**ROAD SAFETY COMMITTEE**

**Inquiry into improving safety at level crossings**

Melbourne — 5 May 2008

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**The CHAIR** — Welcome to the public hearings of the Road Safety Committee's inquiry into safety at level crossings. All evidence taken at this hearing is protected by parliamentary privilege as provided by the Constitution Act 1975 and further subject to the provision of the Parliamentary Committees Act 2003. However, any comments you make outside the hearing may not be afforded such privilege. As you can see, we are recording the evidence and will provide a proof version of the Hansard transcript at the earliest opportunity so you can correct it as appropriate.

I invite you to just state your name and the organisation you belong to and then proceed with your presentation. We will ask questions as we go.

**Overheads shown.**

**Mr GRAHAM** — My name is Brent Graham. I am project director, rail group, with Sinclair Knight Merz in Melbourne, and I am involved in a lot of the level crossing upgrades throughout Victoria and Australia.

I recently returned from a secondment with VicTrack where I worked on the level crossing upgrade program and the AWS program, so I know a little bit about that. Before joining SKM I was principal systems engineer with General Electric Transportation, and there I designed level crossing equipment and train control systems. Prior to that I worked in space and defence where I designed satellite systems, missile defence systems and industrial controls. If at any time anyone has any questions or comments, just jump right in.

I refer to level crossing protection systems. First, I want to give a couple of quotes from a couple of guys you may have heard of. I guess what I am getting at there is I would like everyone to take a fresh look; anything is possible; we can do whatever we want; we do not have to wait for someone else to develop a new system. Just as an aside, for example, is the height that we specify for the cross box on a level crossing — that is so that it can be seen easily when you are driving your horse and buggy. A lot of the things that we do with level crossings we do them because this is the way we have always done them, and I think we should keep in mind that maybe there is a better way of doing it. We do not have to always copy the British or the Americans or anybody else. We should be prepared to take a fresh look.

**Mr LEANE** — Sorry, did you say the height of the signals?

**Mr GRAHAM** — The height of the cross box, the X railway crossing, and to a certain extent I guess the signal as well. And on the same thing, I have tried to find out why the bell is at the top of the post. Is it to keep the birds away? I think it is just so no-one would steal it.

**Mr LEANE** — That is what I would have thought. I would have thought vandalism would have determined height, too.

**Mr GRAHAM** — But nowadays you do not need the bell with the clapper. You can have an electronic bell.

**Mr LEANE** — That can be in there and can be protected.

**Mr GRAHAM** — Yes, you cannot steal it. But we still put it at the top.

**The CHAIR** — Is there anything to suggest that that is not the right place to put it?

**Mr GRAHAM** — There is no scientific evidence. I would suggest that it should be placed at the ear level of the user. So if you are in a truck, it should be perhaps that high. If it is a pedestrian crossing, maybe down at the 2-metre level. Why have it 4 metres up in the air? Or perhaps they could be focused, and I will get to that a little later.

The mass of a train relative to a car is reportedly the same as the relationship of the mass of a car relative to a soft drink can. That is my car and my Coke can, and there it is afterwards. Again, I am not sure how true that is, but I do not think the general public really appreciates that. I have seen a lot of train crash videos and it is just amazing. The train just flies through like there was nothing there. It is really frightening.

On improving safety at railway level crossings, what I want to do is give this presentation in reverse starting with my recommendations or suggestions just so you can keep them in mind throughout the presentation. I would then like to provide a brief overview of how level crossing protection systems work, or how they are supposed to work, then how they are constructed, and finally, some options for level crossings.

Recommendations: I truly believe that the introduction of low-cost systems that can be quickly deployed offer the best solution to improving level crossing safety — that would be overall. We could make some level crossings very safe. We could close them and then they would be really safe. We could do grade separation and then they are very safe. But I am a taxpayer and I want my money to be spent the best way possible.

**Mr WELLER** — Low-cost systems: what is your view on fail-safe systems?

**Mr GRAHAM** — Yes, they need to be fail-safe or their limitations need to be obvious. For instance, there is one example I have later in the presentation. There are people who manufacture stop signs with a ring of LEDs around the outside and initially they were used with a radar system. If they detect a car approaching that stop sign and the little computer inside calculates that this guy is not going to stop, it flashes these red lights. We could do the same thing with level crossings and put these up. Instead of flashing the wigwags at the crossing — the flashing red lights — if we had a non-vital system we could flash the stop sign; in which case if it fails, it is still a stop sign. We would have to get an opinion or decision from Department of Justice, but I think a stop sign with LEDs on the outside is still a stop sign. But still there would be a legal requirement for the people to stop.

**Mr KOCH** — They and give-way signs are used in regional Victoria for the same reason.

**Mr GRAHAM** — Flashing ones?

**Mr KOCH** — Yes, my very word — at Cavendish and Balmoral. I know them. They actually flash as you come up to them.

**Mr MULDER** — A flashing stop sign?

**Mr KOCH** — Yes, and a give-way sign.

**Mr MULDER** — In the triangle?

**Mr GRAHAM** — Excellent. I have not seen them.

**Mr KOCH** — On the Henty Highway.

**Mr GRAHAM** — In most cases they need to be vital, fail-safe. Now we need to evaluate these low-cost systems, and that I think is the real stumbling block because at present there is no simple mechanism for testing them. There is no place I can go to, to say, ‘Hey, I have an idea’, or someone says, ‘I have an idea, let’s try this’. You cannot just go out on the metropolitan network or even the country network and do something. It is just too risky. So I think we really need to build some kind of test track somewhere and a research facility. We do not need $50 million or $100 million; this does not need to be fancy. We just need some place to test out new ideas.

A test track should ideally be a portion of dedicated track and a section of revenue track, perhaps side by side, somehow segregated so we could do the risky things on the dedicated track, tightly controlled conditions with expert drivers, everything in place. And then for the revenue track we could run this equipment in what they call shadow mode where it does not really produce any visible results but the system thinks it is working. It could be a level crossing. It could be points. It could be anything, any kind of railway equipment so it does not affect anything.

Nothing would be affected by it but it is being tested and we can run it in parallel with type-approved equipment and look at it after a month or six months. Did we get exactly the same results? Did these imaginary bells start ringing at the same time as the real ones? That kind of thing could be assessed.

Also by selecting the right location, we can get a maximum diversity in rolling stock. You would also want as high a speed as possible. It would be nice if we could put it at Spencer Street or Flinders Street or something like that where it is convenient and guys can just walk out and check it. But you are not going to get the speed so we want to try to develop worst-case locations.

Someone needs to look after this. I guess ideally or logically it should be either VicTrack or DOI. It needs to be controlled independent of the rail operators, the maintainers and the designers, so it would be someone who can be treated like the way we book out drawings. If we need drawings from the drawing management system at VicTrack, we submit a request and yes, you get it or no, someone else has it. It would be a case of, 'You will have to wait for them to finish' — that kind of thing. I think it is all manageable.

A type of location I am thinking of for a test track would be out near Officer. It is high speeding. You have got freight. You have got V/Line. You have got three of the four types of passenger rolling stock. It is under the electrified network so if there is any interference or complications there we will see it, and it is close to my house, so it will be nice.

**Mr KOCH** — I knew there was something there!

**Mr GRAHAM** — And it should be made available to operators, designers and the maintainers.

**Mr LEANE** — Can I just go back to the point of who should manage it: do you think there should be some sort of involvement of VicRoads as well, seeing as it is also a road problem? That is what I would add to that recommendation.

**Mr GRAHAM** — Definitely. At least for the level crossing. I was thinking more of a general tester. Apparently the PTC had a section of track somewhere that it used, but with privatisation that sort of disappeared and we have got conflicting priorities now with different groups.

Okay, why a low-cost system? I think this is obvious. Given a fixed budget, more crossings can be upgraded. By reducing the number of steps and the complexity of getting a level crossing upgraded, we can do more in the same amount of time, and if we just get more crossings upgraded, it will generally improve the overall safety of the system.

**The CHAIR** — So these low-cost systems are fail-safe?

**Mr GRAHAM** — Not all of them. Some of them are. And you cannot just look at fail-safe, although fail-safe is the primary factor; you also have to look at reliability. If the thing fail-safes twice a day, once in the morning peak and once in the afternoon peak, it is not going to be too popular with anybody. Aeroplanes are not fail-safe. They are reliable but they are not fail-safe.

**Mr WELLER** — But at the same time if it fails then it is not fail-safe and we have a truck wipe out 20 passengers on a train, we will not be too popular, either.

**Mr GRAHAM** — That is right.

**Mr KOCH** — Well, airlines are not too popular.

**Mr MULDER** — With something as simple as a flashing stop light at an outpost level crossing, would that be run off solar power?

**Mr GRAHAM** — Yes, most of these —

**Mr MULDER** — And what would it cost for the installation of something like that if you are rolling them out at hundreds of those passive level crossings?

**Mr GRAHAM** — I would just be guessing off the top of my head: maybe $5000. I inquired about the people that made the flashing stop signs and I have not got a response. A lot of these companies are very reluctant. When you ask them how much they say, 'Well, you send us your specifications and how many do you want and where do they go?'. They do not want to tell you the price right off the bat.

**Mr MULDER** — Yes. So they would be triggered by a circuit system on the rail line?

**Mr GRAHAM** — Yes, it could be exactly the same as what triggers the flashing lights now or we could just use track circuits; we could use axle counters. There is a whole range of technology that is available.

**Mr LEANE** — It is actually what detects the train that is quite expensive to the circuit now.

**Mr GRAHAM** — That is.

**Mr LEANE** — But in saying that, what you are saying is that if it did not flash, you have still got the stop sign. So if there was a cheaper way of detection, axle counters, as you said, and if there was a problem with that particular input for whatever reason, you have still got a stop sign, so it makes a lot of sense.

**Mr GRAHAM** — Yes, in a way it really does not make it all that safe because if people get used to it and think, 'Okay, there's a stop sign; yeah, I know there's a stop sign there and I'm supposed to stop', and I know that if there is a train coming that stop sign is going to be flashing, and if it is not flashing there is no train.

**Mr LEANE** — So you have got the same problem there.

**Mr GRAHAM** — All it does is alleviate the liability, I think, that the system failed. The lights did not flash but it is still a stop sign and you still should have stopped. You can put that on their headstone, I suppose.

**Mr LEANE** — Good point.

**Mr MULDER** — The issue with some of those mechanisms always in remote country areas is vandalism: how well they are protected and how robust they are as a piece of signage.

**The CHAIR** — Yes, especially if there are no rabbits around.

**Mr MULDER** — Shoot them out.

**Mr GRAHAM** — As you mentioned, there are two primary components to a level crossing system: the train detection system and the road warning system. A train detection system in the most basic form is visual. The person driving the car or walking along thinks, 'Hey, is there a train? I don't see any trains. Let's go'. Now that is not terribly reliable. People just get complacent and get hit by trains. The other train detection system is track circuits and finally level crossing predictors.

Here I have tried to draw a visual system: you have got stop signs, you have got a train coming, I did not draw a car there. The system is heavily reliant on the behaviour of the road user and therefore not very reliable at all. It is also affected by environmental factors such as trees. I know those are trees because it says 'tree' under each one of them.

Track circuits are switch-like mechanisms, I guess you could call them. They detect when a train is occupying a particular section of track. This is not unlike the bell above the door of the milk bar when you walk in: ding ding. The proprietor knows that someone has come here, someone has arrived, but does not know when they are going to come to the counter, if at all. So all you know is that a train is probably coming. The track circuits need to be set up for a particular train speed, so that is the distance, the length of this red section in the middle. If you have got a slow train, it is going to result in long warning times. With long warning times, people are going to think, 'Oh, it is going to be 2 minutes before this train gets here, I'm going to go', only this time, it is not a slow train, it is a fast train, and they get picked up by the train. So inconsistent warning times cause people to disobey what they are told to do.

On predictors — the one you see here is a HXP3, which is one of the most common ones — they operate by analysing the electrical properties of the track as the train is driving down it. It actually sends out a signal and measures the phase shift between the voltage and the current in that signal, because now you have got an electrical component of the train driving down that track, sort of like one of those Hawaiian guitars where you can change the sound. It is similar to that. They are pretty good. They can predict when the train will arrive. They predict where the train is, how fast it is going and therefore when it is going to arrive at the level crossing. They do get confused if the train driver decides to speed up or slow down on that approach. It can cause long or short warning times.

**Mr LEANE** — Are they in use in our system at the moment?

**Mr GRAHAM** — Yes.

**Mr LEANE** — What is more common: the track circuit or the predictors?

**Mr GRAHAM** — Right now, I would say the predictors are the predominant one. They are quite a bit more expensive. They take longer to set up and adjust. They are also sensitive to changes in the ballast. Mud spots on the track and bad sections of ballast can change the impedance of the track at a particular location, so they have to be readjusted, and what they call ‘lumped impedance’ has to be adjusted out of it. Then, of course, the maintainers come along and replace all the ballast with new ballast and you have to go back and — —

**Mr LEANE** — How are those particular systems fail-safe?

**Mr GRAHAM** — They hold the relay called the MDR relay. They have to produce a signal to keep that relay going, and if that relay drops — it is the relay that actually keeps the lights from flashing and the boom barriers from going down.

**Mr LEANE** — So if they fail, there is no signal that is fail-safe, as in — —

**Mr GRAHAM** — Yes, if it fails, it blows up, goes up in smoke, someone steals it, there is nothing to prevent those lights from flashing. It calculates the time of arrival and results in a constant warning time normally. I did not include a slide in this — but while we are talking about low cost — there are two ways to go about developing a low-cost system. We start with a blank piece of paper or steal some technology from the military or the aeroplane and aircraft industry or security or we look at the pieces one at a time and say, ‘How can I make this cheaper?’. There are the flashing units, for instance. It costs us over $300 each for these little flasher units that make the lights flash.

You need two of them, because we want them to be not redundant. One flashes one light on this side of the road and the other light on the other side of the road; the other unit flashes the opposite light. They cost $300 each, so that totals $600. You can buy the same thing; a company down in Hallam makes the flasher units for the headlights on police cars, ambulances and fire trucks, each of 12 volts. They are the same thing — plug them in for $30. We pay $300. The $30 one has never been tested. It has not been type approved so we cannot use it.

I asked them about reliability. They said, ‘We have been selling them for 10 years now. We had one come back’, but they never had any data to do MTBF studies, because if you only have one fail, you do not know when the next one is going to happen. We can look at it on a low-cost, component-by-component basis, or start from scratch or somewhere in between.

The other mechanism that could be used would be train control and an intelligent transport system. This is really sort of where I think it is going to be in the future, so that is why I think we should concentrate on low cost, because in another 10 years it is all going to get thrown out. We are all going to have a central kind of system. This is a central system that knows where all the trains are, it knows where the level crossings are, it even knows where the cars are, whether there are any emergency vehicles, any school buses, hazardous cargo and can control all of that.

It will be quite a few years before it actually gets in place, but you have got satellite tracking, and you have got devices inside cars that maybe even actually put the brakes on the car so the driver cannot go through the level crossing. I do not know how far we want to go towards Big Brother, but all this is technically possible now. These are just some of the systems that have been bandied about in the intelligent transport system neighbourhood.

Road user warnings, passive signage — these are road markings, crossing ad signage, cross marks, give-way signs et cetera, flashing lights and boom barriers and also advance warning signs. Just quickly, the steps to build a level crossing — first we have to have site selection, then design it, construct it, test and commission it, and maintain it. So anything that we can do to compress this process or make it more economical will be a benefit. Site selection — usually we start with an ALCAM assessment. I am sure you are all fully aware of that. It is not perfect but it does provide some means of ranking level crossing risks.

**Mr MULDER** — What did you say was not perfect about ALCAM?

**Mr GRAHAM** — Right now it does not take into account near misses. I think that is about to be changed. It does not take into account the economic impact of having cars sitting there idling and spewing gases, having people waiting, and their not working. The model they use in the US called Gradec can actually produce a statistical prediction of how many fatalities will occur at that level crossing with any particular mode of protection. I thought that was particularly nasty, because you could go to whoever holds the purse strings and say, ‘You decide. How many people are you prepared to see killed at that level crossing in the next 10 years?’.

**Mr MULDER** — Perhaps that is why that have not used it.

**Mr GRAHAM** — Pretty dirty — I do not think anyone is going to answer that question. Also it is quite user-friendly. So is the Canadian one. You can instantly change the parameters and say, 'Okay, let us put in boom barriers', and — bang! — it will give out a whole new set of data. You can also have the impact on adjacent crossings. For instance, if you have got two level crossings within 500 metres of each other and they both have stop signs now, if you change one to boom barriers after a couple of weeks the people in town are going to say, 'Hey, I am going to go to that one over there because it has just got stop signs or give way signs rather than the ones with the boom barriers'.

So the boom-barrier ones will be safer, but the road use will drop, and the other one will become less safe. That is something that currently is not in place with ALCAM. But you need something. It is better than just someone's 'off-the-top-of-my-head' opinion that this one needs to be done next.

That will help prioritise, but we also need to group them geographically. Although we cannot really see it, the yellow ones are towns, and the green ones and pink ones are level crossings. They are level crossings; that is all I want to say; they are level crossings that could be upgraded. We will see! In order to make it economically attractive to tenderers you want to group these; usually in a group of 10 or so level crossings, so they can bid on a package of 10. So then you have to, kind of, group them and say, 'Okay, we will put these together and those together'.

They need to be grouped according to geographic region, rail operator, and even the line. Because quite often as soon as you start work on one of these level crossings you need to book out the drawings; they are under your control so no-one else can work on that section of line. So it makes sense to have one company book out all the drawings for one particular Stony Point line, for instance. You book out all the drawings and then work on that; do all the level crossings that need to be upgraded there.

**Mr KOCH** — The Hamilton–Portland line does not look too good over there, Brent.

**Mr GRAHAM** — Yes, there are lots of opportunities. It is funny that they all seem to be in the west, isn't it?

**Mr KOCH** — Strange, that!

**Mr GRAHAM** — Yes. These all came from ALCAM, so maybe ALCAM is biased towards the west. I do not know. I think there are just more rail lines out that way. There are other factors, too. I do not really want to comment on it, but there are other factors that influence site selection and prioritisation. Kerang is a perfect example.

It happened to be down on a list in the ALCAM. I do not know what the number was, but I know it was reported in the media that it was way down on the list. The rail industry responded by jumping on and upgrading Kerang. It can be done. It is not terribly efficient, but it was done, and in record time.

I am not saying the rail industry should or should not do that. It is up to you guys how you answer public outcry. It could be right, it could be wrong. That really does not matter to me, as a designer. If someone wants something done, if someone has decided that Kerang must be upgraded, then so long as you are going to pay for it we will do it. But these things happen. There is public pressure and political pressure to do things in a certain order, and I do not think it is the rail industry's position to question that. I think someone has to make the decision that we do something and do not do something and that is the way we go. It may be right, it may be wrong; it really does not matter. A decision should be made and then go for it.

As I said, ALCAM is only a statistical model, and while it can indicate the level of risk that a collision will occur, it cannot predict when it will happen. If it did, I would get it to pick my lottery numbers!

Firstly, starting with preliminary design — again I will just skip through these briefly — there is a request for tender, the tender is submitted, evaluated and awarded; the successful tenderer performs site inspections and environmental and heritage studies and undertakes stakeholder consultation, and it goes on and on. You have to go to the stakeholders and get stakeholder approval. This is probably the most difficult one because the stakeholders often do not have the same priority for upgrading this level crossing that others would have; they may have more important projects going on, so sometimes it can be difficult to get.

You give someone your preliminary design, and unless you get on their back and start bugging them about it, it could be months before they send back any comments on whether they like it or not. That is just a fact that goes along with privatisation and having different operators. It was probably easier during the Public Transport Corporation days, when everyone was in the same building and you could argue back and forth and then at the end of the day you could settle these things. You have operators who want maximum flexibility in their system; maintainers want to minimise the amount of equipment they have to maintain. So you often have conflicting interests.

Moving on to detailed design, you have to do exactly the same thing, repeat everything: request for tender, tender evaluation/award, detailed design, then procurement of long lead items. A lot of the stuff comes from overseas, from the United States. We are not exactly the no. 1 customer for US equipment from big companies, so quite often we will get the quick response, ‘I am sorry, those are back-ordered. We are going to be running production in another three months. You may wait six months or something for some equipment’. We really have no control over that because it is manufactured outside of Australia.

I move to construction, testing and commissioning. This is another tricky step. We have to get permission from the operator to access the track. Alternative transport may need to be arranged, such as buses to replace trains, and that sort of thing. Access is often limited to after the last train and before the first. The last train could be 1.30 in the morning and the first train could be 4 o’clock in the morning, so you have a couple of hours. Bearing in mind that it takes you an hour to set up and an hour to clean up, you have half an hour of work, so it is not easy. As a result we are really limited to Saturday evenings to do this kind of work. We have Saturday nights after midnight — actually, Sunday morning — until about 5.00 a.m.

Penalties apply if the revenue service trains are delayed. We need contingency plans, risk assessments, and on and on. All this contributes to lower productivity and higher cost. On the maintenance side you need to provide training for maintainers, and you need spare materials.

Impediments to low-cost solutions include the fact that there is no commercial advantage. I am not being very nice here to my former employers, but there is no commercial advantage for any of the major manufacturers to invest the time and resources required to develop a low-cost solution. They have already spent all this money doing R and D, developing the original, the high-priced one, and they would probably be doing their shareholders a disservice if they came out with a cheaper version of what they were building, unless and until the market demanded that of them. So until someone else comes up with another low-cost system, we are not going to offer it.

**Mr KOCH** — Brent, I think we were worried about our constituents and their benefits more than the commercial reality. Hearing about it from a safety point of view is probably what I am a bit more interested in.

**Mr GRAHAM** — Okay. Obtaining type approvals is onerous, expensive and time consuming and discourages the small developer or the small enterprise from coming up with a low-cost rail product. There are no resources to assist developers in obtaining type approvals. In fact, most of them do not even know what they have to do to get type approval. This is where a test facility would really be handy. Multiple stakeholders, each with their own priorities, often result in roadblocks to development.

Now for some options: wayside train horn, something called the audio spotlight, retractable barriers, four-quadrant gates, in-pavement lighting, train illumination, adaptive lighting, and flashing light options. The slide I am showing you now is of somewhere in Texas. The picture on the left shows the train horn volume. The red is the very loud or the required volume and the blue is sort of the area of disturbance. That is with a conventional train horn.

The train horn is at the level crossing and by synthesising that sound you can get this thing shown on the right-hand side. So there is a drastic reduction in noise pollution; you are upsetting far fewer people. When you think about it, if the train driver has to blow his horn 500 metres from the crossing, the people who live 500 metres from the crossing are really not in much danger of being struck by the train — it is the people at the crossing that you want to inform.

The next slide shows — —

**The CHAIR** — Where is this photo from?

**Mr GRAHAM** — I am not sure — in the United States.

**The CHAIR** — Because their lights are just as high.

**Mr GRAHAM** — Yes. They are no better.

**Mr MULDER** — They had horses and carts in America as well!

**Mr GRAHAM** — That flashes to tell the driver that the wayside train horn system is working, that he does not need to blow his horn. If that is not flashing, then he will toot his horn. You can see there the loudspeaker for the horn right there.

**The CHAIR** — How many decibels would that be?

**Mr GRAHAM** — I do not know whether it is 90; it is whatever the requirement is currently. At the crossing it is just as loud. In fact you could make it louder and end up disturbing fewer people than with the real train.

You have heard and seen the video. There you saw the big Xs flashing, indicating to the train driver. In this case you see we are at right angles to the orientation of the speakers, so it is not as loud. So if you lived there, it is probably tolerable. There is a second train coming in the opposite direction.

**The CHAIR** — But we had a presentation before from the trucking association and the way the trucks are built now the cabins are very insulated from sound. Obviously it does not matter how loud that may be; with the new trucks now basically you cannot hear it from within the cabin.

**Mr GRAHAM** — Yes, then you put on your CD player. I agree.

**The CHAIR** — We have got 5 more minutes because of time constraints.

**Mr GRAHAM** — Okay. The other possibility is this audio spotlight. This uses ultrasound which is sort of the reverse of surround sound. It can be focused in a particular area, so you could focus it to the passenger compartment of a car or a truck or down on the ground for pedestrian crossings. You really cannot hear it anywhere else. Again the volume could be higher than it currently is. It would minimise noise pollution and reduce complaints. It could be incorporated with a train horn. It could be a recorded voice message. It could even hook up to the public address system. Obviously retractable barriers have their drawbacks.

**The CHAIR** — All you need is a mechanic there now and you could do an oil change!

**Mr GRAHAM** — You could change the oil. They look nice. This is the opera house — lovely, gently going down. I see on the video there is a ghost jogging across the background. These might be good in a transit-oriented mall or something, where just buses can go through and you want to keep out cars. I do not see these as really filling any purpose, especially if you look at the one on the impact test. I do not see that being all that safe. Someone would have been killed by the super barrier. The guy is going to end up on the tracks.

Anyway, he is going to be hit by a train and the train is going to hit these big concrete blocks as well. And then there are other ones that pop up out of the ground. These sorts of cable barriers are all derived from the military, terrorists, car bombings and this kind of stuff. There may be something we can borrow from that, but it is not going to be your average level crossing. There has to be some real reason for going to these extremes.

There are ramps that pop up and cars that come down. There are four-quadrant gates as well. But that means you have to have a system to make sure that you do not trap a car on the tracks. That means more equipment, more maintenance. Then they come with these super gates. There are some videos showing these things. They will prevent the car from making it onto the level crossing, provided that the train is not right there or you put these things back far enough. One of the problems with these long gates is with the contact with the overhead wiring. The longer they are, the more they are subject to wind; the wind can snap them off or bend them. I do not think it is a really good general solution. There may be applications where we can do it.

I like in-pavement lighting, which are these little LEDs; you can get solar-powered ones or hard-wired ones. In fact they are trying them outside the entrance to Disneyland at a level crossing. Unfortunately halfway through the experiment they did some other road upgrading work so it was difficult to tell how effective they were. But they look good. Sometimes you cannot just do something; you have to be seen to be doing something.

These are visible and people will see them. They can be yellow and they can flash alternating, or whatever. Would they do any good? I do not know. We could do some studies. One thing they would do is increase public awareness, by way of, ‘Hey, that’s a level crossing’; ‘Hey, the government’s finally doing something about my level crossing; I asked them for years’. There are all sorts of reasons for doing this.

Would they be fail-safe? Only if they connected to a train detection system that was fail-safe. I like it. Apparently there are some installed at the Spencer Street station where the buses come in. I have not been able to see them; I guess you have to be a bus driver to see them. They are using crosswalks. I know there are some out in the country where they have installed these, and there are some in the city. They are quite nice. They are about $1800 each, installed. If you had three per lane, you are still talking $18 000.

**Mr MULDER** — There is not an $18 manufacturer floating around with them somewhere too, is there?

**Mr GRAHAM** — No, I think it is still high. I think we could probably get them cheaper.

**The CHAIR** — We are running way over time now.

**Mr GRAHAM** — I think that was pretty much it, anyway.

**The CHAIR** — Any questions? Thank you very much; we appreciate that.

**Witness withdrew.**