Australian Government

Australian Transport Safety Bureau

Our Reference: B2005/0362
Contact: Olivia Sherwood, 02 6274 7249

Mr John Eren MP
Chair
Parliament of Victoria Road Safety Committee
Parliament House, Spring Street
EAST MELBOURNE VIC 3002

Subject: Submission for the Inquiry into Improving Safety at Level Crossings

Dear Mr Eren

Thank you for your letter of 20 August 2007 inviting a submission from the Australian Transport Safety Bureau (ATSB).

I am pleased to provide the enclosed submission on behalf of the Department of Transport and Regional Services, of which the ATSB is a part. The submission draws on input from the AusLink Rail Branch of the Department, as well as national statistical data, and findings from ATSB investigations of level crossing collisions.

I hope the Committee will find this submission useful.

Yours sincerely

Kym Bills
Executive Director
3 October 2007

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Australian Government

Department of Transport and Regional Services

A submission to the Parliament of Victoria Road Safety Committee's Inquiry into Improving Safety at Level Crossings.

October 2007

Terms of Reference

... to inquire into and report ... on existing, new and developing technologies for implementation to improve safety at level crossings.

Level crossing collisions – national context

Railway occurrences – which include collisions, derailments and misadventure at railway stations – account for approximately two per cent of all transport-related deaths. While even this small percentage is a tragedy, it also does not lessen the potentially significant adverse impacts on passenger and freight operations from these occurrences and the need for appropriate risk management practices and measures to be in place.

Most railway deaths occur at level crossings, and involve a road vehicle or a pedestrian moving into the path of a train. Current national data, sourced from the Rail Safety Regulators Panel, and counting collisions at level crossings rather than deaths, show that over the three years from 2004 to 2006, there were 248 collisions at level crossings between either a train and a road vehicle or a train and a pedestrian. The available data do not include a count of deaths at level crossings. There were a total of 125 rail deaths in Australia from all types of railway occurrence over the same three-year period. Other data, sourced from the ABS, suggest that of all deaths occurring at level crossings, pedestrians comprise over 75 per cent.

A breakdown of level crossing collisions over the last six years by state and territory shows that Victoria had the highest number of both car-train collisions and pedestrian-train collisions for each year. Victoria accounts for around one-third of train-car collisions and one-half of all train-person collisions. When normalised by the number of train-kilometres, Victoria's figures are closer to, but still well above the average. On this normalised basis, rates for Queensland are comparable to Victoria, and Tasmania's rates are higher.

Comparisons between jurisdictions do raise important questions, but limitations in the current data sets preclude further interpretation. Specifically, the number and type of level crossings, and their (road and rail) traffic flow, are important determinants of the combined risk of level crossing operation within a given jurisdiction. This breakdown of data is not presently available.

Traffic control systems

Australian Standard AS 1742.7-2007 *Manual of uniform traffic control devices Part 7: Railway crossings*, prescribes the standard for traffic control devices that is to be used at level crossings throughout Australia. Traffic control treatments at the road-rail interface can be placed into three main categories: passive traffic controls, active traffic controls and grade separation.

Passive level crossing traffic control systems

AS 1742.7-2007 defines 'Passive control' as;

> *Control of the movement of vehicular or pedestrian traffic across a railway crossing by signs and devices, none of which are activated during the approach or passage of a train, and which rely on the road user including pedestrians detecting the approach or presence of a train by direct observation.*

Passive traffic control is usually provided by 'Give Way Signs' or 'Stop Signs' and used where the volume of road traffic is relatively low. If the driver of a vehicle approaching a crossing has sufficient visibility to sight an approaching train and make an informed decision whether to stop or proceed across the level crossing, 'Give Way Signs' may be appropriate. If visibility is restricted such that a motorist could only sight an approaching train from the stopped position before making an informed decision whether to proceed, 'Stop Signs' may be more appropriate. In both cases, it is important that road signage is as effective as possible at warning motorists that they are approaching a level crossing, and critical that motorists can sight an approaching train, albeit with slightly different design criteria between stop and give way signs.

Active level crossing traffic control systems

AS 1742.7-2007 defines 'Active control' as;

> *Control of the movement of vehicular or pedestrian traffic across a railway crossing by devices such as flashing signals, gates or barriers, or a combination of these, where the device is activated prior to and during the passage of a train through the crossing.*

Active traffic control is commonly used when passive traffic control is not sufficient and/or the speed and volume of road or rail traffic is relatively high. Flashing lights and bells remove the need for vehicle drivers to sight an approaching train before deciding whether to proceed across the level crossing. Boom barriers provide an additional visual and physical barrier between road vehicles and trains. This system of traffic control removes the requirement for direct observation of an approaching train and relies on the road user sighting the flashing lights, recognising their intended message and reacting in accordance with the road rules.

Grade separation

The most costly type of traffic control involves building a bridge or tunnel to separate the two modes of transport. Grade separation is commonly used where the speed and volume of road or rail traffic is high and road closure due to train movements would cause unacceptable delays to road traffic. This system of traffic control system removes the road-rail interface, eliminating the requirement for road traffic to consider an approaching train.

Suitability of standards

Level crossings in Australia are generally installed subject to the requirements of the relevant standard at that point in time. Australian Standards are periodically reviewed and revised, which over time can result in non-compliance when an existing level crossing is assessed against the current standard. It should be recognised that migration to a new standard is not always considered mandatory. Any changes or upgrades to an existing installation would be expected to comply with the standard current at the time of upgrade. Consequently, existing installations may not incorporate new provisions intended to improve safety at railway level crossings unless the relevant authorities have an effective risk assessment process in place to capture non-compliances against the latest standard (refer to the section titled 'Assessing risk at level crossings').

However, a number of issues are not clearly covered in the Australian Standard AS 1742.7-2007 and in some cases have been found to be deficient.

Sighting distance provisions

AS 1742.7-2007 was published on 20 February 2007, and includes sighting distance provisions that were not included in earlier versions of AS1742(7)[1]. It should be noted that the sighting distance provisions in AS 1742.7-2007 are largely consistent with those documented in the AustRoads *Rural Road Design - A Guide to the Geometric Design of Rural Roads (eighth edition 2003)* and should have been applicable before the current version of AS 1742.7-2007 came into effect. However, even if an installation originally conformed to the relevant standard, growth of road-side and track-side vegetation over time can significantly reduce the sighting distance available to road vehicles[2].

Stopping sight distance is the distance travelled by a vehicle between when the driver first sights a requirement to stop, reacts accordingly, applies the brakes and brings the vehicle to a stop. There appears to be no national guide that defines the stopping sight distance provisions for both passive and active level crossing traffic control systems. AS 1742.7-2007 only describes the process for calculating sight distance provisions at passive control crossings. This implies that these provisions are not mandatory for active control crossings, even though the provision for stopping sight distance (S_1) could be considered appropriate for both types of crossing control.

The Austroads *Guide to Traffic Engineering Practice – Part 5: Intersections at Grade* (June 2005) provides design guidance where two or more roads cross or meet. The same philosophy could be applied to road/rail intersections. This guide also discusses special provisions for trucks and documents a table of 'Truck Stopping Sight Distances'. This guide also draws attention to vehicles queued at signalised intersections and the stopping sight distance to the queued vehicles. The Austroads guide states that where the stopping sight distance cannot be achieved, "...special warning devices may be necessary".

Once a road vehicle has stopped at a crossing, it is important that sufficient information is available to allow the motorist to make an informed decision whether it is safe to proceed. If a vehicle is stopped at a level crossing protected by passive traffic control systems, it is critical that the driver can see far enough along the railway to be able to start, accelerate and clear the crossing before the arrival of any previously unseen train. Australian Standard AS 1742.7-2007 provides guidance for calculating sight distance provisions at passive control crossings. However, tests conducted by the ATSB has identified that the standard may be inadequate for some vehicle configurations.

In some areas of Australia, road-train[3] truck configurations can consist of a prime mover hauling trailer combinations up to 53.5 m in length with a gross combined mass of 175 tonnes. These road-trains are the largest in terms of weight and length allowed on public roads in the world. Tests conducted by the ATSB[4] found that the procedures used to calculate and/or assess the level crossing sighting distance are inadequate for road-train trucks of the configuration tested. It is likely that other level crossings and other high combined gross mass vehicles would exhibit similar results.

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1 Superseded versions - AS1742(7)-1993 published on 15 February 1993 and AS1742(7)-1987 published on 8 June 1987.

2 ATSB report 2006/004 *Collision between Rigid Tipper Truck/Quad Axle Trailer and Freight Train 4AM3 Lismore, Victoria* provides example where vegetation reduced sighting distance at a passive control crossing.

3 Road-train – A combination road vehicle consisting of a prime mover towing two or more trailers, where the second and subsequent trailers are drawn by drawbar connected dollies.

4 ATSB Safety Advisory Notice - RS20070001

Curved level crossing road approach

AS 1742.7-2007 does not provide clear guidance for assessing curved road approaches leading up to a level crossing (passive or active). The Austroads *Guide to Traffic Engineering Practice – Part 5: Intersections at Grade* states that "…as far as possible, avoid locating features which are likely to require trucks to brake on curves". A curved road approach within the stopping sight distance is undesirable since some of the friction at the road/tyre interface is used to hold the motor vehicle on the curved path. This is particularly important for articulated trucks since controlled braking is required to avoid jack-knifing. The Austroads guide focuses on a vehicle's ability to brake on a curve; however it provides no clear guidance related to the traffic control system's ability to capture a motorist's attention if the road approach is curved.

Environmental conditions

Sun-glare can reduce a motorist's ability to clearly sight traffic signals and signs either by shining on the signal lens or shining directly at the driver. There is no clear design guidance documented in AS 1742.7-2007 for assessment of environmental conditions associated with level crossing safety. However, the Australian Standard and the Austroads guides do mention possible strategies to address the issue of sun-glare which are summarised below.

While not specifically mentioning sun-glare, the Australian Standard notes that a "…black supplementary target board of suitable size may be used to enhance the visibility". The Austroads guides also discuss the use of a cowl or visor attached to the face of a signal to minimise the effect of the sun shining on the signal lens. Both strategies are commonly adopted at level crossings with flashing light installations to reduce sun related problems. However, neither document provides clear guidance as to the size of the target board or visor.

The standard also states that active advance warning assemblies, discussed in the following section titled 'Visual devices', should be considered if;

> *Driver visibility of the operating railway crossing flashing lights may be reduced by sun-glare, either as a consequence of the sun shining directly upon the signal lenses or due to the sun shining directly into the driver's line of vision.*

Assessing safety risk at level crossings

Historically, there has been no common national method for assessing risk and evaluating the level of traffic control required at a specific level crossing. Each state developed their own process through local standards and assessment committees. However, in 2003, the Australian Transport Council (ATC)[5] agreed to adopt the Australian Level Crossing Assessment Model (ALCAM) as the national model for assessing safety risk at level crossings. ALCAM is a process that objectively assesses, evaluates and prioritises the safety risks at railway crossings and can also be used to test treatment strategies aimed at improving safety risk at specific sites.

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5 The Australian Transport Council comprises Commonwealth, State, Territory and New Zealand Ministers responsible for transport and road issues.

Potential safety improvements at level crossings

The following sub-sections provide examples of potential safety improvements that can be applied at railway level crossings. (Please note this is not an exhaustive list of strategies).

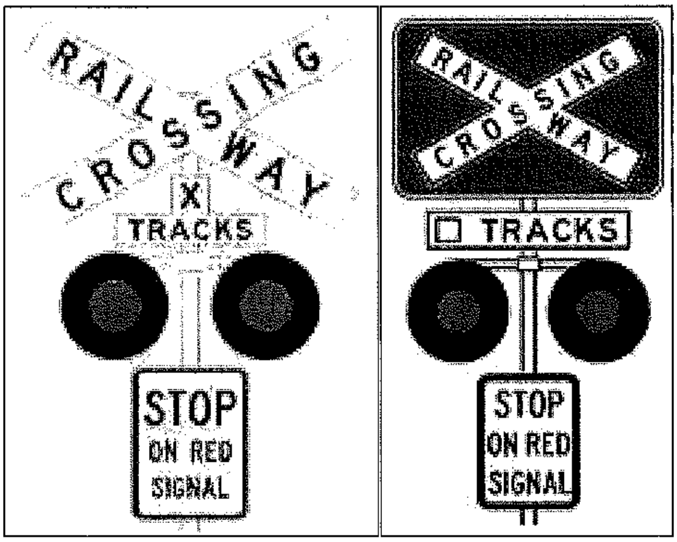
Visual devices

At level crossings, visual devices remain the primary method used to warn motorists of an approaching train. Depending on a risk assessment for each specific location, visual level crossing traffic control is provided by passive signage or a combination of passive signage and active visual devices such as flashing lights and boom barriers.

Signage provides some ability to draw the attention of a motorist, and revisions to the Australian Standard do provide some guidance to make signage more conspicuous.

For example, the standard specifies two approved sign configurations for the flashing light assembly at railway level crossings. The configuration stated as 'preferred' incorporates the 'Railway crossing position sign' with a large red target board (Figure 1), making the crossing more conspicuous to road users.

Figure 1: Flashing light assembly - Preferred design on right



Signal lights are more likely to demand a road user's attention, with flashing lights providing some improvement over steadily lit lights by giving a changing visual cue to draw the attention of a motorist. Boom barriers add a further visual cue as well as a physical barrier, and as such may provide further protection for drivers who make an error. However, they have proved more effective at deterring violations such as driving through a crossing while the signals are operating.

While the Australian Standard describes the configuration of flashing light signals, it does not provide any guidance on signal design (size etc.). For many installations, the flashing light fittings utilise $8^3/_8$ inch (~213mm) lenses and 20 inch (~508mm) black target boards. However, where the road approach had a higher speed limit, and/or visibility could have been reduced due to sun-glare or road configuration, designers sometimes specified the use of 12 inch (~305mm) lenses with either 20 inch (~508mm) or 24 inch (~610mm) black target boards. Either size flashing light configuration can also be retrofitted with 200mm or 300mm LED lights to further improve sighting performance. LED[6] lights generally provide high intensity over a wide viewing angle, ultimately

6 LED – Light Emitting Diode

improving the warning performance from a road perspective. LED lights are also recognised as being less susceptible to the effects of sun shining on the signal lens.

An enhancement not commonly used on level crossings at this time is active advance warning[7]. Active advance warning assemblies incorporate signage and flashing lights positioned to provide road users with advance warning of a requirement to stop due to an impending activation of the level crossing traffic control system. The standard states that active advanced warning should be considered at locations where the crossing is the first active road signal control encountered by a motorist after a long distance of unencumbered travel and/or the road has a high speed limit. The standard also encourages use of active advance warning where the stopping sight distance may be limited or driver visibility of the flashing lights may be reduced.

Audible devices

Historically, audible devices have been considered an important component in the systems used to warn motorists of an approaching train. However, soundproofing, air conditioning and entertainment systems in modern vehicles suggests that audible signals are now less effective than before in warning vehicles of an approaching train.

Considering the sound-excluding performance of most modern vehicles, a suitable sound pressure level inside the vehicle requires a significantly higher sound pressure level at the source of the sound. Achieving this sound pressure level at the source would possibly exceed the human hearing pain threshold for people positioned closer to the sound source and would not generally be acceptable on health and environmental grounds.

Consequently, it would appear that audible warnings are more effective at warning bicycle riders and pedestrians, and a substantial increase in the loudness of train whistles is possibly not a viable option. It should also be noted that portable entertainment systems (iPods etc.) are reducing the effectiveness of audible warning devices for bicycle riders and pedestrians.

Other devices

Audio-tactile road markings are a series of closely spaced small raised bumps in the road surface. This type of road marking is designed to generate noise and steering wheel vibration when traversed by a road vehicle. Audio-tactile line marking is commonly used to indicate the road edge and is recognised as an effective tool to combat driver fatigue. However, the use of audio-tactile road marking in other applications such as railway level crossings is not so common.

Vision is the principal sense used while driving, whereas hearing and especially touch are used to a much lesser degree, suggesting that audio-tactile road marking could be an effective means of capturing attention. Audio-tactile road markings are potentially a relatively low-cost enhancement to level crossing traffic control systems that could assist with refocusing the attention of distracted drivers.

Intelligent Transport Systems (ITS) is a generic term used to describe active in-vehicle warning systems. In the railway level crossing context, these systems are generally activated through a wireless communication link between the rail/train system and the motor vehicle to provide a warning to the driver of an approaching train. However, until ITS becomes part of the standard control system in motor vehicles, these systems are unlikely to be the solution for improving level crossing traffic control.

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7 Australian Standard AS1742(7) – 2007 was published in February 2007 and is the first revision of AS1742(7) to include the requirements for active advance warning.

Restricting access

A design or technological solution may not always be available to ensure the safety risk at a particular level crossing is controlled to an acceptable level. Restricting access to specific vehicles[8] or complete closure of the crossing[9] may need to be considered. Alternatively, grade separation could be considered[10], albeit the most costly solution for level crossing traffic control.

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8 ATSB report 2006/010 *Level Crossing Collision – Elizabeth River, NT* provides example where access to the crossing was restricted to improve safety.

9 ATSB report 2006/009 *Collision between Prime-mover/low loader combination and Ballast Train 4MR1, Tailem Bend, SA* provides example where closure of the crossing could be considered.

10 ATSB report 2006/006 *Level Crossing Collision between XPT Passenger Train ST24 and Passenger Car, Albury, NSW* provides example where grade separation had been utilised.