Worldwide FI Summary

July 2012

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:

- Level crossing use
- Level crossing configuration
- Rolling stock/traction maintenance
- Supply chain/product acceptance
- Train doors
- Driver competence
- Driver recruitment and selection
- On-board detection systems
- Quality of instructions
- On-site safety checks
- Trolley maintenance
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- Level crossing risk management
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- Radio equipment
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Worldwide FI Summary

Declared to ERA 2 July

Slovenia: Collision between a lorry and a passenger train at a level crossing between Brezovica and Preserje, 10 June 2010

For the full report (in English), click here: LINK

At 18:45 (local time) on 10 June 2010, a lorry collided with a passenger train at a level crossing (protected with half-barriers) between Brezovica and Preserje. The lorry driver was killed instantaneously. There were no injuries to passengers or traincrew.

The train was travelling at approximately 100 km/h at the time of the incident. It struck the lorry, rotating it 180°, coming to a stand 359 metres from the interface.

The investigation determined that the direct cause of the accident was that the lorry driver zig-zagged around the barrier, driving onto the crossing as the train was approaching.

However, it also concluded that an indirect cause of the accident was the nature of half-barrier crossings themselves, which enable road users to access the interface when the barriers are closed to road traffic.

Recommendations

- Since road vehicles frequently zig-zag around lowered half-barriers at level crossings, it is recommended that a gradual modification of protection at this type of crossing be undertaken, either by fitting half-barriers for both lanes or full barriers.

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Published 2 July

UK: Detachment of a cardan shaft at Durham station, 10 April 2011

For the full report, click here: LINK

At around 12:30 on 10 April 2011, a cardan shaft fell from an empty coaching stock formation (Class 142) as it was passing through Durham station at 75mph. The unit ran for approximately two miles before being stopped. A member of the public standing on the platform suffered a minor injury from ballast thrown up as the cardan shaft fell onto the track; the train suffered damage, including loss of diesel fuel.

RAIB found the immediate cause of the detachment to be the complete fracture of a final drive input shaft. The input shaft fractured because a seized input bearing generated a large amount of frictional heat, which reduced the strength of the shaft such that it could no longer carry its normal loading.

RAIB listed the following causal factors:

- The seizure of the outer bearing on the input shaft of the final drive caused the cardan shaft to become detached.

- The seizure of the outer bearing was due to the combination of the following factors:
  - The specified end float was small considering the high temperature difference across the bearing rings;
  - The actual installed end float was less than that measured at installation; and
  - The uncontrolled level of misalignment led to additional loads on the bearings increasing their running temperature and further reducing the operating end float.
It is possible that the following were factors in the seizure of the outer bearing:

- The introduction of Engineering Objective GS090 in January 2009 changed the fit between the outer ring of the bearings and the input housing. The fit which was previously a transitional fit was changed to be an interference fit.
- The specified end float measuring technique may have over-estimated the installed end float;
- The testing as specified in working instruction WI-27 may have been inadequate to detect the problem with the end float setting; and
- The input bearings may have been starved of oil cooling thereby increasing their running temperature and reducing the operating end float.

The seizure of the outer bearing was not detected by the lift checks and this was a causal factor.

The detached cardan shaft was not retained by the safety loops and this was a causal factor. The safety loops did not retain the cardan shaft because of the following factors:

- The design of the safety loops was unable to retain a rotating cardan shaft; and
- The geometry of the design was such that the detached cardan shaft could exit the cradle formed by the safety loops without requiring any deformation.

RAIB also found the following underlying factors:

- The original Self Changing Gears company product manual for the overhaul of RF420i final drives was not available to the technical engineering service company (TESCO) when developing WI-27;
- LH Group had no access to the original design drawings for the final drive; and
- LH Group introduced design changes to the setup of the final drive without assessing the effects of the changes.

Recommendations

- The owners of Class 14x vehicles, in consultation with suppliers of overhaul services, should review the final drive design, design tolerances and the maintenance processes in respect of:
  - End float setting;
  - Input and pinion shafts alignment;
  - Fit of the bearings in the housing bore; and
  - Oil pump performance;

Any required changes identified by the review should be suitably documented and incorporated in overhaul procedures. This recommendation applies to the modified design of the final drive.

- The owners of Class 14x vehicles should review the adequacy of their existing arrangements for ensuring that the suppliers of their equipment validate changes to the design of safety critical components.

- Northern Rail, in consultation with the owners of Class 14x vehicles, should develop, validate and implement measure(s) to identify and prevent the onset of failure of a recently overhauled final drive so as to prevent complete failure where practicable. Note: the measure(s) implemented to address this recommendation may be appropriate to all Class 14x final drives.

- For Class 14x vehicles, vehicle owners in consultation with operators should review whether the necessary technical information for the maintenance and overhaul information of the Class 14x final drives is still available and if it is, they should arrange for it to be sourced. This information should be kept by the vehicle owners and made available to all existing and future operators,
maintainers and overhaulers as relevant. Note: the principle outlined in this recommendation may also apply to other traction and rolling stock equipment and other fleets of train.

- The owners of Class 14x vehicles should review the testing of the final drives after overhaul to confirm that it is done in conditions sufficiently representative of their operational duty and where appropriate amend the testing requirements accordingly. The following areas should be considered:
  - Operational speed;
  - Loading on the shafts; and
  - External environmental conditions.
- Northern Rail should complete the review of its procedures governing post-accident actions and implement any necessary changes to ensure that the risks to personnel and the environment from movement of damaged trains and trains with defective equipment is appropriately managed.

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

At 17:29 on 11 July 2011, a loaded Victoria Line train departed from Warren Street station with all the passenger saloon doors open on the platform side of the train. When the train reached 8km/h, an on-board safety system closed the doors, but not before it had entered the tunnel with the leading set open. There were no reported injuries.

The train, consisting of new 2009 tube stock, is fitted with sensitive edge doors designed to apply the brakes if a thin object is detected between them. The sensitive edge system was activated when the train stopped at the previous station, Oxford Circus. The train left Warren Street station with the doors open because the train operator had omitted to close them, having previously disabled the train door interlock. The train operator was unable to reset the sensitive edge system between Oxford Circus and Warren Street, and became more and more confused in his attempts to resolve the problem.

RAIB found that the modification to allow train operators to override an activated sensitive edge system had changed the operation of an indication light, which probably misled the train operator. Deficiencies in the train operator’s competence had not been identified and this lack of competence was also a probable factor leading to his confusion.

RAIB also listed the following causal factors:

- The train operator did not take the train out of service in accordance with London Underground’s (LUL’s) instructions.
- Before starting the train from Warren Street station, the train operator disabled the train door interlock.
- The train operator’s response to the routine event of the sensitive edge system being activated when the train was at Oxford Circus station due to the strap of a bag belonging to a passenger being trapped between the closing doors and not released. The train operator’s determination to keep the train in service and minimise delays is a factor.
- As a result of the activated sensitive edge system which he was unable to reset, the train operator was in a growing state of confusion. The train operator’s growing state of confusion occurred due to the following probable and possible factors which acted in combination:

  Probable factors:
The sensitive edge reset light extinguished even though the system was still activated;

- The absence of any systematic definition of the functional and detailed requirements in respect of the override modification
- The train operator lacked the necessary competence to respond correctly when under pressure while dealing with an out-of-course event; and
- The selection process undergone by the train operator did not assess the ability to retain and apply knowledge;

Possible factors:

- The train operator was distracted by matters external to his work and was taking medication which might have affected his concentration;
- The train operator did not request assistance to resolve the activated sensitive edge system
- The train operator did not fully understand the operation of the sensitive edge override and;
- The briefing leaflet was inconsistent with the actual operation of the sensitive edge reset button light following the override modification.

Recommendations

- In the light of the Warren Street incident, LUL should review the current instructions on the action that train operators should take in the event of the sensitive edge system being activated. This should include, in particular:
  - The options available to train operators for dealing with activations of the sensitive edge system and which option should be used first in specific circumstances;
  - Under what circumstances the sensitive edge override should be used; and
  - The information provided by the TCMS to see whether there is suitable and sufficient information to train operators about using the override.

Any necessary changes to the instructions should be implemented, and train operatorsbriefed and/or trained, as appropriate, on the changes made.

- In relation to the sensitive edge override modification, LUL should review how its process for managing engineering change and the associated management controls was not followed, and why it did not adequately identify the risks associated with the design modification. The review should include:
  - Why good and established practice in engineering change management was not followed during the design and introduction of the sensitive edge override modification with particular reference to the specification of requirements and the risk assessment of the proposed changes; and
  - Why the management system and controls did not identify or correct the design deficiencies relating to the sensitive edge override modification.

LUL should implement any necessary changes to its process for managing engineering change and associated management controls.

- In the light of the findings of this investigation, LUL should review those elements of its competence management system that relate to the ability of train operators to respond to out-of-course events, faults and failures. This should take into account:
  - How the evidence from train operators’ performance in practical training and instruction is captured and dealt with by the competence management system;
How the evidence from train operators’ performance in incidents in service is captured and dealt with by the competence management system and;

How LUL acts on any deficiencies identified from the above, relating to a train operator’s ability to recognise and correctly respond to an out-of-course event, with the aim of eliminating any competence deficiencies identified, including how corrective action plans are developed, implemented and monitored to successful conclusion. LUL should implement any necessary changes to the competence management system.

LUL should review how and in what circumstances train operators should request assistance following defects in service and implement any changes found necessary. This should include the adequacy of the competence management system and competence assessment of train operators in requesting assistance when needed. In addition:

- Train operators should be reminded of the availability of operational and technical advice when they are unable to resolve train defects and how they can obtain it; and
- Service controllers should be reminded that they should challenge train operators if they believe them to be acting outside LUL’s mandatory instructions.

Published 12 July

UK: Incident involving a runaway track maintenance trolley near Haslemere, Surrey, 10 September 2011

For the full report, click here: LINK

At approximately 03:00 on Saturday 10 September 2011, a hand trolley ran unattended for a distance of 2.9 miles along the Portsmouth main line near Haslemere. The incident occurred within an overnight engineering possession and there were no casualties. The trolley operator did not know he was on a long falling gradient when he let go of the trolley and its brakes failed to apply automatically. The brake mechanism probably jammed with the brakes in the ‘off’ position due to a combination of factors including inadequacies in the design, risk assessment and acceptance processes, and in the subsequent maintenance of the trolley.

The immediate cause was due to the trolley did not stop when the COSS let go of the brake handle.

RAIB also listed the following causal factors:

- The COSS did not intervene when the brake handle did not spring back to the ‘on’ position after he let go of it. This arose for one of the following reasons:
  - The COSS was expecting the brakes to apply automatically but they did not, because the brake linkage mechanism had jammed in the ‘off’ position; or
  - The COSS was aware the brakes would not apply automatically (either because he knew that the brake handle could stick in the ‘off’ position or because he had interfered with the mechanism), but was not aware that he was on a long falling gradient when he let go of the trolley.

- Had there been a second person with the trolley while it was being moved they might have prevented the trolley from accelerating away from the COSS. This was a probable causal factor.

- Network Rail does not explicitly require a hand trolley controller to test the automatic brake mechanism as part of the pre-use brake check. This was a possible causal factor.

- The brake linkage was susceptible to damage if the handle was forced in the wrong direction.

- The maintainer did not take action to withdraw the trolleys or repair the bent pushrods. This was due to one of the following reasons:
  - The maintainer did not recognise that the brake pushrods were bent or...
The maintainer noticed that the brake pushrods were bent, but did not think that it mattered. That the manufacturer did not identify the risk from bent brake pushrods, the product acceptance process did not identify either the causes or consequences of possible wrong-direction operation of the brake handle, and Network Rail had a process for reviewing RAIB recommendations made to other operators, but had not implemented changes which might have prevented the incident on 10 September 2011 from occurring, were also considered to be underlying factors.

Recommendations

- Network Rail should review and revise the material used for training and assessing the competence of hand trolley controllers, such that the required pre-use checks for all trolleys are clearly and concisely stated in a form which is readily accessible to hand trolley controllers. These checks should be consistent with the requirements of Handbook 10 of the Rule Book, and should include a functional brake test using the brake handle to test automatic operation of the brake. The revised material should also incorporate suitable references to the risk arising from the use of trolleys on gradients.

- Network Rail should clarify the responsibilities for the specification, assessment, approval and introduction to use of each new item of plant that has the capability to import risk to the operational railway. These responsibilities should include confirming that:
  - A design risk assessment has been carried out, taking account of realistic and potential failure modes, the way the equipment is used and the effects of wear and tear;
  - The supplier has produced operational and maintenance instructions which provide appropriate mitigation for the risks; and
  - Network Rail has incorporated the manufacturer’s instructions into its own work instructions or assessed the risk of adopting an alternative approach.

- Torrent Trackside should improve its processes for providing suitable maintenance information, documents and training to its personnel for all of the plant which they may be required to service. The information provided to its staff should be sufficient to enable them to discharge their responsibilities competently and safely.

- Network Rail should review and, if necessary, revise its processes for taking action on RAIB recommendations, so that suitable actions can be identified, implemented and tracked through to closure. These may have been made for a different system, for example road-rail vehicles instead of trolleys, or may be relevant to its own operations but addressed to other operators.

- Network Rail should review the actions it has taken at Havant depot since the incident, taking account of the issues identified in this report. If appropriate, it should prepare and implement an action plan for any additional actions necessary to provide an adequate level of safety. The review should include (but not necessarily be limited to):
  - Compliance with rules and procedures;
  - Reporting of safety-related incidents; and
  - Management of defective equipment.

- Network Rail should collate information on known areas of poor mobile phone reception on its infrastructure and, where necessary, make arrangements for alternative means of communication between front-line staff with safety responsibilities.
UK: Fatal accident at Gipsy Lane footpath crossing, Needham Market, Suffolk, 24 August 2011

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

At about 13:52 on 24 August 2011, a pedestrian was struck and fatally injured by a train on Gipsy Lane footpath crossing, near Needham Market in Suffolk. The train driver said that he had seen a person on the crossing, on or near to the adjacent line, as the train approached and that when the warning horn was sounded the pedestrian continued to cross and was struck.

RAIB found the immediate cause to be that the pedestrian continued to cross when she became aware of the approaching train.

RAIB also listed the following causal factors:

- The pedestrian moved from the adjacent line into the path of the train because she either did not see the approaching train, she misjudged the speed of the train, or she believed that the train was approaching her on the line she was standing on.
- For vulnerable users, the warning of an approaching Down train was not sufficient to enable them to use the crossing safely.
- In the period up to December 2010, no action was taken to address the risk to vulnerable users.
- No short-term mitigation measures were implemented when it was identified, in May 2011 during the whistle board audit, that the down line whistle board was not providing adequate warning to the users of Gipsy Lane footpath crossing.
- No action was implemented to reduce the risk to pedestrians at Gipsy Lane footpath crossing when the Operational Risk Control Coordinator (ORCC) identified that the warning time for the approach of down trains was insufficient in June 2011.
- No action was implemented to reduce the risk to pedestrians at Gipsy Lane footpath crossing after the ORCC confirmed in August 2011 that the warning time for the approach of down trains was insufficient and that there were vulnerable users at the crossing.

Furthermore, guidance, in the form of a decision flowchart provided by Network Rail’s national level crossings team, sometimes discouraged those involved in level crossing risk management from making short-term changes to reduce risk at crossings such as Gipsy Lane. RAIB consider this to be an underlying factor.

**Recommendations**

- Network Rail should arrange for the closure of Gipsy Lane footpath crossing. If Network Rail is not granted permission by the local council to close Gipsy Lane footpath crossing, it should take appropriate risk-reduction measures so that pedestrians have sufficient time to cross safely, and are adequately warned of approaching trains.
- Network Rail should have effective systems in place for accurate information gathering during data collection visits at level crossings. Any changes from previous data collected should be clearly understood and feedback given to the relevant person where data is incorrect. This includes data relating to:
  - The number of crossing users where the quick census is undertaken;
  - The use of whistle board protected crossings during the night-time quiet period;
  - Use of the crossing by vulnerable users;
  - Location of whistle boards;
  - Crossing length;
Network Rail should develop its guidance for use by level crossing teams to include:
- A clear definition of what constitutes a ‘higher than usual’ number of vulnerable users;
- Implementing risk-reduction measures at crossings that have deficient sighting or warning times; and
- When speed restrictions must be imposed, what type of speed restriction is to be used (emergency, temporary or permanent) and the timescales for imposing speed restrictions.

Network Rail should combine within the ALCRM the two different cost-benefit analysis tools currently used by the level crossing risk management teams so that all benefits are properly considered as part of the cost-benefit analysis of risk reduction measures.

Published 27 June

New Zealand: Collision between passenger train and landslide, and subsequent collision with another train, between Plimmerton and Pukerua Bay, North Island, 30 September 2010

For the full report click here: [LINK]

On 30 September 2010, a passenger train was travelling from Wellington to Paekakariki on the northbound main line with 44 passengers on board.

It had been raining heavily for several hours. A landslide had come down from a cutting above the rail corridor and covered the northbound line with debris between Plimmerton and Pukerua Bay. The train was travelling at 60 km/h when it rounded a curve and the driver saw the landslide. He made a full brake application but his train was still travelling at 59 km/h when it struck the debris and derailed in the direction of the adjacent southbound line.

The driver of a southbound service saw the northbound strike the landslide and derail when his train was about 250 metres away from it. He made an emergency brake application but his train was still travelling at 54 km/h when it struck the unit a glancing blow, stopping about 75 metres past the point of impact (without derailing). There were no reported injuries.

The investigation found that MetService had issued a severe weather warning the day before, forecasting heavy rainfall for the Wellington area. The KiwiRail network control manager had received the warning and passed it on to the Wellington area manager, who had then passed it on to the team responsible for maintaining various sections of track within the area. Instead of the area manager deciding what to do, he left his team to decide whether to carry out any special track inspections or impose any speed restrictions for their respective sections of track.

No special track inspections were made in the area of the...
The investigation found that a special track inspection might have revealed signs that a landslide was about to occur and that, had a speed restriction been put in place, the initial derailment might not have been as severe and the opposing train would have probably been able to stop before meeting the derailed train; in other words, the collision would have been avoided.

The cutting where the landslide occurred was on an ‘essential features list’ because of previous landslides that had occurred there. The slip site had been assessed by a KiwiRail geologist as part of a nationwide assessment of at-risk sites and had been identified as ranking 31 out of a list of 180 identified sites within the Wellington metro area. As such, the order of priority would not have seen remedial work at this site for at least another two years.

The rainfall at the time of the landslide was calculated to have been an event expected to occur once in 15 years; the total rainfall recorded for September was the highest since recording at the site began in 1991.

KiwiRail’s slope ranking system for evaluating the landslide risk on the rail network was an effective tool for prioritising remedial work at locations that were prone to landslides. However, it had not conducted a complete risk assessment for each identified location to identify what action could be taken to reduce the risk in the meantime, such as monitoring rainfall, applying temporary speed restrictions and conducting special track inspections. Since the accident, KiwiRail has put in place a rainfall monitoring system and risk framework which includes information from the slope ranking system. As such, it is a more effective tool for managing the risk associated with landslides.

The report also noted that trains in the Wellington commuter fleet are not equipped with selcall-capable radio equipment, which means that in the event of an emergency brake application or other event that causes a rapid reduction in air brake pipe pressure, there could be a critical delay in train control being alerted in time to prevent the event escalating.

The driving compartments of both trains were damaged during the collision sequence to such an extent that had the drivers not vacated their driving positions before impact they would likely have been fatally injured.

The units involved had met the crashworthiness standards at the time of build some 30 years earlier, but they did not perform as well as a modern train during a similar front-end collision, thereby increasing the risk of injury to the drivers and possibly passengers seated near the ends of the trains.

The investigation listed the following learning points:

- In order to undertake an adequate risk assessment there must be a clearly mapped out methodology that should be followed.
- Good, effective communication in any form is essential for preventing accidents occurring and essential for minimising the consequences if one does occur.
- People with designated responsibility must exercise that responsibility or delegate to another person to ensure important decisions are made at the right time.

Recommendations

- KiwiRail’s predecessors determined that the Wellington rail electric multiple unit commuter service was not a DOO. Irrespective of whether these trains were a ‘single-person’ or a ‘two-person’ operation, as a consequence, the radio system fitted to these trains did not have selcall capability and could not send an alert to train control automatically when there was a rapid drop in brake pipe pressure such as when the driver makes an emergency brake application. Any delay in train control being alerted to an accident or incident within the double-tracked commuter network is a

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1 A 25 km/h temporary train speed restriction would probably have prevented the southbound train from colliding with the derailed train. While it might not have allowed the derailed train to stop the train short of the landslide debris, it would have reduced the risk from derailment (and the subsequent collision).
safety issue. The investigation recommends that the NZ Transport Agency (NZTA) addresses this safety issue.

- On 13 June 2012, the Manager Rail Systems replied that ‘NZTA intends to work closely with the rail industry with an aim to addressing and closing this recommendation as soon as practicable’.

- The driving compartments of both trains were damaged to such an extent that, had the drivers not vacated their driving positions before impact, it is likely that they would have been seriously injured (or worse). Although the Ganz Mavag trains were generally strong and well-built and had met the crashworthiness standards at the time of build some 30 years earlier, they did not perform as a more modern train would have been expected to perform during a similar front-end collision, thereby increasing the risk of injury to the driver and possibly passengers seated near the ends of the trains. The investigation recommends that NZTA monitors the development of current prototype improvements in crashworthiness for the Ganz Mavag rail fleet and requires that such improvements be adopted for any trains that are to remain in service for an appreciable time.

- On 13 June 2012, the Manager Rail Systems replied that ‘NZTA will monitor the development of modifications to the Ganz Mavag rail fleet, taking into account the length of time the Ganz Mavag fleet may remain in service’.