Worldwide FI Summary

September 2013

This is a collation of some of the world’s railway formal inquiry reports. It includes a brief incident synopsis, along with the main causes and recommendations from each investigation. Readers may find some of the actions and recommendations useful to their own operations.

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Key issues in this edition:

- Environmental conditions
- ‘Bad weather’ precautions
- Communications with non-rail agencies
- Plant/unit maintenance and inspection
- Driver competence
- Management check function (SMS)
- Regulation post-safety certificate issue
- Crossing user behaviour – inc distraction
- Crossing visibility – inc effects of sunlight
- Risk assessment
- Signal design
UK: Collision between a passenger train and a washed-out embankment near Knockmore Northern Ireland, 28 June 2012

At around 07:06 on 28 June 2012, a passenger train ran onto a section of washed-out embankment near Knockmore, on the Antrim branch. The driver applied the emergency brake when he became aware of the hazard, but was unable to stop the train before the leading bogie ran over the unsupported rails at the washout. The train came to a stand with the bogies of the leading vehicle either side of the washout. It did not derail and was subsequently reversed away. There were no reported injuries.

RAIB found the immediate cause of the incident to be that a ten-metre section of embankment had been washed away prior to the train’s arrival.

RAIB also listed the following causal factors:

- There was heavy rainfall in the catchment area of the nearby Brokerstown stream on 27 June 2012;
- The culvert system on the Brokerstown stream was unable to cope with the water flows generated by the heavy rainfall, causing water to back up behind the railway embankment;
- The railway embankment could not withstand the differential water levels either side of it and the resulting water flow across the track completely eroded the embankment;
- The train was sent onto the Antrim branch line without additional precautions, despite the heavy rainfall during the previous evening; and
- The driver was unable to see the washout in time to be able to stop the train before it ran onto the unsupported section of track.

The underlying factors were:

- There was no engagement between NIR and the Rivers Agency regarding the potential for flooding due to heavy rainfall around the incident site,
- NIR’s weather preparedness procedure did not include a plan for flooding or heavy rainfall events, and therefore NIR was not in a position to react appropriately to the rainfall event of 27 June 2012.

Recommendations

- NIR, with the assistance of the Rivers Agency, should:
  - Complete the ongoing review of earthworks and structures on its infrastructure with respect to flood risk, including, where necessary, the assessment of the hydraulic capacity of relevant culverts, and identify and prioritise those sites which require mitigating action (eg enhanced monitoring, speed restrictions) in the event of heavy rain or flooding, and the trigger levels for those actions.
  - Develop and implement a formalised procedure for liaison with the Rivers Agency so that NIR is informed of any future developments or changes to watercourses which might adversely affect its infrastructure by an increased risk of flooding.
- NIR should develop its adverse weather procedures in order to address the risks to train operational safety and include the following:
  - Improved weather data collection and dissemination within NIR;
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- Action trigger levels for each type of weather event, the corresponding mitigating actions to be taken (e.g. enhanced weather monitoring, site patrolling, speed restrictions, line blockage) and the nominated person to make those decisions;
- Identification of at-risk locations where special measures must be taken, and the methods and frequency of monitoring at these locations until cessation of the hazard;
- Definition of what safety of line checks should be made before the line is opened at full line speed (e.g. by using the first service train to examine the route at caution, a route proving train or staff on foot);
- Any special measures for infrequently used lines, such as the Antrim branch line.

NIR should:

- Carry out checks to confirm whether drivers are correctly applying the rule book when first reporting incidents, and implement sufficient re-training of its staff as deemed necessary to address any identified areas of deficiency;
- Review the actual quality of safety critical communications between train crew, signallers and controllers in practice, and implement sufficient re-training of its staff to address any identified areas of deficiency;
- Review how it monitors and enforces good practice in communications, and implement any necessary changes to relevant practices and procedures; and
- Implement a system for routinely checking the correct operation of its voice recording equipment.

NIR should put in place a process for the ongoing monitoring and control of weeds on the Antrim branch line, including measures to mitigate the risk to train operations arising from any future missed or ineffective treatments, which result in excessive weed cover that could compromise track inspections, and brief this process out to relevant staff.

NIR should:

- Review the effectiveness of its procedures for checking on the welfare of staff involved directly in an incident or accident and for arranging for their debriefing;
- Develop an integrated accident investigation procedure with common types of investigation and clarity about roles and responsibilities for each type;
- Arrange to have sufficient competent senior management oversight of its investigations so that the full scope of the event which occurred is recognised early, and to supervise the timely collection of relevant evidence (if the RAIB is not attending), set a thorough remit, and review progress; and
- Implement its revised procedures and provide training to relevant staff.

Published 12 September

UK: Dangerous occurrence involving an engineering train at Blatchbridge Junction, 19 March 2012

For the full report, click here.

The incident occurred around 19:27, when an engineers’ train was approaching the junction. The train was made up of a number of engineering vehicles including a track renewal unit (known as a P95 machine). Part of the P95 machine included two control cabs, which were attached to an overhead supporting beam. One of these cabs, weighing around 1.25 tonnes, became detached from the overhead beam and fell to the track below (a distance of around 450 mm).
The unsecured control cab remained loosely connected to its vehicle by electrical control cables and an air brake hose. These helped to guide the control cab in a relatively straight line as it slid along the top of the rails beneath the train, until the train stopped around 1 ½ miles further on. A foot crossing was damaged as the control cab slid along the rails. The control cab itself was significantly damaged and was rebuilt after the incident.

RAIB concluded that the incident occurred because all eight bolts securing the control cab broke. The bolts broke due to a combination of factors, summarised by RAIB as follows:

- When the P95 machine was in its working mode (moving at less than walking pace) the bolts securing the cab experienced very high stress for very short periods. This cycle of strain events occurred several times each shift and caused fatigue in the bolts.
- The fatigue strength of the bolts was reduced by the presence of corrosion on the bolts. The design of the bolt mounting arrangement allowed moisture to reach the bolts.
- Some of the bolts had broken before the incident and maintenance of the P95 had not identified this because the maintenance instructions were not clear and lacked technical detail.
- It is possible that a previous incident adversely affected the fatigue performance of some of the bolts securing the control cab. Other bolts may have been affected by the uneven change in load.
- Following the previous incident the bolts were not inspected because it was believed damage to the control cab was only superficial and the maintenance instructions did not indicate that the bolts needed to be removed for inspection following an incident directly affecting the control cab.

RAIB also noted that the design and maintenance review processes did not identify that the bolts were subject to high stress cycles during the machine’s working mode, that a corrosion trap existed which made the bolts at risk of fatigue failure, and that the maintenance instructions for the P3 cab bolts were unclear.

**Recommendations**

- Network Rail should arrange for the maintainers and operators of its on-track machines to carry out a review of those machines and identify items of attached equipment that have the potential to be a threat to safety should the securing systems fail. For each item identified, the following steps should be taken:

  - Improve the design and/or maintenance arrangements to decrease the likelihood of the securing system failing; or fit secondary retention systems to prevent attached equipment falling onto the track should the securing system fail;
  - Consider the use of movement ‘tell tales’ to help identify bolts that are becoming loose; and
  - Describe the action that should be taken if attached equipment has been subjected to unusual loadings (such as impact or derailment forces) that may have affected the security of the fastening
  - Arrangements (for example, an assessment of the integrity of the fastening arrangements by a competent person).

- Network Rail, in consultation with the maintainers and operators of its on-track machines, should review and improve the maintenance instructions for each machine. As a minimum, the review should include consideration of:

  - The clarity of the description of activities to be performed and the sufficiency of the technical detail included;
  - The provision of key information such as torque settings at those points within maintenance instructions where the maintainer is required to use them;
  - The clarity with which technical terms are described; and
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- Mandating checks to confirm that maintenance technicians are referring to maintenance instructions and that, where prescribed in the manufacturers maintenance instructions, the correct torque values are being used.

- Network Rail should implement a process to require that the owners of all on-track machines that operate on its infrastructure implement measures consistent with the intent of Recommendations 1, 2 and 5.

- Matisa (UK) Ltd should, in consultation with its customers, improve the clarity of the maintenance instructions for its on-track machines. As a minimum, the following improvements should be made:
  - Describe maintenance activities with sufficient technical detail;
  - Define the meaning of key terms that are otherwise open to interpretation such as ‘check the integrity’;
  - Identify which fastenings could pose a risk to safety should they fail;
  - Include key values, such as torque settings, at those points within maintenance instructions where the maintainer is required to use them; and
  - Describe the action that should be taken if attached equipment has been subjected to unusual loadings (such as impact or derailment forces) that may have affected the security of the fastening.
  - Arrangements (for example, an assessment of the integrity of the fastening arrangements by a competent person).

- Network Rail, in consultation with the maintainers of its on-track machines, and taking into account the output from implementing recommendation 1, should enhance the inspection arrangements for its on-track machines by including a periodic cycle of visual inspections of high-risk fastenings (dismantling the mounting arrangement if necessary) to detect the presence of corrosion. Where corrosion of a bolt/fastening is identified, the source of the corrosion should be found and eliminated where possible. Where this is not possible, the relevant maintenance instructions should be enhanced to include the requirement for more frequent replacement of affected bolts/fastenings.

- Matisa (UK) Ltd should modify its processes for designing on-track machines so that it includes the assessment of all modes of operation when designing component mounting arrangements. This includes the mounting arrangements on machines that can operate in a defined ‘working mode’ (i.e. at slow-speed) as well as travelling at higher speeds (i.e. being hauled).

- Matisa (UK) Ltd should communicate the findings from this report to operators and maintainers of P95 machines outside the United Kingdom with advice on necessary measures to reduce the likelihood of the P3 cab becoming detached and falling onto the track due to the failure of the fastening system.

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Published 16 September

UK: SPAD at Stafford, 26 April 2012

For the full report, click here.

The incident occurred at about 13:35, when a locomotive operated by Devon & Cornwall Railways passed signal SD4-81 (Stafford) at danger by about 94 metres.

RAIB’s investigation found that the locomotive had been travelling at excessive speed as it approached the Stafford area. The driver was probably aware that he had been exceeding the maximum permitted
speed for a locomotive running on its own, but he did not make a full brake application as soon as he saw the double yellow ahead of the red.

The driver probably did not have sufficient experience, competence or route knowledge for the task he was performing and Devon & Cornwall Railways had not followed its own process for managing the competence of drivers. The company also had insufficient management controls to ensure compliance with its safety management system.

Furthermore, the ORR had not examined the implementation of Devon & Cornwall Railways’ safety management system following the issue of the company’s safety certificate nearly two years before this incident.

RAIB also noted that the speedometer in the locomotive cab may have ‘partially misled’ the driver.

The RAIB has identified the following key learning point:

_This investigation has identified that vehicle examination and maintenance regimes based on operating hours may not be appropriate for vehicles that spend extended periods in sidings and depots. Railway industry duty holders and the Office of Rail Regulation may therefore wish to give particular attention to the risk arising from the operation of vehicles that are used infrequently on the main line. This risk could be addressed by the inclusion of regular calendar-based examinations or additional pre-use inspections._

**Recommendations**

- Devon & Cornwall Railways should implement formal competence management processes for all safety-critical staff, taking account of best practice in the industry. This should include operational, maintenance and managerial staff, whether permanent or contracted-in. Particular attention should be given to the management of train drivers on ‘zero hours’ contracts and those who drive for more than one company. Devon & Cornwall Railways should subsequently commission an independent review of the arrangements, and audit, to confirm effective implementation. Note: The RAIB has written to Devon & Cornwall Railways to draw its attention to:
  - Potential conflicts of interest which could compromise effective operation of its safety management system(s).
  - Issues relating to the competence of drivers who operate light locomotives, including the learning point the RAIB identified during its investigation of the derailment at Bletchley Junction.

- Devon & Cornwall Railways should implement processes to confirm that locomotives, whether owned or hired-in, have been examined by competent persons and assessed as fit to run before they are released for operational use.

- The Office of Rail Regulation should establish a process for the periodic management review of its assessment of safety certificate applications and the resolution of outstanding issues through supervision. This process should include an evaluation of the extent to which the assessments of applications from new operators are correctly identifying matters for urgent inspection or for refusal of certification. It should also evaluate the effectiveness of post-certification supervision in limiting the risk to the railway in cases requiring urgent inspection.

- The Office of Rail Regulation should satisfy itself as soon as possible, through supervision, that Devon & Cornwall Railways’ revised safety management system has established adequate controls regarding the competence of safety-critical staff, traction & rolling stock maintenance and safety culture.
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- RSSB should amend rail industry standard ‘Management of route knowledge for drivers, train managers, guards and driver managers’, Ref. RIS-3702-TOM, to require an assessment of the training needs of new staff. This should clarify how ‘transferred-in’ route and traction knowledge should be assessed by the new employer. Particular attention should be given to the management of train drivers on ‘zero hours’ contracts and those who drive for more than one company.

Published 24 September

UK: Collision between a train and a car at Beech Hill level crossing, 4 December 2012

For the full report, click here.

At 12:31, a passenger train struck a car at Beech Hill level crossing, near Finningley. One of the occupants of the car, a young child, was seriously injured in the collision and later died in hospital.

The train involved consisted of a single carriage unit and was travelling at 60 mph at the time of the incident. None of the 20 passengers or two crew members.

Equipment beneath the train was damaged in the collision leading to the spillage of diesel fuel from the train’s fuel tank, but there was no fire.

The crossing was fitted with a data logger which showed that the crossing was operating normally at the time of the accident, with the barriers down as the car approached. The car driver stated that she did not see that the wig-wags were flashing as she approached and only noticed the lights and barriers when she was very close to the crossing. The weather was sunny at the time of the collision but there had been rain showers earlier and the road surface was wet, leading to glare from the low winter sun.

RAIB took the wig-wag units and arranged for testing in an optical laboratory. It was found that they were fitted with 36 W lamps and an obsolete design of red lens unit. Their light output was measured to be well below the specification for lights of this type. Network Rail had no plans in place to replace the light units with brighter ones and had no process to identify that such replacement was necessary.

RAIB also listed the following causal factors:

- The visibility of the wig-wags and barriers was poor. This was because of the following factors
  - The environmental conditions,
  - The light output from the red wig-wag light units was lower than specified and was hard to see against the bright sunlight,
  - The light output of the lamps was lower than specified and the red lenses fitted to the wig-wag light units were of an obsolete design that did not meet their specification,
  - The level crossing barrier was not conspicuous against the background when viewed from the north side of the crossing
  - Network Rail did not have a process for checking that existing wig-wag lamps and lenses met their specification.

- Network Rail’s level crossing management process did not adequately recognise and deal with the effect of sunlight on the visibility of crossing equipment; and

Recommendations

- Infrastructure managers should determine which level crossings are fitted with 36 W road traffic light signal (wig-wag) units or with ‘Bliss’ lenses and draw up a time bound plan so that their replacement with LED units is done as soon as possible, those with ‘Bliss’ lenses being dealt with first.
Infrastructure managers should put in place a method of identifying those locations where there is a significant risk from sunlight impairing the visibility of level crossing wig-wags and barriers, propose suitable mitigation measures where appropriate and implement these measures. The method should be based on suitable research and include specific consideration of the possibility of glare, and the wig-wags being seen against a bright background and the barriers against a dark background, taking into account environmental factors and seasonal daytime variations. A programme of training and briefing of the staff carrying out the assessment should be implemented.

Infrastructure managers should, in conjunction with the other industry parties, develop a new type of wig-wag unit with higher luminous intensity than the existing LED units for use at crossings where high background luminance and sunlight glare is a particular problem, and install these units at the appropriate locations.

Infrastructure managers should enhance the inspection and maintenance process for wig-wag lamps to provide assurance that they continue to meet their specified performance standard.

**Published 25 September**

**UK: Train fire at South Gosforth, 8 January 2013**

For the full report, click [here](#).

At around 14:00 on Tuesday 8 January 2013, a train travelling from South Shields to St James on the Tyne & Wear Metro experienced an electrical fault soon after it left South Gosforth station. A fire developed under the rear car as it came to a stand, and smoke entered the passenger accommodation. There were 45 passengers in the rear car, and they used the emergency handles to release the doors, and evacuated themselves onto the side of the line, with assistance from the driver of the train. No-one was hurt, but there was damage to the electrical equipment and wiring of the rear car, and the overhead electrical supply line parted during the fire. The accident occurred on an above-ground section of line; if it had taken place in a tunnel, the amount of smoke that was produced during the fire might have resulted in serious consequences. The fire was caused by a fault within the line breaker case of the rear car, and was sustained because the protection system associated with the electric power supply to the train did not operate until 45 seconds after the fault started.

RAIB concluded that the immediate cause of the accident was electrical arcing following a fault in the line breaker case on the car in question.

RAIB listed the following causal factors:

- A fault developed in the area of line breaker LB1 of car 4052,
- There was no protection against a fault current which develops between the pantograph and the overload monitoring module,
- The fault current was not high enough to operate the primary overload protection system at Benton Square sub-station or the mid-point line relay,
- The inter-tripping equipment between the sub-stations at South Gosforth and Benton Square did not operate.

RAIB also noted two underlying factors:

- Nexus and DBTW did not fully understand the risk associated with line breaker failures and had not assessed the risk from such failures arising from the design of the electrical protection arrangements for the power supplies and the trains; and
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- Nexus had inadequate arrangements for the inspection and maintenance of the inter-tripping system.

Recommendations

- Nexus, supported by DBTW, should carry out a detailed assessment of the risk associated with faults in the line breaker unit, which should include:
  - Identification of actual and potential failure mechanisms and an estimate of their likely frequency;
  - Consideration of the possible effects of line breaker faults, taking account of the configuration and reliability of the electrical protection systems currently provided on the Metro system; and
  - Consideration of possible consequences, taking account of the potential for fire in high risk environments, such as tunnels.

Appropriate actions to reduce the risk and potential consequences of failures should be defined and implemented following the review.

- DBTW, supported by Nexus, should establish the maximum level of force required to enable a diverse range (such as 5th percentile female to 95th percentile male) of passengers to easily operate the emergency door release handles on the Metro car fleet, and implement the necessary inspection and maintenance processes to achieve it in practice, taking account of the need to balance the ease of operation in emergency with the risk of undesired door releases.

- Nexus should review the communication systems used on the Metro network, establish an appropriate level of reliability/availability for them, and implement, in a defined timescale, the introduction of suitable improvements.

Published 26 September

UK: Fatal accident at Bayles and Wylies footpath crossing, 28 November 2012

For the full report, click here.

The incident occurred at around 19:00, when a young person who was using the crossing over the tramway was struck and killed by a tram that was travelling at 43 mph.

The young person moved into the path of the tram as it approached the crossing and appeared to be unaware of its approach. RAIB has been unable to positively establish why she seemingly did not see and react to the approaching tram or respond to the horn. Apart from a break of 0.3 seconds, this was sounded continuously as she walked towards and onto the tram track.

Closed-circuit television coverage from the front of the tram indicates that she did not look towards the tram after she entered the crossing through a chicane on its west side. However, there is no clear evidence to indicate what actions she took at the chicane; it is possible that she may not have looked towards the approaching tram, or looked but not seen it. Furthermore, although there is no direct evidence, it cannot be ruled out that she saw the tram approaching and thought that she had enough time to cross, or that it would stop or slow down.

Bayles and Wylies crossing consisted of two separately managed crossings of the Nottingham tramway and a parallel Network Rail route. Network Rail closed the crossing in February 2013 pending the construction of a footbridge to replace it. This obviated the need for the RAIB to make any recommendations to improve the crossing.
Causal factors

The young person not responding to the sound of the horn of the approaching tram was causal to the accident. Possible factors leading to this are:

- The horn was sounded continuously starting from a distance at which it would have been unlikely to have been audible; and/or
- The young person believed the horn was being sounded by another vehicle in the area.

It is possible that the young person did not look towards the approaching tram when she was at the crossing chicane. Possible factors leading to this, which may have acted singularly or in combination are:

- The young person may have been distracted; and
- The design of the crossing resulting in a weak chicane and no clear demarcation of the crossing boundary.

It is also possible that the young person looked in the direction of Moor Bridge tram stop but did not see the tram. The possible factor leading to this is:

- The glare from the light provided to illuminate the crossing if the young person looked at it momentarily.

Although there is no direct evidence, it cannot be ruled out that the young person saw and/or heard the tram approaching and thought incorrectly that she had time to cross safely, or that it would stop or slow down.

Recommendations

- Where not currently the case, tram operators should review whether it is practicable and appropriate for a series of short, urgent, danger warnings, or other audible warning, to be sounded when there is a person on or close to the line who does not appear to be responding to a tram’s approach. The review should take account of the human factors implications such as the method of operating the warning. Instructions to drivers should be updated accordingly and briefed as necessary.

- Tram operators should review the marking of the boundary of pedestrian crossings crossed by segregated tramways where trams run at relatively high speeds. The review should assess the effectiveness of the means of demarcation in the following respects:
  - Indicating that a pedestrian is entering into a higher risk area; and
  - Prompting pedestrians to look for approaching trams.

- Where appropriate, the review, which should also take account of the emerging findings of RSSB’s research project T984, should include identification of proposals to improve the effectiveness of the means of demarcation. Improvements that are appropriate and practicable should be implemented.

- The Office of Rail Regulation should, in conjunction with the UK tramway industry, ensure that its current guidance to tram operators on pedestrian crossings crossed by segregated tramways where trams run at relatively high speeds is reviewed and amended as necessary. The review should include consideration of the following factors:
The means of indicating that a pedestrian is entering into an area of higher risk; and
The means of prompting pedestrians to look for approaching trams.

- Network Rail and tram operators should provide guidance to their staff or other third party on the best means to illuminate pedestrian crossings, when necessary, taking into account the following factors:

  - Sufficient illumination of the crossing surface to enable pedestrians to see it;
  - The possible impact on the visual capabilities of pedestrians using the crossing, in particular with respect to glare affecting their ability to detect approaching trains/trams; and
  - Relevant findings from RSSB research project T984.

**Received 30 September**

*Norway: Near miss between passenger train and freight train at Dal, 26 September 2012*

At 19:03 (local time) on Wednesday 26 September 2012, a side collision between a passenger train and a freight was only just avoided at Dal station. The freight was about to pass on Track 2 at approximately 80 km/h. The passenger train had completed boarding and alighting on Track 1 and departed in same direction at a permitted speed of 40 km/h. The driver of the freight train saw that the passenger train was moving and applied the emergency brake. The freight stopped approximately 50 metres before the crossover between Tracks 1 and 2. The driver of the passenger train noticed that the exit signal for Track 1 was red and also applied the emergency brake. At the same time, the train was probably stopped by the ATC system. The passenger train stopped on the crossover and was thereby on a conflicting route in relation to the freight.

The investigation concluded that the passenger driver misread the exit signal, but believes that the complex signal aspect at Dal, in combination with the train departure time, had led to staff perceive that they had the correct signal to start driving. It took nearly six years from the first reports about Dal station were recorded until physical changes were made to the signalling system. Previous investigation reports show several examples of accidents where the Norwegian National Rail Administration (NNRA) has been aware of the risk before an accident occurred. This risk concerns both reported undesirable incidents and maintenance thresholds that have been exceeded or not identified.

**Recommendations**

- The NNRA was aware of the risk of passing a stop signal at Dal station. It took nearly six years from the first reports about Dal station were recorded until physical changes were made to the signalling system. Previous investigation reports show several examples of accidents where the NNRA has been aware of the risk before an accident occurred. This risk concerns both reported undesirable incidents and maintenance thresholds that have been exceeded or not identified. The Accident Investigation Board Norway recommends that the Norwegian Railway Inspectorate follow up that the NNRA reviews and improves the processes that are designed to identify and assess reported cases that require immediate action.