APESMA Submission to the Road Safety Committee of the Victorian Parliament.

Inquiry into Improving Safety at Level Crossings.

The submission from APSEMA focuses on rail safety regulations and the challenges of achieving the best practice rail safety regulation. The submission incorporates a submission from Mr Patrick McKay, member of the APESMA Transport Committee.

Safety at level crossings is a Community concern. As evident from the recent railway disaster, multiple injuries, deaths and the psychological impacts affect the community at large and impact on the employer and the employee; Safety is paramount; Safety is Everyone's issue.

Rail safety in Australia

The Australasian Railway Association Inc on its website states that "Rail transport is inherently the safest form of transport. Statistically, rail transport is up to 20 times safer than road transport." Even so, accidents still occur. It is the obligation of Government as regulator, the rail industry and the community to ensure that safety remains of paramount importance.

Submission

APESMA believes that the Associations professional members and potential members are obligated to protect the public interest and must take responsibility for activities that (a) impact on public or worker safety and (b) involve the application of engineering principles.

Christine Parker argues in her book *The Open Corporation*, that effective regulation involves three components:

1. the commitment to respond;
2. The acquisition of specialised skills and knowledge; and
3. The institutionalisation of purpose.

APESMA welcomes this inquiry as a first step in meeting the commitment to respond to the safety challenge. The attached submission from Mr Patrick McKay (APESMA Transport Committee member) deals with some of the specialist engineering and technical issues. The challenge for the Committee will be to ensure that the outcomes from the inquiry are translated into the regulatory, industry and community frameworks.

In our view it would be appropriate for the State Government as the regulator to implement an audit program geared to checking for compliance with any regulatory requirements as well as considering any necessary regulatory improvements.

APESMA looks forward to being part of the future discussions and implementation of any Committee outcomes.

APESMA believes that it is prudent for governments, regulatory bodies and communities at large to work together to ensure protection of the public interest.

SHARELLE HERRINGTON
SENIOR INDUSTRIAL OFFICER
APESMA
03 9695 8971

SUBMISSION BY P.J.McKAY TO
PARLIAMENT OF VICTORIA ROAD SAFETY COMMITTEE
ROAD/RAIL LEVEL CROSSING SAFETY
19 October 2007

a) Author of Submission:

Patrick McKay is a civil engineer who has worked in the railway industry since 1972.

He was formerly District Engineer with the Victorian Railways at Bendigo and Geelong. He was Track Structure Engineer responsible for the technical decisions on pavement design and track structure in both road and pedestrian level crossings. He is currently writing & reviewing technical standards for track and is involved in the development of a new generation train/tram/road level crossing.

A member of the APESMA Transport Committee

b) Definitions:

- Level Crossing = Road/Rail Level Crossing or Pedestrian Footway/Rail Level Crossing, but in common usage, it refers to a Road/Rail Level Crossing.
- Rail Level = the level of the top or crown of the rail in a track.
- Road/Rail Level Crossing = The system of intersection which allows road and railway traffic to cross each other by making the road pavement level equal to the rail level.
- PCR = Public Carriage Roadway, i.e. a road/rail level crossing accessible by the public. This old term used to have a legal status under former Acts controlling railways. It may be irrelevant now, but it is a handy abbreviation.
- OCC = Occupation Crossing, i.e. a totally unprotected road/rail level crossing only accessible by its licensee, who controls land on both sides of the track. The licensee takes complete responsibility for the safety of his crossing movements.
- Actively Protected Level Crossing = a level crossing with active control (eg. gates, boom barriers, flashing lights).
- Passively Protected Level Crossing = a level crossing with passive control (eg. signs, pavement markings).
- Unprotected Level Crossing = a level crossing with no control – this should only apply to OCC crossings.
- Private Roadway Level Crossing = a level crossing on a private roadway. This will normally only apply to sidings within an industrial plant or a workshop, including railway facilities, where such crossings are normally passively protected, although sites in noisy environments or with restricted vision may have active protection. In the case of railway facilities, it may also involve crossing of a main line – note that there was a fatality at such a crossing at Tottenham earlier this year.

c) Terms Adopted in this Submission:

Throughout this submission, the term "PCR" will generally be used to refer to Road/Rail Level Crossings, unless a more specific term is required.

d) Broad Concepts involved in PCR Safety:

The main inputs to the process of safe passage of trains & road vehicles through a PCR are:

- Train Driver: training, reaction time – all probably adequate.
- Train: mass, speed & braking ability – although some small &/or light trains may be able to stop before an obstruction given adequate sight distance for their speed, the plain fact is that nearly all trains will not be able to stop and will strike the obstruction. This is why trains, unlike trams, are always given priority. Motorists need to be educated about this. We still hear of instances where a stranded motorist runs up the track waving at the train driver to get him to stop - a forlorn hope indeed!
- Train driving protocols on approach to PCR: sounding of train horn at whistle post, observing if active protection is working (side slits make flashing lights visible to train drivers), observing if road traffic has stopped, observing if any vehicles have stopped on the crossing – all probably adequate given the inability to stop the train under most circumstances anyway.
- Motorist: a lot of scope for more education.
- Road Vehicle: probably adequate.
- Warning systems: a lot of scope for improvement, including new technology.
- Fallback systems: scope for improvement in systems for escape at the last moment.

This submission shall focus on motorists, their warning and control, and fallback systems available to them, since this is where the most gains are likely.

e) Principles for Warning & Control of Motorists & Motorist Reaction:

A. Motorists shall be warned of their approach to an area of risk, in this case the PCR.
B. The warning shall be of sufficient intensity to get their attention.
C. If the warning might fail to get their attention, it shall be repeated or reinforced by a similar warning of appropriate intensity.
D. Such warnings shall allow sufficient reaction time so that action may be taken to avoid the risk being warned against.
E. Such warnings shall allow for a second or fallback action to be taken if an error is made in the first action.

f) Discussion of Principles, How Applied, How to be Improved:

Principle A: Motorists shall be warned.

1. AS 1742.7 "Manual of uniform traffic control devices" (Part 7: Railway crossings) – this is the Australian Standard governing application of signs & markings to railway level crossings.
2. AS 1742.7 satisfies Principle A by setting down the means and the standards by which such warnings are given.

Principle B: Warning shall be sufficient.

3. The minimum treatment required by AS 1742.7 [clause 5.2.1.1 & Figure 1(a)] at a passively controlled PCR is the RX-1 assembly, consisting of:

- W7-1 Cross bucks
- W7-2 sign indicating number of tracks (if more than one)
- R1-2 sign "Give Way" with a red triangular border.

4. The older Victorian Railways (VR) standard also required the W7-1 & W7-2 signs but had the following differences:
   - a red triangle (RT) alone (no "Give Way" sign was incorporated) on low use roads (VR Std Plan F526).
   - a larger GWTT ("Give Way to Trains") sign on all sealed roads and on unsealed roads with larger traffic volume (VR Std Plan F587).
   - use of a "Stop" sign was quite rare and restricted to small rural crossings with no line-of-sight before reaching the crossing (VR Std Plan F527).
5. An innovation of AS 1742.7 is optional use of sign W7-6 with a crossbucks image on a large red target background. This may be used instead of the usual crossbucks when increased conspicuity is required.
6. I estimate that over 90% of the passively controlled level crossings in Victoria conform to the old VR standard (crossbucks plus RT or GWTT). These are only brought up to the new standard when replacement is necessary due to condition. There is no programmed replacement and this does not seem necessary in general.

Principle C: Warning shall be repeated or reinforced.

7. All of the above passive protection treatments & their variations regard the location of the signs at the crossing itself and their visibility on approach as providing adequate warning on very minor roads & tracks.
8. At level crossings requiring a higher measure of protection, the RX-1 assembly is retained at the level crossing but advance warning signs & pavement markings are added plus 2.3m long "RAILWAY' & "CROSSING" & width marker signs are added at the crossing itself. (See AS 1742.7 for details).
9. Where this is considered no longer adequate, the RX-1 assembly is replaced by the RX-5 assembly consisting of:
   - alternating flashing lights with bells
   - W7-1 Crossbucks.
   - W7-2 sign indicating number of tracks (if more than one).
   - R6-9 sign "Stop on Red Signal".

   This assembly adds two active elements –visual in the form of alternating flashing lights and aural in the form of bells.
10. For a higher standard again, a half-boom barrier is added to the above arrangement. A half-boom barrier is the almost universal arrangement where a single boom is installed on the left-hand side of a road approaching the railway. This adds yet another active element, but it is one that not only warns but also forces a positive behaviour on the motorist.
11. For a yet higher standard, a raised island is installed in the centre of the road for some distance from the railway, which dissuades motorists from the negative behaviour of driving around a half-boom barrier.
12. For a yet higher standard again, boom barriers are installed on both left & right sides of roadways (i.e. 4 booms, one in each corner), which prevents motorists entering the level crossing on the wrong side of the road. Such an arrangement is rare; it may be required where a major road (e.g. 4 lanes each way) has intersections close to the railway and motorists turning into the major road may mistake the 4 one-way lanes for 2 lanes each of a two-way road and turn up the

wrong side of the road. Deliberate use of the wrong side of the road is more a policing matter – unless it is very frequent, the engineering solution of 4 booms should not be considered. Railway gates are no longer used in Victoria due to their requirement for operating staff, their high maintenance requirement and the high incidence of damage.

Principle D: Warnings shall allow sufficient reaction time.

13. The minimum treatments & their variations above regard the location of the signs at the crossing itself and their visibility on approach as providing adequate reaction time on very minor roads & tracks.
14. The standard treatments at crossings with passive control, and the higher level treatments at crossings with active control, particularly in regard to their advance warning signs & pavement markings, are also regarded as providing adequate reaction time for their conditions & circumstances.

Principle E: Allow for late recognition & fall-back behaviour.

15. The repetition of warnings already allows for some degree of motorist inattention. Hopefully the motorist's recognition of the crossing and the risk to himself will not be so late that he cannot stop or take evasive action, since very few design features can be incorporated into a crossing to save such motorists.
16. One such feature which may assist at shallow-angled crossings is the "safety run-off" or "slip lane". In a right-angled crossing, the motorist who sees a train late has no alternative but to brake sharply. As the angle of the crossing increases, the motorist gets a better view of the track ahead of him and a worse view of the track over his shoulder, and if he recognizes too late there is a train over his shoulder and does not have adequate braking distance, he may be able to swerve away from the train instead. So there may be the option at some locations to install a safety run-off right beside and parallel to the railway line. This would take the form of a roadway of sufficient length to allow a truck to stop, accompanied by signs along the lines of "SAFETY RUN-OFF. NO STANDING ANYTIME BETWEEN SIGNS". Railway personnel in particular, especially those involved in PCR maintenance, would have to be instructed not to park there.
17. It would not matter if the safety run-off is on the wrong side of the road, since presumably the oncoming traffic (who have a better view of the train) will have stopped.
18. If signaling equipment was in the way, it could be moved to the other side of the track where an escape is not necessary.
19. If only a short distance was available due to an intervening creek or channel, the end of the safety run-off would require a sand trap.
20. The other main negative consequence of motorist inattentiveness occurs in heavily-trafficked areas: this is the failure to recognize that traffic conditions beyond the crossing will not allow the motorist to complete his own passage, thus causing him to become stranded on the crossing.
21. This generally occurs on main roads where there is a major intersection with long phase times just beyond the railway line. To provide additional warning to motorists that they are about to enter upon a railway level crossing, yellow box marking (similar to cross-hatching) was adopted at certain PCR's. This seems to be reasonably successful since, when all else has failed, it is right in the motorist's vision at his very last chance to stop.

22. This was usually an initiative of the local council or Vicroads and funded by them. It has never been clear to me:
    - who is responsible for replacing the box marking when the pavement has to dug out and replaced for railway purposes, or when it simply needs repainting.
    - if there is a standard for selection of PCR's to be painted with yellow box marking.
    - if there is a technical standard for the painting of yellow box marking.
23. A similar "failure to recognize the traffic conditions" occurs with turning traffic. This will be discussed below in the particular context of the Frankston line.

g) Turning Motorists Obstructing Crossings on the Frankston line.

24. This problem was particularly common on the Frankston line at 9 PCR locations between Mordialloc and Frankston where the Nepean Highway & Station street are parallel and very close to the railway. Here turning motorists find themselves on the crossing as soon as they turn the corner, with no chance to judge the traffic conditions. Despite warning signs, only those with local knowledge are fully aware of the need to pause at the corner before rounding it.
25. In addition, very long trucks, even if they are first in the queue at the traffic lights after crossing the railway, may not have their tails clear of the track. Incidences of trains swiping the tail of trucks used to be common – I do not have any up-to-date knowledge of this.
26. At these 9 locations, additional warning cannot be given. Instead, an escape route has to be offered. This is mainly done by the provision of an additional lane beyond the crossing, but it is/should be designed in such a way that motorists will not choose it (and so occupy it) during normal use. Thus it remains free as an escape for someone stranded on the crossing with a train approaching.
27. If there is a chance that an escape route will be used for parking, (which is most unlikely at the 6 Frankston line locations but it could happen elsewhere), this must be strongly discouraged. It may require a special sign along the lines of "STRICTLY NO STANDING AT ANY TIME. If you stop or park here, you will endanger life".
28. The other common means of escape for a stranded motorist is to do a U-turn, providing that they have left enough room between themselves and the car ahead. To facilitate U-turn escapes, it is desirable to avoid having raised islands between tracks, or if these are necessary, to design them with mountable kerbs.
29. These 9 locations will always be risky, particularly for truck drivers unfamiliar with the territory. There are two approaches to this – mitigate the risk or eliminate the risk.
30. One way to mitigate the risk is to ban use of crossings by all trucks over a certain length.
31. One way to eliminate the risk is simply to close all (or most) of the crossings and allow access only at the ends of the risk area:
    a) Retain PCR at 28.407 km (Station St Mordialloc);perhaps grade separate it to cope with increased traffic.
    b) Close PCR at 30.411 km (Groves St/Lincoln Pde Aspendale)
    c) Close PCR at 31.206 km (Lochiel Ave Edithvale)
    d) Close PCR at 31.75 km (Edithvale Rd Edithvale)
    e) Close PCR at 32.836 km (Swanpool Ave Chelsea)
    f) Close PCR at 33.284 km (Chelsea Rd Chelsea)
    g) Close PCR at 33.795 km(Argyle Ave Chelsea)

h) Close PCR at 34.698 km (Bondi Rd Bonbeach)
i) Close PCR at 35.547 km (near Mascot Ave Bonbeach)
j) Install a bridge over Patterson River to give continuity to Station St
k) Close PCR at 35.957 km (Station St Carrum)
l) Retain PCR at 36.819 km (Eel Race Rd Carrum); perhaps grade separate it to cope with increased traffic.

32. The closure of 9 PCR's would achieve enormous savings (no civil or signal maintenance of PCR's), a huge boost to safety (interfaces/points of conflict are abolished), improved service reliability (reduction of track circuits to only those needed for pedestrian gates), energy/carbon savings (no waiting at the railway crossings and greatly reduced waiting on the highway since the intersections would be replaced by push-button pedestrian crossings). Of course this would be subject to a full investigation and proper cost-benefit analysis.

h) New Technology or New Applications:

33. The following are suggested areas for research &/or development. I have no particular expertise or awareness in these areas:
34. Certain PCR's may have short-range transmitters which cut across all selected radio frequencies with a warning of the PCR ahead.
35. Advance warning lights. If these are connected to the active controls at a PCR and are made fail-safe, these may be permitted to be red lights warning of the presence of a train.
36. Advance advisory lights: If such lights are not linked to fail-safe active controls, these must be yellow advisory lights only, warning motorists of the presence of a crossing, not a train, and motorists will need to be educated in this. These could be solar-powered devices that are activated and only remain activated while they detect movement.
37. A similar advance warning could take the shape of a solar-powered LED moving picture e.g. a steam train) to really grab attention.
38. A large "wiggle picture" which was calculated to change into a train at a particular distance from the crossing could be developed. This has the advantage of no power or moving parts.

i) Other Factors Affecting PCR Safety:

- "Line of Sight' Triangle.
- Angle of Level Crossing.
- Visibility at Night.

j) Line of Sight Triangle:

39. The Line of Sight Triangle consists of:
    - one side of length equal to a distance along the roadway from the level crossing based on the speed of road traffic;
    - a second side of length equal to a distance along the railway from the level crossing based on the speed of rail traffic;
    - a third side to join the above.
40. It is highly desirable that there is nothing inside this triangle which will obscure the vision of a Train Driver or motorist.

11	flashing lights	bad	poor
12	flashing lights	bad	good
13	flashing lights	poor	bad
14	flashing lights	poor	poor
15	flashing lights	poor	good
16	flashing lights	good	bad
17	flashing lights	good	poor
18	flashing lights	good	good
	Boom barriers		
19	boom barriers	bad	bad
20	boom barriers	bad	poor
21	boom barriers	bad	good
22	boom barriers	poor	bad
23	boom barriers	poor	poor
24	boom barriers	poor	good
25	boom barriers	good	bad
26	boom barriers	good	poor
27	boom barriers	good	good

l) Visibility at Night:

48. AS 1742.7 requires that certain PCR signs have Class 1 reflectivity, so that at night or in poor light, car headlights are reflected directly back at the motorist with very little loss.
49. Many signs are decades old and some would have been manufactured before such signs were available in Class 1 reflective materials. Some signs look perfectly OK in daylight but they are very dull at night, even under the full glare of headlights. However in the VR/PTC era, it was the practice to conduct an annual night-time reflectivity inspection at passively protected PCR's to weed out any poor signs. It is not known if this practice has continued since privatization.
50. A less obvious risk is the failure to recognize that there is a train on the crossing. As a train approaches a PCR, its headlight usually announces its presence very well, but once it is on the crossing, its presence will only be noted if the motorist receives information from one of these sources:
    - light reflecting from the sides of the train.
    - noise coming from the train.
    - a background light showing intermittently in the gap between wagons.
51. I will illustrate with an example from my own experience where I failed to detect anything from the first two sources and was only saved from running into the side of a train by a fortunate occurrence of the third source. It was on a highway at night; speed limit was 100 km/hr, but I was tired and probably traveling at about 80 km/hr; I saw the PCR signs ahead, indicating a passively protected crossing; looking left & right, I could see no train; therefore I did not even reduce speed as I continued my approach. But then I noticed a light slowly turning on & off about every 3 seconds; I reduced speed to about 60 km/hr only because I tried to figure out what this light was; I knew it did not come from a railway source; when only some 30 metres from the crossing, I suddenly woke up that there was a slow moving freight train on the crossing and the light was a high street lamp in the

41. At all PCR's with passive protection, adequate Line of Sight Triangles must be maintained or established. Railway officers sometimes combined 'line of sight' improvements with fire protection works, whereby hills & cuttings & trees on railway land within the triangle were removed.
42. Where this cannot be achieved, higher levels of protection may be required, such as a "STOP" signs or active protection.
43. The co-operation of private landowners inside the triangle has often been sought in the past. For example, one school in country Victoria decided to beautify its surrounds by planting trees along its boundaries. A Train Driver pointed out to me that although the young trees did not obstruct the view, they would do so when they matured. On approaching the school, they agreed to remove the young trees within the triangle.
44. It would be a lot more difficult to get such co-operation if it involved construction of a house or factory or shed. It is beyond my competence to say how this might be handled legally. Perhaps triangles identified as critical may require a form of easement which precludes certain uses or outcomes; or a caveat on change of ownership. Matters of compensation may then arise. In the absence of a legal procedure and if agreement could not be reached, active protection may be required.

k) Angle of Level Crossing:

45. All new PCR's should be at right angles or other such angle as research may show does not increase the risk of late recognition of a train.
46. Existing major roads at an angle sufficiently shallow to be regarded as a risk should be realigned on priority basis. A first cut may be based on the angle, the line of sight and the current level of protection - an example is given in the table below. A second cut may be based on speed, road & rail traffic volume (no. of interfaces per day), likelihood of distraction, and incident history.
47. Safety run-offs seem to be a practical option as an interim measure at PCR's with very shallow angles.

Example Table for Prioritizing

Priority for First Cut	Protection	Angle	Line-of-Sight
For info only	passive	bad angle = <45°	bad
For info only	flashing lights	poor angle = 45-59°	poor
For info only	boom barriers	good angle = 60-90°	good
	Passive		
1	passive	bad	bad
2	passive	bad	poor
3	passive	bad	good
4	passive	poor	bad
5	passive	poor	poor
6	passive	poor	good
7	passive	good	bad
8	passive	good	poor
9	passive	good	good
	Flashing Lights		
10	flashing lights	bad	bad

town some 500 metres away, showing itself only in the gap between each slow-moving freight wagon. Fortunately I was able to stop. What led to this?

52. This incident occurred in the late 1970's when the standard colour of VR freight wagons was still a dark red/burgundy, which is not good for low light visibility. In later years, VR/PTC and Freight Australia and Pacific National adopted a bright yellow. However I notice a tendency for various fleet operators who want to distinguish themselves and their rolling stock to choose colours for image & promotional purposes, rather than visibility.
53. The wagons in the incident were also very dirty, which eliminated any final reflectivity that may have existed. When I mentioned this to wagon maintenance people in Bendigo, they began to install self-adhesive highly reflective strips at motorist eye height on the sides of wagons near each end. They also made arrangements to have the strips (but not the whole wagon) cleaned regularly. However this was a local arrangement, and I do not know to what degree this became a common or mandated practice in later years. However I notice that some interstate wagons now have a very large highly reflective area at motorist eye height.
54. The train was long & slow, which meant that there was little change occurring which would help makes its presence known. With the locomotive some way ahead and with the slowness, the train also generated very little noise.

Lessons to be learned:

55. The whole side of the wagon should be a bright colour to maximize visibility.
56. Wagons should have highly reflective strips at motorist eye height.
57. These strips should be cleaned regularly.
58. Although background lights cannot be situated at each crossing, this could be simulated by ensuring that there is an item of Class 1 reflectivity on the reverse of PCR signs. This would only be visible to motorists coming from the opposite direction if there is no train on the crossing, and if located at an appropriate height, it may show up between moving wagons.

PATRICK J. McKAY
12 Bournian Avenue
Strathmore VIC 3041
Tel: 03 9379 2640

"Sharelle Herrington"
<SHerrington@apesma.asn.au>
19/10/2007 02:51 PM

To <alex.douglas@parliament.vic.gov.au>
cc
bcc
Subject Inquiry into improving Safety at Level Crossings

Dear Ms Douglas

Please find attached a submission from the Association of Professional Engineers, Scientists and Managers Australia (Victorian Branch) to the Road Safety Committee of the Victorian Parliament in relation to the Inquiry into Improving Safety at Level Crossings.

An extension has been sought and granted in relation to the making of this submission.

We would request that the submission be forwarded to the Committee.

Regards

Sharelle Herrington
Senior Industrial Officer

APESMA
163 Eastern Rd
South Melbourne Vic 3205

Direct: 03 9695 8971
Fax: 03 9695 8904
sherrington@apesma.asn.au
www.apesma.asn.au

railwaysafetysubmission.doc