rightTrack

Issue 20 **Summer 2017**

T3 Possessions

Our regular features

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Hello, and welcome to issue 20 of Right Track!

In this issue, find out about the changes to speed restrictions when working within possessions and, following a number of collisions, driving at caution.

We also hear about the dangers that come with driving when fatigued, and Network Rail gives us some behind-the-scenes information on why signals go back to danger.

In our regular features, we look at how workload can affect the risk of having a SPAD; what RAIB had to say about a close call at Shawford; and Colin Brace tells us about his role as a signal sighting engineer.

As ever, we would love to have your feedback on any of the articles in this issue. If you have any comments, please email us at righttrack@rssb.co.uk.

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RAIB Report Brief:
Near miss at Shawford

Two of the most frightening words on the railway are 'near miss'. A close call, too close for comfort, a close shave – it doesn't matter what it's called, we all agree that no one wants to have one. But just after 12:20 on 24 June 2016, that's what happened near Shawford station in Hampshire.

A track worker had gone onto the line try to find a rail defect when a train bore down on him at about 85 mph. The driver sounded the horn. The track worker got out of the way. Neither were injured, but while the driver was fit to continue, the track worker was badly shaken.

It was all due to a breakdown in safety discipline and vigilance. The track worker and COSS didn't implement the required safe system of work (SSoW); and the track worker crossed the track without the COSS's permission. He also got distracted and waited on an open line. This time, it was a near miss; but RAIB found a similar breakdown in safety discipline and vigilance when it investigated the fatality at Newark North Gate in 2014.

At Shawford, RAIB said it was likely that the track worker's alertness and decision-making ability had been affected by fatigue – he'd slept in his car all week to avoid making long journeys to and from home each day. Another possible underlying factor was that the rail testing and lubrication section within the Network Rail delivery unit involved was not resilient: it may not have been able to cope with a loss of resources or a sudden increase in workload.

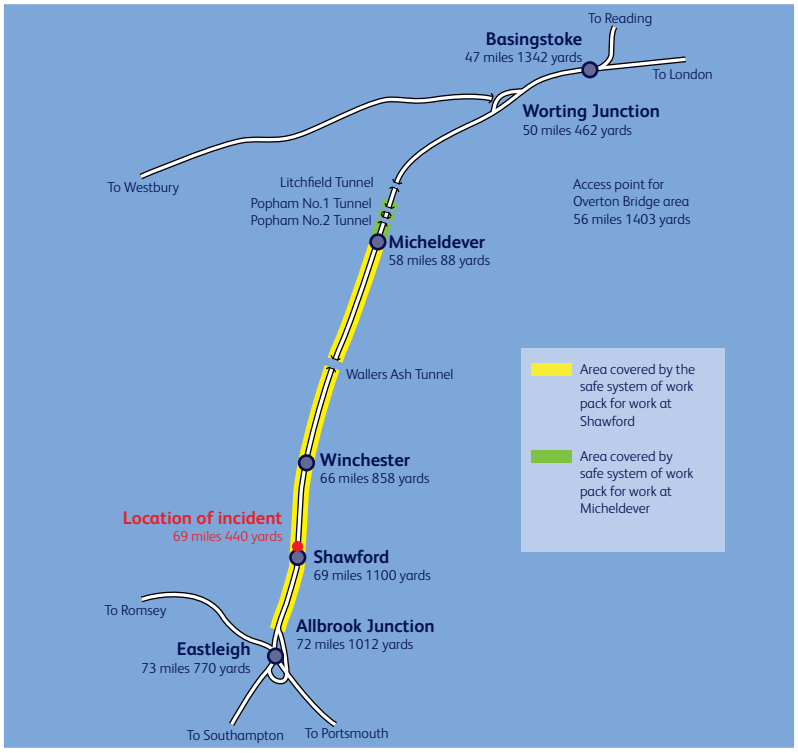
RAIB observed that the way in which the section carried out SSoW planning for its staff was not compliant with Network Rail's processes, and that neither the COSS nor the track worker reported their involvement in the incident at the time.

These images are taken from the forward-facing CCTV camera on the train.

To read the full report, search 'RAIB Shawford' in your search engine.

For more information on the Newark North Gate incident, search 'RAIB Newark North Gate'.

To have look at the relevant Rule Book modules and standards, go to www.rssb.co.uk/railway-group-standards



RAIB identified these key learning points:

- Your COSS / Safe Work Leader (SWL) must brief their group and implement the SSoW provided for working at a location whenever going on or near the line, even if it is just to scope the work activity that the SSoW was intended for.
- Staff should receive a briefing from the COSS / SWL on the SSoW for working at a location whenever going on or near the line, even if it's just to scope the work activity that they are there to carry out. If you are not briefed by the COSS / SWL, or believe that the proposed SSoW is inadequate, you should raise your concerns with the COSS / SWL and not go on or near the line until these have been addressed.
- Rule Book Handbook 7 (GE/RT8000/HB7) requires your COSS / SWL to always stay with your group, so that they can personally observe and advise everyone until work is completed and their group is no longer on or near the line.
- All staff must watch and listen for trains at all times when crossing an open line, looking up at least every five seconds, and not allowing themselves to become distracted with other tasks or by equipment or devices they are carrying.
- For train drivers, this incident highlights how the early use of a train horn to give an urgent warning (a series of short, sharp blasts) can avert an accident. You must do this when track workers on your line do not immediately acknowledge the initial horn warning and move to a position of safety.
- Network Rail staff are reminded that if they are involved in an operational incident, such as a near miss with a train, they must report it immediately. In the first instance, you should report the incident to Route Control or the controlling signal box. You should then also report it to your line manager.

Newswire

1 May 2017, Germany: ICE derails at Dortmund, injuring 2

The rear two carriages of an 'ICE' electric multiple unit derailed as it arrived at Dortmund Central station. Two people were injured, one of whom required hospital treatment. The line remained blocked, with replacement services provided for passengers, until the following day. The cause remains under investigation.

2 May 2017, France: Refugee electrocuted trying to climb Eurostar heading for UK

At around 05:00 (local time), a refugee was electrocuted while attempting to climb on the roof of a Eurostar service heading for Britain. The unidentified man was killed at the Gare du Nord in Paris, after being hit by a bolt of electricity from overhead power lines.

1 June 2017, South Africa: Driver killed and 50 injured in rear-end collision at Elandsfontein

Just before 06:30 (local time), a passenger train struck the rear of a stationary empty coaching stock formation at Elandsfontein station. The driver of the moving train was killed and around 50 people were injured. It was later revealed that at the time of the incident, trains were being signalled manually between Olifantsfontein and Elandsfontein due to the theft of signalling cables.

Network Rail's actions

In July 2016, Wessex Route briefed all its track workers following three near miss incidents within three weeks during June 2016. Staff who managed Network Rail or contractors' staff working on Wessex Route infrastructure were also given the briefing. It reminded staff that, when going on or near the line, they should always:

- Have an SSoW pack that covers the site of work;
- Have a COSS briefing before starting work;
- Follow the instructions given by the COSS;
- Ask questions if they don't understand.

COSSs were reminded that they must always set up the method of protection needed to protect the safety of the staff under their control. All staff were reminded never to cut corners.

The three near misses also prompted the Wessex Route to do further work on:

- Maintaining the profile and importance of the information given in the near miss briefing;
- Improving staff's understanding of the planning process, including better management supervision through periodic safety inspections;
- Improving risk and behavioural awareness among staff; and
- Introducing new technology to improve track worker safety.

After the Shawford incident, the delivery unit's workforce health safety and environment advisor reviewed many of the SSoW packs that the rail testing and lubrication section planner had issued. They found that many of the packs issued for rail testing contained errors, or had been issued as cyclic packs when the work was not a cyclic task. The section planner was therefore suspended from planning, producing and issuing SSoW packs until he'd received further training. All the cyclical packs were deleted, and staff were briefed to check the new packs issued to them before using them.

As well as this, the delivery unit's senior management team has since increased its planning resources. A second planner has temporarily joined the rail testing and lubrication section, and an additional planner, reporting directly to the senior management team, has been recruited. The delivery unit has also brought in a person who is an experienced signaller to assist with planning line blockages.

In September 2016, the delivery unit's senior management authorised funding to employ two contract rail testers and six contract lookouts for an eight-week period within the section. The use of these contractors has continued while the senior management team work to resolve the section's shortfall in resources following the creation of an 'outer delivery unit'. Since February 2017, for one week out of every four, the senior management team has also employed a contract rail tester and lookouts to mitigate the spikes in workload generated by ultrasonic test trains.

More widely, Network Rail is revising its standards for the management of fatigue, so that it will have one standard for all its employees. It'll include a requirement that door-to-door time shall not be planned to exceed a maximum of 14 hours. It also proposes that, while there's no maximum travel time within the 14-hour limit, managers should minimise travel time as far as reasonably practicable, and in cases where travel time cannot be minimised below two hours (in total), working time shall be adjusted so the 14-hour door-to-door time limit isn't exceeded.

6 June 2017, US: Passenger train derails at Chicago station, Illinois, 2 injured

A commuter train derailed as it arrived at Millennium station in Chicago. The incident occurred at low speed. Two people sustained minor injuries. Reports suggest that the train came off on points, but the precise cause is not yet known.

15 June 2017, US: Freight derails in Dubuque County, Iowa, no reported injuries

In the evening, seven wagons from a Canadian Pacific freight derailed near the Mississippi River and Waupeton Road in Sherrill, Dubuque County. None of the vehicles were carrying hazardous materials. An investigation has been launched.

23 June 2017, US: Freight derailed by strong winds in Mitchell County, Texas

A Union Pacific freight derailed in Mitchell County, three miles west of Lorraine, Texas. There were no reported injuries. A number of vehicles were involved, some of which ended up in a nearby creek. Initial investigations suggested that high winds, which also brought down power lines in the area, had blown the wagons off the line.

Revised speeds when travelling within a possession

What you need to know if you're an ES/SWL, PICOP, driver, MC, OTP operator, COSS or IWA, or indeed any railway person involved in planning and delivery of engineering work in possessions.

On 1 August 2015 at about 11:11am, a freight train travelling within a work site collided with the rear of a stationary freight train. There were no injuries, but the locomotive and seven wagons of the moving train, as well as 11 wagons from the stationary train, were derailed. There was also substantial damage to the infrastructure.

Over a nine year period up to and including the collision at Logan, there were five serious incidents of similar nature. Even more alarmingly, six months after the Logan collision came incident number six, at Ivybridge, which was almost identical to Logan only at a much lower speed. All the incidents resulted in minor to major train and infrastructure damage. Staff also suffered injuries, some of which were serious, but not severe enough to fall under the major injuries category.

To reduce the risks and potential consequences of collisions in possessions, Network Rail met with all on-track machine and freight operators (OTMs and FOCs) who operated within possessions. They created a working group, which involved possession planners, trade unions and representatives from both RSSB and the ORR. This group considered the incidents, along with any other concerns the group had in relation to possession working arrangements. It became clear that the industry needed further work on:

- Train speeds;
- Travelling at caution
- Safety-critical communication; and
- Who gives the authority for a train to move;

At the group's first meeting it became clear that the 40mph maximum speed within the possession was a major concern. The FOCs viewed this as a target speed; which was not the view of the OTM community. So FOCs and OTMs agreed to download their on-train data, so that the information from this would be analysed and give a better understanding of actual train running speeds.

As the evidence was being gathered over the next few months, it became clear that most possession trains were traveling at speeds well below the 40mph maximum permissible speed. However by July 2016, Network Rail, with London North West Route in the lead, introduced a mandatory 5/15 rule (5mph in the worksite, 15mph for the remainder of the possession) for all trains moving within possessions operating on their Route. In early September 2016, this was introduced for all Routes, although it didn't apply to On-Track Plant (OTP).

The Rules (until December 2017)

The Rule Book states that in a possession you must:

- make the movement at caution
- not exceed 40mph (65km/h) at any point in the journey when entering, making a movement within, or leaving the possession
- make any movement in a work site at no greater than 5mph (10km/h), unless you are given specific instructions by the ES or SWL on the maximum speed to be applied
- be prepared to stop before reaching a handsignal that is being displayed.

When you're driving "at caution" you must follow TW1 section 25 (see box). As well as not exceeding any specified speed (as on the rest of the operational railway), you must also make sure that you're proceeding at a speed which will allow you to stop the train short within the track that you can see. So you must take account of the conditions (such as the distance you can see to be clear), to make sure that you can stop the train short of any train, vehicle, or other obstruction that you see, or the end of your movement authority. The precise speed this is will depend on various factors, including the weight of your train, the condition of the rail, and the weather. The Rule Book upper limits are not target speeds, they're the maximum permitted speed. The actual speed you should drive at has to be influenced by the rules set out in TW1, no matter what type of vehicle or train you are driving.

GERT8000-TW1 Iss 11, section 25

Proceeding at caution

The person responsible: driver

If instructed to proceed at caution, you must, as well as not exceeding any specified speed, proceed at a speed which takes account of conditions (such as the distance you can see to be clear), that will allow you to stop the train short of any train, vehicle or other obstruction, or the end of your movement authority.

The outcome - December 2017 Rule Book change

By July 2016, Network Rail had used the evidence and concerns of the group to put together a paper which proposed changes to the Rule Book instructions regarding speeds in possessions (see Rule Book changes below). It was presented to the Train Operations Management Standards Committee (TOM SC), which deals with standards related to the management of train operations. TOM SC approved these changes to the Rule Book in February 2017; they will come into force in December 2017.

While this was being done, both the FOC and OTM communities agreed to put their own processes in place. These provided clear maximum permitted speeds in both a worksite and PICOP controlled areas, and reinforced the importance of travelling at caution. Both processes are still in place, and will continue to be in force after the Rule Book update in December 2017.

One of the contributing factors in most of the recent collisions we've had within possessions has been the failure to reach a clear understanding between the person giving the instruction and the person receiving it. This has led to incorrect assumptions about the line being clear to a certain point when it was not. If the driver, operator or machine controller thinks the line is clear, it follows that they would also assume it is safe to travel faster, increasing the risk further.

If you are about to give an instruction, challenge yourself about whether you could be implicated in the cause of a collision at a specified travel speed. Keep it simple; give clear instructions to proceed at caution to the exact location you have specified.

Industry briefing

An industry briefing on the changes to Rule Book module T3 and Handbooks 9, 11, 12 and 15 is currently underway. If you are affected by these changes, you will either have already received it; or you will do so soon. The briefing can be found on Safety Central.

Newswire

27 June 2017, US: NY subway train derails 'after striking rail', injuring 34 at 125th Street

At around 10:00 (local time), a subway train derailed at 125th Street station in New York. A reported 34 people were injured, 17 seriously. Around 800 people detrained into the tunnel. A statement from the Metropolitan Transport Authority said the train came off after striking an 'improperly secured piece of replacement rail'. Two maintenance supervisors reportedly face disciplinary action.

28 June 2017, US: Two CSX employees struck and killed by train near Union station, Washington

At around 23:30 (local time), two CSX employees were struck and killed by an Amtrak train close to Union station, Washington. The pair had stopped their own train and climbed down onto the track in order to examine it. There were no reported injuries on the Amtrak service.

2 July 2017, US: Amtrak service derails in Steilacoom, Washington, minor injuries only

A passenger train derailed at Steilacoom, Washington. A reportedly small number of passengers sustained minor injuries. A spokesperson for operator Amtrak said the train had failed to slow for the 40-mph speed restriction on the approach to the Chambers Bay drawbridge. As a result, it came off on the protecting derailer. The driver was later suspended.

What to do: PICOP

If you are a PICOP, you must instruct the driver of each engineering train, or the MC of each item of OTP, to make each rail movement at caution. You should not imply or encourage anything other than to travel at caution to the exact location you've specified. Stating a speed may lead the driver or operator to believe it's safe to travel at that speed. Make sure your instruction is correctly understood.

What to do: driver / MC / operator

As a driver, MC or Operator, you must always proceed at caution so that you can stop safely within the distance you can see the line ahead to be clear. It is your responsibility to avoid colliding with an object in front of you. Do not set off until you are completely satisfied that you fully understand the instruction. Challenge, don't assume.

What to do: ES / SWL

If you are an ES or SWL, as with the PICOP, you shouldn't quote a maximum speed to the driver, MC or OTP operator. It is equally important that you do not imply or encourage anything other than to proceed at caution to the exact location you've specified.

The default speed in your worksite is 5mph. You may authorise movements at a greater speed than 5 mph when necessary in connection with the work.

The only time you must quote a speed is when you have agreed a speed restriction past a site where there are staff working. You will have agreed this with an IWA or COSS as part of their SSoW, as either 5mph or 20mph. For example, your instruction might be 'Driver, you are authorised to travel to and stop at signal W10 on the approach to Whitby CCTV level crossing at 127 miles 34 chains above 5 mph at caution. You must not exceed 20mph past Teal over-bridge at 126 miles 70 chains, where staff are working.' Make sure your instruction is correctly understood by asking the driver to repeat the instruction.

What to do: COSS / IWA

So, if they're all travelling at different speeds, how do you know what speed to use when setting up a Safe System of Work (SSoW)?

In terms of speed restrictions, a possession is no different to the open line. You wouldn't think twice about setting up the SSoW using anything other than the permissable speed of an open line: if it's a 100mph line, you'll use 100mph, regardless of whether the next train will be a 60mph freight train or 75mph stopping passenger service. In a possession, the maximum speed of movements is restricted to 40mph (25mph from 02 December 2017). So we must assume that the next vehicle could approach at the restricted line speed. The answer is therefore 40mph (25mph from 02 December 2017).

4 July 2017, Vietnam: Two killed in crossing collision near Nghi Loc

At 14:00 (local time), a passenger train struck a car at a level crossing in the central Nghe An province's Nghi Loc District. Two of the car's four occupants were killed; the other two were injured. An investigation has been launched.

6 July 2017, US: Passenger train derails at Penn station, NY

At around 21:00 (local time), a commuter train derailed as it neared Penn station in New York. There were no reported injuries among the 100-150 people on board. Passengers told the media that they had felt the unit rock and then come to a halt in the Hudson River Tunnel, just short of the station.

12 July 2017, Italy: 'Trap and drag' incident injures woman in Rome

A woman was injured at Rome Termini station, when her bag strap became trapped in closing train doors and she was dragged along the platform. The media reported that the driver was eating his lunch before departure, and though he acknowledged the transgression, he added that 'in the video it can also be seen that I looked twice in the mirror; I was not reckless.'

SPADtalk: Workload

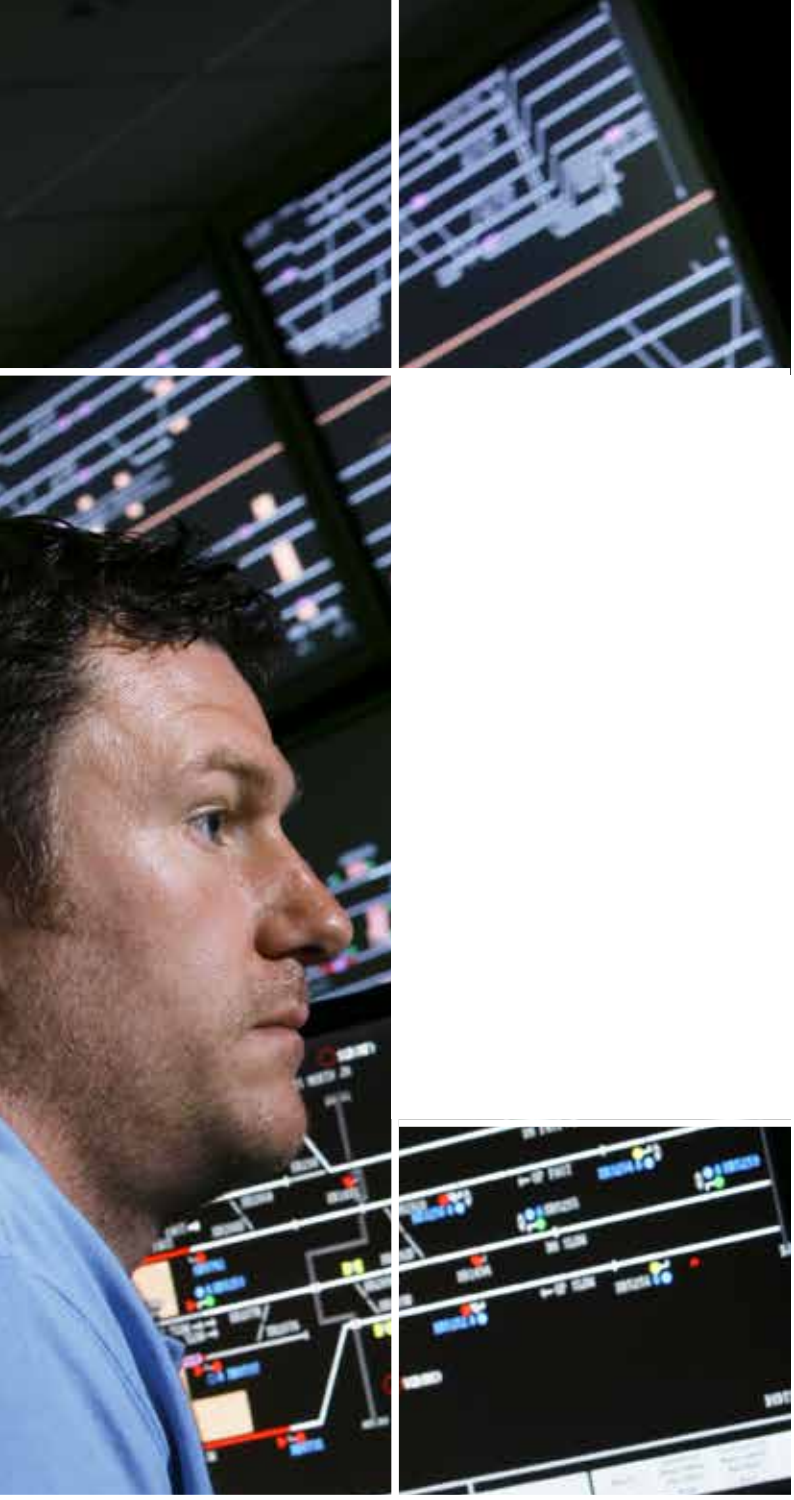
In this, the fifth instalment in our series on the underlying causes of SPADs (see SPADtalk, issue 16), we are shining the spotlight on workload and its contribution to SPADs.

When we think about workload, it's usually to think about how much we have to do, and the amount of information we have to process. So we might find ourselves reminiscing of bygone times when workloads were lighter, and things felt easier. When we hear that workload can impact on the likelihood of a SPAD, it can be easy to conclude that it's because drivers have so much going on that it's difficult to maintain the necessary focus on everything.

Individual tasks add to the workload in routine situations. For example, a driver managing station stops at the same time as running on restrictive aspects, or a signaller prioritising between answering a call and signalling a train, have to give their attention to both the routine task and the one that crops up unexpectedly. Managing short-term conflicts is part of the job, but it can also contribute to the causal chain of an incident.

And it's true, a driver's high workload can impact the probability of a SPAD. But what about a low workload? Not having enough to do can also increase the chance of a SPAD.

In railway roles, fluctuating workloads are often just part of the job. Signallers experience high workload at peak times, or during signalling failures; but sometimes have a much lower workload, such as during a night shift when there is limited engineering work in progress. Station staff are busy during the weekday 'rush hour', or when there's a major event nearby; but not necessarily so much at the weekends. In the same way, drivers can experience high workload, especially when there's an issue on the



network, and low workload when running over long distances on green signals.

It's not necessarily the extremes of high and low workload that impact on SPAD risk. The combination of the two can have an effect. Switching between prolonged high workload and long periods of low workload can lead to a cumulative fatigue effect.

Workload issues are just part of the job – whether that's conflicts from having two tasks to do at the same time, or struggling with boring monotony, or dealing with non-routine situations. We all have to deal with it, but we don't all react to it in the same way.

Fortunately, there are techniques we can apply to help reduce the risks associated with fluctuating workload.

One technique is to consciously prioritise SPAD management during routine tasks. This means choosing to think about SPADs, and constantly bringing your mind back to the signals. For example, in two recent SPAD incidents, one involved a driver who was very focused on station stops; and the other, a driver who was focused on braking techniques. In both cases, the focus of the drivers on one aspect of their driving was a distraction when driving on cautionary aspects. This then directly led to the SPAD incidents.

We can all learn lessons from these examples. Prioritising signal observation, most critically when driving on caution aspects, is essential to avoiding SPAD incidents. To help make sure our workloads are managed safely, we can develop non-technical skills and strategies. These can then be used to lower the impact workload can have on our work: vital, if you're working in a safety critical role.

I'm too tired tonight!

We all experience the nodding head, prickling eyes, struggling to follow a conversation that comes with tiredness; some of us more often than others perhaps. Most of the time it's embarrassing but can be explained away with a brief "the kids were acting up last night" or "I was out celebrating with the lads / girls." Or maybe it comes with a sense of satisfaction because we've been putting in long hours at work.

But there are times when it can be lethal. Television and social media such as YouTube are full of horror crashes caused by drivers who nodded off at the wheel, swerving off the road or colliding into another vehicle. When someone falls asleep behind the wheel, they lose complete control of their car. The vehicle is no longer steered correctly; the brakes aren't applied when something looms ahead. And of course, the higher the speed at impact, the higher the risk of injury – for the driver, their passengers, and others using the road.

So far, it's all pretty obvious. All you have to do is not fall asleep behind the wheel. Well, no argument there. But we are notoriously bad at judging just how tired we are: we might think we can keep ourselves awake, but people behind the wheel nod off sooner than they think they will. And even drivers who don't fall asleep can pose a danger if they're tired.

Studies have shown that when we don't sleep enough, our abilities are affected. It's harder to stay focused on the task at hand, it makes us clumsier, we make poor decisions and, when something does happen, it takes us longer to process it and decide what to do. Lower concentration, reduced awareness and co-ordination, and worse reaction times could lead to a broken cup or a burnt finger when making a cup of tea. But transpose those problems to someone behind the wheel of a vehicle, and the potential outcome is not one you'd want to contemplate.

In fact, research suggests that driving whilst tired can be as dangerous as drink-driving. And, in the same way that you're more likely to lose focus on a boring conversation, boring roads are more likely to make you nod off. A study has found that on motorways and "A" roads, which are among the most monotonous, one in four fatal or serious injury crashes was due to the driver being tired.

> Our body clock, called the circadian rhythm dips and rises at different times of the day. As an adult, you'll feel a strong desire to sleep between 0200 – 0400. Makes sense, that's when most of us are in bed, if we're not on shift. But you may also find yourself wanting some shut-eye in the afternoon between 1300 -–1500, which is rather more surprising.

Newswire

28 July 2017, Spain: 48 injured when passenger train strike stops in Barcelona

At around 07:15 (local time), a train from San Vicenç de Calders collided with the buffer stops at Barcelona's França station. At least 48 people were injured, five seriously (including the driver). Reports suggest the train did not slow for the terminal platform as it pulled in.

July 2017, UK: Crossing collision in Stretham last year leads to jail for car driver

On 12 August 2016, Dimitar Vaclinov's Land Rover was struck by a passenger train at 70mph on Stretham crossing. The farm worker had failed to contact the signaller to get permission to use the interface. The vehicle was thrown from the tracks and Vaclinov was thrown from it, suffering a broken collar bone and fractured skull. The train driver also suffered shock and post-traumatic stress. Vaclinov told police that he did know the procedure for using the level crossing. In July 2017, he was jailed for ten months after pleading guilty at an earlier hearing to endangering the safety of persons on the railway.

So it's little wonder that, faced with potential consequences that are that awful, drivers look for ways of staying awake and alert. One of the favourite methods is having an energy drink like Red Bull, Monster Energy or Relentless. These drinks, and other brands like them, claim to make you more energetic and stop you from being tired. Yet some energy drinks can be high in sugar and low in caffeine, and do very little to help when you are tired. Yes, there's the initial sugar rush which makes you super-alert. But, a study has shown that once this sugar rush wears off after about an hour or so, your reaction times are still affected - but in completely the opposite direction.

The resulting sugar crash can slow your reactions and give you more lapses in concentration, so you're actually less alert than if you hadn't had the drink in the first place. Energy drinks may help athletes, but for us mere mortals who are partial to a bit of caffeine every now and then, a cup of coffee - and a short power-nap – is a better option. Rest is the only proven method for preventing tiredness: a break from a tiring activity, or sleep if your body needs it.

So how do you stay awake behind the wheel? The best way is to plan and prepare for the journey. Whether you're at home or at work, do not drive whilst feeling tired. Take regular breaks while driving, especially if you start to feel tired. If you like a cup of coffee, have one, and try to take a 20-minute nap to allow it to kick in. Share the driving. After all, isn't it better to arrive slightly late than not at all?

What causes fatigue?

Lots of things cause fatigue. Some of them are:

- Lack of sleep
- Irregular or poor quality sleep
- Lack of breaks
- Changing shift pattern
- Sleep disorders, e.g. sleep apnoea
- Medications, which can cause drowsiness

Tips for dealing with fatigue

- Have 8 hours' sleep in every 24-hour period: lack of sleep starts to affect you after 16 hours awake, and sooner if you haven't had enough sleep.
- If you're going on the road, plan your drives Take a break from driving every 2 hours – either stop, or swap with someone who isn't tired.
- Tell your manager if you are on new medication which may cause drowsiness.
- If your job will make you too tired to drive home afterwards, or if driving will make you too tired to work safely, talk to your manager and make other arrangements.

The Lowdown:

Colin Brace, Signal Sighting Engineer, Network Rail

The work of the signal sighting engineer is a bit of a mystery to some people. RSSB's **Martha Parkhurst** went to meet **Colin Brace**, Signal Sighting Engineer at Network Rail, to find out more.

Colin is based at Baskerville House, about 15 minutes' walk from Birmingham New Street. But he doesn't spend all his time there. He is responsible for LNW South, going from south Crewe to London Euston; and as part of his role frequently joins drivers in their cabs: he tries to do this at least once a week.

But what exactly does he do? What is a signal sighting engineer, and what impact do they have on the railway? The short answer is that Colin's aim is to improve the readability of lineside signals and indicators. Pretty vital, as that's what tells drivers when it's safe to go ahead, and when it's not.

Colin has been doing this for 20 years now. He started as a guard in Worcester in 1974; and spent some time as an investigation manager. With this background, he knows the railway, and understands the importance of getting to the bottom of issues to find the root cause.

So how does Colin know when there's an issue with a signal? Well, that's where the cab trips come in handy: he can see what's wrong, and find out from the driver he's with how that impacts the safety of the train. But he will also investigate signals where there's been a SPAD, or when a train operator or maintenance team has made a complaint.

Signals are designed to be seen; so how do they become so hidden?

Colin explains that lot hinges on how the signal fits into its environment: is there something in front of it that hides it; or anything alongside it that could confuse the human eye?

Sometimes it's the railway not considering its infrastructure. For example, new OLE equipment placed in front of an existing signal.

More frequently though, it's the railway's neighbours that can cause an issue. For example, those massive billboards with LED lights that you see sometimes on the motorway. If it's near a line, the signal can look quite dim in comparison, and so your brain has to work harder to find it. Not ideal in a safety-critical environment.

This issue also affects the highways agency and airline pilots. But, Colin says, raising these concerns at the planning permission stage doesn't carry any weight: apparently the court needs hard evidence, not a potential safety concern. But the railway is fighting back. Increasingly, we're using LEDs in our own signals. And we're capturing and monitoring evidence of which signals are easy or difficult to see, so we don't have to use anecdotal evidence when making our case.

Sometimes, the signals themselves can be difficult to read. Drivers have to be aware of the different types and configurations of signals; and, at complex locations, know which signal applies to which line. Semaphores can be hard to read, especially at night; but are being phased out. Gantry signals on curved lines can also be complicated – and they'll be with us for a while longer.

Reading the MARI may be a problem

Sunlight reflecting from a truss arm gives the appearance of an illuminated position 4 junction indicator.

To do the job thoroughly, Colin needs to consider human factors, neuroscience and psychology. After all, the signals need to be read by humans, not robots. If a driver is looking at signals against complex backgrounds, it can cause fatigue as the brain works harder. Colin uses these areas of research to understand the difference between what we see and what we perceive, what risks this can cause, and how they can be mitigated against.

After he's examined a signal, Colin writes a report with suggested alterations. On his bit of the track, that was more than 60 reports in 2016. He also lives and breathes the multi-SPAD list. He used to have 212 signals on that list, but has now lowered that to 21 by improving the signals and learning lessons.

Colin appreciates the social concept of the railways, and believes that if we create the infrastructure, passengers will come. His job ensures that the system is compatible with the driver, which reduces the likelihood of SPADs, and so improves safety, performance and cost efficiency.

As I prepare to make my way back to Birmingham New Street, Colin gives me one last look into what the work involves. The Bullring, which is attached to the station, is covered in mirrors. Every single one of those mirrors has been put through a computer programme to ensure the sun is never reflected in a way that blinds drivers or outshines the signals – whatever time of the year, or day.

Common signal sighting issues

- Signal obscured, for example by another piece of infrastructure or overgrown vegetation
- Signal drowned by neighbouring bright lights (especially at night)
- Signal confused with nearby lights, such as road traffic lights
- Signal lost by strong geometric shapes in the background
- Lack of consistency in how signals are presented.
- Sunlight reflecting on light colours, such as the signal ID board
- Plastic covers degrade over time: visibility has decreased by 30-40 % since BR days.

Some solutions to signal sighting issues

- Keep a constant shape for signal sets when lines run in parallel, so drivers know which signal is theirs each time.
- Make signal boxes bolder
- Install parabolic mirrors to improve strength of signal
- Use banner repeaters to indicate there is a signal ahead

What to do if a signal is difficult to see

- If it's urgent, report it to the signaller immediately
- Raise it with your line manager, who'll pass on your concern to Network Rail.

The road went back!

Sometimes, a signal will unexpectedly return to danger. Network Rail's Operations & Freight Safety Specialist, Ian Muffett gives us an insight into why signals sometimes go back to danger – and what you should do if it happens to you.

Why do signals go back to danger?

A signal will not show a proceed aspect unless the interlocking has proved that it's safe to do so. Hence a signal might go back to danger if something changes after it has cleared. The terminology often used amongst operators is the 'road going back.' This can happen automatically, for example because of a technical issue such as a track circuit failure, or a broken rail, or a blown fuse. Or a level crossing failure; or loss of point detection; or even the line becoming obstructed - perhaps because of a SPAD …

It could also be that the signaller has replaced the signal to danger deliberately in an emergency, as a result of an obstruction: trespassers; a bridge strike; a fallen tree…

Replacing the signal can then avert a catastrophe. But technical faults and emergencies aren't the only reasons signals go back to danger: it is possible that the signaller has accidently replaced it in error.

Can signallers replace any signal to danger?

Controlled signals can be replaced to danger because, as the name suggests, they're controlled by the signaller. Automatic and semi-automatic signals are worked automatically by the passage of trains, so the signaller might not be able to replace these to danger – although more-recently installed ones are provided with replacement facilities. Some signals are not capable of displaying a stop aspect or indication, and can only return to caution, or preliminary caution. More information can be found in RS521 Signals, Handsignals, Indicators and Signs Handbook.

A controlled signal

A signal will not show a proceed aspect unless:

- The track circuit is showing clear
- The points are safe for the movement
- The manual level crossing is closed to traffic

Common types of signal:

- Controlled
- Automatic
- Semi-automatic
- Intermediate block
- Distant signals

What would you expect a driver to do if they witnessed a signal going back to danger?

Well, the driver probably wouldn't know why the signal was suddenly showing a danger aspect. They should immediately stop the train and contact the signaller.

On rare occasions, drivers have continued despite seeing a signal reversion. So, what's the problem? The line ahead looks clear. The next signal is showing a green aspect. So, the signal reversion must have been caused by technical failure. But if the signal had reverted because of an emergency, the consequences for the safety of those on the railway could have been fatal. So, if you're a driver and the road goes back on you – stop immediately and contact the signaller. Don't assume it's a blip and decide to continue because the signals beyond are still showing a proceed aspect. It may be the worst decision you ever make. And possibly the last.