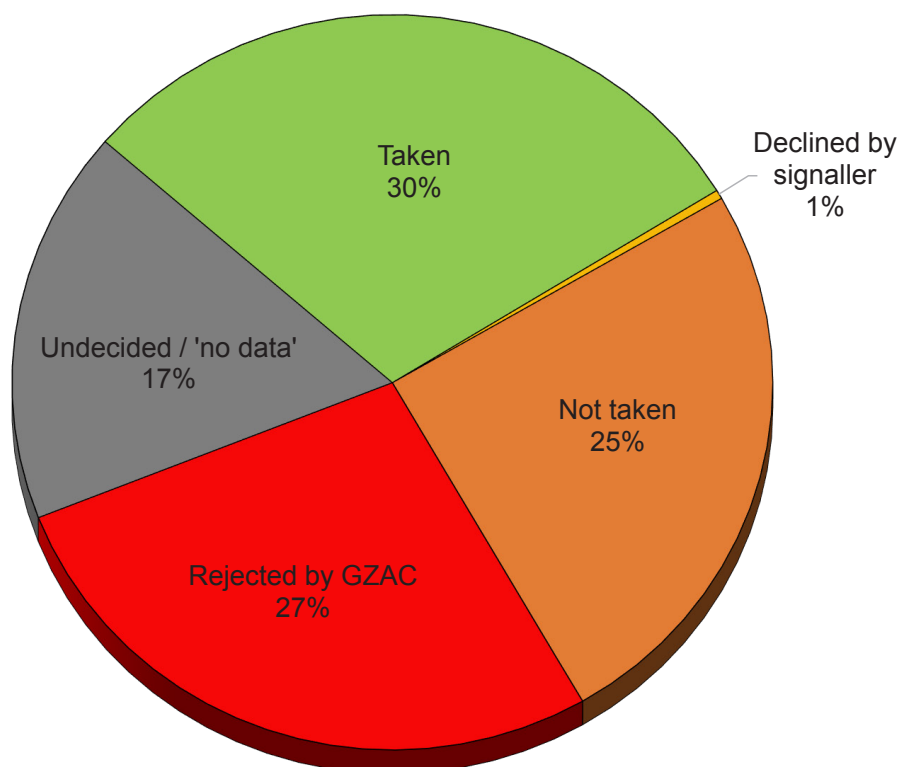


Figure 7: Implementation of pre-planned line blockages (Kent & Sussex)²⁹; twelve months, 03/05/15-02/05/16 (source: Network Rail)

²⁷ This issue was also found during the RAIB's investigations into the accident at Bulwell on 6 August 2012 (RAIB report 20/2013) and the accident near Newark North Gate station on 22 January 2014 (RAIB report 01/2015).

²⁸ This assumes that members of the workgroup are likely to be preoccupied with the task and may not be conscious of the risk from moving trains.

²⁹ Data from GZAM – used by Network Rail and contractors.

- e. Witnesses report that signallers may refuse a request for a line blockage (particularly where this has not been pre-planned, also referred to as a 'lineside request'). This may be because of limits on the numbers of line blockages that signallers are permitted to grant during a shift, resulting from signal box workload assessments, or due to an approach of 'zero tolerance' to departures from published arrangements. This change in circumstances may then result in a change in the SSOW (paragraph 97).

RAIB investigations and safety digests involving track worker safety

- 84 The RAIB has categorised its investigations and safety digests involving track worker safety (summarised at appendix M) using the same factors as those identified for the selected incidents that occurred during 2015 (table G2, appendix G). Figure 8 provides an overview and indicates that the RAIB's investigations and safety digests involve a similar range of factors to the 2015 incidents, although the relative importance of each is different.
- 85 The number of RAIB investigations and safety digests is relatively small, so these are not necessarily representative of all incidents presenting risk to track workers. In general, the RAIB investigates irregularities only if a near miss has occurred (usually defined as a train driver having made an emergency brake application), although other factors are taken into consideration. In most cases signaller errors associated with line blockages (eg granting a line blockage with a train still in section or signalling a train into a line blockage) are such that a near miss does not occur. So, although 18% of the 71 incidents occurring in 2015 directly involved the signaller (figure 4), none of the RAIB's investigations or safety digests related to such an error made by a signaller.

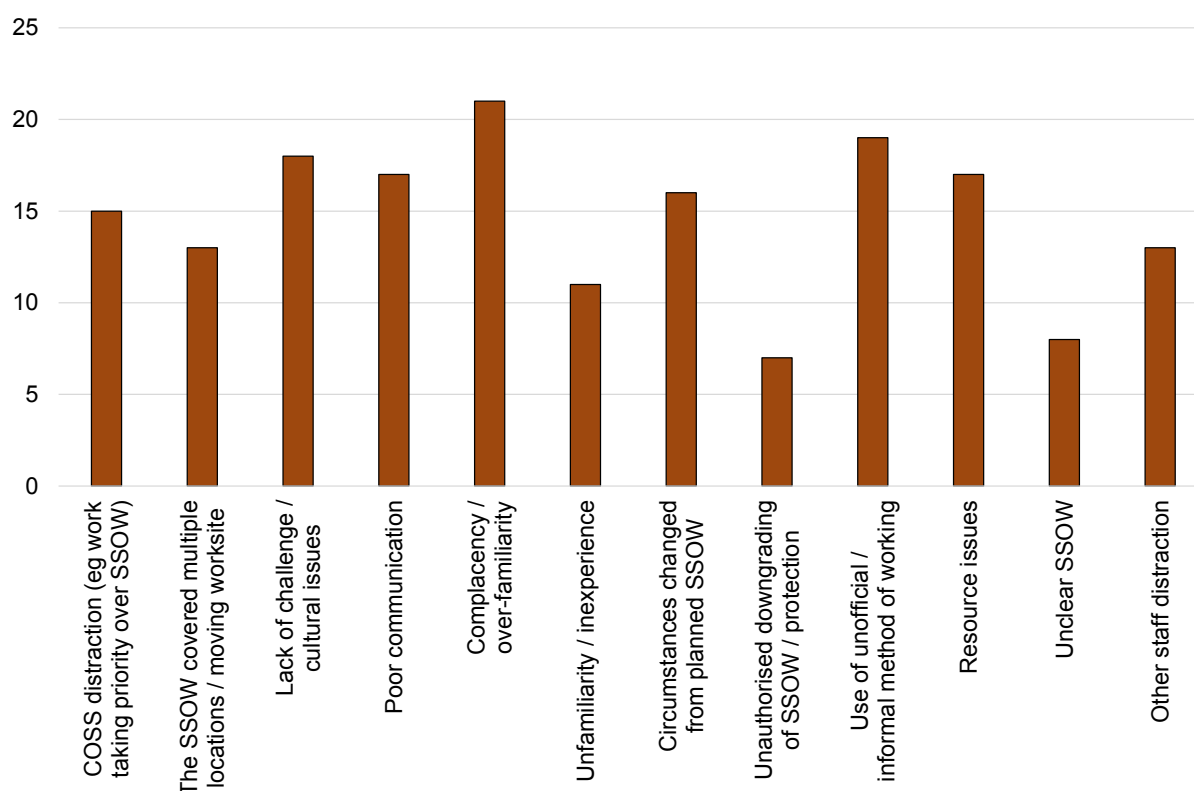


Figure 8: Occurrence of common factors in RAIB investigations and safety digests involving track worker safety

Conclusions

Causal factors

- 86 The causal factors have been identified from analysis of ten incidents occurring in 2015, and are ranked according to the frequency of occurrence:
- a. The COSS became preoccupied with the task and was no longer effectively maintaining the safe system of work (paragraph 43, **Recommendation 2**).
 - b. A single safe system of work covered work at multiple locations, each with potentially different risks, or a mobile work activity (paragraph 48, **Recommendation 3**).
 - c. Members of the workgroup did not challenge the COSS or stop work despite being aware of deviations from the safe system of work (paragraph 51, **Recommendation 2**).
 - d. The standard of communication was such that either a clear understanding was not reached between the COSS and a signaller, or members of the workgroup were left unclear about matters concerning the safety of the group (paragraph 54, **Recommendation 2**).
 - e. The COSS and/or signaller may have been over-familiar with the location, possibly leading to an inappropriate perception of the risks, or they may have been over-tolerant towards risk, leading to mistakes in setting up and/or maintaining the SSOW (paragraph 57, **Recommendation 2**).
 - f. The COSS may have been unfamiliar with the location or inexperienced, leading either to inappropriate decisions or to a misunderstanding of the risks (paragraph 60, **Recommendations 3 and 4**).
 - g. The COSS had not implemented the SSOW as planned because circumstances on site were different from those envisaged by the plan (paragraph 63, **Recommendations 1 and 3**).
 - h. The COSS downgraded the SSOW or the planned protection without seeking authorisation from a responsible manager (paragraph 66, **Recommendation 1**).
 - i. An unofficial method of working was agreed on site, creating the potential for confusion about the arrangements for maintaining safety (paragraph 69, **Recommendation 1**).
 - j. Resource constraints potentially affected the way the SSOW was implemented (paragraph 72, **Recommendation 1**).
 - k. Members of the workgroup were unclear about the SSOW in place (paragraph 74, **Recommendations 1 and 2**).
 - l. Distraction of members of staff, other than the COSS, led to mistakes in planning or implementing the SSOW (paragraph 77, no recommendation).

Other issues identified

- 87 Other issues identified during the investigation were:
- a. Most line blockages are taken without using additional protection (paragraph 81, **Recommendation 5**).
 - b. In some maintenance teams, the safe system of work hierarchy (appendix H) is typically inverted (paragraph 83a, **Recommendation 5**).
 - c. Site warden warning has similarities with lookout warning, in that trains continue to run and the safety of the workgroup depends on a human warning (paragraph 83b, **Recommendations 1 and 5**).
 - d. In some of the incidents examined from 2015 there was an attempt to cover up or not report the incident by some of the staff involved (paragraph 83c, no recommendation).
 - e. SSOW planners often have a high workload although a significant proportion of planned line blockages do not get implemented (paragraph 83d, no recommendation).

Previous RAIB recommendations relevant to this investigation

88 Recommendations with relevance to this investigation, made by the RAIB as a result of its previous investigations, are listed at appendix M. They are listed by theme below.

Appropriateness of safe systems of work

89 The RAIB previously made recommendations about the selection of appropriate safe systems of work as part of the following investigations:

- Track worker fatality at Ruscombe Junction, 29/04/2007; [RAIB report 04/2008](#) (see paragraph M8, appendix M); Recommendation 1.
- Accident at Leatherhead, 29/08/2007; [RAIB report 19/2008](#) (see paragraph M10, appendix M); Recommendation 4.
- Serious injury sustained by a signal technician at Kennington Junction, 23/05/2008; [RAIB report 29/2009](#) (see paragraph M18, appendix M); Recommendation 2.
- Fatal accident involving a track worker, near Newark North Gate station, 22/01/2014; [RAIB report 01/2015](#) (see paragraph M52, appendix M); Recommendation 2.
- Accident involving a track worker near Redhill, 24/06/2014; [RAIB report 06/2015](#) (see paragraph M55, appendix M); Recommendation 1.
- Class investigation into irregularities with protection arrangements during infrastructure engineering work; [RAIB report 14/2015](#) (paragraph 3); Recommendation 2.

Data collection and analysis

90 The RAIB previously made recommendations about collecting and analysing data as part of the following investigations:

- Track worker struck by a train at Bulwell, Nottingham, 06/08/2012; [RAIB report 20/2013](#) (see paragraph M41, appendix M); Recommendation 2.
- Class investigation into irregularities with protection arrangements during infrastructure engineering work; [RAIB report 14/2015](#) (paragraph 3); Recommendation 1.

Human factors

91 The RAIB previously made recommendations relating to research into human factors as part of the following investigation:

- Near miss involving gang of track workers at Hest Bank, 22/09/2014; [RAIB report 08/2015](#) (see paragraph M59, appendix M); Recommendation 1.

Local familiarisation

92 The RAIB previously made recommendations about improving the familiarisation of staff with local geography as part of the following investigations:

- Collision between a passenger train and two rail-mounted grinding machines at Acton West, 24/06/2008; [RAIB report 15/2009](#) (see paragraph M20, appendix M); Recommendations 1 and 3.

- Accident at Dalston Junction, 30/03/2009; [RAIB report 30/2009](#) (see paragraph M23, appendix M); Recommendations 1 and 2.

Non-technical skills

93 The RAIB previously made recommendations with relevance to the non-technical skills of railway staff as part of the following investigations:

- Near miss involving a track worker at Tinsley Green Junction, 17/03/2007; [RAIB report 43/2007](#) (see paragraph M6, appendix M); Recommendation 5.
- Track worker fatality at Ruscombe Junction, 29/04/2007; [RAIB report 04/2008](#) (see paragraph M8, appendix M); Recommendation 2.

Provision of warning systems

94 The RAIB previously made recommendations about the provision of warning systems as part of the following investigations:

- Track worker struck by a train on Grosvenor Bridge, London Victoria, 13/11/2007; [RAIB report 19/2009](#) (see paragraph M12, appendix M); Recommendation 2.
- Near miss involving gang of track workers at Hest Bank, 22/09/2014; [RAIB report 08/2015](#) (see paragraph M59, appendix M); Recommendation 2.

Workgroup responsibilities

95 The RAIB previously made a recommendation about the responsibilities of workgroup members as part of the following investigation:

- Track worker struck by a train on Grosvenor Bridge, London Victoria, 13/11/2007; [RAIB report 19/2009](#) (see paragraph M12, appendix M); Recommendation 1.

Background to the RAIB's recommendations

- 96 The RAIB is mindful of the continuing changes in the arrangements for planning and delivering work on or near the line with the potential to affect the safety of track workers (paragraph 10). However, the common causal factors identified in the course of this investigation indicate that there are important issues that should be taken into account in future changes to these arrangements.
- 97 Based on its analysis of the selected near miss incidents that occurred during 2015, as well as its investigations undertaken over the last 11 years, the RAIB has identified a group of factors linked to planning and the subsequent establishment of a SSOW (table 1). In 53% of all incidents considered by the RAIB (investigations and safety digests as well as the ten incidents from 2015), circumstances on site had changed from those envisaged by the pre-planned SSOW. Providing they are able to recognise that a significant change has arisen, the options available to a COSS in this situation (paragraph 67) are to:
- obtain authority to downgrade the SSOW on site;
 - upgrade the SSOW on site (note: this includes the possibility of changing from lookout warning to site warden warning, even though this may be unsuitable for a moving workgroup); or
 - decide not to carry out the work at all.

Ref ³⁰	Factor	Number of incidents in which this factor was identified (% of category)	
		10 near misses during 2015	RAIB investigations and safety digests
b	The SSOW covered multiple locations and/or moving worksite	60%	46%
f	Unfamiliarity with location and/or inexperience	40%	39%
g	Circumstances changed from planned SSOW	40%	57%
j	Resource constraints	30%	61%
k	Unclear SSOW	30%	29%

Table 1: Factors linked to planning and the subsequent establishment of a safe system of work

- 98 However, a COSS finding that circumstances on site are different from those envisaged may also be tempted to improvise. In table 2 the RAIB has correlated deviations from established processes and procedures with the incidence of the factors identified at table 1.

³⁰ The letters shown in this column relate to the matrix of common factors, appendix G.

Ref ³¹	Deviation from process	% of all incidents ³²	Correlation with factor (% all incidents)				
			b	f	g	j	k
h	Unauthorised downgrading of SSOW protection	29%	13%	8%	24%	18%	5%
i	Use of unofficial and/or informal method of working	61%	34%	24%	39%	42%	21%

Table 2: Correlation of the factors shown at table 1 with process deviations

100 Two particular recurring issues have been highlighted by this class investigation:

- gaps between the plan and the ‘real life’ circumstances found on site (eg plan unclear, out of date, inaccurate or lacking detail for the actual site of work); and
- barriers to correct implementation of the plan (eg lack of resource, unfamiliarity with the location).

101 The RAIB observes that these issues can be addressed in two ways. The first is the implementation of additional measures to improve the delivery of the planning process. SSOW plans need to be based on accurate information, and a proper understanding of the hazards that are likely to be encountered. They also need to identify the resources needed to implement the ‘safe system of work’, be relevant to the task, accurate and easily understood.

102 Changes introduced by Network Rail, such as the revisions to NR/L2/OHS/019, including the greater involvement in the planning activity of the person in charge, may result in improvements in planning. The RAIB also notes that, as part of its Planning and Delivering Safe Work initiative, Network Rail is still intending to introduce:

- an electronic permit to work system (‘e-permit’);
- a new digital map of the railway, showing the key features relevant to planning and implementing SSOWs; and
- a new universal work planning process.

If these measures are fully implemented they have the potential to improve the planning of work. However, the quality of plans will continue to be critically dependent on the competence of the planner, what they can reasonably be expected to know about a given site at a given time and the thoroughness of review by the authoriser.

103 Since there is a limit to the safety improvement that can be won simply by improving planning processes, the second area for potential improvement relates to the way in which safety leaders on site are able to adapt to changed circumstances, whilst protecting the safety of the team. The RAIB’s analysis has shown that teams are often placed in a dangerous situation when they find that the plan is incorrect or when adapting to circumstances that are not allowed for by the plan. Simple examples of this include planning the means of crossing a bridge with limited clearance (ie the absence of a position of safety) or adapting the system of work when faced with unexpectedly poor sighting due to vegetation.

³¹ The letters shown in this column relate to the matrix of common factors, appendix G.

³² ie the 10 near misses during 2015 plus RAIB investigations and safety digests.

- 104 Although improved planning has the potential to reduce the number of dangerous occurrences involving track workers, the railway is a changing and dynamic environment. It will therefore not always be possible to predict and pre-plan every part of a track gang's working day; this will be particularly true where the plan covers the activities of a mobile work group or where work is to be undertaken at different locations. It is also unlikely that planning errors and omissions will ever be entirely eradicated.
- 105 For certain types of work activities, it will always be difficult to pre-define every detail of the system of work until the gang has arrived on site and the COSS has assessed the local circumstances. For example, the establishment of a system of work involving lookout warnings will always require the COSS to assess local conditions such as sighting and then to decide on where to place the lookout(s).
- 106 For the above reasons there will continue to be a need for safety leaders on site to manage local circumstances that are not encompassed by the plan. To do this effectively the person responsible for safety on site will need to:
- recognise any hazards;
 - consider the measures needed to control any risk to the safety of the entire team;
 - assess the risk of any alternative measures; and
 - implement any necessary changes to the system of work.
- 107 The RAIB's analysis suggests that the safety of track workers is best achieved by a combination of good pre-planning to define the type of protection needed (including the resource required to implement it) and the local management of risk by the person responsible for safety on site.
- 108 Recommendation 1 is intended to facilitate the local management of risk by increasing the ability of people in charge of safety on the track to carry out effective assessments of local circumstances and to establish appropriate safe systems of work. This would enable them to safely manage any change in circumstances that affects the safety of the work gang. Underpinning this recommendation is the principle that safety would be improved by better equipping competent people to make safe decisions, within clearly defined guidelines, when the plan is no longer appropriate to the situation. The recommendation has been drafted with the intention that any local adaptations to circumstances not covered by the plan should always be:
- initiated by a safety leader on site who is both competent and fully informed of local circumstances;
 - consistent with the documented 'safe system of work' plan unless this can no longer be applied, is impractical to implement or is considered to be less safe than an alternative;
 - fully briefed to the entire team; and
 - compliant with railway rule book and track safety standards.
- 109 Factors that are linked to behaviour and attitudes are identified at table 3. This table shows that more needs to be done to try to influence the ways that track workers and those with safety roles behave when on and near the line.

- 110 Table 3 reinforces the findings of numerous previous investigations that have revealed serious breakdowns in site discipline and vigilance. These have included the accidents at Stoats Nest Junction ([RAIB report 16/2012](#)), Newark North Gate ([RAIB report 01/2015](#)) and Shawford ([RAIB report 05/2017](#)). In each of these cases the behaviours and attitudes of the safety leader on site and/or the team were found to have been a major factor in the causation of the accident or incident.
- 111 Given the vital importance of the behavioural and cultural issues that can lead to breakdowns in site discipline or loss of vigilance, the RAIB considers that Network Rail should renew the training it provides to track workers in non-technical skills (paragraph D24, appendix D; Recommendation 2).

Ref ³³	Factor	Number of incidents in which this factor was identified (% of category)	
		10 near misses during 2015	RAIB investigations and safety digests
a	COSS distraction (eg work taking priority over SSOW)	60%	54%
c	Lack of challenge / cultural	50%	64%
d	Poor communication	50%	61%
e	Complacency / over-familiarity	50%	75%
l	Other staff distractions	30%	46%

Table 3: Factors linked to behaviours and human error

- 113 Line blockages without additional protection are subject to human error (paragraphs 81 and 85). However, the RAIB has chosen not to make any recommendation in this area as it is subject to work being carried out by the line blockage working group and the development of new *protection systems* as part of the safer trackside working programme (paragraph D14, appendix D).
- 114 Unfamiliarity with location (which featured in up to 39% of all incidents) is addressed by Recommendations 3 and 4.
- 115 The ORR has stated that one of its priorities for workforce safety is the elimination of red zone working, where achievable³⁴. Network Rail Infrastructure Projects now requires director level approval for red zone working (footnote 6 to paragraph 16), with the apparent intention of reducing its extent, and initiatives such as safe and effective working (paragraph D19, appendix D) have the potential to achieve a significant reduction in red zone working for routine maintenance work.

³³ The letters shown in this column relate to the matrix of common factors, appendix G.

³⁴ 'Strategy for regulation of health and safety risks - chapter 8: Workforce safety'; available at <http://orr.gov.uk>.

- 116 Although the RAIB is broadly supportive of initiatives to separate workers from trains where reasonably practicable, it is also concerned about the risk associated with the unprotected line blockages (ie line blockages that are entirely reliant on a signaller keeping one or more signals at danger). Since such arrangements are often used as an alternative to red zone working, the RAIB has concluded that better data is needed to allow a valid comparison between red zone working and the various alternative SSOWs.
- 117 Recommendation 5 is intended to inform the above comparison by providing data that would assist in understanding the relative risk of different SSOWs. The RAIB also suggests that such data is needed to support the proposed introduction of a more risk-based 'hierarchy of safe systems of work' (paragraph D18, appendix D).
- 118 As railway technology continues to develop, the RAIB looks forward to a reduced need for workers to access the track when trains are operating, and the continued roll-out of new engineering systems to mitigate the risk of human error by track worker or signaller.

Recommendations and learning points

Recommendations

119 The following recommendations are made³⁵:

- 1 *The intent of this recommendation is to improve the ability of people in charge of safety on the track to establish a safe system of work that is appropriate to the local circumstances.*

Network Rail should review the ways that it equips those with safety leadership responsibilities to recognise and deal effectively with circumstances not encompassed by the planned 'safe system of work' or permit. These might include the need for additional local planning (for example when placing lookouts) or moving to a new location while carrying out mobile activities such as patrolling, asset inspections and surveying. Circumstances not covered by the plan might also arise due to rest breaks and changes to the composition of the group, or the nature of the work activity.

Appropriate action should be taken to implement any required improvements in procedures and/or the training provided to those in leadership roles. Any changes that are proposed to existing arrangements should be based on the following principles:

- a) compliance with the documented safe system of work or permit, unless this can no longer be applied, is impractical to implement or is considered to be less safe than an alternative;
- b) continued compliance with the railway Rule Book;
- c) dynamic risk assessment of the changed circumstances, and of any alternative safe system of work; and
- d) empowering competent leaders to make safe decisions within clearly defined guidelines (paragraphs 86g, h, i, j, k, and 87c).

³⁵ 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 and Road to enable it to carry out its duties under regulation 12(2) to:

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

Copies of both the regulations and the accompanying guidance notes (paragraphs 200 to 203) can be found on RAIB's website www.gov.uk/raib.

- 2 *The intent of this recommendation is to improve the non-technical skills of track workers.*

Network Rail should review the effectiveness of its existing arrangements for developing the leadership, people management and risk perception abilities of staff who lead work on the track, as well as the ability of other staff to effectively challenge unsafe decisions. This review should take account of any proposed revisions to the arrangements for the safety of people working on or near the line. A time-bound plan should be prepared for any improvements to the training in non-technical skills identified by the review (paragraph 86a, c, d, e and k).

- 3 *The intent of this recommendation is to improve the competence (in the area of local geographic knowledge) of people who lead track work in higher-risk situations.*

Network Rail should review the competence requirements for people who control work on the track while trains are running, under safe systems of work which rely on knowledge of the location, such as the use of lookout warning and line blockages without additional protection. Consideration should be given to requiring enhanced local knowledge for people qualified to implement such systems of work. This may include training and assessment in local conditions and/or experience of work in specified areas or locations. A time-bound plan should be prepared for any changes in competence requirements identified by the review (paragraph 86b, f and g).

- 4 *The intent of this recommendation is to make the fullest possible information on local conditions available to people who plan and lead work on the track.*

Network Rail should implement arrangements to make its databases of photographic and video information (such as its RouteView system) more easily available to planning staff and leaders of work groups (paragraph 115f).

- 5 *The intent of this recommendation is to provide suitable and sufficient information to support decisions on safe methods of working on the track, as well as visibility of the risk to senior management.*

Network Rail should improve the way it collects, analyses and reports information on incidents and accidents to track workers associated with moving trains, to provide more reliable data on the relative risk of the various available methods of protection. Such data should be used to inform improvements to the arrangements for ensuring the safety of people working on or near the line, including the hierarchy of safe systems of work (paragraph 87a, b and c).

Learning points

120 The RAIB has identified the following key learning point³⁶:

- 1 Railway staff are reminded of the importance of reporting all near miss incidents. This facilitates the collation of accurate data on incidents and enables appropriate action to be taken to prevent recurrence of similar incidents.

³⁶ 'Learning points' are intended to disseminate safety learning that is not covered by a recommendation. They are included in a report when the RAIB wishes to reinforce the importance of compliance with existing safety arrangements (where the RAIB has not identified management issues that justify a recommendation) and the consequences of failing to do so. They also record good practice and actions already taken by industry bodies that may have a wider application.

Appendices

Appendix A - Glossary of abbreviations and acronyms

COSS	Controller of site safety
GZAM	Green Zone Access Management system
ISLG	Infrastructure Safety Liaison Group
IWA	Individual working alone
NOC	Network Rail's national operations centre
NTS	Non-technical skills
LOWS	Lookout operated warning system
OCC	Operational Close Call
ORR	Office of Rail and Road
PDSW	Planning and delivering safe work
PICOP	Person in charge of a possession
PICOW	Person in charge of work
PTS	Personal track safety
RINM	Rail Infrastructure Network Model
RSSB	The not-for-profit company registered as 'Rail Safety and Standards Board'
RZUL	A red zone SSOW using unassisted lookouts
S&C	Switches and crossings
SMIS	Safety management information system
SSOW	Safe system of work
STW	Safer trackside working
SWL	Safe work leader
TCOD	Track circuit operating device
TOWS	Train operated warning system
TSA	Track Safety Alliance

Appendix B - Glossary of terms

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

Additional protection	<p>Arrangements to protect line blockages (these are mandated by Handbook 8 of the Rule Book for work that will affect the safety of the line). Such arrangements include:</p> <ul style="list-style-type: none"> ● Disconnection of signalling equipment ● Use of a track circuit operating device (TCOD) ● Obtaining the staff or token for a single line ● Placing of detonator protection ● Application of an engineering protection reminder
Blocking points	The geographic limits of a line blockage.
Bowtie analysis	A form of analysis linking the possible accident scenarios and control measures associated with a specific hazard.
Close call [see also appendix J]	Any unsafe act or unsafe condition that in different circumstances could have led to an accident or personal injury or could have resulted in damage to property or equipment but would not introduce risk to the railway infrastructure.
Control Period	A five-year period of railway funding, regulated by ORR. Control Period 5 runs from April 2014 to March 2019 and Control Period 6 from April 2019 to March 2024.
Controller of site safety (COSS) [from NR/L2/OHS/019]	A person certified as competent and appointed to provide a safe system of work to enable activities to be carried out by a group of persons on Network Rail railway infrastructure in accordance with the requirements of the Rule Book (GE/RT8000).
Cyclical access	Access that has been pre-planned for cyclical maintenance activities (eg patrolling). NR/L2/OHS/019 provides for cyclical SSOWs to be authorised once and then implemented repeatedly within a twelve month period without further verification.
Digital Railway	The railway industry's plan for targeting digital systems to increase rail capacity and improve network performance ³⁶ .
ELLIPSE	A work management system used by Network Rail to record details of assets, cyclic tasks and arising work.
Engineering access statement	The document agreed between the infrastructure controller, freight operating company (FOC) and train operating companies (TOC) that records when possessions may be taken and how severe temporary speed restrictions (TSR) may be.*
Four foot	The area between the running rails of a railway track.

³⁷ www.digitalrailway.co.uk/our-role/industry-programme/.

Green zone [from NR/L2/OHS/019; see also appendix H]	A site of work on or near the line within which there are no train movements.
Infrastructure Projects	Network Rail's internal project management organisation.
Line blockage	The term which replaced sections T2 and T12 of the Rule Book, covering protection of personnel carrying out activities on the line. Prevention of trains from moving on the line is managed by placing or maintaining signals at danger.*
Lookout	A competent person whose duties are to watch for and to give an appropriate warning of approaching trains by means of whistle, horn or lookout operated warning system.*
Lookout operated warning system (LOWS)	A system that provides a warning of an approaching train that is operated by a lookout. Such systems incorporate a vigilance device, requiring a regular response from the lookout.
Maintenance scheduled task	A cyclic inspection or maintenance task which has a frequency prescribed in Network Rail standards and which is scheduled using the ELLIPSE system.
Non-technical skills	Network Rail's initiative to provide COSSs with cognitive (mental) and interpersonal skills needed for competent job performance.
On or near the line	Anywhere less than 3 metres from a railway line unless there is a permanent fence or structure in-between.
Operational close call [see also appendix J]	Any unsafe act (formerly termed irregular working) or unsafe condition that in different circumstances could have led to an accident or personal injury or could have resulted in damage to property or equipment.
Patrolling	A pedestrian visual inspection of the track (and superficial inspection of other lineside items) carried out by a trained member of staff on a regular basis.*
Personal track safety (PTS)	The minimum training and certification required before being allowed on or near the line. The course introduces basic concepts of safety and emergency action.*
Position of safety	A place where it is safe to stand when a train is passing.
Protection controller [from NR/L2/OHS/019]	A person certified as competent and appointed to take overall control of a shared line blockage where two or more COSSs are sharing the same protection.
Protection system	A system that blocks the entry of trains to a site of work.

Red zone [from NR/L2/OHS/019; see also appendix H]	A site of work on or near the line which is not protected from train movements.
Remote disconnection device	A system providing a means of disconnecting or restricting the use of signalling equipment remotely, eg using SMS (short message service) text messages.
Rule Book	Railway Group Standard GE/RT8000, which incorporates most of the rules to be observed by railway staff for the safe operation of the network.
Safe system of work (SSOW)	An arrangement of precautions which ensure that workers are exposed to least possible risk.*
‘Single controlling mind’	An individual responsible for both operational protection and task safety. This role is described as the ‘person in charge’ in NR/L2/OHS/019 Issue 9.
Switches and crossings (S&C)	Track designed to provide a facility for trains to move from one line to another, commonly known as points.
Warning system	A system that provides a warning to staff of trains approaching a site of work.
Worksafe Procedure	Network Rail procedure giving rail staff with concerns about the safety of an activity the right to stop work and have the situation assessed in a fair way.

Appendix C - Investigation details

The objectives of the RAIB's investigation were:

- review the circumstances of accidents and near miss incidents involving trains and track workers outside possessions during 2015;
- determine the causal factors of a representative sample of those incidents;
- understand how and why decisions are made in practice, on the choice of protection arrangement, and identify trends over the last five years in the use of different types of protection arrangement;
- identify the key factors in planning and undertaking work on site (including the behaviour of individuals) that increase the probability of track workers' protection from moving trains being compromised;
- include engagement with staff involved in planning safe systems of work and in implementing safety arrangements on site;
- consult with industry bodies that have an interest in track worker safety; and
- consider previous relevant RAIB investigations and their findings and recommendations.

The RAIB used the following sources of evidence in this investigation:

- safety data published by Network Rail;
- data provided to the RAIB by Network Rail;
- analysis of industry reports into selected incidents occurring during 2015, together with supporting information;
- information provided by witnesses; and
- a review of previous RAIB investigations relating to incidents involving track workers.

Appendix D - Industry track safety initiatives and committees

D1 A brief summary of some of the most relevant railway industry initiatives and working groups is included here for reference.

Network Rail's Home Safe Plan

D2 Network Rail's Annual Return 2016³⁸ describes a list of twenty-one projects that comprise its 'Home Safe Plan'. These are intended to address 'key safety risks to passengers, public and workforce, health priority areas and process improvement for risk controls and an integrated management system'. Projects within the Home Safe Plan with a possible impact on the safety of track workers include (the descriptions are taken from the Annual Return 2016):

- 'Planning & Delivering Safe Work (PDSW) Programme (provide clear, site-specific information on safety).
- 'Fatigue risk management (deliver a fatigue standard and three training modules for managers and [road vehicle] drivers).
- 'Sentinel [the industry's competency control system] enhancements (enable clear rules to be set out across the rail industry).
- 'Risk management including review of Work Activity Risk Assessments (identify and specify controls for health and safety for Network Rail employees).
- 'Safer trackside working (provide engineering control system protection for track workers to enable safer work on the operating railway).
- 'Safety hour (increase risk awareness and safety solution ownership).
- 'Business Critical Rules (delivering a simplified risk control framework using line of sight from risk to control, to contribute to Network Rail's safety, performance and efficiency targets).'

Planning and Delivering Safe Work (PDSW)

D3 The PDSW programme combined two of Network Rail's previous initiatives contained in a ten point plan for improving workforce safety: 'Control of Work' and 'Roles and Responsibilities'. PDSW was originally implemented in the East Midlands area in May 2015, and included the following main elements:

- the new role of safe work leader (SWL), combining responsibility for managing the work activities themselves with responsibility for implementing and maintaining the SSOW;
- an electronic permit to work system ('e-permit');
- a new digital map of the railway, showing the key features relevant to planning and implementing SSOWs; and
- a new universal work planning process.

³⁸ https://www.networkrail.co.uk/wp-content/uploads/2016/11/Network-Rail-Infrastructure-Limited_Annual-Return-2016.pdf.

- D4 The PDSW programme has trained approximately 13,500 people as safe work leaders³⁹; it had originally expected to train approximately 500 and that these would be predominantly Network Rail staff. The increase in the numbers of people required to be trained largely resulted from Network Rail's responsibilities with regard to contractors under the CDM regulations⁴⁰. The competence included some elements of the training in non-technical skills that Network Rail had instituted for *controllers of site safety* (COSSs) in 2012 (see paragraph D20).
- D5 The PDSW programme was paused in January 2016, and the use of the e-permit system was suspended in Network Rail's East Midlands maintenance organisation. It has continued to be used for projects managed by Infrastructure Projects (IP).
- D6 The programme was reviewed and has since been 'refocused'. PDSW is now described as including five core products:
- 'Single controlling mind' – an individual responsible for operational protection and task safety;
 - Planning involvement – the 'single controlling mind' to be involved in verification of the SSOW and task risk assessment prior to authorisation;
 - Task risk – the addition of task risk assessment documentation to operational protection documentation;
 - Schematics – schematic representations of the network and assets, to be used in planning and delivering of work; and
 - E-permit technology – electronic permit to work documentation comprising the safe system of work and task risk assessment.
- D7 Network Rail's stated aim is to introduce the first three elements of PDSW, together with the reissue of its standard 'Safety of People Working On or Near the Line', NR/L2/OHS/019 (refer to paragraph D8), in mid-2017. The remaining two elements, which depend on the development of new technology, are expected to follow in 2018.

Revision of Network Rail's standard 'Safety of People Working On or Near the Line', NR/L2/OHS/019

- D8 Network Rail's standard 'Safety of people working on or near the line', NR/L2/OHS/019 was first issued by Railtrack as 'Protection of people working on or near the line', specification RT/LS/S/019, in April 2002. This introduced the RIMINI (Risk MINImisation) procedure⁴¹ and reflected the new role of COSS that had replaced the role of PICOW in Section B(ii) of the Rule Book. The version of NR/L2/OHS/019 that was current during 2015, Issue 8, was issued in September 2010.

³⁹ In April 2016, 13,371 people held the SWL1 competence; in addition 4,406 people held SWL2, although these probably all held SWL1 as well, and 160 held SWM (safe work manager).

⁴⁰ The Construction (Design and Management) Regulations 2015.

⁴¹ Now referred to as the hierarchy of safe systems of work (see appendix G).

D9 Network Rail has since revised NR/L2/OHS/019 and incorporated appropriate requirements from the 'Code of Practice for Planning and Delivering Safe Work', NR/L2/OHS/133; the new version, Issue 9, was published on 20 December 2016 and is due to be implemented by 3 July 2017. This includes a requirement for there to be a 'person in charge'⁴² of work on site, as well as the requirement for this individual to be involved in planning and undertaking a task risk assessment for the activity. The person in charge will undertake the Rule Book duties of a COSS, as well as being responsible for the work being carried out by the work group. NR/L2/OHS/019 Issue 9 also includes a revised SSOW hierarchy (appendix H).

Lifesaving Rules

D10 Network Rail introduced its lifesaving rules in 2012 and updated them in 2014. There are currently ten lifesaving rules (appendix K). One of these is directly relevant to the risk to track workers from moving trains: 'Always be sure the required plans and permits are in place, before you start a job or go on or near the line.' A second lifesaving rule may also be relevant: 'Never undertake any job unless you have been trained and assessed as competent.'

D11 Compliance with the lifesaving rules is given a high priority by Network Rail management and is taken into account when the company investigates accidents and incidents using its 'fair culture' principles (see appendix L).

Business Critical Rules (BCR)

D12 The business critical rules project aims to develop Network Rail's standards into simpler, risk-based, rules that tell staff what they need to do and how to do it. The intention is to focus on the management of key risks and to clarify accountabilities and responsibilities. Business critical rules include the lifesaving rules (paragraph D10). BCR have been trialled for maintenance of plain line track and Network Rail is currently developing a programme to extend their application to other areas of its business.

D13 BCR are being developed using *bowtie analysis*. The current project scope is focused on risks to railway infrastructure assets rather than the workforce. Network Rail has prepared a bowtie analysis for the separation of workforce from moving trains, but currently has no timescale for documenting the controls (BCRs) that would mitigate the associated risk. In part, this is subject to the availability of resource and the priority that was given to revising NR/L2/OHS/019 (paragraph D9).

Safer Trackside Working (STW)

D14 Network Rail received funding during *Control Period 5* for development of high reliability and integrity protection systems and *warning systems* for track workers. These are intended to reduce reliance on systems containing multiple human error failure modes, such as the use of lookouts. The STW programme is also linked to PDSW, in seeking to improve the planning of protection arrangements for safe access to the lineside.

⁴² The person in charge is equivalent to the 'single controlling mind' envisaged by the PDSW programme, paragraph 20).

- D15 The programme consists of two phases:
- Phase one: Provision of ‘tactical solutions’ that can be deployed quickly, at relatively low cost and with fast realisation of benefits. These would be complemented by PDSW, which would assist staff in planning access to the lineside and choosing the correct warning or protection system.
 - Phase two: Deployment of ‘strategic solutions’ that provide benefits along lines of route, covering a greater proportion of the infrastructure. These would be deployed by Network Rail in Control Period 6 or as part of the *Digital Railway* programme.
- D16 Phase one outputs of STW include a new Lineside Early Warning System (LEWiS) as well as a new *remote disconnection device* and a new track circuit operating device (TCOD), which would support increased use of additional protection with line blockages.
- D17 In addition to the development of new systems, analysis has been carried out as part of STW on the level of risk for maintenance tasks carried out under SSOWs using lookout warning. The intention of this work is to identify the higher risk activities and to target the application of alternative SSOWs. A risk modelling tool has been developed and is being calibrated.
- D18 The STW programme has also challenged the assumption inherent in the safe system of work hierarchy in NR/L2/OHS/019 (appendix H) that a green zone SSOW is always safer than any form of red zone SSOW. An alternative risk-based hierarchy has been proposed (figure D1), although this remains to be validated. As an example, this indicates that a red zone SSOW using a warning system linked to the signalling would have less risk than the use of a line blockage without additional protection.

Safe & Effective Working

- D19 Safe and effective working is an initiative which has been pioneered within Network Rail’s LNE (London North Eastern) South maintenance area during 2016. It involves the detailed planning of cyclical access across all disciplines, to maximise the use of standardised pre-booked possessions taken nightly throughout the week. A stated aim of the approach is the systematic elimination of red zone working for routine maintenance. The approach facilitates the incorporation of maintenance access into the *engineering access statement*, improving predictability and Network Rail’s relationships with train operators. It is also claimed to result in greater reliability, efficiency and productivity.

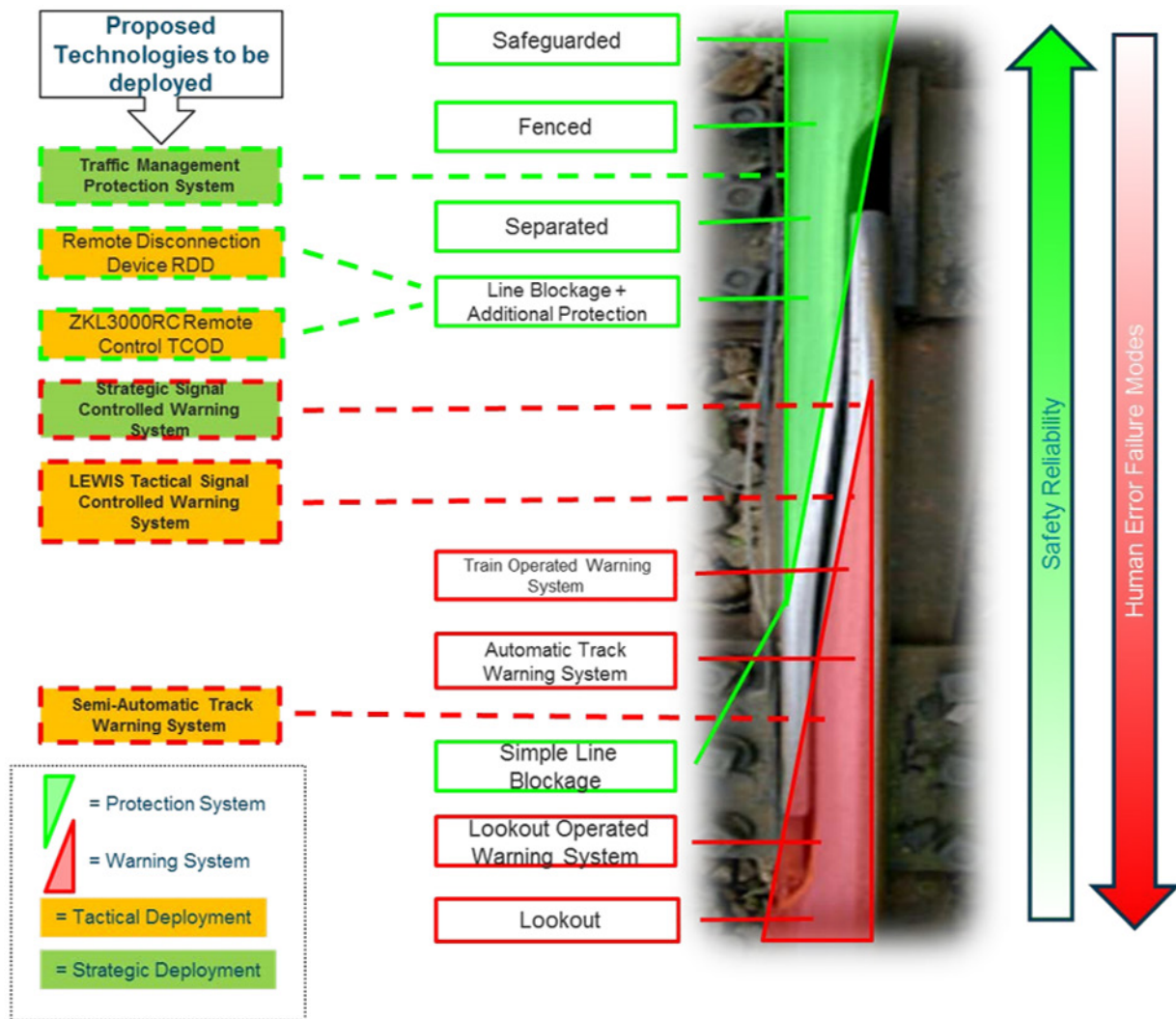


Figure D1: Risk-based hierarchy proposed as part of STW programme (courtesy Network Rail)

Non-technical skills

D20 Non-technical skills (NTS) training was first introduced by the aviation industry in response to a number of accidents; it has since been adopted in other safety critical industries including rail. NTS have been defined as ‘the cognitive, social and personal resource skills that complement technical skills, and contribute to safe and efficient task performance.’⁴³ RSSB states that ‘NTS enable safety critical workers to identify, manage, mitigate and recover from errors and other threats to operations by using all available resources - human, informational, procedural, equipment - to achieve a safe and efficient outcome.’⁴⁴

⁴³ Flin, R., O’Connor, P. and Crichton, M. (2008). ‘Safety at the Sharp End: A Guide to Non-Technical Skills’. Farnham: Ashgate.

⁴⁴ <https://www.rssb.co.uk/research-development-and-innovation/research-and-development/research-project-catalogue/T869>.

D21 Network Rail introduced NTS training following a series of accidents involving track workers, including those at Trafford Park on 26 October 2005 (RAIB report 16/2006), Ruscombe on 29 April 2007 (RAIB report 04/2008) and Stoats Nest on 12 June 2011 (RAIB report 16/2012). This training was originally targeted on COSSs, although Network Rail declared its intention to expand its scope to include other roles such as lookouts, signallers, electrical control operators and operations control staff. The aim was to see a reduction in incidents that had an underlying cause associated with non-technical skills, and a reduction in the number of accidents and incidents involving COSSs.

D22 Network Rail's core NTS framework included the following:

- Conscientiousness*
- Attention Management
- Relationships with People*
- Multi Task Capacity
- Controlled Under Pressure
- Planning and Decision Making*
- Communications*
- Willingness and Ability to Learn*

The skills marked with an asterisk were included and assessed as part of a 'development day' that formed part of Network Rail's NTS programme for COSSs.

D23 NTS training started in 2012 and all COSSs employed by Network Rail were due to have received the training by December 2014; COSSs employed by other companies were to have received it by June 2015. Not attending the development day, or not passing the assessment, resulted in replacement of the individual's COSS competence with a new competence of 'COSS Theory' (the individual would no longer be able to act as a controller of site safety). Network Rail subsequently suspended COSS development day training before the cut-off dates were reached.

D24 Network Rail does not currently provide specific NTS training. It has advised that this is because some elements of the previous COSS development day were incorporated into the training for safe work leaders as part of the PDSW programme (paragraph D3). In addition, NTS have been incorporated into the e-learning which is now a pre-requisite to attendance at *personal track safety* (PTS) and lookout training courses.

D25 Part 3 of European Standard EN 16704⁴⁵, 'Competences for personnel related to work on or near tracks' identifies 'psychological requirements' for track workers. These overlap with, but are not entirely the same as, Network Rail's list of NTS. Depending on the role, the requirements in EN 16704 include (all of these are necessary for a person responsible for implementing safety plans):

- Attention/concentration
- Memory

⁴⁵ 'Railway applications - Track - Safety protection on the track during work', BS EN 16704, was published by BSI (the British Standards Institution) in November 2016.

- Perceptive capability
- Reasoning
- Speed of reaction
- Gestured coordination
- Emotional self-control
- Behavioural reliability
- Autonomy
- Conscientiousness

The standard implies that psychological assessment should be carried out ‘to support the appointment of staff who demonstrate the cognitive, psychomotor, behavioural aptitudes and personality factors required to perform their roles to the standard required.’ Network Rail advised the RAIB that the United Kingdom had voted against adoption of EN 16704. However, as the standard is mandatory, its provisions will now need to be met through future changes to the company’s standards.

Infrastructure Safety Liaison Group

D26 The infrastructure safety liaison group (ISLG)⁴⁶ is a forum for railway contractors and the wider industry. Its objectives are to improve health, safety and environmental performance, share experiences, good practice and knowledge. Its specific aims are to:

- Review health, safety and environmental performance.
- Review legislation and standards.
- Clarify and prioritise risk issues.
- Identify good practice and wider intelligence.
- Facilitate solution.
- Influence and lobby industry.
- Sponsor RSSB research, projects and initiatives.

D27 ISLG has a specific workstream on ‘trains signalled into line blockages’; this is looking at single points of failure in the process, with the purpose of making recommendations for improvements based on analysis of data.

Track Safety Alliance

D28 The Track Safety Alliance (TSA)⁴⁷ is an industry-wide group which allows industry stakeholders to develop and share best practice. This is largely focused on the improvement of health, safety and wellbeing of track workers. The TSA has approximately thirty members, including Network Rail, principal contractors, contractors, plant & machine providers, labour suppliers, trade unions and front-line staff.

⁴⁶ www.islg.org/Pages/Home.aspx.

⁴⁷ www.tracksafetyalliance.co.uk.

D29 The TSA has a number of current workstreams. Those that may be relevant to the risk from moving trains to staff working outside a possession include:

- Increasing awareness, knowledge and management of fatigue within the workforce.
- Improving the collation, processing and analysis of *close call* data.
- Developing fair culture and fair behaviours to improve health and safety within track renewals.

Track Worker Safety Group

D30 The track worker safety group is made up of Network Rail safety specialists and representatives of Network Rail's supply chain, ISLG, the Rail Infrastructure Assurance Group (a sub group of ISLG), TSA, the Rail Industry Contractors Association (RICA)⁴⁸, RSSB, the Office of Rail and Road (ORR) and trades union safety representatives. It is intended to enable collaboration and coordination of key health, safety and welfare programmes and policies related to track worker safety particularly:

- Track worker health, safety and welfare performance and emerging trends.
- Strategic approach to managing risk to workers on or about the track in line with the Network Rail safety strategy.
- Strategic priorities, standards and principles and alignment with industry.
- Significant concerns.

Line Blockage Working Group

D31 The line blockage working group is made up of Network Rail safety specialists and representatives of planners, track workers and signallers, as well as trades union safety representatives; it includes representation from ISLG (paragraph D27). It is intended to:

- Identify and determine strategy or policy changes with the aim of reducing risk for workforce, passengers and public.
- Review and monitor national trends in line blockages and operational close calls with the aim of developing mitigation for current and future risks.
- Identify and evaluate present and proposed legislation or policy external to Network Rail (eg ORR, EU) that could affect how line blockages are managed.

⁴⁸ www.rica.uk.com.

Appendix E - Track worker fatalities 1997 to 2016

Date	Fatalities	Location	Person	SSOW	Details
10/03/1998	2	Ebbw Jcn	Worker	Red zone – lookout	Gang working on two sets of points. Although lookout sounded a warning, two men working on a set of points (near noisy equipment, with ear protection and separated from lookout) did not move to a place of safety and were struck by the train.
03/11/1998	1	Darlington North Rd	IWA	Red zone – IWA / mobile	Worker was walking in four foot of single line for a bridge inspection and was struck by train from behind at Haughton Road bridge.
09/05/1999	1	Edge Hill East Jcn	Worker	Possession	Tamping supervisor engaged in tamping operations on down fast line was struck by train making a propelling move on up fast line. Work was within possession.
20/05/1999	1	Stafford	IWA	Red zone – IWA / mobile	Patrolman struck by train whilst he was lubricating points.
09/10/2000	1	Vauxhall	Blockman	Possession set up	Worker struck by train – sent to place possession protection.
10/10/2000	1	Bradford Mill Lane Jcn	Lookout	Red zone – IWA / mobile	Lookout struck by train. The team of three were replacing a broken fishplate in a red zone.
18/07/2001	1	Purley Oaks	Lookout	Red zone – IWA / mobile	Lookout for a group who were undertaking ultrasonic testing struck by a train. A converging space between adjacent tracks was used as a place of safety without a safe limit being marked.
10/08/2001	1	Desborough	Worker	Possession with adjacent line open	Worker struck by train. Considered that adjacent open line was blocked. No safe system to cross adjacent open line.
28/10/2001	1	Waterloo (Main)	COSS	Red zone – IWA / mobile	COSS struck by train. He crossed over three other lines to points which were outside of the protection of which he was the COSS and in the process of giving up for no obvious reason.
19/12/2001	1	Hitchin	Worker	None	One of a group of three Jarvis S&T staff walking on the track was struck by train when he strayed into its path. No SSOW, getting access to signalling locations not properly considered.

Date	Fatalities	Location	Person	SSOW	Details
20/06/2002	1	Cheddington	Worker	Possession with adjacent line open	Crossing open lines to get to a possession. Acknowledged train on Down Slow and was struck by train on Up Slow.
05/04/2005	1	Newbridge Jcn	Lookout	Red zone – IWA / mobile	Lookout struck by train. Lookout standing in four foot of Bathgate branch, seems to have assumed approaching train was routed on Glasgow main line.
11/06/2005	1	Acton Main Line	Worker	Possession with adjacent line open	Got off train to clear equipment away from adjacent open line.
26/10/2005	1	Trafford Park West Jcn	COSS	None	COSS and one other crossed to the six foot between the arrival and departure roads. The COSS was struck by a train passing the site on the up line.
29/04/2007	1	Ruscombe Jcn	Worker	Red zone – lookout	Struck by empty coaching stock as it changed route – victim was carrying out welding and did not move clear.
29/11/2007	1	Reading	Blockman	Possession set up	PICOP's assistant struck by train during giving-up of possession.
02/12/2009	1	Whitehall Jcn, Leeds	Lookout (distant)	Red zone – lookout	Distant lookout – died of his injuries after being struck by empty coaching stock.
04/12/2012	1	Saxilby	COSS	Line blockage adjacent to open line	COSS struck by train on adjacent line. SSOW required adjacent line to be blocked. COSS acting as site warden.
22/01/2014	1	Newark	Lookout (distant)	Red zone – lookout	Lookout struck by train after traversing crossover.

Note: This table uses data originally presented in the paper 'Do rules keep track workers safe?', David Shirres (2010).

Appendix F - Incidents involving track workers working outside possessions occurring in 2015

Date	Time	Location	CCIL Ref.	SMIS Ref.	Method of protection (from OCC dataset)
11/01/2015	08:21	Stalybridge	1220196	QNW/2015/JAN/183	TS1 line blockage ⁴⁹ - no additional protection
16/01/2015	06:05	Blackburn Bolton Junction	1224266	QNW/2015/JAN/356	TS1 line blockage - no additional protection
21/01/2015	00:59	Shortlands Junction	1224266	QSE/2015/JAN/861	TS1 line blockage - no additional protection
29/01/2015	10:52	Southall	1227623	QGW/2015/JAN/271	Red Zone Working - Lookout
02/02/2015	12:13	Evanton (AIness)	1229129	QSC/2015/FEB/14	Red Zone Working - Separated
06/02/2015	10:10	Between Stanford-Le-Hope and Pitsea	1230913	QSE/2015/FEB/241	Red Zone Working - Lookout
06/02/2015	09:36	Faversham	1230885	QSE/2015/FEB/244	Red Zone Working - Lookout
19/02/2015	13:07	Lancaster North	1235875	QNW/2015/FEB/442	TS1 line blockage - no additional protection
24/02/2015	10:00	Greenford East Junction	1237688	QGW/2015/FEB/224	TS1 line blockage - no additional protection
03/03/2015	09:00	Between Hilgay / Black Horse Drove LC	1240428	QSE/2015/MAR/106	Red Zone Working - Lookout
04/03/2015	08:22	Redhill	1240810	QSE/2015/MAR/199	Red Zone Working - Lookout
09/03/2015	09:27	Liandeilo Junction	1242881	QWA/2015/MAR/58	Red Zone Working - IWA
12/03/2015	10:50	Sandwell and Dudley	1244132	QNW/2015/MAR/298	Signalling Trains - Normal
17/03/2015	11:05	Goring & Streatley station	1245933	QGW/2015/MAR/183	Red Zone Working - Lookout
25/03/2015	10:37	Arlesey	1249000	QNE/2015/MAR/681	General Infrastructure Maintenance (No Protection Needed)
25/03/2015	11:50	Thornaby	1249030	QNE/2015/MAR/666	TS1 line blockage - no additional protection
31/03/2015	10:15	Chiltern Green (Luton Hoo)	1251393	QNE/2015/MAR/854	Red Zone Working - LOWS
08/04/2015	16:12	Rugeley	1254626	QNW/2015/APR/177	General Infrastructure Maintenance (No Protection Needed)
11/04/2015	12:20	Reading TCD	1244132	QGW/2015/APR/121	General Infrastructure Maintenance (No Protection Needed)
15/04/2015	13:21	Great Chesterford	1257506	QSE/2015/APR/598	Red Zone Working - Lookout
15/04/2015	10:15	Cambridge	1257428	QSE/2015/APR/594	TS1 line blockage - no additional protection
16/04/2015	14:47	East Croydon	1258019	QSE/2015/APR/645	Red Zone Working - Lookout
19/04/2015	23:04	Lewisham (Courtthill Loop Jn)	1259267	QSE/2015/APR/787	TS1 line blockage - no additional protection
20/04/2015	11:02	Witley	1259440	QSE/2015/APR/867	TS1 line blockage - no additional protection
21/04/2015	10:39	Penstrowed UWC (Newtown Stn)	1259901	QWA/2015/APR/171	TS1 line blockage - no additional protection

⁴⁹ Refers to 'General Signalling Regulations', Rule Book module TS1.

Date	Time	Location	CCIL Ref.	SMIS Ref.	Method of protection (from OCC dataset)
29/04/2015	10:41	Canton Sidings (Ninian Park)	1263086	QWA/2015/APR/226	General Infrastructure Maintenance (No Protection Needed)
14/05/2015	13:24	Lincoln Flyover, Doncaster	1268979	QNE/2015/MAY/356	General Infrastructure Maintenance (No Protection Needed)
18/05/2015	10:30	Stukley, Doncaster	1270544	QNE/2015/MAY/462	Red Zone Working - Lookout
19/05/2015	10:06	Northam Junction	1270838	QSE/2015/MAY/968	General Infrastructure Maintenance (No Protection Needed)
04/06/2015	22:45	Sankey (Earlestown) Viaduct	1277464	QNW/2015/JUN/102	TS1 line blockage - no additional protection
10/06/2015	08:46	Clapton Junction	1279567	QSE/2015/JUN/509	Red Zone Working - Pee Wee
10/06/2015	12:40	West Brompton	1279640	QSE/2015/JUN/494	T3 Possessions
10/06/2015	12:08	Droitwich Spa	1279627	QGW/2015/JUN/147	General Infrastructure Maintenance (No Protection Needed)
14/06/2015	12:07	Wimbledon	1281334	QSE/2015/JUN/717	General Infrastructure Maintenance (No Protection Needed)
23/06/2015	13:15	Milverton Junction	1284677	QNW/2015/JUN/662	T3 Possessions
24/06/2015	01:57	Chadwell Heath	1285530	QSE/2015/JUN/1340	General Infrastructure Maintenance (No Protection Needed)
01/07/2015	09:12	Kilsby Tunnel (Welton)	1288500	QNW/2015/JUL/5	TS1 line blockage - no additional protection
02/07/2015	08:24	Llandudno Junction	1289133	QWA/2015/JUL/12	TS1 line blockage - no additional protection
02/07/2015	08:51	Dovey Junction	1289139	QWA/2015/JUL/13	Red Zone Working - Fenced
08/07/2015	11:59	Moorthorpe	1291701	QNE/2015/JUL/246	TS1 line blockage - no additional protection
16/07/2015	11:10	Milton Junction, Didcot (Steventon)	1294967	QGW/2015/JUL/183	TS1 line blockage - no additional protection
30/07/2015	11:05	Norwood Junction	1302383	QSE/2015/JUL/1678	Red Zone Working - Lookout
30/07/2015	11:55	Lostock Hall Junction	1300525	QNW/2015/JUL/847	TS1 line blockage - Detonator
04/08/2015	08:38	Norwood Cable Depot LC	1302360	QSE/2015/AUG/102	Red Zone Working - Lookout
05/08/2015	10:13	Between Carlisle and Carlisle London Rd	1302809	QNW/2015/AUG/124	Red Zone Working - Lookout
06/08/2015	14:51	Norton (R/G) Level Crossing	1303284	QNW/2015/AUG/157	TS1 line blockage - no additional protection
12/08/2015	12:37	Durham	1305653	QNE/2015/AUG/319	TS1 line blockage - no additional protection
15/08/2015	15:58	Micklefield	1306984	QNE/2015/AUG/404	Red Zone Working - Lookout
17/08/2015	12:53	West Allerton	1307660	QNW/2015/AUG/464	Signalling Trains - Normal
24/08/2015	10:30	Annbank	1310460	QSC/2015/AUG/364	General Infrastructure Maintenance (No Protection Needed)
24/08/2015	12:35	Leicester Humberstone Road Jn	1310496	QNE/2015/AUG/668	Red Zone Working - Lookout
03/09/2015	12:25	Flitwick Junction	1314345	QNE/2015/SEP/53	Red Zone Working - Lookout
09/09/2015	15:29	Willingdon Jn (Cross Levels Way bridge)	1316655	QSE/2015/SEP/396	Red Zone Working - Lookout

Date	Time	Location	CCIL Ref.	SMIS Ref.	Method of protection (from OCC dataset)
21/09/2015	11:43	Tottenham Hale	1321071	QSE/2015/SEP/1033	Red Zone Working - Lookout
22/09/2015	11:16	Hitchin Cambridge Junction	1321458	QNE/2015/SEP/547	Red Zone Working - Lookout
23/09/2015	14:21	Godalming	1321914	QSE/2015/SEP/1150	Red Zone Working - Lookout
24/09/2015	12:46	Slough	1322262	QGW/2015/SEP/253	Red Zone Working - Lookout
04/10/2015	11:10	Mossend South	1325972	QSC/2015/OCT/26	Signalling Trains - Normal
08/10/2015	11:00	Colwich Junction	1327588	QNW/2015/OCT/176	Red Zone Working - LOWS
13/10/2015	12:17	Chelmsford Brick House Crossover	1329458	QSE/2015/OCT/515	Red Zone Working - Lookout
16/10/2015	10:05	Blackhorse Drive R/G crossing	1330595	QSE/2015/OCT/663	Red Zone Working - IWA
19/10/2015	14:00	Acton Wells Junction		QSE/2015/OCT/1401	Red Zone Working - Lookout
20/10/2015	13:13	Stockton Cut Junction	1332027	QNE/2015/OCT/466	TS1 line blockage - no additional protection
21/10/2015	04:32	Letchworth Carriage Sidings	1332776	QNE/2015/OCT/648	TS1 line blockage - no additional protection
23/10/2015	11:02	Selhurst Depot	1333374	QSE/2015/OCT/927	General Infrastructure Maintenance (No Protection Needed)
03/11/2015	02:35	Chathill Crossovers (Fallodon LC)	1338108	QNE/2015/NOV/64	TS1 line blockage - no additional protection
06/11/2015	09:00	Huntingdon	1339096	QNE/2015/NOV/126	T3 Possessions ⁵⁰
06/11/2015	10:19	Oddingley FPC	1339143	QGW/2015/NOV/44	General Infrastructure Maintenance (No Protection Needed)
01/12/2015	10:00	Slade Green	1350464	QSE/2015/DEC/17	General Infrastructure Maintenance (No Protection Needed)
07/12/2015	12:35	Weig Lane LC	1353050	QWA/2015/DEC/42	Red Zone Working - Lookout
09/12/2015	15:08	Paddington	1353893	QGW/2015/DEC/87	Red Zone Working - Lookout

Notes:

- CCIL refers to the industry's control centre incident log, which is used to record details of operational incidents.
- SMIS refers to the industry's safety management information system, which is managed by RSSB.
- The incidents selected by the RAIB for further analysis as part of this investigation are highlighted in red.

⁵⁰ Refers to 'Possession of a running line for engineering work', Rule Book module T3.

Appendix G - Matrix of common factors

		Factor											
		a	b	c	d	e	f	g	h	i	j	k	l
		COSS distraction (eg work taking priority over SSOW)	The SSOW covered multiple locations / moving worksite	Lack of challenge / cultural issues	Poor communication	Complacency / Over-familiarity	Unfamiliarity / inexperience	Circumstances changed from planned SSOW	Unauthorised downgrading of SSOW / protection	Use of unofficial / informal method of working	Resource issues	Unclear SSOW	Other staff distraction
02/02/15	Evanton	1		1		1		1		1	1		
19/02/15	Lancaster		1		1								1
15/04/15	Great Chesterford	1	1	1	1		1	1	1	1	1		
19/04/15	Lewisham	1			1		1						
21/04/15	Penstrowed	1	1	1		1		1	1	1		1	
29/04/15	Cardiff	1	1	1			1			1			
14/05/15	Doncaster	1		1		1		1	1			1	
06/08/15	Runcorn		1		1	1							1
22/09/15	Hitchin		1		1								1
03/11/15	Chathill					1							

Table G1: Factors identified as being common to 10 selected incidents involving track workers occurring during 2015

		Factor											
		a	b	c	d	e	f	g	h	i	j	k	l
		COSS distraction (eg work taking priority over SSOW)	The SSOW covered multiple locations / moving worksite	Lack of challenge / cultural issues	Poor communication	Complacency / Over-familiarity	Unfamiliarity / inexperience	Circumstances changed from planned SSOW	Unauthorized downgrading of SSOW / protection	Use of unofficial / informal method of working	Resource issues	Unclear SSOW	Other staff distraction
26/10/05	Trafford Park	1		1	1	1				1	1	1	
19/03/06	Manor Park				1		1	1				1	
17/03/07	Tinsley Green Junction			1		1	1			1		1	
29/04/07	Ruscombe Junction			1		1				1	1	1	1
29/08/07	Leatherhead	1	1	1		1	1	1		1	1		
13/11/07	Grosvenor Bridge	1	1	1	1	1				1	1		1
29/11/07	Reading station	1	1			1			1	1			
23/05/08	Kennington Junction	1		1		1		1	1	1			
24/06/08	Acton West				1		1			1	1	1	
30/03/09	Dalston Junction		1	1	1		1			1	1		
02/12/09	Whitehall West Junction					1						1	1
20/03/10	Cheshunt Junction	1	1	1	1	1		1		1		1	1
08/03/11	Clapham and Earlsfield	1		1	1	1	1	1	1	1	1		
12/06/11	Stoats Nest Junction	1		1	1	1		1	1	1	1		1
02/02/12	North Kent East Junction	1	1			1		1					1
16/07/12	Roydon station		1	1			1	1			1		

		Factor											
		a	b	c	d	e	f	g	h	i	j	k	l
		COSS distraction (eg work taking priority over SSOW)	The SSOW covered multiple locations / moving worksite	Lack of challenge / cultural issues	Poor communication	Complacency / Over-familiarity	Unfamiliarity / inexperience	Circumstances changed from planned SSOW	Unauthorised downgrading of SSOW / protection	Use of unofficial / informal method of working	Resource issues	Unclear SSOW	Other staff distraction
06/08/12	Bulwell	1	1			1	1	1	1	1	1		
04/12/12	Saxilby	1		1	1	1		1	1	1	1		
22/03/13	West Drayton				1	1							1
12/07/13	Poole		1			1	1	1		1			1
16/01/14	Bridgeway UWC	1		1	1	1				1	1	1	1
22/01/14	Newark Northgate	1	1	1	1	1		1		1	1		1
24/06/14	Redhill	1		1	1	1		1			1		1
22/09/14	Hest Bank												1
28/12/14	Heathrow Tunnel Junction	1	1	1	1	1	1	1		1		1	
08/04/16	Maesyfelin bridge		1	1	1			1	1	1			
24/06/16	Shawford			1	1	1		1		1	1		1
02/11/16	Surbiton		1		1		1						

Table G2: Factors identified as being common to RAIB investigations and safety digests involving track worker safety

Appendix H - Hierarchy of safe systems of work

H1 The RAIB’s report ‘Dangerous occurrence involving track workers, near Roydon station’, ([RAIB report 07/2013](#)) summarised the planning arrangements for working on or near the line. This included a correlation of the hierarchy of safe systems of work in NR/L2/OHS/019 Issue 8 with the terminology used in ‘A guide to personal track safety’, RT3170⁵¹ (commonly known as the PTS handbook), in descending order of acceptability. This has been updated to include the revised hierarchy from NR/L2/OHS/019 Issue 9, table H1.

NR/L2/OHS/019 Issue 8	NR/L2/OHS/019 Issue 9	Equivalent term in RT3170
1. Safeguarded green zone	1. Safeguarded site of work	Safeguarded
2. Fenced green zone	2. Fenced site of work	Fenced
3. Separated green zone	3. Separated site of work	Site warden warning
4. Red zone with warning given by automatic track warning system (ATWS) [Note: NR/L2/OHS/019 Issue 8 makes no distinction between permanent and portable ATWS installations]	4. Warning systems – permanent, including: <ul style="list-style-type: none"> • Signal controlled warning system • ATWS • Semi-automatic track warning system (SATWS) • TOWS 	Equipment warning
5. Red zone with warning given by train operated warning system (TOWS)		
6. Red zone with warning given by lookout operated warning system (LOWS)	5. Warning systems – human activated equipment	
n/a. Red zone with warning given by automatic track warning system (ATWS) – see note at 4 above	6. Warning systems – portable, including: <ul style="list-style-type: none"> • ATWS • SATWS 	
7. Red zone with warning given by one or more lookouts or COSS/IWA working alone and looking out for him/herself	7. Lookout warning	Lookout warning

Table H1: The hierarchy of safe systems of work in descending order of acceptability

⁵¹ The current version of RT3170 is Issue 9, June 2013.

Appendix J - Network Rail’s definitions of close call and operational close call

Close call (from <https://www.networkrail.co.uk/who-we-are/how-we-work/performance/safety-performance/close-calls/>)

This measure comprises the number of close calls that could be any unsafe act or unsafe condition that in different circumstances could have led to an accident or personal injury or could have resulted in damage to property or equipment but would not introduce risk to the railway infrastructure.

Operational close call (from <https://www.networkrail.co.uk/who-we-are/how-we-work/performance/safety-performance/operational-close-calls/>)

An operational close call is defined as any unsafe act (formerly termed irregular working) or unsafe condition that in different circumstances could have led to an accident or personal injury or could have resulted in damage to property or equipment. These are occasions where no one was hurt or nothing was damaged, but this is more by chance than by the application of systemic controls.

This measure comprises the number of incidents of operational close calls (OCCs) that introduce significant risk to the railway (categorised as potentially significant and potentially severe) based on an evaluation of their actual or potential consequence.

Categories of OCCs

Category	Definition
Protection	An OCC involving the work group (eg Controller of Site Safety (COSS) or a lookout) which results in incorrect or inadequate implementation of a line blockage, working outside of the protection limits or removal of protection. This includes near misses with staff whilst red zone working (areas where trains are still running), staff being slow to clear the line, or a failure to have a safe system of work in place.
Possession	An OCC involving implementation of a possession (ie Person In Charge of a Possession (PICOP), Engineering Supervisor, Nominated Person) which results in the incorrect placement of protection, inadequate or incorrect protection arranged, or irregularity in the removal of protection. Isolation placed incorrectly (ie outside of possession limits or prior to the possession being taken, trolleys placed outside of possession limits).
Operating	Any OCC as a result of an operator (eg a signaller or controller) giving permission for protection to be laid with a train not yet having passed the site of work; signalling a train into a possession / line blockage, vehicles or pedestrians trapped between gates at a level crossing or given permission to cross when the line is not clear; failure to caution trains; miscommunication when the signaller is in the lead; two trains in section; train routed into an isolated section, switching incident.
On Track Machine or Plant / Engineering Train / Equipment	Any OCC involving on track plant or engineering trains or involving incorrect use or placement of equipment or materials, for example unauthorised movements within possessions, machines or plant overturning, unsafe operation of machines or plant, equipment or materials fouling the running line, irregularities involving scaffolding on operational infrastructure.

Appendix K - Network Rail's Lifesaving Rules

Lifesaving Rules (from <http://www.networkrail.co.uk/wp-content/uploads/2016/11/Lifesaving-Rules-Poster.pdf>)

Safe behaviour is a requirement of working for Network Rail. The Lifesaving Rules are in place to keep us safe and must never be broken. We will all personally intervene if we feel a situation or behaviour might be unsafe.

- Working responsibly
 - Plans and permits – Always be sure the required plans and permits are in place, before you start a job or go on or near the line.
 - Right equipment – Always use equipment that is fit for its intended purpose.
 - Training and competency – Never undertake any job unless you have been trained and assessed as competent.
 - Drugs and alcohol – Never work or drive while under the influence of drugs or alcohol.
- Driving
 - Mobile devices – Never use a handheld or hands-free phone, or programme any other mobile device, while driving.
 - Speed limit – Always obey the speed limit and wear a seat belt.
- Working with electricity
 - Test earths – Always test before applying earths or straps.
 - Test equipment – Never assume equipment is isolated – always test before touch.
- Working at height
 - Safety harness – Always use a safety harness when working at height, unless other protection is in place.
- Working with moving equipment
 - Exclusion zone – Never enter the agreed exclusion zone, unless directed to by the person in charge.

Appendix L - Network Rail's fair culture principles



Principles of a Fair Culture

Network Rail, the RMT, the TSSA and Unite are committed to making sure everyone gets home safe, every day. To help make this possible, we have jointly agreed to the following principles of a fair culture.

Behaviours

- ▶ It will be clear to everyone, through the Lifesaving Rules, what behaviours are expected of them at work
- ▶ We aim for a fair culture where we can have honest and open discussions about safety
- ▶ Reporting will be encouraged, valued and listened to
- ▶ Anyone who reports a near miss, unsafe behaviour, unsafe condition or unsafe asset should be able to do so in a blame-free environment and will be supported by the company
- ▶ Failure to report an incident, near miss, unsafe behaviour, unsafe condition or unsafe asset is unacceptable

Consequences

- ▶ There will be consistent messages, processes and agreed consequences applied to any breach of a Lifesaving Rule
- ▶ All potential breaches of a Lifesaving Rule will be properly investigated in a fair and transparent manner with Trade Union involvement
- ▶ Where outcomes from an investigation determine further action is required then they shall be subject to a separate process
- ▶ No action against workers will be taken without recourse to a fair and transparent process
- ▶ Disciplinary action or sanctions against a worker shall as a minimum include an investigation, a hearing and, where necessary, an appeal with the right to Trade Union representation for its members at the hearing and appeal, and observation at the investigation

Network Rail, the RMT, the TSSA and Unite are committed to ensuring *Everyone gets home safe, every day.*

Mark Carne
Chief Executive
Network Rail

December 2014

Mick Cash
General Secretary
National Union of Rail,
Maritime and Transport
Workers

December 2014

Manuel Cortes
General Secretary
Transport Salaried
Staffs' Association

December 2014

Tony Murphy
National Officer
Unite

December 2014



Appendix M - RAIB investigations and safety digests

- M1 A brief summary is provided of relevant RAIB investigations and safety digests. These have been filtered to exclude incidents that did not affect safety of track workers, were related to possessions, involved shunting in sidings or did not involve moving trains.

Trackworker fatality at Trafford Park, 26 October 2005 (RAIB report 16/2006)

- M2 A train travelling between Liverpool and Manchester struck and fatally injured a railway track worker at Trafford Park West Junction. The track workers who were involved in the accident were not aware of the approach of the train and therefore took no action to move towards a position of safety.
- M3 The investigation found that they had accessed the line in an unplanned and uncontrolled manner; no COSS was appointed; there was no defined, appropriate and adequate SSOW for the inspection task being undertaken; none of the three staff involved, who were all COSS certificated, challenged the inadequate safety arrangements; and the staff were preoccupied with the technical tasks to the exclusion of other considerations.

Possession irregularity near Manor Park, 19 March 2006 (RAIB report 26/2007)

- M4 A train travelling between London Liverpool Street and Ipswich struck two wheelbarrows as it approached Manor Park station at over 80 mph (129 km/h) under clear signals. The staff on the track with the wheelbarrows had been able to jump clear, but two members of staff were injured.
- M5 The investigation found that the COSS had established the worksite under the impression that it was protected by a possession, which was in fact given up very shortly after work started. The SSOW was for a different location, and the planning process had not identified the effect that changes to the planned possession would have on the work. Poor planning and inadequate communication between the various parties were significant factors.

Near miss involving a track worker at Tinsley Green Junction, 17 March 2007 (RAIB report 43/2007)

- M6 A track worker engaged in welding work on a set of points had to dive out of the way of a train travelling from Brighton to Watford Junction as it traversed a crossover from the up fast to the down slow line at about 50 mph (80 km/h). The train struck welding rods that had been left behind by the welder.
- M7 The welder, who was also the COSS for the group, had implemented a SSOW which did not take account of the possibility that trains would be routed across the crossover. He had only limited experience of Red Zone working, and was accustomed to rely on a lookout observing the position of points to determine whether approaching trains were routed towards the site of work. He also lacked local knowledge of the junction where he was working.

Track worker fatality at Ruscombe Junction, 29 April 2007 (RAIB report 04/2008)

- M8 This accident occurred in similar circumstances to the near-miss at Tinsley Green. A welder working on the crossing nose of a set of points was struck and fatally injured by an empty passenger train travelling from Old Oak Common to Reading, which was crossing from the down main to the up main line at 66 mph (106 km/h).
- M9 The welder had been warned of the train's approach, but continued to work because he believed that it would not travel over the line on which he was working. He was not the COSS for the group, but he was the senior member of staff and the COSS and the lookout both looked to him for professional guidance. The group had an informal method of working that was intended to maximise the time available for welding. The welder may have believed that the COSS was observing the lie of the points to determine the route of approaching trains.

Accident at Leatherhead, 29 August 2007 (RAIB report 19/2008)

- M10 During track patrolling (inspection) work at the junction south of Leatherhead station, a track worker was struck and injured by a train from London Waterloo to Guildford, travelling at about 25 mph (40 km/h). He had remained in the space between the up and down Bookham lines as trains approached on both of those lines.
- M11 The investigation found that the sighting distances available at that location were inadequate, and therefore red zone working should have been prohibited in the area. The SSOW was inadequate, and local working practices did not comply with the rule book. These deficiencies had not been identified by the local management.

Track worker struck by a train on Grosvenor Bridge, London Victoria, 13 November 2007 (RAIB report 19/2009)

- M12 A group of three track workers was conducting a track patrol from Battersea Pier Junction towards London Victoria station. Shortly after they had crossed Grosvenor Bridge over the river Thames, walking in the four foot of the down Chatham fast line and the wide way between that line and the up Chatham fast line, a train on the up Chatham fast line travelling at about 27 mph (43 km/h) struck a track spanner being carried by one of the group (the COSS), who was seriously injured.
- M13 The group were working under lookout protection applying to trains on the down Chatham fast line, and the COSS had moved away from that line towards the up line which he was also required to observe. The COSS did not respond to the warning horn sounded by the train driver, and communication between the COSS and the lookout was poor. The COSS may have been distracted by the presence of a trainee team member and the close working relationships within the group.
- M14 The arrangements for track patrolling in the area did not take account of the need to examine adjacent lines which were hidden by bridge girders from the line on which the patrol was walking.

Fatal accident to a track worker east of Reading station, 29 November 2007 (RAIB report 21/2008)

- M15 Early on a very wet morning, a track worker who had just removed the detonator protection associated with a possession on the up and down relief lines, was struck and fatally injured by an empty passenger train travelling at 49 mph (78 km/h) on the up relief line. He was walking in the four foot facing the oncoming train, and his forward vision was probably obscured by the umbrella he was using. He was unable to reach a position of safety in sufficient time when a train approached.
- M16 The track worker had informed the PICOP that he was clear of the line before he had actually left the track, thereby not adhering to the SSOW. There was an unusually short time between the removal of the detonator protection and the arrival of the first train.
- M17 The track worker's behaviour had not been observed or identified by his line manager, and there was a heavy workload and lack of robust safety management processes at the Reading depot, which led to managers being unaware of deficiencies in the local working practices.

Serious injury sustained by a signal technician at Kennington Junction, 23 May 2008 (RAIB report 29/2009)

- M18 A signalling technician carrying out a facing point lock test on a points machine was struck and seriously injured by a passenger train travelling at 89 mph (143 km/h). He was one of a group working under lookout protection; however the work had taken longer than expected and darkness had fallen. The group were working on the down line, and the lookout was on the up side. They had not moved to a position of safety clear of the down line when the lookout warned them of an up freight train, and as this train passed it prevented the lookout from giving a warning for a down passenger train which was also approaching. This train struck the team leader as he was replacing the cover of the point machine, with his back to the approaching train.
- M19 The team leader, who was also the COSS, had become focused on completing the task and did not maintain a SSOW as the light deteriorated. His actions were not challenged by any of the team members.

Collision between a passenger train and two rail-mounted grinding machines at Acton West, 24 June 2008 (RAIB report 15/2009)

- M20 Three members of a grinding team placed two rail-mounted grinding machines on the up relief line east of the crossovers at Acton West Junction, intending to push them towards Ealing Broadway. While they were waiting for permission from the COSS to move the machines, a passenger train from Reading to London Paddington ran through the crossovers and struck the machines.
- M21 The COSS was unfamiliar with the area, had no knowledge of the track layout, and did not realise that the access point which the team used was outside the possession limits. He did not check the SSOW pack that he had been issued with, which had been prepared by a person who was also unfamiliar with the area and did not take account of the need to move the heavy grinding equipment along the track from the access point to the site of work.

M22 There were no management arrangements in place for checking that the COSS had adequate local knowledge, or for checking the SSOW packs, and the workload of the engineering supervisor was such that he had limited time to focus on the actions of each COSS in his worksite.

Accident at Dalston Junction, 30 March 2009 (RAIB report 30/2009)

M23 A passenger train from Richmond to Stratford, travelling at about 15 mph (25 km/h), struck a lookout who was walking on the track at Dalston Junction, north London. He was struck on the head and thrown to the ground. He was taken to hospital, but was not seriously injured and subsequently made a full physical recovery.

M24 The lookout was working with a mobile gang engaged in inspection work over a three mile (five km) length of the North London line. He had not reacted to the warning sounded by the approaching train. He was not familiar with the area, and did not realise that the railway narrowed from four lines to two at the junction he was traversing. During the work, the COSS and the lookout did not maintain close communication with each other, and at the time of the accident the lookout was about 150 metres ahead of the rest of the group.

M25 The COSS and the work planner were also unfamiliar with the area. The work could have been done in a green zone, but the planner had not appreciated that this was possible. The accident occurred early in a major project to upgrade the railway in the area, and the management of the early stages of the project led to hasty and inadequate planning.

Fatal accident at Whitehall West junction, Leeds, 2 December 2009 (RAIB report 15/2010)

M26 A westbound train struck and killed a track worker as it passed Whitehall West Junction, near Leeds. The track worker, who was standing in the cess with his back to the train, was acting as lookout for a workgroup lifting and packing track at the junction behind him. He was looking for trains travelling in the less-used direction on a bi-directionally signalled line, and had moved close to the track without realising that he had done so. The train driver was unable to judge, until it was too late, that the lookout was too close to the track.

Track worker struck by a train at Cheshunt Junction, 20 March 2010 (RAIB report 06/2011)

M27 A passenger service running from Stansted Airport to London Liverpool Street, travelling at about 30 mph (48 km/h), struck a member of railway staff at Cheshunt Junction in Hertfordshire. The person who was struck was one of a team of eight people carrying out maintenance work on the track, and he was seriously injured. There was no damage to the train or infrastructure.

M28 The track worker who was struck did not move to a position of safety and remained in the path of the train as it passed through the junction. The track worker had not expected the train to follow the route which took it onto the line on which he was working.

M29 No satisfactory SSOW had been established, and staff did not always move to a position of safety when the lookout warned that trains were approaching.

Two incidents involving track workers between Clapham Junction and Earlsfield, 8 March 2011 (RAIB report 03/2012)

- M30 At around 06:00 hrs on a weekday, two gangs of Network Rail track maintenance staff were involved in incidents with trains between Clapham Junction and Earlsfield stations. The gangs were setting up an emergency speed restriction after the discovery of a rail defect earlier that morning. The work was being carried out following the late handback of an engineering possession. There were no casualties, and only minor disruption to train services following the incidents.
- M31 The incidents occurred on the down main fast line. Both the COSSs believed that they had adequate protection from trains but, in both cases, the signaller was unaware of their presence and signalled a train along the down main fast line while staff were still working on the track. The first gang was unexpectedly passed by a train and the second experienced a near-miss with a following train.
- M32 The staff involved did not follow the rules for setting up safe and appropriate systems of work. This was due to a combination of factors including excessive workload, the pressure to complete the work, fatigue and/or tiredness, the complexity of the rules, the absence of checking of the arrangements by a third party, the ineffectiveness of Network Rail's competence management process and a shortage of staff.

Track worker struck by a train at Stoats Nest Junction, 12 June 2011 (RAIB report 16/2012)

- M33 At 05:28 hrs a passenger service running from Gatwick Airport to London Victoria, travelling at about 60 mph (96 km/h), struck a member of railway staff at Stoats Nest Junction on the main line between London and Brighton, about one mile (1.6 km) south of Purley station. The person who was struck was an assistant track section manager, one of a team of ten people carrying out maintenance work on the track, and he was seriously injured. There was no damage to the train or infrastructure.
- M34 The track worker who was struck did not move to a position of safety and remained in the path of the train as it passed the site of the work. Although one of the lines at the site had been returned to use shortly before the accident, having been closed as part of a possession, work continued in the vicinity of that line, and no measures were put in place to protect personnel from the passage of trains on that line. The COSS for the work had been sent to do tasks away from site by the track section manager some time before the accident, and was not aware of the change in the system of work that had taken place.

Track worker struck by passing train near North Kent East Junction, 2 February 2012 (RAIB bulletin 01/2012)

- M35 A passenger train travelling at 34 mph (55 km/h) struck equipment being carried by a member of a work gang who was standing close to the line. The impact pushed the person forward and he suffered minor injuries as a consequence.

M36 The person who was struck had earlier been acting as lookout for a gang engaged in rail weld inspections. At the time of the accident, the work had been completed and the gang members were standing in the cress discussing their next task. The lookout had ceased to watch for trains and had his back to approaching traffic. He did not realise that he was standing too close to the track, and the train struck the flags that he was carrying over his shoulder.

Dangerous occurrence involving track workers, near Roydon station, 16 July 2012 (RAIB report 07/2013)

M37 A passenger service from Cambridge to London Liverpool Street was approaching a bridge just north of Roydon station, Essex, at a speed of 62 mph (100 km/h). As it did so, two track workers had to run from the bridge in order to avoid being struck by the train. The last of these track workers got clear of the railway line around two seconds before the train passed them.

M38 At the time of the incident, these track workers were working on a line which was open to railway traffic. They were being protected by a system of work which relied on a lookout to provide warning of approaching trains. If established correctly, such a system should allow track workers to reach a position of safety at least 10 seconds before a train arrives.

M39 This incident occurred because the group's lookout was not able to give the track workers on the bridge sufficiently early warning of the approach of the train. This was because the COSS responsible for protecting the group from train movements had implemented a system of work which was inappropriate, given the nature of the task and the location in which it was being undertaken.

M40 The system of work implemented by the COSS had been issued by a planner, who had selected it as an appropriate system based on his knowledge of the location and his previous experience of working on the track. It is possible that this incident could have been avoided had the planner sought approval for the system from a more senior person before it was issued, as is required by Network Rail's standards.

Track worker struck by a train at Bulwell, Nottingham, 6 August 2012 (RAIB report 20/2013)

M41 A passenger train from Nottingham to Worksop struck and seriously injured an off-track inspector on the up-down Mansfield line near to Bulwell station, in Nottingham. At the time of the accident, the off-track inspector was undertaking an inspection of lineside vegetation on foot.

M42 The off-track inspector was struck by the train because he was standing too close to the track. His awareness of where he was standing had become reduced as he was focused on determining his location. It may also have become reduced because he needed to concentrate on some elements of the inspection.

- M43 Because the off-track inspector was working on a line open to railway traffic, he had implemented a pre-planned system of work to protect himself from train movements. However, this system of work was unsuitable for the location and task being undertaken. Had the most appropriate type of system of work been planned and implemented, the accident would have been avoided. The off-track inspector did not realise that the system he was using was unsuitable during the inspection, probably due to the way in which it was implemented. He had also not realised it was unsuitable when the system was issued to him prior to the inspection; this was because the information provided to help him check that it was appropriate did not effectively highlight why it was unsuitable.
- M44 This system of work was issued to the off-track inspector because the planner who had prepared it was unfamiliar with the location. Information provided to support her decisions about which type of system to use either did not effectively highlight its unsuitability or was found by her to be impracticable to use given her workload.

Fatal accident involving a track worker at Saxilby, 4 December 2012 (RAIB report 21/2013)

- M45 A train travelling from Scunthorpe to Lincoln struck and fatally injured a track worker at Saxilby, near Lincoln. The individual concerned was acting in the role of COSS at the time of the accident. He was involved in work taking place on one of the two tracks at this location which was closed to rail traffic, but standing close to the adjacent line over which trains were still operating.
- M46 The RAIB's investigation found that the COSS stepped back into the path of the train as it passed the site of work. The following factors led to the accident:
- the COSS had not implemented a SSOW for the task that was being undertaken at the time that the accident occurred;
 - none of the other track workers on site challenged the absence of a SSOW or the actions of the COSS who was working within an unsafe area;
 - the COSS became distracted and did not see or hear the approaching train;
 - no effective action had been taken in response to the involvement of the COSS in two other safety incidents in the two months preceding the accident;
 - the COSS had not been subject to an effective formal performance review by the agency that had hired him for COSS duties for the work taking place on 4 December 2012 and on other occasions; and
 - deficiencies and omissions within the agency's management systems had not been identified by its parent company.

Track worker struck and seriously injured at West Drayton, 22 March 2013 (RAIB bulletin 05/2013)

M47 A passenger train travelling between West Drayton and Hayes & Harlington struck and seriously injured a track worker. The track worker was acting as a lookout, responsible for warning a group of other track workers when trains approached from the Hayes & Harlington direction. The lookout had his back to the train which struck him and he was not standing clear of the line (his right foot was approximately 0.5 metres from the nearest rail). He had not realised that he was standing too close to the line.

Member of staff struck by train near Poole, Dorset, 12 July 2013 (RAIB bulletin 04/2013)

M48 A signalling technician, walking alongside the track a short distance south-east of Poole High Street level crossing, was struck a glancing blow by a train travelling at about 15 mph (23 km/h) that had approached from behind him and which he had not been aware of. He was slightly hurt, but did not require hospital treatment.

M49 The cause of the accident was that the technician did not remain alert to trains approaching from behind him while he was walking alongside the line. He had been briefed that trains could run in both directions on the adjacent up line, but had not registered this as a likely event because he had not seen it happen in that area before (although he had been working on the project for two weeks, he had only done about thirty minutes work on the line east of Poole level crossing before the day of the accident, and had not seen a train use the crossover).

Serious near miss involving a welding gang at Bridgeway user worked crossing, near Shrewsbury, 16 January 2014 (RAIB report 25/2014)

M50 At around 23:58 hrs a passenger train travelling between Crewe and Shrewsbury struck a welder's trolley that had been placed on the line at Bridgeway user worked crossing. The train was travelling at about 85 mph (137 km/h) at the point of collision and stopped in just under 0.5 miles (0.8 km). A track worker, who was on the trolley loading it with tools, jumped clear when he became aware of the approaching train a few seconds before impact. He suffered minor injuries. The train sustained significant damage to its front and to underframe equipment, including the fuel tank, and the trolley was destroyed. Neither the train driver, conductor, nor the one passenger on board the train was injured.

M51 The accident occurred because the trolley was placed on a line that had not been blocked to normal train operations. The COSS had blocked the opposite line on the advice of the welder, who had been misled by the presentation of information in the paperwork describing the safety arrangements for the job. However, the welder later realised that the work was actually on the line that had not been blocked, but he still placed his trolley on that line believing that no train would approach because of engineering work taking place elsewhere in the area. The COSS was not directly supervising the workers when the trolley was placed on the line. Prior decisions made in work planning and resourcing, and the absence of relevant information in the paperwork about the location of the work, contributed to poor decision-making by the track workers on the night of the accident.

Fatal accident involving a track worker, near Newark Northgate station, 22 January 2014 (RAIB report 01/2015)

- M52 Shortly before midday, a track worker was struck by a passenger train as it approached Newark North Gate station. He was part of a team of three carrying out ultrasonic inspection of two sets of points at Newark South Junction and was acting in the role of lookout. The accident happened around 70 metres south of the platforms at the station.
- M53 A few minutes before the accident, the lookout and two colleagues arrived at the yard adjacent to the tracks in a van. One colleague was in charge of carrying out the inspections and the other, the COSS, was in overall charge of the safety of the team. They had planned to carry out the inspections on lines that were still open to traffic in accordance with a pre-planned SSOW. All three had many years of relevant experience in their respective roles and were familiar with the work site.
- M54 Upon arrival at the yard, the lookout and tester proceeded to the track to start the inspection work; the COSS remained in the van. Shortly after they had started the inspection, the 10:08 hrs London to Newark North Gate passenger service approached. It was due to stop in platform 3, which required it to negotiate two crossovers. The train blew a warning horn and the two staff on site acknowledged the warning and moved to the nominated place of safety. However, just before the train moved onto the first crossover, the lookout turned to face away from the train, walked towards the station and then out of the position of safety. He moved to a position close to where he had been before the train approached, most probably to check for trains approaching in the opposite direction, having decided that the approaching train was proceeding straight into platform 1. Although the train braked and blew a second warning horn, the lookout did not turn to face the train until it was too late for him to take evasive action.

Accident involving a track worker near Redhill, 24 June 2014 (RAIB report 06/2015)

- M55 On a fine, warm morning a track worker was struck by a passenger train travelling at about 80 mph (129 km/h), near Redhill on a section of the main line between Brighton and London known as the Up Quarry line. He was the leader of a team of twelve people who were fitting emergency clamp plates to lengths of rail where cracks had been identified during an earlier inspection. The accident happened on the top of an embankment about ten metres high, on a section of line where trains can travel at up to 90 mph (145 km/h).
- M56 The team was doing the work of fitting clamp plates to one of the two lines at the site while trains continued to run on both lines. They were protected by distant lookouts in both directions. At the time the accident occurred, the work had been in progress for about forty minutes. The other members of the team had completed their tasks, and the team leader was engaged in taking measurements for the lengths of replacement rail that would be required at the site. The lookouts had warned the team of the approach of a southbound train, and a short time after this had passed, and before the COSS had given permission for anyone to return to the track, the lookouts gave another warning, for a northbound train.

- M57 At about the time this warning was given, the team leader began to walk along the side of the line, with his back to the approaching northbound train. As he walked, he moved closer to the Up Quarry line, and the train struck him on his right shoulder and threw him down the side of the embankment.
- M58 The RAIB's investigation found that the position of safety the team were using was not adequate because there was no level place to stand, clear of the line. The team leader was unaware of the imminent danger from the approaching train.

Near miss involving gang of track workers at Hest Bank, 22 September 2014 (RAIB report 08/2015)

- M59 Around the middle of the day, a group of nine track workers repairing a section of the West Coast Main Line south of Hest Bank level crossing, near Lancaster, narrowly avoided being struck by a southbound passenger train. Their site of work was located on a bend which restricted visibility of approaching trains. Warning of approaching trains was intended to be given by lookouts, located remotely with good visibility of the track, using a radio-based lookout operated warning system (LOWS). The system had been working normally prior to the incident, but the workgroup did not receive a warning for the incident train.
- M60 The track workers saw the approaching train with just enough time to clear the track before it passed them while travelling at 98 mph (158 km/h). They were shaken by the incident, but not physically injured. All work on the site was stopped for the remainder of the shift.
- M61 The incident was caused because a lookout did not give a warning, either because he operated the wrong switch on his radio transmitter by mistake, or because he forgot about the need to send a warning during an intended delay period between seeing the train and operating the warning switches. This delay was because he was positioned on a long section of straight track and could see approaching trains for significantly longer than the time required for the workgroup to move into a position of safety. A previous RAIB recommendation intended to mitigate this risk had not been implemented due to administrative errors. It is probable that the lookout's vigilance had degraded as he had been working continuously for almost two hours. Although unrelated to the incident, the RAIB identified that a safety-critical element of the LOWS circuitry was not subject to routine testing.

Near miss involving construction workers at Heathrow Tunnel junction, 28 December 2014 (RAIB report 20/2015)

- M62 Two track workers were engaged in placing a small trolley on the Up Airport line when a passenger train from Heathrow Airport to London Paddington, travelling on that line, emerged from a nearby tunnel at a speed of 45 mph (72 km/h). The track workers moved clear of the line seconds before the train struck the trolley and there were no injuries and only minor damage. The incident occurred because the track workers believed the line was closed, a consequence of the group, and their COSS, being accustomed to working in a way which diverged from the mandated site safety system.

M63 This incident, and one the previous day in which workers went on a nearby line without protection while it was open to traffic, and other safety shortcomings found during the investigation, showed that site supervision processes had not identified that deviation from the mandated site safety system had become normal practice. Also, formalised briefings had not been supplemented by any site signage to increase the likelihood of staff being aware of which lines were open.

Near miss involving a group of track workers at Maesyfelin bridge, near Pontyclun, 8 April 2016 (RAIB safety digest 04/2016)

M64 A group of track workers crossing Maesyfelin bridge had either to run off the bridge or to jump onto its parapet to avoid being struck by a passenger train that approached them at 75 mph (120 km/h). There was no position of safety on the bridge.

M65 The SSOW pack did not recognise the limited clearances and the limited sighting distance at Maesyfelin bridge; these meant that it was not possible to implement either of the pre-planned SSOWs included in the pack. An unofficial method of working was therefore adopted in which the lookout was to provide a warning of approaching trains using a hand-held radio. However this unofficial system proved to be ineffective and resulted in the near miss occurring.

Near miss involving a track worker at Shawford, 24 June 2016 (RAIB report 05/2017)

M66 A track worker was crossing the railway and stopped in between the rails of the down fast line to concentrate on a portable electronic device he was holding. He did not respond to warnings sounded by the driver of a train that was approaching him on the down fast line at approximately 85 mph (137 km/h) until it was about two seconds away from him.

M67 The COSS and the track worker had agreed on an unofficial method of working to locate the exact site of a rail defect prior to implementing the pre-planned SSOW. At the time of the incident, the track worker was approximately 200 metres away from the COSS, and the lookout required for implementation of the SSOW was minding the gang's road vehicles close to the access point. The track worker's alertness and decision making were probably impaired by fatigue.

Near miss involving a lookout near Surbiton, 2 November 2016 (RAIB safety digest 06/2017)

M68 An advance lookout was walking between the up fast and up slow lines (in the space known as the 'six foot') when he was passed by trains on both the adjacent lines. There was an interval of approximately 1½ seconds after the passage of the train on the up fast line before the arrival of the train on the up slow line; this allowed the lookout to take evasive action to avoid being struck by either train.

M69 This incident occurred due to poor communication between the COSS and the lookout and the lookout's lack of experience of working in the location.

Appendix M - Relevant previous recommendations made by the RAIB

Investigation	RAIB report	No.	Intent ⁵²	Recommendation text	Theme	Current status ⁵³
Accident at Leatherhead, 29/08/2007	19/2008	4	n/a	Network Rail should review its arrangements for the assessment and monitoring of staff who have to set up safe systems of work, so that there is regular confirmation that they are making appropriate arrangements, particularly for work which moves along the line	Appropriateness of SSOWs	Implemented
Serious injury sustained by a signal technician at Kennington Junction, 23/05/2008	29/2009	2	The intention of this recommendation is to enable staff undertaking a specific maintenance activity to be clear about whether a particular form of protection that they wish to use provides for the safety of staff and trains. In particular it addresses the need to promote a better understanding of when T2 and T12 protection may be used and the restrictions imposed by the Rule Book and Network Rail instructions. It should encompass all forms of protection and regular maintenance activities including facing point lock tests and should clarify any issues relating to the 'safety of the track' and the 'safety of trains'.	Network Rail should introduce a system whereby staff undertaking a specific maintenance activity can obtain clear guidance that a particular form of protection is suitable and provides for the safety of staff and trains. It should include clear guidance on when T2 and T12 protection may and may not be used and their applicability to specific types of work which may affect the 'safety of the track' and the 'safety of trains'.	Appropriateness of SSOWs	Implemented [Note: ORR reported that changes to the Rule Book had clarified the issue identified in the investigation and that changes to Network Rail's work planning system would assist the selection of the correct means of protection. However the issue of the use of additional protection for line blockages remains open (paragraph 81).]

⁵² Later RAIB reports state the intent of each recommendation in order to reduce any ambiguity in the wording.

⁵³ As shown on the RAIB's website: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/574903/Recs_status_report_Sept_16.pdf.

Investigation	RAIB report	No.	Intent	Recommendation text	Theme	Current status
Fatal accident involving a track worker, near Newark Northgate station, 22/01/2014	01/2015	2	The intent of this recommendation is to improve the implementation of Network Rail's procedures for planning safe systems of work, so that the hierarchy of risk is used in the intended way.	<p>Network Rail should:</p> <p>a) introduce sufficient managerial supervision and audit checking to confirm that the standards governing the safety of track workers are being correctly implemented by its delivery units in the planning of safe systems of work (SSOW), particularly in those areas where staff regularly work on lines that are still open to traffic.</p> <p>b) take steps to strengthen any weaknesses it finds, including the re-training of staff involved in planning safe systems of work.</p>	Appropriateness of SSOWs	Implementation ongoing
Track worker struck by a train at Bulwell, Nottingham, 06/08/2012	20/2013	2	The intent of this recommendation is to ensure that the use of Red and Green Zone safe systems of work is being effectively monitored.	<p>Network Rail should review the effectiveness of the current arrangements in place to monitor the usage of Red and Green Zone safe systems of work. It should identify and implement any appropriate measures identified as necessary for this monitoring to be effective.</p>	Data collection and analysis	In-progress
Class investigation into irregularities with protection arrangements during infrastructure engineering work	14/2015	1	The intent of this recommendation is that Network Rail should implement its post-implementation review in such a way as to monitor and assess the impact of its planning and delivering safe work initiative.	<p>Network Rail should ensure that its post-implementation review of the planning and delivering safe work initiative includes the collection of information on events that are indicative of irregular working during infrastructure engineering work. It should then review this information to verify that the initiative has yielded the benefits intended and, if not, to identify and implement measures to remedy this.</p>	Data collection and analysis	ORR/OPB response awaited

Investigation	RAIB report	No.	Intent	Recommendation text	Theme	Current status
Near miss involving gang of track workers at Hest Bank, 22/09/2014	08/2015	1	The intent of this recommendation is to promote a review of working time limits that is consistent with current human factors research.	Network Rail should reassess the working time limits and duration of breaks applicable to lookouts and provide staff with appropriately updated instructions and guidance based on these findings. This reassessment should make use of current research into vigilance activities akin to railway lookout duties.	Human factors	Implementation ongoing
Class investigation into irregularities with protection arrangements during infrastructure engineering work	14/2015	2	The intent of this recommendation is that Network Rail should reduce the risk of engineering protection irregularities associated with railway roles that are not currently being considered as part of the planning and delivering safe work initiative.	Network Rail should develop an action plan to reduce the risk of irregular application of engineering protection arrangements by railway roles that are outside the scope of the current planning and delivering safe work initiative (for instance signallers, persons in charge of the possession and electrical control operators). As a minimum, consideration should be given to ways of reducing the likelihood of: <ul style="list-style-type: none"> protection being set up when lines are open to traffic; errors when arranging for work to be carried out on or near electrical traction supply equipment; the signalling of trains into protected areas; and irregularities involving the operation of level crossings within protected areas. 	Human factors	ORR/OPB response awaited

Investigation	RAIB report	No.	Intent	Recommendation text	Theme	Current status
Collision between a passenger train and two rail-mounted grinding machines at Acton West, 24/06/2008	15/2009	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.	<p>Network Rail should:</p> <ol style="list-style-type: none"> 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; take steps to achieve compliance with the requirements defined in 1a; and conduct a compliance audit after a suitable period of time to confirm that these requirements defined in 1a are being implemented satisfactorily 	Local familiarisation	Implemented
Collision between a passenger train and two rail-mounted grinding machines at Acton West, 24/06/2008	15/2009	3	The intention of this recommendation is to encourage Network Rail to expedite the provision of track layout signage at access points.	<p>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.</p>	Local familiarisation	<p>Implemented</p> <p>[Note: NR advised ORR it was not cost effective to retrofit signs at all access points. It stated it would update NR/SP/OHS/069 to require signs at new access points, which it has not done.]</p>

Investigation	RAIB report	No.	Intent	Recommendation text	Theme	Current status
Accident at Dalston Junction, 30/03/2009	30/2009	1	n/a	Carillion Construction Ltd, through its Carillion Rail business unit, should review its processes for mobilisation of projects following contract award, so that these processes include arrangements for staff to become familiar with the areas in which they will work, and the provision of suitable and sufficient resources to facilitate this.	Local familiarisation	Implemented
Accident at Dalston Junction, 30/03/2009	30/2009	2	n/a	Carillion Construction Ltd, through its SkyBlue Rail business unit, should revise its operating procedures to include processes to enable people supplied to work in safety critical roles to be familiar with the locations where they are to work, either by previous experience or, where this is not the case, with familiarisation by an appropriate means provided by the client	Local familiarisation	Implemented
Near miss involving a track worker at Tinsley Green Junction, 17/03/2007	43/2007	5	n/a	Network Rail should carry out a detailed assessment of the way in which Business Process Document 0019 and Standard Maintenance Procedure 0094 are being applied. This assessment should include a survey of Work Schedulers to assess the extent to which they feel able to question, or challenge, requests made to them. The results of this assessment should be used to inform a review of the effectiveness of the existing management arrangements and steps taken to rectify any deficiencies identified.	NTS	Implemented [Note: NR advised ORR that it was reviewing the two standards - it is unclear what deficiencies may have been identified by this review or what steps would have been taken to rectify these.]

Investigation	RAIB report	No.	Intent	Recommendation text	Theme	Current status
Track worker fatality at Ruscombe Junction, 29/04/2007	04/2008	2	n/a	Network Rail, in consultation with RSSB, should carry out human factors research into the impact of peer pressure, group communications and dynamics on safety decision making in small COSS led work teams. This should include a consideration of how teams are constituted and how a relatively inexperienced COSS can deliver authority, compliant behaviour, leadership and a challenge function. The findings of this research should be used to inform a review of training and management systems	NTS	Implemented
Track worker struck by a train on Grosvenor Bridge, London Victoria, 13/11/2007	19/2009	2	n/a	In order to reduce the risk to track workers, Network Rail should review their programme for provision of automatic warning systems for red zone track inspections and if practicable should implement a programme to accelerate the introduction of appropriate systems for multi track areas.	Provision of warning systems	Implemented

Investigation	RAIB report	No.	Intent	Recommendation text	Theme	Current status
Near miss involving gang of track workers at Hest Bank, 22/09/2014	08/2015	2	The intent of this recommendation is to ensure that LOWS is appropriately positioned within the safe system of work hierarchy, taking account of engineered solutions available to mitigate the risk of a single point of failure due to complete reliance on the action of one lookout.	Network Rail should reassess the safe system of work hierarchy, taking account of evidence from LOWS related incidents and the risk associated with using unassisted (flag) lookouts. If justified by the results of current tests of Semi-Automatic Track Warning Systems, where workforce warnings are initiated using automatic train detection, Network Rail should include such equipment within the hierarchy. If appropriate, Network Rail should specify any circumstances in which this should be used in preference to LOWS.	Provision of warning systems	Implementation ongoing
Track worker struck by a train on Grosvenor Bridge, London Victoria, 13/11/2007	19/2009	1	n/a	Network Rail should propose a change to the Rule Book, in accordance with the Group Standards code, so that all members of a work group have the responsibility to ensure that they receive a full briefing prior to signing the COSS form.	Workgroup responsibilities	Non-implementation [Note: NR advised the ORR that workgroup members already have to sign the SSOW briefing form.]

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