IRSE
Institution of Railway Signal Engineers
Australasia: Incorporated in Vic.: A0019465H

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5 October 2007

John Eren MP
Chairman
Road Safety Committee
Parliament House
Spring Street
East Melbourne 3002

Dear Mr Eren,

Thank you for inviting the Institution to make a submission to your Inquiry into Improving Safety at Level Crossings.

I have been asked by the Australasian Committee to co-ordinate the Australasian Section's submission to the Inquiry.

We, as professional engineering practicioners, respect the need to both provide a cost effective solution while minimising the risk to all users of the acknowledged hazard at road/rail level crossings.

Please contact me at the above address etc should you require clarification of any of the matters within our enclosed submission.

I look forward your report and recommendations.

Richard A Bell Hon FIRSE
For IRSE Australasia

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Submission to the Road Safety Committee Inquiry into Improving Safety at Level Crossings

Terms of Reference:

"That the Road Safety Committee inquire into and report by 29 February 2008 on existing, new and developing technologies for implementation to improve safety at level crossings."

The Institution of Railway Engineers supports the Road Safety Committee's initiative to explore technologies to improve safety at railway level crossings.

The Institution, however believes that the combination of procedural discipline and high integrity technology will provide the least cost safety solution to actively protected road-rail crossings.

While our members expend significant effort maximising road vehicle access time consistent with minimal delay to rail traffic, this effort is for little return while motorists choose to ignore the hazards present at road-rail level crossings.

We believe that a societal cultural change in attitude to driving a motor vehicle is necessary before a significant impact can be made on the albeit small but always dramatic rate of road-rail level crossing incidents.

To specifically address the Terms of Reference of the Inquiry:

1. To eliminate at-grade crossings by either grade separation OR closure of the crossings. (There are many closely spaced crossings; some no more than 500 metres apart; which now do not bear relationship to actual community need.)

2. To lead the societal change in attitude, install more "red light" type cameras at level crossings and further legislate custodial sentencing as a deterrent.

3. Consider "shame and blame" of level crossing offenders. Local traffic police should also keep targeting offences at level crossings.

4. Ensure that all level crossings (either active or passive) have installed the latest Australian Standard signage and road markings and both the council / VicRoads along with the rail infrastructure manager ensure that adequate and regular maintenance and inspection is carried out.

5. All actively protected level crossings statewide to have remote monitoring / recording of all crossing operations, which would ensure that the level crossing is at least working correctly including the checking of the power, booms, bells and lights as appropriate.

6. Extend the reach of train describer operation to improve the implementation of Express – Stopping selection where a station stop is adjacent to the level crossing. The train timetable and associated stopping pattern can be utilized to program the level crossing protection and associated signalling and thus minimise road closure durations for stopping trains.

7. The use of advance warning lights and road rumble strips can only help increase motorists' awareness of the hazard presented by a road-rail crossing; we support these initiatives.

8. To promote the implementation of the "Low Cost Level Crossing Warning Device" currently under trial at Creswick. (See attached paper delivered to our AGM in March 2006.)

9. We would support a stand by road transport companies not to tolerate illegal driving by their employees, and to send the clear message that their employment is at risk. We appreciate that they may prefer to distance themselves from these issues, leaving the police to do what they can with limited resources.

10. We encourage a move from "fixed approach distance" to "constant warning time" control wherever possible. If the road user is aware that the train is coming and it is consistently not very far away when the lights flash, obedience is more likely.

11. We encourage all road and rail authorities to regularly review the risks of all their crossings to ensure that the method/level of protection is appropriate. Changed circumstances such as changed speeds, type or volume of traffic (on road or rail) may require the protection to be upgraded: including the linking with adjacent road traffic signals to minimize the risk of queued vehicles stopping on the level crossing.

12. We encourage all concerned when upgrading highways, building new roads and designing new residential developments to remove as many level crossings as possible and avoid introducing new ones. There will always be situations where grade separation will appear cost prohibitive, but planners and designers should consider level crossings as the last resort, not the easiest option.

13. For those crossings that cannot be eliminated, we recommend a consistent approach to the appearance of the crossing to the motorist. Road alignment, profile, markings and layout, signs and warning devices all have a part to play. The use of modern LED style warning lights is recommended.

14. The technology in use today provides an appropriate compromise between facilitation of rail traffic and delays to road traffic that is quite adequate if the rules are followed by all.

15. All changes to road traffic usage especially all upgrades to permitted heavy truck usage to be reviewed to ensure that the change does not present any increased Risk to other users of the road and associated infrastructure (including Level Crossings). Any assessed increase in risk to be mitigated to acceptable level prior to any proposed change being implemented.

Richard A. Bell Hon FIRSE
For IRSE Australasia

Attached: "A Trial of a low cost Level Crossing warning device."

The Institution of Railway Signal Engineers
Australasian Section Inc.

A TRIAL OF A LOW COST LEVEL CROSSING WARNING DEVICE

Phillip Jordan BE (Civil), M Eng Sc. – Principal Consultant, Road Safety International; formerly Principal Road Safety Engineer, VicRoads.

SUMMARY
The use of red flashing lights (signals) and boom barriers at rail crossings has been a widely accepted practice in Australia since the 1920's. These devices have an excellent safety record, but are expensive to install.

The State of Victoria now has an annual budget of $6 million for upgrading level crossings from passive to active control. In the 1990's this figure was a low as $600,000. That figure allowed just 4 or 5 crossings to be upgraded from passive to active each year. The present budget results in some 15 road crossings and a handful of pedestrian crossings being upgraded annually. But even now, with some 1500 passive level crossings in the State, it will take the best part of another century to provide active level crossing protection at all sites. Of course, many of these 1500 sites are very low volume crossings, and the use of large amounts of public money at such crossings may well be difficult to justify.

This situation caused a group of road and rail engineers to investigate the possibilities of reducing the cost of level crossing protection through the use of lower cost (but still 100% reliable) detection devices and warning signals. Their intention was not to replace the existing active device with a new low cost option, but rather to have an additional device which could be used to improve the conspicuity of selected passive crossings at the time that a train was in the vicinity.

After an international literature search, five detection units were submitted to a Stage 1 trial on a disused rail line in suburban Melbourne. The most reliable detector out of these five was then further tested during Stage 2 of the trial on a railway line near Ballarat in western Victoria. Finally, as Stage 3 of this trial, the prototype was installed at a passive level crossing at Creswick in western Victoria and monitored in real life situations.

This paper presents the history of this trial, together with some of the results of the trial, through the eyes of a road safety engineer. It outlines the key decisions which were made during the nine year long study and provides some guidance and advice for others who may be thinking of a similar trial. The paper details the decisions which lead to the design of the warning signal used to alert motor vehicle drivers of the presence of a train.

The outcome of the trial to date is very encouraging - VicRoads and Vic Track are now just months away from having a low cost level crossing warning device available for use on low volume roads in rural areas. Its final cost will be in the order of one fifth of the cost of conventional active control.

INTRODUCTION
With the high costs associated with traditional active level crossing protection, many traffic engineers in the 1970's and 1980's expressed frustration at the inability to be able to fund active protection at many of the passive crossings that were the scenes of fatal crashes. Many of these passive crossings were in rural areas, with small road traffic volumes and only a few trains per day. Often the person killed was a local farmer or town resident who knew the area but who, for reasons not fully understood, failed to give way to the train.

Most rural crossings, controlled only by passive signage, and with generally very low traffic and/or rail volumes, were decades away from receiving active (red lights and booms) protection through the Rail Level Crossing Improvement Program. Active protection was being advanced at the busier crossings, usually in metropolitan areas and major provincial centres, but the low volume rural crossings invariably missed the program.

Despite some isolated and random attempts in that era by road engineers to liaise with their rail counterparts in an endeavour to reduce the cost of active protection, little was achieved. It came as a remarkable opportunity then, when in the early 1990's in Victoria a group of like-minded engineers from both sides of the rail level crossing safety issue came together in the Victorian Rail Level Crossing Committee. It became clear that these professionals understood the historical issues well, and were keen enough and broad minded enough to look for alternative crossing protection systems.

At about this same time, a Coronial Inquest into a number of road user deaths at passive crossings in northern Victoria added weight to the concerns for safety at passive crossings. The Coroner (Mr Graeme Johnston) concluded that technology existed that can and should be put to use at passive crossings to alert road users to the presence of a train. He took the positive view that professionals have a responsibility to use available technology to assist public safety, and added that the profession could be seen as negligent in the result of a crash at a crossing if it was known that "crash preventing" technology had existed but had not been used.

A third factor was also influencing rail safety discussions at about the same time. A company was promoting its alerting system for application in various situations, including rail crossings. The system featured a transmitting device that was to be mounted in every train in the state. The signals emitted from that device would be detected by an in-car detector that would then flash a warning light on the car dashboard to alert the car driver to the presence of the train. Apart from the need for every vehicle to be fitted with a detection device, there was a concern that the increasing privatisation of the rail system at that time could lead to non-Victorian trains in the system, with no guarantee that they would have an active transmitter.

With this background, the group of road and rail engineers (the Group) determined to make a positive difference to safety at passive crossings. Supported by the positive nature of the Coroner's comments and noting that there were commercial products starting to be promoted, they resolved to get a trial of a "low cost warning device" started.

The initial aims of the trial were to produce a warning device that would:

- cost about a tenth of conventional active protection systems
- be suitable for use in remote areas, away from mains power
- be "fail safe"
- improve conspicuity of the passive crossing at the critical time that a train was in the vicinity.
- be vandal proof.
- be able to be maintained by existing maintenance teams.
- create no conflicts with the existing Road Rules
- be easily understood by road users.

The objective overall was to develop a device that would make the passive crossing much more conspicuous at the time that a train was in the area, thus improving road safety.

It was recognised that crash data would not be a viable method for assessment, and that the evaluation of the device would be a difficult task.

It was also recognised that legal liability would be the final determining factor for the device. What would the law decide if there was a serious crash at a crossing where the device was installed? What if the device failed?

How would we avoid the perception that the government was trying to save money and was putting people's lives at risk, or similar views?

The legal advice received at the time took the view that the technology used had to be well tested, subjected to rigorous risk assessments, and applied in a professional manner. If this was done, it was concluded that a Court of Law would most likely have little reason to find against the new device, all other matters being equal.

Armed with this background, the Group set off to trial a low cost level crossing warning device

THREE STAGE TRIAL

The "Low Cost Level Crossing Warning Device" (LCLCWD) project aims to improve road safety at remote rural rail crossings by improving the crossing conspicuity at the time that a train is approaching the crossing. It is local people who tend to have crashes at rural rail level crossings. They may be blasé about the passive crossing just down the road from the farmhouse. It is hoped that all drivers will be alerted to the presence of the train by the LCLCWD and will then not be blasé about the crossing.

An international literature survey was undertaken by Sydney based consultants TMG, and it unveiled a small number of proprietary products for level crossing detection. None were fully acceptable to the Group, usually for cost or reliance reasons. Consequently, a call went out to four Australian firms to offer their devices for a first stage trial.

STAGE ONE

The Stage 1 trial took place on a section of disused track in Somerton on the northern fringes of Melbourne in early 1999. Just days before the trial began, the Group were contacted by an overseas firm seeking to have their device included in the trial. Their device was air freighted over to be a part of the trial, but unfortunately it was damaged in transit and was not able to be fully tested.

The five devices in the Stage 1 trial were a Doppler radar unit, two magnetometers, an in-train transmitter, and an induction loop.

A Hi-Rail vehicle was used to travel along the track some 500 times over 4 days to check the reliability of detection of each of the five devices. At the end of the Stage 1 trial, the Consultant convened a risk assessment meeting and reviewed the overall reliability results. The leading device from that Stage was an electromagnetic induction loop detector provided by Hi-Lux Technical Services of Melbourne. It was agreed to take this device on to the next Stage for further trialling.

Before then however, a patent issue arose and the Group found it necessary to engage Patent Attorneys to determine whether or not the induction loop device was at risk of infringing patents. After many months and at considerable cost, the device was given the all-clear to proceed to further trialling.

STAGE TWO

The Hi-Lux device consists of a pair of induction loop detectors placed between the rails and on top of the sleepers, 5 metres apart, and approx 600m in advance of the rail crossing. The detectors are identical to those used to detect cars and trucks on the approaches to traffic signals in the road network. The only difference is that they are set in resin-filled casings on the tracks, instead of being placed into the road pavement.

The detectors recognise the presence of a train, and pass a signal via cable to an adjacent control unit. This information is sent to the logic centre at the crossing via a VHF radio link. Having a radio link obviated the need for trenching, a difficult and expensive matter. The logic centre calculates the speed of the train, and thus the necessary "hold time" for the device, holding it in dormant mode until 25 seconds before the train is due to arrive at the crossing. The signals are required to display a constant 25 seconds warning regardless of train speed. At the calculated moment, the device starts lights flashing on the approach to the passive crossing.

A third detector placed at the crossing will cancel the flashing signals as the train departs the crossing. It also doubles as an absolute last ditch detector in case the first two have failed and the system has not recognised the failure. With detectors placed on both approaches to a crossing, the device is capable of handling trains (both freight and passenger) from both directions and at all expected speed ranges.

The Stage 2 trial took place over one week on a disused section of the Melbourne Ararat line near Burrumbeet. A Road Transferable Locomotive (RTL) was used to make several hundred passes over the device to assess reliability and to allow an evaluation of the two flashing signal designs. The RTL has low axle loading and limited wheel load contact, which create poor detection conditions for track circuits. It was expected to be a tough test vehicle for the induction loop detector.

After the Stage 2 trial a risk assessment meeting was held that included representatives of all of the organisations involved in the trial. The meeting considered that there was a need for a diagnostic remote monitoring device to be built into the system. This was to enable the system to check its health status each day and after each train. The "black box" logic centre was to have a telephone included in it to enable the system to call for help if needed.

A Stage 2A trial was undertaken in early 2002 to check out the reliability of the diagnostic remote monitoring equipment and the other recent additions. The device again proved itself to be reliable, and the Group decided it was appropriate to take the device into the "real world" for Stage 3 testing.

A WARNING SIGN FOR MOTORISTS

The Stage 1 trial was carried out with only a very general thought of how the device would actually warn approaching motorists. The Group talked about "inflatable pink elephants" (these were considered certain to raise the conspicuity of any crossing!) but quickly resolved to develop a warning sign that would comply with Australian Standards (where such exist) and which would

give simple and positive warning to the road users. There was debate about the use of flashing yellow signals as a conspicuity and warning device, versus the use of red flashing signals which would require road vehicles to have to stop.

It was decided to develop two signs and associated signals for trialling during Stage 2. The first design incorporated a pair of yellow flashing lights placed into a Confederate flag "RAILWAY CROSSING" target board. The second design was a pair of red lights placed into a black "RAILWAY CROSSING" target board.

Testing of the two flashing signal designs was qualitative. A dozen observers examined the two designs under varying light conditions during the week-long Stage 2 trial, and filled out a questionnaire about the two designs. It was agreed that the flashing yellow lights set on a Confederate flag backing board offered the better conspicuity for road users under most conditions. A later decision was taken to place the sign in advance of, rather than at, the crossing.
With Confederate flag signs becoming the Australian Standard for passive crossings (AS1742.7) the Group decided to move the flashing lights to advanced warning signs some 50-200m in advance of the passive crossing. The warning sign will read "LOOK FOR TRAINS".

The Group remains determined to keep the device as a warning device only at this time, and not to use it as a regulatory control device. It may be possible to do that one day, but for now the Group remains committed to achieving a low cost level crossing warning device.

STAGE THREE

The Group needed a passive crossing site close enough to Melbourne for convenience, but quiet enough for unobtrusive testing in the "real world". The site had to be within mobile telephone range (for the diagnostic monitoring), it needed to be suitable for line of sight radio connection from the remote detection units to the crossing, and it needed to be suitable for safe monitoring. The Group examined several train lines, and selected the crossing in St Johns Road near Creswick.

Consequently in late 2004 the first real life installation of the LCLCWD in Victoria took place. A similar "blind trial" had been underway at a crossing near Monarto (South Australia) for about 2 years prior to this. The South Australian Department of Transport had purchased one unit and had placed it on a remote crossing to monitor its performance under real life conditions. The results from that trial were of great use in adding support for the on-going Stage 3 trial.

The device has now been undergoing "blind" testing under full train conditions near Creswick for about a year. Retuning of the logic centre has taken place (for example, the placement of the detection units was slightly different to the anticipated 600 metres from the crossing, so the unit needed to be recalibrated to ensure the 25 seconds warning time remained constant. That task took less than a minute!), and the unit has been checked by the use of a data logger. Some battery troubles were sorted out (the first battery had sat in a factory unused for about a year between trials, so it was little surprise that it failed). At present the device is working well, it is being monitored by a data logger, and the results are being monitored remotely from the Hi-Lux factory in Preston. All the while, the device is quietly hidden from public view.

The move to a live trial is imminent. It is expected that road users will very soon see the advanced warning signs in place on St John Road.

CONCLUSION

A Low Cost Level Crossing Warning Device (LCLCWD) has been developed by VicRoads and Vic Track in partnership with a Melbourne based contractor (Hi Lux). It has been successfully tested in off road trials and has been the subject of three risk assessments. It offers a very real and practical option for use at rural rail crossings - not only in Victoria but around the nation and overseas.

The LCLCWD has been developed to provide a warning of a presence of a train, at the time the train is approaching and on the crossing. It has a pair of yellow signals set within the backing board of an advanced warning signs (LOOK FOR TRAINS) some 50-200m out from the crossing to make the crossing more conspicuous at that time.

The device is expected be of assistance to car drivers, truck drivers, pedestrians, motorcyclists and cyclists who may be approaching these crossings. It is solar powered, with robust detectors and radio linked information transmission. As such it does not require expensive trenching for any cables, and it is thus ideally suited to rural locations remote from mains power. It is environmentally sustainable technology, and is intended to improve road safety at these remote rail crossings.

As the overall cost of the LCLCWD will be perhaps 20% of a set of red lights and booms, many more sites can be treated for the same budget.

The signs and signals to be displayed on the approach to the crossing to face the road users are in accordance with Australian Standards regarding shape, colour, symbols and words. There is currently no Standard sign for this situation, and the closest example is the PREPARE TO STOP sign with flashing lights that is now common on the approach to some high speed traffic signals on roads. It is anticipated that the newly developed "LOOK FOR TRAINS" sign and yellow flashing signals may one day be accepted in AS 1742.7 as a standard configuration in advance of passive crossings.

The next step is to evaluate the public reaction to this device, and to monitor its "live" usage at the trial site. Unless something terribly untoward takes place, it can be expected that the new device will soon become an accepted treatment for passive crossings in remote areas across the State.

ACKNOWLEDGEMENTS

The author is a road traffic and safety engineer, who worked with the Victorian Road Authority (VicRoads) for some 31 years. He was fortunate to have been involved with rail level crossing safety issues at the time in the 1990's when this trial was conceived and commenced. He is indebted to many people for their encouragement, support, approval and assistance during the 9 years (to date) of this trial. These include;

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Many others have also been involved, including TMG Consultants and R2A Risk Managers. Their assistance has been greatly appreciated.

The author's objective in writing this paper has been to promote innovative enhancements to rail crossing safety in Victoria and around Australia. The views expressed are those of the author.