It serves the purpose of being an important tool for the regulator to communicate rail safety information and initiatives that will help drive change.

Rail Safety News is a tri-annual newsletter for accredited rail operators in Victoria.
On 19 August 2011, the Council of Australian Governments (COAG) signed Inter-Governmental Agreements to establish national transport safety regulatory scheme frameworks in the rail and commercial maritime sectors. Both frameworks are scheduled to come into effect in 2013.

The rail safety regulatory framework includes the introduction of national rail safety law administered by a new national regulator based in Adelaide.

This process is being led by the National Rail Safety Regulator Project Office who worked with the states and territories, Commonwealth and industry to develop the scope and detailed arrangements for implementation of these significant national reforms. The agreement represents a major milestone in this process.

At this stage, Transport Safety Victoria (TSV) understands that day-to-day regulatory functions will continue to be performed locally under delegation from the national regulator. In addition, TSV will continue to be directly responsible for rail safety regulation in regard to light rail.

TSV and the Department of Transport have worked collaboratively throughout the negotiations to seek to ensure the capacity to respond quickly to changes in local risk factors in Victoria, which is integral to the design of the new regulatory system.

The inter-governmental agreement also includes arrangements for cooperative resource sharing between the Office of the Chief Investigator in Victoria and the Australian Transport Safety Bureau as the national investigator.

TSV is committed to ensuring a smooth transition to the implementation of the new national regulator, and that safety remains the top priority for rail safety regulation in this State.
TSV is delighted that Melbourne plays host to this year’s International Railway Safety Conference (IRSC). For many of Victoria’s rail safety professionals, the opportunity to have this international event on their doorstep and to share industry knowledge and experiences in a global forum is rare and one not to be missed.

‘Rail Safety – perception and reality’ is an enigmatic theme which will be thoroughly explored by participants. TSV is presenting the State’s regulatory roll and showcasing how our risk-based approach to regulation seeks to be best practice.

Alan Osborne, TSV’s Safety Director, is joining Brian Nye (CEO, Australasian Railway Association) and the Hon Terry Mulder MP (Minister for Public Transport) in opening the conference program.

If you are attending the conference, look out for TSV’s Manager, Human Factors, Elizabeth Grey, who is presenting on the second day with her paper that explores the value, benefits and implications of a just culture approach for rail organisations and regulators.

Also check out TSV’s poster paper which is on display, about our commitment to excellence in rail safety regulation. This paper contains reflections on TSV’s experience as one of the rail safety regulator’s with the longest experience in Australia of independently administering modern ‘stand-alone’ rail safety legislation.

Of course, please visit the TSV stand, pick up a wide range of rail safety material and chat with our staff. We are happy to answer any questions that you may have!
Exploring a just culture approach

A topic of exploration within TSV has been the value, benefits and implications of the ‘just culture’ approach both across the rail industry and within the regulator itself. The just culture concept is widely accepted within modern safety science and is often promoted to safety critical organisations as a means of enhancing organisational learning by improving reporting about incidents and accidents.

As part of the activities at this year’s International Rail Safety Conference (IRSC), TSV is presenting a paper that explores the literature and offers some observations from the regulator’s perspective on why and how a regulator might adopt a just culture approach. The impact of adopting a just culture approach within industry, the barriers that may prevent effective adoption by the regulator, as well as the benefits and challenges of such an approach will also be discussed.
Modern thinking about regulation

Modern rail safety regulation aims to promote continuous improvement in the management of rail safety. Achieving this outcome relies on good regulatory decision-making driven by legislation and policies based on prevailing societal values. These decisions should be guided by regulatory good practice, supported by findings from safety science research.

The rail safety legislation in Victoria has, since 2006, provided the regulator with a modern framework that allows for more graduated regulatory interventions and a greater focus on risk management and safety management systems. This legislation enhances the regulator’s scope to facilitate safety improvement through a range of regulatory mechanisms, including the introduction of a chain of responsibility where all stakeholders have safety duties including those ‘upstream’ involved in all aspects of the rail system such as procurement, design, operations, management and maintenance.

This legislation was implemented following serious accidents in New South Wales at Glenbrook, in 19991 and Waterfall in 20032, and in Victoria (for example, Broadmeadows in 20033). It reflects rising public concern as noted by Justice McInerney in the report on the Glenbrook accident, following these events and others in the UK. It also brings our rail safety legislation in line with the changes to safety regulation that have occurred internationally during the last 30 years.

TSV’s regulatory approach4,5 fits broadly within this graduated intervention model. In this model, enforcement begins with cooperative strategies (education and influencing), which are located at the base of the ‘enforcement pyramid’. Interventions then progress through administrative tools such as improvement notices and prohibitions to more punitive strategies (such as prosecution, suspension and revocation of accreditation) if the earlier strategies fail4. Improvement notices sit around the middle of the pyramid.
Modern thinking about safety

The just culture approach seeks to balance the need to hold people accountable for their actions while facilitating opportunities to learn from accidents. It is ‘just’ in that punishment is reserved for willful violations and destructive acts. Actions arising from human error are seen as an opportunity for learning and organisational improvement. The success of this approach depends on a mature understanding of the causes of human error. Error is considered a symptom of wider organisational or systemic deficiencies and the inevitable outcome of human activity. People who ‘make’ errors often inherit error-provocative situations.

Determining accountability

A prerequisite for a just culture is that all members of an organisation understand where the line is drawn between unacceptable behaviour that deserves disciplinary action and the remainder where punishment is neither appropriate nor helpful in furthering the cause of safety. Marx has addressed this issue, distinguishing three classes of behaviour: human error, at risk behaviour and malicious or willful violations. Human error occurs when an intended action fails to achieve an intended outcome, and inadvertently causes an unintended result. Sometimes these errors occur simply because the systems or conditions that people work within fail them. The just culture response is one of consoling, educating and improving design of systems. At risk behaviour tends to involve violations (or rule breaking) that creates a risk to safety, resulting in an unintended outcome. The behaviour may feature short cuts and poor habits in order to get the job done. The individual involved may not expect that there is a risk to safety as such behaviour may well be the norm within the workforce and the organisation. The just culture response to at risk behaviour involves coaching, incentives, and disincentives. Malicious willful acts intend to cause harm. Reckless behaviour is action taken with conscious disregard for safety. These are acts or omissions in which a person knows or can be reasonably expected to foresee the outcome, but proceeds despite this knowledge. In a just culture approach, reckless and malicious acts require sanctions and/or punishment.

Evidence for just culture

The just culture approach is the product of modern thinking on the causes of accidents in complex socio-technical systems and is increasingly supported by evidence from research in a number of safety critical industries. It has been applied in industries such as aviation and healthcare and has been the subject of enquiry in the fields of human factors and sociology. Parallels to the just culture approach may be drawn in regulatory and legal theory particularly responsive regulation and from guidance such as the model litigant guidelines. Further support for a just culture approach may be inferred from some regulatory commentators. For example, it has been suggested that deterrence activities such as prosecution, if not undertaken thoughtfully, could lead to situations where regulated organisations become uncooperative and defensive. Thus sharing of critical information is restricted and the safety outcome reduced. Hence just and fair intervention by a regulator could be a key feature in promoting safety.

Why deterrence is not enough

The traditional view of regulation and justice is punishment of the guilty through prosecution. Prosecution is based on the rationale that safety can be maintained...
by punishing the guilty parties, apparently acting as a deterrent to future behaviour that might lead to accidents. While prosecution should be available as an intervention, the punitive-deterrent strategy seems rigid when considered from a just culture perspective. A more sophisticated approach is required to improve safety in complex socio-technical systems. Such an approach needs to reflect the findings from safety science, and social, behavioural and regulatory research. The issues are worthy of consideration.

**Human error and organisational failures**

Research in psychology suggests that people are fallible as a result of innate limitations which are determined by our biology, for example, our evolved cognitive abilities (such as selective attention), and the impact of distraction and fatigue under contemporary industrial workloads. Threatening people with punishment will not stop them forgetting a crucial item under pressure. Nor will it prevent errors that arise due to poor systems design (such as design that does not match how people perceive and process information, build models of the world, or how decisions are made under pressure).

Research on accidents in complex socio-technical systems has identified contributing factors from the organisational and management system. These latent failures are usually associated with system failures removed in time and/or space from the operational locus of the organisation and originated unintentionally by people such as designers, managers and maintenance staff. These failures are considered latent because the causes of the failure can lie undetected and dormant for considerable periods until they combine with other factors causing an accident situation that reveals them. In a just culture, incidents are recognised as manifestations of earlier systems deficiencies and should be treated accordingly. Incidents are a valuable source of insight required for continual improvement, but only if they are seen as opportunities for learning.

**Punishment as a deterrent for intentional behaviour**

There are two ways that punishment can deter future acts. The first is the idea of specific deterrence. That is, having experienced negative consequences, the prosecuted entity (be it a person or company) is less likely to perform the behaviour again through fear of experiencing those consequences again. The second is the concept of general deterrence. That is, by becoming aware of negative consequences imposed on someone else, other non-prosecuted entities are less likely to engage in that behaviour through fear that they will receive these consequences.

There is mixed evidence for the effectiveness of punishment in deterring future offences. The evidence is particularly weak for general deterrence. General deterrence is based on rational choice theory, which views individuals and companies as ‘utility maximisers’ who logically weigh up the costs and benefits of compliance and make a decision based on maximising benefits and minimising costs. However, research has shown that decisions may not always be made in a rational and logical fashion and may be subject to a range of cognitive biases, which lead to poor decision-making. Decision-making involves complex psychological mechanisms. For example, research has shown that experts do not systematically compare options to select the best one, but use schemas developed from past experience to efficiently choose an option that is known to work in similar situations.

**Benefits of just culture: Learning from incidents and accidents**

Leape, before a hearing of the US Congress, asked how could the “… report gathering function of regulators be modified to become a force for error reduction rather than an incentive for error concealment” (20, p.97). In seeking to build on existing safety improvements, the US rail regulator, the Federal Railways Administration (FRA), acknowledged that it did not know enough about how and why accidents occurred. The FRA identified that the Federal Employee Liability Act (FELA), a law passed by Congress in 1908 to enable railroad employees the right to recover damages for any injury that results from the carrier’s negligence, was a barrier to organisational learning and safety improvement.

A punitive environment has also been found to be a barrier to learning by studies in the healthcare industry. Research focused on blood transfusion safety found that the effectiveness of data collection and analysis of transfusion errors, adverse events,
and near misses, depended on the willingness of individuals to report this information. Errors were widely perceived as a reflection of personal negligence, indeed, medical negligence was defined as the “failure to meet the standard of practice of an average qualified practicing physician in the speciality in question” [22,p.383]. As a result, only a minority of medical errors tended to be reported, typically those errors that cannot be covered up [23]. Further, because a punitive inquiry tends not to go beyond identifying culpable people, there was an unwillingness to understand the whole system, and therefore the benefits of improved system design were not realised.

The implementation of just culture initiatives in the aviation industry has been found to significantly increase reporting of incidents, particularly of ‘low risk’ events and near misses [24,25]. Baines [26] attributed increased reporting to:

- a belief that the just culture principles would be followed and that punitive action would be considered within the just culture policy
- a better understanding of reporting requirements through training
- more effective investigations and dissemination of findings
- a belief that reporting will make a difference in improving safety.

Following the implementation of a mandatory reporting system in Denmark, Naviair, the Danish Air Traffic Control service provider employing all air traffic controllers in Denmark, decided to actively implement this new reporting system. This decision was not made solely because it was mandatory, but because management foresaw a benefit for the company’s main product, flight safety [27]. During the first 24 hours of operation, Naviair received 20 reports from air traffic controllers. One year after the reporting system was implemented, Naviair had received 980 reports compared to the previous year’s 15 reports [28].

**Conclusion**

There is preliminary evidence for benefits to the regulator’s goal of improved system safety through increased reporting by adopting a just culture approach. The literature does not yet reveal whether the adoption of a just culture approach by the regulator leads to similar adoption in industry or what other benefits may accrue through broader application of the approach. However, these findings encourage further exploration of the potential benefits of the approach. There is an opportunity here for leadership in ensuring that performance management systems whether in regulators or rail operators are designed to drive optimal behaviour.

Within a regulator’s office, the success of a just culture approach would depend upon the regulator’s ability to be flexible in its application of its legislation. Jurisdictions with a requirement for punitive action against regulatees or conversely, limited legislative basis for punitive action are likely to have trouble adopting the approach successfully. The enforcement pyramid with its graduated intervention approach adopted in Victoria, allows the regulator to make decisions about how to intervene. The just culture approach adds another dimension to this decision-making that is supported by growing research evidence and meets a commonly held desire for fair and just intervention that promotes trust.

Given our understanding of system safety developed during the last 40 years, there is a moral and pragmatic imperative to deliver the safest systems by taking account of human fallibility and the imperfection of systems. While more research is required, the just culture approach has the potential to provide sound criteria for making these decisions in structured and systematic ways. The just culture approach is not a free pass for poor behaviour. Therefore, specific criteria for determining when to intervene need to be well documented and communicated clearly; so that the parameters of acceptable behaviour are known and understood by all parties. As this discussion continues within TSV, a next step will be to draft criteria for assessing organisational behaviour and test them internally against a range of case studies.
This is a journey the regulator and the industry should consider in order to achieve improved safety outcomes. In adopting such an approach regulators need to seek mature relationships with regulatees, and demonstrate organisational commitment through educated, skilled and committed regulatory staff. Likewise, regulated organisations aiming to benefit from the just culture approach need equally skilled employees and also to seek mature relationships with the regulator founded on mutual respect and an understanding of the role of the regulator as a defence in depth. Both rail safety regulators and the rail industry in Australia should explore further the principles of just culture and its potential application. As we move towards the implementation of the National Rail Regulator in Australia with modern legislation, how just culture is positioned as a part of the regulatory approach will be increasingly important.

→ For the complete conference paper please contact TSV or go to the IRSC website at www.irsc2011.org/

References


As part of enriching the regulatory perspective on rail safety at the IRSC, TSV is also contributing a poster paper. It contains reflections on our experience as one of Australia’s rail safety regulators with the longest experience of independently administering modern ‘stand-alone’ rail safety legislation.

The paper (‘Transport Safety Victoria – a commitment to excellence in rail safety regulation’) begins with background on TSV as Victoria’s independent integrated transport safety regulator committed to excellence in regulation under a modern legislative framework. This framework focuses on continuous safety improvements through performance standards and process requirements for better hazard identification and risk management. Victoria is also one of a number of jurisdictions in Australia and overseas to have regulation dedicated solely to rail safety administered by an independent safety regulator.

The paper reflects TSV’s experience with administering modern legislation, and finds the gap between the promise and the actual performance of ‘modern’ regulatory systems needs to be more carefully considered. Indeed, while TSV has made significant progress, the journey continues to be challenging in some specific areas.
Towards being ‘outcomes-based’

Another major step was the considerable effort expended to develop the internal and industry expertise to effectively achieve compliance with performance and process-based legislation. This requires the regulator to undergo the necessary cultural change in its regulatory approach, as well as be flexible and take a differential approach to managing the varying regulatory capacities across Victoria’s different rail sectors.

Challenges of ‘co-regulation’

Besides being highly dependant on the regulated parties’ capacity to self-regulate, the challenge of co-regulation lies in achieving the appropriate balance in ‘sharing the regulatory task’ between the regulator and regulated parties. Some argue that regulators need to ‘pay more attention to the ‘enforced’ part of enforced self-regulation. Co-regulation is also made more challenging by different understandings of ‘co-regulation’ across government and industry stakeholders.

Challenges of enforcing performance-based legislation

There is now abundant literature on the potential drawbacks of performance-based legislation, including inconsistencies in interpretation, a decrease in certainty and predictability and significant expertise required. Performance-based legislation also requires awareness of the tension between providing adequate guidance to help operators understand requirements while allowing them enough flexibility to choose their own ways to comply.

Challenge of performance measurement

The current push in Victoria is to lift the performance of regulators by measuring outcomes, not just outputs. However, attempts to measure outcomes in any meaningful way are fraught with difficulties, including the limitations of data and proving causality. For TSV, regulatory performance is routinely assessed internally by verifying that the desired outcomes were achieved for each safety ‘topic’ identified. In terms of rail safety outcomes more generally, it is still too early to assess whether the change in regulatory system is causing a direct improvement in safety outcomes. Nevertheless TSV continues to seek to build on its expertise in risk management and prevention and believes it has made meaningful progress towards focussing on and measuring outcomes.

Such experiences highlight the challenges for regulatory governance in administering modern legislation. The challenge for the proposed new national rail safety regulator will be to ensure that Victoria’s learnings are captured in the new regulatory system while continuing to address the sorts of challenges outlined in the paper to promote rail safety in the future.

→ For copy of the full paper, please visit the TSV website, or contact Andrea Fung at Andrea.fung@transportsafety.vic.gov.au
Fatigue is a hazard within the rail industry that needs to be managed. Fatigue can lead to uncontrollable sleep onset and impair performance. Given that the safety of systems often depends on human performance, such impairment can lead to potentially catastrophic incidents such as collisions and derailments. This view is supported by evidence from a review of rail accidents being conducted in the United States by a regulator-industry working party. The Collision Avoidance Working Group (CAWG) examined 65 main-track train collisions (which occurred between 1997 and 2002) in which human factors caused the train accidents. They found that fatigue (or impaired awareness) contributed to 30 percent of the accidents studied.

Australian rail safety legislation imposes obligations on accredited rail operators to manage fatigue so far as is reasonably practicable (SFAIRP). This obligation connotes an expectation that accredited operators understand the impact of fatigue on rail safety workers and the controls available to minimise or prevent its impact. However, fatigue remains one of the more complex and challenging risk factors to control.

On August 4, 2011, Transport Safety Victoria hosted a seminar on ‘Fatigue Management in Rail Operations’. This was attended by a diverse range of members of the Victorian rail and transport industry, including safety specialists and managers, operations personnel, health professionals, union representatives, consultants, and researchers. The three expert presenters discussed fatigue risk management from three different perspectives: that is, as an expert in fatigue science, a specialist working for a rail safety regulator and a specialist working for a rail operator.

Dr Paula Mitchell, a senior consultant at Integrated Safety Support, described the science of fatigue. Paula spoke about fatigue as a state of impairment that can trigger undesirable safety outcomes and highlighted the causes, symptoms, and consequences of fatigue in an operational setting. This presentation discussed a shift towards more comprehensive risk management approaches to fatigue management, rather than traditional strategies focused on limitation through prescriptive hours of work and rest. At the individual level, Paula warned against the dangers of self-assessing one’s own fatigue. People tend to be unreliable when assessing their own level of fatigue because fatigue impairs this assessment ability. Therefore, by the time a person realises that they are fatigued, chances are that they have been in this state for some time.
Jenny Alcock, fatigue risk management specialist at the Independent Transport Safety Regulator (ITSR) in NSW, presented on the importance of a risk management approach to managing fatigue in rail operations. Drawing on her experience in dealing with a variety of rail operators, Jenny discussed the basic steps required to demonstrate a risk management approach to fatigue. Using rail accident data, she identified practical tools to help investigate the potential contribution of fatigue in incidents. Jenny also referred to the potential (often underestimated) costs of fatigue to organisations and industry as well as the importance of creating a business case for fatigue management.

Human Factors Consultant, Fiona Kenvyn presented a case study based on her experiences in implementing a Fatigue Risk Management Program (FRMP) at Network Rail in the UK. Fiona discussed the challenges inherent in integrating modern fatigue management practices into the day to day running of a rail organisation. She noted that the biggest challenge was trying to balance a need for enhanced fatigue management with the competing goals of maintaining performance and cost efficiency. While her presentation focused on fatigue management from the perspective of frontline employees, it also highlighted a number of broader issues that can affect the effectiveness of an FRMP including the role of organisational and industry-wide culture, norms, standards and expectations.

In summary, the presentations highlighted that there is no ‘one-size-fits-all’ solution to fatigue management in rail operations. Indeed, the expert presenters stressed the need for a modern risk management approach to fatigue management that:

- aims to understand the specific risks;
- includes a suite of controls and treatments appropriate for these risks;
- has ongoing monitoring of fatigue levels and fatigue-related issues;
- makes use of scientifically-based evidence and guidance;
- continually improves the knowledge and awareness of individuals; and
- is tailored to the level of fatigue risk maturity of the organisation.

The seminar was highly successful and a follow up seminar is planned for 2012. Copies of the presentations are available on the TSV website www.transportsafety.vic.gov.au/events.

Nic Doncaster works for the Office of the Rail Safety Regulator (ORSR), in the Department for Transport, Energy and Infrastructure. As a part of his Master’s degree, Nic researched the use of cues and feedback by freight train crews. A review of the literature identified little in relation to the cues (a feature of system, state or environment to which a response is required (Wiggins, 2006)) and feedback (information about what has actually happened (Norman, 1988)) used by freight train crews. Most of what was found focussed on suburban and inter-urban passenger operations, particularly in the UK.

In this South Australian research, eight drivers were interviewed. The interviews were not structured, as the intent was to engage the drivers and encourage them to talk openly. A quote from a paper written by Branton (1978) was used to “set the scene”. The participants were asked to comment on the quote and its relevance to their driving. This information was then explored with the driver.

The drivers noted that they generally started to plan for their trip before leaving for work. They report that they knew the type of train that they would be working, which allowed them to run through scenarios in relation to how the train may handle. These scenarios used knowledge that had developed over the years. When operating trains, drivers noted that they were planning up to several sections ahead, “setting up” the train for expected operational needs, and running through alternate scenarios, whilst also monitoring train performance via various feedbacks provided by the train (generally kinaesthetic). Operational information, including radio communications, was used to further refine driving strategies.

Kinaesthetic sensation, made up of the push (buff) and pull (draft) of the train as it “ran in” or “ran out”, the movement of the loco body, as well as how the train responds to commands, was generally described as the “feel”. The drivers consistently identified that much of the movement was felt “by the seat of their pants”, particularly high run-in forces which resulted in a “kick up the arse”!
The drivers also reported that while feedbacks such as displays, exhaust output and sound may be used, these were not generally used as a primary source of information. Some drivers reported that displays are used to validate what they already knew of the state of the train, rather than a primary source of information. A key form of feedback noted was the verbal and non-verbal feedback of co-drivers.

The drivers consistently described difficult sections of corridor, while most noted that, when travelling in a crew car, they would wake and, through the movement of the train, be able to determine within a very short timeframe, where they were on the network. This, along with the other findings, suggest that train crew work from detailed mental models of the network, and of train performance, to such a degree that the behaviour has become "intuitive" (Klein, 2003).

By identifying and understanding the feedback used by train crew, a more focused approach to the design of elements of the railway system may be possible, including enhancement of lineside signage, improvements to enhance audible and kinaesthetic feedbacks, or other displays to support these feedbacks. Understanding feedbacks used may also assist in refining training systems, for example simulators, to enhance their fidelity.

As cues generally develop as a result of experience (Wiggins & Glass, 2006), and may therefore be unique to the individual, identifying and coding them may be difficult. However, lineside features were consistently identified.

The project identified a number of other issues for further research, including how crew develop route knowledge, how they apply it over significant distances of railway, factors associated with relay working and driver only operations.


The following is a summary of the investigations reports into rail safety incidents that have occurred in Victoria, NSW, New Zealand, Europe, Canada, and the USA over recent months.

Common themes in these reports include:
- the importance of controls to prevent train runaways (Norway, Sweden, UK)
- the importance of inspection of road over rail bridge parapets (UK and France)
- risks associated with train drivers using mobile phones while driving (USA, Canada)
- large vehicles at level crossings and their ability to site trains (Finland, Estonia, Canada).

There are also investigations into a passenger caught in train doors (Austria), and a train over-speeding when taking a diverging route owing to misreading signals (Poland). These are of specific interest to Victoria, having been the precursors to fatal incidents.
Comeng train fire, Croxton Railway Station

Occurrence date 17 March 2010
Investigation release date 13 Nov 2011

A Metro Trains Melbourne (MTM) Comeng train was departing the Croxton Railway Station when the driver observed sparks and flames emanating from the undercarriage of the last motor car of the train. The fire was subsequently extinguished by the Metropolitan Fire Brigade. None of the occupants were injured in the incident, though damage was sustained to undercarriage equipment and the train’s exterior. The overhead contact wire parted due to overheating.

The investigation found that there had been a flash-over of a traction motor and that the contacts of one line breaker created a sustained arc between its contacts and the casing. The intense heat generated from this arc melted the steel casing and ignited the fibreglass insulation material causing the fire.

The investigation found that a substation’s circuit breaker settings were incorrectly adjusted and as a result the train was not protected against over-current. This allowed the continuation of an excessive current flow resulting in the overheading and parting of the overhead contact wire. The investigation concluded that the train’s electrical components and the substation circuit breaker were not maintained to a satisfactory standard and this led to the mechanical and electrical failure of these components.

Tram-to-tram collision, Yarra Trams, intersection of Kings Way and Sturt Street, South Melbourne

Occurrence date 12 January 2011
Investigation release date 3 Aug 2011

Two trams on route 55 along Kings Way (one outbound, one city-bound) approached each other at the Sturt Street intersection. A previous tram movement on the citybound track had been a diverted St Kilda Road service. In accordance with normal operating procedure, this left the manually-operated points set for the turn from Kings Way into Sturt Street, requiring the driver of any following Route 55 tram to manually restore their setting. In this case, the next tram on the citybound track was a route 55 service. This tram stopped at the tram stop immediately prior to the intersection. When the traffic lights changed to ‘proceed’, the tram moved ahead with the driver responding to a ‘straight-ahead’ tram priority arrow and turned unexpectedly into the side of the opposing route 55 tram that was passing on the adjacent track.

The leading bogies of both trams derailed and both vehicles sustained significant exterior damage. Consequent reports recommended that some form of interlocking of tram and traffic signals with track points control should be considered by Yarra Trams.

Derailment at points 133D, South Dynon Junction

Occurrence date 20 Oct 2010
Investigation release date 3 Aug 2011

A shunt movement that required access to the main line was being conducted from the Melbourne Freight Terminal. When the shunt move was setting back from the main line into the terminal two wagons in the middle of the rake derailed at points on the main line. At that time, the South Improvement Alliance was engaged in commissioning signalling and track infrastructure upgrades at this area of operation on the Australian Rail Track Corporation network. During the work it was necessary to render the signalling system inoperative and to manage rail traffic utilising a subsystem of administrative procedures. The investigation found that points were incorrectly set for the shunt movement and that the senior signaller did not adhere to the South Improvement Alliance work instructions when setting the route. The investigation also found that Skilled Rail Services did not employ a formal or robust process in the appointment of senior signallers for the commissioning works.

The investigation recommended a review of the practice of permitting the access of normal revenue services to the network during infrastructure commissionings that require the signalling system to be rendered inoperative. The investigation also recommended that South Improvement Alliance and Skilled Rail Services review the roles, responsibilities and training of signalling staff for commissioning works.

Level crossing collision, Wee Waa, 1 Sep 2010

Two Pacific National locomotives struck a road motor vehicle (RMV) on a private level crossing located in the Narrabri West to Wee Waa section. The driver of the RMV suffered fatal injuries. No crew members of D551 were injured but they were treated for shock.

The level crossing is designated by the Australian Rail Track Corporation as a “private accommodation crossing”. It is part of a private road system that provides the property owner with access from the main portion of the property to paddocks and farming infrastructure.

The investigation determined that the primary cause of the collision was the driver of the RMV not stopping and giving way to the approaching train. There were no obvious factors which would have prevented the driver of the RMV from seeing or hearing the approaching train. Although not a contributing or causal factor, the windscreens on the train were scratched and dirty and provided less than optimal visibility.
A loaded freight train travelling from Medway Junction to Berrima Junction, derailed one bogie on the second-last wagon at Exeter, NSW. It was determined that the wagon of the train derailed due to a ‘screwed journal’ as a result of a wheel bearing failure. While there was insufficient evidence to determine the cause of the bearing failure, the investigation identified two safety issues in relation to the in-service condition monitoring of the wheel bearing, and, wagons regularly operated at speeds up to 1.5 km/h higher than the mandated limit for some classes of track.

Safe working irregularity/breach at Bomen NSW

A safe working irregularity involving a freight train occurred when the network controller attempted to set the route for the train to depart Bomen Yard and pass onto the mainline towards Melbourne. The network controller was unable to change an absolute signal from a stop (red) aspect to a proceed aspect (green), so he gave verbal authorisation to the driver of the train to depart Bomen and pass the signal while it was displaying a stop indication. However, issuing a verbal authorisation was not in compliance with the safe working rules in this case. The network controller should have issued a written Special Proceed Authority to authorise the train to pass the signal at stop.

Signal passed at danger at Yerong Creek, NSW

A southbound Brisbane to Melbourne freight train passed the home signal at Yerong Creek at red (stop) without authority. There were no injuries or damage as a result of the incident.

Safe working irregularity involving a freight train and an empty passenger train Manildra, NSW

An empty passenger train WP46 was authorised to travel through Manildra Yard on the main line. However, at the same time a freight train was already standing on the main line, having recently completed shunting within the yard. The driver of WP46 heard radio chatter relating to the freight train, so he broadcast that train WP46 was approaching and was authorised to travel through Manildra on the main line. The crew of the freight train immediately replied that they were standing on the main line and advised the train to stop.

While a number of defences served to avoid a collision in this case, a serious safe working irregularity occurred where one train had been authorised to proceed over track occupied by a second train. The investigation concluded that the ARTC network controller fulfilled a shunt order without entering information into the computer system identifying that both the main line and loop were occupied. The controller had later forgotten about the track occupancies when authorising train WP46 to travel through the Manildra Yard.

Uncontrolled freight train run-back between Shap and Tebay, Cumbria

A train collided with an articulated road tanker at a user worked crossing, causing the train to derail. Four passengers and the train driver were seriously injured. The driver of the road tanker did not use the telephone provided before driving onto the crossing, although it was a requirement to do so. The investigation also found that the long waiting times that road vehicle drivers sometimes experienced before being given permission to use the crossing led to a high level of non-compliance with the correct procedures for its use. Processes relating to misuse at user worked crossings did not identify this issue and procedures for responding to misuse and near miss incidents on user worked crossings were unclear and sometimes not complied with.

Bridge strike and road vehicle incursion onto the roof of a passing train near Oxshott Station

A lorry fell from a road bridge onto the railway and struck the roof of a passing train. The lorry had collided with the bridge’s parapet and partly demolished it. The rear three carriages of the train were damaged and the rear carriage of the train derailed. One passenger, sitting directly beneath the point of impact, was seriously injured and five other passengers received minor injuries. Two recommendations were made concerning issuing guidance for local highway authorities, together with two recommendations concerning local government highway safety inspections and safety measures.
Accident at Falls of Cruachan, Argyll

**Occurrence date** 6 June 2010
**Investigation release date** 14 Jun 2011

A train struck a boulder that had fallen onto the track. The boulder lifted up the front coach of the two-coach train and derailed it to the left and down an embankment. The boulder had fallen down the cutting slope onto the railway from within the railway boundary. It had become insecure due to the growth of tree roots around it, which gradually prised it from its stable position, and soil erosion from normal rainfall. The infrastructure manager’s earthworks management system applied to cutting slopes had not identified the hazard of loose boulders in the area that the accident occurred. Recommendations included improving the clearance of vegetation growing on earthworks so that hazards to the safety of railway operation can be identified, improvements to the collection of slope data, and improvements to the process for the implementation of remediation works to prevent future earthworks failures. A recommendation made relating to the prevention of lighting diffusers and other saloon panels on rolling stock becoming displaced during accidents was similar to a recommended safety action from the investigation into the Craigieburn train collision in 2010 which suggested inspection of the Comeng fleet to assure the adequacy of the fastening of items in overhead positions in passenger saloons.

Runaway and collision of a road-rail vehicle near Raigmore, Inverness

**Occurrence date** 20 July 2010
**Investigation release date** 14 Jul 2011

As an operator was placing a road-rail excavator onto the railway the machine began to run down the gradient. The people who were in attendance were unable to stop the machine before it gathered speed. The machine ran for 1.41 km with the machine operator on board, and then collided, at between 40 and 50 mph (64 to 80 km/h), with the rear of a stationary train. The investigation identified that the excavator was placed into an unbraked condition while being manoeuvred onto the track. Recommendations were made relating to modifications to the design of the excavator, a review of the safety requirements that are specified for this type of machine, and a review of the training of people who control this type of machine on site.

Runaway of an engineering train from Highgate

**Occurrence date** 13 August 2010
**Investigation release date** 16 Jun 2011

An engineering train ran away along part of the Northern Line of London Underground. The train consisted of a self-propelled diesel-powered unit designed for re-profiling worn rails. At the end of grinding operations the crew of the unit found that they were unable to restart its engine to travel away from the site of work. An assisting train, used for passenger services on the Northern line, was sent to the rescue of the grinding unit. The assisting train was coupled to the grinding unit by means of an emergency coupling device, and the braking system of the grinding unit was de-activated to allow it to be towed. The coupling device fractured while being towed and the grinding unit began to run back down the gradient towards central London. The crew of the grinding unit, who had no means of re-applying the brake, jumped off the unit as it passed through a station. It then ran unattended for about four miles. The investigation found that the emergency coupling broke because it was not strong enough for the duties it was intended to perform, and had been inadequately designed and procured. Seven recommendations were made, covering the processes for introducing new engineering equipment, review of existing equipment, investigation of incidents, training of staff, the operation of unbraked vehicles, and the quality assurance processes used by LUL and its associated companies.

Massachusetts Bay Transportation Authority collision

**Occurrence date** 8 May 2009
**Investigation release date** 13 Apr 2011

Westbound Massachusetts Bay Transportation Authority (MBTA) Green Line train 3612 struck the rear of standing westbound MBTA Green Line train 3808 near Government Centre Station in Boston in an underground tunnel segment. One car from each train derailed and 68 injured passengers and crew members were transported to local hospitals. Monetary damages were estimated to be about $9.6 million. The probable cause of the collision was determined to be the failure of the pilot operator of the striking train to observe and appropriately respond to the red signal aspect at 744A because he was engaged in the prohibited use of a wireless device, specifically text messaging, that distracted him from his duties. Contributing to the accident was the lack of a positive train control system that would have intervened to stop the train and prevent the collision.

Collision between long distance passenger train and agricultural trailer on double track line between Limoges and Brives.

**Occurrence date** 3 July 2009
**Investigation release date** Jan 2011

An agricultural trailer loaded with hay fell on the railway after falling down a cutting. Hit by the locomotive of the train, the trailer was projected and fell on a passenger car. Two serious injuries resulted.

Derailment of a train following the collapse of a block of a bridge parapet in Choisy-le-Roi

**Occurrence date** 20 Dec 2009
**Investigation release date** Mar 2011

A motor vehicle struck the parapet of a road over rail bridge. A large stone fell from the parapet onto the track. The train struck the stone and derailed. 600m track was damaged, 4800m catenary destroyed and the train damaged.

Derailment of a freight train at Bully-Grenay station

**Occurrence date** 29 Jul 2010
**Investigation release date** 2011

A brake failure on a wagon locked the axles resulting in 25 cm wheels flats. The concerned wagon, with all 19 following wagons subsequently derailed on a set of points. Track, signals and catenary were also damaged and services on the line were interrupted for five days. The accident was caused by a malfunction of a brake valve, the probable cause being foreign material left, understood to be sealant, in the unit after maintenance. The investigation highlighted poor quality management system in maintenance workshop and made recommendations regarding the maintenance of brake distributors and the implementation of a mandatory system of qualification for those working on safety critical equipment.
### Spain

**Collision with persons crossing track at Platja de Castelldefels, Barcelona**

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<th>Occurrence date</th>
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<td>Investigation release date</td>
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A long distance express train knocked down a group of people who were crossing the tracks to reach the opposite platform instead of using the provided underground passage. As a result 12 people were killed. No recommendations were made by the investigation, though examination of controls in place across Europe was made. One such control is fencing between tracks in station areas.

### Norway

**Uncontrolled freight car movement from Alnabru to Loenga**

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<td>Investigation release date</td>
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A freight car set consisting of empty container freight cars rolled uncontrolled from Alnabru shunting yard, down to Loenga and into the sea at Sydhavna in the Port of Oslo. The accident was triggered by a misunderstanding between the local traffic controller and the shunter about which shunting route to set, and the result was that the freight car set started rolling from an arrival track at Alnabru. When the shunter added an extra freight car to the freight car set, the local traffic controller was convinced that the freight car set was being shunted for loading. The result of this was that the local traffic controller released the mechanical brake that held the freight car set in place on the A track (a track mechanical brake in the form of a beam brake that pinches against the freight wagon wheels was used to hold it in place, the parking brake was not engaged on any of the freight cars). The shunter had not intended to move the freight car set and had uncoupled the shunting engine. There were no shared mental models, standard phrases or readback-hearback systems in place to prevent misunderstandings of communication between the local traffic controller and shunting personnel at Alnabru. When it became clear that the freight car set had started rolling and was not coupled to a locomotive, it was not possible to stop the freight car set by setting a diversion route before it left Alnabru. Nor were there any barriers on the freight train track between Alnabru and Loenga/Sydhavna which could stop the freight car set in a controlled way.

The investigation noted a breach of the ‘no single point of failure’ principle that railway operations shall be planned, organised and performed in such a way that a single failure does not lead to loss of human life or serious personal injury. The basic premise that allowed the accident to happen was the fact that Alnabru was being used in a manner for which it was not originally intended, including structural changes and increased rail freight traffic, combined with a lack of remodelling and improvement of infrastructure to reflect this development. Safety management system deficiencies resulted in the operator and infrastructure manager being unaware that Alnabru had fundamental faults and deficiencies in terms of operational and technical safety barriers.

During the uncontrolled movement it was estimated that the wagons reached a speed of approximately 125 km/h. It was expected that a derailler, combined with the track’s layout and curvature on part of the route would derail the freight cars and bring them to a halt. Instead, the derailler was sheared off and was later found 250–300 metres further down the track. During the uncontrolled movement a two-axled container wagon derailed, together with the wagons behind it, at a set of points. This caused a great deal of damage to the track, to a building close to the track and to motor vehicles along the road. The front section of the freight car set (seven freight cars, 194 tonnes, 207 m) continued on. One person walking close to the track was hit by the freight cars and died. The freight cars continued through a buffer stop at the end of the track, across a parking area, into a container terminal and an associated building. Freight wagons 2 and 3 went over the edge of the quayside, across a tug boat and ended up in the harbour basin, while the rest of the freight wagons stopped on the quayside. Two people inside the building died, and four others were injured. The freight cars damaged the building so badly that it collapsed.

### Sweden

**Wagons rolling uncontrolled on the Östavall – Alby line**

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<th>Occurrence date</th>
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When a train arrived at Östavall, the driver had to move the locomotive to the other end of the train in order to propel the wagons to the timber terminal. After the driver had backed in to the timber terminal in Östavall, he decoupled the wagons and parked them in the terminal. He then drove the locomotive to Ånge. A private individual who was in the vicinity of the railway in Östavall noticed that wagons were rolling and contacted the railway. Just prior to the call, the remote dispatcher had noticed that there was a shorted track circuit and had begun to investigation. The wagons rolled about 4 km before they stopped.

The investigation recommended exploring the possibility of developing standards for how protection should be arranged for sidings to prevent vehicles from rolling out onto/near to the connecting main line, and further analysis of the operators safety management system in capturing behaviours that can endanger traffic safety.
Collision between a passenger train and truck at a passively protected crossing, killed the truck driver and injured a train passenger. The investigation determined that the direct cause of the accident was human error of the truck driver, who could not adequately evaluate the requirements imposed by the warning sign of the crossing. An acute angle between his longitudinal axis and the movement direction of the train, approaching from the right hand side, was a contributing factor. The driver, sitting in the cabin of the truck does not have sufficient range of vision to give adequate evaluation to the traffic situation without halting his truck. He drove without halting at a low speed to the level crossing and was hit by the train on the right side of the truck. Recommendations included consolidating crossings for joining the quarry where the truck came from to the local road network and to apply temporary measures to improve sighting for motor vehicle drivers approaching the level crossing.

A timber-carrying articulated vehicle started to manoeuvre past the half barriers, which were in the lowered position, when the freight train, which had departed from Kyrö railway yard in the direction of Tampere, collided with articulated vehicle's trailer. Both locomotives of the train were derailed. The repair costs arising from the damage to track equipment and the level crossing amounted to EUR 150,000. The decision by the vehicle driver to start manoeuvring past the barriers was apparently influenced by the pressure resulting from being in a queue and because the driver felt that the articulated vehicle was blocking the pedestrian crossing. Other drivers were manoeuvring past the barriers, which gave confirmation to the notion that the barrier installations were not functioning properly. The queues grew to a significant size while the barriers were lowered because the engine driver did not give due regard to the signal and therefore did not notice that the remote controller had given permission to depart. Once the alarm had been issued that the barriers had been lowered too long the remote controller failed to contact the engine driver or take any other action to ease the queue at the level crossing before the departure of the train.

Several safety studies had been undertaken of the crossing, dating back to 1996, and the investigation noted that an underpass should be built as soon as possible in order to solve the traffic problems encountered at the crossing.

An electric locomotive collided with a car at the Koskinen unprotected level crossing in Kokemäki. The accident was fatal to the car driver and a passenger. A second passenger was slightly injured. The accident occurred because the car driver noticed the approaching train too late and despite braking was not able to stop the car before the level crossing. As the car approached the track the driver was driving too fast in relation to how visible the track was from the road. Contributing to this were the inexperience of the driver and the fact that there was little indication that a level crossing was approaching. Underlying factor to the accident was that visibility to the track was poor when approaching and insufficient sightline towards the approaching train made the observation more difficult.

The investigation recommended action to ensure that road maintenance staff are sufficiently aware of proper level crossing maintenance as well as the installation of the relevant warning signs. Safety improvements were completed in the surrounding area following another accident in 2004. The number of level crossings in the area was reduced and traffic was redirected to the Koskinnen level crossing. Redirecting traffic increased traffic and risk exposure at this crossing and the investigation noted that such actions should also include upgrading of remaining crossings. The investigation also notes that there was uncertainty as to which party was responsible for level crossing maintenance and the clearing of sightlines.
A child was caught with one foot in a train door. Only when the child hit the barrier at the end of the platform was the child removed from the door. Recommendations included fitting doors with electrical sensitive edge detectors, as trapped objects with a thickness of less than 50 mm are not currently detected on this type of rolling stock, and assessing whether an optical door closing warning system in accordance with EN 14752 should be installed. The investigation also made a recommendation on the subject of retention of testing records for train doors.

A Canadian Pacific Railway freight train was struck by a garbage truck travelling at a speed of at least 60 km/h, as the train occupied the passive crossing at Mile 13.85, near Grande Pointe, Manitoba. As a result of the collision, 22 car bodies derailed and the fuel tank on the second locomotive was punctured releasing about 4000 gallons of diesel fuel. The garbage truck was destroyed and the driver was seriously injured. The findings included that the presence of a structural pillar between the truck’s windshield and side window, the large side mirrors and the window frame on the truck obstructed a large part of the driver’s field of view.

A Canadian Pacific Railway freight train number 290-14 Mile 13.85, Emerson Subdivision, Grande Pointe, Manitoba derailed and the fuel tank was punctured releasing about 4000 gallons of diesel fuel. The garbage truck was destroyed and the driver was seriously injured. The findings included that the presence of a structural pillar between the truck’s windshield and side window, the large side mirrors and the window frame on the truck obstructed a large part of the driver’s field of view.

Main-track derailment, Canadian National freight train M-365-21-23 Mile 165.80, Saint-Maurice Subdivision, Clova, Quebec

Crossing accident, Canadian Pacific Railway freight train number 290-14 Mile 13.85, Emerson Subdivision, Grande Pointe, Manitoba

Main-track train collision, Canadian Pacific train number 300-02 and No. 671-037, Mile 37, Mountain Subdivision, KC Junction, British Columbia

Train 300 operating eastward side collided with westward Train 671. As a result of the collision, 3 locomotives and 26 cars derailed. The locomotive engineer was later air-lifted to a Calgary hospital in serious condition. It was later determined that the locomotive engineer had been exposed to marijuana, sometime prior to the accident. In an attempt to mask this exposure, he drank approximately 10 litres of water shortly after the accident, which resulted in hyponotremia (water intoxication). The investigation found that the collision occurred when train 300 was operated past the stop signal at the junction and into the side of train 671. The crew’s attention was momentarily diverted from the primary task of stopping their train and was likely focussed on resolving a hot box detector issue related to the reported hot wheels and not on the impending requirement to stop the train. The crew on train 300 conducted numerous cellular telephone communications (voice and text) in the three hour period prior to the accident. While engaged in these communications, the crew operated the train and performed various safety-critical tasks (e.g., negotiating public crossings, complying with temporary and permanent slow orders, and responding to wayside signals). The last communication prior to the accident was completed about 1 minute before receiving the first radio transmission from the signal maintainer concerning the status of the HBD. The report made a finding that despite the existence of rules and protocols regarding the use of personal electronic devices, not all railway employees working in safety sensitive and safety critical positions understand and accept the risks associated with such distractions, increasing the risk of unsafe train operations.
Rail Signalling and TSV

Stephen Backway is a rail signal engineer, his responsibilities include assessing notifications of change, applications to vary accreditation and assisting with or performing compliance inspections and safety audits. Prior to joining TSV, Stephen worked for four years with Engineering and Asset Management branch of the Department of Transport. As part of this role he completed the Rail Engineering Graduate Program, which included studying for a Post Graduate Diploma in Rail Signalling, through Central Queensland University and gained valuable experience in the industry through secondment opportunities.

To meet the current demands of the rail environment, the rail signalling systems regularly undergo change. The changes are often driven by the need to provide greater network capacity, to replace life expired systems and to improve safety. When a change is to be made to signalling infrastructure (including new infrastructure and changes to the existing infrastructure), the accredited rail operator (ARO) is required to submit an application to vary accreditation (AVA) or notification of change (NOC) to TSV.

Application to vary accreditation

Section 54 of the Rail Safety Act 2006 (Vic) (RSA) defines the requirement of when an ARO is to submit an AVA as:

"...if an accredited rail operator proposes to make a change to, or to the manner of carrying out, accredited rail operations that may reasonably be expected—
(a) to change the nature, character and scope of the accredited rail operations; or
(b) to not be within the competence and capacity for which the accredited rail operator is accredited."

In general, for rail signalling projects, an AVA should be submitted if the signalling project results in a diversion from current signalling principles or a significant change to the signalling system. This includes the introduction of new technology which is significantly different to the current signalling technologies.

A review of the AVA is conducted by TSV to verify compliance with the RSA and the ARO’s Safety Management System (SMS). In particular, TSV looks for evidence that the risks to safety have been eliminated or reduced so far as is reasonably practicable (SFAIRP).

It is important in demonstrating SFAIRP that all potential hazards are identified, associated risks assessed, practical controls are identified and justifications for excluding any available controls are provided. A guidance paper is available from TSV, SFAIRP- A Guidance Note and Toolkit (consultation draft). You can find this publication at www.transportsafety.vic.gov.au/publications or feel free to call TSV on 9655 8949 and request a copy to be sent to you.

The review of the AVA by TSV is assessed against general compliance with legislative requirements and does not represent an approval of specific signalling designs. It is the ARO’s responsibility to approve signalling designs and to demonstrate that it has eliminated or reduced the risks to safety associated with the design and operation of signalling infrastructure SFAIRP. This is consistent with the modern legislative approach of the RSA, where the onus is on operators to demonstrate how they have met the requirements of the legislation.
TSV's role is to work with operators to ensure they comply with their legislative obligations, without prescribing the details, methods or processes by which they choose to comply.

TSV's assessment of AVAs that relate to rail signalling is greatly assisted if the following key documents/details are provided:

- a high level statement of the scope of works (for example, project brief)
- a risk register, which includes a comprehensive listing of hazards, risks associated, potential applicable controls and justifications for including/excluding the controls
- a description of the operations of the final design, including train types and moves, line speeds and special signal aspect conditions. (for example, operations specification)
- a signalling arrangement plan, which details all relevant aspects of the design, including but not limited to: overlaps, positions of signals and aspects they can display, line speeds, curve speeds, track layout, level crossing protection controls.
Notification of Change

In general, a NOC should be submitted to TSV when a change is made to the configuration of signalling infrastructure which is within the competence and capacity of the ARO. This includes changes to the operation and maintenance of the signalling system. For NOCs, additional documentation may be requested by TSV for compliance purposes and to assist in our understanding of the risks to safety that are associated with the change.

Past investigations/incidents to consider

During the identification and treatment of hazards and risks to safety, it is important to consider new technology and findings from past investigations and incidents. Three potential safety risks, which have been identified in past incidents, are detailed below. These risks have been considered and mitigated in recent signalling projects. The following risks are not intended to be an exhaustive list of risks and are only discussed briefly by way of general information only.
Risk: A train exceeds more than twice the diverge speed leading to a derailment or roll-over situation.

This scenario occurred in Laverton, 1976. An up Port Fairy train approaching the junction at Laverton was routed onto the adjacent line. This was an abnormal situation and only occurred due to shunting operations at a siding further along the line. The train approached the junction at line speed and took the diverging move, at more than twice the rated speed and subsequently derailed. The Coroner’s report made three recommendations to prevent re-occurrence, the third being:

"On lines where maximum speeds exceed 50 mph where three position signalling is provided, modify the signalling arrangement so that medium speed crossovers are so signalled as to provide a stop signal for the crossover move for sufficient time to ensure that the Driver in observance of that signal reduces the speed of the train to a safe level."

In this situation, the rated speed of the diverging move was 25mph. The specific control stated in the recommendation may not apply to all situations however, it is important to treat the risk presented in this scenario.

Risk: Train exceeds overlap resulting in a collision with another train.

In the past this risk has been demonstrated in multiple incidents, with recent examples including incidents at Footscray (2001) and Epping (2002). In both occasions the train ‘tripped’ at the signal, however due to the length of the overlap, a train – train collision occurred.

The overlap is a safety margin, which is provided past a signal at stop. The design of which is intended to provide the train with a safe distance to stop prior to any danger to trains, people or infrastructure. The overlaps in these incidents were designed for a speed lower than line speed (medium speed) and therefore failed to provide protection for when a driver fails to respond to the warning aspects on prior signals. This risk is more predominate at stopping locations (home signals or platforms) or at converging junctions, due to the higher frequency of stopped trains and previous design practices.

The relevant recommendations include:

- Footscray ATSB Investigation report, recommendation 4: "The signalling system and overlap should be reviewed with a view to ensuring trains passing a signal at danger are stopped within a safe distance. In sections before a station this distance should ensure a train is brought to a halt before a possible collision with another train stopped at the station."

- Epping ATSB Investigation report, recommended safety action RR20020002: "The ATSB recommends that the Department of Infrastructure review the design of the signalling system, including the safety margin and route interlocking, particularly on single line sections of track with only one signal protection from oncoming movements."

Risk: Human error in operation of points leads to train-train collision or train derailment.

This risk was one of the significant factors in the Ararat (1999) accident. A train travelling along the mainline heading for Melbourne, entered the siding and collided with a stationary train. This accident was attributed to a railway employee changing the lie of the points from the mainline to the siding, using the local mechanical levers (and annett lock). At this location the points were in no way interlocked with the signalling system or indicated to the controller, as such the approaching train was unaware of the lie of the points, until immediately upon them.

As a result of this accident, reviews of similar locations were undertaken in Victoria and suitable controls were implemented to eliminate or reduce the risks appropriately.

Footnotes

1 Source: Laverton, Derailment UP Port Fairy Passenger Train, 10.5.1976, Summary of Coroner’s Board of Enquiry Evidence

2 Source: Rail Investigation Report, Collision between suburban electric passenger train 6369 and the empty express electric train 6371, Footscray, Victoria, 5 June 2001, ATSB, Nov 2001


TSV supports innovative research into motorist behaviour at level crossings

Safety issues at rail level crossings are a key concern for TSV, the Victorian Government, the wider rail industry and the community. Upgrades to level crossing protection are expensive and compete with other important projects for limited government resources. Therefore, new ways to improve safety at level crossings are a high priority. New and innovative countermeasures are proposed at regular intervals, and the implications of these for road user behaviour and level crossing system safety must be assessed systematically.

In recognition of the safety issues at level crossings, the Monash University Accident Research Centre (MUARC) received funding from the Australian Research Council to conduct research on human factors issues at level crossings. The research is a partnership between MUARC and a number of organisations that are providing funding or in-kind support for the project.
The organisations are:

- TSV
- VicTrack
- Department of Transport (DOT)
- V/Line
- VicRoads
- Transport Accident Commission (TAC)
- University of Southampton (in the United Kingdom).

In June, 2010, Monash University received funding for the project, “Application of contemporary systems-based methods to reduce trauma at rail level crossings”.

This research will be conducted over four years and aims to develop a systems-based model of railway level crossing performance that accounts for road user behaviour, the factors that influence road user behaviour (such as signage, the types of protection provided, the sighting distance on the crossing), and the factors known to lead to incidents and accidents. The model will be used to prioritise current and new countermeasures. A proportion of these will be formally tested using additional methods of assessment.

The knowledge developed during the project will include a world-first model of the level crossing system and will support the development of countermeasures that will improve safety. TSV looks forward to the findings of the research and seeing these implemented.
Failure of bridges due to scour

Scour is the loss of foundation material (that is, soil and rocks) from around bridge abutments or piers caused by the flow of water over time. It can lead to the undermining of bridge foundations and has been the cause of numerous catastrophic bridge failure incidents.

Recent incidents that have identified scour as the main causal factor include the River Crane Bridge collapse in UK (November 2009) and the Malahide Viaduct collapse in Ireland (August 2009).
River Crane Bridge collapse UK

The Rail Accident Investigation Branch (RAIB), Rail Accident Report¹, identified the following contributing factors:

- an obstruction in the watercourse, which channelled the flow towards the east abutment, increasing its velocity and making it more likely that scour would occur
- Network Rail being unaware of the obstruction and therefore not taking action to mitigate the risk of scour
- the vulnerability of the east abutment of the bridge to undermining by scour by virtue of being located on the outside of a bend in the river, constructed with shallow foundations and founded on erodible material
- the absence of checks by Network Rail staff for obstructions against the upstream faces of bridges
- weaknesses in Network Rail’s process for annual assessments of structures, particularly the information provided to the individuals involved
- Network Rail having inadequate knowledge about the condition of the foundations of the bridge as they had not commissioned mandatory underwater examinations
- the lack of a mechanism to encourage members of the public to report the obstruction to Network Rail
- Environment Agency staff not being aware of the safety risk presented by the obstruction found in the watercourse at the bridge and not being under an obligation to report non-flood risks to the infrastructure owner.

As a consequence of this accident the RAIB made five recommendations to Network Rail:

- mandating frequent checks for obstructions against the upstream faces of bridges
- improving the annual assessment process for structures to ensure that key personnel have sufficient information to undertake the task competently. The river crane report found it was unreasonable to expect scour to be detected by track patrollers undergoing routine inspections
- introduction of a means to prompt members of the public to report obstructions
- improvements in Network Rail’s process for managing scour risk
- improvements in the guidance provided by Network Rail to staff who may have to evaluate whether it is safe to run trains in the immediate aftermath of an incident.

The RAIB has also made one recommendation targeted at the Environment Agency covering the introduction of arrangements for reporting obstructions to railway infrastructure owners, regardless of whether there is a risk of flooding.
The Railway Accident Investigation Unit (RAIU) in Ireland, investigation report ‘Malahide Viaduct Collapse on the Dublin to Belfast Line’, dated 21 August 2009, identified the following contributing factors:

- The infrastructure manager (IM) had not developed a flood/scour management plan.
- Engineers were not appropriately trained for inspection duties, in that the inspections training course they completed was an abridged version of the intended format, and there was no formal mentoring program for engineers on completion of this course.
- There existed an unrealistic requirement for patrol gangers to carry out annual checks for scour, as they did not have access under the structure and in addition, they did not have the required specialist training/skills to identify defects caused by scouring.
- The IM’s suite of structural inspection standards providing guidance for inspectors carrying out inspections was not formalised.
- A formal program for special inspections for structures vulnerable to scour was not adopted, as per the IM’s inspection standard at the time of the accident.

The RAIU made 15 recommendations, some of which are summarised below. The full list of recommendations can be found in the investigation report.

- The IMs should remove the requirement for track patrollers to check for scour.
- The IMs should formalise their guidance standard for inspections and reissue to all relevant personnel.
- The IMs should introduce a verification process to ensure that all requirements of their standard are carried out in full.
- The IMs should carry out inspections for all bridges subject to the passage of water for their vulnerability to scour, and where possible identify the bridge foundations. A risk-based management system should then be adopted for the routine examination of these vulnerable structures.

The report also stated that the underlying factors to the accident were:

- Loss of corporate memory when the IM’s staff left the division, which results in valuable information to the historic scouring and maintenance not being available to the staff in place at the time of the accident.
  
- Information regarding the bridge was missing due to there not being a properly introduced information asset management system.
- The IM failing to meet all of the requirements of its inspection standard: visual inspections were not carried out for all visible elements of structures, bridge inspection cards for recording findings of inspections were not completed to standard or approved by the relevant personal. A formal program for systematic visual inspections of all elements of a structure, including hidden or submerged elements, despite an independent review recommending the IM implement this program in 2006.

The factors listed above contributed to the bridge collapse due to scour and highlight the importance of assessing and managing risks associated with scour. It can be difficult for bridge inspectors to check for scour during scheduled bridge inspections due to access difficulties and the possibility of infilling, that is the void created by scour has been filled by loose soil and sediment making the void appear filled. IMs are therefore advised to implement a scour risk management plan as part of their bridge inspection regime.

Footnotes

1 Source: Laverton, Derailment UP Port Fairy Passenger Train, 10.5.1976, Summary of Coroner’s Board of Enquiry Evidence
2 Source: Rail Investigation Report, Collision between suburban electric passenger train 6369 and the empty express electric train 6371, Footscray, Victoria, 5 June 2001, ATSB, Nov 2001

Endnotes

1 Rail Accident Report 17/2010, Failure of Bridge RDG1 48 (River Crane) between Whitton and Feltham, Rail Accident Investigation Branch (RAIB), Department for Transport (UK), 14 November 2009.
Variation of Accreditation for complex projects

Background

An accredited rail operator (ARO) must submit an application for variation of accreditation (AVA) to TSV when they propose to make a change to, or to the manner of carrying out, their accredited rail operations that may reasonably be expected:

- to change the nature, character and scope of the accredited rail operations, or
- to not be within the competence and capacity for which the ARO is accredited (s54(1) Rail Safety Act 2006 (Vic) (RSA)).

Examples of significant proposed changes to accredited rail operations which require the submission of an AVA include:

- geographic change to rail operations e.g. a new line or extension to a rail corridor
- maintenance or construction activities not currently undertaken
- increasing train running speeds
- new signalling or safe working system
- new communications systems
- new train stations or new types of tram stops
- a change in the rail operations which could result in the ARO no longer having the competence or capacity to maintain the safety of their operations
- new types of rolling stock, including maintenance vehicles
- changing from a freight operator to a passenger rail operator
- an alteration to working arrangements for train crews e.g. two persons to driver only operation.

An ARO must not implement the change to, or to the manner of carrying out, their accredited rail operations unless the AVA has been granted by TSV.

Following submission of the AVA, TSV may request that the applicant supply additional information regarding the proposed change. Based on the information provided, TSV must make a decision whether or not to grant an AVA:

- within six months of the initial application being received by TSV
- within six months of TSV receiving the last of any further information requested (or another period agreed by both parties), or
- a time period set by TSV so long as TSV notifies the applicant in writing of the extension before the relevant six month period expires-whichever is longer (s54(5) and (9) RSA).

AROs are therefore strongly advised to take the requirements of any AVA into consideration when planning their project timelines in order to avoid TSV’s review causing a delay to project implementation.

Complex projects

For more complex or larger projects, consultation with TSV should commence as early as possible (such as the project planning stage), and continue on a regular basis until the ARO’s AVA has been granted by TSV. Engaging TSV early ensures:

- TSV can identify and raise any concerns that may affect the accreditation of the project as early as possible (when any issues may be more easily and cost effectively addressed), in order to avoid delays when the AVA is sought by the ARO, and
- ongoing compliance with the requirements of the RSA throughout the project by the ARO and any other party that is involved in the project (for example, contractors engaged in design and construction activities).

Engagement well ahead of the formal submission of the AVA will promote a more comprehensive understanding of the project and also provide an opportunity for the ARO (and any other parties to the project) to demonstrate how the risks to safety associated with the project are being eliminated or reduced ‘so far as is reasonably practicable’ throughout the project. This may be demonstrated by:

- implementation of appropriate processes to identify hazards, assess risk, assess controls and make decisions for rejecting, implementing and reviewing controls, to replicate steps in SFAIRP guidance
- the elimination or reduction of hazards and risks by design
- incorporation of appropriate controls to eliminate or reduce hazards and the risks to safety at the design stage
- implementation of appropriate processes for managing the design, development and implementation of the system or infrastructure
- the effective identification and management of problems and issues that often occur during the design and development of complex projects.

With a more comprehensive understanding of the project and exposure to the risk management process, TSV will be in a better position to quickly review, assess and process the ARO’s AVA making it more likely that overall project timeframes will be met.
Mudholes are sections of track where the ballast has been fouled by mud. Mudholes can be formed by failure of the capping layer and formation. This may be caused by:

- poor drainage in the track section causing saturation, degradation and subsequent failure of the capping layer and formation
- damage to the capping layer and formation caused by track maintenance, or
- damage to the capping layer and formation caused by rail defects such as dipped welds or corrugations.

When a loaded train hits the defective rail, it generates a severe impact which penetrates the ballast, formation and sub-grade, and over time causes damage and degradation.

When the formation and sub-grade fail, these materials migrate through the ballast and retain water, creating a mudhole.

Mudholes can also be formed by dirt blown from adjacent fields or cess drains or from ballast wear, fouling the ballast.

One of the key functions of ballast is to hold the sleepers securely in position and to ensure there is minimal movement of the track when it is subject to:

- vertical and lateral forces generated by the passage of trains or
- the forces generated by the expansion and contraction of the rail due to changes in ambient temperature.

The development of mudholes can adversely affect the ballast’s ability to hold sleepers in position and maintain vertical or horizontal track geometry.

Failure of the ballast to hold the sleepers securely in position can result in the track moving excessively in the vertical direction under load (which is characterised by rough ride on trains) or track buckling, during periods of high ambient temperature.

From a safety perspective, if track geometry is not maintained to specification, there is an increased risk of derailment of trains.

There are a range of controls that can be implemented to manage the immediate risk to safety associated with track geometry defects arising from mudholes. These include:

- reducing train speed
- increase in the frequency of track inspections, and
- recording and analysis of track geometry data generated by a track recording car operated at regular intervals.

Risks associated with the above controls include a track geometry defect going undetected between track inspections or running of the track recorder car. The track maintainer should ensure that this risk is managed by ensuring that the level of track monitoring is appropriate for the track conditions, and that safety performance indicators are regularly assessed to provide an objective measurement that the track geometry defects are being managed so far as is reasonably practicable.

Emerging technologies are increasingly being used internationally, such as track geometry measurement systems, fitted to in-service rolling stock, enabling continuous measurement of track geometry under the passage of a loaded vehicle.

While reducing train speed may increase travel times, it is an effective control to ensure the safety performance of the rail network affected by mudholes.
Rail Safety News has been getting some great feedback, and our Rail Safety cow from issue 5 has been very well received. So much so, we have had inquiries as to her well-being and her name! Here’s one such example from Rowan Bravington, Secretary Rail Safety Accreditation, Mornington Railway.

“... PS We did like to ruminant in the hard-hat. However, she did seem a bit close to the railway line (and no hi-vis vest). Maybe we can let her off, as there were no udder cows about.

Regards
Rowan”

As yet, our Rail Safety News cow is nameless, and we invite you to send us your suggestions for a suitable appellation via email: information@transportsafety.vic.gov.au