

# NEWSLETTER No 5/2004



Railway Technical Society of Australasia  
SA Chapter  
Engineering House, Bagot Street  
NORTH ADELAIDE SA 5006

**MAY 2004**

**THURSDAY 3rd JUNE AT THE  
RIVIERA MOTEL AND FUNCTION ROOMS,  
31-34 NORTH TERRACE ADELAIDE  
- at 17:30.**

**\*\*\*\*NOTE THE CHANGE IN VENUE \*\*\*\***

## **THE AK TRACK RECORDING CARS**

This will be a joint meeting with the PWI and is hosted by the PWI.

The meeting starts at 17.30 with the presentation. Following the presentation light refreshments will be served.

At the meeting Neil Orange will talk about the track recording car set known as the AK Cars that are used to monitor track geometry over most of the standard gauge tracks in Australia.



Photo - AK Car Track Recording Car Consist

The Rail Corporation owned cars have recently been fitted with a number of condition monitoring systems. The AK Cars now undertake runs covering the continent from north to south and east to west. The presentation will provide a brief history of the AK Cars followed by a description of the various measuring systems that have been integrated into the cars.

This presentation will be a unique opportunity to learn about track recording and one of the best consists available to the Australian railway systems.

Don't miss it.

## **FUTURE MEETINGS**

3<sup>rd</sup> June at North Terrace: Joint meeting hosted by PWI at their normal North Terrace venue on the topic of the 'AK' track condition monitoring train.

20<sup>th</sup> to 23<sup>rd</sup> June: CORE2004 in Darwin – a not to be missed event. Registration brochures, for anyone who missed out (or needs additional copies) contact the CORE2004 Secretariat at [techrev@core2004.on.net](mailto:techrev@core2004.on.net) or by writing to GRMS Media at PO Box 595, Prospect East, SA, 5082 without delay.

An update item is included later in this newsletter.

30<sup>th</sup> June: Eminent speaker, Hans Bier, Project Director of GSM-R Communications in Germany will talk about communications upgrade for the DB (German Railways).

5<sup>th</sup> August at Bagot St.: Malcolm Owens of ARTC will present on CORE2004 revisited – a précised version of papers presented by South Australians at CORE2004.

2<sup>nd</sup> September at Bagot St: a joint meeting with PWI hosted by RTSA at Bagot St, Nth Adelaide will have Keith Charlton and Daniel Martucci giving a presentation on concrete sleepers on the Trans Adelaide network.

7<sup>th</sup> October at Bagot St.: a presentation by Dean Phillips on TransAdelaide's experience in outsourcing railcar maintenance

4<sup>th</sup> November at Bagot St.: Subject to sufficient progress having been made we will hear about the new Port River rail bridge.

30<sup>th</sup> November at a Very Pleasant Location: the annual dinner with AGM attached.

This program is, of course always subject to the vagaries of life and may therefore change as the year moves on. Newsletters (or at the very least a flyer) will be sent out before each meeting with confirmed details of the up coming meeting and up to date version of the future program.

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## LAST MEETING

Our own sectional Treasurer and well-known senior engineer with TransAdelaide, George Erdos, gave us a presentation on the concept and development of rail safety. His paper follows.

## THE EVOLUTION OF RAIL SAFETY

### SUMMARY

Trains and railways have captured the imagination of people for more than 200 years. This is reflected in the huge following of rail enthusiasts who continue to chase trains all over the world capturing that last photograph before another piece of history vanishes into eternity. However, in recent times, Governments and communities worldwide have recognised that rail transportation is the salvation for congestion and environmental problems (rail transport is one of the most energy efficient means of mechanised land transport known) faced by their countries as road and air transport struggle to meet ever growing demands. As a result, we are now seeing a renaissance of both heavy and light rail in many countries, but have we learnt the SAFETY lessons of the past. Will we need to re-learn these lessons through the bitter experience of accidents and collisions re-lived?

Inherently, rail is recognised as one of the safest modes of transport. However, this postulate can be used to resist reform and to hide underlying problems of capital investment, culture and/or management. In this paper, I will examine a history of railway accidents and associated safety developments. I will then talk about rail safety in general terms with particular emphasis on the Australian scene and will finally discuss where in my opinion we need to go from here.

### INTRODUCTION

Horse-drawn wagonways appeared in Germany as early as the 1550's. Wagonways were the genesis of the modern railroad.

In 1789 an Englishman, William Jessup designed the first wagons with flanged wheels. The flange kept the wagons on line and improved safety. This was an important design feature that has in principal carried through to today. In September 1825, the Stockton & Darlington Railroad Company began as the first railroad to carry both goods and passengers on regular scheduled services using locomotives designed by English inventor, George Stephenson. Stephenson's locomotive pulled six loaded coal cars and 21 passenger cars with 450 passengers over 9 miles in about one hour. In 1829 George and Robert Stephenson's locomotive, The Rocket, set a speed

record of 47 km/h (29 mph) at The Rainhill Trials held near Liverpool. Transportation had entered a new era and railways began to flourish. The mass, length and speed of trains steadily increased, but this growth was also a weakness. Newton has taught every engineer that mass and speed is a recipe for disaster and sitting on top of a ribbon of steel it would not be long before disaster struck.

Travel by rail is acknowledged as one of the safest forms of transport, however when accidents do occur it often involves multiple fatalities and injuries and a reawakening by the community as to the dangers that can exist with rail transport.

Accordingly, and in most cases, if a rail accident occurs the community looks for answers and often heads will roll.

The following list is indicative of some of the major rail accidents to have occurred in time worldwide:

**6 May 1853** - Norwalk, Connecticut, USA. New Haven Railroad train ran through an open drawbridge and plunged into the Norwalk River. 46 passengers were crushed to death or drowned.

**20 Apr 1908** - Sunshine near Melbourne: Two trains collided in the station killing 44 people.

**22 May 1915** - Quintinshill Scotland. Troop train carrying a battalion of the 7th Royal Scots. 227 killed and 246 injured.



Quintinshill (Gretna Green) Scotland

**12 Dec 1917** - Modane, France: 550 killed in derailment of troop train near mouth of Mt. Cenis tunnel.

**14 Mar 1926** - Virilla River Canyon, Costa Rica: An overcrowded train carrying pilgrims derailed while crossing the Colima Bridge, killing over 300 people and injuring hundreds more.

**22 Dec 1939** - Magdeburg, Germany: 125 killed in collision and another 99 killed in another wreck near Friedrichshafen.

**02 Mar 1944** - Salerno, Italy: 521 suffocated when Italian train stalled in a tunnel.

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**08 Oct 1952** - Harrow-Wealdstone, England: Two express trains crashed into a commuter train, 112 dead.

**03 May 1962** - Tokyo: 163 killed and 400 injured when a train crashed into wreckage of collision between inbound freight train and outbound commuter train.

**04 Feb 1970** - Buenos Aires: 236 killed when express train crashed into standing commuter train.

**18 Jan 1977** Granville, Sydney: Australia's worst-ever railway disaster. 83 people were killed when a commuter train derailed and crashed into the pillars of a bridge.

**06 Jun 1981** - Mansi, India: Driver of train carrying over 500 passengers braked to avoid hitting a cow, causing train to plunge off a bridge into the Baghmati River; 268 passengers were reported killed, but at least 300 more were missing.

**12 Sep 1988** - Clapham Jct. UK: Faulty wiring in a signalling junction box caused an incorrect clear signal to be displayed to the driver of a Poole - Waterloo train. This then collided with the rear of another train, which was stationary. The wreckage was displaced into the path of an oncoming train. 35 people killed.

**22 Sep 1993** - Mobile Alabama USA: Amtrak's Sunset



Bridge over the Big Bayou collapsed

Limited, en route to Miami, jumped rails on weakened bridge and plunged in Big Bayou Canot, killing 47 people.

**20 Aug 1995** - Firozabad, northern India: A speeding passenger train rammed another train that was stalled after hitting a cow. About 300 people were killed and over 400 injured.

**03 Jun 1998** - Eschede, Germany: Inter City Express passenger train travelling at 125 mph crashed into support pier of overpass, killing 98. Is Germany's worst post-war train accident. A defective wheel may have caused crash.

**05 Oct 1999** - London: An out-bound Thames commuter train passed a red signal near Paddington Station and collided with London-bound Great Western express, killing 30 people and injuring 245.

**20 Feb 2002** - Ayyat, Egypt: 361 killed in fire after gas cylinder used for cooking exploded aboard crowded passenger train. Egypt's worst train disaster.

**25 May 2002** -Muamba, Mozambique: 192 died and dozens more injured when passenger cars rolled for several miles at top speed into freight cars from which they had been disconnected because of mechanical problems.

**24 Jun 2002** - Msagali, central Tanzania: A runaway passenger train collided with freight train on same track, leaving 200 dead.

## RAIL ACCIDENTS – CAUSUAL FACTORS

A history of rail accidents both in Australia and overseas tends to suggest that causal factors fall into two distinct categories, namely "Infrastructure" and "Human" with the latter dominating.

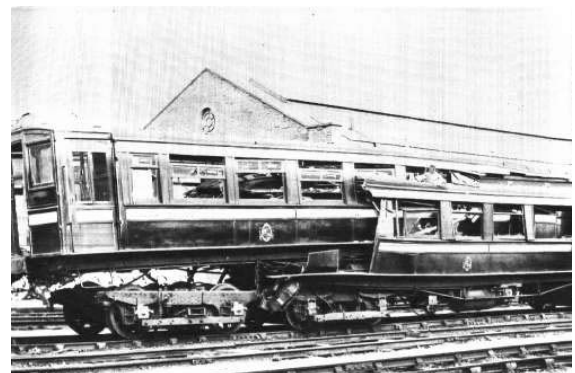
### Infrastructure

Over the last 200 years, rail safety has dramatically improved as technology and engineering solutions have eliminated many of the significant risks that previously existed.

These improvements without being limited have included:

### Rolling Stock Design

Modern railway rolling stock is significantly improved in terms of crashworthiness. Telescoping, an occurrence in a train crash where one coach rides-up over the buffers of another and the under frame intrudes into the body of the other coach was a common feature in early railway accidents. This design flaw has now largely been eliminated with effective vehicle design. Modern



West Hampstead 1907 - The effect of telescoping

rollingstock design has also resulted in huge improvements in ride quality and vehicle stability on track with fewer derailments and improved safety.

## Train Brakes

Train braking systems have evolved from simply setting handbrakes from wagon to wagon through to vacuum brakes, compressor based air braking systems, the Westinghouse brake system to the latest of braking technologies now embracing disc brakes, magnetic track brakes, electro dynamic braking and in-line electronic braking. The aim of all these systems has been to efficiently stop a fast moving train in the shortest possible distance. However, a limiting factor remains the coefficient of friction between the wheel and rail. Trains, particularly heavy freight trains can still take over a kilometre to stop.

## Railway Signalling

The fundamental principals of railway signalling have not changed with time and are intended to:

- i) "Regulate Train Movements" to meet service demands and line speed.
- ii) "Maintain Safe Distance" between trains including effective train detection.
- iii) "Safeguard Trains at Junctions" including Level Crossings.

Early signalling systems relied upon policemen at stations, crossings and junctions using hand held flags and balls to regulate train movements.



Early "Ball Signal"

Similar to train braking systems "Railway Signalling" has evolved and now embraces a range of technologies such as:

- i) Multiple-Aspect Signals: To provide a simple & clear indication to train drivers regarding status of the line ahead.
- ii) Track Circuits: For ensuring that trains on a running line cannot be undetected. With a track circuit a train is, under all conditions, continuously active in maintaining its own protection.
- iii) Interlocking Plant: For ensuring effective interlocking between conflicting routes and ensuring the safe passage of trains from one signal to the next.

The aim of all of these signalling systems is to provide advance information to train drivers regarding the condition of the line/track ahead and also ensure that any route that is set remains correctly set for the entire passage a the train movement. Once again this need arises because of the characteristic poor braking performance of trains.

## Communications

As the speed and frequency of trains increased, a number of early accidents were often simply due to a train stopping unexpectedly and the following train running into the back of it. Obviously some method of quickly passing messages between control points was required so that following trains could be given advanced warning of obstructions. The evolution of the electric telegraph, telephone and radio systems now provide a direct means of communications between control points and trains. However we still find in recent accidents, for example Glenbrook NSW (1999) in which 7 people died and 51 were injured, The Honourable Peter Aloysius McInerney highly criticised what he considered to be an ineffective radio communication system.

## Track & Structures

Railway track and structures, including bridges, tunnels, viaducts, cuttings, etc, are basic elements of any railway.

These fundamentals elements of the railway track have remained substantially unchanged. It is the technology in the rail, fastenings, sleepers, quality of the sub-grade, etc, where the major improvements have occurred. Historically track evolved from timber rails tied to wooden sleepers to the now heavy weight head hardened steel rails fastened to concrete sleepers with elastic fasteners. Methods of attaching the rails to the sleepers have evolved from the simple dog-spike to highly engineered fastening clips that allow rails to be

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stressed thus avoiding the need for plated joints. However, one of the biggest areas of evolution is in the mechanisation of track laying and maintenance, which has not only resulted in high quality track but has seen this occur with a significant reduction in the labour force. Highly sophisticated machinery backed by complex computer systems has given the track engineer the ability to lay and maintain track that is suitable for high-speed/heavy rail operations. Track laying machinery, ballast regulators, ballast cleaners, track tampers are just a small selection of machines available to the track engineer. Diagnostic tools such as ultrasonic rail flaw detectors, track inspection cars for the checking of gauge, alignment, twist, top, etc, all allow the track engineer to tune the track to the needs of the railway, cost efficiently while maintaining the track at levels of safety not previously achievable. Similar to the track, structures such as bridges, tunnels, viaducts and cuttings are functionally not too different from their cousins of the past, it is in the machinery to design and fabricate this infrastructure where the real quantum changes have occurred.



Track Tamper

In spite of these advances where levels of capital investment have been limited, particularly in older systems' the need to remain vigilant and put in place active safety management systems is an imperative. With rail networks that use older technologies there must be a higher dependence on people to be observant, maintain their competencies and report all risks associated with deficiencies identified in the "Infrastructure". It is notable that where organisations have striven to gain financial efficiencies through staff reduction without an appropriate risk assessment(s) and capital investment strategies, unacceptable levels of risk are being taken with the potential for serious consequences.

## Human Factors

Over the last 25 years or so, the rail industry has been through a period of continual upheaval, which has included privatisation, and significant restructuring, mostly brought on by the need to improve the financial performance of the industry. At the same time, public expectations with respect to safety have risen. This is reflected in many areas of law, OHS&W, etc. Failure to satisfy legislative requirements can result in significant fines and even gaol sentences for senior members of rail organisations.

As a result of these pressures there has been a continuous outflow of core organisational expertise and the employees that are left often find themselves overloaded and their morale challenged. Against this background and recognising the risk brought on by reform and privatisation many Governments worldwide have resorted to the introduction of "Regulatory Regimes" to ensure that railways continue to provide a safe mode of transport.

Rail safety management in Australia is based on an often-debated co-regulatory model. With this model, industry is primarily responsible for managing its operational risks and safety performance and regulators are responsible for the audit of the safety systems. The basic powers of the Regulators are enshrined in State Legislation, which in many cases has been underpinned by the Australian Rail Safety Standard AS4292.

AS4292 and State Legislation address many areas of safety, such as the organisations "Safety Management Systems", employee competencies and fitness for duty. Most if not all Legislation requires railways to enforce a strategy of zero alcohol and drug tolerance, validated through testing, and strategies that can demonstrate that employees are medically and physiologically fit to undertake "Rail Safety Work".

Recent rail accidents overseas and in particular the Waterfall accident in NSW, have shown up deficiencies in Safety Management Systems. In the Waterfall accident which occurred on 31 January 2003, a State Rail Authority (SRA) passenger train service C311 travelling from Sydney to Port Kembla, overturned at high speed and collided with stanchions and a rock cutting approximately 2 km south of Waterfall. As a result of the accident, the driver and 6 passengers were killed.

The investigation into this accident established that the most likely cause of the accident was:

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Waterfall – Accident Scene

- i) The driver suffered some form of incapacitation, possibly related to his cardiac function.
- ii) The deadman's system could be circumvented.
- iii) The driver's weight and position at the controls probably coincided with the conditions that could cause inadvertent circumvention of the deadman system.



Driver feigning incapacitation with both feet on the deadman pedal.

There were a total of 66 recommendations to come out of the Waterfall accident. All rail operators throughout Australia have been asked to review these recommendations as might apply to their respective organisations and report back to the State Regulator on strategies that will be implemented to mitigate risk if it exists.

There are several recommendations to come out of the Waterfall accident that are worthy of note, they include:

- i) That SRA address as a matter of urgency the latent technical deficiencies identified in the deadman system.
- ii) That no cab-based equipment could be deliberately or inadvertently used to circumvent the deadman system or any other safety device.

- iii) Rail Safety Regulator mandate medical standards for train crews and other railway safety workers to provide for predictive and preventive management of potentially incapacitating medical conditions.
- iv) Employees at every level of the organisation understand and carry out their responsibilities under the Safety Management System.
- v) Safety specialists within the rail industry not in possession of adequate qualifications, commence a professional development program to be completed within a nominated time.
- vi) Effective and reliable communications equipment.
- vii) SRA have a formal Safety Culture Survey independently undertaken, with particular emphasis on identifying ALL of the factors that had an adverse effect on safety culture.

The Waterfall crash has highlighted how, given the wrong combination of circumstances, a dormant failure within a rail network can result in a major disaster.

It has also highlighted the need for continual vigilance if rail safety is to be a realistic objective, particularly where levels of capital investment have been limited.

## CONCLUSIONS

- i) Rail is recognised as one of the safest modes of transport.
- ii) Rail safety has dramatically improved with capital investment as technology and engineering solutions have eliminated many of the significant risks that previously existed.
- iii) Where levels of capital investment have been limited, particularly in older systems the need for employees to remain vigilant and for the organisation to put in place active safety management systems is an imperative.
- iv) Rail networks that are dependent on older technologies must have a higher reliance on employees to report all risks associated with deficiencies identified in the "Infrastructure" and "Operational" systems.
- v) Over the last 25 years the rail industry has been through a period of continual upheaval, which has included privatisation, and significant restructuring.
- vi) There has been an outflow of core expertise within the industry and the employees that are left can find themselves overloaded and their morale challenged.
- vii) The recent release of the Special Commission of Inquiry Report into the Waterfall Rail accident highlights the need for human factors training in rail

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with a particular reference to establishing an appropriate "Safety Culture".

- viii) Improved technology, employee training, which embraces an understanding of "Safety Principals" as compared to a purely prescriptive approach, along with enhancing staff morale are key ingredients in improving Rail Safety.
- ix) Creating a culture in which employees are not fearful of reporting safety concerns is an imperative.
- x) Employees/professionals engaged in "Rail Safety Work" must be appropriately trained/re-trained in the work they are required to perform.
- xi) Rail organisations need to ensure that appropriate strategies for succession planning are in place so that long-term corporate knowledge is retained within the organisation.

## **ACKNOWLEDGMENTS**

Roy Arnold – General Manager TransAdelaide for allowing me to publish the paper.

Elke Erdos – My wife, for allowing me the time to research and write the paper.

## **REFERENCES**

"Rail Crash" – The Video

"Danger Ahead"

<http://danger-ahead.railfan.net/gallery/>

Waterfall - Rail Safety Investigation Final Report

<http://www.transport.nsw.gov.au/waterfall/index.html>

## **CHAIRMAN'S MESSAGE**

The local committee has been working very hard to bring the SA members an informative and rewarding range of speakers for the monthly technical meetings. I am sure I speak for all those that regularly attend that the meetings held to date this year have been both stimulating and interesting. It is good to see everyone come early to enjoy and partake in the networking with fellow Railway Engineering experts. We still have lots of room for more to attend so please make it a goal to attend at least one Chapter meeting this year.

In SA we are very lucky that we have a very good writing team for our regular newsletter, which is the envy of the other chapters. The regular news spots from our globetrotting editor make for very captivating reading.

We have also been busy in organizing CORE2004 which is now just weeks away. All the hard work and dedicated efforts of the committee will certainly be on display in Darwin. I hope to see many of you in Darwin and show off the Engineering Marvel of the long awaited Alice Springs to Darwin Railway. For those of you unable to attend we will be holding a meeting with highlights from the conference on August 5<sup>th</sup> 2004.

Rob Schweiger  
Chairman – SA Chapter

## **CORE2004**

CORE2004 Close to a sell-out.

The biennial Conference on Railway Engineering will be held in Darwin from 20-23 June and is likely to sell-out well in advance.

With an upper limit of 350 delegates, already 320 presenters and delegates have registered along with 30 exhibitors.

The support of our sponsors has been fantastic and we are very grateful for their assistance.

Major Sponsors: ARTC, FreightLink, Northern Territory Government

Gold Sponsors: iQR, Norgren

Silver Sponsors: OneSteel, John Holland, Barclay Mowlem, Bradken Rail, United Goninan, RTAA, Hansen

The participation of sponsors and exhibitors is vital to the success of the CORE conferences.

CORE is recognised as the forum where the latest and most informative Technical papers are presented and debated.

CORE2004 will see a total of 54 technical papers presented plus an in depth plenary session on the planning and construction of the Alice to Darwin railway.

You can check for further details at:

[www.core2004.on.net](http://www.core2004.on.net)

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Version 6 of Adobe Acrobat Reader may be downloaded free of charge from the internet at [www.adobe.com](http://www.adobe.com).

Alternatively, Adobe Acrobat Reader 6 is generally included on the CD ROM attached to most computer magazines.

## **KEY RTSA CHAPTER COMMITTEE CONTACTS**

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Roger Wyatt	8344 6939	Secretary
Malcolm Menadue	8270 2873	N/L despatch
Max Michell	8390 3300	N/L Editor

Articles or editorial comment for Newsletter are very welcome. We have over 100 members locally some of whom must have stories, events or developments of interest that could be reported in Newsletter.

Part of the function of RTSA is to keep members in touch with what is going on in the industry and with each other and to that end we are only too happy to publish items of interest.

Send copy to the Editor, Max Michell at [samrom@bigpond.com](mailto:samrom@bigpond.com) or fax to 08 8390 3772

Electronic despatch of Newsletter is undertaken by Malcolm Menadue – contact Malcolm on [mmanadue@ozemail.com.au](mailto:mmanadue@ozemail.com.au) if you have any problems receiving Newsletter electronically or in hard copy. Note that electronic subscribers will get their Newsletters and flyers as soon as the editorial stuff is done, while the hard copy mail will of course be some days slower.

For all other matters relating to RTSA SA Chapter contact Roger Wyatt (the Hon Secretary) at e-mail [januseng@chariot.net.au](mailto:januseng@chariot.net.au) or on phone 8344 6939